

AMENDMENT OF WHOLE IN COMMITTEE
9/3/14

FILE NO. 140882

RESOLUTION NO.

1 [Contract - Siemens Industry, Inc. - Procurement of New Light Rail Vehicles - Not to Exceed
2 \$1,192,651,577]

3 **Resolution approving a contract with Siemens Industry, Inc., to procure up to 260 light**
4 **rail vehicles, associated services, spare parts, special tools, training and**
5 **documentation, in an amount not to exceed \$1,192,651,577 for a term not to exceed 15**
6 **years, to commence following Board approval; and making environmental findings.**
7

8 WHEREAS, The San Francisco Municipal Transportation Agency (SFMTA) currently
9 operates a fleet of 151 light rail vehicles (LRVs), which are scheduled for retirement starting in
10 2021; and

11 WHEREAS, The start of revenue service for the Central Subway Extension will require
12 an additional 24 light rail vehicles to be delivered by 2018; and

13 WHEREAS, Ridership projections and planned service expansions indicate a need for
14 an additional 85 light rail vehicles over the next ten years, including 40 light rail vehicles
15 needed between 2018 and 2021; and

16 WHEREAS, In September 2013, the SFMTA issued an RFP for the procurement of up
17 to 260 LRVs, with a scope of work that includes the design, manufacture, delivery and test of
18 LRVs, together with associated services, spare parts, special tools, training and
19 documentation; and

20 WHEREAS, In February 2014, the SFMTA received proposals from two car builders;
21 after reviewing the proposals, the selection panel determined Siemens Industry, Inc. to be the
22 highest-ranked proposer; and

23 WHEREAS, The SFMTA has negotiated a final agreement with Siemens Industry, Inc.,
24 to procure up to 260 LRVs, associated services, spare parts, special tools, training and
25

1 documentation, for an amount not to exceed \$1,192,651,577, and a term not to exceed 15
2 years; and

3 WHEREAS, The base portion of the contract for 175 LRVs will be funded with federal,
4 state and local funds; and

5 WHEREAS, The Department of City Planning has determined that the replacement and
6 expansion vehicle portions of the procurement are statutorily exempt under Section
7 21080(b)(11) of the California Resources Code and Section 15275(a) of the implementing
8 CEQA Guidelines because those portions of the procurement involve an increase of service
9 on rail lines already in use; said determination is on file with the Clerk of the Board of
10 Supervisors in File No. 140882 and is incorporated herein by reference; and

11 WHEREAS, The vehicles for the Central Subway Project were reviewed as part of the
12 Central Subway Final Supplemental EIS/EIR, certified by the Planning Commission on August
13 7, 2008, and on August 19, 2008, the SFMTA Board of Directors, in Resolution No. 08-150,
14 adopted the findings and conclusions with respect to Central Subway Final Supplemental
15 EIS/EIR; based upon its review of the Final Supplemental EIS/EIR, the SFMTA Board of
16 Directors found that no additional environmental review is required under Public Resources
17 Code section 21166 for the subject procurement; and

18 WHEREAS, On July 15, 2014, the SFMTA Board of Directors adopted Resolution No.
19 14-12, which authorized the Director of Transportation to execute Contract No. SFMTA 2013-
20 19 with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts,
21 special tools, training and documentation, for an amount not to exceed \$1,192,651,577, and a
22 term not to exceed 15 years; and

23 WHEREAS, A copy of the said contract is on file with the Clerk of the Board of
24 Supervisors in File No. 140882, which is hereby declared to be part of this motion as if set
25 forth fully herein; now, therefore, be it

1 RESOLVED, That the Board of Supervisors authorizes the SFMTA to enter into a
2 contract with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare
3 parts, special tools, training and documentation, in an amount not to exceed \$1,192,651,577,
4 and for a term not to exceed 15 years subject to the following conditions: (1) that the contract
5 provide for two separate options, Option 1 for 40 LRVs and Option 2 for 45 LRVs; (2) that the
6 SFMTA obtain approval from this Board prior to exercising Option 2, contingent on
7 identification of \$234,664,852 in funding to pay for the Option; and (3) that the SFMTA obtain
8 approval from this Board for any vendor-financing agreement with Siemens Industry, Inc.; and
9 be it

10 FURTHER RESOLVED, That within 30 days of the contract being fully executed by all
11 parties, the SFMTA shall provide the final contract to the Clerk of the Board for inclusion into
12 the official file.

<p>Item 8 File 14-0882</p>	<p>Department: Municipal Transportation Agency (MTA)</p>
<p>EXECUTIVE SUMMARY</p>	
<p style="text-align: center;">Legislative Objectives</p>	
<p>The proposed resolution would approve a new contract between the MTA and Siemens, Inc. (Siemens) to procure up to 260 new light-rail vehicles for a not-to-exceed amount of \$1,192,651,577 over a term of 15 years.</p>	
<p style="text-align: center;">Key Points</p>	
<ul style="list-style-type: none"> • The MTA currently operates 151 light-rail vehicles. According to the 2014 Transit Fleet Management Plan, approved by the MTA Board of Directors in March 2014, the MTA requires 151 replacement light-rail vehicles between 2021 and 2028, and up to 109 new light-rail vehicles to meet increased demand due to the new Central Subway and increased ridership overall. • Under the proposed contract, MTA would purchase 175 light-rail vehicles over the 15-year term, with the first 24 vehicles delivered in FY 2016-17 and FY 2017-18. In addition, the MTA has the option to purchase up to 85 additional vehicles, for a total of 260 vehicles. 	
<p style="text-align: center;">Fiscal Impact</p>	
<ul style="list-style-type: none"> • The MTA has identified funding for \$957,986,995 of the \$1,192,651,577 contract amount. Funding sources include existing Central Subway project funds, Metropolitan Transportation Commission funds, Proposition K Sales Tax Revenues, MTA Revenue Bonds, and State Infrastructure Bonds. These funds are sufficient to purchase 175 light-rail vehicles under the base contract plus an additional 40 light-rail vehicles under the first purchase option. • However, MTA has not yet identified funding of \$234,664,582 to purchase 45 light-rail vehicles under the second purchase option. 	
<p style="text-align: center;">Issues</p>	
<ul style="list-style-type: none"> • Although the MTA plans to purchase the 85 optional light-rail vehicles under two separate purchase options of 40 and 45 vehicles respectively, the proposed contract only provides for one purchase option of 85 vehicles. • The proposed contract includes a provision that would allow the MTA to finance up to 40 additional light-rail vehicles through direct financing from Siemens. However, MTA does not yet have details on the provisions of such financing, including the term or the interest rate. 	

Recommendations

- Amend the proposed resolution to request the MTA to amend the proposed contract to include two options, option I for 40 additional light-rail vehicles and option II for 45 additional light-rail vehicles respectively at the discretion of the City.
- Amend the proposed resolution to require the MTA to obtain Board of Supervisors approval prior to exercising option II to purchase an additional 45 light-rail vehicles, contingent upon identification of \$234,664,852 in funding sources to pay for the costs of such purchase.
- Amend the proposed resolution to state that any provision to allow the MTA to enter into a direct financing agreement with Siemens be subject to Board of Supervisors approval.
- Approve the proposed resolution as amended.

MANDATE STATEMENT / BACKGROUND

Mandate Statement

City Charter Section 9.118(b) states that a contract entered into by a department, board or commission that (1) has a term of more than ten years, (2) requires expenditures of \$10 million or more, or (3) requires a modification with a \$500,000 impact or more is subject to Board of Supervisors approval.

Background

The San Francisco Municipal Transportation Agency (MTA) currently operates 151¹ light-rail vehicles to provide mass transportation over 71.5 miles of track throughout the City. The current fleet of light-rail vehicles started operating in 1996 with a 25-year operating life through 2021. Ansaldo Breda, Inc. (Breda), a private for-profit company, built and assembled the current fleet of MTA light-rail vehicles.

According to the MTA, the Breda light-rail vehicles are failing regularly. On average, only 114, or approximately 75 percent, of the current fleet operates on a daily basis with the remaining 37 vehicles needing maintenance and repair.

Table 1 below shows the MTA costs of labor and parts expended to maintain and repair the current fleet from January 2014 through June 2014 and includes an annual estimate.

Table 1: Light Rail Vehicle Maintenance and Repair Costs

	Labor Jan – June 2014	Materials Jan - June 2014	Total	Annual Estimate
Propulsion System	\$862,861	\$3,889,220	\$4,752,081	\$9,504,162
Advanced Train Control System	1,922,752	2,598,293	4,521,045	9,042,090
Door and Steps	1,145,094	871,816	2,016,910	4,033,820
Lighting	289,974	772,952	1,062,926	2,125,852
Trucks	531,986	526,312	1,058,298	2,116,596
Power Supply	557,521	394,154	951,675	1,903,350
Heating, Ventilation, and Air Conditioning	589,593	220,241	809,834	1,619,668
Brakes	339,842	371,653	711,495	1,422,990
Coupler and Draft Gear	312,506	300,073	612,579	1,225,158
Communications	133,295	296,935	430,230	860,460
Total	\$6,685,424	\$10,241,649	\$16,927,073	\$33,854,146

Source: San Francisco Municipal Transportation Agency, Budget and Legislative Analyst's Office

According to Ms. Trinh Nguyen, MTA Senior Program Manager, the new Siemens light-rail vehicles would have electric doors with fewer parts that are less likely to fail and propulsion

¹ According to the MTA Transit Fleet Management Plan (March 2014), two light-rail vehicles are damaged beyond repair and cannot return to service. There are four additional vehicles that are scheduled to return to service some time in calendar year 2015.

systems that are less likely to get clogged and overheated. Additionally, Ms. Nguyen notes that the new Siemens light-rail vehicles will be designed in such a way that failing parts can be easily removed and swapped for working parts, which would reduce the amount of time that a vehicle would be out of service.

Increasing the Fleet

According to MTA documents, light-rail vehicles provide daily ridership to 173,500 people. However, the MTA estimates that daily ridership will increase when the MTA completes the Central Subway project and as a result of natural population growth in San Francisco. The MTA estimates that, by 2040, ridership during peak times could increase by as much as 95 percent over the current peak time ridership.

According to the MTA’s 2014 Transit Fleet Management Plan, adopted by the MTA Board of Directors in March 2014, in order to meet the growing demand for timely transit services over the next 25 years, the MTA will need to (1) replace the current fleet of 151 light-rail vehicles and (2) increase the total number of light-rail vehicles by 109, or 72 percent, from 151 to a 260.

Competitive Request for Proposals (RFP) Process to Acquire New Light-Rail Vehicles

In March 2013, the MTA issued a Request for Qualifications to select a group of manufacturers that would be eligible to provide proposals for a new contract to procure new light rail vehicles. Four vendors submitted statements of qualification and all were deemed qualified².

In September 2013, the MTA issued RFPs to the four qualified vendors, of which only two submitted responsive proposals. Table 2 below shows the scoring categories and scores of the two proposals.

Table 2: Proposal Scores

	Construcciones y Auxiliar de Ferrocarriles (CAF)		Siemens, Inc.	
	Points	Weighted Score	Points	Weighted Score
Qualitative Responsibility	35	4	62	6
Technical Evaluation	45	29	82	53
Price Evaluation	79	20	100	25
Alternate Approaches	1	1	7	7
Total Score		54		91

Source: San Francisco Municipal Transportation Agency

As shown in Table 2 above, Siemens, Inc. (Siemens) received the highest score of 91. Siemens received a higher score in every category including the technical evaluation and price evaluation categories, which were, respectively, the most heavily weighted categories.

In July 2014, the MTA Board of Directors approved a resolution authorizing the MTA Director to enter into contract with Siemens to acquire new light-rail vehicles.

² Breda was initially disqualified as a vendor but was deemed eligible after an appeal.

DETAILS OF PROPOSED LEGISLATION

The proposed resolution would approve a 15-year contract between the MTA and Siemens for the manufacture and delivery of up to 260 new light-rail vehicles as well as the associated spare parts, special tools, training and documentation, in an amount not-to-exceed \$1,192,651,577.

The products and services that Siemens will provide under the proposed contract are divided into two phases. During the first phase, Siemens will deliver 24 light-rail vehicles in FY 2016-17 and FY 2018-19 that will allow the MTA to meet the anticipated increase in demand after completing the Central Subway Project.³

During the second phase, Siemens will deliver 151 light-rail vehicles to replace the current fleet of Breda light-rail vehicles beginning in FY 2020-21 through FY 2027-2028, which is when the Breda light-rail vehicles reach the end of their useful life. The two phases, combined, will provide a total of 175 vehicles.

The proposed contract for up to 260 light-rail vehicles includes the base amount of 175 vehicles and an option, which the MTA would like to divide and exercise twice, to purchase up to 85 additional light-rail vehicles. The MTA estimates that it will need to exercise the first option for 40 light-rail vehicles immediately in order to meet service demands in calendar years 2018-2020. The MTA estimates that it will need to exercise the second option, for 45 light-rail vehicles, prior to 2024 in order to meet service demands for 2028-2040.

Table 3 below shows the anticipated purchase plan related to the phases and options for up to 260 new light-rail vehicles.

³ The Central Subway project will extend the City's light-rail lines by 1.7 miles from the South of Market neighborhood to Chinatown. The MTA estimates that average daily ridership, after the project is completed, will increase by 43,500 in 2019 and by 65,000 in 2030.

Table 3: Purchase Plan for Up To 260 New and Replacement Light Rail Vehicles

Year	Existing Number of Vehicles	Purchase of New Vehicles and Removal of Vehicles at End of Service					Net Increase
		Phase I - Increase Fleet by 24 Vehicles	Option I - Increase Fleet by 40 Vehicles	Phase II - Replace 151 Vehicles	Remove End of Service Vehicles	Option II - Increase Fleet by 45 Vehicles	
2014-15	151						151
2015-16	151						151
2016-17	151	6					157
2017-18	157	18					175
2018-19	175		18				193
2019-20	193		14				207
2020-21	207		8	5	(5)		215
2021-22	215			24	(24)		215
2022-23	215			24	(24)		215
2023-24	215			24	(24)		215
2024-25	215			24	(18)		221
2025-26	221			24	(24)		221
2026-27	221			24	(24)		221
2027-28	221			2	(8)	22	237
2028-29	237					23	260
Total		24	40	151	(151)	45	

Source: San Francisco Municipal Transportation Agency, Budget and Legislative Analyst's Office

As shown in Table 3 above, under the proposed contract, Siemens would deliver the vehicles in phases with the largest number of vehicles coming between 2021 and 2028 to replace the existing fleet of Breda light-rail vehicles.

FISCAL IMPACT

The proposed resolution would authorize a not-to-exceed contract amount of \$1,192,651,577 for the costs to provide up to 260 new light-rail vehicles including 85 optional vehicles and the associated spare parts, training and documentation.

Escalation Allowance

The initial price per light-rail vehicle for the first 24 light-rail vehicles in Phase I is \$3,327,350. The proposed contract between the MTA and Siemens includes an escalation allowance to provide for the costs of inflation on labor and materials that Siemens may apply to: (1) Phase II (151) light-rail vehicles, (2) all option (up to 85) light-rail vehicles, (3) training simulators, and (3) spare parts for the Phase II and optional light-rail vehicles.

For Phase II light-rail vehicles and associated parts and simulators: the MTA will calculate the base index rate using the three-month average of Unit Labor Cost Index and the Producer Price

Index as published by the U.S. Bureau of Labor and Statistics. The escalation costs will then be compared to the three-month period prior to May 15, 2020, which is one-year prior to the delivery of the first Phase II light-rail vehicle.

For the optional light-rail vehicles parts and simulators: the MTA and Siemens will negotiate and set the escalation allowance at the time the City exercises its option.

However, as noted above, the total not-to-exceed contract amount is \$1,192,651,577.

Contract Costs

Table 4 below shows the base and estimated escalation costs that MTA would pay to Siemens under the proposed not-to-exceed contract amount of \$1,192,651,577.

Table 4: Total Estimated Costs for All Phases and Options Including Annual Escalation⁴

Phase I and Phase II	Initial Cost	Estimated Escalation	Total
Phase II Light-Rail Vehicles (151)	\$502,414,750	\$129,483,215	\$631,897,965
Phase I Spare Parts	14,153,840	3,647,753	17,801,593
Train Simulator	1,704,650	169,221	1,873,871
Design, Project Management, and Testing	37,541,102	0	37,541,102
Allowance for Regulatory Changes	10,000,000	0	10,000,000
Phase I Vehicles (24 – not escalated)	79,854,000	0	79,854,000
Manuals	809,478	0	809,478
Training	361,557	0	361,557
Special Tools and Equipment	1,792,624	0	1,792,624
Subtotal, Phase I and Phase II	\$648,632,001	\$133,300,189	\$781,932,190
Option I			
Light-Rail Vehicles (40)	\$133,160,440	\$12,329,932	\$145,490,372
Train Simulator	1,704,650	157,841	1,862,491
Optional Spare Parts	15,000,000	1,388,918	16,388,918
Additional Spare Parts	11,269,527	1,043,497	12,313,024
Subtotal, Option I	\$161,134,617	\$14,920,188	\$176,054,805
Subtotal, Phases I/II and Option I	\$809,766,618	\$148,220,377	\$957,986,995
Option II			
Light-Rail Vehicles (45)	\$149,805,495	\$84,859,087	\$234,664,582
Subtotal, Option II	\$149,805,495	\$84,859,087	\$234,664,582
Total	\$959,572,113	\$233,079,464	\$1,192,651,577

Source: San Francisco Municipal Transportation Agency, Budget and Legislative Analyst's Office

The proposed resolution approves only the contract costs between the MTA and Siemens and does not reflect the costs for sales tax, project support costs, and a five percent project contingency. According to Ms. Nguyen those costs will be included in the MTA biennial capital

⁴ On a budgetary basis, the MTA assumed 4 percent annual inflation for the escalation allowance. Actual escalation costs will vary depending on actual inflation in the Unit Cost Labor Index, the Producer Price Index, and subsequent negotiations between the MTA and the

budgets, through FY 2028-29, that are subject to Board of Supervisors appropriation approval. The MTA estimates these associated costs at a total of \$231,821,650 and is currently planning on paying these costs with the same funding sources used to pay for the light-rail vehicles as explained below

Sources of Funds

MTA has identified funds for \$957,986,995 of the contract not-to-exceed amount of \$1,192,651,577 to fund Phase I, Phase II and Option I, providing for the purchase of 215 of the proposed 260 light-rail vehicles, as shown in Table 5 below. MTA has not yet identified the balance of \$234,664,582 (see Table 4 above) to fund the 45 light-rail vehicles under Option II.

Table 5: Proposed Revenue Sources for Light-Rail Vehicle Contract

Sources	Total
Phase I and Phase II (175 Light-Rail Vehicles) Revenues	
Central Subway Project Funding (Combined State and Federal Funds)	\$24,000,000
Metropolitan Transportation Commission Funding	517,096,972
Proposition K Sales Tax Revenues	133,866,733
San Francisco Municipal Transportation Agency Revenue Bond Proceeds	106,968,485
Subtotal, Revenues	\$781,932,190
Option I – 40 Light-Rail Vehicles	
State Cap and Trade Revenues from the Metropolitan Transportation Commission	168,054,805
State Infrastructure Bond Proceeds	8,000,000
Subtotal, Option I - 40 Light-Rail Vehicles	\$176,054,805
Total Revenues	\$957,986,995

Source: San Francisco Municipal Transportation Agency

As shown in Table 5 above, the MTA is proposing to use a combination of funding for the proposed contract including: \$24,000,000 in funds from the State and Federal funds to provide light-rail vehicles when the Central Subway Project is completed, \$517,096,972 in funding from the Metropolitan Transportation Commission that will be available starting in FY 2020-21 and will be used to pay for 151 replacement vehicles, \$133,866,733 in Proposition K sales tax revenue, and \$106,968,485 in MTA revenue bond proceeds.

Revenue Bonds

The MTA's proposed financing plan for the proposed contract base amount includes \$106,968,485 in MTA revenue bond proceeds. Under the City Charter and Administrative Code, MTA revenue bond sales must be approved by the MTA Board of Directors and by the Board of Supervisors. Of that \$106,968,485, \$12,500,000 was issued in FY 2013-14, \$12,500,000 has been authorized and will be issued in FY 2014-15, and \$81,968,485 has not been authorized or issued.

According to Ms. Ariel Espiritu Santo, MTA Principal Financial Analyst, this project is included in the City's Capital Plan, which projects capital expenditures through FY 2022-23 and includes the

anticipated use of revenue bond proceeds for this project. According to Ms. Espiritu Santo, in the event that the MTA revenue bonds were not approved by the MTA Board of Directors or the Board of Supervisors, the MTA would cancel or defer \$81,968,485 in other capital projects to provide funding for the light-rail vehicles.

Cap and Trade Funds

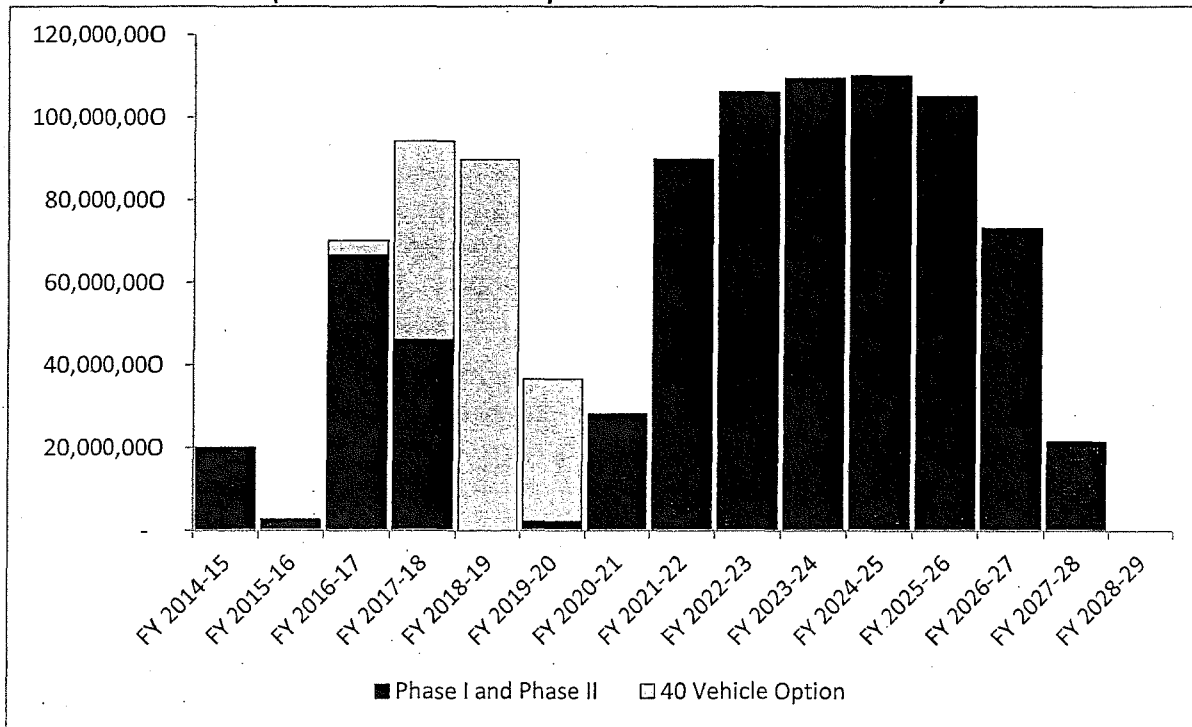
As shown in Table 5 above, the MTA financing plan for the 40 additional vehicles under Option I includes \$168,054,805 in proceeds from the State cap-and-trade program. According to Ms. Espiritu Santo, these cap-and-trade revenues would be allocated directly to the MTA, based, in part, on recommendations by the Metropolitan Transportation Commission, which has prioritized up to \$400 million in these funds to replace and enhance the existing MTA fleet of light-rail vehicles, motor coaches and trolley coaches.

While these funds have been prioritized for this purpose, these funds have not yet been secured by either the MTA or the Metropolitan Transportation Commission. According to Ms. Espiritu Santo, in the event that these funds came in under current estimates, the Metropolitan Transportation Commission would either allocate other funding for this project or the MTA would purchase fewer than anticipated vehicles.

Timing of Contract Payments

As noted above, MTA has not secured all of the funding from the proposed revenue sources shown in Table 5. Under the proposed contract, the MTA pays Siemens at the various points of delivery. As a result, the MTA is responsible for relatively small payments at the beginning and end of the contract term with larger payments owed in the middle, as shown in Chart 1 below.

**Chart 1: Anticipated Contract Payments Over the Full Term
(Includes 40 Vehicle Option and Estimated Escalation)**



Source: San Francisco Municipal Transportation Agency, Budget and Legislative Analyst's Office

Funding for Vehicles Purchased Under Option II

As noted above, as of the writing of this report, the MTA has not identified a source of funds at an estimated cost of \$234,664,582 for the 45 light-rail vehicles to be purchased under Option II in approximately FY 2027-28 and FY 2028-29 (which MTA would need to order prior to 2024) with the expectation that the MTA would be able to secure financing for the full amount at a later date. Therefore the Budget and Legislative Analyst's Office recommends amending the proposed resolution to require MTA to obtain Board of Supervisors approval prior to exercising Option II to purchase an additional 45 light-rail vehicles, contingent on the identification of the funding sources to pay for the estimated \$234,664,582.

Options to Purchase Additional Vehicles

Under the terms of the contract, the City may exercise its option for more light-rail vehicles within a seven-year window beginning when the MTA issues the notice to proceed. While the MTA plans to purchase an additional 85 light-rail vehicles by exercising two separate options, the proposed contract only provides for one option to purchase 85 additional light-rail vehicles within a seven-year window beginning when the MTA issues the notice to proceed. According to Ms. Nguyen, while the contract language is not written this way, the MTA and Siemens have been in discussion about this issue and appear to be in agreement.

Therefore, the Budget and Legislative Analyst's Office recommends amending the proposed resolution to request the MTA to amend the proposed contract to include two options, option I

for 40 and option II for 45 additional light-rail vehicles respectively at the discretion of the City. As noted above, the Budget and Legislative Analyst's Office recommends that exercising option II to purchase 45 additional light-rail vehicles should be subject to future Board of Supervisors approval.

Exercising Option I

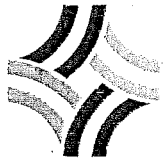
According to Ms. Nguyen, subject to the negotiations between the MTA and Siemens, if the MTA exercises the first option for 40 additional light-rail vehicles within one year after the MTA issues the notice-to-proceed, then the MTA could potentially save up to an estimated \$14,920,188 in escalation costs. However, the actual savings from exercising option I within one year after the MTA issues the notice-to-proceed will depend on several factors, including the timing of available funds from the Metropolitan Transportation Commission.

Potential Financing of Vehicle Purchase through Siemens

The proposed contract includes a provision that would allow the MTA to finance up to 40 additional vehicles through direct financing from Siemens at the sole discretion of MTA. However, as of the writing of this report, the MTA does not have details on the provisions of such financing including the term of the financing or the interest rate. Therefore, the Budget and Legislative Analyst's Office recommends amending the proposed resolution to state that any agreement between the MTA and Siemens, that would allow for direct financing of light-rail vehicles through Siemens, be subject to Board of Supervisors approval.

RECOMMENDATIONS

1. Amend the proposed resolution to request the MTA to amend the proposed contract to include two options, option I for 40 additional light-rail vehicles and option II for 45 additional light-rail vehicles respectively at the discretion of the City.
2. Amend the proposed resolution to require the MTA to obtain Board of Supervisors approval prior to exercising option II to purchase an additional 45 light-rail vehicles, contingent upon identification of \$234,664,852 in funding sources to pay for such cost.
3. Amend the proposed resolution to state that any provision, which allows the MTA to enter into a direct financing agreement for the proposed light-rail vehicles with Siemens be subject to Board of Supervisors approval.
4. Approve the proposed resolution as amended.



SFMTA
Municipal
Transportation
Agency

Edwin M. Lee, *Mayor*

Tom Nolan, *Chairman*

Gwyneth Borden, *Director*

Jerry Lee, *Director*

Cristina Rubke, *Director*

Edward D. Reiskin, *Director of Transportation*

Cheryl Brinkman, *Vice-Chairman*

Malcolm Heinicke, *Director*

Joél Ramos, *Director*

July 29, 2014

**The Honorable Members of the Board of Supervisors
City and County of San Francisco
1 Dr. Carlton Goodlett Place, Room 244
San Francisco, CA 94102**

Subject: Request for Approval -- SFMTA Contract No. 2013-19 with Siemens Industry, Inc. to Procure up to 260 New Light Rail Vehicles

Honorable Members of the Board of Supervisors:

The San Francisco Municipal Transportation Agency (SFMTA) requests that the San Francisco Board of Supervisors approve a contract between the City and County of San Francisco and Siemens Industry, Inc., to procure up to 260 Light Rail Vehicles (LRVs), associated services, spare parts, special tools, training and documentation, in an amount not to exceed \$1,192,651,577, and for a term not to exceed 15 years.

Background

The SFMTA has a fleet of 151 LRVs. These vehicles went into service beginning in 1996 and are scheduled for retirement starting in 2021. The SFMTA is seeking to procure up to 260 new light rail vehicles to serve all of the Agency's LRV needs for the next 25 years, including fleet replacement, Central Subway and Mission Bay/Third Street corridor needs, and other projected ridership increases through 2040.

Bid Process

This procurement followed a two-phased approach to select a contractor after an extensive outreach process to solicit interest in this procurement. The procurement was designed to select a car builder who can deliver quality cars to SFMTA on schedule and at the best value for SFMTA. The process applied lessons learned from recent procurements and from experience with the existing fleet to assure that the new fleet is safe, reliable and cost effective to maintain.

In March 2013, the SFMTA issued a Request for Qualifications to pre-qualify car builders who were eligible to receive the Request for Proposals (RFP). Four car builders submitted Statements of Qualifications, and all four were deemed eligible to receive the RFP.

In September 2013, the SFMTA issued the RFP to the four qualified car builders and received proposals from two car builders, Siemens Industry, Inc., and CAF USA, in February 2014. The selection panel scored the submittals and determined that Siemens was the highest-ranked proposer.

The Siemens proposal demonstrated superiority over the CAF proposal in the following respects:

- Stronger technical proposal, offering higher reliability and exceeding requirements of the Specifications
- Proven, well documented approach to project management and quality assurance
- Single, Sacramento-based location for project management, engineering and design, carshell manufacture, final assembly and post-delivery support
- Financially stable parent company, offering parent company guarantee and financing to support the procurement
- Proven history of on-time performance, committed to beating the required delivery schedule
- Offered alternate approaches to improve the performance, reliability and efficiency of the project, from both a technical standpoint and based on commercial/financial considerations
- Significantly lower price – Siemens proposed \$ 3.34M per vehicle versus CAF's price of \$4.21M, not including contract non-recurring costs.

Description of Work

The planned procurement will provide up to 260 new LRVs, together with associated services, spare parts, special tools, training and documentation. The new LRVs are expected to have a 25-year life, which assumes that the cars will undergo a mid-life overhaul, funding for which was identified as part of the Transportation 2030 process.

The SFMTA requires new LRVs for three purposes:

- (1) 24 LRVs for near-term increased service demand for the Central Subway Project and Mission Bay, and system-wide growth. These vehicles would be scheduled for delivery from 2016 through 2018;
- (2) The replacement of the existing fleet of 151 LRVs, with deliveries projected to start in 2021 and continue through 2028; and
- (3) Up to 85 LRVs to meet additional projected growth in ridership and system capacity expansion needs through 2040. SFMTA estimates that approximately 40 cars of the option will be needed from 2018 to 2020 to cover service demands, and the remaining option vehicles will cover the expansion needs from 2028 to 2040.

The base quantity in the contract will be 175 LRVs. The contract provides that the base amount per car (\$3,327,250) will cover the first 24 LRVs, and contains cost escalation provisions for the remaining cars, considering the prolonged delivery schedule of this fleet. The contract includes a formula for determining escalation, based on separate material and labor manufacturing industry indices. In shorter contracts, the risk of inflation is typically taken by the contractor and is built into the price. The duration of this contract (15 years), however, effectively precluded the proposers from factoring in escalation costs into the price proposed for the vehicles. The proposers would have had to either submit a very high price for each vehicle or not bid at all due to the level of risk.

The technical requirements are set forth in the Technical Specifications, which is performance-based, rather than a prescriptive detailed specification, allowing the carbuilders the flexibility to offer proven technologies, thereby increasing reliability while decreasing costs. The new LRVs will be compatible with SFMTA's existing light rail system and any planned extensions.

Alternatives Considered

The current fleet does not have the capacity to support increased service demand resulting from both the Central Subway extension and future expansion needs identified in recent ridership projections. The alternative considered was to procure only 24 LRVs to serve the immediate need for the service expansion associated with the Central Subway Extension. A second procurement for the replacement of the existing fleet would then be conducted at a later date. However, procurement of only 24 cars, a relatively small quantity of vehicles, would not likely have result in sufficient competition or competitive pricing. In addition, if SFMTA procured a 24-car fleet, that fleet would be different from both the current fleet and the ultimate replacement fleet. Operating two separate fleets for an extended period would cause operation and maintenance challenges, as well as increased costs associated with separate fleets.

Funding Impact

The total contract with Siemens Industry, Inc. is a maximum of \$1,192,651,577. This amount includes 175 Central Subway and replacement LRVs, plus options for up to 85 additional LRVs, including all required labor, inspections, engineering, special tools, training, manuals, materials, spare parts, and other equipment specified by the SFMTA. As noted earlier, an escalation allowance is also included. Following is a table showing how the estimated escalation affects the contract price.¹

	Value	Escalation Allowance	Total
Base 175	\$ 648,632,001	\$ 133,300,188	\$ 781,932,189
Option 40	\$ 161,134,617	\$ 14,920,188	\$ 176,054,805
Option 45	\$ 149,805,495	\$ 84,859,087	\$ 234,664,582
Total	\$ 959,572,113	\$ 233,079,464	\$ 1,192,651,577

¹ For budgetary purposes, the SFMTA estimated the escalation allowance at four percent annually for materials and labor. Note that the escalation allowance factors in the number of years before the SFMTA would receive the vehicles. In the case of the replacement vehicles, for example, the SFMTA plans on receiving new vehicles as the current vehicles retire, starting in 2021.

Financial Plan

A funding plan for the base contract of 175 LRVs is in place. Funding for the initial 24 expansion cars includes \$26M from the Central Subway Project (FTA, Prop 1B State Bond, Prop K and other funds) and the balance from future SFMTA revenue bonds (subject to approval of the SFMTA Board).

Nearly 80 percent of the funding for the 151 replacement LRVs will come from future FTA formula grant funds programmed by the Metropolitan Transportation Commission (with the remaining 20 percent from local matching funds from a variety of sources, including Prop K and future Revenue Bonds).

Potential funding sources for the 85 Option Vehicles include developer contributions, Transit Impact Development Fees, Transit Sustainability Fees, FTA's Core Capacity Expansion Program, bridge toll funds, SFMTA revenue bonds, general obligation bonds, local vehicle license fees, local sales tax, and/or State funds. The use of SFMTA commercial paper or other gap financing is likely to be required to cover those periods during which budgeted funding is not accessible.

The RFP invited proposers to suggest alternate approaches to financing gaps in vehicle delivery. As an alternate approach, Siemens offered vendor financing to bridge the gap between available funding and vehicle delivery requirements. The Agreement includes a provision to negotiate financing with Siemens if funds can be secured to repay such a loan.

The priority for funding is for approximately 40 option vehicles to be delivered between 2018 and 2021 due to the urgent need to meet service demands. Vendor-provided financing for the 40 option vehicles may be available should the SFMTA determine that such financing is feasible and advantageous to the Agency, with any final financing agreement to be approved by the SFMTA Board of Directors. The option(s) will be exercised only in the event that funding is secured.

SFMTA Board Action

On July 15th, 2014, the SFMTA Board of Directors adopted Resolution No. 14-120, which authorized the Director of Transportation to execute the Contract with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts, special tools, training and documentation, in an amount not to exceed \$1,192,651,577, and for a term not to exceed 15 years. The Resolution also authorized the Director of Transportation to enter into negotiations with Siemens Industry, Inc. to provide financing for approximately 40 Option vehicles to be delivered between 2018 and 2021 should SFMTA determine that such financing is feasible and advantageous to the SFMTA, with any final financing agreement to be approved by the SFMTA Board.

Recommendation

The SFMTA recommends that the Board of Supervisors authorize the SFMTA to enter into a contract with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts,

special tools, training and documentation, in an amount not to exceed \$1,192,651,577, and for a term not to exceed 15 years.

Thank you for your consideration of this proposed agreement. Should you have any questions or require more information, please do not hesitate to contact Ms. Trinh Nguyen at (415) 701-4602 at any time.

Sincerely,

A handwritten signature in black ink, appearing to read 'E. Reiskin', written over a horizontal line.

Edward D. Reiskin
Director of Transportation

SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY
BOARD OF DIRECTORS
RESOLUTION No. 14-120

WHEREAS, The San Francisco Municipal Transportation Agency ("SFMTA") currently operates a fleet of 151 light rail vehicles (LRVs), which are scheduled for retirement starting in 2021; and,

WHEREAS, The start of revenue service for the Central Subway Extension will require an additional 24 light rail vehicles to be delivered by 2018; and,

WHEREAS, Ridership projections and planned service expansions indicate a need for an additional 85 light rail vehicles over the next ten years; including 40 light rail vehicles needed between 2018 and 2021; and,

WHEREAS, In order to procure new LRVs to meet these anticipated needs, the SFMTA issued a Request for Qualifications in March 2013 seeking Statements of Qualification (SOQs) from LRV car builders; and,

WHEREAS, The SFMTA received SOQs from four car builders, and after evaluating the SOQs, found all four car builders eligible to continue on to the Request for Proposals (RFP) phase of the procurement; and,

WHEREAS, In September 2013, the SFMTA issued an RFP for the procurement of up to 260 LRVs, with a scope of work that includes the design, manufacture, delivery and test of LRVs, together with associated services, spare parts, special tools, training and documentation; and,

WHEREAS, In February 2014, the SFMTA received proposals from two car builders; after reviewing the proposals, the selection panel determined Siemens Industry, Inc. to be the highest-ranked proposer; and,

WHEREAS, The SFMTA has negotiated a final agreement with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts, special tools, training and documentation, for an amount not to exceed \$1,192,651,577, and a term not to exceed 15 years; and,

WHEREAS, The base portion of the contract for 175 LRVs will be funded with federal, state and local funds; and

WHEREAS, The Department of City Planning has determined that the replacement and expansion vehicle portions of the procurement are statutorily exempt under Section 21080(b)(11) of the California Resources Code and Section 15275(a) of the implementing CEQA Guidelines because those portions of the procurement involve an increase of service on rail lines already in use; and


WHEREAS, The vehicles for the Central Subway Project were reviewed as part of the Central Subway Final Supplemental EIS/EIR, certified by the Planning Commission on August 7, 2008, and on August 19, 2008, this Board, in Resolution No. 08-150, adopted the findings and conclusions with respect to Central Subway Final Supplemental EIS/EIR; and based upon its review of the Final Supplemental EIS/EIR, this Board finds that no additional environmental review is required under Public Resources Code section 21166; now, therefore, be it,

RESOLVED, That the SFMTA Board of Directors authorizes the Director of Transportation to execute SFMTA Contract No. 2013-19: Procurement of New Light Rail Vehicles (LRV4), with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts, special tools, training and documentation, in an amount not to exceed \$1,192,651,577, and for a term not to exceed 15 years; subject to the FTA's resolution of the protest submitted to them by CAF USA; and be it further

RESOLVED, That the SFMTA Board of Directors authorizes the Director of Transportation to enter into negotiations with Siemens Industry, Inc. to provide financing for approximately 40 Option vehicles to be delivered between 2018 and 2021 should SFMTA determine that such financing is feasible and advantageous to the Agency, with any final financing agreement to be approved by this Board; and be it further

RESOLVED, That the SFMTA Board of Directors urges the Board of Supervisors to approve this Agreement.

I certify that the foregoing resolution was adopted by the Municipal Transportation Agency Board of Directors at its meeting of July 15, 2015.



Secretary to the Board of Directors
San Francisco Municipal Transportation Agency

SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY
BOARD OF DIRECTORS
CITY AND COUNTY OF SAN FRANCISCO

RESOLUTION NO. 08-150

WHEREAS, The Third Street Light Rail Project Final Environmental Impact Statement/Environmental Impact Report (FEIS/FEIR) was certified in November 1998; and,

WHEREAS, On January 19, 1999, the Public Transportation Commission approved Resolution No. 99-009, which adopted the environmental findings for the Third Street Light Rail Project, including mitigation measures set forth in the 1998 FEIS/FEIR and Mitigation Monitoring Report; and,

WHEREAS, The Federal Transit Administration issued a Record of Decision on the 1998 FEIS/FEIR for the IOS on March 16, 1999; and,

WHEREAS, The Central Subway is the second phase of the Third Street Light Rail Project; and,

WHEREAS, Studies undertaken subsequent to the Final EIS/EIR certification identified a new Fourth/Stockton Alignment to be evaluated for the Central Subway Project; and,

WHEREAS, On June 7, 2005, the San Francisco Municipal Transportation Agency (SFMTA) Board of Directors adopted Resolution 05-087, selecting the Fourth/Stockton Alternative (Alternative 3A) as the Locally Preferred Alternative (LPA) to be carried through the Supplemental EIS/EIR (SEIS/SEIR) and the federal New Starts process; and,

WHEREAS, Alternative 3B, Fourth/Stockton Alignment, was developed as a modified LPA in response to comments received through the public scoping process for the SEIS/SEIR initiated in June 2005 and also as a result of preliminary cost estimates identifying the need for Project cost savings; and,

WHEREAS, On October 17, 2007, SFMTA released for public comment a Draft SEIS/SEIR for the Central Subway Project, which evaluated a reasonable range of alternatives including: No Build/TSM (Alternative 1); Enhanced EIS/EIR Alternative (Alternative 2); Fourth/Stockton Alignment, LPA (Alternative 3A); and Fourth/Stockton Alignment, Modified LPA (Alternative 3B) with semi-exclusive surface right-of-way and mixed-flow surface operation options; and,

WHEREAS, The semi-exclusive surface right-of-way option for Alternative 3B, Fourth/Stockton Alignment, Modified LPA, would improve surface rail operations on Fourth

Street and reduce travel times for Central Subway patrons when compared to the mixed-flow option; and,

WHEREAS, The majority of comments received during the public comment period that concluded on December 10, 2007 supported construction of the Central Subway Project, and support was greater for Alternative 3B as the LPA; and,

WHEREAS, The SEIS/SEIR concluded that Alternative 3B will have significant unavoidable environmental impacts to traffic, historic resources and socioeconomics; and,

WHEREAS, The SEIS/SEIR identified Alternative 3B as the environmentally superior Build Alternative and the only fully funded alternative; and,

WHEREAS, The three other alternatives analyzed in the SEIS/SEIR, including a No Project/TSM Alternative, an Enhanced EIS/EIR Alignment (Alternative 2) and a Fourth/Stockton Alignment (Alternative 3A), are addressed, and found to be infeasible, in the CEQA Findings attached as Enclosure 3, which are incorporated herein by reference as though fully set forth. The CEQA Findings also set forth the benefits of the project that override its unavoidable significant impacts to traffic, historic resources and socioeconomics; and,

WHEREAS, The Final SEIS/SEIR was prepared to respond to comments on the Draft SEIS/SEIR and was distributed on July 11, 2008; and,

WHEREAS, the San Francisco Planning Commission certified the SEIS/SEIR as adequate, accurate and objective and reflecting the independent judgment of the Commission on August 7, 2008; and,

WHEREAS, The SFMTA Board has reviewed and considered the information contained in the SEIS/SEIR; and,

WHEREAS, the Central Subway project will assist SFMTA in meeting the objectives of Strategic Plan Goal No. 1 to provide safe, accessible, clean, environmentally sustainable service and encourage the use of auto-alternative modes through the Transit First policy; Goal No. 2 to improve transit reliability; Goal No. 3 to improve economic vitality through improved regional transportation; and Goal No. 4 to ensure the efficient and effective use of resources; now, therefore, be it

RESOLVED, That the San Francisco Municipal Transportation Agency Board of Directors adopts the Central Subway Project Alternative 3B, Fourth/Stockton Alignment with semi-exclusive surface rail operations on Fourth Street and a construction variant to extend the tunnel another 2,000 feet north of Jackson Street to extract the Tunnel Boring Machine in a temporary shaft on Columbus Avenue near Union Street; and be it further

RESOLVED, That the San Francisco Municipal Transportation Agency Board of

Directors adopts the CEQA Findings and Statement of Overriding Considerations for the SEIS/SEIR attached as Enclosure 3, and adopts the Mitigation Monitoring and Reporting Plan attached as Enclosure 4; and be it further

RESOLVED, That the San Francisco Municipal Transportation Agency Board of Directors authorizes the Executive Director/CEO to direct staff to continue with otherwise necessary approvals and to carry out the actions to implement the project.

I certify that the foregoing resolution was adopted by the San Francisco Municipal Transportation Agency Board of Directors at its meeting of AUG 19 2008.

R. Boomer

Secretary, San Francisco Municipal Transportation Agency Board

SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY
BOARD OF DIRECTORS

RESOLUTION No. 14-120

WHEREAS, The San Francisco Municipal Transportation Agency (“SFMTA”) currently operates a fleet of 151 light rail vehicles (LRVs), which are scheduled for retirement starting in 2021; and,

WHEREAS, The start of revenue service for the Central Subway Extension will require an additional 24 light rail vehicles to be delivered by 2018; and,

WHEREAS, Ridership projections and planned service expansions indicate a need for an additional 85 light rail vehicles over the next ten years; including 40 light rail vehicles needed between 2018 and 2021; and,

WHEREAS, In order to procure new LRVs to meet these anticipated needs, the SFMTA issued a Request for Qualifications in March 2013 seeking Statements of Qualification (SOQs) from LRV car builders; and,

WHEREAS, The SFMTA received SOQs from four car builders, and after evaluating the SOQs, found all four car builders eligible to continue on to the Request for Proposals (RFP) phase of the procurement; and,

WHEREAS, In September 2013, the SFMTA issued an RFP for the procurement of up to 260 LRVs, with a scope of work that includes the design, manufacture, delivery and test of LRVs, together with associated services, spare parts, special tools, training and documentation; and,

WHEREAS, In February 2014, the SFMTA received proposals from two car builders; after reviewing the proposals, the selection panel determined Siemens Industry, Inc. to be the highest-ranked proposer; and,

WHEREAS, The SFMTA has negotiated a final agreement with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts, special tools, training and documentation, for an amount not to exceed \$1,192,651,577, and a term not to exceed 15 years; and,

WHEREAS, The base portion of the contract for 175 LRVs will be funded with federal, state and local funds; and

WHEREAS, The Department of City Planning has determined that the replacement and expansion vehicle portions of the procurement are statutorily exempt under Section 21080(b)(11) of the California Resources Code and Section 15275(a) of the implementing CEQA Guidelines because those portions of the procurement involve an increase of service on rail lines already in use; and

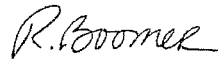
WHEREAS, The vehicles for the Central Subway Project were reviewed as part of the Central Subway Final Supplemental EIS/EIR, certified by the Planning Commission on August 7, 2008, and on August 19, 2008 this Commission, in Resolution No. 08-150 adopted the findings and conclusions with respect to Central Subway Final Supplemental EIS/EIR; and based upon this Commission's review of the Final Supplemental EIS/EIR, the Commission finds that no additional environmental review is required under Public Resources Code section 21166; now, therefore, be it,

RESOLVED, That the SFMTA Board of Directors authorizes the Director of Transportation to execute SFMTA Contract No. 2013-19: Procurement of New Light Rail Vehicles (LRV4), with Siemens Industry, Inc., to procure up to 260 LRVs, associated services, spare parts, special tools, training and documentation, in an amount not to exceed \$1,192,651,577, and for a term not to exceed 15 years; subject to FTA's resolution of the protest submitted to them by CAF USA; and be it further

RESOLVED, That the SFMTA Board of Directors authorizes the Director of Transportation to enter into negotiations with Siemens Industry, Inc. to provide financing for approximately 40 Option vehicles to be delivered between 2018 and 2021 should SFMTA determine that such financing is feasible and advantageous to the Agency, with any final financing agreement to be approved by this Board; and be it further

RESOLVED, That the SFMTA Board of Directors urges the Board of Supervisors to approve this Agreement.

I certify that the foregoing resolution was adopted by the Municipal Transportation Agency Board of Directors at its meeting of July 15, 2014.



Secretary to the Board of Directors
San Francisco Municipal Transportation Agency



SFMTA
Municipal
Transportation
Agency

2014.0929E

Edwin M. Lee, Mayor

Tom Nolan, Chairman

Malcolm Harbuck, Director

Joel Barnes, Director

Edward D. Moskaly, Director of Transportation

Cheryl Brinkman, Vice Chairman

Jerry Lee, Director

Christina Rucore, Director

LIGHT RAIL VEHICLE PROCUREMENT

As part of its regular daily passenger transit service, the SFMTA has a fleet of 151 light rail vehicles (LRVs). Vehicles in service operate 21 hours per day, 365 days a year, on the Muni Metro system. These vehicles typically have a lifespan of 25 years, and will be scheduled for retirement starting in 2021.

The planned procurement will provide up to 260 new LRVs, together with associated services, spare parts, special tools, training and documentation. The new LRVs are expected to have a 25-year life, which assumes that the cars will undergo a mid-life overhaul. SFMTA requires new LRVs for three purposes:

- (1) 24 LRVs for increased service demand for the Central Subway Project and Mission Bay, and system-wide growth along those corridors. These vehicles would be scheduled for delivery from 2016 through 2018;
- (2) the replacement of the existing fleet of 151 LRVs, with deliveries projected to start in 2021 and continue through 2028; and
- (3) Up to 85 LRVs to meet additional projected growth in ridership and system capacity expansion needs through 2040.

These cars will be housed at Muni Metro East Facility and Green Facility.

Statutorily exempt
under CEQA Guidelines
Section 15275(a) -
increase in service on
rail lines already in use.

New LRVs for Central
Subway covered under
Central Subway EIS/EIR

Final Supplemental

Case NO. 1996.281E

~~Categorically exempt from Environmental Review
CEQA Guidelines 15301 Class 1 (e): Additions to
existing structures provided that the addition will
not result in an increase of more than 50 percent
of the floor area of the structures before the
addition, or 2,500 square feet, whichever is less.~~

~~Gerald Robbins~~

Gerald Robbins

Date

- Jeanie Poling 6/19/14

Agreement Between

The City and County Of San Francisco

San Francisco Municipal Transportation Agency

And

Siemens Industry, Inc.

For

Procurement of New Light Rail Vehicles (LRV4)

Contract No. SFMTA-2013-19

TABLE OF CONTENTS

	Page
1. Certification of Funds; Budget and Fiscal Provisions; Termination in the Event of Non-Appropriation	3
2. Term of the Agreement.....	4
3. Effective Date of Agreement.....	4
4. Work Contractor Agrees to Perform	4
5. Compensation	4
6. Guaranteed Maximum Costs.....	4
7. Payment; Invoice Format.....	5
7.1. Amount	5
7.2. Invoices.....	5
7.3. Progress Payments	5
7.4. Exchange Rate Risk	6
7.5. Escalation	6
7.5.1 Sole Remedy for Cost Increases.....	6
7.5.2 Reserved.....	6
7.5.3 Adjustment Methodolgy.....	6
(a) Labor Indices.....	6
(b) Material Indices	6
(c) Determination of Base and Current Indices.....	7
(d) Determination of Escalated Price	7
7.5.4 Escalation for Price of Spare Parts	7
7.5.5 Escalation for Price of Train Simulator.....	7
7.6. Release.....	7
8. Submitting False Claims; Monetary Penalties	7
9. Disallowance	8
10. Taxes.....	8
10.1. Payment of Taxes	8
10.2. Possessory Interest	8
11. Payment Does Not Imply Acceptance of Work.....	9
12. Qualified Personnel	9

13.	Responsibility for Equipment	9
14.	Independent Contractor; Payment of Taxes and Other Expenses.....	9
	14.1. Independent Contractor	9
	14.2. Payment of Taxes and Other Expenses	10
15.	Insurance; Bonds.....	10
	15.1. Insurance	10
	15.2. Bonds/Letter of Credit	12
	15.2.1 General	12
	15.2.2 Security	12
	(a) Phase 1 (24 Base Order Vehicles).....	12
	(b) Phase 2 (Base Order Vehicles 25-175).....	13
	(c) Optional Delivery Phase (Option Vehicles 1-25)	13
	15.2.3 Labor and Materials Bond	13
	(a) Phase 1 (24 Base Order Vehicles).....	13
	(b) Phase 2 (151 Base Order Vehicles).....	14
	(c) Phase 2 (Option Vehicles 1-85).....	14
	15.2.4 Warranty Bond	14
	15.2.5 Requirements for Letter of Credit	15
	(a) General Requirements	15
	(b) Financial Institution.....	15
	(c) Demand on Letter of Credit	15
	(d) Expiration or Termination	15
	(e) Return of Letter of Credit.....	16
	(f) Excessive Demand.....	16
	15.2.6 Requirements for Bonds	16
16.	Indemnification	17
	16.1. General.....	17
	16.2. Duty to Defend.....	17
	16.3. Intellectual Property	17
	16.4. Limitation of Liability	17
	16.5. Notice of Claim	17
17.	Incidental and Consequential Damages.....	18
18.	Liability of City	18

19.	Liquidated Damages/ Weight Incentives	18
19.1.	Liquidated Damages	18
19.2.	Weight Limits and Incentives	19
20.	Default; Remedies	19
20.1.	Event of Default	19
20.2.	Remedies.....	19
21.	Termination for Convenience.....	20
21.1.	Exercise of Option	20
21.2.	Contractor Actions	20
21.3.	Contractor Invoice.....	20
21.4.	Non-Recoverable Costs.....	21
21.5.	Deductions.....	21
21.6.	Survival	21
22.	Rights and Duties Upon Termination or Expiration.....	21
22.1.	Survival of Sections	21
22.2.	Contractor Duties.....	21
23.	Conflict of Interest.....	21
24.	Proprietary or Confidential Information of City.....	22
25.	Notices to the Parties	22
26.	Intellectual Property.....	22
26.1.	Works for Hire; Ownership of Results	22
26.2.	Licenses Granted.....	23
26.2.1	Computerized Software and Systems	23
26.2.2	Other Deliverables	23
26.3.	Proprietary Materials.....	23
27.	Exhibits.....	24
28.	Audits and Inspection of Records.....	24
29.	Subcontracting.....	24
30.	Assignment.....	24
31.	Non-Waiver of Rights	24
32.	Reserved	24
33.	Reserved	24
34.	Nondiscrimination; Penalties	24

34.1.	Contractor Shall Not Discriminate.....	24
34.2.	Subcontracts.....	25
34.3.	Nondiscrimination in Benefits.....	25
34.4.	Incorporation of Administrative Code Provisions by Reference	25
35.	Tropical Hardwoods and Virgin Redwood Ban	25
36.	Drug-Free Workplace Policy.....	25
37.	Resource Conservation	25
38.	Compliance with Americans with Disabilities Act.....	26
39.	Sunshine Ordinance	26
40.	Public Access to Meetings and Records	26
41.	Notification of Limitations on Contributions.....	26
42.	Requiring Minimum Compensation for Covered Employees	27
43.	First Source Hiring Program	27
44.	Prohibition on Political Activity with City Funds.....	27
45.	Preservative-Treated Wood Containing Arsenic.....	27
46.	Modification of Agreement.....	27
46.1.	City-Ordered Changes.....	27
46.2.	Regulatory Changes	28
46.3.	Schedule Changes	28
47.	Authority of Project Manager; Claims; Disputes	28
47.1.	Authority of Project Manager	28
47.2.	Claims for Additional Compensation.....	28
47.3.	Other Claims.....	29
47.4.	Resolution of Disputes.....	29
47.5.	No Cessation of Work.....	29
47.6.	Alternative Dispute Resolution.....	29
47.7.	Disputes Among Contractor's Partners.....	29
48.	Agreement Made in California; Venue.....	29
49.	Construction	29
50.	Entire Agreement.....	30
51.	Compliance with Laws.....	30
52.	Services Provided by Attorneys.....	30
53.	Reserved.....	30

54.	Severability	30
55.	Protection of Private Information	30
56.	Time of Essence.....	30
57.	Technical Specifications	30
	57.1. Fabrication	30
	57.2. Omission.....	30
58.	Project Management Plan	31
59.	Reserved	31
60.	FTA Requirements	31
61.	Cooperative Drafting.....	31
62.	Warranty.....	31
63.	Title.....	31
64.	Option Vehicles, Equipment and Spare Parts	31
	64.1. Option for New Light Rail Vehicles	31
	64.2. Option for Additional Spare Parts	31
	64.3. Spare Parts For Options	31
	64.4. Optional Train Simulator	32
	64.5. Financing of Option Vehicles	32
65.	Precedence of Contract Documents.....	32
66.	Deliveries.....	32
	66.1. Predelivery Tests and Inspections	32
	66.2. Delivery Procedure	32
	66.3. Spare Parts Delivery Procedure	32
67.	Acceptance Of Vehicles	33
	67.1. Procedure	33
	67.2. Conditional Acceptance	33
	67.3. Assumption of Risk of Loss.....	33
68.	Repairs Prior To Acceptance.....	33
	68.1. Repairs by Contractor.....	33
	68.2. Repairs by SFMTA	34
69.	Unavoidable Delays.....	34
	69.1. Definition.....	34
	69.2. Notification of Delay.....	34

69.3. Request for Extension.....	34
70. MacBride Principles—Northern Ireland	35

Exhibits

Exhibit 1	Schedule of Prices
Exhibit 2	Payment Schedule
Exhibit 3	Project Delivery Schedule
Exhibit 4	FTA Requirements
Exhibit 5	Warranty Provisions
Exhibit 6	Parent Company Guarantee

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

**Agreement between the City and County of San Francisco and
Siemens Industry, Inc.**

This Agreement is made this _____ day of _____, 2014, in the City and County of San Francisco, State of California, by and between: Siemens Industry, Inc. at 7464 French Road, Sacramento, CA 95828 ("Contractor") and the City and County of San Francisco, a municipal corporation ("City"), acting by and through its Municipal Transportation Agency ("SFMTA").

Recitals

A. SFMTA wishes to obtain the services of a qualified firm to procure up to 260 Light Rail Vehicles.

B. A Request for Qualifications ("RFQ") was issued on March 29, 2013, and City qualified three proposers to submit proposals.

C. A Request for Proposals ("RFP") was issued on September 30, 2013 to the qualified proposers, and City selected Contractor as the highest-qualified proposer pursuant to the RFP.

Now, THEREFORE, the parties agree as follows:

Definitions

Acceptance: The formal written acceptance by the City that all Work, or a specific portion thereof, under the contract has been satisfactorily completed.

Award: 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.

Base Order: Work referenced as Items 1 – 7 in Exhibit 1.

Certification: Certification by the Controller that funds necessary to make payments as required under the Contract are available in accordance with the City's Charter.

City: The City and County of San Francisco.

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

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

Contract, Agreement: The written contract executed by the City and Contractor, 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 Contractor's Proposal, the Contract bonds or other security, and all and Contract Modifications.

Contract Modification: A written amendment to the Contract, agreed to by the City and Contractor, covering changes in the 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.

Contractor: The proposer to whom the Award is made.

Controller: Controller of the City.

Correction: The elimination of a defect.

Days: Unless otherwise designated, "Days" as used in the Contract shall mean calendar days.

Defect: Any patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

Director: The Director of Transportation of the SFMTA or his or her designee.

Engineer: The SFMTA Engineer assigned to the Contract or designated agent.

Final Acceptance: 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.

Light Rail Vehicles: The Vehicles procured under this Contract, also referred to as "Cars," "LRV4s," or "Vehicles."

Material and/or Equipment: The Light Rail Vehicles (including all parts and equipment installed in them) and other deliverables furnished by the Contractor under the provisions of the Contract.

Notice To Proceed (NTP): A written notice to the Contractor of the date on which it shall begin prosecution of the work to be done under the contract.

Option: A unilateral right in the Contract, by which, for a specified time, the SFMTA may elect to purchase, at a pre-determined price specified in the Contract, additional Work called for by the Contract.

Phase 1: Work related to the acquisition of 24 Base Order Vehicles to supplement the existing fleet when SFMTA Central Subway opens.

Phase 2: Work related to the acquisition of 151 Base Order Vehicles to replace the existing LRV fleet.

Project Manager: The Project Manager assigned to the Contract for the SFMTA, or his or her designated agent.

Proposal: The technical and management information and prices submitted by Contractor in response to the RFP.

Related Defect(s): The damages inflicted on any component or subsystem as a direct result of a Defect.

Request for Qualifications; RFQ: The Request for Qualifications issued by the SFMTA on March 29, 2013 to qualify proposers for the RFP.

Request for Proposals; RFP: The Request for Proposals issued by the SFMTA on September 30, 2013, to procure up to 260 Light Rail Vehicles.

SFMTA: The San Francisco Municipal Transportation Agency, an agency of the City with responsibility for the Municipal Railway and the Division of Sustainable Streets (Parking and Traffic).

Subcontractor, Supplier: 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.

Technical Specifications: The portion of the Conformed Contract Documents 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.

Work: 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.

Working Days: Those calendar 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.

Acronyms

AW0	Assigned Weight (empty load)
FDR	Final Design Review
FTA	Federal Transit Administration
PDR	Preliminary Design Review
RFP	Request for Proposals
RFQ	Request for Qualifications
SOQ	Statement of Qualifications

1. Certification of Funds; Budget and Fiscal Provisions; Termination in the Event of Non-Appropriation.

1.1. 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, 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.

1.2. 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.

1.3. 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.

2. Term of the Agreement.

Subject to Section 1, the term of this Agreement shall not exceed 15 years from the Effective Date.

3. Effective Date of Agreement.

This Agreement shall become effective on the date the Controller has certified to the availability of funds and Contractor has been notified in writing.

4. Work Contractor Agrees to Perform.

The Contractor agrees to perform the Work provided for in the Technical Specifications, and in the Contractor's Proposal (as incorporated into the Conformed Contract Documents), according to the Project Delivery Schedule set forth in Exhibit 3.

5. Compensation.

5.1. In no event shall the amount of this Agreement exceed One Billion, One Hundred Ninety-Two Million, Six Hundred Fifty-One Thousand, Five Hundred Seventy-Seven Dollars (\$1,192,651,577). The breakdown of costs associated with this Agreement appears in the Schedule of Prices (Exhibit 1) and Payment Schedule (Exhibit 2).

5.2. No charges shall be incurred under this Agreement nor shall any payments become due to Contractor until equipment, reports, services, or both, required under this Agreement are received from Contractor and approved by SFMTA as being in accordance with this Agreement. City may withhold payment to Contractor in any instance in which Contractor has failed or refused to satisfy any material obligation provided for under this Agreement.

5.3. In no event shall City be liable for interest or late charges for any late payments.

6. Guaranteed Maximum Costs.

6.1. The City's obligation hereunder shall not at any time exceed the amount certified by the Controller for the purpose and period stated in such certification.

6.2. Except as may be provided by laws governing emergency procedures, officers and employees of the City are not authorized to request, and the City is not required to reimburse the Contractor for, Commodities or Services beyond the agreed upon contract scope unless the changed scope is authorized by amendment and approved as required by law.

6.3. Officers and employees of the City are not authorized to offer or promise, nor is the City required to honor, any offered or promised additional funding in excess of the maximum amount of funding for which the contract is certified without certification of the additional amount by the Controller.

6.4. The Controller is not authorized to make payments on any contract for which funds have not been certified as available in the budget or by supplemental appropriation.

6.5. This contract will be initially certified for \$ _____. Contractor shall not incur costs in excess of such amount without written authorization from the SFMTA, signed by the SFMTA Chief Financial Officer, or his or her designee.

7. Payment; Invoice Format

Invoices furnished by Contractor under this Agreement must be in a form acceptable to the Controller, and must include the Contract Progress Payment Authorization number. All amounts paid by City to Contractor shall be subject to audit by City. Progress payments shall be made by the City to Contractor at the address specified below:

7.1. Amount. Subject to any subsequent deductions for Liquidated Damages for late delivery of Contract deliverables as specified in Section 19 of this Agreement, the City agrees to pay an amount not to exceed the compensation amount stated in Section 5.1 of this Agreement and in accordance with the terms and conditions of this Agreement.

7.2. Invoices. Contractor's invoices shall be submitted to the following address:

San Francisco Municipal Transportation Agency
Transit Division
1 South Van Ness Avenue, Room 7068
San Francisco, CA 94103
Attention: Ms. Trinh Nguyen P.E., Senior Program Manager

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.

7.3. Progress Payments. SFMTA shall make payments as the work proceeds in accordance with the progress payment provisions as set forth in the Payment Schedule (Exhibit 2). Progress payments shall be conditioned on either (1) 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 15.1 of this Agreement; or (2) issuance of a letter of credit in conformance with the provision of Section 15.2.5 in the amount of the progress payment. Progress payments for which a letter of credit shall be required are as follows: Milestones A, B and C of Item 1 of Exhibit 2 to this Agreement, and Milestones A, B (except if title is delivered prior to payment by SFMTA) and C of Item 2 of Exhibit 2 to this Agreement. Letter(s) of credit for such progress payments will be released upon Acceptance of 80 percent of the total Vehicles for each respective phase: Phase 1 Base Order Vehicles, Phase 2 Base Order Vehicles, and Option Vehicles.

In lieu of a letter of credit to secure progress payments, Contractor may elect to increase its performance bond required under Section 15.2.2 of this Agreement by the cumulative amount of progress payments for each of the above Milestones 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. For any Advance Payment Bond or increase in the Performance Bond based upon the above, the Advance Payment Bond will be released or the Performance Bond will be reduced based upon Acceptance of 80 percent of the total Vehicles for each respective phase: Phase 1 Base Order Vehicles, Phase 2 Base Order Vehicles, and Option Vehicles.

All Work covered and paid for during the construction of the Light Rail Vehicles shall become the sole property of SFMTA. This provision shall not be construed as relieving the Contractor from the sole responsibility for all Work upon which payments have been made or for the restoration of all damaged Work or as waiving the right of SFMTA to require the fulfillment of all of the terms of the Contract specifications. The Contractor shall remain liable for insuring and delivering the material in the final form as specified in the Contract, and shall replace material at no cost to SFMTA in the event it is not delivered and accepted by SFMTA.

Contractor shall prepare invoices supported by evidence satisfactory to SFMTA that the Work invoiced has been accomplished and that the materials listed, if any, are stored and ready for use. City will endeavor to pay 30 days after receipt of the complete invoice package.

7.4. Exchange Rate Risk. The City will not make price adjustments on this Contract to protect the Contractor from fluctuations in the value of the applicable foreign currency in relation to the United States dollar.

7.5. Escalation. SFMTA will make price adjustments to this Contract to protect Contractor from economic inflation as set forth below. This adjustment will apply to the Base Order Phase 2 Vehicles, the Option Vehicles (Section 64.1), the optional Train Simulator, the spare parts for Phase 2, and the Option spare parts (see Section 7.5.4 below).

7.5.1. Sole Remedy for Cost Increases. This escalation adjustment shall be the sole remedy for any increases or decreases in the Contractor's costs for Phase 2 Vehicles, Option Vehicles, equipment and spare parts due to inflation or deflation. Adjustments will be calculated applied independently for each Option exercised.

7.5.2. Reserved.

7.5.3. Adjustment Methodology. The unit price of the Vehicle shall be broken down by the percentages of labor and material comprising the unit price as follows: 35% material, 60% labor, and 5% profit. The profit portion of the unit price shall not be subject to adjustment. In making any price adjustments under this Section, SFMTA will use the labor and material indices published by the U.S. Department of Labor, Bureau of Labor Statistics (BLS) at www.bls.gov/iag/tgs/iag335.htm and www.bls.gov/iag/tgs/iag336.htm.

(a) Labor Indices. SFMTA will make any adjustments based on the change in the following indices, equally weighted:

(i) Unit Labor Cost Index for the NAICS Manufacturing Series, Code 335, Electrical Equipment, Appliance and Component Manufacturing, and

(ii) Unit Labor Cost Index for the NAICS Manufacturing Series, Code 336, Transportation Equipment.

(b) Material Indices. SFMTA will make adjustments based on the change in the following indices, equally weighted:

(i) Producer Price Index (PPI) for the NAICS Manufacturing Series, Code 335, Electrical Equipment, Appliance and Component Manufacturing, and

(ii) The Producer Price Index (PPI) for the NAICS Manufacturing Series, Code 336, Transportation Equipment.

(c) Determination of Base and Current Indices

(i) SFMTA will determine the Base labor and material indices by calculating the arithmetic average of the final published indices for the three months prior to the date of Notice to Proceed.

(ii) SFMTA will determine the current labor and material indices for Phase 2 Vehicles by calculating the arithmetic average of the final published indices for the three months prior to one year before the scheduled date of delivery of the first Car of Phase 2 in accordance with Exhibit 3, Project Delivery Schedule.

(iii) SFMTA will negotiate and agree escalation to be applied to the Options at the time Options may be exercised.

(d) Determination of Escalated Price

(i) SFMTA will use the unit price of Vehicles as adjusted by any Contract Modifications in effect at the time of escalation (Adjusted Unit Price).

(ii) SFMTA will escalate the Adjusted Unit Prices of Vehicle according to the methodology in Section 7.5.3(c) to determine the escalated Vehicle unit price.

7.5.4. Escalation for Price of Spare Parts. Any price adjustment for spare parts shall be determined according to the methodology described above for escalating the price of Vehicles and in accordance with the table below.

Schedule of Prices Reference	Base Phase 1 Cars 1-24	Base Phase 2 Cars 25-175	Option Vehicles Cars 1-85
Nominal Spare (item 5)	NO ESCALATION	In accordance with Phase 2, Section 7.5.3 (c)(ii)	/
Optional Spare (item 8)	In accordance with Section 7.5.3(c)(iii)	In accordance with Section 7.5.3(c)(iii)	
Spares for Option Vehicles (item 9)			

7.5.5. Escalation for Price of Train Simulator. Any price adjustment for the optional train simulator shall be determined according to the methodology described above for Option Vehicles, Section 7.5.3(c)(iii).

7.6. Release. The Contractor shall, if required by the City, execute and deliver at the time of final payment and as a condition precedent to final payment, a release in a form satisfactory to the City, discharging the City, its officers, agents and employees of and from liabilities, obligations, and claims arising under this Contract.

8. Submitting False Claims; Monetary Penalties.

Pursuant to San Francisco Administrative Code §21.35, any contractor, subcontractor or consultant who submits a false claim shall be liable to the City for three

times the amount of damages which the City sustains because of the false claim. A contractor, subcontractor or consultant who submits a false claim shall also be liable to the City for the costs, including attorneys' fees, of a civil action brought to recover any of those penalties or damages, and may be liable to the City for a civil penalty of up to \$10,000 for each false claim. A contractor, subcontractor or consultant will be deemed to have submitted a false claim to the City if the contractor, subcontractor or consultant: (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.

9. Disallowance

If Contractor claims or receives payment from City for a service, 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.

10. Taxes

10.1. Payment of Taxes. The City will reimburse the Contractor for any levied sales tax on articles purchased by the City under this Agreement. However, if the Contractor cannot be authorized to collect and pay the sales taxes to the State of California, then the City will pay the sales tax directly to the State. Contractor shall be solely responsible for any penalties, interest or fees assessed as a result of late or erroneous payment of such taxes except to the extent that the City is responsible for making payments directly to the State.

The City warrants that it is a public entity exempt from certain federal excise taxes and in connection therewith that it has obtained a federal excise tax exemption certificate. Contractor will pay all other taxes, including possessory interest taxes, licenses, imposts, duties, and all other governmental charges of any type whatsoever levied upon or as a result of this Agreement or Work performed pursuant hereto.

10.2. Possessory Interest. Contractor recognizes and understands 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:

10.2.1. 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;

10.2.2. 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.

10.2.3. 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.

10.2.4. 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.

11. Payment Does Not Imply Acceptance of Work

The granting of any payment by City, or the receipt thereof by Contractor, shall in no way lessen the liability of Contractor to replace unsatisfactory work, equipment, or materials, although the unsatisfactory character of such work, equipment or materials may not have been apparent or detected at the time such payment was made. Materials, equipment, components, or workmanship that does not conform to the requirements of this Agreement may be rejected by City and in such case must be replaced by Contractor without delay.

12. Qualified Personnel

Work under this Agreement shall be performed only by competent personnel under the supervision of and in the employment of Contractor. Contractor will comply with City's reasonable requests regarding assignment of personnel, but all personnel, including those assigned at City's request, must be supervised by Contractor. Contractor shall commit adequate resources to complete the project within the project schedule specified in this Agreement.

13. Responsibility for Equipment

City shall not be responsible for any damage to persons or property as a result of the use, misuse or failure of any equipment used by Contractor, or by any of its employees, even though such equipment be furnished, rented or loaned to Contractor by City.

14. Independent Contractor; Payment of Taxes and Other Expenses

14.1. Independent Contractor. 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 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.

14.2. Payment of 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 or Work 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, should any court, arbitrator, or administrative authority determine that Contractor is an employee for any other purpose, then Contractor agrees to a reduction in City's financial liability so that City's total expenses under this Agreement are not greater than they would have been had the court, arbitrator, or administrative authority determined that Contractor was not an employee.

15. Insurance; Bonds

15.1. Insurance

15.1.1. Without in any way limiting Contractor's liability pursuant to the "Indemnification" section of his Agreement, Contractor shall 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, illness or injury. The Worker's Compensation policy shall be endorsed with a waiver of subrogation in favor of the City for all work performed by the Consultant, its employees, agents and subcontractors; **and**

(b) (i) Commercial General Liability Insurance with limits not less than \$50,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Contractual Liability, Personal Injury, Products and Completed Operations, and any exclusion for railroads shall be removed; **or** (ii) A combination of Umbrella or Excess Insurance and Commercial General Liability Insurance with combined limits not less than \$50,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Contractual Liability, Personal Injury, Products and Completed Operations; such coverage shall be written on a follow form basis, and any exclusion for railroads shall be removed; **and**

(c) Commercial Automobile Liability Insurance with limits not less than \$1,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Owned, Non-Owned and Hired auto coverage, as applicable; **and**

(d) Garage Liability insurance (if applicable, in SFMTA's sole discretion, based on means and methods employed by Contractor), including coverage for garage operations arising from premises/operations, product/completed operations, contracts, owned vehicles, non-owned vehicles

and damage to vehicles owned by others (bailment), with a minimum limit of liability of \$2,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage; **and**

(e) Garagekeepers' Legal Liability insurance (if applicable, in SFMTA's sole discretion, based on means and methods employed by Contractor), with an endorsement for coverage of Light Rail Vehicles, comprehensive form, with limits not less than \$2,000,000 each occurrence; **and**

(f) All Risk Property Insurance with replacement cost coverage and limits of no less than (amount TBD based on value of maximum cars stored). Insurance shall cover all risk of physical loss or damage to the Contractor's site, including buildings, contents, any storage facility and its contents; **and**

(g) Professional liability insurance, applicable to Contractor's profession, with limits not less than \$10,000,000 each claim with respect to negligent acts, errors or omissions in connection with professional services to be provided under this Agreement; **and**

(h) Unless otherwise covered by Commercial General Liability and/or Umbrella or Excess Insurance specified in paragraph 15.1.1(b)(i), Transit Liability coverage with limits not less than \$50,000,000, to be in place prior to testing of Vehicles on any public or third-party rails; **and**

(i) Crane Operator's/Riggers Liability Insurance (if applicable), covering crane operations while at Contractor's site with limits of no less than \$10,000,000 per occurrence and in the aggregate. This insurance applies only if Contractor uses a crane in the performance of the Work; **and**

(j) Any shipping contractor or subcontractor shall carry, at a minimum, physical damage insurance (including destruction, damage, fire and theft) in the amount of not less than the value of the item(s) shipped, as stated in Exhibit 1A, Price Item 2, and commercial liability insurance in the amount of not less than \$1,000,000.

15.1.2. Commercial General Liability, Business Automobile Liability Insurance, Garagekeepers' Legal Liability, Transit Liability and Shippers Coverage policies must provide the following:

(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 Insured, 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.

15.1.3. Waiver of Subrogation. Contractor agrees to waive subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. Contractor agrees to obtain any endorsement that may be necessary to effect this waiver of subrogation.

15.1.4. All policies shall provide 30 Days' advance written notice to City of cancellation or reduction in coverage for any reason, mailed to the following address:

San Francisco Municipal Transportation Agency
Transit Division
1 South Van Ness Avenue, 7th Floor, San Francisco, CA 94103
Attention: Ms. Trinh Nguyen P.E., Senior Program Manager
LRV4, Contract No. SFMTA-2013-19

15.1.5. 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 five 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

15.1.6. 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.

15.1.7. 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.

15.1.8. Before commencing any operations under this Agreement, Contractor shall do the following: (a) 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 coverage's set forth above, and (b) furnish complete copies of policies promptly upon City request.

15.1.9. Approval of the insurance by City shall not relieve or decrease the liability of Contractor hereunder.

15.1.10. If a subcontractor will be used to complete any portion of this agreement, the Contractor shall ensure that the subcontractor shall provide all necessary insurance and shall name the City and County of San Francisco, its officers, agents and employees and the Contractor listed as additional insureds.

15.2. Bonds/Letter of Credit

15.2.1. General. The following provisions set forth financial guarantees that must be met by Contractor. Contractor may choose to meet the requirements of this Section 15.2 by obtaining either the required bonds or an irrevocable letter of credit ("Letter of Credit") in an equivalent amount, or a combination of the two types of instruments. In addition, for each subsequent Vehicle delivery phase described below, Contractor may elect to change how the obligations are met by furnishing a bond to cover an obligation previously covered by a Letter of Credit or vice-versa, subject to approval of the SFMTA and the City's Risk Manager. The Contractor may provide a Parent Company Guarantee in lieu of the bond required under this Agreement, subject to the approval of the SFMTA and the City's Risk Manager. The form of the Parent Company Guarantee is provided in Exhibit 6.

15.2.2. Security. Contractor shall furnish to the City either a performance bond or a Letter of Credit for each phase of delivery as set forth below:

(a) Phase 1 (24 Base Order Vehicles)

(i) A performance bond or Letter of Credit in the amount of 25 percent of the total price for Phase 1 within 20 Days following the receipt of the notice of award of the Contract.

(ii) If requested by Contractor and agreed to by City, the amount of the performance bond may be reduced, or the City may authorize a reduction in the amount of the Letter of Credit from 25 percent

to 12.5 percent of the total price for Phase 1 upon Acceptance or Conditional Acceptance of the 24th Car. Upon expiration of the warranty period of the 24th Car, the City will release the performance bond (or authorize the release of the Letter of Credit) covering the 24 Cars. Alternatively, the City may release the performance bond (or authorize the release of the Letter of Credit) upon Acceptance or Conditional Acceptance of the 24th Car provided that Contractor has furnished to City a warranty bond or Letter of Credit in accordance with the requirements of Section 15.2.4.

(b) Phase 2 (151 Base Order Vehicles – 25-175)

(i) Contractor shall furnish to the City a performance bond or Letter of Credit in the amount of 25 percent of the total price for Phase 2 no later than 18 months prior to the planned delivery of Base Order Vehicle 25; Contractor shall issue a phase commencement letter to the City no later than 30 days prior to the issuance of the performance bond or Letter of Credit.

(ii) If requested by Contractor and agreed to by City, the amount of the performance bond may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit) as Phase 2 Vehicles are Accepted as follows:

(A) from 25 percent to 20 percent of the total price for Phase 2 upon expiration of the warranty period of the 75th Car;

(B) from 20 percent to 15 percent of the total price for Phase 2 upon expiration of the warranty period of the 125th Car.

(iii) Upon expiration of the warranty period of the 175th Car, the City will release the performance bond or authorize the release of the Letter of Credit. Alternatively, the City may release the performance bond or authorize the release of the Letter of Credit upon Acceptance or Conditional Acceptance of the 175th Car provided Contractor has furnished to City a warranty bond or Letter of Credit in accordance with the requirements of Section 15.2.4 at the time of Acceptance or Conditional Acceptance of the 175th Car.

(c) Optional Delivery Phase (Option Vehicles 1-85). If SFMTA exercises the option for delivery of additional Vehicles (Option Vehicles), Contractor shall furnish to the City a performance bond or Letter of Credit in the amount of 25% of the total option price within 20 Days of Contractor's receipt of notice from SFMTA of the Agency's intention to exercise the option. The amount of the performance bond for the Option Vehicles may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit for such Vehicles) from 25% to 5% upon Acceptance or Conditional Acceptance of the last Option Vehicle. The City will release the performance bond or authorize the release of the Letter of Credit, upon the expiration of the warranty period of the last Option Vehicle. Alternatively, the City may release the performance bond or authorize the release of the Letter of Credit upon Acceptance or Conditional Acceptance of the last Option Vehicle provided that Contractor has furnished the City with a warranty bond or Letter of Credit in accordance with the requirements of Section 15.2.4.

15.2.3. Labor and Materials Bond.

(a) Phase 1 (24 Base Order Vehicles) Within 20 days following the receipt of notice of Award of the Contract, the Contractor shall furnish to City either a labor and materials bond (in the form to be approved by

the City) or a Letter of Credit in the amount of 25 percent of the of the total price for Phase 1, to guarantee Contractor's payment of materials, provisions, or other supplies used for or in the performance of Phase 1 of the contract. Upon delivery and acceptance by the City of 75 percent of the contracted number of Vehicles for Phase 1, the amount of the labor and materials bond may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit) to 30 percent of the original amount. Upon final payment by the City for all Contract deliverables under Phase 1, the obligations of the Contractor and surety under the labor and materials bond shall be released by the City in writing (or in the case of a Letter of Credit, the City shall authorize the release of the Letter of Credit for this purpose). The original bond document(s) shall be retained by the City.

(b) Phase 2 (151 Base Order Vehicles). Contractor shall furnish to the City either a labor and materials bond or Letter of Credit in the amount of 25 percent of the total price for Phase 2, to guarantee Contractor's payment of materials, provisions, or other supplies used for or in the performance of Phase 2 no later than 18 months prior to the planned delivery of Base Order Vehicle 25; Contractor shall issue a phase commencement letter to the City no later than 30 days prior to the issuance of the performance bond or Letter of Credit. Upon delivery and acceptance by the City of 75 percent of the contracted number of Vehicles for Phase 2, the amount of the labor and materials bond may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit) to 30 percent of the original amount. Upon final payment by the City for all Contract deliverables under Phase 2, the obligations of the Contractor and surety under the labor and materials bond shall be released by the City in writing (or in the case of a Letter of Credit, the City shall authorize the release of the Letter of Credit for this purpose). The original bond document(s) shall be retained by the City.

(c) Optional Delivery Phase (Option Vehicles 1-85.) Within 20 days of receipt of a notice from City of its intention to exercise the Option for delivery of additional Vehicles, the Contractor shall furnish to City either a separate labor and materials bond or a Letter of Credit in the amount of 25 percent of the cost of the additional Vehicles to be purchased, to guarantee performance of all Contract obligations with respect to such Optional Vehicles. Provisions for releasing or reducing the amount of the bond or Letter of Credit shall apply in the same manner as described above. Any such bond shall also be retained by the City.

15.2.4. Warranty Bond. Once all Vehicles have been Accepted or Conditionally Accepted for Phase 1, Phase 2, or for Option Delivery, Contractor may replace the performance bond for that phase, or request that the City authorize the release of a Letter of Credit provided in lieu of a performance bond by obtaining a warranty or guaranty bond or an additional Letter of Credit in the amount of 10 percent of the Contract amount for that phase or for the Option Vehicles, as appropriate. Where Contractor's performance is secured by a Letter of Credit and Contractor obtains a warranty bond to cover Contractor's warranty obligations for a given phase or the Option Delivery period, Contractor may request that the Letter of Credit be released to reflect that the Contractor's obligations under that delivery phase have otherwise been fulfilled. A bond or Letter of Credit under this paragraph 15.2.4 shall be for the purpose of covering all of Contractor's warranty obligations under the Contract for that phase or for Option delivery, and shall become effective upon release of the performance bond or City's authorization to release the Letter of Credit specified in Subsection 15.2.2 above. At the end of each year of warranty coverage, the Contractor may request a reduction of coverage, which may be approved at the discretion of SFMTA and the City's Risk Manager.

15.2.5. 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 as otherwise provided in this Section 15.2 to reflect the adjustments set forth above) 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, 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 30, 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.

15.2.6. 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 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 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 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.

15.2.7. Parent Company Guarantee If a Parent Company Guarantee is used, the City reserves the right to review the financials of the Parent Company at agreed intervals; Contractor's agreement for such review shall not be unreasonably withheld.

16. Indemnification

16.1. General. Contractor shall indemnify and save harmless City and its officers, agents and employees from, and, if requested, shall defend them against any and all loss, cost, damage, injury, liability, and claims thereof for injury to or death of a person, including employees of Contractor or loss of or damage to property, arising 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 in effect on or validly retroactive to the date of this Agreement, 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.

16.2. Duty to Defend. 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.

16.3. Intellectual Property. 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 in consequence of the use by City, or any of its officers or agents, of articles or Work to be supplied in the performance of this Agreement.

16.4. 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 5.1, as that amount may be modified by a properly approved and executed Contract Modification. Said limitation on liability shall not apply to:

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

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

16.4.3. damages and other liability arising under claims by third parties, including indemnity or contribution for claims brought by a third party (see Paragraph 16.1);

16.4.4. damages and other liability for infringement of any intellectual property right as provided in Section 16.3.

16.5. 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.

17. Incidental and Consequential Damages.

Except for liquidated damages, Contractor shall not be responsible for indirect, incidental and consequential damages resulting from Contractor's acts or omissions, including but not limited to, lost profits or revenue and business interruption. Nothing in this Agreement shall constitute a waiver or limitation of any rights that City may have under applicable law.

18. Liability of City

CITY'S PAYMENT OBLIGATIONS UNDER THIS AGREEMENT SHALL BE LIMITED TO THE PAYMENT OF THE COMPENSATION PROVIDED FOR IN SECTION 5 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 OR WORK PERFORMED IN CONNECTION WITH THIS AGREEMENT.

19. Liquidated Damages/ Weight Incentives

19.1. Liquidated Damages

By entering into this Agreement, the Contractor agrees that in the event the Work, as provided under Section 4, is delayed beyond the scheduled milestones and timelines as provided in the Project Delivery Schedule in Exhibit 3 of this Agreement, 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 SFMTA.

Milestone	Amount per Day
Delivery of first 2 Vehicles	\$2000 per Vehicle
Delivery of Vehicles 3 - 260	\$1000 per Vehicle
Completion of training program	\$500
Completion of delivery of Phase 1 spare parts	\$500
Completion of delivery of Phase 2 spare parts	\$500
Conditional Acceptance of manuals (operation, maintenance and parts manuals)	\$500
Delivery of diagnostic test equipment and special tools	\$500
Failure to provide a plan for correction of fleet defects	\$500 per Vehicle
Failure to fully correct fleet defects according to approved plan	\$500 per Vehicle

Liquidated Damages imposed under this Agreement shall be in addition to any other damages which are recoverable by the City specified elsewhere in the Contract. The total amount of liquidated damages shall not exceed 10 percent of the total amount of the Contract, as stated in Section 5.1 of this Agreement, as that amount may be amended by Contract Modification(s).

19.2. Weight Limits and Incentives

The nominal Vehicle weight shall be 78,770 pounds at AW0. Vehicles shall be weighed prior to delivery, and, for each pound in excess of the nominal weight, the City will deduct \$10 per pound per Vehicle from the Contractor's invoice. For each pound below the nominal weight, the City will pay an incentive payment of \$10 per pound per Vehicle. To allow for manufacturing variations, neither penalties nor incentives will be assessed on the first one percent excess or under weight. SFMTA shall reject Vehicles weighing in excess of 80,000 pounds at AW0 and shall not be required to pay for rejected Vehicles.

20. Default; Remedies

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

20.1.1. Contractor fails or refuses to perform or observe any term, covenant or condition contained in any of the following Sections of this Agreement: 8, 10, 15, 24, 30, 36, 51, or 55.

20.1.2. Contractor fails or refuses to perform or observe any other term, covenant or condition contained in this Agreement, and such default continues for a period of 15 Days after written notice thereof from City to Contractor.

20.1.3. San Francisco Municipal Transportation Agency 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.

20.1.4. 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.

20.2. 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, 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 all damages, losses, costs or expenses incurred by City as a result of such Event of Default and any liquidated damages due from Contractor pursuant to the terms of this Agreement or any other agreement. 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.

21. Termination for Convenience

21.1. 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.

21.2. Contractor Actions. Upon receipt of the notice, 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:

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

21.2.2. Not placing any further orders or subcontracts for materials, services, equipment or other items.

21.2.3. Terminating all existing orders and subcontracts.

21.2.4. At City's direction, assigning to City any or all of Contractor's right, title, and interest under the orders and subcontracts terminated. Upon such assignment, City 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.

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

21.2.6. Completing performance of any services or Work that City designates to be completed prior to the date of termination specified by City.

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

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

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

21.3.2. A reasonable allowance for profit on the cost of the services and Work described in the immediately preceding subsection 21.3.1, provided that the Contractor can establish, to the satisfaction of City, that Contractor would have made a profit has all services and Work under this Agreement been completed, and provided further, that the profit allowed shall in no event exceed five percent of such cost.

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

21.3.4. 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 City, and any other appropriate credits to City against the cost of the services or other work.

21.4. Non-Recoverable Costs. In no event shall City be liable for costs incurred by Contractor or any of its Subcontractors after the termination date specified by City, except for those costs specifically enumerated and described in the immediately preceding subsection 21.3. Such non-recoverable costs include, but are not limited to, anticipated profits on 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 such subsection 21.3.

21.5. Deductions. In arriving at the amount due to Contractor under this Section, City may deduct: (a) all payments previously made by City for Work or services covered by Contractor's final invoice; (b) any claim which City may have against Contractor in connection with this Agreement; (c) any invoiced costs or expenses excluded pursuant to the immediately preceding subsection 21.4; and (d) in instances in which, in the opinion of the City, the cost of any service or other work performed under this Agreement is excessively high due to costs incurred to remedy or replace defective or rejected services or Work, the difference between the invoiced amount and City's estimate of the reasonable cost of performing the invoiced services or Work in compliance with the requirements of this Agreement.

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

22. Rights and Duties Upon Termination or Expiration

22.1. Survival of Sections. This Section and the following Sections of this Agreement shall survive termination or expiration of this Agreement: 8 through 11, 13 through 18, 24, 26, 28, 46 through 50, 54, 55, 61, 62 and 67.

22.2. Contractor Duties. Subject to the immediately preceding subsection 22.1, upon termination of this Agreement prior to expiration of the term specified in Section 2, this Agreement shall terminate and 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. This subsection shall survive termination of this Agreement.

23. Conflict of Interest

Through its execution of this Agreement, Contractor acknowledges that it is familiar with the provisions of section 15.103 of the City's Charter, Article III, Chapter 2 of the City's Campaign and Governmental Conduct Code and sections 87100 et seq. and sections 1090 et seq. of the Government Code of the State of California, and certifies that it does not know of any facts which constitute a violation of said provision and agrees that if it becomes aware of any such fact during the term of this Agreement it shall immediately notify the City.

24. Proprietary or Confidential Information of City

Contractor understands and agrees that, in the performance of the Work or services under this Agreement or in contemplation thereof, Contractor may have access to private or confidential information, which may be owned or controlled by City, and that such information may contain proprietary or confidential details, the disclosure of which to third parties may be damaging to City. Contractor agrees that all information disclosed by City to Contractor shall be held in confidence and used only in performance of 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 data.

25. Notices to the Parties

Unless otherwise indicated elsewhere 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,
1 South Van Ness Avenue, 7th Floor, San Francisco, CA 94103
Attention: Ms. Trinh Nguyen P.E. Senior Program Manager
lr4@sfmta.com

To Contractor:

Siemens Industry, Inc.
Infrastructure & Cities Sector
7464 French Road
Sacramento, CA 95828
Attention: Mr. Viorel Aninoiu
viorel.aninoiu@siemens.com

Any notice of default must be sent by registered mail.

26. Intellectual Property

26.1. Works for Hire; Ownership of Results. Any interest of Contractor or its Subcontractors, in drawings, plans, specifications, blueprints, studies, reports, memoranda, computation sheets, computer files and media or other documents prepared by Contractor or its subcontractors solely for the City in connection with services or Work to be performed under this Agreement, shall become the property of and will be transmitted to City. However, Contractor may retain and use copies for reference and as documentation of its experience and capabilities. If, in connection with services or Work performed under this Agreement, Contractor or its subcontractors create artwork, copy, posters, billboards, photographs, videotapes, audiotapes, systems designs, software, reports, diagrams, surveys, blueprints, source codes or any other original works of authorship, such works of authorship shall be works for hire as defined under Title 17 of the United States Code, and all copyrights in such works are the property of the City if prepared solely for the City and for no other customer or application. These shall include: City route specific information (e.g. public address system information, destination information), City specific propulsion and brake software code; and Contract-specific manuals, artwork, copy, posters, billboards, photographs, videotapes and audiotapes. If it is ever determined that any works created by Contractor or its subcontractors under this Agreement are not works for hire under U.S. law, Contractor hereby assigns all copyrights to such works to the City, and agrees to

provide any material and execute any documents necessary to effectuate such assignment. With the approval of the City, Contractor may retain and use copies of such works for reference and as documentation of its experience and capabilities.

26.2. Licenses Granted

26.2.1. Computerized Software and Systems. To the extent that that the Contractor is providing its proprietary software, firmware, systems designs, computerized manuals, training modules, or other such deliverables that 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 hereby warrants that it has title to and/or the authority to grant a license of such deliverables to the City. Upon request, Contractor shall provide to City a copy of the source code, which corresponds to the most current version of the deliverable, as well as any and all applicable proprietary materials that are otherwise not furnished under this Agreement, but may become necessary for the long-term maintenance and operation of the Vehicles. Alternatively, prior to Notice to Proceed, City and Contractor shall negotiate and enter into an escrow agreement whereby the applicable source codes for software that is proprietary to Contractor or its suppliers or subcontractors, including periodic updates of said source codes, and other proprietary materials, are placed in escrow. The source codes placed in escrow shall be on electronic media and shall be accompanied by detailed software documentation, including a list of applicable software development tools. The Director of Transportation shall execute said escrow agreement on behalf of City.

26.2.2. Other Deliverables. Contractor grants City a perpetual, non-exclusive, non-transferable license to use, retain, and reproduce at all locations controlled by 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 (i) prepared by Contractor or its subcontractors or suppliers (but not exclusively for City); and (ii) required to be provided to City in connection with this Agreement. Contractor hereby warrants that it has title to and/or the authority to grant a license of such deliverables to the City.

26.2.3. Proprietary Materials. 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. Alternatively, at SFMTA's request, documents shall be placed in escrow, along with source codes, as described in subsection 26.2.1 above. 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. 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.

27. Exhibits

All exhibits are incorporated by reference and made a part of this Agreement as though fully set forth.

28. Audits 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 under this Agreement. 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 less 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 conferred upon City by this Section.

29. Subcontracting

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 performance of the Work. City's execution of this Agreement constitutes its approval of the major subcontractors/suppliers listed below. 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.

	Commodity	Supplier
1	APC	INIT
2	ATCS	Thales
3	CCTV	Kratos
4	Event Recorder	Hasler Rail
5	HVAC	Thermo King
6	Radio	Harris

30. Assignment

The Work to be performed by Contractor are personal in character and neither this Agreement nor any duties or obligations hereunder may be assigned or delegated by the Contractor unless first approved by City by written instrument executed and approved in the same manner as this Agreement.

31. 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.

32. Reserved

33. Reserved

34. Nondiscrimination; Penalties

34.1. Contractor Shall Not Discriminate. In the performance of this Agreement, Contractor agrees not to discriminate against any employee, City and

County employee working with such contractor or subcontractor, applicant for employment with such contractor or subcontractor, or against any person seeking accommodations, advantages, facilities, privileges, services, or membership in all business, social, or other establishments or organizations, on the basis of the fact or perception of a person's race, color, creed, religion, national origin, ancestry, age, height, weight, sex, sexual orientation, gender identity, domestic partner status, marital status, disability or Acquired Immune Deficiency Syndrome or HIV status (AIDS/HIV status), or association with members of such protected classes, or in retaliation for opposition to discrimination against such classes.

34.2. Subcontracts. Contractor shall incorporate by reference in all subcontracts the provisions of §§12B.2(a), 12B.2(c)-(k), and 12C.3 of the San Francisco Administrative Code (copies of which are available from SFMTA) and shall require all subcontractors to comply with such provisions. Contractor's failure to comply with the obligations in this subsection shall constitute a material breach of this Agreement.

34.3. Nondiscrimination in Benefits. 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 bereavement leave, family medical leave, health benefits, membership or membership discounts, moving expenses, pension and retirement benefits or travel benefits, as well as any benefits other than the benefits specified above, between employees with domestic partners and employees with spouses, and/or between the domestic partners and spouses of such employees, where the domestic partnership has been registered with a governmental entity pursuant to state or local law authorizing such registration, subject to the conditions set forth in §12B.2(b) of the San Francisco Administrative Code.. As a condition to this Agreement, Contractor shall execute the "Chapter 12B Declaration: Nondiscrimination in Contracts and Benefits" form (form HRC-12B-101) with supporting documentation and secure the approval of the form by the San Francisco Human Rights Commission.

34.4. Incorporation of Administrative Code Provisions by Reference. The provisions of Chapters 12B and 12C of the San Francisco Administrative Code are incorporated in this Section by reference and made a part of this Agreement as though fully set forth herein. Contractor shall comply fully with and be bound by all of the provisions that apply to this Agreement under such Chapters, including but not limited to the remedies provided in such Chapters. Without limiting the foregoing, Contractor understands that pursuant to §12B.2(h) of the San Francisco Administrative Code, a penalty of \$50 for each person for each calendar day during which such person was discriminated against in violation of the provisions of this Agreement may be assessed against Contractor and/or deducted from any payments due Contractor.

35. Tropical Hardwoods and Virgin Redwood Ban

Pursuant to §804(b) of the San Francisco Environment Code, the City and County of San Francisco urges contractors not to import, purchase, obtain, or use for any purpose, any tropical hardwood, tropical hardwood wood product, virgin redwood or virgin redwood wood product.

36. Drug-Free Workplace Policy

Contractor acknowledges that pursuant to the Federal Drug-Free Workplace Act of 1989, the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited on City premises. Contractor agrees that any violation of this prohibition by Contractor, its employees, agents or assigns will be deemed a material breach of this Agreement.

37. Resource Conservation.

Chapter 5 of the San Francisco Environment Code ("Resource Conservation") is incorporated herein by reference. Failure by Contractor to comply with any of the applicable requirements of Chapter 5 will be deemed a material breach of contract.

38. Compliance with Americans with Disabilities Act

Contractor acknowledges that, pursuant to the Americans with Disabilities Act (ADA), programs, services and other activities provided by a public entity to the public, whether directly or through a contractor, must be accessible to the disabled public. Contractor shall provide the Work specified in this Agreement in a manner that complies with the ADA and any and all other applicable federal, state and local disability rights legislation. Contractor agrees not to discriminate against disabled persons in the provision of services or Work, benefits or activities provided under this Agreement and further agrees that any violation of this prohibition on the part of Contractor, its employees, agents or assigns will constitute a material breach of this Agreement.

39. Sunshine Ordinance

In accordance with San Francisco Administrative Code §67.24(e), contracts, contractors' bids, responses to solicitations and all other records of communications between City and persons or firms seeking contracts, shall be open to inspection immediately after a contract has been awarded. Nothing in this provision requires the disclosure of a private person or organization's net worth or other proprietary financial data submitted for qualification for a contract or other benefit until and unless that person or organization is awarded the contract or benefit. Information provided which is covered by this paragraph will be made available to the public upon request.

40. Public Access to Meetings and Records.

If the Contractor receives a cumulative total per year of at least \$250,000 in City funds or City-administered funds and is a non-profit organization as defined in Chapter 12L of the San Francisco Administrative Code, Contractor shall comply with and be bound by all the applicable provisions of that Chapter. By executing this Agreement, the Contractor agrees to open its meetings and records to the public in the manner set forth in §§12L.4 and 12L.5 of the Administrative Code. Contractor further agrees to make-good faith efforts to promote community membership on its Board of Directors in the manner set forth in §12L.6 of the Administrative Code. The Contractor acknowledges that its material failure to comply with any of the provisions of this paragraph shall constitute a material breach of this Agreement. The Contractor further acknowledges that such material breach of the Agreement shall be grounds for the City to terminate and/or not renew the Agreement, partially or in its entirety.

41. Notification of Limitations on Contributions.

Through execution of this Agreement, Contractor acknowledges that it is familiar with section 1.126 of the City's Campaign and Governmental Conduct Code, which prohibits any person who contracts with 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, or for a grant, loan or loan guarantee, from making any campaign contribution to (1) an individual holding a City elective office if the contract must be approved by the individual, a board on which that individual serves, or a board on which an appointee of that individual serves, (2) a candidate for the office held by such individual, or (3) a committee controlled by such individual, at any time from the commencement of negotiations for the contract until the later of either the termination of negotiations for such contract or six months after the date the contract is approved. Contractor acknowledges that the foregoing restriction applies only if the contract or a combination or series of contracts approved by the same individual or board in a fiscal year have a total anticipated or actual value of \$50,000 or more. Contractor further acknowledges that 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 20 percent in Contractor; any subcontractor listed in the bid or contract; and any committee that is sponsored or controlled by Contractor. Additionally, Contractor acknowledges that Contractor must inform each of the persons described in the preceding sentence of the prohibitions contained in Section 1.126.

42. Requiring Minimum Compensation for Covered Employees

Contractor agrees to pay covered employees no less than the minimum compensation required by San Francisco's Minimum Compensation Ordinance (MCO), and shall otherwise comply with the MCO as set forth in San Francisco Administrative Code Chapter 12P (Chapter 12P). The provisions of Chapter 12P, including but not limited to the penalties for noncompliance provided therein, are incorporated herein by this reference, and made part of this Agreement as though fully set forth herein.

43. First Source Hiring Program

Contractor shall 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, including but not limited to the remedies for noncompliance provided therein. The provisions of Chapter 83 are incorporated herein by this reference, and made part of this Agreement as though fully set forth herein.

44. Prohibition on Political Activity with City Funds

In accordance with San Francisco Administrative Code Chapter 12.G, Contractor may not participate in, support, or attempt to influence any political campaign for a candidate or for a ballot measure (collectively, "Political Activity") in the performance of the services provided under this Agreement. Contractor agrees to comply with San Francisco Administrative Code Chapter 12.G and any implementing rules and regulations promulgated by the City's Controller. The terms and provisions of Chapter 12.G are incorporated herein by this reference. In the event Contractor violates the provisions of this section, the City may, in addition to any other rights or remedies available hereunder, (i) terminate this Agreement, and (ii) prohibit Contractor from bidding on or receiving any new City contract for a period of two (2) years.

45. Preservative-Treated Wood Containing Arsenic

Contractor may not purchase preservative-treated wood products containing arsenic in the performance of this Agreement unless an exemption from the requirements of Chapter 13 of the San Francisco Environment Code is obtained from the Department of the Environment under Section 1304 of the Code. The term "preservative-treated wood containing arsenic" shall mean wood treated with a preservative that contains arsenic, elemental arsenic, or an arsenic copper combination, including, but not limited to, chromate copper arsenate preservative, ammonia cal copper zinc arsenate preservative, or ammonia cal copper arsenate preservative. Contractor may purchase preservative-treated wood products on the list of environmentally preferable alternatives prepared and adopted by the Department of the Environment. This provision does not preclude Contractor from purchasing preservative-treated wood containing arsenic for saltwater immersion. The term "saltwater immersion" shall mean a pressure-treated wood that is used for construction purposes or facilities that are partially or totally immersed in saltwater.

46. Modification of Agreement

This Agreement may not be modified, nor may compliance with any of its terms be waived, except by written instrument executed and approved as required by law.

46.1. City-Ordered Changes

The City may order changes in the Work and may order extra materials and extra work in connection with the performance of the Agreement, and the Contractor shall respond within 30 days to such orders, except that:

If changes ordered in design, workmanship, services, or materials are of such a nature as to increase or decrease the cost or the time required to execute the change in scope of Work, the City shall make a reasonable and proper adjustment in the Contract price, delivery schedule, or both, as agreed upon by the Contractor and the Agency as the reasonable and proper allowance for the increase or decrease required.

No order for any alteration, modification, or extra that will increase or decrease the cost of the Work shall be valid unless the resulting increase or decrease in price shall have been agreed upon in writing and approved by the City in the manner required under City law. No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this Contract, which include the requirements of the Technical Specifications.

46.2. Regulatory Changes

If a price adjustment is necessary to incorporate changes mandated by legislation or regulations that are promulgated or become effective after the Effective Date of the Contract and before Acceptance of the Vehicles, the Agency and the Contractor shall negotiate the price adjustment, which shall be added to the cost of the Vehicle and/or the engineering costs from Item 1.1 of Exhibit 1. Such price adjustments may be audited, where required.

46.3. Schedule Changes

If City-ordered changes have potential impact on the delivery schedule, the Contractor shall submit a schedule change request for City approval.

47. Authority of Project Manager; Claims; Disputes.

47.1. Authority of Project Manager Authority of Project Manager. 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 47.4 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 5 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.

47.2. Claims for Additional Compensation.

47.2.1. 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.

47.2.2. 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.

47.2.3. It is the intention of this Section 47.2 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.

47.3. 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.

47.4. 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.

47.5. 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.

47.6. Alternative Dispute Resolution. If agreed to by both parties, disputes may be resolved by a mutually agreed to alternative dispute resolution process.

47.7. 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.

48. 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.

49. Construction

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

50. Entire Agreement

This Contract sets forth the entire Agreement between the parties, and supersedes all other oral or written provisions. This Contract may be modified only as provided in Section 46.

51. Compliance with Laws

Contractor shall keep itself fully informed of the City's Charter, codes, ordinances 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.

52. Services Provided by Attorneys

Any services to be provided by a law firm or attorney must be reviewed and approved in writing in advance by the City Attorney. No invoices for services provided by law firms or attorneys, including, without limitation, as Subcontractors of Contractor, will be paid unless the provider received advance written approval from the City Attorney.

53. Reserved

54. 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, 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.

55. Protection of Private Information

Contractor has read and agrees to the terms set forth in San Francisco Administrative Code Sections 12M.2, "Nondisclosure of Private Information," and 12M.3, "Enforcement" of Administrative Code Chapter 12M, "Protection of Private Information," which are incorporated herein as if fully set forth. Contractor agrees that any failure of Contractor to comply with the requirements of Section 12M.2 of this Chapter shall be a material breach of the Contract. In such an event, in addition to any other remedies available to it under equity or law, the City may terminate the Contract, bring a false claim action against the Contractor pursuant to Chapter 6 or Chapter 21 of the Administrative Code, or debar the Contractor.

56. Time of Essence

Time is of the essence in this Agreement.

57. Technical Specifications

57.1. Fabrication. The Vehicles shall be designed, fabricated, and tested in accordance with the requirements in Volume 2 (Technical Specifications).

57.2. Omission. Notwithstanding the Technical Specifications or other data provided by the Project Manager, the Contractor shall have the responsibility of supplying all parts and details required to make these Vehicles complete and ready for

service even though such details may not be specifically mentioned in the Specifications. Items that are installed by SFMTA shall not be the responsibility of the Contractor unless they are included in this Contract or should have been installed by the Contractor.

58. Project Management Plan.

The Project shall be managed, planned and controlled in accordance with the requirements of Section 20 of the Technical Specifications (Program Management and Quality Assurance).

59. Reserved

60. FTA Requirements

The provisions contained in "FTA Requirements for Procurement Contracts," attached as Exhibit 4. If there is any conflict between the FTA terms and conditions and any other terms and conditions of this Agreement, the FTA terms and conditions shall take precedence.

61. Cooperative Drafting

This Agreement has been drafted through a cooperative effort of both parties, 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.

62. Warranty

Contractor shall provide warranties of Vehicles, training, parts and special tools as described in Exhibit 5 (Warranty Provision).

63. Title

Adequate documents for securing the title of the Vehicle shall be provided to the Project Manager at the time the Vehicle is delivered. Upon Acceptance or, in the case of a Vehicle being Conditionally Accepted, upon Conditional Acceptance of each Vehicle, the Contractor warrants that the title shall pass to the SFMTA free and clear of all liens, mortgages and encumbrances, financing statements, security agreements, claims and demands of any character. Title to the spare parts to be delivered under this Contract shall vest in the SFMTA immediately upon Acceptance by the SFMTA.

64. Option Vehicles, Equipment and Spare Parts

All items purchased under the Options shall be identical in every way to those purchased under the Base Order portion of the Contract. All conditions, Technical Specifications, and requirements set forth for the Base Order purchases shall apply to the items purchased under Option unless otherwise specified in this Section.

64.1. Option for New Light Rail Vehicles. At the option of the City, the Contractor shall provide additional Vehicles in quantities indicated in the Schedule of Prices. The Option for 1 to 85 Vehicles (Item 7 on Exhibit 2 -- Payment Schedule) may be executed any time within seven years after NTP. The price of Option Vehicles will be adjusted in accordance with Section 7.5 of this Agreement.

64.2. Option for Additional Spare Parts. At the option of the City, Contractor shall provide additional spare parts (Item 8 on the Payment Schedule, Exhibit 2). Prices shall remain firm for 24 months after NTP. The price of Option for additional spare parts will be adjusted in accordance with Section 7.5 of this Agreement.

64.3. Spare Parts For Options. At the option of the City, Contractor shall provide spare parts for Option Vehicles (Item 9 on the Exhibit 2 Payment Schedule).

The price of spare parts for Option Vehicles will be adjusted in accordance with Section 7.5 of this Agreement.

64.4. Optional Train Simulator. At the option of the City, Contractor shall provide optional train simulator (Item 10 on the Exhibit 2 Payment Schedule). The price of optional train simulator will be adjusted in accordance with Section 7.5 of this Agreement.

64.5. Financing of Option Vehicles. At the sole election of the SFMTA, the parties shall negotiate vendor financing of approximately 40 Option Vehicles to be delivered between 2018 and 2021. Any financing agreement shall be subject to approval by the SFMTA Board of Directors.

65. Precedence of Contract Documents

Any inconsistency in requirements of the Contract shall be resolved by giving precedence in the following order:

- (a) Agreement (including all exhibits and Contract Modifications)
- (b) Technical Specifications (conformed with Addenda)
- (c) Contractor's Proposal (incorporated with Clarifications)

Wording shall take precedence over conceptual drawings and renderings. Any discrepancy shall be decided in the sole discretion of the SFMTA.

66. Deliveries

66.1. Predelivery Tests and Inspections. Pre-delivery tests and inspections shall be performed prior to shipment to SFMTA. Such tests and inspections shall be performed in accordance with the procedures defined in Verification Section 21.3 of the Technical Specifications, and they may be witnessed by the SFMTA Resident Inspector. When a Vehicle passes these tests and inspections, the Resident Inspector shall authorize release of the Vehicle for shipment. Such authorization does not imply Acceptance of the Vehicle by SFMTA.

66.2. 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:

San Francisco Municipal Transportation Agency
Transit Division
Muni Metro East Facility
601 – 25th Street
San Francisco, CA 94107

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

66.3. Spare Parts Delivery Procedure. Contractor shall deliver Contract spare parts in two shipments or smaller lots provided that all spare parts shipments are delivered in accordance with Exhibit 3. Composition of spare parts in each lot is subject to SFMTA approval. Contractor shall provide SFMTA with one-weeks advance notice before shipment of each lot of spare parts. Such notice shall include a packing list clearly identifying all parts and their quantity in the shipment.

Delivery shall be determined 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, SFMTA will issue a notification of acceptance, non-acceptance or Conditional Acceptance of the spare parts. The point of delivery shall be:

San Francisco Municipal Transportation Agency
Transit Division
Muni Metro East Facility
601 – 25th Street
San Francisco, CA 94107

67. Acceptance Of Vehicles

67.1. Procedure. After arrival at the designated point of delivery, each Vehicle will undergo pre-Acceptance and Acceptance tests by SFMTA as defined in the Verification Section 21.3 of the Technical Specifications. When a Vehicle passes all tests, SFMTA will provide written Acceptance of the Vehicle to the Contractor. Contractor shall transfer title to the Vehicle to the City on the day of Acceptance, or Conditional Acceptance, if the Vehicle is not fully Accepted. Acceptance of one Vehicle does not imply Acceptance of any other delivered Vehicles.

If a Vehicle fails the Acceptance tests, the Vehicle shall not be Accepted until the repair procedures defined in Section 68, of this Agreement have been carried out and the Vehicle has been retested and passes all applicable tests. All deliveries of Vehicles shall be halted whenever five or more Vehicles have failed or have not been Accepted or Conditionally Accepted and are awaiting repairs or corrections.

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

67.2. Conditional Acceptance. If a Vehicle does not meet all requirements for Acceptance, SFMTA may, at its exclusive option, "conditionally accept" the Vehicle 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 7 above.

67.3. Assumption of Risk of Loss. Prior to delivery as described in Section 66 of this Agreement, and regardless whether Title has passed to the City, the Contractor shall bear risk of loss of the Vehicle, including any damage sustained during transportation to the delivery site. Risk of loss will pass to the SFMTA upon delivery of each LRV, except that loss or damage to the Vehicle resulting from acts or omissions of the Contractor shall be the responsibility of the Contractor until Acceptance of said Vehicle.

68. 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 work be done by SFMTA personnel with reimbursement by the Contractor. Contractor shall inform SFMTA in advance of any modifications made to the Vehicle during the Acceptance period.

68.1. Repairs by Contractor. If the SFMTA Project Manager requires the Contractor to perform repairs after non-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 option, the Contractor may be required to remove the Vehicle 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 Vehicle is under its control.

68.2. Repairs by SFMTA. If the SFMTA Project Manager agrees to a request by the Contractor for SFMTA to perform repairs on a Contractor-owned Vehicle prior to SFMTA Acceptance, 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.

If the Contractor supplies parts for repairs being performed by SFMTA before Acceptance of the Vehicle, Contractor shall ship these parts prepaid to SFMTA within ten 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.

Contractor shall reimburse SFMTA for all costs of labor and materials (including taxes) for repairs made or caused to be made by SFMTA. If SFMTA performs the repairs itself, the amount shall be determined by multiplying the number of man-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 Vehicle if such action was necessary. If SFMTA requires the service of an outside repair facility, Contractor shall reimburse SFMTA for all such repair invoices. Contractor shall also reimburse 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.

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.

69. Unavoidable Delays

69.1. 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.

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

69.3. Request for Extension. The Contractor agrees to supply, as soon as such data are available, any reasonable proof that is required by SFMTA to make a decision on any request for extension. SFMTA shall examine the request and any documents supplied by the Contractor and shall determine if the Contractor is entitled to

an extension and the duration of such extension. 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.

70. MacBride Principles—Northern Ireland

Pursuant to San Francisco Administrative Code §12F.5, the City and County of San Francisco urges companies doing business in Northern Ireland to move towards resolving employment inequities, and encourages such companies to abide by the MacBride Principles. The City and County of San Francisco urges San Francisco companies to do business with corporations that abide by the MacBride Principles. By signing below, the person executing this agreement on behalf of Contractor acknowledges and agrees that he or she has read and understood this section.

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

CITY


CONTRACTOR

San Francisco Municipal
Transportation Agency

Edward D. Reiskin
Director of Transportation

Approved as to Form:

Dennis J. Herrera
City Attorney

By 
Robin M. Reitzes
Deputy City Attorney

San Francisco Municipal
Transportation Agency
Board of Directors

Resolution No. _____

Dated: _____

Attest:

Secretary

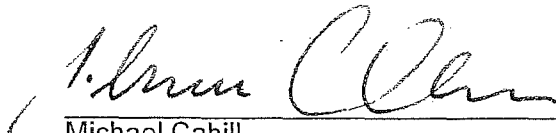
Board of Supervisors

Resolution No. _____

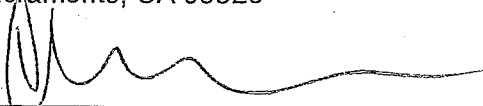
Dated: _____

Attest:

Clerk



Michael Cahill
President
Rail Systems Division
Siemens Industry, Inc.
Infrastructure & Cities Sector
7464 French Road
Sacramento, CA 95828



Christopher Halleus
Vice President, Finance & Business
Administration
Rail Systems Division
Siemens Industry, Inc.
Infrastructure & Cities Sector
7464 French Road
Sacramento, CA 95828

City vendor number: 50009
Federal Taxpayer ID No.13-2762488

EXHIBIT 1
A. Schedule of Prices

BASE

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 1	Engineering Design, Project Management and Design Qualification Testing	Lump Sum	x 1	\$37,541,102
Item 1.1	Allowance for regulatory mandated changes, requested passenger enhancements and system modifications resulting from changes to project interfaces	Lump Sum	x 1	\$10,000,000
Item 2	Vehicle Price for Base Order	\$3,327,250	x 175 cars	\$582,268,750
Item 3	Operating, Maintenance and Parts Manuals	Lump Sum	x 1	\$809,478
Item 4.1	Training	Lump Sum	x 1	\$361,557
Item 4.2	Train Simulator (1) (In accordance with Section 22.2.8 of Technical Specifications)	Lump Sum	x 1	\$1,704,650
Item 5	Spare Parts (Total of Exhibit 1.B)	Lump Sum	x 1	\$14,153,840
Item 6	Special Tools, Test and Diagnostic Equipment (Total of Exhibit 1.D)	Lump Sum	x 1	\$1,792,624
Total Base: Items 1 – 6				\$648,632,001

OPTIONS

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 7	Option for 1 to 85 Additional New Light Rail Vehicles	\$3,329,011	x 85 cars	\$282,965,935
Item 8	Additional Spare Parts (Total of Exhibit 1.C)	Lump Sum	x 1	\$11,269,527
Item 9	Spare Parts for Options	Lump Sum	x 1	\$15,000,000
Item 10	Train Simulator (2) (In accordance with Section 22.2.8 of Technical Specifications)	Lump Sum	x 1	\$1,704,650
Total Options: Items 7 – 10				\$310,940,112

Note: The Prices do not include escalation. Escalation will be applied in accordance with Agreement Section 7.5.

B. Nominal Spare Parts

Total Price \$14,153,840

Carbody and Interior

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	5 car sets	6 car sets	Windshield	\$12,798	\$76,789
2	0 car sets	2 car sets	2 car sets	Articulation section, complete	\$25,737	\$51,475
3	1 car set	4 car sets	5 car sets	Passenger seat assemblies, complete (frame, inserts, hinges, mounting hardware, etc)	\$28,103	\$140,516
4	1 car set	3 car sets	4 car sets	Destination sign, complete (side and ends)	\$25,326	\$101,305
5	1 car set	1 car set	2 car sets	Passenger side window glass	\$10,481	\$20,962
6	1 car set	1 car set	2 car sets	Glass - all (except windshield and passenger side window)	\$3,484	\$6,969

Coupler and Draft Gear

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Coupler & draft gear assembly, complete	\$150,880	\$754,402

Cab and Train Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 units	18 units	20 units	Master Controller assembly	\$4,181	\$83,625
2	1 cab set	1 cab set	2 cab sets	Cab control panel, complete (excluding master controller)	\$50,860	\$101,720

Doors and Door Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Door actuator unit, including linkages and gear drives or actuators	\$71,325	\$356,626
2	1 car set	4 car sets	5 car sets	Door Leafs	\$45,750	\$228,749
3	2 doorway sets of each type	6 doorway sets of each type	8 sets	Door control board or module, complete	\$3,005	\$24,042

Exhibit 1-2

Air Comfort System

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Air conditioner units	\$93,730	\$468,648
2	1 car set	1 car set	2 car sets	Air conditioning blower motors	\$10,244	\$20,488
3	1 unit	5 units	6 units	Air conditioning compressor motors	\$0	\$0
4	1 units	5 units	6 units	Air conditioning compressors	\$5,200	\$31,203

Power Supply and Auxiliary Electric

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 units	8 units	10 units	Pantograph assembly, complete	\$15,941	\$159,410
2	1 car set	1 car set	2 car sets	Battery	\$10,833	\$21,666
3	1 unit	3 units	4 units	Auxiliary Inverter	\$76,947	\$307,789

Propulsion

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 units	6 units	8 units	Traction motor, complete with coupling	\$44,393	\$355,141
2	1 car set	1 car set	2 car sets	Propulsion/brake dynamic resistors assembly, complete	\$20,121	\$40,241
3	1 car set	1 car set	2 car sets	Traction power contactors (motor circuit configuration contactors, reverser, et al., except line switch or main breaker)	\$5,464	\$10,927
4	2 units	3 units	5 units	Line switch	\$1,192	\$5,958
5	1 car set	1 car set	2 car sets	Control relays and sensors, all (except speed sensors or tach generators)	\$4,575	\$9,150
6	1 car set	3 car sets	4 car sets	Speed sensors or tach generators (if required)	\$20,573	\$82,292
7	1 car set	4 car sets	5 car sets	Electronic control unit, complete	\$49,401	\$247,005
8	1 car set	3 car sets	4 car sets	Printed circuit boards, logic	\$64,515	\$258,060
9	1 car set	2 car sets	3 car sets	Propulsion inverters	\$225,725	\$677,174

Truck Assembly and Suspension

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Trucks, complete (ready to install)	\$1,239,478	\$6,197,389
2	2 truck sets	3 truck sets	5 truck sets	Motor truck axle assembly, complete (including gear box, brake disc, ground bearings, primary suspension if needed)	\$229,134	\$1,145,672
3	2 truck sets	3 truck sets	5 truck sets	Trailer truck wheel/axle assembly, complete	\$172,792	\$863,961

Friction Brakes

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	3 car sets	4 car sets	All friction brake equipment (except air compressor, connecting hoses, fittings, inter-unit wiring and electronic control unit)	\$276,600	\$1,106,401
2	2 units	5 units	7 units	Compressor assembly (if required)	\$0	\$0

Communications

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	3 car sets	4 car sets	PA, Communication systems, complete	\$45,170	\$180,678

Miscellaneous

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	1 car set	2 car sets	AC and DC motors, other (except traction motors)	\$8,704	\$17,408

C. Optional Spare Parts

Total Price \$ 11,269,527

Carbody and Interior

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	1 car set	2 car sets	Rubber window glazing, all	\$0	\$0
2	1 car set	1 car set	2 car sets	Windscreen, complete	\$0	\$0
3	1 car set	1 car set	2 car sets	Access covers of all underfloor equipment boxes	\$2,439	\$4,878
4	0 car sets	2 car sets	2 car sets	Stanchions	\$6,969	\$13,938
5	2 car sets	0 car sets	2 car sets	Graphics and decals	\$6,098	\$12,196

Coupler and Draft Gear

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Electrical head, complete	\$52,266	\$261,330
2	200 units	200 units	400 units	Electrical contacts	\$232	\$92,800
3	4 units	6 units	10 units	Electrical head cover	\$5,192	\$51,920
4	2 car sets	3 car sets	5 car sets	Coupler attenuation tubes	\$7,317	\$36,585

Cab and Train Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 cab set	3 cab sets	4 cab sets	Cab door, complete with hardware	\$784	\$3,136
2	2 units	8 units	10 units	CCTV system (for outside rear view)	\$47,039	\$470,390
3	2 cab sets	6 cab sets	8 cab sets	Wiper motor	\$1,394	\$11,152
4	4 units	36 units	40 units	Wiper arms	\$348	\$13,920
5	2 car sets	2 car sets	4 car sets	Horn assembly	\$12,753	\$51,012
6	2 car sets	2 car sets	4 car sets	Gong assembly	\$0	\$0
7	1 cab set	3 cab sets	4 cab sets	Switches, pushbuttons, console displays, meters, gauges, indicating lamps, LEDs, lenses, all	\$16,432	\$65,728
8	4 car sets	0 car sets	4 car sets	Inside sunvisors and mirrors	\$742	\$2,968
9	250 units	0 units	250 units	Wiper blades	\$87	\$21,750
10	2 car sets	2 car sets	4 car sets	Operator's sash	\$3,680	\$14,720
11	1 units	1 unit	2 units	Operator's seat	\$4,007	\$8,014
12	2 cab sets	8 cab sets	10 cab sets	Cab seat cushions (seat and back)	\$0	\$0

Doors and Door Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 doorway sets	8 doorway sets	10 sets	Door panel set, complete with glazing, suspension, and edges	\$6,063	\$60,630
2	20 doorway sets	0 doorway sets	20 sets	Sensitive edges	\$638	\$12,760
3	3 car sets	0 car sets	3 car sets	Stop request switches	\$0	\$0
4	2 car sets	8 car sets	10 car sets	Limit switches, all	\$6,901	\$69,010
5	1 car set	4 car sets	5 car sets	Passenger door pushbutton switches (interior and exterior)	\$6,969	\$34,845
6	1 car set	2 car sets	3 car sets	Stop request light lenses	\$0	\$0
7	1 car set	3 car sets	4 car sets	Step assembly, complete	\$155,244	\$620,976

Air Comfort System

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	1 car set	2 car sets	All heating elements (passenger compartment and cab)	\$2,526	\$5,052
2	1 car set	1 car set	2 car sets	Temperature control relays	\$0	\$0
3	1 car set	1 car set	2 car sets	Air conditioning valves, complete	\$505	\$1,010
4	1 car set	1 car set	2 car sets	Air flow switches, all	\$0	\$0
5	1 car set	2 car set	3 car sets	Thermostats, all	\$235	\$705
6	1 car set	3 car set	4 car sets	Air conditioning pressure switches	\$491	\$1,964
7	1 car set	3 car set	4 car sets	Flexible ducting	\$0	\$0
8	24 car sets	76 car set	100 car sets	Disposable air filters	\$160	\$16,000

Lighting

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	0 car sets	1 car set	1 car set	Fixtures for all interior lights, complete	\$20,783	\$20,783
2	2 car sets	0 car sets	2 car sets	Fixtures for all exterior lights, complete	\$30,154	\$60,308
3	1 unit of each type	1 unit of each type	2 units	Light fixtures complete (sockets, lens, etc.)	\$1,497	\$2,994
4	1 car set	0 car sets	1 car set	Light sockets	\$0	\$0
5	2 car sets	0 car sets	2 car sets	Lights (except head lights)	\$0	\$0
6	10 units	40 units	50 units	Head Lights	\$3,310	\$165,500
7	1 car set	1 car set	2 car sets	Lenses for all lights, interior and exterior (except cab console)	\$3,920	\$7,840
8	1 car set	0 car sets	1 car sets	Lenses for Light fixtures	\$8,432	\$8,432

Power Supply and Auxiliary Electric

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	5 units	15 units	20 units	Pantograph head, complete	\$5,923	\$118,460
2	2 car sets	2 car sets	4 car sets	Pantograph raise and lower actuator assembly	\$4,683	\$18,732
3	2 car sets	3 car sets	5 car sets	Lightning or surge arrester	\$1,742	\$8,710
4	1 car set	1 car set	2 car sets	Battery rack assembly	\$35	\$70
5	1 car set	1 car set	2 car sets	Relays, all	\$27,744	\$55,488
6	2 car sets	3 car sets	5 car sets	Inverter printed circuit boards	\$31,514	\$157,570
7	2 car sets	4 car sets	6 car sets	Battery charger/ low voltage supply	\$46,203	\$277,218
8	2 car sets	2 car sets	4 car sets	Printed circuit boards for battery charger / low voltage DC supply	\$0	\$0
9	5 units	0 units	5 units	Shop power plug, complete (male, car mounted)	\$871	\$4,355
10	2 units	2 units	4 units	High speed circuit breaker	\$10,342	\$41,368
11	50 car sets	150 car sets	200 car sets	Pantograph shoe carbon inserts (complete with retainer socket)	\$3,275	\$655,000
12	1 car sets	1 car sets	2 car sets	Pantograph insulators	\$1,673	\$3,346
13	20 car sets	0 car sets	20 car sets	Pantograph shunts	\$8,502	\$170,040

Propulsion

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Filter Capacitor	\$188	\$940
2	1 car set	1 car set	2 car sets	Line reactor	\$14,185	\$28,370
3	1 car set	1 car set	2 car sets	Motor reactor	\$19,422	\$38,844
4	2 car sets	3 car sets	5 car sets	Motor cable connecting lugs	\$871	\$4,355
5	10 car sets	10 car sets	20 car sets	Contactors tips (traction power contactors)	\$15,157	\$303,140
6	10 car sets	10 car sets	20 car sets	Contactors tips, all other	\$12,157	\$243,140
7	2 car sets	2 car sets	4 car sets	Arc chutes, all	\$184	\$736
8	0 sets	50 sets	50 sets	Tractor motor bearings	\$6,620	\$331,000

Truck Assembly and Suspension

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	4 car sets	5 car sets	Primary springs	\$9,296	\$46,480
2	1 car set	4 car sets	5 car sets	Secondary springs	\$8,366	\$41,830
3	4 units	4 units	8 units	Gear box with axle & motor couplings	\$41,200	\$329,600
4	1 car set	1 car set	2 car sets	Load sensing device	\$0	\$0
5	5 car sets	0 car sets	5 car sets	Shock absorber	\$441	\$2,205
6	5 car sets	0 car sets	5 car sets	Motor truck pivot replacement liner / bearings	\$0	\$0
7	5 car sets	0 car sets	5 car sets	Trailer truck pivot replacement liner / bearings	\$0	\$0
8	3 car sets	2 car sets	5 car sets	Ball bearing slew rings for trailer truck	\$52,527	\$262,635
9	4 car sets	0 car sets	4 car sets	Ground brush holders	\$13,893	\$55,572
10	4 car sets	0 car sets	4 car sets	Journal bearing	\$39,722	\$158,888
11	6 car sets	18 car sets	24 car sets	Wheel assembly, complete	\$142,372	\$3,416,928
12	16 car sets	0 car sets	16 car sets	Wheel tire sets	\$52,266	\$836,256
13	40 units	0 units	40 units	Ground brushes	\$544	\$21,760
14	40 units	0 units	40 units	Ground brush springs	\$23	\$920
15	6 units	0 units	6 units	Axles, final machined	\$4,963	\$29,778
16	2 car sets	3 car sets	5 car sets	Bearings, gear assembly	\$0	\$0

Friction Brakes

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	1 car set	2 car sets	Electronic control unit, complete (if not included as part of propulsion ECU)	\$35,546	\$71,092
2	2 car sets	3 car sets	5 car sets	Printed circuit boards - brake control (if required)	\$28,746	\$143,730
3	3 truck sets	3 truck sets	6 truck sets	Track brake assembly, complete	\$11,195	\$67,170
4	2 car sets	2 car sets	4 car sets	Sander valves	\$22,837	\$91,348
5	2 units	2 units	4 units	Compressor control unit, complete with contactors	\$0	\$0
6	2 car sets	0 car sets	2 car sets	Brake disc	\$19,187	\$38,374
7	200 car sets	0 car sets	200 car sets	Brake pads	\$2,788	\$557,600
8	4 car sets	0 car sets	4 car sets	Connecting air hoses and fittings, all	\$0	\$0
9	1 car set	2 car sets	3 car sets	Track brake wear plates, complete	\$1,045	\$3,135

Communications

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car set	1 car set	2 car sets	Interior speakers	\$274	\$548
2	2 car sets	0 car sets	2 car sets	Exterior speakers	\$730	\$1,460
3	10 units	0 units	10 units	Radio antenna	\$166	\$1,660
4	10 units	0 units	10 units	Handsets	\$629	\$6,290
5	2 car sets	2 car sets	4 car sets	GPS system	\$0	\$0
6	2 car sets	2 car sets	4 car sets	Infotainment System (Digital route maps, etc)	\$24,009	\$96,036
7	2 car sets	2 car sets	4 car sets	Mobile access router	\$2,307	\$9,228
8	2 car sets	2 car sets	4 car sets	Event Recorder	\$12,857	\$51,428

Miscellaneous

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	10 car sets	14 car sets	24 car sets	Circuit Breakers, all (except propulsion main breaker and auxiliary)	\$9,152	\$219,648
2	1 car set	1 car set	2 car sets	Circuit Breaker holders, all	\$0	\$0
3	25 car sets	25 car sets	50 car sets	Air and pneumatic filter elements, all	\$436	\$21,800
4	10 car sets	10 car sets	20 car sets	Contactors tips (except propulsion)	\$0	\$0

D. Diagnostic Test Equipment/Special Tools

Total Price \$ 1,792,624

Portable Test Equipment

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	18 units	18 units	36 units	Laptop (to be able to diagnose equipment below: Propulsion system, Brake and spin/slide systems, Auxiliary inverter, LVPS and battery, Heating and cooling system, Couplers/trainlines, Master controller, Door systems, Communications system)	\$3,190	\$114,835

Shop Test Equipment

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 unit	1 unit	2 units	Propulsion system	\$252,530	\$505,060
2	1 unit	1 unit	2 units	Friction Brake	\$95,820	\$191,641
3	1 unit	1 unit	2 units	Auxiliary inverter	\$216,322	\$432,644
4	1 unit	1 unit	2 units	LVPS and battery	\$28,254	\$56,508
5	1 unit	1 unit	2 units	Air conditioner	\$21,255	\$42,509
6	1 unit	1 unit	2 units	Master controller	\$0	\$0
7	1 unit	1 unit	2 units	Pneumatic/hydraulic controllers	\$60,976	\$121,952

Special Tools (IF REQUIRED)

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1	1	2	Jacking inserts and levelling bars	\$57,736	\$115,472
2	1	1	2	Bogie Press	\$55,506	\$111,012
3	1	1	2	Flushing Cart	\$26,133	\$52,266
4	1	1	2	HVAC lifting fixture and trolley	\$14,007	\$28,014
5	1	1	2	Lifting fixture for APS	\$10,356	\$20,711

Exhibit 2
PAYMENT SCHEDULE
 (All Item references are to Exhibit 1.A)

Item 1 - Engineering Design, Project Management and Design Qualification Testing

	Milestone	Percent of Bid Item
A	Submittal and Approval of Test Program, System Safety, Reliability, Maintainability and other plans as negotiated with SFMTA	2%
B	Completion and Approval of Preliminary Design Review	2%
C	Completion and Approval of Final Design Review	35%
D	Completion and Approval of Vehicle Performance Qualification Testing	30%
E	Completion and Approval of Test Program as specified	26%
F	Completion and Approval of all Contract Requirements (Retention)	5%
Total for Item 1		100%

Item 2 – Vehicle Price for Base Contract

Item 2A – Vehicle Price for Base Contract (Cars 1 - 24)

	Milestone	Percent of Bid Item
A	Placement of contracts with the following major subcontractors (Cars 1 - 24).* <ul style="list-style-type: none"> • Propulsion • Friction Brake • Air Comfort • Door Operators & Controls • Carbody • Train Control • Coupler • Communication 	2%
B	Delivery of complete set of subsystems to site of installation.	20%/Vehicle
C	Vehicle structure complete and ready for shipment to final assembly site	20%/Vehicle
D	SFMTA Acceptance for shipment of Vehicle from final assembly site to SFMTA property	25%/Vehicle
E	Conditional Acceptance of Vehicle by SFMTA	30%/Vehicle

	Milestone	Percent of Bid Item
F	Completion and Approval of all Contract Requirements for Phase 1 (Retention)	3%
Total for Item 2A		100%

*Payment will be made only to the extent that deposits have been paid to suppliers and up to the amount of the deposits or 2%, whichever is the lesser value; in addition Contractor must provide security for payment under Section 7.3 of the Agreement.

Item 2B – Vehicle Price for Base Contract (Cars 25 - 175)

	Milestone	Percent of Bid Item
A	Placement of contracts with the following major subcontractors (Cars 25 - 175).* <ul style="list-style-type: none"> • Propulsion • Friction Brake • Air Comfort • Door Operators & Controls • Carbody • Train Control • Coupler • Communication 	2%
B	Delivery of complete set of subsystems to site of installation.	20%/Vehicle
C	Vehicle structure complete and ready for shipment to final assembly site	20%/Vehicle
D	SFMTA Acceptance for shipment of Vehicle from final assembly site to SFMTA property	25%/Vehicle
E	Conditional Acceptance of Vehicle by SFMTA	30%/Vehicle
F	Completion and Approval of all Contract Requirements for phase 2 (Retention)	3%
Total for Item 2B		100%

*Payment will be made only to the extent that deposits have been paid to suppliers and up to the amount of the deposits or 2%, whichever is the lesser value; in addition, Contractor must provide security for the payment, as required under Section 7.3 of the Agreement.

Item 3 - Operating, Maintenance and Parts Manuals

	Milestone	Percent of Bid Item
A	Acceptance of Draft Manuals	5%
B	Delivery and Acceptance of Operating, Maintenance and Parts Manuals	90%
C	Completion and Approval of all Contract Requirements (Retention)	5%
Total for Item 3		100%

Item 4.1 – Training

	Milestone	Percent of Bid Item
A	Completion of Training Program and delivery and acceptance of all deliverables	95%
B	Completion and approval of all Contract Requirements (Retention)	5%
Total for Item 4		100%

Item 4.2 – Train Simulator

	Milestone	Percent of Bid Item
A	Delivery and Acceptance of Train Simulator	95%
B	Completion and Acceptance of all Contract Requirements (Retention)	5%
Total for Item 4.2		100%

Item 5 - Spare Parts

	Milestone	Percent of Bid Item
A	Delivery and acceptance of spare parts. Delivery and payment will be on a line-item basis.	95%
B	Completion and approval of all Contract Requirements (Retention)	5%
Total for Item 5		100%

Item 6 – Special Tools, Test and Diagnostic Equipment

	Milestone	Percent of Bid Item
A	Delivery and acceptance of Diagnostic Test Equipment, Special Tools, Bench Test Equipment.	95%
B	Completion and approval of all Contract Requirements (Retention)	5%
Total for Item 6		100%

Item 7 - Option for 1 to 85 Additional New Light Rail Vehicles
Progress payments will be made in accordance with Item 2B.

Item 8 – Additional Spare Parts

Progress payments will be made in accordance with Item 5.

Item 9 – Spare Parts for Options

Progress payments will be made in accordance with Item 5.

Item 10 – Train Simulator

Progress payments will be made in accordance with Item 4.2.

Exhibit 3: PROJECT DELIVERY SCHEDULE

Item	Calendar Days after Notice to Proceed
Project Plan	60
Delivery of 1st Vehicle to SFMTA	737
Delivery of 2nd Vehicle to SFMTA	810
Training Start	870
Training Complete	990
Special Tools / Diagnostic Test Equipment	870
Delivery of Publications (Manuals, Parts Book, Drawings) - Prelim	870
Delivery of Publications (Manuals, Parts Book, Drawings) - Final	1080
Delivery of Spare Parts (Phase 1)	990
Testing Complete / Acceptance of Vehicle	990
Delivery Rate of Base Phase 1 Vehicles (3-24)	1 Car/ 2 week
Delivery of 24th Vehicle (Phase 1) to SFMTA	1298
Delivery of 1st Vehicle (Phase 2) to SFMTA	May15, 2021
Delivery Rate of Phase 2 Vehicles	1 Car/ 2 week
Delivery of 151st Vehicle (Phase 2) to SFMTA	2114 days after delivery of 1 st Car (Phase 2)
Delivery of 1st Option Vehicle to SFMTA	TBD
Delivery Rate of Option Vehicles	TBD
Delivery of the last Option Vehicle	TBD

EXHIBIT 4
FTA REQUIREMENTS FOR PROCUREMENT CONTRACTS

I. DEFINITIONS

A. Approved Project Budget means the most recent statement, approved by the FTA, of the costs of the Project, the maximum amount of Federal assistance for which the City is currently eligible, the specific tasks (including specified contingencies) covered, and the estimated cost of each task.

B. Contractor means the individual or entity awarded a third party contract financed in whole or in part with Federal assistance originally derived from FTA.

C. Cooperative Agreement means the instrument by which FTA awards Federal assistance to a specific Recipient to support a particular Project or Program, and in which FTA takes an active role or retains substantial control.

D. Federal Transit Administration (FTA) is an operating administration of the U.S. DOT.

E. FTA Directive includes any FTA circular, notice, order or guidance providing information about FTA's programs, application processing procedures, and Project management guidelines. In addition to FTA directives, certain U.S. DOT directives also apply to the Project.

F. Grant Agreement means the instrument by which FTA awards Federal assistance to a specific Recipient to support a particular Project, and in which FTA does not take an active role or retain substantial control, in accordance with 31 U.S.C. § 6304.

G. Government means the United States of America and any executive department or agency thereof.

H. Project means the task or set of tasks listed in the Approved Project Budget, and any modifications stated in the Conditions to the Grant Agreement or Cooperative Agreement applicable to the Project. In the case of the formula assistance program for urbanized areas, for elderly and persons with disabilities, and non-urbanized areas, 49 U.S.C. §§ 5307, 5310, and 5311, respectively, the term "Project" encompasses both "Program" and "each Project within the Program," as the context may require, to effectuate the requirements of the Grant Agreement or Cooperative Agreement.

I. Recipient means any entity that receives Federal assistance directly from FTA to accomplish the Project. The term "Recipient" includes each FTA "Grantee" as well as each FTA Recipient of a Cooperative Agreement. For the purpose of this Agreement, Recipient is the City.

J. Secretary means the U.S. DOT Secretary, including his or her duly authorized designee.

K. Third Party Contract means a contract or purchase order awarded by the Recipient to a vendor or contractor, financed in whole or in part with Federal assistance awarded by FTA.

L. Third Party Subcontract means a subcontract at any tier entered into by Contractor or third party subcontractor, financed in whole or in part with Federal assistance originally derived from FTA.

M. U.S. DOT is the acronym for the U.S. Department of Transportation, including its operating administrations.

II. FEDERAL CHANGES

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Master Agreement between the City and FTA, as they may be amended or promulgated from time to time during the term of this contract. Contractor's failure to so comply shall constitute a material breach of this contract.

III. ACCESS TO RECORDS

A. The Contractor agrees to provide the City and County of San Francisco, the FTA Administrator, the Comptroller General of the United States or any of their authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to this Agreement for the purposes of making audits, examinations, excerpts and transcriptions.

B. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

C. The Contractor agrees to maintain all books, records, accounts and reports required under this Agreement for a period of not less than three years after the date of termination or expiration of this Agreement, except in the event of litigation or settlement of claims arising from the performance of this Agreement, in which case Contractor agrees to maintain same until the City, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto. 49 CFR 18.36(i)(11).

IV. DEBARMENT AND SUSPENSION (Contracts over \$25,000)

Grantees and subgrantees must not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs under Executive Order 12549, "Debarment and Suspension." Therefore, by signing and submitting its bid or proposal, the bidder or proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the San Francisco Municipal Transportation Agency ("SFMTA"). If it is later determined that the bidder or proposer knowingly rendered an erroneous certification, in addition to remedies available to the SFMTA, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 CFR Parts 180, Subpart C and 1200, Subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

V. NO FEDERAL GOVERNMENT OBLIGATIONS TO CONTRACTOR

A. The City and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the City, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.

B. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

VI. CIVIL RIGHTS

A. Nondiscrimination - In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 41 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

B. Equal Employment Opportunity - The following equal employment opportunity requirements apply to the underlying contract:

B.1. Race, Color, Creed, National Origin, Sex - In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOT) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 CFR Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

B.2. Age - In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. § 623 and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

B.3. Disabilities - In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

C. The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

VII. DBE/SBE ASSURANCES

Pursuant to 49 C.F.R. Section 26.13, the Contractor is required to make the following assurance in its agreement with SFMTA and to include this assurance in any agreements it makes with subcontractors in the performance of this contract:

The Contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 C.F.R. Part 26 in the award and administration of DOT-assisted contracts. Failure by the Contractor or subcontractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as SFMTA deems appropriate.

VIII. CONTRACT WORK HOURS AND SAFETY STANDARDS *(applicable to non-construction contracts in excess of \$100,000 that employ laborers or mechanics on a public work)*

A. Overtime requirements - No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

B. Violation; liability for unpaid wages; liquidated damages - In the event of any violation of the clause set forth in paragraph A of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph A of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph A of this section.

C. Withholding for unpaid wages and liquidated damages - The City and County of San Francisco shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.

D. Subcontracts - The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs A through D of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs A through D of this section.

IX. ENERGY CONSERVATION REQUIREMENTS

The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

X. CLEAN WATER REQUIREMENTS (*applicable to all contracts in excess of \$100,000*)

A. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251 et seq. Contractor agrees to report each violation of these requirements to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA regional office.

B. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

XI. CLEAN AIR (*applicable to all contracts and subcontracts in excess of \$100,000, including indefinite quantities where the amount is expected to exceed \$100,000 in any year.*)

A. Contractor agrees to comply with applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. The Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

B. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

XII. PRIVACY

If Contractor or its employees administer any system of records on behalf of the Federal Government, Contractor and its employees agree to comply with the information restrictions and other applicable requirements of the Privacy Act of 1974, 5 U.S.C. § 552a (the Privacy Act). Specifically, Contractor agrees to obtain the express consent of the Federal Government before the Contractor or its employees operate a system of records on behalf of the Government. Contractor acknowledges that the requirements of the Privacy Act, including the civil and criminal penalties for violations of the Privacy Act, apply to those individuals involved, and that failure to comply with the terms of the Privacy Act may result in termination of this Agreement. The Contractor also agrees to include these requirements in each subcontract to administer any system of records on behalf of the Federal Government financed in whole or in part with Federal assistance provided by FTA.

XIII. DRUG AND ALCOHOL TESTING

To the extent Contractor, its subcontractors or their employees perform a safety-sensitive function under the Agreement, Contractor agrees to comply with, and assure compliance of its subcontractors, and their employees, with 49 U.S.C. § 5331, and FTA regulations, "Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations," 49 CFR Part 655.

XIV. TERMINATION FOR CONVENIENCE OF CITY (required for all contracts in excess of \$10,000)

See Agreement Terms and Conditions.

XV. TERMINATION FOR DEFAULT (required for all contracts in excess of \$10,000)

See Agreement Terms and Conditions.

XVI. BUY AMERICA

The Contractor agrees to comply with 49 U.S.C. 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7, and include microcomputer equipment, software, and small purchases (\$100,000 or less) made with capital, operating, or planning funds. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 CFR 661.11. Rolling stock not subject to a general waiver must be manufactured in the United States and have a 60 percent domestic content.

XVII. CARGO PREFERENCE - USE OF UNITED STATES FLAG VESSELS

The Contractor agrees: (a) to use privately owned United States-Flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to the underlying Agreement to the extent such vessels are available at fair and reasonable rates for United States-Flag commercial vessels; (b) to furnish within 20 working days following the date of loading for shipments originating within the United States or within 30 working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English for each shipment of cargo described above to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the Contractor in the case of a subcontractor's bill-of-lading.); and (c) to include these requirements in all subcontracts issued pursuant to this Agreement when the subcontract may involve the transport of equipment, material, or commodities by ocean vessel.

XVIII. RECYCLED PRODUCTS

The Contractor agrees to comply with all the requirements of Section 6002 of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6962), including, but not limited to, the regulatory provisions of 40 CFR Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 CFR Part 247.

XIX. BUS TESTING (applies to contracts for rolling stock)

To the extent applicable, the Contractor (or Manufacturer) agrees to comply with the requirements of 49 U.S.C. § 5323(c) and FTA implementing regulations at 49 CFR Part 665, and shall perform the following:

A. A manufacturer of a new bus model or a bus produced with a major change in components or configuration shall provide a copy of the final test report to the Recipient at a point in the procurement process specified by the Recipient which will be prior to the Recipient's final acceptance of the first vehicle.

B. A manufacturer who releases a report under paragraph 1 above shall provide notice to the operator of the testing facility that the report is available to the public.

C. If the manufacturer represents that the vehicle was previously tested, the vehicle being sold should have the identical configuration and major components as the vehicle in the test report, which must be provided to the Recipient prior to Recipient's final acceptance of the first vehicle. If the configuration or components are not identical, the manufacturer shall provide a description of the change and the manufacturer's basis for concluding that it is not a major change requiring additional testing.

D. If the manufacturer represents that the vehicle is "grandfathered" (has been used in mass transit service in the United States before October 1, 1988, and is currently being produced without a major change in configuration or components), the manufacturer shall provide the name and address of the recipient of such a vehicle and the details of that vehicle's configuration and major components.

XX. PRE-AWARD AND POST-DELIVERY AUDIT REQUIREMENTS

To the extent applicable, Contractor agrees to comply with the requirements of 49 U.S.C. § 5323(l) and FTA implementing regulations at 49 CFR Part 663, and to submit the following certifications:

A. Buy America Requirements: The Contractor shall complete and submit a declaration certifying either compliance or noncompliance with Buy America. If the Bidder/Offeror certifies compliance with Buy America, it shall submit documentation which lists (1) component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and (2) the location of the final assembly point for the rolling stock, including a description of the activities that are planned to take place and actually took place at the final assembly point and the cost of final assembly.

B. Solicitation Specification Requirements: The Contractor shall submit evidence that it will be capable of meeting the bid specifications and provide information and access to Recipient and its agents to enable them to conduct post-award and post-delivery audits.

C. Federal Motor Vehicle Safety Standards (FMVSS): The Contractor shall submit (1) manufacturer's FMVSS self-certification sticker information that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations

XXI. FALSE OR FRAUDULENT STATEMENTS AND CLAIMS

A. The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying Agreement, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA-assisted project for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

B. The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307(n)(1) on the Contractor, to the extent the Federal Government deems appropriate.

C. The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

XXII. FLY AMERICA

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and subrecipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S. Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

XXIII. NATIONAL ITS ARCHITECTURE POLICY (*Applicable to contracts for ITS projects*)

If providing Intelligent Transportation Systems (ITS) property or services, Contactor shall comply with the National ITS Architecture and standards to the extent required by 23 U.S.C. § 512, FTA Notice, "FTA National ITS Architecture Policy on Transit Projects," 66 FR 1455, et seq., January 8, 2001, and later published policies or implementing directives FTA may issue.

XXIV. INCORPORATION OF FEDERAL TRANSIT ADMINISTRATION (FTA) TERMS

The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1F, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any (name of grantee) requests which would cause (name of grantee) to be in violation of the FTA terms and conditions.

XXV. TEXTING WHILE DRIVING; DISTRACTED DRIVING

Consistent with Executive Order 13513 "Federal Leadership on Reducing Text Messaging While Driving", Oct. 1, 2009 (available at <http://edocket.access.gpo.gov/2009/E9-24203.htm>) and DOT Order 3902.10 "Text Messaging While Driving", Dec. 30, 2009, SFMTA encourages Contractor to promote

policies and initiatives for employees and other personnel that adopt and promote safety policies to decrease crashes by distracted drivers, including policies to ban text messaging while driving, and to include this provision in each third party subcontract involving the project.

XXVI. SEAT BELT USE

In compliance with Executive Order 13043 "Increasing Seat Belt Use in the United States", April 16, 1997 23 U.S.C. Section 402 note, the SFMTA encourages Contractor to adopt and promote on-the-job seat belt use policies and programs for its employees and other personnel that operate company owned, rented, or personally operated vehicles, and to include this provision in each third party subcontract involving the project.

EXHIBIT 5: WARRANTY PROVISIONS

1.1 BASIC PROVISIONS

1.1.1 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 SFMTA each complete Vehicle 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 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.

Upon request of 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 Vehicle. 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 this Exhibit, the Contractor shall inform SFMTA of this additional warranty and pass it through to SFMTA at no additional cost to SFMTA.

The Contractor shall ensure that such suppliers, sub suppliers, vendors, and subcontractors satisfactorily perform warranty-related work.

1.1.1.1 Complete Vehicle

The Vehicle shall be warranted and guaranteed to be free from Defects for five years, beginning on the date of official Acceptance or Conditional Acceptance of each Vehicle. During this warranty period, the Vehicle shall maintain its structural and functional integrity. The warranty shall be based on regular operation of the Vehicle within the Muni Metro System.

1.1.1.2 Intentionally left blank

1.1.1.3 Subsystem And Components

Primary load carrying members of the Vehicle structure shall be warranted against corrosion failure and/or fatigue failure for a period of 12 years.

1.1.1.4 Additional Warranties

If the customary standard warranties for the Material and/or Equipment, and installation thereof, exceed the period specified in Section 1.1.1.1, such warranties shall run to the SFMTA

If separate or additional warranties covering the Material and/or Equipment are furnished by the manufacturer, supplier, or seller of component part or parts of any item of said Material and/or Equipment, the SFMTA shall have the right, but not the duty, to benefit from these separate or additional warranties, along with the primary warranties set forth herein above. The SFMTA shall look only to Contractor for fulfillment of all warranty requirements expressed and implied by the making of the Contract.

The existence of any separate or additional warranties that run to the Contractor from the manufacturer, supplier, or installer of a component part of an item of Material and/or Equipment shall not relieve the Contractor of its obligation to repair or replace any of the Material and/or Equipment on account of faulty design, manufacture or workmanship during the warranty period. The SFMTA shall not be required to look to any other party for fulfillment of warranty provisions.

1.1.2 Voiding Of Warranty

The warranty shall not apply to any part or component of the Vehicle 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 Vehicle shall also be void if 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 SFMTA is the sole cause of the part or component failure.

1.1.3 Exceptions To Warranty

The warranty shall not apply to scheduled maintenance items and items furnished by SFMTA, except insofar as such equipment may be damaged by the failure of a part or component for which the Contractor is responsible.

1.1.4 Detection Of Defects

If SFMTA finds Defects within the warranty period defined in Section 1.1.1.1, it shall notify the Contractor's representative in writing. 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 sub-system 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 sub-system or component shall be mutually resolved between SFMTA and the Contractor. Contractor shall commence all Work necessary to perform inspection or repairs, under the provisions of Section 1.2, Repair Procedures, immediately after receipt of notification by the Contractor from the SFMTA. If within 10 Working Days of notification to Contractor, SFMTA and Contractor are unable to agree whether a Defect is covered by warranty provisions, SFMTA

reserves the right to commence repairs and seek reimbursement through Section 1.2 Repair Procedures.

If Contractor independently becomes aware of a Defect in accepted Material and/or Equipment or services, the Contractor shall submit to SFMTA, in writing, within 15 working days a recommendation for corrective actions, together with supporting information in sufficient detail to enable SFMTA to determine what corrective action, if any, shall be taken.

The Contractor shall promptly comply with any timely written direction from the SFMTA to correct or partially correct a Defect, at no cost to the SFMTA. Contractor shall also correct any other systems or components of the Vehicle that have been damaged in any way as a result of the Defect (Collateral Damage).

The Contractor shall also prepare and furnish to the SFMTA data and reports applicable to any correction required under this Section (including revision and updating of all other affected data called for under the Contract) at no cost to the SFMTA.

In the event of timely notice of a decision not to correct, or only to partially correct, the Contractor shall submit a technical and cost proposal within fifteen (15) working days to amend the Contract to permit acceptance of the affected Material and/or Equipment or services in accordance with the revised requirement, and an equitable reduction in the Contract Price shall promptly be negotiated by the parties and be reflected in a Change Order to the Contract.

1.1.5 Intentionally Left Blank

1.1.6 Fleet Defects

A fleet defect is defined as cumulative failures of any kind in the same components in the same or similar application where such items are covered by the warranty and such failures occur within the warranty period in at least ten (10) percent of the Vehicles delivered under the same Phase of this contract. SFMTA shall have final approval of corrections or changes under these conditions.

1.1.6.1 Correction of Fleet Defects

The Contractor shall correct a fleet defect under the procedures specified in Section 1.2, Repair Procedures. Within ten (10) working days of receipt of notification of a fleet defect, unless SFMTA grants an extension, the Contractor shall provide SFMTA with a plan, acceptable to SFMTA, specifying how and when all Vehicles with defects shall be corrected, including correction of Collateral Damage. Said plan is subject to approval by SFMTA. In addition, after correcting such defects, the Contractor shall promptly undertake and complete a work program, acceptable to SFMTA, reasonably designed to prevent the occurrence of the same defect in all other Vehicles and spare parts purchased under this contract. Any proposed changes to a fleet defect work plan or program must be submitted to SFMTA for its approval. If (a) Contractor does not provide a plan for correction within the time specified above (or as extended by 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 Vehicles are not

corrected in accordance with the Contractor's work program; SFMTA will assess liquidated damages in accordance with Section 19 of the Agreement.

The warranty on parts, components or sub-systems replaced as a result of a fleet defect shall be assigned a new warranty period equal to the original manufacturers or contract part warranty, whichever is longer, effective the replacement date. Any extended warranties shall commence at the conclusion of the new warranty period.

1.1.6.2 Fleet Defect Repairs

When SFMTA requires the Contractor to perform warranty-covered repairs under the Fleet Defect provisions, the Contractor's representative must begin work necessary to effect repairs in a proper and timely manner, within five Working Days after the approval of the retrofit plan/schedule. 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 SFMTA. SFMTA shall make the Car 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 SFMTA for all expenses incurred, including labor for moving Cars, or towing charges for Cars transported, between SFMTA's facilities and Contractor's service center or the facilities of its subcontractors or suppliers.

1.1.6.3 Contractor Supplied Parts

The Contractor shall furnish parts for all warranty work performed by the Contractor.

1.1.6.4 Voiding Of Warranty Provisions

The fleet defect provisions shall not apply to Vehicle defects solely caused by noncompliance with the Contractor's recommended normal maintenance practices and procedures or caused solely by abuse of the equipment.

1.1.6.5 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.

1.1.7 Contractor's Representative

The Contractor shall, at its own expense, provide qualified service personnel at the SFMTA facilities in accordance with Section 22.2.7 of Technical Specifications.

1.2 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, 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 SFMTA, for all costs for warranty work performed by SFMTA personnel or by any contractor(s) hired by SFMTA to perform warranty work, as described in Section 1.2.2, Repairs by SFMTA.

1.2.1 Repairs By Contractor

When 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 ten working days after receiving notification of a defect from 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 SFMTA. SFMTA shall make the Vehicle 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 SFMTA for all expenses incurred, including labor for driving Vehicles, or towing charges for Vehicles transported, between SFMTA's facilities and Contractor's service center or the facilities of its subcontractors or suppliers. At SFMTA's option, the Contractor shall repair Vehicles at an offsite location, and not on SFMTA's property. If the Vehicle is removed from SFMTA's property, the Contractor's representative shall diligently pursue the acquisition of parts and repair procedures. The schedule and scope of the repairs shall be approved by SFMTA.

1.2.2 Repairs By SFMTA

If SFMTA elects to perform or procure a contractor to perform, the warranty-covered repairs, the following shall apply.

1.2.2.1 Parts Used

SFMTA shall use new parts, subcomponents and subsystems that Contractor shall provide specifically for these repairs. 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 Car has been repaired. The warranty on parts, components or sub-systems replaced as a result of a standard warranty repair shall be assigned a new warranty period equal to the original manufacturers or contract part warranty, whichever is longer, effective the replacement date. Any extended warranties shall commence at the conclusion of the new warranty period.

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 SFMTA to the Contractor for reimbursement or replacement of parts or components. The Contractor shall provide forms for these reports.

1.2.2.2 Contractor-Supplied Parts

The Contractor shall warehouse, at the Contractor's service center in San Francisco, all necessary parts to support its warranty obligations. The Contractor shall furnish parts for all warranty work, whether the warranty labor is performed by the Contractor or by SFMTA. Contractor shall deliver, prepaid, warranty parts for repairs within five calendar days of notification from SFMTA.

1.2.2.3 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 a 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.

1.2.2.4 Reimbursement For Labor

Contractor shall reimburse SFMTA for all warranty labor incurred by SFMTA. The amount shall be determined by multiplying the number of man-hours required to correct the defect by the current top mechanic's or technician's hourly overtime wage rate, which includes fringe benefits, multiplied by the project overhead rate (150% of the wage rate). Additionally, Contractor will be responsible for the cost of towing the Vehicle if such action was necessary and if the Vehicle was in the normal service area.

The wage rate, and therefore, the warranty labor rate, is subject to adjustment each year. Through January 31, 2013, the warranty labor rate shall be based on the technician's wage rate of \$140.00/hour, which includes labor, fringe benefits, and overhead.

In the event SFMTA deems it necessary to contract out for warranty repairs, the Contractor shall reimburse SFMTA for the actual cost of the repair, including charges for any warrantable parts, consequential parts or damages, labor, and towing or transportation.

Contractor shall reimburse SFMTA for warranty claims within 30 days after each claim has been submitted by SFMTA. If SFMTA does not receive payment within 30 Days, SFMTA will deduct the amount of the claim, which

includes labor, parts, administrative overhead and towing costs from payments due to Contractor.

1.2.2.5 Reimbursement For Parts; Towing

In the event SFMTA uses its own parts for warranty repairs, the Contractor shall reimburse SFMTA for those parts, including all Defective parts, components, and consequential parts supporting the warranty repair. The reimbursement shall be at the invoice cost of the parts or components at the time of repair and shall include applicable taxes plus a 15% handling fee.

The warranty will include the cost of towing because of the failure of a warranted part. Towing costs consist of the cost any SFMTA labor expended, any parts utilized in the transfer of the Car, and the actual cost of any other transportation costs incurred by SFMTA because of the failure of a warranted part, plus a 15% handling fee.

1.2.3 Warranty After Replacement Or Repairs

The warranty on parts, components or sub-systems replaced as a result of a standard warranty repair shall be as follows: (a) each part or component replaced with a brand new component or part will be assigned a new warranty period equal to the original manufacturer's or contract part warranty, whichever is longer, effective the replacement date, with any extended warranties commencing at the conclusion of the new warranty period; (b) any SFMTA replaced component or part that is a certified rebuilt, certified reconditioned or a certified remanufactured component or part shall be warranted for the remainder of the original warranty period of the component or part, commencing on the replacement date.

1.2.4 Failure Analysis

At 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 Vehicles under the terms of the warranty. The analysis shall be documented and compiled into a report. The Failure Analysis Reports shall be delivered to SFMTA Project Manager within 60 Days of the receipt of failed parts

EXHIBIT 6 – PARENT COMPANY GUARANTEE

Exhibit 6-1

San Francisco Municipal Transportation Agency

RFP Evaluation Summary

Proposal Evaluations	CAF USA, Inc.		Siemens Industry, Inc., Rail Systems	
	Points from Evaluations	Scores % (After conversion)	Points from Evaluations	Scores % (After conversion)
Qualitative Responsibility Combined (10%) (CONVERT 100 Points to 10%)	35	4	62	6
Technical Evaluation Combined (65%) (CONVERT 100 Points to 65%)	45	29	82	53
Price Evaluation Combined (25%) (Formula based) (CONVERT 100 Points to 25%)	79	20	100	25
Alternate Approaches Combined (10%) (NO CONVERSION)	1	1	7	7
FINAL TOTAL SCORE (sum of four scores)		54		91

**CITY AND COUNTY OF SAN FRANCISCO
San Francisco Municipal Transportation Agency**

Request for Proposals

Procurement of New Light Rail Vehicles (LRV4)

CONTRACT No. SFMTA-2013-19

VOLUME 1

September 30, 2013

PRE-PROPOSAL CONFERENCE

DATE: October 29, 2013

SUBMISSION DEADLINE

December 10, 2013

Procurement of New Light Rail Vehicles (LRV4)

TABLE OF CONTENTS

I.	NOTICE OF REQUEST FOR PROPOSALS.....	1
II.	REQUEST FOR PROPOSALS	3
II.A	Introduction	3
II.B	Scope of Work	3
II.C	Information for Proposers	4
II.C.1	General Information.....	4
II.C.2	Technical Specifications.....	4
II.C.3	Shipping Location.....	4
II.C.4	RFP Copies for Subcontractors and Contractors.....	4
II.D	Time and Place for Submission of Proposals.....	4
II.E	Pre-Proposal Conference and Clarifications to RFP	5
II.F	Format.....	6
II.F.1	Technical Proposal	6
II.F.2	Price Proposal	6
II.F.3	Alternate Approach(es).....	7
II.G	Responsibility of Proposer	7
II.H	Technical Proposal	8
II.H.1	Introduction and Executive Summary – Part A (maximum 3 pages)	8
II.H.2	Vehicle Description – Part B.....	9
II.H.3	Management Approach and Schedule – Part C.....	13
II.H.4	Other Required Documents – Part D	15
II.I	Price Proposal	16
II.I.1	Price Proposal Forms – Part A.....	16
II.I.2	Proposal Security – Part B	16
II.J	Alternate Approaches	16
II.K	Sample Agreement.....	17
II.L	Evaluation Process	17
II.L.1	General.....	17
II.L.2	Evaluating the Proposals.....	17
II.L.3	Evaluation Criteria and Relative Weights	18
II.L.4	Technical Evaluation and Methodology	18
II.L.5	Price Proposal Evaluation.....	19
II.L.6	Evaluation of Alternate Approaches	20
II.L.7	Final Score and Post-Evaluation	20
II.L.8	Request for Best And Final Offer.....	20
II.L.9	Contract Award	21
II.L.10	Debrief to Unsuccessful Proposers.....	21
II.L.11	Bonds, Insurance, Letters of Credit and Execution of Contract.....	21
II.L.12	Cost and Price Analyses	22
II.L.13	Pre-Award Buy America Certification.....	22
II.M	Federal and Local Requirements	23
II.N	Terms and Conditions for Receipt of Proposals	23
II.N.1	Errors and Omissions in RFP.....	23
II.N.2	Objections to RFP Terms.....	23
II.N.3	Addenda to RFP.....	24
II.N.4	Term of Proposal.....	24

II.N.5	Revision of Proposal	24
II.N.6	Errors, Omissions and Deviations in Proposal	25
II.N.7	Financial Responsibility	25
II.N.8	Proposer's Obligations under the Campaign Reform Ordinance	25
II.N.9	Sunshine Ordinance	26
II.N.10	Public Access to Meetings and Records	26
II.N.11	Reservations of Rights by the City	27
II.N.12	No Waiver	27
II.N.13	Communications Prior to Contract Award	27
III.	Contract Requirements	28
III.A	Standard Contract Provisions	28
III.B	Nondiscrimination in Contracts and Benefits	29
III.C	Minimum Compensation Ordinance (MCO)	29
III.D	Health Care Accountability Ordinance (HCAO)	29
III.E	First Source Hiring Program (FSHP)	29
III.F	Conflicts of Interest	30
IV.	Certifications	30
IV.A	Debarment Certification	30
IV.B	Certification Regarding Lobbying (Appendix 3A)	31
IV.C	Attestation of Compliance (Appendix 3B)	31
IV.D	Buy America Certificate (Appendix 3C)	31
IV.E	San Francisco Business Tax Certificate (Appendix 3E)	31
V.	Protest Procedures (Appendix 4A)	31

Appendices

Appendix 1 Price Forms

- 1A: FORM I – A Schedule of Prices
- 1B: FORM I – B Nominal Spare Parts and Optional Spare Parts
 - FORM I – B1: Nominal Spare Parts
 - FORM I – B2: Optional Spare Parts
- 1C: FORM I – C Diagnostic Test Equipment/Special Tools

Appendix 2 Technical Forms

- 2A: Form II – A Technical Worksheets
- 2B: Form II – B Supplier Worksheet
- 2C: Form II – C Whole Life Cycle Cost

Appendix 3 Other Forms

- 3A: Certification Regarding Lobbying
- 3B: Attestation Of Compliance
- 3C: Buy America Certificate
- 3D: Confirmation of RFP Receipt
- 3E: Business Registration Certificate
- 3F: Declaration: Nondiscrimination in Benefits
- 3G: Financial Statement
- 3H: FTA DBE Requirements/Transit Vehicle Manufacturer Certification

Appendix 4 Referenced Documents

- 4A: Protest Procedure
- 4B: Sample Agreement
- 4C: Negotiated Procurement Procedure

I. NOTICE OF REQUEST FOR PROPOSALS

OFFICIAL NOTIFICATION

INSTRUCTION TO QUALIFIED PROPOSERS

The San Francisco Municipal Transportation Agency ("SFMTA"), desires to procure up to 260 Light Rail Vehicles (LRVs) (the "Project" or "LRV4"). SFMTA is using a two-phase selection process for the selection of a Vendor for the Project. SFMTA previously issued a Request for Qualifications ("RFQ") for this procurement, and, based on its evaluation of the Statements of Qualifications received in response to the RFQ, has short-listed the Prospective Qualifiers. Only the Short-Listed Qualified Proposers ("Qualified Proposers") will be allowed to submit a Proposal in response to this Request for Proposals ("RFP").

Proposals submitted in response to this RFP should explain how the Proposer intends to meet the requirements of the RFP. Legibility, clarity, and completeness of the technical approach are essential. Statements merely indicating that the Proposer shall meet specific requirements are not sufficient. SFMTA expects all Proposals to be fully compliant and meet all requirements and conditions as set forth herein. The use of promotional or marketing information is discouraged unless specifically requested.

The Proposer shall respond to each of the sections described within this RFP in the specific order presented in the RFP and addressing each item individually. Proposers should avoid making references to other Proposal sections unless it is not practicable to convey the information in another manner. The Proposer shall identify specific elements planned for the new Light Rail Vehicle (LRV4), as well as the Proposer's experience with the proposed elements of the vehicle, and shall identify the names of proposed Subcontractors and Suppliers for each major vehicle subsystem describing in detail the interfaces and how the Proposer will manage each. The Proposer must demonstrate full responsibility for the execution of the Work, including management of all subcontractors, suppliers, and integration efforts that will be required. Proposals shall be written in the English language.

The contract shall be a firm fixed-price contract, with progress payments and liquidated damages in accordance with the terms of the Sample Agreement in Appendix 4B. The contract award is subject to approval by the Board of Directors of the SFMTA and the San Francisco Board of Supervisors, and is also subject to the concurrence of the Federal Transit Administration (FTA) of the U.S. Department of Transportation. Funding for the agreement is subject to receipt of financial assistance from the San Francisco County Transportation Authority, the Metropolitan Transportation Commission, and the FTA.

The Proposer selected to contract with SFMTA ("Selected Contractor") will be required to comply with all applicable Federal, State and City laws and regulations. The Selected Contractor will also be required to comply with all applicable Equal Employment Opportunity laws and regulations and the terms and conditions set forth in the Nondiscrimination in Contracts and Benefits provisions of Chapter 12B of the San

Francisco Administrative Code.

The SFMTA notifies all Proposers that it will ensure that Small Business Enterprises (SBEs), including Disadvantaged Business Enterprises (DBEs), will be afforded full opportunity to submit proposals in response to this RFP and will not be discriminated against on the basis of race, color, sex, or national origin in consideration for an award. All Proposers will be required to comply with the FTA's DBE requirements found in 49 CFR Part 26.

A proposal bond (bid bond), a cashier's or certified check, or a money order in the amount of \$3,000,000 must accompany each Price Proposal. Prior to certification of the contract, the successful Proposer will be required to furnish to the City a letter of credit or performance bond, in accordance with the requirements in Section 15.2 of the Sample Agreement, as well as evidence of insurance as specified in Section 15.1.

The SFMTA reserves the right to reject any and all proposals. The Proposer's Price Proposal shall remain in effect for 240 calendar days.

Qualified Proposers shall submit their Technical Proposals, Price Proposals, Alternative Proposals (if any), and all completed forms so that they are received by the SFMTA no later than 2:00 p.m., December 10, 2013, at the following address:

San Francisco Municipal Transportation Agency
Transit Division,
1 South Van Ness Avenue, 7th Floor, San Francisco, CA 94103
Attention: Ms. Trinh Nguyen
Procurement of New Light Rail Vehicles (LRV4)
RFP for Contract No. SFMTA-2013-19

Qualified Proposers may obtain Volumes 1 and 2 (Technical Specifications) of the RFP, as well as additional information and addenda, at the address given above or by emailing Ms. Trinh Nguyen at LRV4@sfmta.com.

Questions regarding this RFP should be addressed to Ms Trinh Nguyen at LRV4@sfmta.com or at the address listed above. All questions regarding the RFP must be received by SFMTA no later than 4:00 PM 15 calendar days prior to the due date for the proposals. SFMTA may or may not respond to questions received after that time.

A mandatory pre-proposal conference will be held on October 29, 2013 at 10:00 a.m. PDT, at the Muni Metro East Facility, 601 25th Street, San Francisco, California 94107, 2nd Floor, Room 235, to discuss the RFP and the Contract.

Proposers should be aware that the SFMTA currently does not have all funding required to purchase all base contract vehicles for the term of the contract. If the SFMTA awards this contract, it will only issue a notice to proceed for the amount then certified by the City Controller. As further funding is secured, SFMTA will issue subsequent notice(s) to proceed up to the amount(s) then certified. SFMTA will pursue efforts to seek gap financing to cover those periods during which budgeted funding is not accessible.

II. REQUEST FOR PROPOSALS

II.A Introduction

The SFMTA operates the San Francisco Municipal Railway ("Muni"), which is the seventh largest public transit system in the United States. SFMTA has approximately 700,000 riders on an average weekday. Its fleet of about 1,000 vehicles, over half of which are electric, consists of subway-surface light-rail vehicles, electric trolley buses, diesel buses, the world-famous cable cars, and a unique collection of historic streetcars. More information about SFMTA is available at <http://www.SFMTA.com>.

SFMTA is initiating a new light rail vehicle procurement to acquire up to 260 LRVs (also referred to as "vehicles" or "cars") over the next 15 years. The scope of the Project will include the design, manufacture, delivery and testing of the LRVs, together with associated services, spare parts, special tools, training and documentation. The Base Quantity will be 175 vehicles. This will include an initial delivery of 24 cars, scheduled for delivery from 2016 through 2018 to supplement the fleet when the SFMTA's Third Street Phase 2 (Central Subway) opens. SFMTA will require an additional 151 LRVs to replace the existing LRV fleet, with deliveries projected to start in 2021 and continue through 2028. The initial delivery of 24 cars will be Phase 1; the subsequent delivery of 151 cars will be Phase 2. SFMTA also expects to acquire 85 expansion cars for projected increased ridership, with deliveries to commence on a schedule to be determined. These 85 vehicles will be an option to the base quantity of vehicles.

II.B Scope of Work

As mentioned above, the scope of work of the proposed Contract is for the procurement of 175 LRVs, with an option for 85 additional LRVs. Specific requirements for the vehicles, including deliverables required by SFMTA, are outlined in Volume 2 (Technical Specifications [TS]) of this RFP.

The Proposer shall supply and coordinate all labor, inspections, engineering, tools, materials, parts, facilities, and equipment required to design, build, test, and commission the LRVs to provide a level of performance, safety, quality of materials, workmanship, and reliability sufficient to provide a 25-year minimum car service with mid-life overhaul (as recommended by the Proposer), and shall prepare all required detailed technical data as specified in the Technical Specifications. The new vehicles will operate on all lines of the system within the current system constraints.

The work shall be performed at the Proposer's or subcontractor's facility, except for the qualification and acceptance testing, which shall be performed in accordance with the testing requirements of TS 21.3.4.5. The Proposer shall strictly monitor the quality of work within its facilities and in those of its subcontractors.

II.C Information for Proposers

II.C.1 General Information

Prospective Proposers shall submit a formal proposal that complies with the requirements of this RFP, and all applicable federal, state, and local laws. The proposal shall be signed by an officer legally authorized to bind the proposer to a contract. Proposals shall be submitted to SFMTA in writing, in the time and in the manner described in this RFP.

II.C.2 Technical Specifications

The Technical Specifications define the functional requirements for design, manufacturing, delivery, testing, and commissioning. Where possible, the Technical Specifications have been developed from LRV performance requirements based on the constraints of SFMTA infrastructure. This approach will allow Proposers to employ innovative and advanced technology where appropriate, subject to SFMTA acceptance.

II.C.3 Shipping Location

The Contractor shall be responsible for the shipment of each car to SFMTA's Muni Metro East facility, as well as to any third party testing facility (if needed). The Proposer shall not ship any LRV without written authorization by SFMTA. The Proposer shall be responsible for any damage to the LRV and equipment or to any part of the car that occurs during the course of shipment and until Acceptance or Conditional Acceptance by SFMTA. Until that time, the selected Proposer shall repair or replace any damaged item at no cost to SFMTA. Refer to Sample Agreement Section 68.3 for details.

II.C.4 RFP Copies for Subcontractors and Contractors

To avoid any potential confusion over the requirements of this RFP, the Proposer shall ensure that each potential major Subcontractor as identified in Appendix 2B has obtained a complete copy of both volumes of the RFP and shall provide a completed Confirmation of RFP Receipt (Appendix 3D) for each.

II.D Time and Place for Submission of Proposals

SFMTA must **receive** Proposals no later than 2:00 p.m., PDT, on December 10, 2013. Postmarks will not be considered in judging the timeliness of submissions. Proposals may be delivered in person or mailed to:

San Francisco Municipal Transportation Agency
Transit Division,
1 South Van Ness Avenue, 7th Floor, San Francisco, CA 94103
Attention: Ms. Trinh Nguyen
RFP for Contract No. SFMTA-2013-19

Partial or complete omission from a proposal of any of the items set out in Section II.F Format may render a proposal non-responsive and disqualify proposals from further consideration. Proposals that are submitted by fax will not be accepted. Late submissions will not be considered.

II.E Pre-Proposal Conference and Clarifications to RFP

Proposers shall attend a mandatory pre-proposal conference on October 29, 2013, at 10:00 AM PDT, to be held at the following address:

San Francisco Municipal Transportation Agency
Muni Metro East Facility,
601 25th Street,
San Francisco, California 94107,
2nd Floor, Room 235

The pre-proposal conference will include the Project overview, contractual and technical questions and answers, and a site visit to view the current LRVs.

SFMTA encourages the submittal of written questions for the pre-proposal conference at least seven days prior to the conference. The questions should be sent to Ms. Trinh Nguyen, Project Manager, by email: LRV4@sfmta.com. All questions will be addressed at this conference and any available new information will be provided at that time.

Any requests for information concerning the RFP whether submitted before or after the pre-proposal conference, must be in writing, and any substantive replies will be issued as written addenda to all parties who have received a copy of the RFP from the SFMTA Contracting Section. Questions raised at the pre-proposal conference may be answered orally. If any substantive new information is provided in response to questions raised at the pre-proposal conference, it will also be memorialized in a written addendum to this RFP and will be distributed to all parties that received a copy of the RFP from the SFMTA.

Modifications and clarifications will be made by addenda. Questions regarding this RFP should be addressed in writing to:

Ms. Trinh Nguyen P.E., Senior Program Manager
San Francisco Municipal Transportation Agency
1 South Van Ness Avenue, 7th Floor
San Francisco CA 94103
email LRV4@SFMTA.com

Questions sent via email are acceptable. It is the responsibility of the sender to ensure that the transmission was sent properly and received by Ms. Nguyen. SFMTA will send responses in writing, along with all the questions received, to all Qualified Proposers. **Any questions should be directed to the SFMTA no later than 4:00PM PDT 15 calendar days prior to the date for receipt of proposals.**

II.F Format

Each Qualified Proposer submitting a proposal must provide one original (with wet signatures), nine hard copies, and 10 electronic copies in pdf format of the Proposer's Technical Proposal, Price Proposal and Alternative Proposal (if any). Technical and Price Proposal forms shall also be provided in Excel format. The hard copies of proposals shall be submitted in three-ring binders, all pages shall be double-sided and on 8.5 by 11 inch recycled paper to the maximum extent feasible. The proposer may provide 11 by 17 inch foldout drawings where appropriate. All prices shall be in U.S. dollars and shall be typed or clearly written in ink. Proposers shall use English units of measure, and may provide metric equivalents in parentheses. All text shall be in the English language. Proposers shall not submit extensive drawings, catalogs, parts lists or marketing brochures.

The Proposer shall respond to each of the sections described within this RFP in the specific order presented in the RFP and address each item individually. Proposers should avoid making references to other Proposal sections unless it is not practicable to convey the information in another manner.

II.F.1 Technical Proposal

Technical Proposals must include all the parts divided by tabs and in the sequence indicated below:

- Part A – Introduction and Executive Summary
- Part B – Vehicle Description
- Part C – Management Approach and Schedule
- Part D – Other Required Documents

Details are provided in Section II.H (Technical Proposal). Each Part shall have tabbed subsections as set forth in Section II.H (e.g., for Vehicle Description, include subsections i, ii, iii, etc.).

Excluding the specific forms and drawings required by this RFP, the Technical Proposal shall not exceed 150 (double sided) pages.

II.F.2 Price Proposal

Price Proposals must include all the parts divided by tabs and in the sequence indicated below:

- Part A – Price Proposal Forms
- Part B – Bid Bond or Letter of Credit

Details are provided in Section II.I (Price Proposal). Each part shall have tabbed subsections as set forth in Section II.I.

All copies of the Price Proposal shall be enclosed in a separate sealed envelope, which shall be marked as follows:

Price Proposal: Procurement of New Light Rail Vehicles (LRV4)
RFP Contract No. SFMTA-2013-19
Submitted by: [Company Name]

II.F.3 Alternate Approach(es)

If the Proposer chooses to submit one or more Alternate Approaches (see Section II.J), they must be in a separate binder from the Technical and Price Proposals, and must clearly explain to which requirement each Alternate Approach applies. Proposer shall clearly organize the content using tabbed dividers to facilitate the evaluation.

II.G Responsibility of Proposer

Minimum Qualifications

SFMTA will only evaluate a Proposal from a Proposer that the SFMTA has determined meets minimum responsibility qualifications. The Proposer shall furnish adequate documentation with its proposal to permit SFMTA to determine the responsibility of the Proposer and its subcontractors and suppliers. A responsible Proposer is one that meets all of the following minimum qualifications:

1. Will only use subcontractors/suppliers that have supplied, for use on rail transit vehicles, equipment similar to that being proposed for subsystems, elements, and components; and
2. Provides a written commitment from a surety to provide the Proposer with performance and labor and materials bonds in the amounts required and meeting all standards set forth in Section 15.2 of the Sample Agreement (Appendix 4B) or a commitment from a financial institution to provide a letter or letters of credit meeting all standards set forth in Section 15.2 of the Sample Agreement; and
3. Provides a written commitment from its insurance broker to provide Proposer insurance meeting all the required coverages set forth in Section 15.1 of the Sample Agreement (Appendix 4B) for the term of the Contract.

Qualitative Responsibility Evaluation

Proposers shall submit the following additional information.

1. Updated versions of the information required by Section 4.c.2.b of the RFQ (i.e., contracts for new rail cars in the past five years) and Section 4.c.2.d of the RFQ (i.e., projects over last 10 years resulting in termination for unsatisfactory performance, claims or litigation, or payment of liquidated damages) to bring the information up to date as of the date of Proposal; and
2. As to Proposer and each affiliated business entity Proposer relies on to meet minimum qualifications 2 and 3 specified above: audited financial statements

for the last three years, the most recent Dunn & Bradstreet ratings for each such business entity and any other recent rating agency reports, and a completed Financial Statement (attached as Appendix 3G).

If any such information becomes inaccurate or requires further updating during the course of the procurement process, the Contractor must immediately notify SFMTA and provide updated accurate information in writing.

The SFMTA will conduct a qualitative evaluation of the responsibility information described above and rank Proposers based on their capacity to timely meet the financial and performance demands of a long term multi-phase manufacturing process while minimizing disputes that result in claims or litigation. There will be a maximum of 100 points available for the qualitative evaluation.

Three hard copies and an electronic copy of the above information shall be provided in a separate envelope, which shall be marked as follows:

Responsibility Documents: Procurement of New Light Rail Vehicles (LRV4)
RFP Contract No. SFMTA-2013-19
Submitted by: [Company Name]

II.H Technical Proposal

In its proposal, the Proposer shall identify specific elements planned for the new LRVs, as well as the Proposer's experience with the proposed elements of the vehicle, and shall specify the names of proposed subcontractors and suppliers for each major vehicle subsystem, describing in detail the interfaces and how the Proposer will manage each subcontractor and supplier. The Proposer must demonstrate full responsibility for the execution of the Work, including management of all subcontractors, suppliers, and integration efforts that will be required.

II.H.1 Introduction and Executive Summary – Part A (maximum 3 pages)

Submit a letter of introduction and executive summary of the proposal. The letter must be signed by a person authorized by your firm to obligate your firm to perform the commitments contained in the proposal. The letter must acknowledge receipt of all Addenda. No price information shall be included. The proposal letter shall attest that the Proposer:

- Has reviewed all of the provisions of the RFP and any addenda;
- Has carefully reviewed the accuracy of all statements made in its Proposal;
- Has examined the experience, skill and certification (if any) requirements specified in the RFP and that all entities (Proposer, subcontractor, supplier) performing the work fulfill the specified requirements;

- Has submitted its proposal without exceptions (other than Alternate Approaches) and confirms that all SFMTA requirements in this RFP, including the Sample Agreement, are acceptable to the Proposer;
- Will complete the work as required and comply fully with the project schedule;
- Will keep its proposal, including price, in effect for the period stated in Section II.N.4; and
- Will execute the SFMTA Agreement following Notice of Intent to Award.
- Will provide the required bonds and/or letters of credit and insurance documents following Notice of Award of the contract.

II.H.2 Vehicle Description – Part B

The Technical Proposal shall demonstrate that all the equipment satisfies the functional and performance requirements in the Technical Specifications, and that all work performed will be in compliance with the Technical Specifications. The proposal shall present a concise, detailed technical description of the work to be performed. The format, style, and integrated nature of each submittal shall reflect the fact that the proposer, rather than a supplier, is submitting the Technical Proposal.

In order to facilitate SFMTA's review, each proposal must also include a summary in the front of each binder with the technical information requested in the subsections below. The response to each paragraph shall be contained within its respective tab. Each response shall include all information requested, be fully self-contained, and not reference attachments that may be in other sections of the proposal unless it is not practicable to do otherwise. These responses should be clear and concise, and shall completely explain how the proposer will meet the stated objectives without additional explanation or information. Brevity and clarity are desired. Statements merely indicating that the Proposer will meet specific requirements are not adequate and will potentially impact the evaluation.

Vehicle Description requirements for the new LRVs are as follows (where noted by the initials "TS," these requirements refer to the Technical Specifications):

- i. **General Description**
 - A. Generally describe the proposed LRVs, noting key features and how the Proposer intends to meet or exceed the requirements of the Technical Specifications.
 - B. Describe how the Vehicle and its systems and components will achieve optimum reliability and maintainability in accordance with TS 2.8 and TS 2.9.

- C. Provide completed Form II-A, Technical Worksheet and Form II-B Supplier Worksheet.
- D. Describe the general arrangement of the vehicle, showing overall dimensions, and the layout of interior and exterior equipment and cabs. Show a side view, plan and reflected plan views, and end view and cross sections as needed to fully convey the design.
- E. Provide color renderings of the proposed interior and exterior design of the vehicle. Please note that these conceptual designs are intended to represent a general understanding of the requirements of the Technical Specifications and are not intended to represent the precise design to be supplied or to initiate the design review process.
- F. The Proposer may identify a maximum of two possible subcontractors per subsystem.

ii. **System Requirements:**

- A. Provide propulsion and braking characteristics, including graphs of:
 1. Vehicle speed vs. time and vehicle speed vs. distance in accordance with TS 2, Design and Performance Criteria.
 2. Tractive effort vs. speed for maximum acceleration.
 3. Tractive effort vs. speed for maximum braking. Indicate if the above plots depict actual performance of an existing car or represent Proposer's estimate of anticipated performance.
- B. Provide performance simulations over a complete round trip on Muni's L-line, including the duty cycle requirements in TS2 and TS10.
- C. Provide braking system performance calculations for both blended brakes and friction-only brakes under the following conditions, indicating if the information depicts actual performance of an existing car or represents Proposer's estimate of anticipated performance:
 1. *AW3 loading;*
 2. *Maximum service braking command;*
 3. *Level, tangent track.*
- D. Provide anticipated car weight and axle weight distribution.
- E. Provide estimates for interior and exterior noise and vibration of the proposed LRV and the plan that the Proposer will use to manage these levels.
- F. Provide evidence of service-proven design for systems and components. SFMTA realizes that no existing vehicles may meet all requirements of the Technical Specifications, and

modifications to existing designs may be necessary. Proposers should base their overall vehicle design on proven subsystems. Concepts based on a single vehicle or hybrids of two or more existing vehicles are acceptable.

- iii. **Carbody:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS3 (Carbody Structure).
 - B. Describe the approach that will be used to achieve the carbody structural design load requirements. Indicate previous experience in providing the levels of car body strength similar to those specified.
- iv. **Coupler:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS4 (Coupler).
- v. **Operators Cab:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS5 (Operator's Cab), including the ergonomic approach.
- vi. **Passenger Door and Step:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS6 (Passenger Doors).
 - B. Describe the general arrangement and function of the door and step system.
- vii. **Heating Ventilation and Air Conditioning:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS7 (Heating, Ventilation and Air Cooling).
- viii. **Lighting System:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS8 (Lighting).
- ix. **Auxiliary Electric:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS9 (Electrical).
 - B. Describe the car safety grounding and power return arrangement.
 - C. Describe the vehicle network topology, protocol and architecture.
- x. **Propulsion System:**
 - A. Explain how the Proposer intends to meet or exceed the requirements of TS10 (Propulsion).

- B. Describe the spin/slide correction system and its interface with the braking system.
 - C. Describe the propulsion control system, including its interface with the friction brake system.
 - D. Describe the EMI control. Describe overload and transient protection.
- xi. Truck Assemblies:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS11 (Truck Requirements).
 - B. Provide general arrangement drawings of the proposed trucks.
 - C. Describe the primary and secondary suspension system, including the load leveling system.
- xii. Friction Braking:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS12 (Braking Equipment).
 - B. Describe the electronic control system.
 - C. Describe the parking brake system, parking brake application and parking brake release in case of failure.
 - D. Describe the load weigh system.
- xiii. Vehicle Communication:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS13 (Communications).
- xiv. Automatic Train Control:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS14 (Automatic Train Control).
- xv. Interior:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS15 (Interior).
- xvi. Monitoring & Diagnostics:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS17 (Monitoring and Diagnostics).
- xvii. Software:**
- A. Explain how the Proposer intends to meet or exceed the requirements of TS18 (Software Systems) for all software used on the vehicle.
 - B. Describe the Proposer's software change control, approval and tracking procedures.

xviii. Materials, Workmanship and Alternative Standards:

- A. Submit a proposal for materials and workmanship as set forth in TS 19 (Materials and Workmanship).

II.H.3 Management Approach and Schedule – Part C

- i. **Program Management Description** Describe how the Proposer intends to achieve the requirements of project management outlined in TS 20 (Program Management and Quality Assurance). The actual plan shall be included as an attachment to Technical Proposal Part C.

Note that TS20 and Appendix C of the Technical Specifications require that the Proposer provide its proposed Project Management Plan and Project Quality Assurance Plan for SFMTA as a part of the proposal submittal, that review and acceptance of these documents will be part of the negotiation process, and that they will become part of the final Agreement.

- ii. **Project Organization Chart:** Provide a complete project organization chart, including major subcontractors, along with how the project organization fits into the overall company organization chart. Include the following information:
1. Key individuals and their departments;
 2. Their responsibilities within the organization;
 3. System integration responsibilities;
 4. Design, manufacturing and testing responsibilities of the Proposer and each subcontractor or supplier for all systems and major subsystems;
 5. Resumes of key personnel (see TS20 and TS Appendix C) listed in the organization chart.
- iii. **Manufacturing Plan:** Provide a manufacturing plan indicating plants and locations for manufacture of major components and for final assembly. List the work to be performed by the Proposer and the location at which this work will be performed. Identify the final assembly location. If carbody or truck assembly is to be performed by subcontractor(s), identify them by name and work locations. Describe the plant capacity for these locations and indicate the capacity available for work under this contract while satisfying other commitments. Demonstrate that the Proposer has the capacity, personnel and other resources to manufacture the cars specified in this document within the time proposed.
- iv. **Quality Assurance Plan:** Describe how the proposer intends to meet or exceed the requirements for Quality Assurance as

described in TS 20 and TS Appendix C. The actual plan shall be included as an Attachment to Technical Proposal Part C.

Note that TS20 and Appendix C of the Technical Specifications require that the Proposer provide its proposed Project Management Plan and Project Quality Assurance Plan to SFMTA as a part of the proposal submittal, that review and acceptance of these documents will be part of the negotiation process, and that they will become part of the final Agreement.

- v. **Whole Life Cycle Costs:** Describe the Proposer's approach to providing SFMTA the best benefit in whole life cycle costs for the new LRVs. Include Proposer's experience with whole life cycle costing in the explanation. Projected costs shall be included in Form II – C.
- vi. **Technical Integration:** Describe the design responsibility of the proposer and major subcontractors (by name), and how the design work will interface among these groups. In particular, highlight where systems integration and industrial design responsibilities are focused. Describe the approach for systems integration as required by the equipment being purchased. Describe the intended design interface between the proposer's team and SFMTA's technical staff for the program management and design refinement process.
- vii. **Testing Plan:** Describe the approach for conducting the tests required in the Technical Specifications. Provide a preliminary plan for test sequencing. Describe the methods by which ongoing test results will be cycled through the design process to ensure that design modifications are implemented into all cars.
- viii. **Safety Considerations:** Describe the approach applied by the Proposer to the incorporation of safety considerations in its design.
- ix. **Reliability Estimate:** Describe how the Proposer will meet its total car system reliability estimate, including a preliminary allocation list covering vehicle subsystems indicating the contribution of each towards meeting this overall estimate as set forth in TS 2.8.
- x. **On-Site Support:** Provide a preliminary plan and approach for on-site support during delivery, testing, training and the warranty period, as set forth in TS 21.

- xi. Samples of Training Materials and Manuals:** Provide brief representative samples extracted from training materials, manuals and parts catalogs from Proposer's previous projects that demonstrate the Proposer's experience, capability and approach.
- xii. Schedule with Milestones:** Provide a comprehensive schedule showing key milestones. Proposals should include suggested measures and methods to address the gap in delivery between the first 24 vehicles and the subsequent replacement of the 151 vehicles.

The schedule requirements set forth in this RFP are of the utmost importance to SFMTA, and compliance with these requirements are fundamental to the success to SFMTA's light rail expansion program as well as fleet replacement. Therefore, in addition to the comprehensive schedule defined above, the Proposer shall also include with its proposal a clearly written declaration, signed by an appropriate Corporate Officer, that reaffirms the Proposer's understanding of and absolute commitment to full compliance with the schedule requirements. This declaration shall include outline the steps and efforts that the Proposer will undertake to ensure schedule compliance.

The organization and management chart, resumes, manufacturing plan and schedule in conjunction shall demonstrate that there is sufficient design and production staff and plant capacity available at the times indicated in the schedule, and that processes and structures are in place or are planned to ensure that the schedule will be maintained.

II.H.4 Other Required Documents – Part D

In addition to the requirements on the content of the proposal discussed above, Proposers **must** submit the following as part of the Appendix with the Proposal in order to be considered responsive:

1. Certification Regarding Lobbying (Appendix 3A)
2. Attestation of Compliance (Appendix 3B)
3. Buy America Certificate (Appendix 3C)

The following additional forms must be submitted to be eligible for award of the contract:

1. Confirmation of RFP Receipt (Appendix 3D)
2. Business Registration Certificate Requirement (Appendix 3E)
3. San Francisco Administrative Code Chapters 12B & 12 C Declaration: Nondiscrimination in Benefits (Appendix 3F)
4. DBE Requirements Certification (Appendix 3H)

These forms are located in Appendix 3 of this RFP.

A PDF Version of the Business Registration Certificate form is available at:
<http://sfgsa.org/index.aspx?page=4762>.

II.I Price Proposal

The Price Proposal shall remain valid for the period stated in Section II.N.4 of this RFP. The Proposer shall list all prices on the forms provided in Appendix 1 to this RFP. All blank spaces shall be filled in and the Proposer shall make no changes in the wording of the forms. SFMTA may require Proposers to provide additional detailed breakdowns of costs during the evaluation process. Each Proposer is urged to submit a Price Proposal with the most favorable pricing terms to the SFMTA.

II.I.1 Price Proposal Forms – Part A

- (a) Appendix 1A Schedule of Prices**
- (b) Appendix 1B Nominal Spare Parts and Optional Spare Parts**
- (c) Appendix 1C Diagnostic Test Equipment / Special Tools**

II.I.2 Proposal Security – Part B

The Price Proposal shall be accompanied by a proposal bond (bid bond), letter of credit, cashier's or certified check, or money order in the amount of \$3,000,000 payable to the City and County of San Francisco, to guarantee the filing of performance and labor and materials bonds and insurance certificates and proper execution of the Agreement. After the successful proposer has furnished same, or the City has rejected proposals, all bid securities, except those which may have been forfeited, will be returned to the proposers. The cashier's or certified check, or money order is to be drawn on a U.S. bank.

II.J Alternate Approaches

Qualified Proposers shall provide a Proposal that fully complies with the requirements of this RFP and associated documents. In addition, the City encourages Proposers to submit alternatives to the proposed technical, management, schedule and payment approaches. The City will consider for acceptance alternatives to portions of the Proposal. Additional points (up to a maximum of 10 points) may be awarded where, in the opinion of the SFMTA, such alternate approaches provide a tangible benefit and value to the City.

For each alternate approach, the Proposer shall provide a description of the proposed change in sufficient detail to understand the nature and impact of the change, including the provision of the Proposal that the Proposer would like to change. The Proposer shall provide alternate language if appropriate, and clearly specify the benefits to the City, considering technical merit, quality, schedule and cost factors.

II.K Sample Agreement

The Sample Agreement for this project is included here as Appendix 4B. The Sample Agreement contains the following Exhibits:

- Exhibit 2: Payment Schedule
- Exhibit 3: Project Delivery Schedule
- Exhibit 4: FTA Requirements for Procurement Contracts
- Exhibit 5: Warranty Requirements

The Proposer shall carefully review all requirements of the Sample Agreement in this RFP prior to preparation of its Price Proposal. In preparation of its Price Proposal, the Proposer must assume that SFMTA will not make modifications to the terms of the Agreement as attached unless it has issued an addendum changing the terms of the Agreement.

II.L Evaluation Process

II.L.1 General

SFMTA will review Technical Proposals, Price Proposals, Qualitative Responsibility submissions and Alternate Approaches (if any) from each Proposer that has been found to meet the minimum responsibility qualifications.

II.L.2 Evaluating the Proposals

- A. SFMTA will use the Negotiated Procurement Procedures attached as Appendix 4C in the evaluation of Proposals.
- B. SFMTA will appoint a Technical Evaluation Committee to evaluate Technical Proposals, a Price Evaluation Committee to evaluate the Price Proposals. The Technical Evaluation Committee will open the Technical Proposals first and review them for responsiveness to the RFP.
- C. Proposals will be evaluated based on the information received before the Proposal deadline as stated in Section II.D. Any part of a Proposal received after the Proposal deadline will be considered late and will be rejected without evaluation.
- D. At any time during the Proposal evaluation process, the SFMTA may require a Proposer to provide oral or written clarification of its Proposal. The SFMTA reserves the right to make an award without further clarifications of Proposals received.
- E. SFMTA will recommend award of the contract to the responsible Proposer whose Proposal is most advantageous and provides the best value to SFMTA. The objective of the evaluation is to

assess the best value to SFMTA in terms of acceptability of technical and all other evaluation factors at a price that is reasonable in relation to the work being performed.

II.L.3 Evaluation Criteria and Relative Weights

After the SFMTA determines that a Proposer has met the minimum responsibility qualifications and has submitted a responsive proposal, the SFMTA will review each respective section of the Proposal and establish three intermediate scores, a Technical Score, a Price Score and a Qualitative Responsibility Score, which will then be combined for each Proposal. SFMTA has established the following relative weights for the Technical Proposal, the Price Proposal, and the Qualitative Responsibility scores:

- Technical Proposal 65%
- Price Proposal 25%
- Qualitative Responsibility Evaluation 10%

Any extra points awarded for the Alternate Approaches will be added to determine the Final Score for each Proposal.

II.L.4 Technical Evaluation and Methodology

A. Evaluation Criteria. The Technical Evaluation Committee will employ the following criteria and relative weights in evaluating Technical Proposals, which shall total 100% of the unweighted Technical Score:

1. **General Organization, Format and Clarity 5%;**
 - a. Follows the format for Technical Proposal as set forth in Section II.F.
 - b. Is clear and concise.
 - c. Includes all requirements in Part A – Introduction and Executive Summary.
2. **Vehicle Design and Characteristics (Part B) 60%**
 - a. Compliance with Technical Specifications
 - b. Quality of proposed vehicle design and proposed subsystems
 - c. Design approach including basis of design, use of proven methodologies and integration of subsystems.
 - d. Maintainability and reliability
 - e. Compatibility and ease of integration with existing fleet, system and facilities
3. **Management Approach and Schedule (Part C) 35%**
 - a. Management Approach and Schedule, including Program Management, Project Organization, Testing, and System Support

- b. Manufacturing, System Assurance and Quality Assurance Plan
- c. Whole Life Cycle Cost approach

B. Technical Score: The Technical Score will be established by the following procedure:

The Technical Evaluation Committee will review each Technical Proposal in accordance with requirements set in Section II.L.4.A above. There will be a total of 100 points possible for the Technical Proposal based on the percentages assigned to specific criteria detailed in Section II.L.4.A. To the extent that a particular Technical Specification sets a minimum performance standard, proposals that exceed the requirements will be eligible to receive higher scores. Where the Proposer has proposed two suppliers or configurations for a particular system or subsystem, SFMTA will evaluate each and use the lower of the scores for the systems of the two suppliers or configurations.

II.L.5 Price Proposal Evaluation

A. Evaluation Criteria. The basis for scoring of Price Proposals will be as follows and shall total 100% of the unweighted Price Score:

1. Evaluation of Prices as provided in the following forms :
 - a. Appendix 1A Schedule of Prices
 - b. Appendix 1B Nominal Spare Parts and Optional Spare Parts
 - c. Appendix 1C Diagnostic Test Equipment/Special Tools

B. Review of Forms. The Price Evaluation Committee will check all Appendices 1A, 1B, and 1C for mathematical or clerical errors and will correct any errors and recalculate prices on the assumption that the lowest unit prices are correct and thus predominate. In the event of a discrepancy between the unit bid price and the extension, the unit bid price shall govern. In the event of a discrepancy between the sum of the extended amounts and the total bid shown, the sum of the extended amounts shall govern. SFMTA also reserves the right to reject any Proposal with widespread or egregious mathematical errors or with significantly unbalanced unit prices as solely determined by SFMTA.

C. Price Score. The Price Score will be established according to the following procedure:

The Price Proposals will be scored by the Price Evaluation Committee in accordance with the requirements set forth in Section II.L.5.A above. There will be a total of 100 points possible for the Price Proposal.

Cost Formula: The cost criterion will be scored by giving the proposal with the lowest total cost the maximum number of Cost points available. The remaining proposals will be rated by applying the following formula:

$$Y = (L/N) \times 100$$

where

N = The total evaluated cost for this proposer

L = The lowest evaluated cost submitted by any proposer

Y = The evaluation cost points for this proposer

II.L.6 Evaluation of Alternate Approaches

Alternate Approaches will be considered after evaluation of the Technical Proposals. SFMTA will award additional points, up to a maximum of 10 points, to Proposers who demonstrate that they will provide real and tangible benefits and value added to the SFMTA from their Alternate Approach(es), considering technical, management, contractual and costing factors.

II.L.7 Final Score and Post-Evaluation

The Final Score will be established by weighing the Technical, Price and Qualitative Responsibility Scores using the relative weights stated in Section II.L.3. Any additional points collected from scoring of the Alternate Approaches will be added to the Technical, Price and Qualitative Responsibility Scores to determine the Final Score.

After evaluation, the SFMTA, in accordance with the Negotiated Procurement Procedures, will decide whether to:

- A. Award to the highest-ranked Proposer;
- B. Reject all Proposals; or
- C. Establish a competitive range and enter into negotiations with all Proposers within the competitive range.

SFMTA reserves the right to reject all Proposals if the prices are, in SFMTA's opinion, unreasonable or for any other reason in best interests of the SFMTA.

The City intends to award this Agreement to the firm that it considers will provide the best overall project services. In the event that an agreement cannot be reached with the highest-ranked firm, negotiations may be entered into with other qualified firms in the order of their ranking. **SFMTA reserves the right to accept other than the lowest-priced offer and to reject proposals, in whole or in part, that are not responsive to this RFP.**

II.L.8 Request for Best And Final Offer

In accordance with the Negotiated Procurement Procedures, after the first round of evaluation, as described above, SFMTA may revise the provisions of the Technical Specifications or the Sample Agreement to reflect information

garnered during the first round and issue a request for Best and Final Offer (BAFO) to each Proposer within the competitive range.

SFMTA will notify the Proposer, prior to Request for BAFO, of any subcontractors who are not compliant with the contract documents and who are unacceptable to SFMTA. After the submittal of BAFO, Proposer may not substitute any other subsystem subcontractor than those submitted in the BAFO, unless accepted by SFMTA.

II.L.9 Contract Award

The SFMTA will recommend award of the contract to the Proposer who receives the highest ranking in the evaluation process and with whom a contract has been successfully negotiated. SFMTA will issue a Notice of Intent to Award to that Proposer. The Selected Proposer agrees to permit City to perform audits and inspections as indicated in Exhibit 4 of the Sample Agreement (FTA Requirements for Procurement Contracts).

The contract is subject to approval by the Board of Directors of the SFMTA and the City's Board of Supervisors. If the contract is approved by these governing bodies, the SFMTA will issue a Notice of Award to the successful Proposer.

II.L.10 Debrief to Unsuccessful Proposers

Upon request, SFMTA will debrief unsuccessful Proposers after award of the Contract.

II.L.11 Bonds, Insurance, Letters of Credit and Execution of Contract

Within 20 calendar days following the receipt of a Notice of Award, the Proposer to whom the contract has been awarded shall deliver the required insurance certificates, and the specified letter(s) of credit and/or performance and labor and materials bonds, to the City, in accordance with Section 15 of the Sample Agreement.

If a Proposer to whom Notice of Award is made fails or refuses to furnish the required bonds and insurance certificates within 20 calendar days after receiving notice from the City to file such documents, or fails or refuses to properly execute and return the Agreement, the City may, at its option, determine that this Proposer has abandoned its proposal. Thereupon, the recommended award of the Contract to the Proposer shall be null and void, and the full principal amount of the proposal bond (bid bond) shall be payable to the City and County of San Francisco (or the cashier's or certified check or money order accompanying its proposal shall be deposited with the Treasurer of the City and County of San Francisco for collection) and the proceeds thereof shall be retained by the City as partial liquidated damages for failure of such proposer to properly execute the Agreement or file the documents required. The foregoing in no way limits the damages that may be recoverable by the City.

II.L.12 Cost and Price Analyses

SFMTA shall conduct a price analysis, and if necessary, a cost analysis of the Proposal to assess whether the prices offered by the Proposer are fair and reasonable. A price analysis is the process of examining and evaluating a prospective price without evaluation of the separate cost elements. A cost analysis includes the appropriate verification of cost data, the evaluation of specific elements of cost, and the projection of the data to determine the effect on price. If so requested by SFMTA, the Proposer shall promptly submit cost data and related information on a form provided by SFMTA.

SFMTA may choose to have auditors perform an audit of the Proposer's cost data, and the Proposer shall cooperate with SFMTA and make personnel and cost information available to the auditors.

Permissibility of costs will be reviewed under the standards established in U.S. OMB, "Cost Principles for State, Local, and Indian Tribal Governments (U.S. OMB Circular A-87)," 2 C.F.R. part 225. If SFMTA receives only one responsive and responsible Proposal, SFMTA may negotiate with the single Proposer and request a revised Proposal before obtaining detailed cost data for a cost analysis.

II.L.13 Pre-Award Buy America Certification

49 CFR Part 663 requires SFMTA to certify to FTA that a pre-award audit has been performed and to verify compliance with Buy America requirements. After a Proposer has been selected for award and has been sent a Notice of Intent to Award, the Proposer shall provide an SFMTA auditor with appropriate documentation to assist in the completion of the pre-award audit. The documentation supplied by the successful Proposer concerning its compliance with the Buy America regulations (49 C.F.R. Part 661) must list the components of the LRVs by manufacturer, country of origin, and percent of total cost of all components. In addition, the successful Proposer must identify the subcomponents of each component listed as a domestic component in the content calculation for Buy America compliance. Each such subcomponent must be identified by manufacturer, country of origin, and percent of total cost of all subcomponents. The Selected Proposer must identify the proposed final assembly location for the LRVs, and provide documentation detailing the manufacturing activities that will take place during final assembly at that location. The Selected Proposer shall cooperate with SFMTA and, within four calendar days after the date of the Notice of Intent to Award, provide enough detail concerning these activities to allow SFMTA's auditor to determine if these activities constitute adequate final assembly under the Buy America requirements. To assure confidentiality, the auditor's report will contain only summary data, not cost and pricing data, of individual components and subcomponents. Proposer shall clearly mark as proprietary all such cost data. To the fullest extent permitted under applicable law, SFMTA and its auditor shall keep such information confidential.

II.M Federal and Local Requirements

Refer to Sample Agreement Appendix 4B for Federal and Local Requirements.

II.N Terms and Conditions for Receipt of Proposals

II.N.1 Errors and Omissions in RFP

Proposers are responsible for reviewing all portions of this RFP. Proposers are to promptly notify the SFMTA, in writing, if the proposer discovers any ambiguity, discrepancy, omission, or other error in the RFP. Any such notification should be directed to the SFMTA promptly after discovery, but in no event later than the time set forth in Section II.N.2 below.

II.N.2 Objections to RFP Terms

Should a Proposer object on any ground to any provision or legal requirement set forth in this RFP (including all Appendices and all Addenda), including but not limited to objections based on allegations that: (a) the RFP is unlawful in whole or in part; (b) one or more of the requirements of the RFP is onerous, unfair or unclear; (c) the structure of the RFP does not provide a correct or optimal process for the procurement; or (d) the RFP contains one or more ambiguity, conflict, discrepancy or other errors., the Proposer must, **not more than 21 Days after the RFP is issued**, submit such objection in the manner described below.

- a. Objections must be delivered to Trinh Nguyen, at the address provided on page 2 of this RFP. If an objection is mailed, the Proposer bears the risk of non-delivery within the required time period. Objections should be transmitted by a means that will objectively establish the date of receipt by the City. Objections or notices of objections delivered orally (e.g., by telephone) will not be considered.
- b. The objection shall state the basis for the objection, refer to the specific requirement or portion of the RFP at issue, and shall describe the modification to the RFP sought by the prospective Proposer. The Objection shall also include the name, address, telephone number, and email address of the person representing the Proposer.
- c. The SFMTA, at its discretion, may make a determination regarding an objection without requesting further documents or information from the Proposer who submitted the objection. Accordingly, the initial objection must include all grounds of objection and all supporting documentation or evidence reasonably available to the Proposer at the time the objection is submitted. If the Proposer later raises new grounds or evidence that were not included in the initial objection, but which could have been raised at that time, the City may not consider such new grounds or new evidence.

- d. Upon receipt of a timely and proper objection, the SFMTA will review the objection and conduct an investigation as it deems appropriate. As part of its investigation, the SFMTA may consider information provided by sources other than Proposer. At the completion of its investigation, the City will provide a written determination to the Proposer who submitted the objection. If required, the City may extend the proposal submittal deadline to allow sufficient time to review and investigate the objection, and issue Addenda to incorporate any necessary changes to the RFP.
- e. Objections not received within the time and manner specified will not be considered. A Proposer's failure to provide the City with a written objection as specified above on or before the time specified above shall constitute a complete and irrevocable waiver of the ground(s) of objection and forfeit the Proposer's right to raise such ground(s) of objection later in the procurement process (including as part of a protest), in a Government Code Claim, or in other legal proceedings.
- f. A Proposer may not rely on an objection submitted by another Proposer, but must timely pursue its own objection.

II.N.3 Addenda to RFP

The SFMTA may modify the RFP, prior to the proposal due date, by issuing written addenda. Addenda will be sent by email and, if necessary, by facsimile, to each firm listed with the SFMTA as having received a copy of the RFP for proposal purposes. The SFMTA will make reasonable efforts to notify proposers in a timely manner of modifications to the RFP. Notwithstanding this provision, the proposer shall be responsible for ensuring that its proposal reflects any and all addenda issued by the SFMTA prior to the proposal due date, regardless of when the proposal is submitted.

II.N.4 Term of Proposal

Submission of a proposal signifies that the proposed services and prices are valid for 240 Days from the proposal due date and that the quoted prices are genuine and not the result of collusion or any other anti-competitive activity.

II.N.5 Revision of Proposal

A proposer may revise a proposal on the proposer's own initiative at any time before the deadline for submission of proposals. The proposer must submit the revised proposal in the same manner as the original. A revised proposal must be received on or before the proposal due date.

In no case will a statement of intent to submit a revised proposal, or commencement of a revision process, extend the proposal due date for any proposer.

II.N.6 Errors, Omissions and Deviations in Proposal

Failure by the SFMTA to object to an error, omission, or deviation in the proposal will in no way modify the RFP or excuse the Contractor from full compliance with the specifications of the RFP or any contract awarded pursuant to the RFP.

II.N.7 Financial Responsibility

The SFMTA accepts no financial responsibility for any costs incurred by a firm in responding to this RFP. Submissions in response to the RFP will become the property of the SFMTA and may be used by the SFMTA in any way deemed appropriate.

II.N.8 Proposer's Obligations under the Campaign Reform Ordinance

Proposers must comply with Section 1.126 of the S.F. Campaign and Governmental Conduct Code, which states:

No person who contracts with the City and County of San Francisco for the rendition of personal services, for the furnishing of any material, supplies or equipment to the City, or for selling any land or building to the City, whenever such transaction would require approval by a City elective officer, or the board on which that City elective officer serves, shall make any contribution to such an officer, or candidates for such an office, or committee controlled by such officer or candidate at any time between commencement of negotiations and the later of either (1) the termination of negotiations for such contract, or (2) three months have elapsed from the date the contract is approved by the City elective officer or the board on which that City elective officer serves.

If a proposer is negotiating for a contract that must be approved by an elected local officer or the board on which that officer serves, during the negotiation period the proposer is prohibited from making contributions to:

- the officer's re-election campaign
- a candidate for that officer's office
- a committee controlled by the officer or candidate.

The negotiation period begins with the first point of contact, either by telephone, in person, or in writing, when a Proposer approaches any city officer or employee about a particular contract, or a city officer or employee initiates communication with a potential Proposer about a contract. The negotiation period ends when a contract is awarded or not awarded to the Proposer. Examples of initial contacts include: (i) a Contractor contacts a city officer or employee to promote himself or herself as a candidate for a contract; and (ii) a city officer or employee contacts a Proposer to propose that the Proposer apply for a contract. Inquiries for information about a particular contract, requests for documents relating to a Request for Proposal, and requests to be placed on a mailing list do not constitute negotiations.

Violation of Section 1.126 may result in the following criminal, civil, or administrative penalties:

- a) Criminal. Any person who knowingly or willfully violates section 1.126 is subject to a fine of up to \$5,000 and a jail term of not more than six months, or both.
- b) Civil. Any person who intentionally or negligently violates section 1.126 may be held liable in a civil action brought by the civil prosecutor for an amount up to \$5,000.
- c) Administrative. Any person who intentionally or negligently violates section 1.126 may be held liable in an administrative proceeding before the Ethics Commission held pursuant to the Charter for an amount up to \$5,000 for each violation.

For further information, proposers should contact the San Francisco Ethics Commission at (415) 581-2300.

II.N.9 Sunshine Ordinance

In accordance with S.F. Administrative Code Section 67.24(e), Proposer's bids, responses to RFPs and all other records of communications between the City and persons or firms seeking contracts shall be open to inspection immediately after a contract has been awarded. Nothing in this provision requires the disclosure of a private person's or organizations net worth or other proprietary financial data submitted for qualification for a contract or other benefits until and unless that person or organization is awarded the contract or benefit. Information provided which is covered by this paragraph will be made available to the public upon request.

II.N.10 Public Access to Meetings and Records

If a proposer is a non-profit entity that receives a cumulative total per year of at least \$250,000 in City funds or City-administered funds and is a non-profit organization as defined in Chapter 12L of the S.F. Administrative Code, the proposer must comply with Chapter 12L. The proposer must include in its proposal (1) a statement describing its efforts to comply with the Chapter 12L provisions regarding public access to proposer's meetings and records, and (2) a summary of all complaints concerning the proposer's compliance with Chapter 12L that were filed with the City in the last two years and deemed by the City to be substantiated. The summary shall also describe the disposition of each complaint. If no such complaints were filed, the proposer shall include a statement to that effect. Failure to comply with the reporting requirements of Chapter 12L or material misrepresentation in proposer's Chapter 12L submissions shall be grounds for rejection of the proposal and/or termination of any subsequent Agreement reached on the basis of the proposal.

II.N.11 Reservations of Rights by the City

The issuance of this RFP does not constitute an agreement by the City that any contract will actually be entered into by the City. The City expressly reserves the right at any time to:

- a. Waive or correct any defect or informality in any response, proposal, or proposal procedure;
- b. Reject any or all proposals;
- c. Reissue a Request for Proposals;
- d. Prior to submission deadline for proposals, modify all or any portion of the selection procedures, including deadlines for accepting responses, the specifications or requirements for any materials, equipment or services to be provided under this RFP, or the requirements for contents or format of the proposals;
- e. Procure any materials, equipment or services specified in this RFP by any other means;
- f. Determine that no project will be pursued.
- g. Accept any proposals in whole or in part

II.N.12 No Waiver

No waiver by the City of any provision of this RFP shall be implied from any failure by the City to recognize or take action on account of any failure by a proposer to observe any provision of this RFP.

II.N.13 Communications Prior to Contract Award

It is the policy of the SFMTA that only employees identified in the RFP as contacts for this competitive solicitation are authorized to respond to comments or inquiries from Proposers or potential Proposers seeking to influence the Proposer selection process or the award of the contract. This prohibition extends from the date the RFP is issued until the date when the Proposer selection is finally approved by the SFMTA Board of Directors and, if required, by the San Francisco Board of Supervisors.

All firms and subcontractor(s) responding to this RFP are notified that they may not contact any SFMTA staff member, other than a person with whom contact is expressly authorized by this RFP, for the purpose of influencing the Proposer selection process or the award of the contract from the date the RFP is issued to the date when the contract award is approved by the Board of Directors of SFMTA and, if required, by the San Francisco Board of Supervisors. This prohibition does not apply to communications with SFMTA staff members regarding normal City business not regarding or related to this RFP.

All firms and subcontractor(s) responding to this RFP are notified that any written communications sent to one or more members of the SFMTA Board of Directors concerning a pending contract solicitation shall be distributed by the SFMTA to all members of the SFMTA Board of Directors and the designated staff contact person(s) identified in the RFP.

Except as expressly authorized in the RFP, where any person representing a Proposer or potential Proposer contacts any SFMTA staff for the purpose of influencing the content of the competitive solicitation or the award of the contract between the date when the RFP is issued and the date when the final selection is approved by the SFMTA Board of Directors, and, if required, by the San Francisco Board of Supervisors, the Proposer or potential Proposer shall be disqualified from the selection process.

However, a person who represents a Proposer or potential Proposer may contact City elected officials and may contact the Director of Transportation of the SFMTA if s/he is unable to reach the designated staff contact person(s) identified in the RFP or wishes to raise concerns about the competitive solicitation. Additionally, the firms and subcontractor(s) responding to this RFP will not provide any gifts, meals, transportation, materials or supplies or any items of value or donations to or on behalf of any SFMTA staff member from the date the RFP is issued to the date when the contract award is approved by the Board of Directors of SFMTA and if required, by the San Francisco Board of Supervisors. All lobbyists or any agents representing the interests of Proposer and subcontractor(s) shall also be subject to the same prohibitions.

An executed Attestation of Compliance (Appendix 3B) certifying compliance with this section of the RFP will be required to be submitted signed by all firms and named subcontractor(s) as part of the response to the this RFP. Any proposal that does not include the executed Attestation of Compliance as required by this section will be deemed non-responsive and will not be evaluated. Any Proposer who violates the representations made in such Attestation of Compliance, directly or through an agent, lobbyist or subcontractor will be disqualified from the selection process.

III. Contract Requirements

III.A Standard Contract Provisions

The successful proposer will be required to enter into a contract substantially in the form as shown in Appendix 4B – Sample Agreement. Failure to timely execute the contract, or to furnish any and all certificates, bonds or other materials required in the contract, shall be deemed an abandonment of a contract offer. The SFMTA, in its sole discretion, may select another firm and may proceed against the original selected for damages.

Proposers are urged to pay special attention to the requirements of Administrative Code Chapters 12B and 12C, Nondiscrimination in Contracts and Benefits, (§Section 34 in the Agreement); the First Source Hiring Program (§Section 44 in the Agreement); and applicable conflict of interest laws (§ Section 23 in the Agreement), as set forth in paragraphs B, C, D, E and F below.

III.B Nondiscrimination in Contracts and Benefits

The successful proposer will be required to agree to comply fully with and be bound by the provisions of Chapters 12B and 12C of the San Francisco Administrative Code. Generally, Chapter 12B prohibits the City and County of San Francisco from entering into contracts or leases with any entity that discriminates in the provision of benefits between employees with domestic partners and employees with spouses, and/or between the domestic partners and spouses of employees. The Chapter 12C requires nondiscrimination in contracts in public accommodation. Additional information on Chapters 12B and 12C is available on the HRC's website at www.sf-hrc.org.

III.C Minimum Compensation Ordinance (MCO)

The successful proposer is urged to agree to comply with and be bound by the provisions of the Minimum Compensation Ordinance (MCO), as set forth in S.F. Administrative Code Chapter 12P. Generally, this Ordinance requires contractors to provide employees covered by the Ordinance who do work funded under the contract with hourly gross compensation and paid and unpaid time off that meet certain minimum requirements

For the amount of hourly gross compensation currently required under the MCO, see www.sfgov.org/olse/mco. Note that this hourly rate may increase on January 1 of each year and that contractors are urged to pay any such increases to covered employees during the term of the contract.

Additional information regarding the MCO is available on the web at www.sfgov.org/olse/mco.

III.D Health Care Accountability Ordinance (HCAO)

The successful proposer is urged to agree to comply fully with and be bound by the provisions of the Health Care Accountability Ordinance (HCAO), as set forth in S.F. Administrative Code Chapter 12Q. Contractors should consult the San Francisco Administrative Code to determine their compliance obligations under this chapter. Additional information regarding the HCAO is available on the web at www.sfgov.org/olse/hcao.

III.E First Source Hiring Program (FSHP)

If the contract is for more than \$50,000, then the First Source Hiring Program (Admin. Code Chapter 83) may apply. Generally, this ordinance requires

contractors to notify the First Source Hiring Program of available entry-level jobs and provide the Workforce Development System with the first opportunity to refer qualified individuals for employment.

Contractors should consult the San Francisco Administrative Code to determine their compliance obligations under this chapter. Additional information regarding the FSHP is available on the web at <http://www.workforcedevelopmentsf.org/> and from the First Source Hiring Administrator, (415) 401-4960.

III.F Conflicts of Interest

The successful proposer will be required to agree to comply fully with and be bound by the applicable provisions of state and local laws related to conflicts of interest, including Section 15.103 of the City's Charter, Article III, Chapter 2 of City's Campaign and Governmental Conduct Code, and Section 87100 et seq. and Section 1090 et seq. of the Government Code of the State of California. The successful proposer will be required to acknowledge that it is familiar with these laws; certify that it does not know of any facts that constitute a violation of said provisions; and agree to immediately notify the City if it becomes aware of any such fact during the term of the Agreement.

Individuals who will perform work for the City on behalf of the successful proposer might be deemed consultants under state and local conflict of interest laws. If so, such individuals will be required to submit a Statement of Economic Interests, California Fair Political Practices Commission Form 700, to the City within ten calendar days of the City notifying the successful proposer that the City has selected the proposer.

IV. Certifications

The list of certifications required for this Proposal is set forth in Section II.H.4. Additional information is provided below.

IV.A Debarment Certification

Certification Regarding Debarment, Suspension, and Other Responsibility Matters-

Lower Tier Covered Transactions (Third Party Contracts over \$25,000)

Grantees and subgrantees must not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs under Executive Order 12549, "Debarment and Suspension." Therefore, **by signing and submitting its bid or proposal**, the bidder or proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the San Francisco Municipal Transportation Agency ("SFMTA"). If it is later determined that the bidder or proposer knowingly rendered an erroneous certification, in addition to remedies available to the SFMTA, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 CFR Parts 180, Subpart C and 1200, Subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

IV.B Certification Regarding Lobbying (Appendix 3A)

All prospective proposers are required to complete and submit along with their proposals, the certification form shown as Appendix 3A regarding lobbying. The same certification shall be obtained and submitted from all lower tier participants (sub-consultants, suppliers, etc.) with work greater than \$100,000.

IV.C Attestation of Compliance (Appendix 3B)

The Proposer shall sign this certification to indicate compliance with the requirements of Section II.N.13 of this RFP.

IV.D Buy America Certificate (Appendix 3C)

The Proposer shall complete and sign this certification and submit it with its proposal.

IV.E San Francisco Business Tax Certificate (Appendix 3E)

San Francisco Ordinance No. 345-88 requires that, in order to receive an award, a firm located in San Francisco or doing business in San Francisco must have a current Business Tax Certificate. Since work contemplated under the proposed Agreement will be performed in San Francisco, a San Francisco Business Tax Certificate will be required. The Business Tax Declaration (shown as Appendix 3E) shall be completed and submitted with the proposal.

V. Protest Procedures (Appendix 4A)

The protest procedures for bidding and award of federally assisted third party contracts are contained in Appendix 4A of this RFP.

Appendix 1A: FORM I-A – Schedule of Prices

City is exempt from federal excise taxes. State, local sales, and use taxes are not to be included in these prices. All bid item prices shall be accurate reflections of the bid items proposed. Every line item must be priced on every sheet.

PROPOSER'S NAME: _____

BASE

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 1	Engineering Design, Project Management and Design Qualification Testing	Lump Sum	x 1	\$
Item 2	Vehicle Price for Base Contract	\$	x 175 Cars	\$
Item 3	Operating, Maintenance and Parts Manuals	Lump Sum	x 1	\$
Item 4	Training	Lump Sum	x 1	\$
Item 5	Spare Parts (Total of Form I-B1)	Lump Sum	x 1	\$
Item 6	Special Tools, Test and Diagnostic Equipment (Total of Form I-C)	Lump Sum	x 1	\$
Total Base: Items 1 – 6				\$

OPTIONS

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 7	Option for 1 to 85 Additional New Light Rail Vehicles	\$	x 85 Cars	\$
Item 8	Additional Spare Parts (Total of Form I-B2)	Lump Sum	x 1	\$
Total Options: Items 7 – 8				\$

ITEMS BELOW ARE FOR INFORMATION ONLY

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 9.1 *	Letter of Credit	Lump Sum	x 1	\$
Item 9.2 *	Performance Bond	Lump Sum	x 1	\$
Item 10	Insurance	Lump Sum	x 1	\$
Item 11	Warranty (In accordance with Exhibit 5 of Sample Agreement)	Lump Sum	x 1	\$

* Provide cost for surety method selected.

Appendix 1B: Form I-B – Nominal Spare Parts and Optional Spare Parts

FORM I-B1 Nominal Spare Parts

Note: Phase 1 corresponds to Cars 1-24 and Phase 2 corresponds to Cars 25-175.

Nominal Spare Parts Total Price \$ _____

Carbody and Interior

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	5 car sets	6 car sets	Windshield		
2	0 car sets	2 car sets	2 car sets	Articulation section, complete		
3	1 car sets	4 car sets	5 car sets	Passenger seat assemblies, complete (frame, inserts, hinges, mounting hardware, etc)		
4	1 car sets	3 car sets	4 car sets	Destination sign, complete (side and ends)		
5	1 car sets	1 car sets	2 car sets	Passenger side window glass		
6	1 car sets	1 car sets	2 car sets	Glass - all. (except windshield and passenger side window)		

Coupler and Draft Gear

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Coupler & draft gear assembly, complete		

Cab and Train Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 units	18 units	20 units	Master Controller assembly		
2	1 cab sets	1 cab sets	2 cab sets	Cab control panel, complete (excluding master controller)		

Doors and Door Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Door actuator unit, including linkages and gear drives or actuators		
2	1 car sets	4 car sets	5 car sets	Door Leafs		
3	2 doorway sets of each type	6 doorway sets of each type	8 sets	Door control board or module, complete		

Air Comfort System

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Air conditioner units		
2	1 car sets	1 car sets	2 car sets	Air conditioning blower motors		
3	1 units	5 units	6 units	Air conditioning compressor motors		
4	1 units	5 units	6 units	Air conditioning compressors		

Power Supply and Auxiliary Electric

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 units	8 units	10 units	Pantograph assembly, complete		
2	1 car sets	1 car sets	2 car sets	Battery		
3	1 units	3 units	4 units	Auxiliary Inverter		

Propulsion

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 units	6 units	8 units	Traction motor, complete with coupling		
2	1 car sets	1 car sets	2 car sets	Propulsion/brake dynamic resistors assembly, complete		
3	1 car sets	1 car sets	2 car sets	Traction power contactors (motor circuit configuration contactors, reverser, et al., except line switch or main breaker)		
4	2 units	3 units	5 units	Line switch		
5	1 car sets	1 car sets	2 car sets	Control relays and sensors, all (except speed sensors or tach generators)		
6	1 car sets	3 car sets	4 car sets	speed sensors or tach generators (if required)		
7	1 car sets	4 car sets	5 car sets	Electronic control unit, complete		
8	1 car sets	3 car sets	4 car sets	Printed circuit boards, logic		
9	1 car sets	2 car sets	3 car sets	Propulsion inverters		

Truck Assembly and Suspension

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Trucks, complete (ready to install)		
2	2 truck sets	3 truck sets	5 truck sets	Motor truck axle assembly, complete (including gear box, brake disc, ground bearings, primary suspension if needed)		
3	2 truck sets	3 truck sets	5 truck sets	Trailer truck wheel/axle assembly, complete		

Friction Brakes

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	3 car sets	4 car sets	All friction brake equipment (except air compressor, connecting hoses, fittings, inter-unit wiring and electronic control unit)		
2	2 units	5 units	7 units	Compressor assembly (if required)		

Communications

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	3 car sets	4 car sets	PA, Communication systems, complete		

Miscellaneous

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	1 car sets	2 car sets	AC and DC motors, other (except traction motors)		

FORM I-B2 Optional Spare Parts

Note: Phase 1 corresponds to Cars 1-24 and Phase 2 corresponds to Cars 25-175.

Optional Spare Parts \$ _____

Carbody and Interior

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	1 car sets	2 car sets	Rubber window glazing, all		
2	1 car sets	1 car sets	2 car sets	Windscreen, complete		
3	1 car sets	1 car sets	2 car sets	Access covers of all underfloor equipment boxes		
4	0 car sets	2 car sets	2 car sets	Stanchions		
5	2 car sets	0 car sets	2 car sets	Graphics and decals		

Coupler and Draft Gear

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Electrical head, complete		
2	200 units	200 units	400 units	Electrical contacts		
3	4 units	6 units	10 units	Electrical head cover		
4	2 car sets	3 car sets	5 car sets	Coupler attenuation tubes		

Cab and Train Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 cab sets	3 cab sets	4 cab sets	Cab door, complete with hardware		
2	2 units	8 units	10 units	CCTV system (for outside rear view)		
3	2 cab sets	6 cab sets	8 cab sets	Wiper motor		
4	4 units	36 units	40 units	Wiper arms		
5	2 car sets	2 car sets	4 car sets	Horn assembly		
6	2 car sets	2 car sets	4 car sets	Gong assembly		
7	1 cab sets	3 cab sets	4 cab sets	Switches, pushbuttons, console displays, meters, gauges, indicating lamps, LEDs, lenses, all		
8	4 car sets	0 car sets	4 car sets	Inside sunvisors and mirrors		
9	250 units	0 units	250 units	Wiper blades		
10	2 car sets	2 car sets	4 car sets	Operator's sash		
11	1 units	1 units	2 units	Operator's seat		
12	2 cab sets	8 cab sets	10 cab sets	Cab seat cushions (seat and back)		

Doors and Door Control

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	2 doorway sets	8 doorway sets	10 sets	Door panel set, complete with glazing, suspension, and edges		
2	20 doorway sets	0 doorway sets	20 sets	Sensitive edges		
3	3 car sets	0 car sets	3 car sets	Stop request switches		
4	2 car sets	8 car sets	10 car sets	Limit switches, all		
5	1 car sets	4 car sets	5 car sets	Passenger door pushbutton switches (interior and exterior)		
6	1 car sets	2 car sets	3 car sets	Stop request light lenses		
7	1 car sets	3 car sets	4 car sets	Step assembly, complete		

Air Comfort System

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	1 car sets	2 car sets	All heating elements (passenger compartment and cab)		
2	1 car sets	1 car sets	2 car sets	Temperature control relays		
3	1 car sets	1 car sets	2 car sets	Air conditioning valves, complete		
4	1 car sets	1 car sets	2 car sets	Air flow switches, all		
5	1 car sets	2 car sets	3 car sets	Thermostats, all		
6	1 car sets	3 car sets	4 car sets	Air conditioning pressure switches		
7	1 car sets	3 car sets	4 car sets	Flexible ducting		
8	24 car sets	76 car sets	100 car sets	Disposable air filters		

Lighting

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	0 car sets	1 car sets	1 car sets	Fixtures for all interior lights, complete		
2	2 car sets	0 car sets	2 car sets	Fixtures for all exterior lights, complete		
3	1 units of each type	1 units of each type	2 units	Light fixtures complete (sockets, lens, etc.)		
4	1 car set	0 car set	1 car sets	Light sockets		
5	2 car set	0 car set	2 car sets	Lights (except heat lights)		
6	10 units	40 units	50 units	Heat Lights		
7	1 car sets	1 car sets	2 car sets	Lenses for all lights, interior and exterior (except cab console)		
8	1 car sets	0 car sets	1 car sets	Lenses for Light fixtures		

Power Supply and Auxiliary Electric

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	5 units	15 units	20 units	Pantograph head, complete		
2	2 car sets	2 car sets	4 car sets	Pantograph raise and lower actuator assembly		
3	2 car sets	3 car sets	5 car sets	Lightning or surge arrestor		
4	1 car sets	1 car sets	2 car sets	Battery rack assembly		
5	1 car sets	1 car sets	2 car sets	Relays, all		
6	2 car sets	3 car sets	5 car sets	Inverter printed circuit boards		
7	2 car sets	4 car sets	6 car sets	Battery charger/ low voltage supply		
8	2 car sets	2 car sets	4 car sets	Printed circuit boards for battery charger / low voltage DC supply		
9	5 units	0 units	5 units	Shop power plug, complete (male, car mounted)		
10	2 units	2 units	4 units	High speed circuit breaker		
11	50 car sets	150 car sets	200 car sets	Pantograph shoe carbon inserts (complete with retainer socket)		
12	1 car sets	1 car sets	2 car sets	Pantograph insulators		
13	20 car sets	0 car sets	20 car sets	Pantograph shunts		

Propulsion

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Filter Capacitor		
2	1 car sets	1 car sets	2 car sets	Line reactor		
3	1 car sets	1 car sets	2 car sets	Motor reactor		
4	2 car sets	3 car sets	5 car sets	Motor cable connecting lugs		
5	10 car sets	10 car sets	20 car sets	Contactors tips (traction power contactors)		
6	10 car sets	10 car sets	20 car sets	Contactors tips, all other		
7	2 car sets	2 car sets	4 car sets	Arc chutes, all		
8	0 sets	50 sets	50 sets	Tractor motor bearings		

Truck Assembly and Suspension

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	4 car sets	5 car sets	Primary springs		
2	1 car sets	4 car sets	5 car sets	Secondary springs		
3	4 units	4 units	8 units	Gear box with axle & motor couplings		
4	1 car sets	1 car sets	2 car sets	Load sensing device		
5	5 car sets	0 car sets	5 car sets	Shock absorber		
6	5 car sets	0 car sets	5 car sets	Motor truck pivot replacement liner / bearings		
7	5 car sets	0 car sets	5 car sets	Trailer truck pivot replacement liner / bearings		
8	3 car sets	2 car sets	5 car sets	Ball bearing slew rings for trailer truck		
9	4 car sets	0 car sets	4 car sets	Ground brush holders		
10	4 car sets	0 car sets	4 car sets	Journal bearing		
11	6 car sets	18 car sets	24 car sets	Wheel assembly, complete		
12	16 car sets	0 car sets	16 car sets	Wheel tire sets		
13	40 units	0 units	40 units	Ground brushes		
14	40 units	0 units	40 units	Ground brush springs		
15	6 units	0 units	6 units	Axles, final machined		
16	2 car sets	3 car sets	5 car sets	Bearings, gear assembly		

Friction Brakes

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	1 car sets	2 car sets	Electronic control unit, complete (if not included as part of propulsion ECU)		
2	2 car sets	3 car sets	5 car sets	Printed circuit boards - brake control (if required)		
3	3 truck sets	3 truck sets	6 truck sets	Track brake assembly, complete		
4	2 car sets	2 car sets	4 car sets	Sander valves		
5	2 units	2 units	4 units	Compressor control unit, complete with contactors		
6	2 car sets	0 car sets	2 car sets	Brake disc		
7	200 car sets	0 car sets	200 car sets	Brake pads		
8	4 car sets	0 car sets	4 car sets	Connecting air hoses and fittings, all		
9	1 car sets	2 car sets	3 car sets	Track brake wear plates, complete		

Communications

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 car sets	1 car sets	2 car sets	Interior speakers		
2	2 car sets	0 car sets	2 car sets	Exterior speakers		
3	10 units	0 units	10 units	Radio antenna		
4	10 units	0 units	10 units	Handsets		
5	2 car sets	2 car sets	4 car sets	GPS system		
6	2 car sets	2 car sets	4 car sets	Infotainment System (Digital route maps, etc)		
7	2 car sets	2 car sets	4 car sets	Mobile access router		
8	2 car sets	2 car sets	4 car sets	Event Recorder		

Miscellaneous

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	10 car sets	14 car sets	24 car sets	Circuit Breakers, all (except propulsion main breaker and auxiliary)		
2	1 car sets	1 car sets	2 car sets	Circuit Breaker holders, all		
3	25 car sets	25 car sets	50 car sets	Air and pneumatic filter elements, all		
4	10 car sets	10 car sets	20 car sets	Contactors tips (except propulsion)		

Appendix 1C: FORM I-C – Diagnostic Test Equipment/Special Tools

Diagnostic Test Equipment / Special Tools

Note: Phase 1 corresponds to Cars 1-24 and Phase 2 corresponds to Cars 25-175.

Diagnostic Test Equipment / Special Tools Total Price \$ _____

Portable Test Equipment

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	18 units	18 units	36 units	Laptop (to be able to diagnose equipment below)		
2				Propulsion system		
3				Brake and spin/slide systems		
4				Auxiliary inverter		
5				LVPS and battery		
6				Heating and cooling system		
7				Couplers/trainlines		
8				Master controller		
9				Door systems		
10				Communications system		

Shop Test Equipment

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1	1 units	1 units	2 units	Propulsion system		
2	1 unit	1 units	2 units	Friction Brake		
3	1 unit	1 units	2 units	Auxiliary inverter		
4	1 unit	1 units	2 units	LVPS and battery		
5	1 unit	1 units	2 units	Air conditioner		
6	1 unit	1 units	2 units	Master controller		
7	1 unit	1 units	2 units	Pneumatic/hydraulic controllers		

Special Tools (IF REQUIRED)

No.	Phase1 Qty.	Phase2 Qty.	Total Qty.	Description of Item	Unit Price	Total Price
1						
2						
3						
4						
5						

Appendix 2A: Form II - A – Technical Worksheets

PROPOSER'S NAME _____

INSTRUCTIONS TO PROPOSER

Sections A through P must be filled in completely. In Sections B through O where subcontracting is involved, the Proposer must list at least one subcontractor but not more than two. For any subcontractor, the requested information must be filled in completely. This worksheet is to be included as part of the Proposer's Technical Proposal. Each proposal of any multiple proposal package must have a completed worksheet.

A. DATA AND DIMENSIONS (AT AW0 WEIGHT, EXCEPT AS SPECIFIED)

- | | | | | | |
|-----|---|-------|-----|-------|-----|
| 1. | Length of car, over couplers | _____ | ft. | _____ | in. |
| 2. | Maximum outside width | _____ | ft. | _____ | in. |
| 3. | Width of car at door threshold | _____ | ft. | _____ | in. |
| 4. | Height from top of rail (TOR) to car floor | _____ | ft. | _____ | in. |
| 5. | Height from TOR to top of roof-mounted equipment | _____ | ft. | _____ | in. |
| 6. | Height from floor to ceiling, minimum | _____ | ft. | _____ | in. |
| 7. | Width of side door openings (clear) | _____ | ft. | _____ | in. |
| 8. | Height of side door openings | _____ | ft. | _____ | in. |
| 9. | Distance, center-to-center of trucks | _____ | ft. | _____ | in. |
| 10. | Truck wheelbase | _____ | ft. | _____ | in. |
| 11. | Number of seats | _____ | | | |
| 12. | Number of standees | _____ | | | |
| 13. | Weight of complete vehicle - see Section P | _____ | lbs | | |
| 14. | Wheel Gauge | _____ | in. | | |
| 15. | Wheel diameter | _____ | in. | | |
| 16. | Aisle width | _____ | in. | | |
| 17. | Minimum radius of track curve | _____ | in. | | |
| 18. | Undercar clearance to top of rail (worst case) | _____ | in. | | |
| 19. | Under-truck clearance to top of rail (worst case) | _____ | in. | | |
| 20. | Car body to truck clearance (worst case) | _____ | in. | | |
| 21. | Coupler height (centerline to top of rail) | _____ | in. | | |
| 22. | Maximum height of Pantograph | _____ | in. | | |

B. CARBODY

- | | | | | | |
|----|-----------------------------|-------|--|-------|--|
| 1. | Supplier name | _____ | | | |
| 2. | Construction material | _____ | | _____ | |
| 3. | Floor construction material | _____ | | _____ | |
| 4. | Carbody skin (exterior) | _____ | | _____ | |
| 5. | Interior trim materials | _____ | | _____ | |

C. SEATS

- 1. Subcontractor name _____
- 2. Seat model no. _____
 - a. Two Passenger Seat _____
 - b. Back-to-Back Passenger Seat _____
- 3. Width of Two Passenger Seat _____ in. _____ in.
- 4. Width of Back-to-Back Passenger Seat _____ in. _____ in.
- 5. Both seats hip to knee _____ in. _____ in.

D. DESTINATION SIGNS

- 1. Subcontractor name _____
- 2. Front destination sign, type _____
- 3. Side destination sign, type _____
- 4. Height of characters, front sign _____ in. _____ in.
- 5. Height of characters, side sign _____ in. _____ in.
- 6. Control method _____

E. COUPLER, DRAWBAR AND DRAFT GEAR

- 1. Subcontractor name _____
- 2. Coupler face, type _____
- 3. Gathering range _____
 - a. Vertical _____ in. _____ in.
 - b. Horizontal _____ in. _____ in.
- 4. Buff or draft load capacity, maximum (without permanent deformation) _____ lbs. _____ lbs.
- 5. Draft gear capacity to withstand coupling with empty cars, maximum speed (without release or deformation) _____ mph _____ mph.
- 6. Centering device, type _____
- 7. Electric coupler location _____
- 8. Type of circuit isolation _____

F. DOOR OPERATORS AND CONTROLS

- 1. Subcontractor name _____
- 2. Type of door _____
- 3. Door construction material _____
- 4. Number of door operators _____
- 5. Door operator power source _____
- 6. Minimum force required for obstruction detection _____ lbs. _____ lbs.

G. HEATING, VENTILATING, AND COOLING SYSTEM

- | | | |
|-------------------------------------|------------|------------|
| 1. Subcontractor name | _____ | _____ |
| 2. Ventilating capacity | _____ cfm. | _____ cfm. |
| 3. Overhead heater capacity | _____ kW | _____ kW |
| 4. Air Conditioning System Capacity | _____ tons | _____ tons |
| 5. Cab heat | _____ kW | _____ kW |
| 6. Refrigerant Type | _____ | _____ |

H. INTERIOR LIGHTS

- | | |
|------------------------------|-------|
| 1. Subcontractor name | _____ |
| 2. Number of fixtures, A-Car | _____ |
| 3. Number of fixtures, B-Car | _____ |
| 4. Lighting Fixture Type | _____ |

I. AUXILIARY ELECTRIC EQUIPMENT

- | | |
|---------------------------|---------------------|
| 1. Auxiliary Power System | |
| a. Subcontractor name | _____ |
| b. Capacity | _____ kVA _____ kVA |
| c. Nominal voltage | _____ VAC _____ VAC |
| d. Power semiconductors | _____ |
| e. Cooling method | _____ |
| 2. Battery | |
| a. Subcontractor name | _____ |
| b. Capacity | _____ AH _____ AH |
| c. Technology | _____ |
| d. No. of cells | _____ |

J. PROPULSION SYSTEM

- | | |
|--|-----------------------|
| 1. Subcontractor name | _____ |
| 2. AC inverter drive - number of inverter drives per car | _____ |
| 3. Inverter Technology | _____ |
| 4. Inverter Cooling Method (self or forced air) | _____ |
| 5. Traction motor rating | |
| a. 1 hour | _____ HP. _____ HP. |
| b. Continuous | _____ HP. _____ HP. |
| 6. Motor model no. | _____ |
| 7. No. of motors per powered truck | _____ |
| 8. Motor speed, maximum safe | _____ rpm. _____ rpm. |
| 9. Motor cooling type | _____ |
| 10. Dynamic brake resistor design | _____ |

- 11. High-speed breaker manufacturer _____
- 12. No. of control logics per car _____
- 13. Control logic cooling type _____
- 14. Minimum opening line voltage _____ VDC _____ VDC

K. GEAR DRIVE

- 1. Subcontractor name _____
- 2. Type _____
- 3. Gear ratio _____

L. TRUCKS AND SUSPENSION

- 1. Truck frame design/manufacture _____
- 2. Primary suspension type _____
- 3. Secondary suspension type _____
- 4. No. of leveling valves _____
- 5. Journal bearing manufacturer _____
- 6. Axle, solid or hollow _____
- 7. Wheel manufacturer _____
- 8. Wheel Type _____

M. FRICTION BRAKING

- 1. Subcontractor name _____
- 2. Friction braking type (hydraulic or pneumatic) _____
- 3. Parking Brake type _____
- 4. Disc temperature, maximum rated _____ F _____ F
- 5. Control unit design, separate or part of propulsion _____
- 6. Air compressor manufacturer _____
- 7. Air compressor capacity _____ cfm. _____ cfm.

N. COMMUNICATION

- 1. PA/Intercom system manufacturer _____
- 2. Radio manufacturer _____
- 3. Destination Signs manufacturer _____
- 4. CCTV manufacturer _____

O. AUTOMATIC TRAIN CONTROL

- 1. ATC equipment manufacturer _____

Appendix 2B: Form II-B – Supplier Worksheet

CARBODY

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

COUPLER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

DOORS

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

SEATS

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

HVAC

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

LIGHTING

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

AUXILIARY POWER SUPPLY

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

LOW VOLTAGE POWER SUPPLY

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

PANTOGRAPH

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

PROPULSION CONTROL

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

TRACTION MOTORS

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

GEAR BOX/DRIVE SYSTEM

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

MOTOR TRUCK

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

TRAILER TRUCK

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

PRIMARY SUSPENSION

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

SECONDARY SUSPENSION

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

FRICION BRAKE SYSTEM

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

CCTV SYSTEM

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

COMMUNICATIONS

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

AUTOMATIC PASSENGER COUNTING SYSTEM

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

CARBODY – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

COUPLER – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

DOORS – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

SEATS – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

HVAC – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

LIGHTING – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

AUXILIARY POWER SUPPLY – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

LOW VOLTAGE POWER SUPPLY – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

PANTOGRAPH – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

PROPULSION CONTROL – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

TRACTION MOTORS – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

GEAR BOX/DRIVE SYSTEM – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

MOTOR TRUCK ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

TRAILER TRUCK – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

PRIMARY SUSPENSION – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

SECONDARY SUSPENSION – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

FRICION BRAKE SYSTEM – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

CCTV SYSTEM – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

COMMUNICATIONS – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

AUTOMATIC PASSENGER COUNTING SYSTEM – ALTERNATE SUPPLIER

1. Supplier	
2. Manufacturing Facility	
3. Years of Facility Operation	
4. Locations of Units in Operation	
5. Number of Units in Operation	
6. Number of Years in Operation	
7. Owner Contact Information (phone/email)	

Appendix 2C: Form II - C – Whole Life Cycle Cost

Supplier Name _____
Submitted By _____
Submittal Date _____
Contact Name _____
Contract Number _____
Email Address _____

Supplier: _____

Submittal Date: _____

Supplier: _____

Submittal Date: _____

R-CM Whole Life (25 Years) Project Cost Estimate by Sub-System

System	Supplier	Scope of Work	MTRR	Source	Material (\$)	Replacement Interval (Years)
ATC						
ATP						
ATO						
Antenna						
Speed Sensor						
Auxiliary Power Supply						
Batteries						
Trucks						
Primary Suspension						
Secondary Suspension						
Gear boxes						
Wheel Sets						
Dampers						
Wear Plates						
Carbody						
Interiors (seats, floors, wall panels, wiring, ceiling panels, etc)						
Exterior (decals, paint, glazing, seals, wiring, piping etc)						
Gangways						
Coupler/Drawbar						

System	Supplier	Scope of Work	MTTR	Source	Material (\$)	Replacement Interval (Years)
Communications						
Controls						
Destination signs						
Public Address						
CCTV						
PIS						
Diagnostics & TMS						
Doors						
Controls						
Operators						
Leafs						
Steps						
Friction Brake						
Air Compressor (if used)						
Hydraulics (if used)						
HVAC						
Controls						
Compressor						
Evaporator						
Condenser						
Elements						
Propulsion						
Master Controller						
Traction Motors & Mounting						
Inverter						
Logic						
Line Filter						
Contactors & Relays						
Speed Sensor						
Pantograph						

Supplier: _____

Submittal Date: _____

Annual Scheduled Maintenance Cost Estimate By Sub-System

ATC

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Auxiliary Power Supply

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Batteries

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Trucks

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Carbody

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Coupler/Drawbar

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Communications

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Diagnostics & TMS

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Doors & Steps

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

HVAC

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Propulsion

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Pantograph

System / Interval	Scope of Work	Annual MTTR (hours)	Source	Annual Material Costs (\$)
Enter proposed intervals e.g. Daily				
Monthly				
Semi-annually				
Hours				
Miles				
Others				

Supplier: _____

Submittal Date: _____

Annual Unscheduled Maintenance Cost Estimate By Sub-System

System	MDBF (miles)	Source	Number of Failures Per Year	MTRR (single failure)	Source	Material Costs (single failure) (\$)
ATC						
ATP						
ATO						
Antenna						
Speed Sensor						
Auxiliary Power Supply						
Batteries						
Trucks						
Primary Suspension						
Secondary Suspension						
Mechatronics & Controls						
Wheel Sets						
Dampers						
Wear Plates						
Carbody						
Interiors (seats, floors, wall panels, wiring, ceiling panels, etc.)						
Exterior (carshell, decals, paint, glazing, seals, wiring, piping etc.)						
Gangways						
Coupler/Drawbar						
Communications						
Controls						
Destination signs						
Public Address						
CCTV						
PIS						
Diagnostics & TMS						
Doors						
Controls						
Operators						
Leafs						
Steps						
Friction Brake System						
Air Compressor (if used)						
Hydraulic system (if used)						
Heating and Ventilation						

System	MDBF (miles)	Source	Number of Failures Per Year	MTRR (single failure)	Source	Material Costs (single failure) (\$)
Air Conditioning						
Controls						
Blowers						
Compressor						
Evaporator						
Condenser						
Propulsion						
Master Controller						
Traction Motors						
Inverter						
Logic						
Line Filter						
Contactors & Relays						
Speed Sensor						
Pantograph						

Appendix 3A: 49 CFR, PART 20--CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans and Cooperative Agreements
(To be submitted with each bid or offer exceeding \$100,000)

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub awards at all tiers (including subcontracts, sub grants, and contracts under grants, loans, and cooperative agreements) and that all sub recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. § 3801, et seq., apply to this certification and disclosure, if any.

Executed this _____ day of _____, 20_____.

By: _____
(Signature of Authorized Official)

Appendix 3B: ATTESTATION OF COMPLIANCE

To be completed by all Proposing Firms and All Individual Subcontractors

(Please check each box, sign this form and submit it with your response.)

Name of Individual Completing this Form: _____

The Form is Submitted on Behalf of Firm: _____

Name of RFP: _____

1. I attest that I and all members of the firm listed above will and have complied to date with Section II.N.13 of the RFP.

Yes

2. I understand that if my firm or any members of the firm listed above are found to be in violation of the Section II.N.13 of the above RFP, this will disqualify my firm and any Proposal in which my firm is named from further consideration.

Yes

I have entered required responses to the above questions to the best of my knowledge and belief.

Signature: _____

Date _____

Appendix 3C: Buy America Certificate

Bids or offers that are not accompanied by a completed Buy America certification must be rejected as non-responsive. This requirement does not apply to lower tier subcontractors.

If buses or other rolling stock (including train control, communication, and traction power equipment) are being procured, the appropriate certificate as set forth below shall be completed and submitted by each bidder in accordance with the requirement contained in §661.13(b) of 49 CFR Part 661. Bidder shall only sign one certification.

Certificate of Compliance with Buy America Rolling Stock Requirements

The bidder or offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j), and the applicable regulations of 49 CFR 661.11.

Date: _____

Signature: _____

Company: _____

Name: _____

Title: _____

Certificate of Non-Compliance with Buy America Rolling Stock Requirements

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but may qualify for an exception to the requirement consistent with section 165(b)(2) or (b)(4) of the Surface Transportation Assistance Act, as amended, and the applicable regulations in 49 CFR 661.7.

Date: _____

Signature: _____

Company: _____

Name: _____

Title: _____

Appendix 3D: Confirmation of RFP Receipt

RFP Contract No. SFMTA-2013-19
Procurement of New Light Rail Vehicles (LRV4)

Subcontractor confirms that it has received from a Qualified Proposer the referenced Request for Proposals (RFP) and associated addenda.

PROPOSER'S NAME: _____

Confirmation of RFP Receipt

Date: _____

Signature: _____

Company: _____

Name: _____

Title: _____



Appendix 3E: Business Registration Certificate Requirement

General

To receive an award, a Contractor must have a current Business Registration Certificate or else not be required to register. The registration fee is \$25, \$150, \$250 or \$500, depending on the type and size of your business. The fee (except the \$25 fee) may be pro-rated for new registrations, depending on when during the year you started conducting business in San Francisco, and is based on estimated tax liability for your payroll expense. To determine your registration fee go online to: www.sfgov.org/Tax/BusinessForms and select "Understanding the S.F. Business Registration Certificate." In addition, every entity "conducting business in San Francisco" must file a combined Payroll Expense Tax Statement and Business Registration renewal annually. Effective January 1, 2009, businesses with a computed tax of \$3,750 or less are exempt from paying payroll expense tax provided the statement is filed on time.

Who must obtain a Business Registration Certificate?

Any business that is located or conducting business in San Francisco.

What is "conducting business in San Francisco"?

If an entity answers "yes" to any of Items 1-8 on the reverse, it is considered to be "conducting business in San Francisco."

Are there exceptions?

Yes. An entity receiving rental income solely from one cooperative housing corporation, one residential structure of fewer than 4 units, or one residential condominium shall not be deemed to be engaging in business.

My business is not located in San Francisco. Is a registration certificate still required?

- If the entity "conducts business in San Francisco," a registration certificate is required. See Items 1-8 on the reverse.
- Entities that do not "conduct business in San Francisco" (excluding government agencies) must sign and return the Declaration.

What's involved in obtaining a registration certificate?

Obtaining a certificate is easy, but not automatic. Once the Tax Collector receives an application, the office must check the payment status of other taxes (Unsecured Personal Property Tax, Payroll/ Business Tax), licenses/permits. If any tax or license/permit fee is delinquent, the certificate cannot be issued. Only when all taxes and fees are paid in full will the

certificate be issued.

How do I apply for and obtain the certificate?

Complete an application form and submit it along with the appropriate registration fee in person or by mail to:

Office of the Treasurer & Tax Collector
ATTN: Taxpayer Assistance
City Hall, Room 140
1-Dr. Carlton B. Goodlett Place
San Francisco, CA 94102-4696

There are two different application forms, one for Sole Proprietorships and one for all other ownership types. Both applications are available in person at the address above or online at: www.sfgov.org/Tax/BusinessForms

Do Company Divisions, Parents and Subsidiaries have to register separately?

That depends on a company's individual situation. Contact the Tax Collector at (415) 554-6718 or 554-4400 for more information.

Can I do business with the City without a certificate?

As a rule, if you do not "conduct business in San Francisco" as outlined on the reverse, you are not required to obtain a Business Registration Certificate. The City can make purchases from businesses only in the following situations:

- The entity conducts business in San Francisco and has registered and possesses a current Business Registration Certificate.
- The entity does not conduct business in San Francisco and has signed and submitted the Declaration.
- The entity is a government agency.
- There is an emergency. Although OCA can award the contract, the Contractor may be subject to business taxes and required to possess a certificate.

These requirements cover service contracts, construction contracts, and product purchases.

What if my application is pending during a bid evaluation?

If you are the low bidder on a City contract, and have applied for the certificate but your application has not yet been approved, the City may make the award to you if you sign the Declaration. If you have a receipt from the Tax Collector for the registration fee, submit a copy of the receipt with your bid.

What if I currently “do not conduct business in San Francisco,” but would register if I win this bid?

You may answer the questions based on your current status, and you should not register at this time. If you win the bid, you should register with the Office of the Treasurer & Tax Collector.

What must I file?

Unless you previously submitted this form, fax it to the Treasurer & Tax Collector at (415) 554-6207 or mail it to Treasurer & Tax Collector, City Hall, Room 140, #1 Carlton B Goodlett Place, San Francisco, CA 94102-4696.

If you are bidding on a City contract, you must resolve any Business Tax issues before the contract can be awarded to you. That means either registering with the Tax Collector if you are required to do so, or submitting this form showing that you are not required to register.

What if I have submitted this form previously?

If you submitted this form for an earlier transaction, and if your business tax status has not changed, please discard this form.

What if I don't have a City Contractor number yet?

You need to get one before submitting this form. To do that, go to <http://www.sfgov.org/site/oca>. Click on "Required Contractor Forms," download the IRS Form W-9 and New Contractor Number Request Form and fax them to the Controller at (415) 554-6261.

For more information:

For information on how to apply for the certificate, call the Tax Collector's Office at (415) 554-6718 or 554-4400. For information on your eligibility to receive a particular award, call Trinh Nguyen at (415) 701-4602.

Business Tax Declaration

Please indicate "Yes" or "No" by marking the boxes on Items 1-8, based on your company's situation *as of now*, whether a contract is signed or not. If any answers would change for your company if awarded a bid that is pending, see the last paragraph in this column*.

Do you conduct business in San Francisco?

- | Yes | No | <u>Does the business entity currently...</u> |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | 1. ...maintain a fixed place of business within San Francisco? |
| <input type="checkbox"/> | <input type="checkbox"/> | 2. ...exercise corporate or franchise powers within San Francisco? |
| <input type="checkbox"/> | <input type="checkbox"/> | 3. ...own or lease real property within San Francisco for business purposes? |
| <input type="checkbox"/> | <input type="checkbox"/> | 4. ...regularly maintain a stock of tangible personal property for sale in San Francisco? |
| <input type="checkbox"/> | <input type="checkbox"/> | 5. ...employ or loan capital on property within San Francisco? |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. ...solicit business within San Francisco for all or part of any seven days during one fiscal year? |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. ...perform work or render services within San Francisco for all or part of any seven days during one fiscal year? |
| <input type="checkbox"/> | <input type="checkbox"/> | 8. ...utilize the street within San Francisco in connection with the operation of motor vehicles for business purposes for all or part of any seven days during one fiscal year? |

- > If you indicated "Yes" to any of Items 1-8, you must complete Items 9-15 in this Declaration and **must register immediately**.
- > If you answered "No" to all Items 1-8, ordinarily you are not conducting business in San Francisco. In this case, you need not register with the Tax Collector and may omit items 9-15, but you **must sign and return** this Declaration, which is subject to review by the Tax Collector.

* If the awarding of a bid would cause any of the responses to items 1-8 to change to "Yes," indicate those item numbers here:

- 1 2 3 4 5 6 7 8

If awarded a bid, an application for a Business Registration Certificate must be submitted within 15 days of the effective date.

Tax-exempt Entities, Banks, Insurance Companies, Others

If you answer "Yes" to any of Items 9-12, you still need to register but need not pay the registration fee. To register, you must submit proof of tax-exempt status to the Tax Collector, with other forms. For non-profit entities, proof is usually an exemption letter from the IRS, noting §501(c) or (d) of the Internal Revenue Code.

- | Yes | No | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | 9. This is a non-profit, tax-exempt entity. |
| <input type="checkbox"/> | <input type="checkbox"/> | 10. This entity is a bank or an insurance company. If "Yes," indicate your type of business:

_____ |
| <input type="checkbox"/> | <input type="checkbox"/> | 11. This entity is a skilled nursing facility licensed under Title 22, CA Admin. Code, Div. 5. |

12. Other Exemptions. See Francisco Business and Tax Regulations Code Article 12A, Section 906(d) to (f), available online at www.sfgov.org/BTRcode

Applying for a Business Registration Certificate

If you answered "Yes" to any of Items 1-8, check item 13, 14, or 15 and complete any applicable blanks. If no item is checked, or if the Declaration is not signed, this will constitute a basis for OCA to reject the bid.

13. This entity has registered with the Tax Collector and is assigned Certificate Number:
_____ (6 digits, e.g., "123456").
14. This entity applied for a Certificate by mailing the application and fee to the Tax Collector, or by submitting the application in person, on
_____ (mm-dd-yyyy).
The application is pending.
(NOTE: Completing this Declaration is not the same as applying for a Business Registration Certificate.)
15. This entity needs to register and will do so immediately.

.....

I understand that my representation, if any, that I am not engaged in business in San Francisco is subject to review by the Tax Collector. If the Tax Collector determines that I am conducting business in San Francisco, the City may either cancel the contract or withhold payment ten days after written notification by the Tax Collector. I declare (or certify) under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that I am authorized to bind this entity contractually.

Executed this _____ day of _____, 20____, at

(State)

(City)

Name of company (please print)

Signature

City Contractor number (see reverse for how to obtain one)

Name of person signing

Mailing address

Telephone

City, State, ZIP

Federal Employer Identification Number (FEIN)

- Routing:**
- Please fax this P-25 form to (415) 554-6207, or you may mail it to: Treasurer & Tax Collector, City Hall, Room 140, #1 Carlton B. Goodlett Place, San Francisco, CA 94102-4696.
 - If you are registering, obtain an application from the Tax Collector's website (<http://sfgov.org/tax/business> forms). Include this form.
 - If you submitted this form previously and if your business tax status has not changed, discard this form.

Questions:

... regarding how to apply for a certificate, call the Tax Collector at (415) 554-6718 or (415) 554-4400.

... regarding a bid, call Trinh Nguyen at (415) 701-4602.

Appendix 3F: S.F. Administrative Code Chapters 12B & 12C

CITY AND COUNTY OF SAN FRANCISCO HUMAN RIGHTS COMMISSION



S.F. ADMINISTRATIVE CODE CHAPTERS 12B & 12C DECLARATION: NONDISCRIMINATION IN CONTRACTS AND BENEFITS (HRC-12B-101)

➤ **Section 1. Vendor Information**

Name of Company: _____
 Name of Company Contact Person: _____
 Phone: _____ Ext.: _____ Fax: _____
 E-mail Address: _____
 Vendor Number (if known): _____
 Federal ID or Social Security Number: _____
 Approximate Number of Employees in the U.S.: _____

DATE & TIME RECEIVED BY HRC (FOR HRC USE ONLY)

Are any of your employees covered by a collective bargaining agreement or union trust fund? Yes No

Union name(s): _____

➤ **Section 2. Compliance Questions**

Question 1. Nondiscrimination – Protected Classes

A. Does your company agree it will not discriminate against its employees, applicants for employment, employees of the City, or members of the public on the basis of the fact or perception of a person's membership in the categories listed below? *Please note: a "YES" answer is required for compliance. Please answer yes or no to each category.*

- | | | | |
|-------------------|--|--|--|
| • Race | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Sex | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • Color | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Sexual orientation | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • Creed | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Gender identity (transgender status) | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • Religion | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Domestic partner status | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • National origin | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Marital status | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • Ancestry | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Disability | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • Age | <input type="checkbox"/> Yes <input type="checkbox"/> No | • AIDS/HIV status | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| • Height | <input type="checkbox"/> Yes <input type="checkbox"/> No | • Weight | <input type="checkbox"/> Yes <input type="checkbox"/> No |

B. Does your company agree to insert a similar nondiscrimination provision in any subcontract you enter into for the performance of a substantial portion of the contract you have with the City? *Please note: you must answer this question even if you do not intend to enter into any subcontracts.*

Yes No

Question 2. Nondiscrimination – Equal Benefits for Employees with Spouses and Employees with Domestic Partners

A. Does your company provide or offer access to any benefits to employees with spouses or to spouses of employees?

Yes No

B. Does your company provide or offer access to any benefits to employees with (same or opposite sex) domestic partners* or to domestic partners of employees?

Yes No

Questions 2A and 2B should be answered YES even if your employees pay some or all of the cost of spousal or domestic partner benefits.

*The term "Domestic Partner" includes both same-sex and opposite-sex couples who have registered with any state or local government domestic partnership registry. See S.F. Admin. Code Ch. 12B.1(c).

If you answered "NO" to both Questions 2A and 2B, go to Section 4, complete and sign the form, filling in all items requested.

If you answered "YES" to either or both Questions 2A and 2B, please continue to Question 2C.

(OVER)

Question 2. (continued)

C. Please check all benefits that apply to your answers above and list in the "other" section any additional benefits not already specified. Note: some benefits are provided to employees because they have a spouse or domestic partner, such as bereavement leave; other benefits are provided directly to the spouse or domestic partner, such as medical insurance.

BENEFIT	Yes for Employees with Spouses	Yes for Employees with Domestic Partners	No, this Benefit is Not Offered	Documentation of this Benefit is Submitted with this Form
• Health Insurance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Dental Insurance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Vision Insurance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Retirement (Pension, 401(k), etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Bereavement Leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Family Leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Parental Leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Employee Assistance Program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Relocation & Travel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Company Discount, Facilities & Events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Credit Union	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Child Care	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Dependent Life Insurance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: If you can't offer a benefit in a nondiscriminatory manner *because of reasons outside your control*, (e.g., there are no insurance providers in your area willing to offer domestic partner coverage) you may be eligible for Reasonable Measures compliance. To comply on this basis, you must agree to pay a cash equivalent, submit a completed Reasonable Measures Application Form (HRC-12B-102) with all necessary attachments, and have your application approved by the HRC. For more information, see Rules of Procedure section II B or contact the HRC.

➤ Section 3. Required Documentation

YOU MUST SUBMIT SUPPORTING DOCUMENTATION

to verify each benefit marked in Question 2C. Without proper documentation, your company cannot be certified as complying with Chapters 12B & 12C. For example, to document medical insurance submit a statement from your insurance provider or a copy of the eligibility section of your plan document; to document leave programs, submit a copy of your company's employee handbook. If documentation of a particular benefit does not exist, attach an explanation. For more information see the Quick Reference Guide at <http://www.sfgov.org/site/uploadedfiles/sfhumanrights/forms/quickref.pdf> or contact the HRC.

Have you submitted supporting documentation for each benefit offered? Yes No

➤ Section 4. Executing the Document

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that I am authorized to bind this entity contractually.

Executed this _____ day of _____, in the year _____, at _____, _____
(City) (State)

Signature

Mailing Address

Name of Signatory (please print)

City, State, Zip Code

Title

➔ **Submit this form and supporting documentation to:** HRC, 25 Van Ness Ave., Suite 800, San Francisco, CA 94102-6033, or to the City department that sent it to you if the department so requests.

✓ **Resource Materials** and additional copies of this form may be found at: www.sfhrc.org.

☎ For assistance please contact the Human Rights Commission at 415-252-2500 (TTY: 415-252-2550).

HRC-12B-101 (11/05)

APPENDIX 3G

Financial Statement

To be completed by all proposers (please provide figures in U.S. Dollars) for three most recent audited fiscal years. Please use a separate sheet for each fiscal year.

Fiscal Year ending _____

ASSETS

Cash on Hand and in Banks (Provide Proofs)*	\$
Account and Notes Receivable	\$
Current Assets	\$
Fixed Assets (net of depreciation)	\$
Other Assets (include sub categories)	\$
Total Assets	\$

* Please include any letters or lines of credit and provide supporting documentation

LIABILITIES

Accounts Payable	\$
Notes Payable to Banks in next twelve months	\$
Notes Payable to Others	\$
Taxes Payable	\$
Current Liabilities	\$
Long Term Liabilities (More than twelve months)	\$
Other Liabilities	\$
Total Liabilities	\$
Net Worth	\$

INCOME FROM OPERATIONS

Revenue	\$
Interest Income	\$
Cost of Goods Sold (if appropriate)	\$
Gross Profit	\$
Non-Operating Revenue (include sub categories)	\$
General & Administrative Expenses	\$
Depreciation	\$
Interest Paid	\$
Non-Operating Expense (include sub categories)	\$
Net Gain or Loss	\$

- Please provide quarterly cash flow for the last 36 months.
- List any material outstanding litigation and potential amount of exposure.

I certify that the above information is true and accurate to the best of my knowledge and belief. I understand false statements may result in denial of pre-qualification, and possible debarment for a period of five years.

Signature of Owner or Officer

Date Signed

Company Name

Federal ID #

Appendix 3H: DBE Requirements

DISADVANTAGED BUSINESS ENTERPRISE (DBE) REQUIREMENTS

SECTION 1

FTA SPECIAL PROVISIONS FOR TRANSIT VEHICLE MANUFACTURERS (TVMs)

**-- TITLE 49 CODE OF FEDERAL REGULATIONS PART 26:
PARTICIPATION BY DISADVANTAGED BUSINESS ENTERPRISES
IN DEPARTMENT OF TRANSPORTATION FINANCIAL ASSISTANCE
PROGRAMS**

Section I

FTA SPECIAL PROVISIONS FOR TRANSIT VEHICLE MANUFACTURERS (TVMS)

General - This procurement is subject to the provisions of Section 26.49 of 49 CFR Part 26 ("the Regulations"). Accordingly, as a condition of permission to bid, a Transit Vehicle Manufacturer's certification must be completed and submitted with the bid. A bid which does not include the certification **WILL NOT** be considered.

INTRODUCTION – PROCEDURES FOR TRANSIT VEHICLE MANUFACTURERS

The SFMTA shall require that each transit vehicle manufacturer, as a condition of being authorized to bid on transit vehicle procurements in which FTA funds participate, certify that it has complied with the requirements of 49 CFR Section 26.49.

Each manufacturer shall establish and submit, for the FTA Administrator's approval, an annual percentage overall goal. **In setting your overall goal, you should be guided, to the extent applicable, by the principles underlying 49 CFR Part 26, §26.45.** The base from which you calculate this goal is the amount of FTA financial assistance included in transit vehicle contracts you will perform during the fiscal year in question. You must exclude from this base funds attributable to work performed outside the United States and its territories, possessions, and commonwealths. The requirements and procedures of this part with respect to submission and approval of overall goals apply to you as they do to recipients.

The manufacturer may make the certification called for in paragraph (1) above if it has submitted the goal required by paragraph (2), and the FTA Administrator has either approved it or not disapproved it.

For questions regarding certification information or technical assistance, TVMs should contact:

Britney Berry
Federal Transit Administration
Office of Civil Rights
1200 New Jersey Avenue SE
Washington, DC 20590
202-366-1065

EXHIBIT A
SAMPLE FORMAT

**TRANSIT VEHICLE MANUFACTURERS CERTIFICATION OF
COMPLIANCE WITH SUBPART C, 49 CFR PART 26**

This procurement is subject to the provisions of Section 26.49 of 49 CFR Part 26. Accordingly, as a condition of permission to bid, the following certification must be completed and submitted with the bid. A bid which does not include the certification will not be considered.

TRANSIT VEHICLE MANUFACTURERS CERTIFICATION

(Name of Firm), a TVM, hereby certifies that it has complied with the requirements of Section 26.49 and Section 26.45 of 49 CFR Part 26 by submitting a current annual DBE goal to FTA.

The goal applies to Federal Fiscal Year _____ (October 1, 20____ to September 30, 20____) and has been approved or not disapproved by FTA.

(Name of Firm), hereby certifies that the manufacturer of the transit vehicle to be supplied

(Name of Manufacturer) has complied with the above-referenced requirement of **Section 26.49 and Section 26.45** of 49 CFR Part 26.

Signature: _____

Date: _____

Title: _____

Firm: _____

EXHIBIT B

TRANSIT VEHICLE MANUFACTURER

1. ANNUAL OVERALL GOAL 49 CFR Part 26 Sections 26.45, 26.47, 26.51, 26.53 and 26.55.
2. **TVMs are required to submit to the FTA Administrator, or his/her designee for approval an annual percentage overall goal for the utilization of DBEs.**
 - a. A TVM goal is submitted and approved using the same procedure followed by recipients under Subpart C – Goals, Good Faith efforts, and Counting: Sections 26.45, 26.47, 26.51, 26.53, and 26.55 of the Regulations.
(See http://www.fta.dot.gov/civilrights/dbe/civil_rights_5263.html).
 - b. Work performed outside the United States or by the TVM's own work force is excluded from the base used to calculate the goal.
3. SOLICITATION OF BIDS/PROPOSALS (26.49)
 - a. The Regulations provide that the TVM will certify to the recipient that:
 - (1) It has submitted the required annual percentage overall goal to FTA; and
 - (2) FTA has either approved its annual percentage overall goal or has not disapproved the goal.
 - b. A distributor or dealer must provide a certification of the manufacturer's compliance for those vehicles the distributor or dealer seeks to offer.
 - c. The recipient is required to include a provision in its bid specifications requiring the above certification from TVMs, distributors, or dealers, as a condition of permission to bid.
4. **BIANNUAL REPORTS.** Biannual reports of contracting with DBEs are required from TVMs to assess their progress toward meeting the projected DBE goal. **These reports are to be submitted to Ms. Britney Berry, Federal Transit Administration, Office of Civil Rights, 1200 New Jersey Avenue SE, Washington, DC 20590, 202-366-1065, britney.berry@dot.gov, in accordance with Section 23.49 of the Regulations.**

Appendix 4A: Protest Procedure

MUNICIPAL TRANSPORTATION AGENCY

PROTEST PROCEDURES FOR THE BIDDING AND AWARD OF FEDERALLY ASSISTED THIRD PARTY CONTRACTS [TO BE ADDED]

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Appendix 4B: SAMPLE AGREEMENT

Agreement Between

**The City and County Of San Francisco
San Francisco Municipal Transportation Agency**

And

[Contractor]

For

Procurement of New Light Rail Vehicles (LRV4)

Contract No. SFMTA-2013-19

TABLE OF CONTENTS

	Page
1. Certification of Funds; Budget and Fiscal Provisions; Termination in the Event of Non-Appropriation	3
2. Term of the Agreement	5
3. Effective Date of Agreement	5
4. Work Contractor Agrees to Perform	5
5. Compensation	5
6. Guaranteed Maximum Costs	5
7. Payment; Invoice Format	6
7.1. Amount.....	6
7.2. Invoices	6
7.3. Progress Payments.....	6
7.4. Exchange Rate Risk.....	7
7.5. Inflation Risk.....	7
7.6. Release	7
8. Submitting False Claims; Monetary Penalties	7
9. Disallowance	8
10. Taxes	8
10.1. Payment of Taxes	8
10.2. Possessory Interest.....	8
11. Payment Does Not Imply Acceptance of Work	9
12. Qualified Personnel	9
13. Responsibility for Equipment	9
14. Independent Contractor; Payment of Taxes and Other Expenses	9
14.1. Independent Contractor	9
14.2. Payment of Taxes and Other Expenses	9
15. Insurance; Bonds	10
15.1. Insurance	10
15.2. Bonds/Letter of Credit	12
15.2.1 General	12
15.2.2 Security	12

	(a) Phase 1 (Vehicles 1-24).....	12
	(b) Phase 2 (Vehicles 25-175).....	13
	(c) Optional Delivery Phase (Vehicles 176-260).....	13
	15.2.3 Labor and Materials Bond.....	13
	(a) Phase 1 (Vehicles 1-24).....	13
	(b) Phase 2 (Vehicles 25-175).....	14
	(c) Optional Delivery Phase (Vehicles 176-260).....	14
	15.2.4 Warranty Bond.....	14
	15.2.5 Requirements for Letter of Credit.....	14
	(a) General Requirements.....	14
	(b) Financial Institution.....	15
	(c) Demand on Letter of Credit.....	15
	(d) Expiration or Termination.....	15
	(e) Return of Letter of Credit.....	16
	(f) Excessive Demand.....	16
	15.2.6 Requirements for Bonds.....	16
16.	Indemnification.....	17
	16.1. General.....	17
	16.2. Duty to Defend.....	17
	16.3. Intellectual Property.....	17
	16.4. Limitation of Liability.....	17
	16.5. Notice of Claim; Tender of Defense.....	18
17.	Incidental and Consequential Damages.....	18
18.	Liability of City.....	18
19.	Liquidated Damages/ Weight Incentives.....	18
	19.1. Liquidated Damages.....	18
	19.2. Weight Limits and Incentives.....	19
20.	Default; Remedies.....	20
	20.1. Event of Default.....	20
	20.2. Remedies.....	20
21.	Termination for Convenience.....	21
	21.1. Exercise of Option.....	21
	21.2. Contractor Actions.....	21
	21.3. Contractor Invoice.....	21

21.4.	Non-Recoverable Costs	22
21.5.	Deductions	22
21.6.	Survival	22
22.	Rights and Duties Upon Termination or Expiration	22
22.1.	Survival of Sections.....	22
22.2.	Contractor Duties	22
23.	Conflict of Interest	22
24.	Proprietary or Confidential Information of City	23
25.	Notices to the Parties	23
26.	Intellectual Property.....	23
26.1.	Works for Hire; Ownership of Results.....	23
26.2.	Licenses Granted.....	24
26.3.	Proprietary Materials.....	24
27.	Reserved	25
28.	Audits and Inspection of Records.....	25
29.	Subcontracting.....	25
30.	Assignment.....	25
31.	Non-Waiver of Rights.....	25
32.	Reserved	25
33.	Reserved	26
34.	Nondiscrimination; Penalties	26
34.1.	Contractor Shall Not Discriminate.....	26
34.2.	Subcontracts	26
34.3.	Nondiscrimination in Benefits.....	26
34.4.	Incorporation of Administrative Code Provisions by Reference	26
35.	Tropical Hardwoods and Virgin Redwood Ban.....	26
36.	Drug-Free Workplace Policy	27
37.	Resource Conservation.....	27
38.	Compliance with Americans with Disabilities Act.....	27
39.	Sunshine Ordinance	27
40.	Public Access to Meetings and Records.....	27
41.	Notification of Limitations on Contributions.....	28
42.	Requiring Minimum Compensation for Covered Employees	28

43.	Health Benefits for Covered Employees	28
44.	First Source Hiring Program	28
45.	Prohibition on Political Activity with City Funds	29
46.	Preservative-Treated Wood Containing Arsenic	29
47.	Modification of Agreement	29
	47.1. City-Ordered Changes.....	29
	47.2. Regulatory Changes.....	30
	47.3. Schedule Changes.....	30
48.	Authority of Project Manager; Claims; Disputes	30
	48.1. Authority of Project Manager.....	30
	48.2. Claims for Additional Compensation.....	30
	48.3. Other Claims.....	31
	48.4. Resolution of Disputes.....	31
	48.5. No Cessation of Work.....	31
	48.6. Alternative Dispute Resolution.....	31
	48.7. Disputes Among Contractor's Partners.....	31
49.	Agreement Made in California; Venue	31
50.	Construction	31
51.	Entire Agreement	31
52.	Compliance with Laws	31
53.	Services Provided by Attorneys	32
54.	Reserved	32
55.	Severability	32
56.	Protection of Private Information	32
57.	Time of Essence	32
58.	Technical Specifications	32
	58.1. Fabrication.....	32
	58.2. Omission.....	32
	58.3. Design Review.....	32
	58.4. Preliminary Drawings.....	32
	58.5. Materials/Accessories Responsibility.....	33
59.	Project Planning, Scheduling and Control	33
	59.1. Introduction.....	33

59.2.	Descriptions of Submittals	33
60.	Reserved	33
61.	FTA Requirements	33
62.	Cooperative Drafting.....	33
63.	Warranty.....	33
64.	Title.....	33
65.	Option Vehicles	33
65.1.	Option for New Light Rail Vehicles	33
65.2.	Option for Additional Spare Parts	34
66.	Precedence of Contract Documents	34
67.	Deliveries	34
67.1.	Predelivery Tests and Inspections	34
67.2.	Delivery Procedure.....	34
67.3.	Spare Parts Delivery Procedure	34
68.	Acceptance Of Vehicles	35
68.1.	Procedure.....	35
68.2.	Conditional Acceptance	35
68.3.	Assumption of Risk of Loss.....	35
69.	Repairs Prior To Acceptance	35
69.1.	Repairs by Contractor	35
69.2.	Repairs by SFMTA.....	35
70.	Unavoidable Delays	36
70.1.	Definition	36
70.2.	Notification of Delay	36
70.3.	Request for Extension.....	36
71.	MacBride Principles—Northern Ireland	37

Exhibits

- Exhibit 1 Schedule of Prices (Form I-A)
- Exhibit 2 Payment Schedule
- Exhibit 3 Project Delivery Schedule
- Exhibit 4 FTA Requirements
- Exhibit 5 Warranty

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

Agreement between the City and County of San Francisco and

[insert name of contractor]

This Agreement is made this _____ day of _____, 2014, in the City and County of San Francisco, State of California, by and between: [insert name and address of contractor] ("Contractor") and the City and County of San Francisco, a municipal corporation ("City"), acting by and through its Municipal Transportation Agency ("SFMTA").

Recitals

- A. SFMTA wishes to obtain the services of a qualified firm to procure up to 260 Light Rail Vehicles.
- B. A Request for Qualifications ("RFQ") was issued on March 29, 2013, and City qualified three proposers to submit proposals.
- C. A Request for Proposals ("RFP") was issued on September 20, 2013 to the qualified proposers, and City selected Contractor as the highest-qualified scorer pursuant to the RFP.

Now, THEREFORE, the parties agree as follows:

Definitions

Acceptance: The formal written acceptance by the City that all Work, or a specific portion thereof, under the contract has been satisfactorily completed.

Award: 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.

Certification: Certification by the Controller that funds necessary to make payments as required under the Contract are available in accordance with the City's Charter.

City: The City and County of San Francisco.

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

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

Contract, Agreement: The written contract executed by the City and Contractor, 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, and all supplemental agreements.

Contract Modification: A written amendment to the Contract, agreed to by the City and Contractor, covering changes in the 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.

Contractor: The proposer to whom the Award is made.

Controller: Controller of the City.

Correction: The elimination of a defect.

Days: Unless otherwise designated, "Days" as used in the Contract shall mean calendar days.

Defect: Any patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

Director: The Director of Transportation of the SFMTA or his or her designee.

Engineer: The SFMTA Engineer assigned to the Contract or designated agent.

Final Acceptance: 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.

Light Rail Vehicles: The vehicles procured under this Contract, also referred to as "Cars," "LRV4s," or "Vehicles."

Material and/or Equipment: The Light Rail Vehicles (including all parts and equipment installed in them) and other deliverables furnished by the Contractor under the provisions of the Contract.

Notice To Proceed (NTP): A written notice to the Contractor of the date on which it shall begin prosecution of the work to be done under the contract.

Project Manager: The Project Manager assigned to the Contract for the SFMTA, or his or her designated agent.

Proposal: The technical and management information and prices submitted by Contractor in response to the RFP.

Related Defect(s): The damages inflicted on any component or subsystem as a direct result of a Defect.

Request for Qualifications; RFQ: The Request for Qualifications issued by the SFMTA on March 29, 2013 to qualify proposers for the RFP.

Request for Proposals; RFP: The Request for Proposals issued by the SFMTA on (Date), to procure up to 260 Light Rail Vehicles.

SFMTA: The San Francisco Municipal Transportation Agency, an agency of the City with responsibility for the Municipal Railway and the Division of Sustainable Streets (Parking and Traffic).

Subcontractor, Supplier: Any individual, partnership, firm, or corporation that 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.

Technical Specifications: The portion of the Conformed Contract Documents 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.

Work: 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.

Working Days: Those calendar 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.

Acronyms

FDR	Final Design Review
FTA	Federal Transit Administration
PDR	Preliminary Design Review
RFP	Request for Proposals
RFQ	Request for Qualifications
SOQ	Statement of Qualifications

1. Certification of Funds; Budget and Fiscal Provisions; Termination in the Event of Non-Appropriation

1.1. 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, 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.

1.2. 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.

1.3. 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.

2. Term of the Agreement

Subject to Section 1, the term of this Agreement shall not exceed 15 years from the Effective Date.

3. Effective Date of Agreement

This Agreement shall become effective on the date the Controller has certified to the availability of funds and Contractor has been notified in writing.

4. Work Contractor Agrees to Perform

The Contractor agrees to perform the Work provided for in the Technical Specifications, and in the Contractor's Proposal (as incorporated into the Conformed Contract Documents), according to the Project Delivery Schedule set forth in Exhibit 3.

5. Compensation

5.1. In no event shall the amount of this Agreement exceed [insert whole dollar amount in numbers and words – no pennies]. The breakdown of costs associated with this Agreement appears in the Schedule of Prices (Exhibit 1) and Payment Schedule (Exhibit 2), incorporated by reference as though fully set forth herein.

5.2. No charges shall be incurred under this Agreement nor shall any payments become due to Contractor until equipment, reports, services, or both, required under this Agreement are received from Contractor and approved by SFMTA as being in accordance with this Agreement. City may withhold payment to Contractor in any instance in which Contractor has failed or refused to satisfy any material obligation provided for under this Agreement.

5.3. In no event shall City be liable for interest or late charges for any late payments. City will not make price adjustments to this Contract to protect Contractor from economic inflation.

6. Guaranteed Maximum Costs

6.1. The City's obligation hereunder shall not at any time exceed the amount certified by the Controller for the purpose and period stated in such certification.

6.2. Except as may be provided by laws governing emergency procedures, officers and employees of the City are not authorized to request, and the City is not required to reimburse the Contractor for, Commodities or Services beyond the agreed upon contract scope unless the changed scope is authorized by amendment and approved as required by law.

6.3. Officers and employees of the City are not authorized to offer or promise, nor is the City required to honor, any offered or promised additional funding in excess of the maximum amount of funding for which the contract is certified without certification of the additional amount by the Controller.

6.4. The Controller is not authorized to make payments on any contract for which funds have not been certified as available in the budget or by supplemental appropriation.

6.5. This contract will be initially certified for \$ _____. Contractor shall not incur costs in excess of such amount without written authorization from the SFMTA, signed by the SFMTA Chief Financial Officer.

7. Payment; Invoice Format

Invoices furnished by Contractor under this Agreement must be in a form acceptable to the Controller, and must include the Contract Progress Payment Authorization number. All amounts paid by City to Contractor shall be subject to audit by City. Progress payments shall be made by the City to Contractor at the address specified below:

7.1. Amount. Subject to any subsequent deductions for Liquidated Damages for late delivery of Contract deliverables as specified in Section 19 of this Agreement, the City agrees to pay an amount not to exceed the compensation amount stated in Section 5.1 of this Agreement and in accordance with the terms and conditions of this Agreement.

7.2. Invoices. Contractor's invoices shall be submitted to the following address:

San Francisco Municipal Transportation Agency
Transit Division
1 South Van Ness Avenue, 7th Floor
San Francisco, CA 94103
Attention: Ms. Trinh Nguyen P.E., Senior Program Manager

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.

7.3. Progress Payments. SFMTA shall make payments as the work proceeds in accordance with the progress payment provisions as set forth in the Payment Schedule (Exhibit 2). Progress payments shall be conditioned on either (1) 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 15.1 of this Agreement; or (2) issuance of a letter of credit in conformance with the provision of Section 15.2.5 in the amount of the progress payment. Progress payments for which a letter of credit shall be required are as follows: Milestones A, B and C of Item 1 of Exhibit 2 to this Agreement, and Milestones A, B (except if title is delivered prior to payment by SFMTA) and C of Item 2 of Exhibit 2 to this Agreement. Letter(s) of credit for such progress payments will be released upon Acceptance of 80 percent of the total Vehicles.

In lieu of a letter of credit to secure progress payments, Contractor may elect to increase its performance bond required under Section 15.2.2 of this Agreement by the

cumulative amount of progress payments for each of the above Milestones 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.

For any Vehicle subject to Conditional Acceptance, the payment shall be reduced by an amount equal to twice the estimated cost for parts and labor for the corrective action, which amount shall be withheld and paid after corrective action by the Contractor and final Acceptance by SFMTA.

All Work covered and paid for during the construction of the Light Rail Vehicles (LRV4) shall become the sole property of SFMTA. This provision shall not be construed as relieving the Contractor from the sole responsibility for all Work upon which payments have been made or for the restoration of all damaged Work or as waiving the right of SFMTA to require the fulfillment of all of the terms of the Contract specifications. The Contractor shall remain liable for insuring and delivering the material in the final form as specified in the Contract, and shall replace material at no cost to SFMTA in the event it is not delivered and accepted by SFMTA.

Contractor shall prepare invoices supported by evidence satisfactory to SFMTA that the Work invoiced has been accomplished and that the materials, listed, if any, are stored and ready for use.

7.4. Exchange Rate Risk. The City will not make price adjustments on this Contract to protect the Contractor from fluctuations in the value of the applicable foreign currency in relation to the United States dollar.

7.5. Inflation Risk. City will not make price adjustments to this Contract to protect Contractor from economic inflation.

7.6. Release. The Contractor shall, if required by the City, execute and deliver at the time of final payment and as a condition precedent to final payment, a release in form satisfactory to the City, discharging the City, its officers, agents and employees of and from liabilities, obligations, and claims arising under this contract.

8. Submitting False Claims; Monetary Penalties.

Pursuant to San Francisco Administrative Code §21.35, any contractor, subcontractor or consultant who submits a false claim shall be liable to the City for three times the amount of damages which the City sustains because of the false claim. A contractor, subcontractor or consultant who submits a false claim shall also be liable to the City for the costs, including attorneys' fees, of a civil action brought to recover any of those penalties or damages, and may be liable to the City for a civil penalty of up to \$10,000 for each false claim. A contractor, subcontractor or consultant will be deemed to have submitted a false claim to the City if the contractor, subcontractor or consultant: (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.

9. Disallowance

If Contractor claims or receives payment from City for a service, 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.

10. Taxes

10.1. Payment of Taxes. Payment of any taxes, including possessory interest taxes and California sales and use taxes, levied upon or as a result of this Agreement, or the Work performed pursuant hereto, shall be the obligation of Contractor.

10.2. Possessory Interest. Contractor recognizes and understands 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:

10.2.1. 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;

10.2.2. 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.

10.2.3. 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.

10.2.4. 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.

11. Payment Does Not Imply Acceptance of Work

The granting of any payment by City, or the receipt thereof by Contractor, shall in no way lessen the liability of Contractor to replace unsatisfactory work, equipment, or materials, although the unsatisfactory character of such work, equipment or materials may not have been apparent or detected at the time such payment was made.

Materials, equipment, components, or workmanship that does not conform to the requirements of this Agreement may be rejected by City and in such case must be replaced by Contractor without delay.

12. Qualified Personnel

Work under this Agreement shall be performed only by competent personnel under the supervision of and in the employment of Contractor. Contractor will comply with City's reasonable requests regarding assignment of personnel, but all personnel, including those assigned at City's request, must be supervised by Contractor. Contractor shall commit adequate resources to complete the project within the project schedule specified in this Agreement.

13. Responsibility for Equipment

City shall not be responsible for any damage to persons or property as a result of the use, misuse or failure of any equipment used by Contractor, or by any of its employees, even though such equipment be furnished, rented or loaned to Contractor by City.

14. Independent Contractor; Payment of Taxes and Other Expenses

14.1. Independent Contractor. 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 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.

14.2. Payment of 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 or Work 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, should any court, arbitrator, or administrative authority determine that Contractor is an employee for any other purpose, then Contractor agrees to a reduction in City's financial liability so that City's total expenses under this Agreement are not greater than they would have been had the court, arbitrator, or administrative authority determined that Contractor was not an employee.

15. Insurance; Bonds

15.1. Insurance

15.1.1. Without in any way limiting Contractor's liability pursuant to the "Indemnification" section of his Agreement, Contractor shall 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, illness or injury. The Worker's Compensation policy shall be endorsed with a waiver of subrogation in favor of the City for all work performed by the Consultant, its employees, agents and subcontractors; and

(b) (i) Commercial General Liability Insurance with limits not less than \$50,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Contractual Liability, Personal Injury, Products and Completed Operations, and any exclusion for railroads shall be removed; or

(ii) A combination of Umbrella or Excess Insurance and Commercial General Liability Insurance with combined limits not less than \$50,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Contractual Liability, Personal Injury, Products and Completed Operations; such coverage shall be written on a follow form basis, and any exclusion for railroads shall be removed; and

(c) Commercial Automobile Liability Insurance with limits not less than \$1,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Owned, Non-Owned and Hired auto coverage, as applicable.

(d) Garage Liability insurance, including coverage for garage operations arising from premises/operations, product/completed operations, contracts, owned vehicles, non-owned vehicles and damage to vehicles owned by others (bailment), with a minimum limit of liability of \$2,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage; and

(e) Garagekeepers' Legal Liability insurance, with an endorsement for coverage of Light Rail Vehicles, comprehensive form, with limits not less than \$2,000,000 each occurrence; and

(f) All Risk Property Insurance with replacement cost coverage and limits of no less than (amount TBD based on value of maximum cars stored). Insurance shall cover all risk of physical loss or damage to the Contractor's site, including buildings, contents, any storage facility and its contents; and

(g) Professional liability insurance, applicable to Contractor's profession, with limits not less than \$10,000,000 each claim with respect to negligent acts, errors or omissions in connection with professional services to be provided under this Agreement; and

(h) Unless otherwise covered by Commercial General Liability and/or Umbrella or Excess Insurance specified in paragraph 15.1.1(b), Transit Liability coverage with limits not less than \$50,000,000, to be in place prior to testing of Vehicles on any public or third-party rails; and

(i) Crane Operator's/Riggers Liability Insurance covering crane operations while at Contractor's site with limits of no less than \$10,000,000 per occurrence and in the aggregate. This insurance applies only if Contractor uses a crane in the performance of the Work.

(j) Any shipping contractor or subcontractor shall carry, at a minimum, physical damage insurance (including destruction, damage, fire and theft) in the amount of not less than the value of the item(s) shipped, as stated in Exhibit 1A, Price Item 2, and commercial liability insurance in the amount of not less than \$1,000,000.

15.1.2. Commercial General Liability, Business Automobile Liability Insurance, Garagekeepers' Legal Liability, Transit Liability and Shippers Coverage policies must provide the following:

(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 Insured, 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.

15.1.3. Waiver of Subrogation. Contractor agrees to waive subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. Contractor agrees to obtain any endorsement that may be necessary to effect this waiver of subrogation.

15.1.4. All policies shall provide 30 Days' advance written notice to City of cancellation or reduction in coverage for any reason, mailed to the following address:

San Francisco Municipal Transportation Agency
Transit Division
1 South Van Ness Avenue, 7th Floor, San Francisco, CA 94103
Attention: Ms. Trinh Nguyen P.E., Senior Program Manager
Contract No. SFMTA-2013-19

15.1.5. 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 five 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

15.1.6. 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.

15.1.7. 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.

15.1.8. Before commencing any operations under this Agreement, Contractor shall do the following: (a) 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 coverage's set forth above, and (b) furnish complete copies of policies promptly upon City request.

15.1.9. Approval of the insurance by City shall not relieve or decrease the liability of Contractor hereunder.

15.1.10. If a subcontractor will be used to complete any portion of this agreement, the Contractor shall ensure that the subcontractor shall provide all necessary insurance and shall name the City and County of San Francisco, its officers, agents and employees and the Contractor listed as additional insureds.

15.2. Bonds/Letter of Credit

15.2.1. General. The following provisions set forth financial guarantees that must be met by Contractor. Contractor may choose to meet the requirements of this Section 15.2 by obtaining either the required bonds or an irrevocable letter of credit ("Letter of Credit") in an equivalent amount, or a combination of the two types of instruments. In addition, for each subsequent Vehicle delivery phase described below, Contractor may elect to change how the obligations are met by furnishing a bond to cover an obligation previously covered by a Letter of Credit or vice-versa, subject to approval of the SFMTA and the City's Risk Manager.

15.2.2. Security. Contractor shall furnish to the City either a performance bond or a Letter of Credit for each phase of delivery as set forth below:

(a) Phase 1 (Vehicles 1-24)

(i) A performance bond or Letter of Credit in the amount of 25% of the total price for Phase 1 within 20 Days following the receipt of the notice of award of the Contract.

(ii) If requested by Contractor and agreed to by City, the amount of the performance bond may be reduced, or the City may authorize a reduction in the amount of the Letter of Credit from 25% to 12.5% of the total price for Phase 1 upon Acceptance of the 24th Car. Upon expiration of the warranty period of the 24th Car, the City will release the performance bond (or authorize the release of the Letter of Credit) covering the 24 Cars. Alternatively, the City may release the performance bond (or authorize the release of the Letter of Credit) upon Acceptance of the 24th Car provided that

Contractor has furnished to City a warranty bond or Letter of Credit in accordance with the requirements of Section 15.2.4.

(b) Phase 2 (Vehicles 25-175)

(i) Contractor shall furnish to the City a performance bond or Letter of Credit in the amount of 25% of the total price for Phase 2 as a condition precedent to issuance of a Notice to Proceed to Contractor for Phase 2.

(ii) If requested by Contractor and agreed to by City, the amount of the performance bond may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit) as Phase 2 Vehicles are Accepted as follows:

(A) from 25% to 20% of the total price for Phase 2 upon expiration of the warranty period of the 75th Car;

(B) from 20% to 15% of the total price for Phase 2 upon expiration of the warranty period of the 125th Car.

(iii) Upon expiration of the warranty period of the 175th Car, the City will release the performance bond or authorize the release of the Letter of Credit. Alternatively, the City may release the performance bond or authorize the release of the Letter of Credit upon Acceptance of the 175th Car provided Contractor has furnished to City a warranty bond or Letter of Credit in accordance with the requirements of Section 15.2.4 at the time of Acceptance of the 175th Car.

(c) Optional Delivery Phase (Vehicles 176-260). If SFMTA exercises the option for delivery of additional Vehicles (Option Vehicles), Contractor shall furnish to the City a performance bond or Letter of Credit in the amount of 25% of the total option price within 20 Days of Contractor's receipt of notice from SFMTA of the Agency's intention to exercise the option. The amount of the performance bond for the Option Vehicles may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit for such Vehicles) from 25% to 5% upon Acceptance of the last Option Vehicle. The City will release the performance bond or authorize the release of the Letter of Credit, upon the expiration of the warranty period of the last Option Vehicle. Alternatively, the City may release the performance bond or authorize the release of the Letter of Credit upon Acceptance of the last Option Vehicle provided that Contractor has furnished the City with a warranty bond or Letter of Credit in accordance with the requirements of Section 15.2.4.

15.2.3. Labor and Materials Bond

(a) Phase 1 (Vehicles 1-24) Within 20 days following the receipt of notice of award of contract, the Contractor shall furnish to City either a labor and materials bond (in the form to be approved by the City) or a Letter of Credit in the amount of 25% of the of the total price for Phase 1, to guarantee Contractor's payment of materials, provisions, or other supplies used for or in the performance of Phase 1 of the Contract. Upon delivery and acceptance by the City of 75% of the contracted number of vehicles for Phase 1, the amount of the labor and materials bond may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit)

to 30% of the original amount. Upon final payment by the City for all Contract deliverables under Phase 1, the obligations of the Contractor and surety under the labor and materials bond shall be released by the City in writing (or in the case of a Letter of Credit, the City shall authorize the release of the Letter of Credit for this purpose). The original bond document(s) shall be retained by the City.

- (b) **Phase 2 (Vehicles 25-175).** Contractor shall furnish to the City either a labor and materials bond or Letter of Credit in the amount of 25% of the total price for Phase 2, to guarantee Contractor's payment of materials, provisions, or other supplies used for or in the performance of Phase 2 of the Contract as a condition precedent to issuance of a Notice to Proceed to Contractor for Phase 2. Upon delivery and acceptance by the City of 75% of the contracted number of vehicles for Phase 2, the amount of the labor and materials bond may be reduced (or the City may authorize a reduction in the amount of the Letter of Credit) to 30% of the original amount. Upon final payment by the City for all Contract deliverables under Phase 2, the obligations of the Contractor and surety under the labor and materials bond shall be released by the City in writing (or in the case of a Letter of Credit, the City shall authorize the release of the Letter of Credit for this purpose). The original bond document(s) shall be retained by the City.
- (c) **Optional Delivery Phase (Vehicles 176-260)** Within 20 days of receipt of a notice from City of intention to exercise the option for delivery of additional Vehicles, the Contractor shall furnish to City either a separate labor and materials bond or a Letter of Credit in the amount of 25% of the cost of the additional Vehicles to be purchased, to guarantee performance of all Contract obligations with respect to such optional Vehicles. Provisions for releasing or reducing the amount of the bond or Letter of Credit shall apply in the same manner as described above. Any such bond shall also be retained by the City.

15.2.4. Warranty Bond. Once all Vehicles have been Accepted for Phase 1, Phase 2, or for Option Delivery, Contractor may replace the performance bond for that phase, or request that the City authorize the release of a Letter of Credit provided in lieu of a performance bond by obtaining a warranty or guaranty bond or an additional Letter of Credit in the amount of 10 percent of the Contract amount for that phase or for the Option Vehicles, as appropriate. Where Contractor's performance is secured by a Letter of Credit and Contractor obtains a warranty bond to cover Contractor's warranty obligations for a given phase or the Option Delivery period, Contractor may request that the Letter of Credit be released to reflect that the Contractor's obligations under that delivery phase have otherwise been fulfilled. A bond or Letter of Credit under this paragraph 15.2.4 shall be for the purpose of covering all of Contractor's warranty obligations under the Contract for that phase or for Option delivery, and shall become effective upon release of the performance bond or City's authorization to release the Letter of Credit specified in Subsection 15.2.2 above. At the end of each year of warranty coverage, the Contractor may request a reduction of coverage, which may be approved at the discretion of SFMTA and the City's Risk Manager.

15.2.5. 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 as otherwise provided in this Section 15.2 to reflect the adjustments set forth above) 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, 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 30, 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.

15.2.6. 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 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 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 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.

16. Indemnification

16.1. General. Contractor shall indemnify and save harmless City and its officers, agents and employees from, and, if requested, shall defend them against any and all loss, cost, damage, injury, liability, and claims thereof for injury to or death of a person, including employees of Contractor or loss of or damage to property, arising 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 in effect on or validly retroactive to the date of this Agreement, 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.

16.2. Duty to Defend. 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.

16.3. Intellectual Property. 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 in consequence of the use by City, or any of its officers or agents, of articles or Work to be supplied in the performance of this Agreement.

16.4. 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 5.1, as that amount may be modified by a properly approved and executed Contract Modification. Said limitation on liability shall not apply to:

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

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

16.4.3. damages that fall within the insurance coverages required under the Agreement;

16.4.4. Contractor's warranty obligations under the Agreement;

16.4.5. damages and other liability arising under claims by third parties, including indemnity or contribution for claims brought by a third party (see Paragraph 16.1);

16.4.6. damages and other liability for infringement of any intellectual property right as provided in Section 16.3.

16.5. 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.

17. Incidental and Consequential Damages

Contractor shall be responsible for incidental and consequential damages resulting in whole or in part from Contractor's acts or omissions. Nothing in this Agreement shall constitute a waiver or limitation of any rights that City may have under applicable law.

18. Liability of City

CITY'S PAYMENT OBLIGATIONS UNDER THIS AGREEMENT SHALL BE LIMITED TO THE PAYMENT OF THE COMPENSATION PROVIDED FOR IN SECTION 5 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 OR WORK PERFORMED IN CONNECTION WITH THIS AGREEMENT.

19. Liquidated Damages/ Weight Incentives

19.1. Liquidated Damages

By entering into this Agreement, the Contractor agrees that in the event the Work, as provided under Section 4, is delayed beyond the scheduled milestones and timelines as provided in the Project Delivery Schedule in Appendices 1E and 2C of this Agreement, 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 SFMTA .

<u>Milestone</u>	<u>Amount per Day</u>
Delivery of first 2 Vehicles	\$2000 Per Vehicle
Delivery of Vehicles 3 - 260	\$1000 Per Vehicle
Completion of training program	\$500
Completion of delivery of Phase 1 spare parts	\$500
Completion of delivery of Phase 2 spare parts	\$500
Conditional Acceptance of manuals (operation, maintenance and parts manuals)	\$500
Delivery of diagnostic test equipment and special tools	\$500
Failure to provide a plan for correction of fleet defects	\$500 per Vehicle
Failure to fully correct fleet defects according to approved plan	\$500 per Vehicle

Liquidated Damages imposed under this Agreement shall be in addition to any other damages which are recoverable by the City specified elsewhere in the contract documents.

19.2. Weight Limits and Incentives

The nominal Vehicle weight shall be [insert weight from Contractor's proposal in pounds] at AW0. Vehicles shall be weighed prior to delivery, and, for each pound in excess of the nominal weight, the City will deduct \$10 per pound per Vehicle from the Contractor's invoice. For each pound below the nominal weight, the City will pay an incentive payment of \$10 per pound per Vehicle. To allow for manufacturing variations, neither penalties nor incentives will be assessed on the first one percent excess or under weight. SFMTA shall reject Vehicles weighing in excess of 80,000 lbs at AW0 and shall not be required to pay for rejected Vehicles.

20. Default; Remedies

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

20.1.1 Contractor fails or refuses to perform or observe any term, covenant or condition contained in any of the following Sections of this Agreement: 8, 10, 15, 24, 30, 36, 52, 54 or 56.

20.1.2 Contractor fails or refuses to perform or observe any other term, covenant or condition contained in this Agreement, and such default continues for a period of 15 Days after written notice thereof from City to Contractor.

20.1.3 San Francisco Municipal Transportation Agency 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.

20.1.4 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.

20.2. 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, 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 all damages, losses, costs or expenses incurred by City as a result of such Event of Default and any liquidated damages due from Contractor pursuant to the terms of this Agreement or any other agreement. 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.

21. Termination for Convenience

21.1. 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.

21.2. Contractor Actions. Upon receipt of the notice, 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:

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

21.2.2 Not placing any further orders or subcontracts for materials, services, equipment or other items.

21.2.3 Terminating all existing orders and subcontracts.

21.2.4 At City's direction, assigning to City any or all of Contractor's right, title, and interest under the orders and subcontracts terminated. Upon such assignment, City 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.

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

21.2.6 Completing performance of any services or Work that City designates to be completed prior to the date of termination specified by City.

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

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

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

21.3.2 A reasonable allowance for profit on the cost of the services and Work described in the immediately preceding subsection (a), provided that Contractor

can establish, to the satisfaction of City, that Contractor would have made a profit had all services and Work under this Agreement been completed, and provided further, that the profit allowed shall in no event exceed five percent of such cost.

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

21.3.4 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 City, and any other appropriate credits to City against the cost of the services or other work.

21.4. Non-Recoverable Costs. In no event shall City be liable for costs incurred by Contractor or any of its Subcontractors after the termination date specified by City, except for those costs specifically enumerated and described in the immediately preceding subsection 21.3. Such non-recoverable costs include, but are not limited to, anticipated profits on 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 such subsection 21.3.

21.5. Deductions. In arriving at the amount due to Contractor under this Section, City may deduct: (a) all payments previously made by City for Work or services covered by Contractor's final invoice; (b) any claim which City may have against Contractor in connection with this Agreement; (c) any invoiced costs or expenses excluded pursuant to the immediately preceding subsection (21.4); and (d) in instances in which, in the opinion of the City, the cost of any service or other work performed under this Agreement is excessively high due to costs incurred to remedy or replace defective or rejected services or Work, the difference between the invoiced amount and City's estimate of the reasonable cost of performing the invoiced services or Work in compliance with the requirements of this Agreement.

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

22. Rights and Duties Upon Termination or Expiration

22.1. Survival of Sections. This Section and the following Sections of this Agreement shall survive termination or expiration of this Agreement: 8 through 11, 13 through 20, 24, 26 through 28, 49 through 52, 55, 56, 61, 62 and 67.

22.2. Contractor Duties. Subject to the immediately preceding subsection 22.1, upon termination of this Agreement prior to expiration of the term specified in Section 2, this Agreement shall terminate and 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. This subsection shall survive termination of this Agreement.

23. Conflict of Interest

Through its execution of this Agreement, Contractor acknowledges that it is familiar

with the provisions of section 15.103 of the City's Charter, Article III, Chapter 2 of the City's Campaign and Governmental Conduct Code and sections 87100 et seq. and sections 1090 et seq. of the Government Code of the State of California, and certifies that it does not know of any facts which constitute a violation of said provision and agrees that if it becomes aware of any such fact during the term of this Agreement it shall immediately notify the City.

24. Proprietary or Confidential Information of City

Contractor understands and agrees that, in the performance of the Work or services under this Agreement or in contemplation thereof, Contractor may have access to private or confidential information, which may be owned or controlled by City, and that such information may contain proprietary or confidential details, the disclosure of which to third parties may be damaging to City. Contractor agrees that all information disclosed by City to Contractor shall be held in confidence and used only in performance of 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 data.

25. Notices to the Parties

Unless otherwise indicated elsewhere 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,
1 South Van Ness Avenue, 7th Floor, San Francisco, CA 94103
Attention: Ms. Trinh Nguyen P.E. Senior Program Manager
lr4@sfmta.com

To Contractor: [insert name of contractor, mailing address, e-mail address and fax number]

Any notice of default must be sent by registered mail.

26. Intellectual Property

26.1. Works for Hire; Ownership of Results. Any interest of Contractor or its Subcontractors, in drawings, plans, specifications, blueprints, studies, reports, memoranda, computation sheets, computer files and media or other documents prepared by Contractor or its subcontractors in connection with services or Work to be performed under this Agreement, shall become the property of and will be transmitted to City. However, Contractor may retain and use copies for reference and as documentation of its experience and capabilities. If, in connection with services or Work performed under this Agreement, Contractor or its subcontractors create artwork, copy, posters, billboards, photographs, videotapes, audiotapes, systems designs, software, reports, diagrams, surveys, blueprints, source codes or any other original works of authorship, such works of authorship shall be works for hire as defined under Title 17 of the United States Code, and all copyrights in such works are the property of the City.

These shall include [INSERT ANY SPECIFIC SYSTEMS ITEMS COVERED] If it is ever determined that any works created by Contractor or its subcontractors under this Agreement are not works for hire under U.S. law, Contractor hereby assigns all copyrights to such works to the City, and agrees to provide any material and execute any documents necessary to effectuate such assignment. With the approval of the City, Contractor may retain and use copies of such works for reference and as documentation of its experience and capabilities.

26.2. Licenses Granted

26.2.1. 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, 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 hereby warrants that it has title to and/or the authority to grant a license of such deliverables to the City. Upon request, Contractor shall provide to City a copy of the source code, which corresponds to the most current version of the deliverable, as well as any and all applicable proprietary materials that are otherwise not furnished under this Agreement, but may become necessary for the long-term maintenance and operation of the Vehicles. Alternatively, prior to Notice to Proceed, City and Contractor shall negotiate and enter into an escrow agreement whereby the applicable source codes for software that is proprietary to Contractor or its suppliers or subcontractors, including periodic updates of said source codes, and other proprietary materials, are placed in escrow. The source codes placed in escrow shall be on magnetic media and shall be accompanied by detailed software documentation, including a list of applicable software development tools. The Director of Transportation shall execute said escrow agreement on behalf of City.

26.2.2. Other Deliverables. Contractor grants City a perpetual, non-exclusive, non-transferable license to use, retain, and reproduce at all locations controlled by 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 (i) prepared by Contractor or its subcontractors or suppliers (but not exclusively for City); and (ii) required to be provided to City in connection with this Agreement. Contractor hereby warrants that it has title to and/or the authority to grant a license of such deliverables to the City.

26.3. Proprietary Materials. 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. Alternatively, at SFMTA's request, documents shall be placed in escrow, along with source codes, as described in subsection 26.2.1 above. 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. 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.

27. Reserved

28. Audits 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 under this Agreement. 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 less 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 conferred upon City by this Section.

29. Subcontracting

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 performance of the Work. City's execution of this Agreement constitutes its approval of the subcontractors listed below. 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.

[LIST APPROVED SUBCONTRACTORS]

30. Assignment

The Work to be performed by Contractor are personal in character and neither this Agreement nor any duties or obligations hereunder may be assigned or delegated by the Contractor unless first approved by City by written instrument executed and approved in the same manner as this Agreement.

31. 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.

32. Reserved

33. Reserved

34. Nondiscrimination; Penalties

34.1. Contractor Shall Not Discriminate. In the performance of this Agreement, Contractor agrees not to discriminate against any employee, City and County employee working with such contractor or subcontractor, applicant for employment with such contractor or subcontractor, or against any person seeking accommodations, advantages, facilities, privileges, services, or membership in all business, social, or other establishments or organizations, on the basis of the fact or perception of a person's race, color, creed, religion, national origin, ancestry, age, height, weight, sex, sexual orientation, gender identity, domestic partner status, marital status, disability or Acquired Immune Deficiency Syndrome or HIV status (AIDS/HIV status), or association with members of such protected classes, or in retaliation for opposition to discrimination against such classes.

34.2. Subcontracts. Contractor shall incorporate by reference in all subcontracts the provisions of §§12B.2(a), 12B.2(c)-(k), and 12C.3 of the San Francisco Administrative Code (copies of which are available from SFMTA) and shall require all subcontractors to comply with such provisions. Contractor's failure to comply with the obligations in this subsection shall constitute a material breach of this Agreement.

34.3. Nondiscrimination in Benefits. 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 bereavement leave, family medical leave, health benefits, membership or membership discounts, moving expenses, pension and retirement benefits or travel benefits, as well as any benefits other than the benefits specified above, between employees with domestic partners and employees with spouses, and/or between the domestic partners and spouses of such employees, where the domestic partnership has been registered with a governmental entity pursuant to state or local law authorizing such registration, subject to the conditions set forth in §12B.2(b) of the San Francisco Administrative Code. As a condition to this Agreement, Contractor shall execute the "Chapter 12B Declaration: Nondiscrimination in Contracts and Benefits" form (form HRC-12B-101) with supporting documentation and secure the approval of the form by the San Francisco Human Rights Commission.

34.4. Incorporation of Administrative Code Provisions by Reference. The provisions of Chapters 12B and 12C of the San Francisco Administrative Code are incorporated in this Section by reference and made a part of this Agreement as though fully set forth herein. Contractor shall comply fully with and be bound by all of the provisions that apply to this Agreement under such Chapters, including but not limited to the remedies provided in such Chapters. Without limiting the foregoing, Contractor understands that pursuant to §12B.2(h) of the San Francisco Administrative Code, a penalty of \$50 for each person for each calendar day during which such person was discriminated against in violation of the provisions of this Agreement may be assessed against Contractor and/or deducted from any payments due Contractor.

35. Tropical Hardwoods and Virgin Redwood Ban

Pursuant to §804(b) of the San Francisco Environment Code, the City and County of San Francisco urges contractors not to import, purchase, obtain, or use for any purpose, any tropical hardwood, tropical hardwood wood product, virgin redwood or

virgin redwood wood product.

36. Drug-Free Workplace Policy

Contractor acknowledges that pursuant to the Federal Drug-Free Workplace Act of 1989, the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited on City premises. Contractor agrees that any violation of this prohibition by Contractor, its employees, agents or assigns will be deemed a material breach of this Agreement.

37. Resource Conservation

Chapter 5 of the San Francisco Environment Code ("Resource Conservation") is incorporated herein by reference. Failure by Contractor to comply with any of the applicable requirements of Chapter 5 will be deemed a material breach of contract.

38. Compliance with Americans with Disabilities Act

Contractor acknowledges that, pursuant to the Americans with Disabilities Act (ADA), programs, services and other activities provided by a public entity to the public, whether directly or through a contractor, must be accessible to the disabled public. Contractor shall provide the Work specified in this Agreement in a manner that complies with the ADA and any and all other applicable federal, state and local disability rights legislation. Contractor agrees not to discriminate against disabled persons in the provision of services or Work, benefits or activities provided under this Agreement and further agrees that any violation of this prohibition on the part of Contractor, its employees, agents or assigns will constitute a material breach of this Agreement.

39. Sunshine Ordinance

In accordance with San Francisco Administrative Code §67.24(e), contracts, contractors' bids, responses to solicitations and all other records of communications between City and persons or firms seeking contracts, shall be open to inspection immediately after a contract has been awarded. Nothing in this provision requires the disclosure of a private person or organization's net worth or other proprietary financial data submitted for qualification for a contract or other benefit until and unless that person or organization is awarded the contract or benefit. Information provided which is covered by this paragraph will be made available to the public upon request.

40. Public Access to Meetings and Records.

If the Contractor receives a cumulative total per year of at least \$250,000 in City funds or City-administered funds and is a non-profit organization as defined in Chapter 12L of the San Francisco Administrative Code, Contractor shall comply with and be bound by all the applicable provisions of that Chapter. By executing this Agreement, the Contractor agrees to open its meetings and records to the public in the manner set forth in §§12L.4 and 12L.5 of the Administrative Code. Contractor further agrees to make-good faith efforts to promote community membership on its Board of Directors in the manner set forth in §12L.6 of the Administrative Code. The Contractor acknowledges that its material failure to comply with any of the provisions of this paragraph shall

constitute a material breach of this Agreement. The Contractor further acknowledges that such material breach of the Agreement shall be grounds for the City to terminate and/or not renew the Agreement, partially or in its entirety.

41. Notification of Limitations on Contributions:

Through execution of this Agreement, Contractor acknowledges that it is familiar with section 1.126 of the City's Campaign and Governmental Conduct Code, which prohibits any person who contracts with 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, or for a grant, loan or loan guarantee, from making any campaign contribution to (1) an individual holding a City elective office if the contract must be approved by the individual, a board on which that individual serves, or a board on which an appointee of that individual serves, (2) a candidate for the office held by such individual, or (3) a committee controlled by such individual, at any time from the commencement of negotiations for the contract until the later of either the termination of negotiations for such contract or six months after the date the contract is approved. Contractor acknowledges that the foregoing restriction applies only if the contract or a combination or series of contracts approved by the same individual or board in a fiscal year have a total anticipated or actual value of \$50,000 or more. Contractor further acknowledges that 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 20 percent in Contractor; any subcontractor listed in the bid or contract; and any committee that is sponsored or controlled by Contractor. Additionally, Contractor acknowledges that Contractor must inform each of the persons described in the preceding sentence of the prohibitions contained in Section 1.126.

42. Requiring Minimum Compensation for Covered Employees

Contractor agrees to pay covered employees no less than the minimum compensation required by San Francisco's Minimum Compensation Ordinance (MCO), and shall otherwise comply with the MCO as set forth in San Francisco Administrative Code Chapter 12P (Chapter 12P). The provisions of Chapter 12P, including but not limited to the penalties for noncompliance provided therein, are incorporated herein by this reference, and made part of this Agreement as though fully set forth herein.

43. Health Benefits for Covered Employees

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

44. First Source Hiring Program

Contractor shall 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, including but not limited to the remedies for noncompliance provided therein. The provisions of Chapter 83 are incorporated herein by this reference, and made part of this Agreement as though fully set forth herein.

45. Prohibition on Political Activity with City Funds

In accordance with San Francisco Administrative Code Chapter 12.G, Contractor may not participate in, support, or attempt to influence any political campaign for a candidate or for a ballot measure (collectively, "Political Activity") in the performance of the services provided under this Agreement. Contractor agrees to comply with San Francisco Administrative Code Chapter 12.G and any implementing rules and regulations promulgated by the City's Controller. The terms and provisions of Chapter 12.G are incorporated herein by this reference. In the event Contractor violates the provisions of this section, the City may, in addition to any other rights or remedies available hereunder, (i) terminate this Agreement, and (ii) prohibit Contractor from bidding on or receiving any new City contract for a period of two (2) years.

46. Preservative-Treated Wood Containing Arsenic

Contractor may not purchase preservative-treated wood products containing arsenic in the performance of this Agreement unless an exemption from the requirements of Chapter 13 of the San Francisco Environment Code is obtained from the Department of the Environment under Section 1304 of the Code. The term "preservative-treated wood containing arsenic" shall mean wood treated with a preservative that contains arsenic, elemental arsenic, or an arsenic copper combination, including, but not limited to, chromate copper arsenate preservative, ammonia cal copper zinc arsenate preservative, or ammonia cal copper arsenate preservative. Contractor may purchase preservative-treated wood products on the list of environmentally preferable alternatives prepared and adopted by the Department of the Environment. This provision does not preclude Contractor from purchasing preservative-treated wood containing arsenic for saltwater immersion. The term "saltwater immersion" shall mean a pressure-treated wood that is used for construction purposes or facilities that are partially or totally immersed in saltwater.

47. Modification of Agreement

This Agreement may not be modified, nor may compliance with any of its terms be waived, except by written instrument executed and approved as required by law.

47.1. City-Ordered Changes

The City may order changes in the Work and may order extra materials and extra work in connection with the performance of the Agreement, and the Contractor shall respond within 30 days to such orders, except that:

If changes ordered in design, workmanship, services, or materials are of such a nature as to increase or decrease the cost or the time required to execute the change in scope of Work, the City shall make a reasonable and proper adjustment in the Contract price, delivery schedule, or both, as agreed upon by the Contractor and the Agency as the reasonable and proper allowance for the increase or decrease required.

No order for any alteration, modification, or extra that will increase or decrease the cost of the Work shall be valid unless the resulting increase or decrease in price shall have

been agreed upon in writing and approved by the City in the manner required under City law. No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this Contract, which include the requirements of the Technical Specifications.

47.2. Regulatory Changes

If a price adjustment is necessary to incorporate changes mandated by legislation or regulations that are promulgated or become effective after the Effective Date of the Contract and before manufacture of the Vehicles, the Agency and the Contractor shall negotiate the price adjustment. Such price adjustments may be audited, where required.

47.3. Schedule Changes

If City-ordered changes have potential impact on the delivery schedule, the Contractor shall submit a schedule change request for City approval.

48. Authority of Project Manager; Claims; Disputes.

48.1. Authority of Project Manager Authority of Project Manager. 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 48.4 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 5 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.

48.2. Claims for Additional Compensation.

48.2.1. 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.

48.2.2. 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 15 Days after the happening of the event, thing, occurrence, or other cause giving rise to the potential claim.

48.2.3. It is the intention of this Section 48.2 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.

48.3. 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.

48.4. 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.

48.5. 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.

48.6. Alternative Dispute Resolution. If agreed to by both parties, disputes may be resolved by a mutually agreed to alternative dispute resolution process.

48.7. 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.

49. 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.

50. Construction

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

51. Entire Agreement

This contract sets forth the entire Agreement between the parties, and supersedes all other oral or written provisions. This contract may be modified only as provided in Section 47.

52. Compliance with Laws

Contractor shall keep itself fully informed of the City's Charter, codes, ordinances 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.

53. Services Provided by Attorneys

Any services to be provided by a law firm or attorney must be reviewed and approved in writing in advance by the City Attorney. No invoices for services provided by law firms or attorneys, including, without limitation, as Subcontractors of Contractor, will be paid unless the provider received advance written approval from the City Attorney.

54. Reserved

55. 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, 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.

56. Protection of Private Information

Contractor has read and agrees to the terms set forth in San Francisco Administrative Code Sections 12M.2, "Nondisclosure of Private Information," and 12M.3, "Enforcement" of Administrative Code Chapter 12M, "Protection of Private Information," which are incorporated herein as if fully set forth. Contractor agrees that any failure of Contractor to comply with the requirements of Section 12M.2 of this Chapter shall be a material breach of the Contract. In such an event, in addition to any other remedies available to it under equity or law, the City may terminate the Contract, bring a false claim action against the Contractor pursuant to Chapter 6 or Chapter 21 of the Administrative Code, or debar the Contractor

57. Time of Essence

Time is of the essence in this Agreement.

58. Technical Specifications

58.1. Fabrication. The Vehicles shall be designed, fabricated, and tested in accordance with Volume 2 "Technical Specifications."

58.2. Omission. Notwithstanding the Technical Specifications or other data provided by the Project Manager, the Contractor shall have the responsibility of supplying all parts and details required to make these Vehicles complete and ready for service even though such details may not be specifically mentioned in the Specifications. Items that are installed by SFMTA shall not be the responsibility of the Contractor unless they are included in this Contract or should have been installed by the Contractor.

58.3. Design Review. Refer to Technical Specification Appendix C Section 0.2.4.

58.4. Preliminary Drawings. Refer to Technical Specification Appendix C Section 0.2.4.

58.5. Materials/Accessories Responsibility. Refer to Technical Specification Section 19.

59. Project Planning, Scheduling and Control

59.1. 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. Contractor shall employ Critical Path Method scheduling (CPM) for planning, scheduling and reporting all work required by the Contract Documents.

59.2. Descriptions of Submittals. Submittals will be provided in accordance with Technical Specification Appendix C Section 0.2.3.4.

60. Reserved

61. FTA Requirements

The provisions contained in "FTA Requirements for Procurement Contracts," attached as Exhibit 4, are incorporated into this Agreement. If there is any conflict between the FTA terms and conditions and any other terms and conditions of this Agreement, the FTA terms and conditions shall take precedence.

62. Cooperative Drafting

This Agreement has been drafted through a cooperative effort of both parties, 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.

63. Warranty

Contractor shall provide warranties of Vehicles, training, parts and special tools as described in Exhibit 5 (Warranty).

64. Title

Adequate documents for securing the title of the Vehicle shall be provided to the Project Manager at the time the Vehicle is delivered. Upon Acceptance or, in the case of a Vehicle being Conditionally Accepted, upon Conditional Acceptance of each Vehicle, the Contractor warrants that the title shall pass to the SFMTA free and clear of all liens, mortgages and encumbrances, financing statements, security agreements, claims and demands of any character. Title to the spare parts to be delivered under this Contract shall vest in the SFMTA immediately upon Acceptance by the SFMTA.

65. Option Vehicles

All items purchased under the options shall be identical in every way to those purchased under the base Contract. All conditions, Technical Specifications, and requirements set forth in the base Contract documents shall apply to the items purchased under option unless otherwise specified in this section.

65.1. Option for New Light Rail Vehicles. At the option of the City, the Contractor shall provide additional light rail Vehicles in quantities indicated in the Schedule of Prices. The option for 1 to 85 Vehicles (Item 7 on the Payment Schedule Exhibit 2) may be executed any time within seven years after NTP.

65.2. Option for Additional Spare Parts. At the option of the City, Contractor shall provide additional spare parts (Item 8 on the Payment Schedule, Exhibit 2). Prices shall remain firm for 24 months after NTP.

66. Precedence of Contract Documents

Any inconsistency in requirements of the contract documents shall be resolved by giving precedence in the following order:

- (a) Executed Agreement
- (b) Technical Specifications
- (c) Warranty Provisions

67. Deliveries

67.1. Predelivery Tests and Inspections. Pre-delivery tests and inspections shall be performed prior to shipment to SFMTA. Such tests and inspections shall be performed in accordance with the procedures defined in Verification Section 21.3 of the Technical Specifications, and they may be witnessed by the SFMTA Resident Inspector. When a Vehicle passes these tests and inspections, the Resident Inspector shall authorize release of the Vehicle for shipment. Such authorization does not imply Acceptance of the Vehicle by SFMTA.

67.2. 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:

San Francisco Municipal Railway
Muni Metro East Facility

Contractor shall deliver Vehicles during weekday working hours, Monday through Friday, 9am – 3pm., except SFMTA holidays or as otherwise specified in writing by SFMTA. Contractor shall provide at least five Working Days notice to SFMTA prior to delivery. Delivery of the Vehicles shall be F.O.B. point of delivery, freight pre-paid and allowed. Contractor shall ensure that all Vehicles are fully operable when they are delivered.

67.3. Spare Parts Delivery Procedure. Contractor shall deliver Contract spare parts in two shipments or smaller lots provided that all spare parts shipments are delivered in accordance with Exhibit 3. Composition of spare parts in each lot is subject to SFMTA approval. Contractor shall provide SFMTA with one-weeks advance notice before shipment of each lot of spare parts. Such notice shall include a packing list clearly identifying all parts and their quantity in the shipment.

Delivery shall be determined 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, SFMTA will issue a notification of acceptance, non-acceptance or Conditional Acceptance of the spare parts. The point of delivery shall be:

San Francisco Municipal Railway
Muni Metro East Facility

68. Acceptance Of Vehicles

68.1. Procedure

After arrival at the designated point of delivery, each Vehicle will undergo pre-Acceptance and Acceptance tests by SFMTA as defined in the Verification Section 21.3 of the Technical Specifications. When a Vehicle passes all tests, SFMTA will provide written Acceptance of the Vehicle to the Contractor. Contractor shall transfer title to the Vehicle to the City on the day of Acceptance, or Conditional Acceptance, if the Vehicle is not fully Accepted. Acceptance of one Vehicle does not imply Acceptance of any other delivered Vehicles.

If a Vehicle fails the Acceptance tests, the Vehicle shall not be Accepted until the repair procedures defined in Section 69, of this Agreement have been carried out and the Vehicle has been retested and passes all applicable tests. All deliveries of Vehicles shall be halted whenever five or more Vehicles have failed or have not been Accepted or Conditionally Accepted and are awaiting repairs or corrections.

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

68.2. Conditional Acceptance. If a Vehicle does not meet all requirements for Acceptance, SFMTA may, at its exclusive option, "conditionally accept" the Vehicle 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 7 above.

68.3. Assumption of Risk of Loss. Prior to Acceptance by SFMTA, and regardless whether title has passed to the City, the Contractor shall bear risk of loss of the Vehicle, including any damage sustained during transportation to the delivery site. Notwithstanding the foregoing, Contractor shall not be responsible for any loss to the Vehicle that is caused by the active negligence of the SFMTA or where the Vehicle has been Conditionally Accepted by the SFMTA.

69. 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 work be done by SFMTA personnel with reimbursement by the Contractor. Contractor shall inform SFMTA in advance of any modifications made to the Vehicle during the Acceptance period.

69.1. Repairs by Contractor. If the SFMTA Project Manager requires the Contractor to perform repairs after non-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 option, the Contractor may be required to remove the Vehicle 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 Vehicle is under its control.

69.2. Repairs by SFMTA: If the SFMTA Project Manager agrees to a request by the Contractor for SFMTA to perform repairs on a Contractor-owned Vehicle prior to SFMTA Acceptance, 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.

If the Contractor supplies parts for repairs being performed by SFMTA before Acceptance of the Vehicle, Contractor shall ship these parts prepaid to SFMTA within ten 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.

Contractor shall reimburse SFMTA for all costs of labor and materials (including taxes) for repairs made or caused to be made by SFMTA. If SFMTA performs the repairs itself, the amount shall be determined by multiplying the number of man-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 Vehicle if such action was necessary. If SFMTA requires the service of an outside repair facility, Contractor shall reimburse SFMTA for all such repair invoices. Contractor shall also reimburse 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.

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.

70. Unavoidable Delays

70.1. 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.

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

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

71. MacBride Principles—Northern Ireland

Pursuant to San Francisco Administrative Code §12F.5, the City and County of San Francisco urges companies doing business in Northern Ireland to move towards resolving employment inequities, and encourages such companies to abide by the MacBride Principles. The City and County of San Francisco urges San Francisco companies to do business with corporations that abide by the MacBride Principles. By signing below, the person executing this agreement on behalf of Contractor acknowledges and agrees that he or she has read and understood this section.

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

CITY

CONTRACTOR

San Francisco Municipal
Transportation Agency

Edward D. Reiskin
Director of Transportation

Approved as to Form:

Dennis J. Herrera
City Attorney

[name of authorized representative]
[title]
[address]

City vendor number:

By _____
David A. Greenburg
Deputy City Attorney

San Francisco Municipal
Transportation Agency
Board of Directors

Resolution No. _____

Dated: _____

Attest:

Secretary

Board of Supervisors
Resolution No. _____

Dated: _____

Attest:

Clerk

Exhibit 1
Form I-A – Schedule of Prices

City is exempt from federal excise taxes. State, local sales, and use taxes are not to be included in these prices. All bid item prices shall be accurate reflections of the bid items proposed. Every line item must be priced on every sheet.

PROPOSER'S NAME: _____

BASE

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 1	Engineering Design, Project Management and Design Qualification Testing	Lump Sum	x 1	\$
Item 2	Vehicle Price for Base Contract	\$	x 175 Cars	\$
Item 3	Operating, Maintenance and Parts Manuals	Lump Sum	x 1	\$
Item 4	Training	Lump Sum	x 1	\$
Item 5	Spare Parts (Total of Form I-B1)	Lump Sum	x 1	\$
Item 6	Special Tools, Test and Diagnostic Equipment (Total of Form I-C)	Lump Sum	x 1	\$
Total Base: Items 1 – 6				\$

OPTION

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 7	Option for 1 to 85 Additional New Light Rail Vehicles	\$	x 85 Cars	\$
Item 8	Additional Spare Parts (Total of Form I-B2)	Lump Sum	x 1	\$
Total Options: Items 7 – 8				\$

ITEMS BELOW ARE FOR INFORMATION ONLY

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 9.1 *	Letter of Credit	Lump Sum	x 1	\$
Item 9.2 *	Performance Bond	Lump Sum	x 1	\$
Item 10	Insurance	Lump Sum	x 1	\$

ITEM	DESCRIPTION	UNIT PRICE	QUANTITY	EXTENDED PRICE
Item 11	Warranty (In accordance with Exhibit 5 of Sample Agreement)	Lump Sum	x 1	\$

* Provide cost for surety method selected.

Exhibit 2
PAYMENT SCHEDULE

Item 1 - Engineering Design, Project Management and Design Qualification Testing
(FORM I-A Item 1)

	Milestone	Percent of Bid Item
A	Submittal and Approval of Test Program, System Safety, Reliability, Maintainability and other plans as negotiated with SFMTA	2%
B	Completion and Approval of Preliminary Design Review	2%
C	Completion and Approval of Final Design Review	35%
D	Completion and Approval of Vehicle Performance Qualification Testing	30%
E	Completion and Approval of Test Program as specified	26%
F	Completion and Approval of all Contract Requirements (Retention)	5%
Total	For Item 1	100%

Item 2 – Vehicle Price for Base Contract
(FORM I-A Item 2)

Item 2A – Vehicle Price for Base Contract (Cars 1 - 24)

	Milestone	Percent of Bid Item
A	Placement of contracts with the following major subcontractors (Cars 1 - 24).* <ul style="list-style-type: none"> • Propulsion • Friction Brake • Air Comfort • Door Operators & Controls • Carbody • Train Control • Coupler • Communication 	2%
B	Delivery of complete set of subsystems to site of installation.	20%/Vehicle
C	Vehicle structure complete and ready for shipment to final assembly site	20%/Vehicle
D	SFMTA acceptance for shipment of vehicle from final assembly site to SFMTA property (Conditional Acceptance)	25%/Vehicle

	Milestone	Percent of Bid Item
E	Acceptance of vehicle by SFMTA	30%/Vehicle
F	Completion and Approval of all Contract Requirements for Phase 1 (Retention)	3%
Total	For Item 2A	100%

*Payment will be made only to the extent that deposits have been paid to suppliers and up to the amount of the deposits or 2%, whichever is the lesser value; in addition Contractor must provide security for payment under Section 7.3 of the Agreement.

Item 2B – Vehicle Price for Base Contract (Cars 25 - 175)

	Milestone	Percent of Bid Item
A	Placement of contracts with the following major subcontractors (Cars 25 - 175).* <ul style="list-style-type: none"> • Propulsion • Friction Brake • Air Comfort • Door Operators & Controls • Carbody • Train Control • Coupler • Communication 	2%
B	Delivery of complete set of subsystems to site of installation.	20%/Vehicle
C	Vehicle structure complete and ready for shipment to final assembly site	20%/Vehicle
D	SFMTA acceptance for shipment of vehicle from final assembly site to SFMTA property (Conditional Acceptance)	25%/Vehicle
E	Acceptance of vehicle by SFMTA	30%/Vehicle
F	Completion and Approval of all Contract Requirements for Phase 2 (Retention)	3%
Total	For Item 2B	100%

*Payment will be made only to the extent that deposits have been paid to suppliers and up to the amount of the deposits or 2%, whichever is the lesser value; in addition, Contractor must provide security for the payment, as required under Section 7.3 of the Agreement.

Item 3 - Operating, Maintenance and Parts Manuals (FORM I-A Item 3)

	Milestone	Percent of Bid Item
A	Acceptance of Draft Manuals	5%
B	Delivery and Acceptance of Operating, Maintenance and Parts Manuals	95%
Total	For Item 3	100%

Item 4 – Training
(FORM I-A Item 4)

	Milestone	Percent of Bid Item
A	Completion of Training Program and delivery and acceptance of all deliverables	95%
B	Completion and approval of all Contract Requirements (Retention)	5%
Total	For Item 4	100%

Item 5 - Spare Parts
(FORM I-A Item 5)

	Milestone	Percent of Bid Item
A	Delivery and acceptance of spare parts. Delivery and payment will be on a line-item basis.	95%
B	Completion and approval of all Contract Requirements (Retention)	5%
Total	For Item 5	100%

Item 6 – Special Tools, Test and Diagnostic Equipment
(FORM I-A Item 6)

	Milestone	Percent of Bid Item
A	Delivery and acceptance of Diagnostic Test Equipment, Special Tools, Bench Test Equipment	95%
B	Completion and approval of all Contract Requirements (Retention)	5%
Total	For Item 6	100%

Item 7 - Option for 1 to 85 Additional New Light Rail Vehicles
(FORM I-A Item 7)

Progress payments will be made in accordance with Item 2B.

Item 8 – Additional Spare Parts
(FORM I-A Item 8)

Progress payments will be made in accordance with Item 5.

Exhibit 3: PROJECT DELIVERY SCHEDULE

The Contractor shall submit as part of their proposal for review and evaluation a Project Schedule that indicates key design process duration, manufacturing duration, testing, training (for new systems), and delivery milestones. Significant project events should be noted including design reviews and inspection hold points. In any event, the total project schedule must not be greater than 180 months from NTP.

Item	Calendar Days after Notice to Proceed
Test Program, System Safety, Reliability, Maintainability and other plans as negotiated with SFMTA	60
Delivery of 1st vehicle to SFMTA	750
Delivery of 2nd vehicle to SFMTA	810
Training Start	870
Training Complete	990
Special Tools / Diagnostic Test Equipment	870
Delivery of Publications (Manuals, Parts Book, Drawings) - Prelim	870
Delivery of Publications (Manuals, Parts Book, Drawings) - Final	1080
Delivery of Spare Parts (Phase 1)	990
Testing Complete / Acceptance of Vehicle	990
Delivery Rate of remaining LRV4 (3-24)	2/month
Delivery of 24th vehicle to SFMTA	1320
Delivery of Spare Parts (Phase 2)	2490
Delivery of 25th vehicle to SFMTA	2490
Delivery Rate of remaining LRV4 (25-175)	2/month
Delivery of 175th vehicle to SFMTA	4650
Delivery of 176th vehicle to SFMTA	4665
Delivery Rate of Option Vehicles	TBD
Delivery of the last vehicle	TBD

EXHIBIT 4

FTA REQUIREMENTS FOR PROCUREMENT CONTRACTS

I. DEFINITIONS

A. Approved Project Budget means the most recent statement, approved by the FTA, of the costs of the Project, the maximum amount of Federal assistance for which the City is currently eligible, the specific tasks (including specified contingencies) covered, and the estimated cost of each task.

B. Contractor means the individual or entity awarded a third party contract financed in whole or in part with Federal assistance originally derived from FTA.

C. Cooperative Agreement means the instrument by which FTA awards Federal assistance to a specific Recipient to support a particular Project or Program, and in which FTA takes an active role or retains substantial control.

D. Federal Transit Administration (FTA) is an operating administration of the U.S. DOT.

E. FTA Directive includes any FTA circular, notice, order or guidance providing information about FTA's programs, application processing procedures, and Project management guidelines. In addition to FTA directives, certain U.S. DOT directives also apply to the Project.

F. Grant Agreement means the instrument by which FTA awards Federal assistance to a specific Recipient to support a particular Project, and in which FTA does not take an active role or retain substantial control, in accordance with 31 U.S.C. § 6304.

G. Government means the United States of America and any executive department or agency thereof.

H. Project means the task or set of tasks listed in the Approved Project Budget, and any modifications stated in the Conditions to the Grant Agreement or Cooperative Agreement applicable to the Project. In the case of the formula assistance program for urbanized areas, for elderly and persons with disabilities, and non-urbanized areas, 49 U.S.C. §§ 5307, 5310, and 5311, respectively, the term "Project" encompasses both "Program" and "each Project within the Program," as the context may require, to effectuate the requirements of the Grant Agreement or Cooperative Agreement.

I. Recipient means any entity that receives Federal assistance directly from FTA to accomplish the Project. The term "Recipient" includes each FTA "Grantee" as well as each FTA Recipient of a Cooperative Agreement. For the purpose of this Agreement, Recipient is the City.

J. Secretary means the U.S. DOT Secretary, including his or her duly authorized designee.

K. Third Party Contract means a contract or purchase order awarded by the Recipient to a vendor or contractor, financed in whole or in part with Federal assistance awarded by FTA.

L. Third Party Subcontract means a subcontract at any tier entered into by Contractor or third party subcontractor, financed in whole or in part with Federal assistance originally derived from FTA.

M. U.S. DOT is the acronym for the U.S. Department of Transportation, including its operating administrations.

II. FEDERAL CHANGES

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Master Agreement between the City and FTA, as they may be amended or promulgated from time to time during the term of this contract. Contractor's failure to so comply shall constitute a material breach of this contract.

III. ACCESS TO RECORDS

A. The Contractor agrees to provide the City and County of San Francisco, the FTA Administrator, the Comptroller General of the United States or any of their authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to this Agreement for the purposes of making audits, examinations, excerpts and transcriptions.

B. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

C. The Contractor agrees to maintain all books, records, accounts and reports required under this Agreement for a period of not less than three years after the date of termination or expiration of this Agreement, except in the event of litigation or settlement of claims arising from the performance of this Agreement, in which case Contractor agrees to maintain same until the City, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto. 49 CFR 18.36(i)(11).

IV. DEBARMENT AND SUSPENSION (Contracts over \$25,000)

Grantees and subgrantees must not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs under Executive Order 12549, "Debarment and Suspension." Therefore, by signing and submitting its bid or proposal, the bidder or proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the San Francisco Municipal Transportation Agency ("SFMTA"). If it is later determined that the bidder or proposer knowingly rendered an erroneous certification, in addition to remedies available to the SFMTA, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 CFR Parts 180, Subpart C and 1200, Subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

V. NO FEDERAL GOVERNMENT OBLIGATIONS TO CONTRACTOR

A. The City and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the City, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.

B. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

VI. CIVIL RIGHTS

A. **Nondiscrimination** - In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 41 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

B. **Equal Employment Opportunity** - The following equal employment opportunity requirements apply to the underlying contract:

B.1. **Race, Color, Creed, National Origin, Sex** - In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOT) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 CFR Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

B.2. **Age** - In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. § 623 and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

B.3. **Disabilities** - In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission,

"Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

C. The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

VII. DBE/SBE ASSURANCES

Pursuant to 49 C.F.R. Section 26.13, the Contractor is required to make the following assurance in its agreement with SFMTA and to include this assurance in any agreements it makes with subcontractors in the performance of this contract:

The Contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 C.F.R. Part 26 in the award and administration of DOT-assisted contracts. Failure by the Contractor or subcontractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as SFMTA deems appropriate.

VIII. CONTRACT WORK HOURS AND SAFETY STANDARDS *(applicable to non-construction contracts in excess of \$100,000 that employ laborers or mechanics on a public work)*

A. **Overtime requirements** - No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

B. **Violation; liability for unpaid wages; liquidated damages** - In the event of any violation of the clause set forth in paragraph A of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph A of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph A of this section.

C. **Withholding for unpaid wages and liquidated damages** - The City and County of San Francisco shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor

or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.

D. Subcontracts - The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs A through D of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs A through D of this section.

IX. ENERGY CONSERVATION REQUIREMENTS

The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

X. CLEAN WATER REQUIREMENTS (*applicable to all contracts in excess of \$100,000*)

A. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251 et seq. Contractor agrees to report each violation of these requirements to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA regional office.

B. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

XI. CLEAN AIR (*applicable to all contracts and subcontracts in excess of \$100,000, including indefinite quantities where the amount is expected to exceed \$100,000 in any year.*)

A. Contractor agrees to comply with applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. The Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

B. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

XII. PRIVACY

If Contractor or its employees administer any system of records on behalf of the Federal Government, Contractor and its employees agree to comply with the information restrictions and other applicable requirements of the Privacy Act of 1974, 5 U.S.C. § 552a (the Privacy Act). Specifically, Contractor agrees to obtain the express consent of the Federal Government before the Contractor or its employees operate a system of records on behalf of the Government. Contractor acknowledges that the requirements of the Privacy Act, including the civil and criminal penalties for violations of

the Privacy Act, apply to those individuals involved, and that failure to comply with the terms of the Privacy Act may result in termination of this Agreement. The Contractor also agrees to include these requirements in each subcontract to administer any system of records on behalf of the Federal Government financed in whole or in part with Federal assistance provided by FTA.

XIII. DRUG AND ALCOHOL TESTING

To the extent Contractor, its subcontractors or their employees perform a safety-sensitive function under the Agreement, Contractor agrees to comply with, and assure compliance of its subcontractors, and their employees, with 49 U.S.C. § 5331, and FTA regulations, "Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations," 49 CFR Part 655.

XIV. TERMINATION FOR CONVENIENCE OF CITY (required for all contracts in excess of \$10,000)

See Agreement Terms and Conditions.

XV. TERMINATION FOR DEFAULT (required for all contracts in excess of \$10,000)

See Agreement Terms and Conditions.

XVI. BUY AMERICA

The Contractor agrees to comply with 49 U.S.C. 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7, and include microcomputer equipment, software, and small purchases (\$100,000 or less) made with capital, operating, or planning funds. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 CFR 661.11. Rolling stock not subject to a general waiver must be manufactured in the United States and have a 60 percent domestic content.

XVII. CARGO PREFERENCE - USE OF UNITED STATES FLAG VESSELS

The Contractor agrees: (a) to use privately owned United States-Flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to the underlying Agreement to the extent such vessels are available at fair and reasonable rates for United States-Flag commercial vessels; (b) to furnish within 20 working days following the date of loading for shipments originating within the United States or within 30 working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English for each shipment of cargo described above to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the Contractor in the case of a subcontractor's bill-of-lading.); and (c) to include these requirements in all subcontracts issued pursuant to this Agreement.

when the subcontract may involve the transport of equipment, material, or commodities by ocean vessel.

XVIII. RECYCLED PRODUCTS

The Contractor agrees to comply with all the requirements of Section 6002 of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6962), including, but not limited to, the regulatory provisions of 40 CFR Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 CFR Part 247.

XIX. BUS TESTING *(applies to contracts for rolling stock)*

To the extent applicable, the Contractor (or Manufacturer) agrees to comply with the requirements of 49 U.S.C. § 5323(c) and FTA implementing regulations at 49 CFR Part 665, and shall perform the following:

A. A manufacturer of a new bus model or a bus produced with a major change in components or configuration shall provide a copy of the final test report to the Recipient at a point in the procurement process specified by the Recipient which will be prior to the Recipient's final acceptance of the first vehicle.

B. A manufacturer who releases a report under paragraph 1 above shall provide notice to the operator of the testing facility that the report is available to the public.

C. If the manufacturer represents that the vehicle was previously tested, the vehicle being sold should have the identical configuration and major components as the vehicle in the test report, which must be provided to the Recipient prior to Recipient's final acceptance of the first vehicle. If the configuration or components are not identical, the manufacturer shall provide a description of the change and the manufacturer's basis for concluding that it is not a major change requiring additional testing.

D. If the manufacturer represents that the vehicle is "grandfathered" (has been used in mass transit service in the United States before October 1, 1988, and is currently being produced without a major change in configuration or components), the manufacturer shall provide the name and address of the recipient of such a vehicle and the details of that vehicle's configuration and major components.

XX. PRE-AWARD AND POST-DELIVERY AUDIT REQUIREMENTS

To the extent applicable, Contractor agrees to comply with the requirements of 49 U.S.C. § 5323(l) and FTA implementing regulations at 49 CFR Part 663, and to submit the following certifications:

A. Buy America Requirements: The Contractor shall complete and submit a declaration certifying either compliance or noncompliance with Buy America. If the Bidder/Offeror certifies compliance with Buy America, it shall submit documentation which lists (1) component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and (2) the location of the final assembly point for the rolling stock, including a description of the activities that are planned to take place and actually took place at the final assembly point and the cost of final assembly.

B. Solicitation Specification Requirements: The Contractor shall submit evidence that it will be capable of meeting the bid specifications and provide information and access to Recipient and its agents to enable them to conduct post-award and post-delivery audits.

C. Federal Motor Vehicle Safety Standards (FMVSS): The Contractor shall submit (1) manufacturer's FMVSS self-certification sticker information that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

XXI. FALSE OR FRAUDULENT STATEMENTS AND CLAIMS

A. The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying Agreement, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA-assisted project for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

B. The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307(n)(1) on the Contractor, to the extent the Federal Government deems appropriate.

C. The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

XXII. FLY AMERICA

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and subrecipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S. Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

XXIII. NATIONAL ITS ARCHITECTURE POLICY (*Applicable to contracts for ITS projects*)

If providing Intelligent Transportation Systems (ITS) property or services, Contactor shall comply with the National ITS Architecture and standards to the extent required by 23 U.S.C. § 512, FTA Notice, "FTA National ITS Architecture Policy on Transit Projects," 66 FR 1455, et seq., January 8, 2001, and later published policies or implementing directives FTA may issue.

XXIV. INCORPORATION OF FEDERAL TRANSIT ADMINISTRATION (FTA) TERMS

The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1F, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any (name of grantee) requests which would cause (name of grantee) to be in violation of the FTA terms and conditions.

XXV. TEXTING WHILE DRIVING; DISTRACTED DRIVING

Consistent with Executive Order 13513 "Federal Leadership on Reducing Text Messaging While Driving", Oct. 1, 2009 (available at <http://edocket.access.gpo.gov/2009/E9-24203.htm>) and DOT Order 3902.10 "Text Messaging While Driving", Dec. 30, 2009, SFMTA encourages Contractor to promote policies and initiatives for employees and other personnel that adopt and promote safety policies to decrease crashes by distracted drivers, including policies to ban text messaging while driving, and to include this provision in each third party subcontract involving the project.

XXVI. SEAT BELT USE

In compliance with Executive Order 13043 "Increasing Seat Belt Use in the United States", April 16, 1997 23 U.S.C. Section 402 note, the SFMTA encourages Contractor to adopt and promote on-the-job seat belt use policies and programs for its employees and other personnel that operate company owned, rented, or personally operated vehicles, and to include this provision in each third party subcontract involving the project.

EXHIBIT 5: WARRANTY

1.1 BASIC PROVISIONS

1.1.1 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 SFMTA each complete vehicle 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 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 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 vehicle. 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 this Exhibit, the Contractor shall inform SFMTA of this additional warranty and pass it through to SFMTA at no additional cost to SFMTA.

The Contractor shall ensure that such suppliers, sub suppliers, vendors, and subcontractors satisfactorily perform warranty-related work.

1.1.1.1 Complete Vehicle

The vehicle shall be warranted and guaranteed to be free from defects and related defects for five (5) years, beginning on the date of official Acceptance or Conditional Acceptance of each vehicle. During this warranty period, the vehicle shall maintain its structural and functional integrity. The warranty shall be based on regular operation of the vehicle within the Muni Metro System.

1.1.1.2 Intentionally left blank

1.1.1.3 Subsystem And Components

Primary load carrying members of the vehicle structure shall be warranted against corrosion failure and/or fatigue failure for a period of 12 years.

1.1.1.4 Additional Warranties

If the customary standard warranties for the Material and/or Equipment, and installation thereof, exceed the period specified in Section 1.1.2, such warranties shall run to the SFMTA.

If separate or additional warranties covering the Material and/or Equipment are furnished by the manufacturer, supplier, or seller of component part or parts of any item of said Material and/or Equipment, the SFMTA shall have the right, but not the duty, to benefit from these separate or additional warranties, along with the primary warranties set forth herein above. The SFMTA shall look only to Contractor for fulfillment of all warranty requirements expressed and implied by the making of the Contract.

The existence of any separate or additional warranties that run to the Contractor from the manufacturer, supplier, or installer of a component part of an item of Material and/or Equipment shall not relieve the Contractor of its obligation to repair or replace any of the Material and/or Equipment on account of faulty design, manufacture or workmanship during the warranty period. The SFMTA shall not be required to look to any other party for fulfillment of warranty provisions.

1.1.2 Voiding Of Warranty

The warranty shall not apply to any part or component of the vehicle 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 vehicle shall also be void if 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 SFMTA is the sole cause of the part or component failure.

1.1.3 Exceptions To Warranty

The warranty shall not apply to scheduled maintenance items and items furnished by SFMTA, except insofar as such equipment may be damaged by the failure of a part or component for which the Contractor is responsible.

1.1.4 Detection Of Defects

If SFMTA finds Defects within the warranty period defined in Section 1.1.2 it shall notify the Contractor's representative in writing. Within 5 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 sub-system 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 sub-system or component shall be mutually resolved between SFMTA and the Contractor. Work necessary to commence the inspection or repairs, under the provisions of Section 1.2, Repair Procedures shall proceed immediately after receipt of notification by the Contractor. If within 10 Working Days of notification to Contractor, SFMTA and Contractor are unable to agree whether a Defect is covered by warranty provisions, SFMTA reserves the right to commence repairs and seek reimbursement through Section 1.2 Repair Procedures.

If Contractor independently becomes aware of a Defect in accepted Material and/or Equipment or services, the Contractor shall submit to SFMTA, in writing, within 15 working days a recommendation for corrective actions, together with supporting information in sufficient detail to enable SFMTA to determine what corrective action, if any, shall be taken.

The Contractor shall promptly comply with any timely written direction from the SFMTA to correct or partially correct a Defect, at no cost to the SFMTA. Contractor shall also correct any other systems or components of the Vehicle that have been damaged in any way as a result of the Defect (Collateral Damage).

The Contractor shall also prepare and furnish to the SFMTA data and reports applicable to any correction required under this Section (including revision and updating of all other affected data called for under the Contract) at no cost to the SFMTA.

In the event of timely notice of a decision not to correct, or only to partially correct, the Contractor shall submit a technical and cost proposal within fifteen (15) working days to amend the Contract to permit acceptance of the affected Material and/or Equipment or services in accordance with the revised requirement, and an equitable reduction in the Contract Price shall promptly be negotiated by the parties and be reflected in a Change Order to the Contract.

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1.1.6 Fleet Defects

A fleet defect is defined as cumulative failures of any kind in the same components in the same or similar application where such items are covered by the warranty and such failures occur within the warranty period in at least ten (10) percent of the vehicles delivered under the same Phase of this contract. SFMTA shall have final approval of corrections or changes under these conditions.

1.1.6.1 Correction of Fleet Defects

The Contractor shall correct a fleet defect under the procedures specified in Section 1.2, Repair Procedures. Within ten (10) working days of receipt of notification of a fleet

defect, unless SFMTA grants an extension, the Contractor shall provide SFMTA with a plan, acceptable to SFMTA, specifying how and when all vehicles with defects shall be corrected, including correction of Collateral Damage. Said plan is subject to approval by SFMTA. In addition, after correcting such defects, the Contractor shall promptly undertake and complete a work program, acceptable to SFMTA, reasonably designed to prevent the occurrence of the same defect in all other vehicles and spare parts purchased under this contract. Any proposed changes to a fleet defect work plan or program must be submitted to SFMTA for its approval. If (a) Contractor does not provide a plan for correction within the time specified above (or as extended by 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 vehicles are not corrected in accordance with the Contractor's work program; SFMTA will assess liquidated damages in accordance with Section 19 of the Agreement.

The warranty on parts, components or sub-systems replaced as a result of a fleet defect shall be assigned a new warranty period equal to the original manufacturers or contract part warranty, whichever is longer, effective the replacement date. Any extended warranties shall commence at the conclusion of the new warranty period.

1.1.6.2 Fleet Defect Repairs

When SFMTA requires the Contractor to perform warranty-covered repairs under the Fleet Defect provisions, the Contractor's representative must begin work necessary to effect repairs in a proper and timely manner, within five Working Days after the approval of the retrofit plan/schedule. 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 SFMTA. SFMTA shall make the Car 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 SFMTA for all expenses incurred, including labor for moving Cars, or towing charges for Cars transported, between SFMTA's facilities and Contractor's service center or the facilities of its subcontractors or suppliers.

1.1.6.3 Contractor Supplied Parts

The Contractor shall furnish parts for all warranty work performed by the Contractor.

1.1.6.4 Voiding Of Warranty Provisions

The fleet defect provisions shall not apply to vehicle defects solely caused by noncompliance with the Contractor's recommended normal maintenance practices and procedures or caused solely by abuse of the equipment.

1.1.6.5 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.

1.1.7 Contractor's Representative

The Contractor shall, at its own expense, provide qualified service personnel at the SFMTA facilities in accordance with Section 22.2.7 of Technical Specifications.

1.2 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, 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 SFMTA, for all costs for warranty work performed by SFMTA personnel or by any contractor(s) hired by SFMTA to perform warranty work, as described in Section 1.2.2, Repairs by SFMTA.

1.2.1 Repairs By Contractor

When 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 ten (10) working days after receiving notification of a defect from 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 SFMTA. SFMTA shall make the vehicle 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 SFMTA for all expenses incurred, including labor for driving vehicles, or towing charges for vehicles transported, between SFMTA's facilities and Contractor's service center or the facilities of its subcontractors or suppliers. At SFMTA's option, the Contractor shall repair vehicles at an offsite location, and not on SFMTA's property. If the vehicle is removed from SFMTA's property, the Contractor's representative shall diligently pursue the acquisition of parts and repair procedures. The schedule and scope of the repairs shall be approved by SFMTA.

1.2.2 Repairs By SFMTA

If SFMTA elects to perform or procure a contractor to perform, the warranty-covered repairs, the following shall apply.

1.2.2.1 Parts Used

SFMTA shall use new parts, subcomponents and subsystems that Contractor shall provide specifically for these repairs. 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 Car has been repaired. The warranty on parts, components or sub-systems replaced as a result of a standard warranty repair shall be assigned a new warranty period equal to the original manufacturers or contract part warranty, whichever is longer, effective the replacement date. Any extended warranties shall commence at the conclusion of the new warranty period.

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 SFMTA to the Contractor for reimbursement or replacement of parts or components. The Contractor shall provide forms for these reports.

1.2.2.2 Contractor-Supplied Parts

The Contractor shall warehouse, at the Contractor's service center in San Francisco, all necessary parts to support its warranty obligations. The Contractor shall furnish parts for all warranty work, whether the warranty labor is performed by the Contractor or by SFMTA. Contractor shall deliver, prepaid, warranty parts for repairs within five (5) calendar days of notification from SFMTA.

1.2.2.3 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 a 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.

1.2.2.4 Reimbursement For Labor

Contractor shall reimburse SFMTA for all warranty labor incurred by SFMTA. The amount shall be determined by multiplying the number of man-hours required to correct the defect by the current top mechanic's or technician's hourly overtime wage rate, which includes fringe benefits, multiplied by the project overhead rate (150% of the wage rate). Additionally, Contractor will be responsible for the cost of towing the vehicle if such action was necessary and if the vehicle was in the normal service area.

The wage rate, and therefore, the warranty labor rate, is subject to adjustment each year. Through January 31, 2013, the warranty labor rate shall be based on the technician's wage rate of \$140.00/hour, which includes labor, fringe benefits, and overhead.

In the event SFMTA deems it necessary to contract out for warranty repairs, the Contractor shall reimburse SFMTA for the actual cost of the repair, including charges for any warrantable parts, consequential parts or damages, labor, and towing or transportation.

Contractor shall reimburse SFMTA for warranty claims within 30 days after each claim has been submitted by SFMTA. If SFMTA does not receive payment within 30 Days, SFMTA will deduct the amount of the claim, which includes labor, parts, administrative overhead and towing costs from payments due to Contractor.

1.2.2.5 Reimbursement For Parts; Towing

In the event SFMTA uses its own parts for warranty repairs, the Contractor shall reimburse SFMTA for those parts, including all Defective parts, components, and consequential parts supporting the warranty repair. The reimbursement shall be at the invoice cost of the parts or components at the time of repair and shall include applicable taxes plus a 15% handling fee.

The warranty will include the cost of towing because of the failure of a warranted part. Towing costs consist of the cost any SFMTA labor expended, any parts utilized in the transfer of the Car, and the actual cost of any other transportation costs incurred by SFMTA because of the failure of a warranted part, plus a 15% handling fee.

1.2.3 Warranty After Replacement Or Repairs

The warranty on parts, components or sub-systems replaced as a result of a standard warranty repair shall be as follows: (a) each part or component replaced with a brand new component or part will be assigned a new warranty period equal to the original manufacturer's or contract part warranty, whichever is longer, effective the replacement date, with any extended warranties commencing at the conclusion of the new warranty period; (b) any SFMTA replaced component or part that is a certified rebuilt, certified reconditioned or a certified remanufactured component or part shall be warranted for the remainder of the original warranty period of the component or part, commencing on the replacement date.

1.2.4 Failure Analysis

At 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 vehicles under the terms of the warranty. The analysis shall be documented and compiled into a report. The Failure Analysis Reports shall be delivered to SFMTA Project Manager within sixty (60) calendar days of the receipt of failed parts.

Appendix 4C: NEGOTIATED PROCUREMENT PROCEDURE

[TO BE ADDED]

CITY AND COUNTY OF SAN FRANCISCO
San Francisco Municipal Transportation Agency

Technical Specification

Procurement of New Light Rail Vehicles (LRV4)

CONTRACT No. SFMTA-2013-19

Release for RFP

VOLUME 2

September 30, 2013

1	INTRODUCTION AND GENERAL REQUIREMENTS	1-1
1.1	General.....	1-1
1.2	Abbreviations and Definitions.....	1-1
1.3	Units of Measure.....	1-11
1.4	Description of Work.....	1-11
1.5	Human Engineering	1-13
2	DESIGN AND PERFORMANCE CRITERIA	2-1
2.1	General Design Requirements.....	2-1
2.2	General Vehicle Configuration	2-1
2.3	Operating Environment.....	2-3
2.4	Performance Requirements.....	2-5
2.5	Noise, Vibration, Ride Quality	2-8
2.6	Electromagnetic Interference and Compatibility	2-10
2.7	Service-Proven Design	2-11
2.8	Reliability	2-11
2.9	Maintainability	2-12
2.10	Codes and Regulations.....	2-13
3	CARBODY STRUCTURE.....	3-1
3.1	Performance Requirements.....	3-1
3.2	Validation Requirements	3-3
3.3	Interface Requirements	3-3
3.4	Maintenance Requirements.....	3-3
4	COUPLER.....	4-1

4.1	PERFORMANCE REQUIREMENTS	4-1
4.2	Performance Requirements.....	4-1
4.3	Interface Requirements.....	4-3
5	OPERATOR'S CAB	5-1
5.1	General.....	5-1
5.2	Performance Requirements.....	5-1
5.3	Specific Requirements.....	5-2
6	PASSENGER DOORS	6-1
6.1	General.....	6-1
6.2	Performance Requirements.....	6-1
6.3	Specific Requirements.....	6-1
7	HEATING, VENTILATION, AND AIR COOLING	7-1
7.1	Performance Requirements.....	7-1
7.2	Specific Requirements.....	7-1
7.3	Validation Requirements.....	7-2
8	LIGHTING	8-1
8.1	General.....	8-1
8.2	Performance.....	8-1
8.3	Specific Requirements.....	8-1
8.4	Maintenance Requirements.....	8-2
9	ELECTRICAL	9-1
9.1	GENERAL	9-1
9.2	Specific Requirements.....	9-1

10	PROPULSION	10-1
10.1	Performance.....	10-1
11	TRUCK REQUIREMENTS	11-1
11.1	General	11-1
11.2	Performance Requirements.....	11-1
11.3	Specific Requirements.....	11-1
12	BRAKING EQUIPMENT.....	12-1
12.1	Performance Requirements.....	12-1
12.2	Specific Requirements.....	12-1
12.3	Maintenance Requirements.....	12-1
13	COMMUNICATIONS	13-1
13.1	General	13-1
13.2	Performance Requirements.....	13-1
13.3	Specific Requirements.....	13-1
13.4	Interface with Radio, CAD/AVL System	13-3
13.5	List of SFMTA Defined Equipment.....	13-3
14	AUTOMATIC TRAIN CONTROL.....	14-1
14.1	Specific Requirements.....	14-1
14.2	List of SFMTA Defined Equipment.....	14-1
15	INTERIOR	15-1
15.1	Specific Requirements.....	15-1
16	NOT USED	16-1

17	MONITORING AND DIAGNOSTICS	17-1
17.1	Performance Requirements.....	17-1
18	SOFTWARE SYSTEMS	18-1
18.1	Specific Requirements.....	18-1
19	MATERIALS AND WORKMANSHIP.....	19-1
19.1	General.....	19-1
19.2	Flammability and Smoke Emission Requirements.....	19-1
20	PROGRAM MANAGEMENT AND QUALITY ASSURANCE	20-1
20.1	General.....	20-1
21	REQUIREMENTS MANAGEMENT, DESIGN VALIDATION AND VERIFICATION.....	21-1
21.1	General.....	21-1
21.2	Requirements Traceability Management.....	21-1
21.3	Verification	21-2
22	SYSTEM SUPPORT	22-1
22.1	General.....	22-1
22.2	Specific Requirements.....	22-1
23	OWNER DEFINED EQUIPMENT	23-1
23.1	General.....	23-1
23.2	NOT USED	23-1
23.3	Owner Defined Equipment.....	23-1
23.4	Specific Requirements.....	23-3
	SPECIFICATION INDEX.....	1

APPENDIX A – EXISTING SYSTEM INFORMATION	1
A.1 Wayside Characteristics	1
A.2 Current System Configuration.....	2
A.3 Contract Drawings.....	4
APPENDIX B – MATERIALS AND WORKMANSHIP	1
B.1 General.....	1
B.2 Joining and Fastening	2
B.3 Stainless Steel.....	6
B.4 High Strength Low Alloy Steel.....	7
B.5 Structural Castings	7
B.6 Aluminum	9
B.7 Welding and Brazing.....	10
B.8 Elastomers.....	13
B.9 Glazing Materials.....	14
B.10 Floor Covering.....	15
B.11 Piping and Tubing.....	15
B.12 Air Filters.....	17
B.13 Paints and Coatings.....	17
B.14 Flammability and Smoke Emission Requirements.....	19
B.15 Wood and Panels	20
B.16 Fiberglass Reinforced Plastic	21
B.17 Thermoplastic Sheet.....	22
B.18 Seat Cushion Material.....	23
B.19 Seat Upholstery Material.....	23

B.20	Wire and Cable.....	23
B.21	Wiring Installation	25
B.22	Wiring Connections.....	31
B.23	Conduit.....	34
B.24	Wire Ducts	34
B.25	Junction Boxes.....	35
B.26	Electrical Devices and Hardware.....	36
B.27	Semi-Conductors	38
B.28	Printed Circuit Boards.....	39
APPENDIX C – PROGRAM MANAGEMENT AND QUALITY ASSURANCE.....		1
C.1	GENERAL.....	1
C.2	Specific Requirements.....	6
APPENDIX D – SFMTA TECHNICAL DOCUMENTS INFORMATION.....		1
D.1	General.....	1

1	INTRODUCTION AND GENERAL REQUIREMENTS	1-1
1.1	General	1-1
1.2	Abbreviations and Definitions.....	1-1
1.2.1	Abbreviations.....	1-1
1.2.2	Definitions (Terms).....	1-4
1.3	Units of Measure.....	1-11
1.4	Description of Work.....	1-11
1.4.1	General.....	1-11
1.4.2	Infrastructure Description.....	1-12
1.4.3	Performance.....	1-12
1.4.4	Compatibility.....	1-12
1.4.5	Quality.....	1-13
1.5	Human Engineering	1-13

1 INTRODUCTION AND GENERAL REQUIREMENTS

1.1 GENERAL

These Technical Specifications are a part of the Contract documents specifying the technical requirements for the SFMTA light rail vehicle (LRV) procurement, LRV4. The provisions serve to define the design parameters and functional requirements for the LRVs.

This Technical Specification is meant to be a guide to prospective car builders that defines what is required for functionality. For systems and subsystems where there are no specification details, it is up to the Contractor to propose the most suitable equipment to integrate and operate in the SFMTA environment. In this manner, the Contractor has the flexibility to design LRV4 based on performance with the goal of providing SFMTA with a safe, effective, and reliable fleet with a lower overall cost. The Contractor is fully responsible for the design and integration of this LRV4.

Technical information provided by the SFMTA shall be for the Contractor's guidance and shall not be understood to be necessarily accurate and factual. The Contractor shall verify, inspect, test, or otherwise check the accuracy of information provided by the SFMTA as necessary to assure compliance.

Within this Technical Specification there are references to standards. This is not meant to limit the Contractor to the specific use of those standards, but to provide the Contractor with the minimum requirements of a given subject. Contractors may propose alternative standards and SFMTA will review those on a case by case basis. Contractors that choose to propose alternative standards must submit each request in writing with detailed information including differences between the standard specified and the proposed standard along with any benefit to SFMTA for accepting the alternative. Any requests for alternative standards should be submitted for acceptance during this RFP process.

In the various parts of the Contract Documents where reference is made to applicable codes and standards, the Work shall, except as otherwise specified, conform to the latest issue of the referenced code or standard available at the time the Work is delivered or performed. Upon any point of conflict between codes and standards applicable to the Work, SFMTA shall be notified, but the code or standard imposing the more or most stringent requirement as the case may be shall govern, unless otherwise stipulated by SFMTA in writing.

1.2 ABBREVIATIONS AND DEFINITIONS

1.2.1 Abbreviations

The following acronyms and abbreviations appear in this document. They are defined as indicated:

AAR	Association of American Railroads
ac	Alternating Current
ADA	Americans with Disabilities Act
ANSI	American National Standards Institute

APS	Auxiliary Power Supply
APTA	American Public Transit Association
AREA	American Railway Engineering Association
AREMA	American Railway Engineering and Maintenance Association
ARI	Air Conditioning and Refrigeration Institute
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning
ASIC	Application Specific Integrated Circuit
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATCS	Automatic Train Control System
ATP	Automatic Train Protection
AWG	American Wire Gauge
AWS	American Welding Society
BAFO	Best and Final Offer
BLS	Bureau of Labor Statistics
BOM	Bill of Materials
CAD/AVL	Computer-Aided Dispatch/Automatic Vehicle Location
CCTV	Closed Circuit Television
CCU	Communications Control Unit
CDRL	Contract Deliverables Requirements List
CEM	Crash Energy Management
CFR	Code of Federal Regulations
CPUC	California Public Utilities Commission
DB	Dry Bulb
dB	Decibels
dc	Direct Current
DIN	Deutsche Industrie Norm (German Industrial Standard)
DOT	United States Department of Transportation
DTE	Diagnostic and Test Equipment
DTEM	Diagnostic Test Equipment Manual
DVAS	Digital Voice Announcement System
EB	Emergency Brake
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Standards Engineers
FAI	First Article Inspections
FCC	Federal Communications Commission
FDR	Final Design Review
FEA	Finite Elements Analysis
FMECA	Failure Mode Effect and Criticality Analysis
FRA	Federal Railroad Administration
FRACAS	Failure Reporting And Corrective Action System
FRP	Fiberglass Reinforced Plastic
FSB	Full Service Brake
FTA	Federal Transit Administration

GEBR	Guaranteed Emergency Brake Rate
GPS	Global Positioning System
HRM	Heavy Repair and Overhaul Manual
HSCB	High-Speed Circuit Breaker
HV	High Voltage
HVAC	Heating, Ventilation, and Air Conditioning
HVDC	High Voltage Direct Current
ICD	Interface Control Document
ICEA	Insulated Cable Engineers Association
ICP	Interface Control Plan
IEC	International Electro-technical Committee
IEEE	Institute of Electrical and Electronic Engineers
IPC	Illustrated Parts Catalog
IS	Integrated Schematic
ISO	International Organization for Standards
LAHT	Low Alloy High Tensile Strength (Steel)
LED	Light Emitting Diode
LLRU	Lowest Level Replacement Unit
LRU	Line Replacement Unit
LRV	Light Rail Vehicle
LV	Low Voltage
LVDN	Low Voltage Distribution Network
LVPS	Low Voltage Power Supply
MCWB	Mean Coincident Wet Bulb
MDBF	Mean Distance Between Failure
MDS	Monitoring and Diagnostics System
MIL	Military Specification
MSB	Maximum Service Brake
MTTR	Mean Time to Repair
NDT	Non-Destructive Test
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFL	No Field Lubrication
NFPA	National Fire Protection Association
NTP	Notice to Proceed
OEM	Original Equipment Manufacturer
PA	Public Address
PIN	Personal Identification Number
PDR	Preliminary Design Review
PEI	Passenger Emergency Intercom
PIV	Peak Inverse Voltage
POE	Power Over Ethernet
PTE	Portable Test Equipment
PTU	Portable Test Unit
PVC	Polyvinyl Chloride

QA/QC	Quality Assurance/Quality Control
RFP	Request for Proposals
RMM	Running Maintenance Manual
RMS	Root Mean Square
RTM	Requirements Traceability Matrix
SAE	Society of Automotive Engineers
SFMTA	San Francisco Municipal Transportation Agency,
SSPP	System Safety Program Plan
t	Time
TIG	Tungsten Inert Gas
TWC	Train to Wayside Communications
UL	Underwriters Laboratories, Inc.
UMTA	Obsolete reference for FTA predecessor organization
v	Velocity
VAC	Volts – Alternating Current
VDC	Volts – Direct Current
VHB	Vehicle History Book
WB	Wet Bulb
WLAN	Wireless Local Area Network

1.2.2 Definitions (Terms)

The following terms may appear in this document. They are defined as indicated:

A End – One end of the vehicle shall be designated the A end. This end shall carry the pantograph. The opposite end of the vehicle shall be designated the B end.

A Section – The section of an articulated vehicle at the A end.

Active Cab – The controlling light rail vehicle cab in a train.

ADA - 49 CFR, Part 38, Americans with Disabilities Act (ADA) Accessibility Specifications for Transportation Vehicles.

Adhesion, Coefficient of – During rolling contact, the ratio between the tangential force at the wheel-rail interface and normal force

Agreement (Contract) – The negotiated written agreement executed by SFMTA and the Contractor in conformance with the Contract Documents for the performance of the Work which incorporates and includes the remaining Contract Documents.

Alteration – A change or substitution in the form, character or detail of the work done or to be done within the original scope of the Contract.

Approved or Approved Type – Design, type material, procedure, or method given acceptance by the SFMTA.

Assembly – A collection of subassemblies and components typically performing a variety of functions within the context of a larger system. Examples of assemblies are trucks, electronic control units, air compressors, etc.

Auxiliary Equipment – Any mechanism or structure, other than the vehicle body, traction motor, or propulsion equipment gearing, that performs a function at any time during the operation of the LRV, such as the heating and cooling subsystem, pumps, auxiliary inverter, vehicle door mechanism, air compressor, or light rail vehicle lighting.

Average Brake Rate (V/t) – The speed (V) at which brake force, as measured by motor current or brake cylinder pressure, has ramped up to its full service level, divided by the elapsed time (T) required to go from that speed to a lower speed.

Average Deceleration Rate – The ratio of the light rail vehicle speed at which braking effort achieves the commanded value and the elapsed time from that occurrence to zero vehicle speed. The elapsed time does not include braking effort build up time during jerk limiting and does not include operator reaction time or allowable dead time.

AW0 – Weight of empty ready-to-run vehicle.

AW1 – AW0 plus full seated load, including crew.

AW2 – AW1 plus standees at 4 passengers/M²

AW3 – AW1 plus standees at 6 passengers/M².

B Section – the section of an articulated vehicle at the B end.

Blending – In braking, the simultaneous control of dynamic (rheostatic and regenerative) and friction braking, with the effort of each continuously proportioned to achieve the required total braking effort.

Braking Effort – Retarding force developed by the propulsion subsystem, braking subsystem, or a combination of both subsystems.

Burn-In – Operating a component, system, or device in a test mode, often in an extreme or cycled temperature environment, for a specified period of time or distance, to confirm reliable operation.

Car – SFMTA Light Rail Vehicles, also referred to as "LRV4's" and "vehicles."

Car Stop – Street level stops, mainly at intersections where passengers may board and alight trains.

Catenary – Overhead power supply consisting of a combination of conductors and other hardware suspended above the tracks by means of cantilevers and wayside structures.

Coast – The mode of operation in which no propulsion (positive traction) or braking effort is in effect, except for normal drive train losses.

Compatibility – The condition where vehicle performance and control are operationally identical between two or more vehicles. Compatibility will allow multiple vehicles to couple together, with control of systems on all vehicles being effected by any lead vehicle of the consist.

Component – Portions of equipment not typically repaired or disassembled, such as nuts, bolts; resistors, fittings, single-piece castings. Used interchangeably with "parts".

Console – The control panel located in the cab of a light rail vehicle directly in front of the operator's seat.

Contact Line – A system that conducts electric power between the wayside and a vehicle. Can consist of third rail, catenary, or trolley wire.

Contract Drawings – Drawings provided by the SFMTA as part of this procurement.

Contractor's Drawings – Items such as general drawings, detail drawings, graphs, diagrams, sketches, calculations, and catalog cuts prepared by the Contractor for use in its manufacturing facility, assembly facility, or shop, to fabricate, assemble, and install parts of the vehicle whether manufactured by it from raw materials or purchased from others in a ready to use condition.

Coupler – A device for mechanically coupling light rail vehicles together. This term is also applied to connectors, as in "electric coupler" and "pneumatic coupler."

Critical Path – In a production schedule, a sequence of stages toward the achievement of a final task that accounts for all other tasks that must be completed in order to accomplish the final task.

Deadman Feature – A device designed to detect a lack of attention or disability of an operator and to automatically apply full-service braking when it detects such lack of attention or disability.

Design Life – The period of time for which the light rail vehicle is intended to be safely and reliably usable for its original purpose.

Draft Gear – The resilient portion of the coupler device that cushions buff and draft forces transmitted between coupled vehicles.

Drive – A system consisting of one or several motors or actuators, their direct control equipment (power circuits) and the associated mechanical devices required to produce tractive effort.

Dwell – The period of time from the instant a train stops at a station until the instant the train resumes moving.

Dynamic Braking – Braking which is not part of the friction braking system and is instead produced by the Drive.

Electric Braking – A type of Dynamic Braking in which the power generated by the traction motors, when driven as generators, is either regenerative or is dissipated in resistor banks.

Emergency Stop – The stopping of a light rail vehicle or train by an emergency brake application. Once initiated, the emergency brake application cannot be released until the light rail vehicle or train has stopped.

Equal – Providing the same function, performance, and reliability.

Failsafe – A design principle of a system or hardware configuration that ensures that a failure shall not result in an unsafe condition.

Failure – A condition in which equipment does not function as specified, designed, or expected.

Failure Reporting And Corrective Action System – A system that will record all failures during production, functional testing (at the Contractors Facilities and on-site at SFMTA), identify the systematic failure data collection, management, analysis, and corrective action implementation.

Failure, Service – Any failure that prevents a vehicle from being placed into service or from completing a trip as scheduled.

Failure Rate – The frequency of failure, expressed as failures per hour or failures per mile; the mathematical reciprocal of MTBF or MDBF.

First Article – The first item produced that conforms and defines all subsequent production items. First articles are intended for review by the SFMTA.

Form, Fit and Function – The physical attributes of a device that allow the device to be used in place of another device due to similarities of general shape (outline, clearances), mounting arrangement (footprint), and operation (inputs/outputs) of the device.

Full Service Braking – The maximum braking effort employed to stop a light rail vehicle in the absence of an emergency stop signal.

Gauge, Track – The distance between the inside face of rails, usually measured $\frac{5}{8}$ -inch below the top of the centerline of heads of running rails and at a right angle thereto.

Headway – The time separation between two trains, both traveling in the same direction on the same track, that is measured from the time the front end of the leading train passes a given reference point to the time the front end of the train immediately following passes the same reference point.

High Voltage – See Primary Power.

Indicated – As presented in this document.

Inspector – The person or firm designated by the SFMTA as its quality control representative.

Interface – The points where two or more systems, subsystems, or structures meet, transfer energy, or transfer information.

Interface Control Plan – Contractor provided plan that will identify all vehicle to wayside interfaces, validate the accuracy of the interface, and document how the design accommodates all interfaces.

Interlock – A condition whereby one function is dependent on the operation of another function.

Irretrievable – Describes an application of the brakes that cannot be released until the train is at zero speed.

Jerk – Time rate of change of acceleration and deceleration, equal to the second derivative of velocity.

Lead Vehicle – In the direction of travel, the forward-most light rail vehicle of the train.

Left Hand – Left side of the light rail vehicle when one is facing the windshield of the “A” end of the vehicle from inside the vehicle.

Light – The transparent portion of a window.

Line Replaceable Unit (LRU) – A component of a system that when failed or in need of repair, is intended to be exchanged and repaired off of the vehicle. The exchange, including removal of one component and installation of its replacement, is designed to be accomplished within one working shift.

Liner (as in interior liner) – The visible covering material for the walls, ceiling, and other interior surfaces.

Load Weighing – The measurement of total passenger weight for the purpose of adjusting tractive effort to produce a constant acceleration or braking rate.

LRT System (MUNI Metro System)– SFMTA’s light rail transit infrastructure, facilities, systems, services, and vehicles dedicated to public transportation within the SFMTA’s geographical territory.

Maintainability – The degree to which any system or equipment can be rapidly, easily, effectively, and properly maintained.

Manufacturer – The builder or producer supplying materials, equipment, or apparatus for installation on the car.

Mask, Window – Interior liner that surrounds the windows, often molded to include the sill and other portions of the sash.

Mean Distance Between Failures (MDBF) – The mean operating mileage between independent failures.

Mean Distance Between Component Failures (MDBCF) – The mean operating mileage between independent failures of a component.

Mean Distance Between Service Failures (MDBSF) – The mean operating mileage between independent service failures.

Mean Distance Between Train Delays (MDBTD) – The mean operating mileage between train delays caused by equipment or system failures.

Mean Time Between Failures (MTBF) – The mean operating time between independent failures.

Mission Profile – An analysis of the operating environment of the LRV to include environmental conditions (in tunnel and surface - averages and extremes), operating mileage, operating hours, duty cycles, and time factor utilization. The Mission Profile is used for Reliability predictions and analysis.

No Motion – The vehicle speed at or below the lowest speed detectable by the vehicle control systems.

Operator – The individual onboard who is responsible for the light rail vehicle and train operation.

Pantograph – A device used for current collection from an overhead contact line. It consists of a dual-strip electrical collection shoe carried by a collapsible and adjustable frame.

Part – See component, above.

Performance – The measure of output or results obtained by a component, system, person, team, etc., as specified in the Contract Documents.

Primary Power – The unconditioned electric power that enters the propulsion system, either from external current collection means or from an on-board prime mover.

Procurement – The furnishing of all the items, materials, equipment, data, design, services, management, labor, and incidentals specified or otherwise necessary for timely and properly designing, manufacturing, delivering, and testing the LRVs or otherwise completing the Work.

Proof (used as a suffix) – As in splashproof, dustproof. The device and contents are impervious to, or unharmed by, application of the indicated material.

SFMTA Supplied Equipment – Equipment furnished by the SFMTA to the Contractor for installation in or on an LRV.

Recovery Time – The time required for a system or condition to return to its original state (or some stated percentage of its original value) after being disrupted or destabilized.

Redundancy – The existence in a system of more than one means of accomplishing a given function.

Regenerative Braking – Electric braking where the power generated by the traction motors, when driven as generators or alternators, is conditioned and returned to the contact line or on-board energy storage.

Reliability – The probability of performing a specified function, without failure and within design parameters, for the period of time indicated.

Revenue Service – The provision of transportation services to the SFMTA's customers.

Right Hand – Right side of the light rail vehicle when one is facing the windshield of the "A" end of the vehicle from inside the vehicle.

Service – As in Service Use, Service Braking. The operation of the cars under normal conditions.

Service Proven Design – Any component, system, or subsystem that has a proven history of successful operation in revenue service similar to that of the LRV System. Proof of successful operation shall be substantiated by submission of reliability/failure data, service time and location, modification information, and maintenance records as required by the Contract Documents.

Slide, Wheel – During braking, the condition when the rotational speed of the wheel is less than that for pure rolling contact between tread and rail.

Slip, Wheel – While tractive effort is applied, the condition when the rotational speed of the wheel is greater than that for pure rolling contact between tread and rail.

Spare Parts – Components supplied by the Contractor to the SFMTA intended for use in maintenance or repair of vehicles.

Speed, Balancing – The speed attained by the vehicle or train when resisting forces exactly equal applied tractive forces.

Speed, Base – The speed to which the maximum constant acceleration can be maintained at the nominal line voltage or rated prime mover output.

Speed, Schedule – The average speed of a vehicle or train, from terminal to terminal, obtained by dividing the distance between these points by the time taken to make the trip including time for intermediate station stops.

Spin, Wheel – see Slip, Wheel.

Start-Up Spare Parts – Spare parts provided by the Contractor to support the LRVs first delivered to SFMTA.

Station Stops – Locations identified on SFMTA’s MUNI Metro System Maps where passengers board and alight trains during revenue service. Also see Car Stop.

Stop, Emergency – The stopping of a vehicle or train by an emergency brake application.

Stop, Service – The stopping of a vehicle or train by application of service braking.

Subassembly – A collection of components used to perform a distinct function, usually in conjunction with other subassemblies and components, as part of a larger system. Subassemblies are usually replaceable as units, such as circuit boards, bearings, and valves.

Superelevation – On a curve, the vertical distance, measured in inches that the outer rail is above the inner rail.

Technical Provisions - see Technical Specifications as defined in the Agreement.

Tight (used as a suffix) – As in watertight, airtight. Enclosed or protected as to completely exclude the indicated material from passage.

Time Constant – Slope of curve in units of controlled variable per unit of time, measured during the buildup time interval.

Time, Build-Up – In response to a step-forcing function, time interval from 10% of the total change in value to the attainment of 90% of the total change in value of the controlled variable. Build-up time is equal to response time minus dead time.

Time, Dead (also Time, Reaction) – Time from the occurrence of a step change of the control signal to the attainment of 10% of the total change in value of the controlled variable.

Time, Down – The time during which equipment is not capable of doing useful work because of maladjustment, malfunction, or maintenance in progress.

Time, Response – Time from the occurrence of a step change of control signal to the attainment of 90% of the total change in value of the controlled variable.

Time, Warm-up – The elapsed time from application of power to an operable device until it is capable of performing its intended function.

Traction System – The system of wheels, motors, gears, brakes, direct controls, and appurtenances that propels or retards a car in response to control signals.

Tractive Effort – The horizontal force that is measured at the wheel-rail interface.

Train – Any number of vehicles, from one to four, coupled together and moving as one.

Trainline – The means of sending a signal to all light rail vehicles in a consist via a continuous electrical or pneumatic circuit connected through appropriate coupling devices.

Tram – Short form referring to trammel point inspection of truck frames for squareness. "In tram" is the condition of ideal truck geometry in which the axles are perfectly parallel and the wheels longitudinally in perfect alignment. The centers of the journal bearings represent the corners of a perfect rectangle. Verification that a truck is in tram is determined by measuring the diagonal and longitudinal distance between reference points on the axle bearing housings.

Vehicle – A single operating unit, which may consist of one or more sections.

Wainscot – The lower portion of a wall, especially if finished differently from the upper portion.

Warm Up Time – The elapsed time from application of power to an operable device until it is capable of performing its intended function.

Warp, Track – The vertical distance between the plane of any three of four rail head contact points (two on each rail) forming a rectangle and the remaining point.

1.3 UNITS OF MEASURE

A	- Ampere
Btu	- British Thermal Unit
dB	- Decibel
dBA	- Decibel on the 'A' weighted scale
ft	- Foot
ft ³ /min	- Cubic Feet per Minute
g	- Acceleration due to Gravity (32.2 ft/s ²)
h	- Hour
Hz	- Hertz
in	- Inch
J	- Joule
kg	- Kilogram
kWh	- Kilowatt hour
lb	- Pound
lbf	- Pound force
mph	- Miles per hour
mphps	- Miles per hour per second
mphpsps	- Miles per hour per second per second
min	- Minute
mV	- Millivolt
μV	- Microvolt
N	- Newton
oz	- Ounce
psi	- Pounds force per square inch
s	- Second
V	- Volt
°C	- Degrees Celsius
°F	- Degrees Fahrenheit

1.4 DESCRIPTION OF WORK

1.4.1 General

The Work shall include the designing, manufacturing, testing, furnishing, delivery, and performance testing of New LRVs. The Work shall also include delivery of data, manuals, drawings, training and support services, spare parts, special tools, and test equipment which shall be delivered as specified in the Contract Documents. Contractor may deviate from these requirements only with specific approval of the SFMTA.

1. Contractor Responsibilities:

- a. The Contractor is responsible for the design and integration of all vehicle systems such that all specified requirements are achieved without conflict or error within or between systems.
- b. The Contractor is responsible for the selection, application, and integration of equipment and materials as necessary to conform to specified requirements.
- c. All equipment provided under this Contract shall be new. Rebuilt or refurbished equipment is prohibited. New equipment damaged during execution of this Contract may be restored to new condition only where approved by the SFMTA on a case-by-case basis, and all restorations shall be performed by the original equipment manufacturer.
- d. The Contractor shall be responsible for becoming familiar with the SFMTA's LRT System. The SFMTA will make available for review existing information upon request at a mutually convenient time and place.
- e. The Contractor shall ensure the LRV4 accommodates all existing conditions on the SFMTA system, whether or not they are defined in this specification. During the design phase the Contractor shall be responsible for validating all interfaces between the LRV and its subsystems with all wayside elements through an Interface Control Plan (ICP) that will identify all interfaces, validation that the wayside interface is accurate, and documenting how the Contractor is addressing each interface throughout the entire design phase.

1.4.2 Infrastructure Description

1. The LRV shall operate safely on the infrastructure used by the SFMTA. The characteristics of this infrastructure are provided in Section 2 of this Specification. In addition, the Contractor shall be responsible for becoming familiar with the SFMTA's LRT System, and the Contractor bears the responsibility for confirming the correctness of the detailed system information described in this specification as it relates to the Contractor's design.

1.4.3 Performance

The LRV shall meet the performance requirements of the SFMTA which are contained in this Specification. The Contractor's test plan shall include elements that demonstrate the ability of the vehicle to meet the performance requirements of the SFMTA.

1.4.4 Compatibility

The vehicle shall be fully compatible with SFMTA's existing infrastructure, including maintenance facilities. Mechanical compatibility with the existing LRV2/3 vehicle fleet is also required as described in these specifications. The Contractor shall provide an interoperability and compatibility report describing the compatibility of the LRV4 with the existing LRVs and the wayside/facilities elements.

1.4.5 Quality

Manufacturing, quality control and quality assurance shall be equivalent to the requirements set forth in Section 19, Materials & Workmanship. The workshop practices and manufacturing control procedures shall produce a product quality consistent with the installation, assembly and part drawings.

1.5 HUMAN ENGINEERING

The car design shall take into consideration the human factors engineering of the U.S. adult population anthropomorphic data and be based on human factors engineering, with the range of people from the 2.5 percentile female to the 97.5 percentile male as defined by "The Measure of Man & Woman".

2	DESIGN AND PERFORMANCE CRITERIA.....	2-1
2.1	General Design Requirements.....	2-1
2.2	General Vehicle Configuration	2-1
2.2.1	General Characteristics	2-1
2.2.2	Seating Arrangement	2-1
2.2.3	Elderly and Disabled Accessibility	2-1
2.2.4	Identification.....	2-2
2.2.5	Critical Vehicle Dimensions	2-2
2.2.5.1	Car Body Dimensions	2-2
2.2.5.2	Pantograph Dimensions	2-2
2.2.5.3	Wheel Dimensions	2-2
2.2.5.4	Truck Dimensions	2-2
2.2.6	Clearance Requirements	2-2
2.2.6.1	General.....	2-2
2.2.6.2	Dynamic Envelope	2-3
2.2.6.3	Station Platform Interface	2-3
2.2.7	Weight and Passenger Loading.....	2-3
2.3	Operating Environment.....	2-3
2.3.1	Right-of-Way Description	2-3
2.3.2	Vehicle Dynamic Analysis	2-3
2.3.3	Climatic Conditions	2-4
2.3.3.1	Vehicle Operational Climate Conditions	2-4
2.3.3.2	HVAC Design Conditions	2-4
2.3.4	Fordability.....	2-4
2.3.5	Supply Voltages.....	2-5
2.3.6	Wayside Power Supply	2-5
2.3.7	Low Voltage Power System.....	2-5
2.4	Performance Requirements.....	2-5
2.4.1	General.....	2-5
2.4.2	Propulsion and Braking Assumptions.....	2-5
2.4.3	Contact Line Voltage Range.....	2-5

2.4.4	Acceleration Requirements	2-6
2.4.5	Speed Requirements	2-6
2.4.6	Service Brake Requirements	2-6
2.4.7	Emergency Braking Requirements	2-6
2.4.8	Wheel Spin/Slide Correction	2-7
2.4.9	Jerk Limits	2-7
2.4.10	Parking Brake	2-7
2.4.11	Duty Cycle Rating	2-7
2.5	Noise, Vibration, Ride Quality	2-8
2.5.1	General.....	2-8
2.5.2	Pure Tones	2-8
2.5.3	Interior Noise	2-8
2.5.4	Wayside Noise Limits.....	2-8
2.5.5	Ground Borne Vibration	2-9
2.5.6	Vibration Generation	2-9
2.5.7	Vibration and Impact Loads.....	2-9
2.5.8	Ride Quality.....	2-9
2.5.9	Curving and Derailment Safety	2-9
2.5.10	Stability.....	2-9
2.6	Electromagnetic Interference and Compatibility	2-10
2.6.1	General.....	2-10
2.6.2	EMC Plan	2-10
2.6.3	Field Conducted Emission Limit and Test.....	2-10
2.6.4	Field Inductive Emission Limit and Test.....	2-10
2.6.5	Field Radiated Emission Limit and Test.....	2-10
2.6.6	Field Radio Frequency Immunity Test	2-10
2.6.7	Reports.....	2-11
2.7	Service-Proven Design	2-11
2.8	Reliability	2-11
2.8.1	General.....	2-11
2.9	Maintainability	2-12

2.9.1	General.....	2-12
2.9.2	Maintenance Plan.....	2-12
2.9.3	Maintenance.....	2-13
2.10	Codes and Regulations.....	2-13

2 DESIGN AND PERFORMANCE CRITERIA

2.1 GENERAL DESIGN REQUIREMENTS

1. Contractor shall design and manufacture the LRV to operate successfully within the SFMTA's environment as described herein.
2. Subject to the Contractor's recommended maintenance practices and normal industry accepted operating procedures; Contractor shall design the LRVs for the following normal revenue service characteristics in the SFMTA's environment:
 - a. A Maximum Revenue Service Speed (MRSS) of 50 mph,
 - b. A minimum service life of 25 years,
 - c. Annual average mileage of 40,000 miles per vehicle.
3. Life cycle costs are of the utmost importance to SFMTA. Therefore Contractor shall design the LRV to minimize such costs by focusing on reliability, ease and quantity of preventive maintenance, ease of corrective maintenance, low weight and low overall energy consumption.

2.2 GENERAL VEHICLE CONFIGURATION

2.2.1 General Characteristics

1. The car body shall have multiple sections, joined by articulations.
2. The vehicle shall be of a high floor design, with provision for both high and low level boarding.
3. The vehicle shall be equipped with sufficient passenger doorways to minimize load/unload times, consistent with the existing fleet (which has four doorways per side), and minimize station dwell times.
4. The vehicle shall feature a fully equipped operator's cab on each end of the vehicle.
5. The vehicle shall feature equal operation, control, and performance in both directions.
6. The vehicle shall be capable of normal multiple unit operation in consists of up to four LRVs, and in emergency towing situations, consists of up to eight LRVs.

2.2.2 Seating Arrangement

1. The predominant seating arrangement shall be transverse, bi-directional, knee-to-back, and four abreast (2 plus 2) unless otherwise accepted by SFMTA.
2. A minimum aisle width of 32 inches between transverse seats and continuously from one end of the car to the other end shall be provided.
3. A minimum of 60 passenger seats per LRV is desired; however passenger capacity and flow for boarding and alighting should take precedence.

2.2.3 Elderly and Disabled Accessibility

1. Space shall be provided in each end of the vehicle, immediately adjacent to the side doors to accommodate at least two wheelchairs per end (four spaces per vehicle).

Because of infrastructure constraints, the existing locations cannot change and shall be in each end of the vehicle, adjacent to the end door closest to the cab.

2. Flip down seats may be provided in wheelchair areas to provide additional seating capacity when the areas are not in use

2.2.4 Identification

1. The numbering scheme shall utilize four-digit numbers as specified by the SFMTA.

2.2.5 Critical Vehicle Dimensions

2.2.5.1 Car Body Dimensions

1. Length of car shall be not greater than 75 feet over coupler faces.
2. Width of car shall be as wide as possible consistent with the structural constraints of the SFMTA system.
3. Height of car (including locked down pantograph) shall be not greater than 11 feet 6 inches.

2.2.5.2 Pantograph Dimensions

1. The minimum pantograph operating height, at any car weight and any condition of wheel wear, shall be 12 feet 2 inches.
2. The maximum pantograph operating height, at any car weight and any condition of wheel wear, shall be not less than 19 feet.
3. The pantograph head shall be sized to maintain contact without dewirement under all conditions of wire stagger and offset and vehicle throw due to curvature and sway due to roll.

2.2.5.3 Wheel Dimensions

1. The wheel tread profile shall be optimized by the Contractor to minimize derailment risk, noise and wear, and to maximize wheel life and truing interval, while operating on the SFMTA infrastructure.

2.2.5.4 Truck Dimensions

1. The truck spacing, centerline to centerline, shall be 24 feet and consistent with SFMTA's maintenance facilities layouts for jacking and lifting.

2.2.6 Clearance Requirements

2.2.6.1 General

1. Vertical undercar clearance shall be at least 2 in from top of rail with the maximum suspension deflection and Car Body roll, minimum vertical curve radius, and fully worn wheels.
2. Clearances between truck components and the Car Body shall be sufficient to avoid contact under all normal and degraded operating conditions.

2.2.6.2 Dynamic Envelope

1. The dynamic envelope and swept path of the vehicle shall be based on that shown in the Contract Drawings for all normal operating conditions and certain abnormal conditions which could include a reasonable combination of failed suspension elements. However the Contractor is required to verify existing conditions to ensure worst case conditions are identified and addressed in the design of the LRV, including actual clearance conditions. If the Contractor wishes to use a larger envelope, then responsibility for validation of such an envelope shall rest with the Contractor.

2.2.6.3 Station Platform Interface

1. The LRV shall provide ADA compliant level boarding at high level platforms (new vehicle/new station requirements will apply) and shall provide ergonomically appropriate stepping from low level platforms to the car floor.
2. Station platform heights on the SFMTA system are nominally 34 inches above top of rail for high platform stations, and at varying elevations of sidewalk height elsewhere, with platform edges of high level platforms at a nominal 56 inches from track centerline.
3. Station platforms occur on both curved and graded track. There is one non-tangent high platform, at Castro Station, and the steepest stop is 9%.
4. There are high-blocks at the leading ends of some low level stations, for wheelchair access. Doorways shall be compatible with wheelchair access at such stations.
5. An LRV mounted between car barrier system shall be provided to comply with ADA requirements at high level station platforms.

2.2.7 Weight and Passenger Loading

1. The maximum desired AW0 vehicle weight shall be 76,000 pounds.
2. The maximum AW3 vehicle weight shall be 110,000 pounds. All equipment shall be arranged so that its weight is distributed to maximize adhesion and minimize the propensity to derail.
3. Moveable steps may be considered when calculating passenger loading.

2.3 OPERATING ENVIRONMENT

2.3.1 Right-of-Way Description

1. See Appendix A for a System Description and the Contract Drawings of the SFMTA's operating right-of-way. SFMTA will provide the Contractor with SFMTA track maintenance standards and route profile. However, the Contractor is required to verify existing conditions to ensure worst case conditions are identified and addressed in the design of the LRV, including actual track conditions.

2.3.2 Vehicle Dynamic Analysis

1. The Contractor shall demonstrate the performance of the vehicle for safety against derailment during low speed curving, and freedom from truck hunting at all operating speeds.

2.3.3 Climatic Conditions

2.3.3.1 Vehicle Operational Climate Conditions

1. The vehicle shall be capable of full operational functionality and performance in the SFMTA's operating climate, defined by the normal and expected climatic design information for the City of San Francisco contained within the latest edition of the ASHRAE Handbook.
2. The vehicle shall be suitable for operation in the presence of normal and expected amounts of sand, dust, trash, and leaf accumulation on the streets and rights of way in the SFMTA's operating environment.

2.3.3.2 HVAC Design Conditions

1. The acceptable interior Temperature range for the vehicle is 72 degrees Fahrenheit to 78 degrees Fahrenheit, for ambient temperatures 95 degrees Fahrenheit and below.
2. For ambient temperatures above 95 degrees Fahrenheit, the LRV interior temperature shall be kept to 20 degrees Fahrenheit less than ambient.
3. The HVAC system shall be designed to maintain the above interior temperatures, while the vehicle is subjected to the following ambient environmental conditions as specified in the Climatic Design Information chapter of the latest edition of the ASHRAE Handbook.
 - a. Minimum ambient dry bulb temperature (Extreme Annual DB, Mean, Max),
 - b. Maximum ambient dry bulb temperature (Extreme Annual DB, Mean, Min),
 - c. Cooling design dry bulb and coincident wet bulb temperatures (Cooling DB/MCWB, 1%),
 - d. Heating design dry bulb temperature (Heating DB, 99%).
4. The HVAC system shall also be subjected to the following design conditions:
 - a. The passenger loading shall be taken at the AW2 condition, at 450 BTU/hr (132 Watts) per passenger at 50% sensible heat ratio (cooling),
 - b. Fresh airflow to the car shall be a minimum of 5.0 ft³/min/passenger,
 - c. The solar load shall be per ASHRAE recommendations,
 - d. Interior relative humidity shall be 50% maximum.
5. The heating capacity shall be sufficient to raise the fresh air temperature from the winter design day ambient temperature to the required interior temperature as stated within 30 minutes.
6. The cooling capacity shall be sufficient to lower the fresh air temperature from the summer design day ambient temperature to the required interior temperature as stated within 30 minutes.

2.3.4 Fordability

1. With maximum wheel wear, the LRV shall operate without damage or equipment malfunction in water up to 3 in above the top of rail, at speeds up to 10 mph.
2. A stationary vehicle, not connected to line power, shall not be damaged by water levels up to 6 in above top of rail.

2.3.5 Supply Voltages

1. Unless otherwise specified, rated performance and full functionality shall be delivered at any voltage between nominal and maximum voltages.
2. All equipment on the vehicle shall be self-protected from damage and improper operation due to:
 - a. High-voltage transients across the supply terminals of that equipment,
 - b. High-voltage transients impressed between either supply terminal and the vehicle body, and
 - c. Long-term over-voltage and under-voltage conditions resulting from other equipment failure modes.

2.3.6 Wayside Power Supply

1. All equipment on the vehicle shall be protected from damage or continued shutdown caused by random interruptions of the contact line system power due to isolation gaps, contact shoe bounce, or other conditions.

2.3.7 Low Voltage Power System

1. Where circuits are powered through trainlines, powered apparatus shall function satisfactorily in all vehicles, including the last vehicle of a maximum train, with the trainlines powered from the low voltage power system of the lead vehicle.

2.4 PERFORMANCE REQUIREMENTS

2.4.1 General

1. The following establishes the performance required of the LRV, whether in a single vehicle consist or multiple unit consist of up to the maximum specified length, and of similar or dissimilar weights, as specified below.

2.4.2 Propulsion and Braking Assumptions

1. All specified acceleration, braking and jerk rate requirements are based on level tangent dry track in still air except as otherwise noted.
2. All specified performance capabilities shall be provided over the full-specified range of the following:
 - a. Wheel wear,
 - b. Ambient temperatures.

2.4.3 Contact Line Voltage Range

1. Vehicle equipment shall be designed and tested for operation at nominal 600 VDC power, but normal voltage variations and power isolation gaps shall not cause damage.
2. Line voltage ranges from 450 VDC to 750 VDC, with occasional voltage spikes of 1,800 volts peak with a duration of 30 milliseconds.
3. All equipment shall be designed for required performance provided down to 575 VDC supply voltage. Performance may be degraded between 575 and 450 VDC.

4. Above 575 VDC, the tractive effort versus speed characteristic shall not vary as a function of catenary voltage.
5. Full specified dynamic braking rates shall be available at the nominal or higher catenary voltage during regenerative braking.
6. Once dynamic brake is initiated, full specified dynamic braking rates shall be available whenever catenary is not receptive and with no catenary voltage present.
7. For line voltages outside the normal 450-750 VDC limits, equipment may be designed to shut down or operate at modified performance levels.

2.4.4 Acceleration Requirements

1. The vehicle shall provide acceleration capabilities on level tangent track as follows:
 - a. Full acceleration average rate at master controller maximum power position of 3.0 mphps \pm 5% at all vehicle weights from AW0 to AW2, and shall be available to at least 20 mph. At loads greater than AW2, tractive effort shall be held at the AW2 level.
 - b. From a standing start, time to reach 50 mph shall not exceed 35 s, at AW2 loading.
 - c. In addition, from zero speed, the vehicle shall travel a minimum of 600 feet in 20 seconds.
 - d. These times shall be measured from change in trainline signals to the propulsion equipment.

2.4.5 Speed Requirements

1. The maximum design speed of the vehicle shall be 55 mph with all conditions of wheel wear.
2. Actual operating speed shall be limited to 52 mph by over-speed protection.

2.4.6 Service Brake Requirements

1. The full service brake (FSB) for all vehicle weights up to AW3 and speeds from 50 mph to 0 mph shall provide an average retardation rate of 3.5 mphps \pm 5%, with a maximum rate of 4.0 mphps and a minimum rate of 3.0 mphps.
2. Braking rates shall also be in compliance with CPUC GO143B.

2.4.7 Emergency Braking Requirements

1. Release of the Deadman Handle shall cause a Full Service Brake application.
2. Application of Emergency Braking (EB) shall be available by actuating the console EB push button switch, or the Emergency brake position on the Master Controller.
3. EB is considered a safety system. The friction brake system (disc only) shall have the capability of producing at least one stop from maximum service speed under AW3 loading in case of dynamic brake failure.
4. A Guaranteed Emergency Brake Rate (GEBR) is required by ATCS system. See Section 14 Automatic Train Control for details.

5. For EB brake entry speeds below 30 mph the average deceleration rate shall be a minimum of 5.0 mphps.
6. Braking rates shall also be in compliance with CPUC GO143B.
7. The following adhesion levels are provided as information only and the Contractor should verify by field testing to determine actual adhesion levels. It is anticipated that in tunnels, an adhesion level of 16% can be achieved and that elsewhere the adhesion level may be lower than 11.4%.

2.4.8 Wheel Spin/Slide Correction

1. A system shall be provided to detect and correct wheel spin and slide on each vehicle whether random or synchronous on an individual truck basis, both in acceleration and braking.
2. The spin/slide system shall be designed for safe operation such that a spin/slide system failure must not prevent the application of braking at any level less than desired, in any braking mode.
3. The spin/slide system shall be functional under all acceleration and all dynamic and disc braking commands except for emergency brake applications initiated by the console EB pushbutton switch.
4. The spin/slide system shall comply with CPUC GO143B.

2.4.9 Jerk Limits

1. In response to a step input command signal, the average rate of change of actual acceleration or deceleration, after any mode change dead time, shall be between 2.0 mphpsps and 3.0 mphpsps.
2. Emergency brake applications shall not be jerk limited.

2.4.10 Parking Brake

1. The parking brake system shall be capable of holding a vehicle at all weights up to AW3 on a 9% grade indefinitely.
2. The parking brake system shall comply with CPUC GO143B.

2.4.11 Duty Cycle Rating

1. The vehicle shall be capable of continuous operation on any SFMTA route without exceeding the continuous rating of any equipment, under the following conditions:
 - a. A constant AW2 load,
 - b. A dwell time of 15 s at each stop,
 - c. Acceleration and braking at maximum service rates,
 - d. Operation to and maintenance of maximum track speeds,
 - e. A one minute layover at each end of the line.
2. In addition, a train with an AW3 load shall be capable of pushing or towing another unpowered, unbraked train of equal length with an AW3 load from the point of equipment failure to the next stop, and then at AW0 load to the end of the line in the

- original direction of travel, at reduced speeds, without damage or reduction in equipment life.
3. The vehicle shall be capable of operating at speeds of 5 mph or less continuously at AW2 on any portion of the SFMTA's line, without overheating or damage to the vehicle.

2.5 NOISE, VIBRATION, RIDE QUALITY

2.5.1 General

1. Unless otherwise indicated, noise level (as defined by the latest version of ANSI S1.4) is the weighted sound pressure level measured by the use of a metering characteristic and weighing A, B, or C as specified in ANSI S1.4. The unit of noise level is decibels (dB), and the reference pressure is 20 micropascals.

2.5.2 Pure Tones

1. The maximum allowable noise level shall be reduced by at least 3 dB if significant pure tones in the range from 250 Hz to 4,000 Hz are present in the noise.
2. Pure tone noise shall be considered significant in this context if any one-third octave band sound pressure level is 5 dB, or more, higher than the arithmetic average of the 2 adjacent bands containing no pure tones.

2.5.3 Interior Noise

1. The vehicle shall meet the following interior noise level as measured in an open section:
 - a. With the vehicle stationary with windows and doors closed, with all auxiliary equipment operating simultaneously under normal operating conditions, the interior noise level shall not exceed 72 dBA.
 - b. With the vehicle stationary and any one system of equipment operating at normal conditions, the vehicle interior noise shall not exceed 68 dBA.
 - c. With the vehicle operating on the SFMTA's system, on non-corrugated, appropriately lubricated rail, at any speed up to the maximum permitted, in any curve down to 45 ft radius, and under any acceleration or deceleration condition, interior noise shall not exceed 78 dBA.

2.5.4 Wayside Noise Limits

1. The measurement shall be taken at a distance of 50 ft from the centerline of the track, 5 ft the above ground.
2. Average noise levels emanating from the vehicle shall not exceed the following levels with all auxiliary equipment operating simultaneously:
 - a. Vehicle stationary, empty: 68 dBA,
 - b. Vehicle empty, on tangent track in motion under all conditions of speed and acceleration or braking: 75 dBA.

2.5.5 Ground Borne Vibration

1. Ground borne vibration has been a significant problem in San Francisco in the past. The LRV4 shall have a ground borne vibration signature which is better than that exhibited by the LRV2 with comparable track, loading, suspension and speed conditions. This shall be demonstrated by the Contractor by analysis and test.

2.5.6 Vibration Generation

1. Equipment and auxiliaries mounted anywhere on the vehicle, Car Body, or trucks shall not cause objectionable vibrations anywhere on the vehicle floor, walls, ceiling panels and seat frames.

2.5.7 Vibration and Impact Loads

1. All vehicle equipment shall operate without damage or degradation of performance when subjected to vibration and impacts encountered during normal service, and shall be compliant with and tested per IEC 61373 standard, including all functional and durability requirements.

2.5.8 Ride Quality

1. Ride quality shall be equal to, or better than, that provided by an LRV2/3 vehicle, which is equipped with new suspension and newly trued wheels.
2. Ride quality shall be evaluated for all load conditions AW0 to AW3, and all normal vehicle acceleration, deceleration, and speed conditions on comparable quality track.

2.5.9 Curving and Derailment Safety

1. The LRV shall curve smoothly and have low risk of derailment under conditions of new wheel/new rail and worn wheel/worn rail.
2. Analysis and test shall be used to demonstrate that, for all conditions within SFMTA's accepted condemning limits for wheel and rail:
 - a. Single wheel L/V, measuring the resistance to wheel climb derailment, shall not exceed the Nadal limit for the effective flange angle of the wheel/rail pair with a wheel/rail coefficient of friction of 0.5.
 - b. Minimum Vertical Wheel Force, to prevent wheel unloading, shall be greater than 10% of the static wheel load.
 - c. Net Axle Lateral force (NAL), as a check on track panel shift, shall be less than one-half the static vertical axle load for AW0 and AW3.

2.5.10 Stability

1. The contractor shall analyze vehicle stability in tangent track at speeds up to 110% of maximum revenue service speed, for worst case combinations of worn wheel and rail (within SFMTA condemning limits). The output of lateral accelerations from transducers on the truck frame shall be reported to indicate if truck hunting occurred. Hunting shall be defined as six or more consecutive oscillations where truck frame lateral accelerations exceed 0.8g peak-to-peak. Hunting shall not occur up to

maximum revenue service speed. Tangent track segments in the model shall be at least 2000 ft long.

2.6 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

2.6.1 General

1. The Contractor shall design and construct the vehicle such that its equipment does not electrically interfere with the safe and proper operation of the vehicle itself or any wayside equipment, including signaling and communications equipment or systems external to the LRT system. Refer to IEEE Standard 16 for general electromagnetic compatibility requirements. The Contractor shall be fully responsible to survey the existing SFMTA system to confirm the acceptability of these limits on the new vehicles.
2. The Current LRV uses the following frequencies to communicate over the loop cable:
 - a. A frequency of 36 kHz with a frequency shift of +/-400 Hz.
 - b. A frequency of 56 kHz with a frequency shift of +/-200 Hz.
3. It is possible that the system could be upgraded to use IEEE 802.11 (WLAN) 2.4 GHz or 5GHz bands in the future.

2.6.2 EMC Plan

1. The Contractor shall develop an EMC Plan (EMCP) in accordance with APTA SS-E-010-98 identifying how the Contractor will achieve electromagnetic compatibility through its organization, activities, schedule, qualifications of staff, procedures and methods.

2.6.3 Field Conducted Emission Limit and Test

1. The contractor shall develop a Conducted EMI Test Procedure and perform a Field Conducted EMI Test based on UMTA-MA-06-0153-85-6.
2. The test procedure shall include worst-case conditions including SFMTA worst case track circuits.

2.6.4 Field Inductive Emission Limit and Test

1. The Contractor shall develop an Inductive EMI Test Procedure and perform a Field Inductive EMI Test based on UMTA-MA-06-0153-85-8.

2.6.5 Field Radiated Emission Limit and Test

1. The Contractor shall develop a Radiated EMI Test Procedure and perform a Field Radiated EMI Test based on UMTA-MA-06-0153-85-11.

2.6.6 Field Radio Frequency Immunity Test

1. The Contractor shall develop a Field Radio Frequency Immunity Test Procedure and perform a Field Radio Frequency Immunity EMI Test.

2. Radio Frequency emitting devices include handheld radios typically used by SFMTA and cell phones typically used by passengers to demonstrate immunity of the train equipment operation under test and the emitting device shall be six (6) inches.

2.6.7 Reports

1. The Contractor shall provide reports for all testing from Sections 2.6.3, 2.6.4, 2.6.5, and 2.6.6.

2.7 SERVICE-PROVEN DESIGN

1. Vehicle subsystem equipment shall be service proven in a rail transit environment, unless otherwise approved by the SFMTA.
2. In general, a service-proven design will meet all the following criteria:
 - a. In revenue rail operation for at least 2 years,
 - b. Used in revenue rail operation for at least 1 million vehicle miles with at least 50,000 miles per vehicle,
 - c. Has a minimum fleet size of 20 vehicles,
 - d. Has achieved a level of reliability consistent with the requirements in this Specification.

2.8 RELIABILITY

2.8.1 General

1. Contractor shall design each component, assembly, subsystem, and system element in a manner such that it will perform its function under the specified design operating conditions without failure for the durations specified. The Contractor shall demonstrate the Mean Distance Between Component Failure (MDBCF) and Mean Distance Between (chargeable) Train Delays (MDBTD) for its vehicle design, considering all failure modes for each component, assembly, subsystem, and system element. The combination shall result in realization of a fleet vehicle MDBTD of 25,000 miles.
2. The Contractor shall define the quantitative reliability of the overall vehicle and the vehicles' major systems. That definition shall maximize vehicle availability while minimizing vehicle overall life cycle costs. The data shall be provided for each major vehicle system and for the overall LRV. For systems requiring significant non-mileage related duty/loading, SFMTA will consider modifying the average speed factors for certain items, as demonstrated through a Contractor generated "Car Mission Profile Analysis," which would be subject to acceptance.
3. For this analysis, vehicle system reliability calculations shall be based on single vehicle operation with an average speed of 13 mph and an average of 40,000 miles per vehicle per year. For time operated equipment, a utilization factor will be developed through the mission profile to apply to equipment that is functioning when the vehicle is not accumulating mileage.
4. A Train Delay is defined as an incident causing a revenue train to be:
 - a. More than five minutes late at its destination terminal;

- b. Canceled either at its original terminal or en route; or
 - c. Rerouted.
- 5. A chargeable failure is defined as any failure that requires repair or replacement of any subsystem or vehicle component. Chargeable failures shall include intermittent, unverified and software failures which occur more than three times on a specific vehicle. The time, place or type of service in which the car was being operated at the time of a failure shall not be of any consequence. Failures outside of the control of the Contractor are excluded.
- 6. Mean Distance Between Component Failures shall be as follows:
 - a. Traction Equipment & Controls shall have an MDBCF of 50,000 miles.
 - b. Friction Braking shall have an MDBCF of 50,000 miles.
 - c. Communications equipment shall have an MDBCF of 75,000 miles.
 - d. Side Doors and Control equipment shall have an MDBCF of 85,000 miles.
 - e. Lighting equipment shall have an MDBCF of 350,000 miles.
 - f. Auxiliary Electrical Apparatus shall have an MDBCF of 100,000 miles.
 - g. HVAC equipment shall have an MDBCF of 100,000 miles.
 - h. Couplers and Draft Gear shall have an MDBCF of 100,000 miles.
 - i. Trucks and Suspension shall have an MDBCF of 170,000 miles.
 - j. Train to Wayside Communications equipment shall have an MDBCF of 170,000 miles.
- 7. The Contractor shall propose and utilize a Failure Reporting And Corrective Action System (FRACAS) that is a closed loop failure reporting system used to record all failures throughout the production and warranty phase of the Contract and the monthly reporting of MDBF.

2.9 MAINTAINABILITY

2.9.1 General

- 1. The vehicle design shall incorporate approaches which minimize Mean Time To Repair (MTTR) and maintenance costs throughout its intended useful life.
- 2. The Contractor shall develop a maintainability program for the vehicle, including corrective and preventive maintenance, which shall provide for enhancement of vehicle availability, and the minimization of maintenance costs.

2.9.2 Maintenance Plan

- 1. The Contractor's maintainability program shall include a detailed plan outlining all schedules and activities for vehicle preventive maintenance.
- 2. This plan, along with the outline of the proposed maintenance manuals and associated drawings, shall be submitted to the SFMTA for acceptance as according to the Project Delivery Schedule defined in Exhibit 3 of the Agreement.
- 3. The plan shall outline each maintenance task, time schedules, recommended tools, personnel, and skill levels required.

4. These recommendations shall be based upon those of the Contractor and of the equipment suppliers.
5. The weighted average of the component MTTR shall illustrate compliance with the overall MTTR requirements.
6. This plan shall be coordinated with the maintenance manuals and agree with them.

2.9.3 Maintenance

1. The LRV shall be designed for ease of routine and corrective maintenance, such as to minimize maintenance time, and hence life cycle cost.
2. The maintenance schedule shall be designed to minimize life cycle costs.

2.10 CODES AND REGULATIONS

1. All equipment shall comply with all applicable local, state and federal rules, codes, standards, and regulations. Contractor shall pay particular attention to the requirements of CPUC General Order 143B.

3	CARBODY STRUCTURE.....	3-1
3.1	Performance Requirements.....	3-1
3.1.1	Corrosion Prevention.....	3-1
3.1.2	Static Loads.....	3-1
3.1.3	Fatigue Loads.....	3-1
3.1.4	Crash Energy Management.....	3-1
3.1.5	Allowable Stresses.....	3-1
3.1.5.1	Static Strength.....	3-1
3.1.5.2	Fatigue Strength of Welded Structure.....	3-2
3.1.6	Water Tightness and Drainage.....	3-2
3.1.7	Bodyside Flatness.....	3-2
3.1.8	Anticlimber.....	3-2
3.1.9	Exterior Finish.....	3-2
3.2	Validation Requirements.....	3-3
3.3	Interface Requirements.....	3-3
3.3.1	Jacking Pads and Lifting Points.....	3-3
3.4	Maintenance Requirements.....	3-3

3 CARBODY STRUCTURE

3.1 PERFORMANCE REQUIREMENTS

3.1.1 Corrosion Prevention

1. The materials used in the car body shall be protected from corrosion.
2. Dissimilar metal joints shall be protected against electrolytic corrosion.
3. The structure shall be designed to eliminate all water traps.

3.1.2 Static Loads

1. The car body shall be designed to meet the static load requirements of CPUC GO 143.
2. Jacking pads and supporting structure shall be designed to withstand without permanent deformation 200% of the normal jacking loads in the vertical direction combined with 110% of the normal jacking loads in the transverse direction.

3.1.3 Fatigue Loads

1. The car body shall be designed to resist the alternating loads that occur in normal service over the life of the car without fatigue failure. Designs shall be based on allowable stresses for 10 million cycles.
2. The fatigue loads are to be a combination of the following minimum load components, zero to peak:
 - a. Longitudinal load component in the X direction of 15% of car body weight at AW2;
 - b. Lateral load component in the Y direction of 15% of car body weight at AW2;
 - c. Vertical Load component in the Z direction of 20% of car body weight at AW2;
 - d. 15% of worst case torsion between adjacent trucks.
3. The loads listed above shall be applied in the phasing that results in highest stresses at critical locations.

3.1.4 Crash Energy Management

1. Design for crash energy management shall be in accordance with ASME RT-1 for LRV's to the extent this is compatible with the requirements of CPUC GO 143.

3.1.5 Allowable Stresses

3.1.5.1 Static Strength

1. The limiting static material properties shall be the minimum yield strengths as given in the material specifications in Section 19.
2. The values used shall be taken from ASME RT-1 for LRV's.

3.1.5.2 Fatigue Strength of Welded Structure

1. Structural welding practices shall be according to requirements of;
 - a. AWS D1.1, "Structural Welding Code – Steel;"
 - b. AWS D1.2, "Structural Welding Code – Aluminum;"
 - c. AWS D1.3, "Structural Welding Code – Sheet Steel;"
 - d. AWS D1.6, "Structural Welding Code – Stainless Steel;" and
 - e. The AWS Handbook.
2. Requirements for dynamically loaded structures shall be applied.
3. Cast steel welding shall be according to ASTM A 488/488M, "Steel Castings, Welding, Qualification of Procedures and Personnel."
4. Resistance welding shall be in accordance with AWS D17.2/D17.2M, Class B for structural applications and Class C for non-structural applications.
5. Materials joining processes other than those listed here shall be for infinite life to a standard to be approved by the SFMTA.

3.1.6 Water Tightness and Drainage

1. The car body shall be designed to prevent the accumulation and ingress of water.
2. Roof drains shall be accessible for cleaning and protected from blockage by leaves or other foreign material.
3. Rain gutters shall be provided over doorways and cab side windows.
4. Splashboards shall be positioned at the end of the roof to minimize the cascading of water during acceleration and braking.

3.1.7 Bodyside Flatness

1. All car body exterior surfaces shall be free of ripples exceeding $3/32$ -in (peak to valley) in 3 ft measured in any direction, before fillers are applied, and the use of such fillers shall be minimized.

3.1.8 Anticlimber

1. The anticlimber shall be wide enough to engage the anticlimber of an opposing vehicle (existing LRV2/3 or new LRV4 type) under the worst-case condition of vehicle-to-vehicle relative position on horizontal track curves.
2. A jack pad shall be provided under the center of each anticlimber.
3. A towing hitch shall be provided to allow recovery of other vehicle types, and to allow attachment of a safety strap used in dead tow situations per SFMTA standard operating procedures.

3.1.9 Exterior Finish

1. The LRVs shall have decals applied or be painted in approved SFMTA color scheme, with branding decals in number and location similar to the existing fleet.

3.2 VALIDATION REQUIREMENTS

1. Validation requirements shall be in accordance with ASME RT-1, to the extent these are compatible with the requirements of CPUC GO 143.
2. The fatigue analysis is to be used to demonstrate the ability of the carbody to survive its intended operational requirement without fatigue failure.

3.3 INTERFACE REQUIREMENTS

3.3.1 Jacking Pads and Lifting Points

1. The vehicle shall be provided with jacking pads and lifting points to facilitate routine maintenance operations, emergency lifting, and rerailing.
2. Jacking and lifting points shall be compatible with the SFMTA's current maintenance equipment.
3. Jacking pads shall be designed with an anti-slip surface.

3.4 MAINTENANCE REQUIREMENTS

1. The car body structure and finish shall be compatible with the SFMTA's existing car washing equipment and chemicals.
2. Roof access shall be compatible with SFMTA shops. The LRV roof shall be designed for maintenance accessibility and roof surfaces and equipment covers shall support maintenance personnel and their tools.

4	COUPLER.....	4-1
4.1	PERFORMANCE REQUIREMENTS.....	4-1
4.1.1	Automatic Couplers	4-1
4.2	Performance Requirements.....	4-1
4.2.1	Mechanical Coupler.....	4-1
4.2.1.1	Geometric Requirements.....	4-1
4.2.1.2	Gathering Range	4-1
4.2.1.3	Strength Requirements	4-2
4.2.1.4	Energy Management	4-2
4.2.2	Pneumatic Coupling (if applicable)	4-2
4.2.3	Electric Coupler	4-2
4.3	Interface Requirements	4-3

4 COUPLER

4.1 PERFORMANCE REQUIREMENTS

4.1.1 Automatic Couplers

1. Each coupler shall provide fully automatic mechanical, electrical and, if applicable, pneumatic coupling between LRV4 vehicles.
2. Each coupler shall provide fully automatic mechanical, and, if applicable, pneumatic coupling (air supply only) to LRV2/3 vehicles. Electrical trainline compatibility is not required.
3. Couplers shall be self-centering.
4. The coupler shall have draft gear providing cushioning in buff and draft.
5. The coupler system shall permit operation of a maximum-length train under normal conditions.
6. Couplers shall have automatically operated covers which conceal and protect the electrical portion when not in use for trainline functions.
7. The coupler equipment and controls shall provide, at a minimum, the following functions:
 - a. Automatic coupling;
 - b. Operator-activated uncoupling;
 - c. Operator-activated electrical isolation;
 - d. Manual mechanical uncoupling; and
 - e. Manual isolation and reconnection of the electric trainline functions.

4.2 PERFORMANCE REQUIREMENTS

4.2.1 Mechanical Coupler

4.2.1.1 Geometric Requirements

1. The coupler system shall be capable of operating over all track profiles, including worst-case horizontal and vertical curves singly and in combination, superelevation, track wear, and track misalignment without damage to the coupler, other equipment, or the vehicle structure.
2. In addition, the coupler system shall accommodate variations between adjacent cars resulting from uneven loading, wheel wear, maximum suspension travel, and suspension failure without damage to the coupler, other equipment, or the vehicle structure.

4.2.1.2 Gathering Range

1. The gathering range of the coupler and the centering and leveling device tolerances shall be sufficient for two vehicles with correctly adjusted couplers to automatically

couple on level tangent track under the worst-case combination of permitted wear and vehicle displacement.

2. The distance shall be as follows: Measured from the centered position, at least ± 3 inches in the vertical direction and ± 6 inches in the horizontal direction.

4.2.1.3 Strength Requirements

1. The coupler assembly shall be capable of withstanding buff or draft loads up to a minimum of 110 % of the maximum release load of the coupler.
2. The coupler shall be designed to:
 - a. Have sufficient strength to withstand an upward vertical load for lifting the end of an AWO vehicle, including the adjacent truck, from beneath the mechanical coupler, when proper blocking is provided between the coupler and the end sill.
 - b. Withstand a downward vertical load of minimum 400 lbf applied at the coupler head at its maximum installed longitudinal outboard dimension, and for any possible lateral position, without causing any permanent damage to the coupler and its supporting car body structure.

4.2.1.4 Energy Management

1. As a minimum, the design shall provide for one AWO vehicle moving into another AWO vehicle parked with the brakes applied, under the following conditions:
 - a. The draft gear and/or energy absorbing elements shall manage coupling for all speeds up to 5 mph and self-restore, with no permanent deformation to any of the coupler elements or to the vehicle.
 - b. For all coupling/collisions above 5 mph the draft gear elements and/or energy absorption unit(s) shall compress, followed by activation of the release mechanism to allow the coupler system to retract a sufficient distance to permit the car body anticlimbers to engage.
 - c. If the collision forces are sufficiently high such that compression continues following the full retraction of the coupler system, the coupler system shall not impede the Crash Energy Management (CEM) response of the car body to overload conditions.
 - d. The coupler system shall be supported in a safe manner at all times. The coupler shall not drop to the track.
 - e. Partial release shall be clearly detectable by maintenance staff and correctable in the maintenance shop without coupler removal.

4.2.2 Pneumatic Coupling (if applicable)

1. Manual isolation of the pneumatic trainlines shall be possible with the use of a cut-out cock located inboard of the hoses, so that the hoses are isolated.

4.2.3 Electric Coupler

1. Each electric coupler shall be provided with a weather-resistant front cover to protect the contact area from the environment when closed.

4.3 INTERFACE REQUIREMENTS.

1. For pushing and towing purposes, LRV4 cars shall be able to couple mechanically with existing LRV2/3 cars, and, if the LRV4 uses an air system, pneumatic coupling shall be possible, otherwise the coupler shall not cause loss of air from an LRV2/3. Electrical coupling is not required.
2. The LRV2/3 uses a Dellner Coupler Type 100 coupler. If the electric coupler trainline configuration will be different than the existing LRV, the Contractor shall ensure that the electric coupler heads of both vehicles will not extend and make contact during mechanical coupling.
3. LRV4 cars shall be provided with a hitch to allow attachment of a safety strap for use in dead tow situations.

5	OPERATOR'S CAB	5-1
5.1	General	5-1
5.1.1	Introduction	5-1
5.2	Performance Requirements	5-1
5.2.1	Arrangement	5-1
5.2.2	Visibility Requirements	5-1
5.2.2.1	Forward Visibility	5-1
5.2.2.2	Rearward Visibility	5-1
5.2.2.3	Sideward Visibility	5-1
5.2.2.4	Platform Visibility	5-1
5.3	Specific Requirements	5-2
5.3.1	Operator's Seat	5-2
5.3.2	Diagnostics Display	5-2
5.3.2.1	General Requirements	5-2
5.3.2.2	Operator Mode	5-2
5.3.2.3	Maintenance Mode	5-2
5.3.3	Master Controller	5-2
5.3.3.1	General	5-2
5.3.3.2	Interlock	5-3
5.3.3.3	Master Controller Function	5-3
5.3.4	Deadman Feature	5-3
5.3.4.1	General	5-3
5.3.5	Emergency Stop Pushbutton	5-3
5.3.6	Windshield Wipers	5-3
5.3.7	Windshield Washer	5-3
5.3.8	Sun Screen	5-3
5.3.9	Fire Extinguisher	5-3
5.3.10	Miscellaneous	5-4
5.3.10.1	Coat hook	5-4
5.3.10.2	Cabinets	5-4
5.3.10.3	Covert Alarm	5-4
5.3.11	Rear Wall and Cab/Saloon Partition Door	5-4

5.3.12	Run Number Sign	5-4
5.3.13	SFMTA Defined Equipment.....	5-4

5 OPERATOR'S CAB

5.1 GENERAL

5.1.1 Introduction

1. The general arrangement of the cab shall be full width, with the Operator located on or close to the LRV centerline.
2. The cab partition shall be full width, with a closed and locked access door when not in use, with a window that can be opened to provide access to the farebox when in use.

5.2 PERFORMANCE REQUIREMENTS

5.2.1 Arrangement

1. The general arrangement of the cab controls and indications shall enable all normal driving functions to be performed while the operator is seated and subject to the required Ergonomic and Human Machine Interface analysis using the 2.5 percentile Female and the 97.5 percentile Male.

5.2.2 Visibility Requirements

5.2.2.1 Forward Visibility

1. An operator, in all possible operator seat adjustment positions, shall be provided with:
 - a. A minimum vertical upward view sufficient to view signals;
 - b. A downward view sufficient to see a 39-inch tall person standing 19.5 inches from the front-most surface of the vehicle;
 - c. A minimum 90 degrees about the horizontal line of sight in the forward direction (i.e. 45 degrees to each side);
 - d. Minimum "blind spots" such as might be caused by A-pillars or other obstacles that may block sections of viewable area from the operator; and
 - e. Distortion-free windshield in the required field of view.

5.2.2.2 Rearward Visibility

1. The operator shall be provided with a means of viewing the passenger compartment.

5.2.2.3 Sideward Visibility

1. The operator shall be capable of viewing automobile traffic lanes at mixed-traffic intersections in order to safely execute left and right-hand turns.

5.2.2.4 Platform Visibility

1. From a seated position, the operator shall be capable of viewing passenger egress consistent with Section 13.3.3, item 2, and compliant with CPUC GO143B and recorded as required in Section 13.3.3, item 3.

5.3 SPECIFIC REQUIREMENTS

5.3.1 Operator's Seat

1. The operator's seat shall have ability to adjust: the height, fore/aft travel, and lumbar support and shall accommodate the human engineering factors as specified in Section 1.5.

5.3.2 Diagnostics Display

5.3.2.1 General Requirements

1. The diagnostics display shall be of a 2-tier design; operator mode and maintenance mode.
 - a. Operator mode:
 - i. The Operator mode shall be the default display.
 - b. Maintenance mode:
 - i. The Maintenance mode shall be activated by a key switch or inputting a PIN password (alternatives to a PIN may be proposed).
 - ii. The Maintenance mode shall provide access to more in depth diagnostics that a maintainer would require.

5.3.2.2 Operator Mode

5.3.2.2.1 Default Operator Screen

1. In operator mode, the diagnostics display shall display:
 - a. Train configuration.
 - b. Operating status of all critical systems.
 - c. Vehicle parameters of all major subsystems.
 - d. Fault display with instructions to the operator whenever a critical fault that requires operator intervention is detected.

5.3.2.3 Maintenance Mode

1. In maintenance mode the diagnostics display shall provide an interactive interface to review diagnostic data.

5.3.3 Master Controller

5.3.3.1 General

1. A master controller group consisting of reverser switch, and hand operated master controller and shall be supplied as a single integrated unit.
2. The master controller shall operate in the car longitudinal direction, with power forward and brake to the rear, with the rearmost position being Emergency Brake.
3. Trainlined control signals shall comply with the requirements of IEEE STD 1475.

5.3.3.2 Interlock

1. The master controller shall be mechanically interlocked so that the master controller is inactive when the cab control switch is in the "OFF" position.
2. The master controller shall be operative only when the direction control selector is moved to the "FORWARD" or "REVERSE" position.
3. A change of mode from "FORWARD" or "REVERSE" to "OFF" or vice-versa shall be impossible unless the master controller is at neutral, and vehicle is at zero-speed and parking brake is applied.

5.3.3.3 Master Controller Function

1. A single master controller handle shall be provided to issue the command signals to the propulsion and braking systems.
2. The master controller shall operate in a proportional manner in both power and brake from the respective minimum to maximum positions.

5.3.4 Deadman Feature

5.3.4.1 General

1. An operator's Deadman feature shall be incorporated in the vehicle controls to safely stop the vehicle in the event of the incapacity of the operator.
2. The Contractor shall provide at least two independent methods of Deadman activation to decrease operator fatigue.

5.3.5 Emergency Stop Pushbutton

1. An emergency stop pushbutton shall be provided at location on the operator's console approved by SFMTA.

5.3.6 Windshield Wipers

1. The windshield wiper shall wipe sufficient width and height to provide required visibility for driving purposes.
2. The windshield wiper shall have at least two frequencies or speeds.
3. The design shall have an arrangement that automatically returns the wiper to a "PARK" position when the control is switched off.

5.3.7 Windshield Washer

1. A windshield washer system shall be installed to enable the operator to eject onto the windshield a cleaning and/or anti-freezing agent of the standard automotive type.

5.3.8 Sun Screen

1. A sun screen or shade shall be provided for windshield and side windows.

5.3.9 Fire Extinguisher

1. A class 4-A-60BC fire extinguisher shall be located in each operators cab.

2. The fire extinguisher shall be 10lb capacity.

5.3.10 Miscellaneous

5.3.10.1 Coat hook

1. A coat hook shall be provided in each cab.

5.3.10.2 Cabinets

1. A cabinet suitable for the storage of emergency equipment shall be provided within the cab.
2. A second cabinet/space for the operator's belongings shall be provided within the cab.

5.3.10.3 Covert Alarm

1. A covert alarm that allows the operator to push a button and alert central control via the radio system of an emergency, shall be provided.

5.3.11 Rear Wall and Cab/Saloon Partition Door

1. The door between the cab and the passenger area shall be in a locked position from the passenger side when the door is in the closed position.
2. An window, which shall be locked when closed, shall be provided to allow passenger access to the farebox.
3. The door shall be equipped to allow the operator to exit the cab quickly in an emergency.
4. Rearward visibility of the passenger compartment by the operator shall be provided, with neutral tinted glass provided above waist level in the partition.

5.3.12 Run Number Sign

1. An illuminated run number sign shall be provided and installed to the right of the Operator's position in each cab.

5.3.13 SFMTA Defined Equipment

1. The cab shall accommodate train control, communications and fare systems equipment to be defined by SFMTA. A listing of SFMTA defined equipment is provided in Section 23.
2. SFMTA defined equipment shall be supplied, installed, integrated, and tested by Contractor, unless otherwise specified.

6	PASSENGER DOORS	6-1
6.1	General.....	6-1
6.2	Performance Requirements.....	6-1
6.3	Specific Requirements.....	6-1
6.3.1	Door Panels.....	6-1
6.3.1.1	Strength Requirements.....	6-1
6.3.2	Door Operator.....	6-2
6.3.2.1	Manual Emergency Release.....	6-2
6.3.3	Obstruction Detection.....	6-2
6.3.3.1	Operational Requirements.....	6-2
6.3.3.2	Sensitivity Requirements.....	6-2
6.3.4	Control Switches and Pushbuttons.....	6-2
6.3.4.1	General Requirements.....	6-2
6.3.4.2	Crew Switches.....	6-2
6.3.4.3	Operator's Console Door Control Pushbuttons.....	6-2
6.3.4.4	Passenger Controls.....	6-2
6.3.5	Bypass Devices.....	6-3
6.3.5.1	General Requirements.....	6-3
6.3.6	Annunciations.....	6-3
6.3.6.1	Door Out-of-Service Illuminated Sign.....	6-3
6.3.6.2	Door Closing Warning Signals.....	6-3
6.3.7	Step System.....	6-3

6 PASSENGER DOORS

6.1 GENERAL

1. The door system shall comply with the following standards:
 - a. APTA SS-C&S-012-02, Standard for Door Systems for New and Rebuilt Passenger Cars.
 - b. 49 CFR 38, Americans with Disabilities Act (ADA) Accessibility Specifications for Transportation Vehicles, Subparts A and D.
 - c. 49 CFR 238, Passenger Equipment Safety Standards, Section 238.235.
2. When enabled by the operator (at low level platforms), passengers shall be able to command door opening from internal and external controls.
3. To accommodate both platform and street-level boarding, moveable steps shall be provided at all door locations. The changeover shall be controlled from the active cab. The changeover shall also automatically change the warning device from gong when the steps are down, to horn when the steps are up, and shall be equipped with an override feature.
4. All major door components (mechanisms and controls) shall be interchangeable between doorways.

6.2 PERFORMANCE REQUIREMENTS

1. The maximum force exerted on an obstacle during the closing motion of the door shall not exceed the following:
 - a. The force of an impact on a person or obstacle shall be limited to a maximum of 65 lbf.
 - b. The effective mean force including further closing attempts after obstruction detection shall be limited to a maximum of 45 lbf.
 - c. These values shall be measured in accordance with the method described in EN 14752 Appendix D.
2. The trainline signals shall be interlocked with the no-motion circuitry, such that door trainline commands cannot be activated unless the train is stopped.

6.3 SPECIFIC REQUIREMENTS

6.3.1 Door Panels

6.3.1.1 Strength Requirements

1. The door panel system shall have the strength and rigidity to sustain passenger loading due to overcrowding conditions without activating sensors or causing permanent deformation.

6.3.2 Door Operator

6.3.2.1 Manual Emergency Release

1. An interior and exterior emergency manual release mechanism shall be provided at each side doorway.
2. The emergency manual release shall comply with the requirements of 49 CFR 238.235.

6.3.3 Obstruction Detection

6.3.3.1 Operational Requirements

1. Upon sensing an obstruction, the local door controls shall cause the door operator(s) on the obstructed panels to immediately reverse and open.
2. The controls shall attempt to reclose the panels three times before remaining open.

6.3.3.2 Sensitivity Requirements

1. Obstruction detection sensitivity shall be as specified in APTA SS-C&S-012-02, Section 5.3.4.1.

6.3.4 Control Switches and Pushbuttons

6.3.4.1 General Requirements

1. The doors shall be controlled from the crew switches, the Operator's cab door control pushbuttons, and the passenger pushbuttons.

6.3.4.2 Crew Switches

1. A crew switch operated by the standard crew key shall be located outside and inside, as a minimum, at one door per side per vehicle (closest passenger access door to the cab), each diagonally opposite the other.

6.3.4.3 Operator's Console Door Control Pushbuttons

1. The door control panel shall include the following functions:
 - (a) Open/close right front door of the vehicle
 - (b) Open all right side doors
 - (c) Release all right side doors and enable passenger door controls
 - (d) Close/lock all right side doors
 - (e) Open/close left front door of the vehicle
 - (f) Open all left side doors
 - (g) Release all left side doors and enable passenger door controls
 - (h) Close/lock all left side doors.

6.3.4.4 Passenger Controls.

1. Each side door opening shall be provided with controls on both sides of the doorway on both the inside and outside of the vehicle, for use by passengers.

2. Internal control shall be using touchbars, similar to the existing LRV2/3 fleet.
3. External pushbuttons shall be located to be accessible from low level platforms – access at high level platforms is not required.
4. Door panels opened from the passenger pushbuttons shall automatically close after a time delay, which shall be adjustable from 2 to 30 seconds.

6.3.5 Bypass Devices

6.3.5.1 General Requirements

1. Bypass devices shall be provided to circumvent specific door system faults so that the train can continue in revenue service, or be removed from revenue service. In these situations the bypassed door shall be physically locked closed.

6.3.6 Annunciations

6.3.6.1 Door Out-of-Service Illuminated Sign

1. An illuminated sign stating “DOOR OUT-OF-SERVICE” sign shall be provided on the vehicle interior at each doorway. The sign shall be illuminated any time a door is removed from service by activation of the DOOR OUT-OF SERVICE switch.

6.3.6.2 Door Closing Warning Signals

1. Audible and visual warnings shall be initiated at each doorway to warn the passengers that the door has been commanded to open or close in accordance with 49 CFR Part 38.

6.3.7 Step System

1. The step modes and the changeover cycle shall not interfere with the operation and physical position of the doors.
2. When changing from low to high, or vice versa, the top surface of the steps shall remain horizontal at all times.
3. In the high-level position, the threshold and loading area shall be a single surface set flush with the normal interior floor level.
4. The steps shall be capable of operating in either direction with a uniformly distributed static load of 500 pounds, and of remaining in either position for extended periods of time whether or not power is available to the car.
5. Step operation shall be interlocked with the door operation to ensure that, at high level platforms, doors cannot open until the associated step is in the selected position.
6. An audible warning shall sound at the step location whenever the high/low switch is activated and steps are in the process of changing position.
7. There shall be an interlock for the step system such that left side doors cannot be unlocked or opened when the right side steps are down, except for the forward most left side door.
8. The left side steps shall be raised up whenever a cab is keyed-on.
9. All the steps shall be set to same level as the lead car whenever the cars are coupled.

7	HEATING, VENTILATION, AND AIR COOLING.....	7-1
7.1	Performance Requirements.....	7-1
7.2	Specific Requirements.....	7-1
7.2.1	Heating System.....	7-1
7.2.1.1	Heater Guards	7-1
7.2.1.2	Windshield and Cab Side Windows heaters	7-1
7.2.2	Ventilation	7-1
7.2.2.1	General.....	7-1
7.2.2.2	Air Filters	7-1
7.2.3	Cooling System.....	7-1
7.2.3.1	Refrigerant	7-1
7.2.3.2	Design Criteria	7-1
7.2.4	Controls	7-2
7.2.4.1	Interior Car Conditions	7-2
7.3	Validation Requirements.....	7-2
7.3.1	Qualification and Climate Room Testing	7-2

7 HEATING, VENTILATION, AND AIR COOLING

7.1 PERFORMANCE REQUIREMENTS

1. The control system shall be designed to automatically maintain the car interior temperature, including both cabs, at the conditions specified in Section 2.3.3.2, with variable internal heat loads such as passengers, motors, lights and solar gain, when the auxiliary power supply (APS) is at its nominal voltage.

7.2 SPECIFIC REQUIREMENTS

7.2.1 Heating System

7.2.1.1 Heater Guards

1. The temperature of surfaces accessible to passengers and operators shall not exceed 125°F.

7.2.1.2 Windshield and Cab Side Windows heaters

1. The heater/window defroster system shall have the appropriate capacity to provide for defrosting the glass in 10 minutes under the worst-case temperature and humidity parameters specified in Section 2.

7.2.2 Ventilation

7.2.2.1 General

1. A ventilation fresh airflow of not less than 5 ft³/min per AW2 passenger shall be provided at all times when the vehicle is in passenger service.
2. Full ventilation shall be continuously available when the vehicle is in passenger service even in the event of failure of the refrigeration system.

7.2.2.2 Air Filters

1. The filters and filter holders shall be designed in a commercially available standard size and available for sale from at least two US commercial-industrial HVAC distributors.

7.2.3 Cooling System

7.2.3.1 Refrigerant

1. The air-cooling unit shall be designed for and delivered with a refrigerant approved by the United States Environmental Protection Agency (USEPA).

7.2.3.2 Design Criteria

1. The air cooling equipment shall have sufficient capacity to condition the air inside the car to the requirements and loads defined in Section 2.3.3.2.

2. The cooling system shall be able to start and operate without damage at any time of the year when the exterior temperature is above 50 degrees Fahrenheit, and when interior car conditions require cooling to meet the specified interior temperatures.

7.2.4 Controls

7.2.4.1 Interior Car Conditions

1. When the ambient temperatures are outside the design limits presented in Section 2.3.3.1, the interior temperatures shall be as follows:

Table 7-1 Interior Car Conditions

Ambient Temperature; (T_a)	Interior Temperature; (T_i)
Less than Minimum Ambient	$T_a + 43^\circ\text{F}$
Maximum Ambient to Maximum Ambient +15°F	$T_a - 20^\circ\text{F}$
Greater than Maximum Ambient + 15°F	As the system will provide.

7.3 VALIDATION REQUIREMENTS

7.3.1 Qualification and Climate Room Testing

Tests shall be conducted to validate HVAC system performance in accordance with the requirements of this specification.

8	LIGHTING	8-1
8.1	General	8-1
8.2	Performance	8-1
8.3	Specific Requirements	8-1
8.3.1	Emergency lighting	8-1
8.3.2	Exterior Lighting	8-1
8.3.2.1	General :.....	8-1
8.3.2.2	Marker Lights	8-1
8.3.2.3	Brake Lights	8-2
8.3.2.4	Local Car Fault Lights	8-2
8.4	Maintenance Requirements	8-2

8 LIGHTING

8.1 GENERAL

1. All lighting on the vehicle shall utilize high efficiency, i.e. Energy Star, components to reduce power consumption.
2. LED technology shall be used where practical for illumination.

8.2 PERFORMANCE

1. The headlights shall be arranged to illuminate a person at least 800 feet ahead and in front of the vehicle.
2. Passenger compartment and Operator cab lighting shall conform to EN 13272 for mass transit vehicles except as detailed in this Technical Specification.
3. The exterior lighting shall conform with CPUC GO143B requirements.

8.3 SPECIFIC REQUIREMENTS

8.3.1 Emergency lighting

1. Emergency lighting shall be in compliance with APTA RT-S-VIM-020-08.
2. The following lights shall remain functional under emergency power conditions for a minimum of one hour:
 - a. Lights near the doors and doorway lights for illuminating platforms.
 - b. Main interior lights such that total emergency lighting meets the above standards for luminance vs. time.
 - c. Operator cab and control panel lights.
 - d. Direction indicator lights (4 way flashers) in the emergency flashing mode.
 - e. Side and End Marker Lights.
 - f. Headlights.
 - g. Tail lights.
 - h. Stop lights.

8.3.2 Exterior Lighting

8.3.2.1 General:

1. The exterior lighting shall include headlights, stoplights, taillights, marker lights, directional indicators with four-way flasher function, door open warning lights, door out of service indicators and doorway lights.

8.3.2.2 Marker Lights

1. Two green marker lights shall be located at each end of the vehicle on the sides of, or above, the A-end destination sign.

2. Two red, upper marker lights shall be located at each end of the vehicle on the sides of, or above, the destination sign.
3. Two red, lower lights "tail lights" shall be located one in each of the clusters at each end of the vehicle.

8.3.2.3 Brake Lights

1. Brake lights on the vehicle shall illuminate automatically under any one of the following conditions:
 - a. On a brake command;
 - b. On an emergency stop command;
 - c. The vehicle is stopped or parked.

8.3.2.4 Local Car Fault Lights

1. One blue LED lamp, visible in both directions, shall be installed on both sides of the vehicle to indicate the presence of one of the following local car faults:
 - a. Propulsion System,
 - b. Auxiliary Inverter,
 - c. Friction Brake System,
 - d. Bypass/cut-out in use.

8.4 MAINTENANCE REQUIREMENTS

1. All consumable lamps and ballasts shall be of a standard type commercially available from two proven sources in North America.

9	ELECTRICAL.....	9-1
9.1	GENERAL.....	9-1
9.2	Specific Requirements.....	9-1
9.2.1	Circuit Protection.....	9-1
9.2.1.1	General Circuit Protection.....	9-1
9.2.2	Connection.....	9-1
9.2.2.1	General.....	9-1
9.2.2.2	Wiring.....	9-1
9.2.3	Primary Power System.....	9-2
9.2.3.1	Shop Power Connection.....	9-2
9.2.3.2	Pantograph.....	9-2
9.2.4	Convenience Outlets.....	9-2
9.2.5	Battery.....	9-2
9.2.6	Controls.....	9-3
9.2.6.1	Primary Power Switch.....	9-3

9 ELECTRICAL

9.1 GENERAL

1. All electric devices, wiring and connections shall be selected to function properly and safely under the worst-case combination of the following:
 - a. Ambient conditions,
 - b. Equipment operating tolerances,
 - c. Train length,
 - d. Voltage drop in wiring connections including the coupler.
2. According to IEEE STD 16-2004:
 - a. The vehicle electrical circuits shall be physically and functionally segregated;
 - b. The Contractor must define selected parameters;
 - c. All equipment on the vehicle, including resiliently mounted equipment, truck frame, and truck-mounted equipment, shall be safety grounded and bonded to the vehicle structure;
 - d. The vehicle structure shall be safety grounded to the axles and to the tires, if independently rotating or resilient wheels are used.
3. Gap and creepage distances shall comply, as a minimum, with the recommendations of APTA RP-004-98.

9.2 SPECIFIC REQUIREMENTS

9.2.1 Circuit Protection

9.2.1.1 General Circuit Protection

1. Auxiliary apparatus and their controls shall be designed such that all devices are able to withstand the transients as specified in IEEE STD 16-2004 Section 4.3.

9.2.2 Connection

9.2.2.1 General

1. Each connector shall contain 10% spares or a minimum of one spare by approval of SFMTA.

9.2.2.2 Wiring

1. Wiring shall conform, at a minimum, to the requirements of APTA RP-E009-98.
2. Vehicle wiring shall comply with NFPA 130, section 4-3.7. Wiring within enclosures shall comply with IEEE Std.16-2004, section 4.8.

9.2.3 Primary Power System

9.2.3.1 Shop Power Connection

1. Shop power connection shall be on the side of the car, positioned at a similar location as the existing LRV2. The plug shall mate with Pyle National part #3024, 600 volt, 200 ampere, 5-pin shop connectors.

9.2.3.2 Pantograph

1. The pantograph design shall comply with IEC 60494-2 requirements.
2. The minimum static pantograph uplift pressure shall be sufficient to maintain contact under all normal conditions without causing excess wear.
3. An automatic drop feature shall be provided to lower the pantograph to reduce damage to the pantograph itself and the overhead wire during and after contacting an obstruction whenever some part of the pantograph contacts an obstruction equaling 300 lbf or greater.
4. A shear pin safety system shall be provided to minimize pantograph and contact line damage caused by hard contact between some part of the pantograph and an overhead obstruction.
5. Impact shall cause the pin to shear, causing the pantograph to drop to its lowered position.
6. Provision shall be made for manually raising, lowering and unlatching the pantograph in the event of a loss of power or control.

9.2.4 Convenience Outlets

1. A minimum of two (2) duplex convenience outlets shall be installed for 120 VAC, 20 A service within the carbody.
2. One (1) duplex outlet shall be provided in each cab.

9.2.5 Battery

1. The battery shall be sized to provide at least the following loads, with associated duty cycles:
 - a. Door Control (cycle doors open for 20 s every two (2) minutes),
 - b. Communications (operate PA and radio 20 s every two (2) minutes),
 - c. Propulsion and Braking Control (continuous),
 - d. ATP, Cab Signal or Train Stop Equipment (continuous),
 - e. Operator's Console Indicators, and Interlocks (continuous),
 - f. Gong and Horn (on for five (5) s every two (2) minutes),
 - g. Track Brakes (on for 30 s at end of each 20 minute period),
 - h. Pantograph Control (raise and lower twice),
 - i. Coupler control (one (1) couple and uncouple cycle),
 - j. Windshield Wiper (continuous),
 - k. Train-to-Wayside Communications (continuous),

- l. Event recorder (continuous),
 - m. MDS,
 - n. CCTV,
 - o. Brake system hydraulic pump motors (if applicable),
 - p. Propulsion container blower fans (if LV DC powered),
 - q. Emergency Lighting per Section 8.3.1.
2. For an initial battery condition with the cells at 80% of full charge and the ambient temperature appropriate for the range specified in Section 2, the battery capacity shall be able to carry all the above loads for a period of one hour.

9.2.6 Controls

9.2.6.1 Primary Power Switch

1. The switch shall provide the following positions and functions, with positions labeled as indicated:
- a. RUN- In this position, main power from the current collector shall be connected to both propulsion and auxiliary circuits. The switch shall be in this position in normal operation.
 - b. OFF- In this position, both the propulsion and auxiliary circuits shall be completely isolated from main power.
 - c. AUX- In this position, propulsion circuits shall be completely isolated from main power, and main power from the current collector shall be connected only to the auxiliary circuits.
 - d. SHOP- In this position, propulsion circuits shall be completely isolated from main power, and main power from a shop power connector shall be provided only to the auxiliary circuits provided that the shop power connector is connected to a wayside source.

10	PROPULSION	10-1
10.1	Performance.....	10-1
10.1.1	General.....	10-1
10.1.2	Duty Cycle and Thermal Performance.....	10-1
10.1.2.1	General.....	10-1
10.1.2.2	Normal Duty	10-1
10.1.2.3	Abnormal Operating Modes.....	10-1
10.1.2.4	Towing.....	10-1

10 PROPULSION

10.1 PERFORMANCE

10.1.1 General

1. Propulsion and braking equipment shall comply with the applicable sections of IEEE STD 16-2004.
2. The operating environment must be considered in the design of the propulsion equipment to prevent the entry of moisture, dust, sand, dirt, and debris. The Contractor shall propose equipment enclosures that will keep the equipment cool, clean, and reduce maintainability.

10.1.2 Duty Cycle and Thermal Performance

10.1.2.1 General

1. The propulsion system ratings shall be based on the worst-case duty cycle defined in this section.

10.1.2.2 Normal Duty

1. The propulsion system thermal capacity shall exceed by at least 10% that required to operate continuously without damage over the LRT system under the following conditions:
 - a. Route profile and schedule as specified in Section 2.
 - b. AW2 loading.
 - c. All propulsion systems operative.
 - d. Line voltage within the limits specified for full performance in Section 2.
 - e. Maximum ambient temperature as specified in Section 2.

10.1.2.3 Abnormal Operating Modes

1. The propulsion system thermal capacity shall be at least that required to make one round trip without damage over the LRT system under the following conditions:
 - a. Route profile and schedule as specified in Section 2.
 - b. AW3 loading.
 - c. Half of all propulsion systems operative; half inoperative.
 - d. Line voltage at the minimum limit specified for full performance in Section 2.
 - e. Rheostatic electric braking only.
 - f. Fully operative friction braking on all vehicles.
 - g. Maximum ambient temperature as specified in Section 2.

10.1.2.4 Towing

1. Unless otherwise approved by the SFMTA, it shall be possible for a train with normally operating vehicles to tow an equal number of vehicles with inoperative

propulsion systems from any point on the LRT system to the appropriate maintenance facility without damage to any of the vehicles, under the following conditions:

- a. Train speed limited to not less than 20 mph.
- b. AW3 loading to the next station, at which point all passengers are discharged; AW0 loading thereafter.
- c. Line voltage at the minimum limit specified for full performance in Section 2.
- d. Fully operative friction braking on the vehicles being towed.

11	TRUCK REQUIREMENTS	11-1
11.1	General.....	11-1
11.2	Performance Requirements.....	11-1
11.2.1	Truck Connection to Carbody.....	11-1
11.2.2	Wheel Load Equalization.....	11-1
11.3	Specific Requirements.....	11-1
11.3.1	Design Loads	11-1
11.3.2	Truck Features and Component Design Requirements.....	11-2
11.3.2.1	Wheels, Axles and Bearings	11-2
11.3.2.2	Obstacle Deflectors	11-2
11.3.2.3	Sanding Equipment.....	11-2

11 TRUCK REQUIREMENTS

11.1 GENERAL

1. Trucks of a like design shall be interchangeable.
2. Trucks shall be compatible with SFMTA shops, including cranes, turntables, presses, in-floor jacks, wheel truing lathes.

11.2 PERFORMANCE REQUIREMENTS

11.2.1 Truck Connection to Carbody

1. Strength of connection shall be in accordance with ASME RT-1.

11.2.2 Wheel Load Equalization

1. Equalization shall be such that with the car on level track under an AWO load, lifting or dropping any wheel 1.50 in shall not change the load on any other wheel of the car by more than 60%.
2. Raising or lowering any wheel up to 2 in shall not result in loss of contact between any of the other wheels on the car and the rail.

11.3 SPECIFIC REQUIREMENTS

11.3.1 Design Loads

1. The basis for determining maximum load variation for static and fatigue loadings shall include forces resulting from passenger load, track shocks and forces, motor torque, friction brakes, track brakes, and any possible combination of these forces when operating under all possible conditions on track not condemnable under SFMTA's maintenance standards, at speeds up to and including 110% of maximum revenue service speed.
2. Under these conditions, stresses shall not exceed allowable fatigue stresses with an additional Factor of Safety of 1.5 on the mean stress where the applied stress is at the fatigue limit for the materials used.
3. Allowable fatigue stresses for truck materials shall be limited to published endurance stress values.
4. Allowable fatigue stresses for welded connections shall not exceed the requirements of AWS D1.1 for Dynamic Structures or Contractor tests of the specific connection establishing its endurance stress (load) value for 95% survival at 69% confidence level.

11.3.2 Truck Features and Component Design Requirements

11.3.2.1 Wheels, Axles and Bearings

11.3.2.1.1 Wheels

1. The shunting resistance of each assembled wheel set shall not exceed 0.01 ohms when measured across the axle from tire tread to tire tread.

11.3.2.1.2 Axles

11.3.2.1.2.1 General Requirements

1. Both ends of each axle shall be chamfered and furnished with standard 60° at the centers for tram measurements and wheel truing.
2. The axle assembly components shall be designed to be compatible with SFMTA's wheel press and wheel truing machine.

11.3.2.1.3 Bearings

1. Journal bearings shall be designed for a minimum L-10 life rating of 1,000,000 miles based on an AW3 vehicle weight with loads typical of light rail operation.
2. The bearings shall be fully enclosed, shall not require field lubrication, and shall not require inspection more than once every 150,000 miles.

11.3.2.2 Obstacle Deflectors

1. Each end truck shall be provided with safety bars at its outer or lead end, to deflect debris and to prevent such material from getting under the truck per CPUC GO143B requirements.

11.3.2.3 Sanding Equipment

1. Sanding nozzles shall be positioned so as to deposit sand immediately in front of the leading wheels on all powered trucks as per Section 12.2.3.

12	BRAKING EQUIPMENT.....	12-1
12.1	Performance Requirements.....	12-1
12.1.1	Design Criteria and Requirements	12-1
12.2	Specific Requirements.....	12-1
12.2.1	Friction Braking.....	12-1
12.2.2	Hydraulics (if used)	12-1
12.2.3	Sanding System	12-1
12.3	Maintenance Requirements.....	12-1

12 BRAKING EQUIPMENT

12.1 PERFORMANCE REQUIREMENTS

12.1.1 Design Criteria and Requirements

1. Without the aid of dynamic braking the friction brake system shall be capable of one (1) emergency brake application from maximum rated speed followed by continuous friction only revenue service from the furthest point on the system to the maintenance facility, without damage.
2. The friction brakes shall be mounted so that they are protected to the greatest extent possible against damage due to minor collisions, automobile side impacts, derailments, dirt, dust, ballast and water.
3. A sanding system shall be provided that deposits friction enhancing material in the front of leading wheels.

12.2 SPECIFIC REQUIREMENTS

12.2.1 Friction Braking

1. A means for emergency release of the disc brake system, over and above an electrically commanded override from the operator's cab, shall be incorporated.
 - a. The emergency release must be accessible to the crew under all conditions.
 - b. Manually released calipers shall be reset to normal operation on the next normal service application.

12.2.2 Hydraulics (if used)

1. The hydraulic fluid shall be commercially available in the North American market.
2. Use of a hand pump as the only means to manually release the brakes will not be permitted. Use of a dc drive motor may be considered for this purpose, however an ac motor will not be acceptable.

12.2.3 Sanding System

1. The sand box shall be filled from outside the car.
2. Sanding shall be applied automatically to assist in spin/slide control and to achieve the required acceleration and deceleration rates without excess usage.
3. The automatic use of sand shall be optimized to minimize sand consumption.
4. Manual application shall be possible and operational regardless of vehicle speed.

12.3 MAINTENANCE REQUIREMENTS

1. The Contractor shall identify any specialized maintenance facility requirements that are necessary for the servicing of the hydraulic system components (i.e. clean room), if used.

2. Equipment necessary to filter and/or decontaminate the hydraulic system (if used) shall be supplied (3 complete sets).
3. Should an air compressor be used, DC motors are not acceptable.

13	COMMUNICATIONS	13-1
13.1	General.....	13-1
13.2	Performance Requirements.....	13-1
13.2.1	Sound Level	13-1
13.3	Specific Requirements.....	13-1
13.3.1	Audio Systems	13-1
13.3.1.1	General.....	13-1
13.3.1.2	Public Address System.....	13-2
13.3.2	Information Signs	13-2
13.3.3	Vehicle Interior/Exterior Surveillance and Rear View System.....	13-2
13.3.4	Automatic Passenger Counting System	13-2
13.3.5	Car to Car Data Communications	13-2

13 COMMUNICATIONS

13.1 GENERAL

1. Each car shall have a digital vehicle communication system (DVCS) installed to provide at a minimum the following:
 - Audio System
 - Radio System
 - Video System
 - Passenger Information Sign System
 - Wireless Data link
 - Local Ethernet Network
 - Infotainment System
 - GPS
 - Run Number Signs
 - Dynamic Route Signs
 - Automatic Passenger Counting System
2. Car-to-Car data communication system is defined in TS 23. It is the Contractor's responsibility to ensure that the installed system is compatible with the latest communication system on SFMTA LRV fleet.

13.2 PERFORMANCE REQUIREMENTS

13.2.1 Sound Level

1. The public address system's output level shall be automatically set in accordance with the ambient noise level in each individual car prior to activation of the amplifier for announcement.
2. The output level shall be a minimum of 15 dB above the interior ambient noise level resulting from vehicle operation at full speed.

13.3 SPECIFIC REQUIREMENTS

13.3.1 Audio Systems

13.3.1.1 General

1. The Audio System shall provide the following functionality:
 - a. One-way communication from the Train operator to passengers (PA System).
 - b. Two-way communication between the Train operator and the SFMTA's Train Control Center and/or SFMTA's Rail Supervisors (Radio).
 - c. Two-way Passenger Emergency Intercom (PEI).
 - d. Cab-to-cab intercom (Cab-to-Cab).
 - e. Automatic announcements including route, destination, next station, time of day, etc. (PA System and Passenger Information Signs).

- f. Interface with the vehicle interior and exterior message signs.
- g. Passenger Emergency, Cab-to-Cab, PA Activation, PA Speaker Control, and PA Exterior Speaker Selection.
- h. Configured such that failure of a CCU in a train does not cause loss of communications functions within the train.

13.3.1.2 Public Address System

- 1. The Contractor shall provide SFMTA with all necessary hardware, software, recording devices and all necessary tools to provide the SFMTA with the ability to record and up-load new announcements without the need for Contractor support.

13.3.2 Information Signs

- 1. The sign system for each car shall consist of two front-end destination signs, one run number sign per cab, four double-sided (interior and exterior view) side destination signs and at least two interior message displays.
- 2. Information conveyed shall include destination, location on route and next stop, as a minimum. Flexible signs capable of providing service information and alerts shall be provided.
- 3. All the information signs need to be controlled by radio vehicle logic unit using the latest SFMTA protocol.

13.3.3 Vehicle Interior/Exterior Surveillance and Rear View System

- 1. The surveillance system shall record not less than the most recent eight full calendar days of vehicle activity in all areas of the interior and exterior areas and be in full compliance with CPUC General Order 172.
- 2. At a minimum cameras shall cover all aisle, entry doors, seating areas, the interior of the cab with a full view of the Operator, and the Operator's view from the cab. The current planned configuration and the number of cameras and location are provided in Appendix A.
- 3. In lieu of side mirrors, the Contractor shall supply CCTV Cameras that will provide the operator with a clear view of the exterior of the train on both sides of the vehicle along the full length of the platform (high platform and street level) with two flat panel screens located near the corner posts on the left and right hand side of the cab for operator viewing. These cameras shall also meet the minimum recording requirements identified in Section 13.3.3, item 1 above.

13.3.4 Automatic Passenger Counting System

- 1. An Automatic Passenger Counting system shall be installed to record boardings and alightings at station stops. The means of reporting the data and the level of accuracy shall be compatible with SFMTA's existing systems.

13.3.5 Car to Car Data Communications

- 1. A Car-to-Car data communication system shall be furnished and installed for all onboard systems to communication between cars when the cars are coupled.

13.4 INTERFACE WITH RADIO, CAD/AVL SYSTEM

The following interfaces shall be furnished between the radio, CAD/AVL system and other vehicle systems. All the software shall be installed to SFMTA latest version at the time of delivery:

1. Farebox - The radio vehicle logic unit and farebox shall exchange the information through SAE J1587 messaging protocol over the SAE J1708 physical connection.
2. Destination Sign - Destination sign shall be controlled by radio vehicle logic unit through the Car-to-Car Data Communication network using existing protocol.
3. EA switch (each cab) shall be interfaced with radio vehicle logic unit.
4. GPS signal shall be interfaced with Surveillance Camera.
5. Critical Control Point Speakers (CCP Speakers), Destination signs, stop request, doors status shall interface with radio vehicle logic unit through cable connection.
6. Speed Sensors - Speed sensors shall be connected to radio vehicle logic unit.
7. Mobile Access Router - Router shall be connected to radio vehicle logic unit via 4 port Ethernet switch and to the Surveillance camera system.
8. Door Status - Front Right and left doors status shall be connected to radio vehicle logic unit.
9. Stop Request - Stop request shall be connected to radio vehicle logic unit.

13.5 LIST OF SFMTA DEFINED EQUIPMENT

1. The Contractor shall supply, install and test SFMTA specified equipment for the communication system. A listing of SFMTA defined equipment is provided in Section 23. It is the Contractor's responsibility to ensure that the installed system is compatible with the latest communication system on SFMTA LRV fleet.

14	AUTOMATIC TRAIN CONTROL	14-1
14.1	Specific Requirements	14-1
14.1.1	Event Recorder	14-1
14.1.2	Alerter	14-1
14.1.3	Automatic Train Control Interfaces	14-1
14.1.4	Train to Wayside Communications	14-1

14 AUTOMATIC TRAIN CONTROL

14.1 SPECIFIC REQUIREMENTS

14.1.1 Event Recorder

1. The event recorder shall comply with the requirements of IEEE STD 1482.1.
2. The event recorder shall be able to store a minimum of thirty (30) calendar days of most recent train operation data, including any signals from the spare channels, in non-volatile memory.

14.1.2 Alerter

1. The Contractor shall provide an Alerter subsystem (also known as an Alertness or Vigilance Control subsystem) in each basic operating unit.
2. The Alerter system shall interface with the Deadman control described in Section 5.

14.1.3 Automatic Train Control Interfaces

1. The Contractor shall supply, install and test an Automatic Train Control (ATC) system compatible with the SFMTA system. The current SFMTA system is defined in Section 13. All required interfaces with existing system shall be provided, including interface with Guaranteed Emergency Brake Rate (GEBR) system. The current setting for GEBR is 2.5mphs. The Contractor shall test for build up time and stopping distances for GEBR.

14.1.4 Train to Wayside Communications

1. Each basic operating unit shall be equipped with a Train to Wayside Communication system (TWC) to provide control of selected interlocking routes from on board the train.

14.2 LIST OF SFMTA DEFINED EQUIPMENT

1. The Contractor shall supply, install, and test SFMTA specified equipment for the ATCS and Train to Wayside communications systems. A list of equipment is provided in Section 23. It is the Contractor's responsibility to ensure that the installed system is compatible with the latest ATCS and Train to Wayside communications system on SFMTA LRV fleet

15	INTERIOR	15-1
15.1	Specific Requirements	15-1
15.1.1	Emergency Egress and Access Provisions.....	15-1
15.1.2	Emergency Signage	15-1
15.1.3	Glazing	15-1
15.1.3.1	Side and Door Windows	15-1
15.1.3.2	Windshields	15-1
15.1.3.3	Cab Side Window	15-1
15.1.4	Seating	15-1
15.1.4.1	Seat Construction.....	15-1
15.1.5	Stanchions and Handrails	15-1
15.1.6	Advertisement Card Holders	15-1
15.1.7	Keys and Locks	15-2
15.1.8	Passenger Stop Request.....	15-2
15.1.9	Bicycle Racks	15-2

15 INTERIOR

15.1 SPECIFIC REQUIREMENTS

15.1.1 Emergency Egress and Access Provisions

1. Emergency egress and access shall be provided in accordance with standard APTA-RP-S-VIM-023-08.

15.1.2 Emergency Signage

1. Emergency signage on the vehicle interior and exterior shall be provided in accordance with standard APTA-RT-S-021-08.
2. Emergency exit path markings shall be provided in accordance with standard APTA-RT-S-022-08.

15.1.3 Glazing

15.1.3.1 Side and Door Windows

1. All side facing glazing shall meet the requirements of ANSI Z26.1.

15.1.3.2 Windshields

1. The windshield shall be constructed to meet the FRA Type I impact and ballistics requirements per 49 CFR 223.

15.1.3.3 Cab Side Window

1. The cab side windows to the left of the operator shall be capable of being opened.
2. The cab side windows shall be laminated safety glass constructed to meet the FRA Type II impact and ballistics requirements per 49 CFR 223.

15.1.4 Seating

15.1.4.1 Seat Construction

1. The seat construction and its attachments to the car body shall withstand, without permanent deformation, the loads to be reasonably expected in transit operation, including vandalism. Passenger seating may use inserts, however no fabric or cushions will be considered.

15.1.5 Stanchions and Handrails

1. Stanchions and handrails and their mountings and supports shall withstand the loads to be expected in transit service.

15.1.6 Advertisement Card Holders

1. Continuous card holder channels shall be located inside the car on the panels above the windows.

15.1.7 Keys and Locks

1. Two types of keys shall be supplied to provide access to all locks on the vehicle, as listed below. Three of each type of key shall be provided with each car. SFMTA will provide details of each type of lock and key.
 - a. Crew Key: This key shall enable the master controller and allow access to the vehicle through operation of door key switches, window locks, mechanical locks, and cab door locks, etc.
 - b. Maintenance Key: This key shall allow maintenance personnel access to equipment boxes, panels, enclosures, etc.

15.1.8 Passenger Stop Request

1. A passenger stop request system shall be provided to allow passengers to alert the operator to an upcoming stop. In addition, the passenger stop system shall include a push button for wheel chair stop request and an indicator in the cab to inform the operator that a wheel chair stop is required. The pushbutton for the stop request shall be blue and similar to what is currently in use on SFMTA buses.

15.1.9 Bicycle Racks

1. Provision for safe storage of up to 4 bicycles shall be made within the LRV. Locations for these bicycle storage racks are subject to SFMTA approval and shall not be located near or in conflict with the Elderly and Disabled Accessibility locations.

16 NOT USED

17 MONITORING AND DIAGNOSTICS 17-1
17.1 Performance Requirements..... 17-1

17 MONITORING AND DIAGNOSTICS

17.1 PERFORMANCE REQUIREMENTS

1. The MDS shall have sufficient non-volatile storage to retain all recorded data without overwriting for at least the interval between periodic inspections.

18	SOFTWARE SYSTEMS	18-1
18.1	Specific Requirements	18-1
18.1.1	Software Documentation	18-1

18 SOFTWARE SYSTEMS

18.1 SPECIFIC REQUIREMENTS

18.1.1 Software Documentation

1. For custom software, thorough and accurate software documentation submittal and the SFMTA acceptance are required.
2. Software documentation shall be in accordance with IEEE Std 1558-2004, "Standard for Software Documentation for Rail Equipment and Systems" and with the additional requirements in this section.
3. The IEEE Std 1558 requirements shall be for a type 5 procurement type as defined within that standard unless approved by the SFMTA.
4. For "Commercially Available" software, software documentation requirements shall be limited to:
 - a. The original data storage/transfer media,
 - b. Functional and usage details,
 - c. All provider manuals,
 - d. Licenses required for SFMTA use.
5. The software details, tools, and documentation specified by this section shall be delivered to the SFMTA prior to the end of the warranty period;
6. Software source code for non-commercially available software shall be provided at the end of the warranty period. Use of Escrow agreements will be accepted.
7. The City shall receive licenses for all software in accordance with Section 26.2 of the Agreement.

19 MATERIALS AND WORKMANSHIP..... 19-1

19.1 General..... 19-1

19.1.1 SFMTA Plan for this Section..... 19-1

19.1.2 Prohibited Materials..... 19-1

19.2 Flammability and Smoke Emission Requirements..... 19-1

19.2.1 General..... 19-1

19.2.2 Toxicity..... 19-1

19.2.3 Electrical Fire Safety 19-1

19 MATERIALS AND WORKMANSHIP

19.1 GENERAL

19.1.1 SFMTA Plan for this Section

1. It is SFMTA's intention that proposers, at the RFP stage, offer their proposed materials and workmanship criteria for review. During negotiations, discussions will be held to establish agreed upon criteria for this section. The agreed language will form the final Section 19 of this document. Appendix B contains suggested standard language for consideration.
2. The specific provisions below are firm requirements.

19.1.2 Prohibited Materials

1. The following materials are prohibited for use in the construction of these cars, except where specifically permitted:
 - a. PVC
 - b. Asbestos
 - c. Lead in brake shoes
 - d. Urethane Foam
 - e. Cadmium (except for battery)
 - f. Aluminum Threaded Fasteners
 - g. PCB's
 - h. Materials listed in 29 CFR 1910.19

19.2 FLAMMABILITY AND SMOKE EMISSION REQUIREMENTS

19.2.1 General

1. All combustible material used in the construction of the car shall satisfy the flammability, smoke emission, and toxicity requirements, NFPA 130 or a standard approved by the SFMTA.

19.2.2 Toxicity

1. Those materials and products generally recognized to have highly toxic products of combustion shall not be used.

19.2.3 Electrical Fire Safety

1. Electrical equipment, wiring and apparatus shall conform to NFPA 130, Section 8, except where more restrictive requirements are imposed by this Technical Specification.

20	PROGRAM MANAGEMENT AND QUALITY ASSURANCE	20-1
20.1	General.....	20-1
20.1.1	SFMTA Plan for this Section.....	20-1
20.1.2	SFMTA Program Management Principles.....	20-1
20.1.3	Construction Photographs.....	20-1
20.1.4	Mock-up and Samples	20-2
20.1.5	As-Built Drawings	20-2

20 PROGRAM MANAGEMENT AND QUALITY ASSURANCE

20.1 GENERAL

20.1.1 SFMTA Plan for this Section

1. It is SFMTA's intention that proposers, at the RFP stage, offer their proposed program management and Quality Assurance approaches for review. During negotiations, discussions will be held to establish agreed criteria for this section. The agreed language will form the final Section 20 of this document. Appendix C contains suggested standard language for consideration.
2. Proposers should submit their Program Management Plan in response to the RFP. This submittal will be used to evaluate the value it offers SFMTA and to earn scoring points in the selection process.
3. During negotiations, a Program Management Plan will be jointly developed. This plan will set forth the general principles that will govern the participation of SFMTA, its consultants, and the Contractor throughout the project duration. When complete this Plan will become a part of the Contract.
4. The specific provisions below are firm requirements.

20.1.2 SFMTA Program Management Principles

1. The SFMTA will be involved in all phases of the work to the degree necessary to protect public policy interests in safety, cost, performance, legal, & regulatory compliance.
2. The Contractor will be responsible for all phases of work needed to deliver a safe, timely, and cost effective product that is in compliance with legal, regulatory and performance requirements as called for in the Contract.
3. The following principles illustrate SFMTA's approach to the management of the LRV4 project.
 - a. The SFMTA will "accept" or "reject" work products, rather than "approving" such products. This includes designs, materials, analyses, QA/QC plans etc.
 - b. SFMTA's role will be to provide oversight of all phases and elements of work. This will not include direct participation in the execution of the Contractors activities, except as required by FTA regulations.
 - c. The SFMTA will not assume or acquire the Contractor's responsibilities.
 - d. The SFMTA will retain the right to audit any element of work at anytime throughout the duration of the project.
 - e. The SFMTA will assist the Contractor where and when able to protect or effect its interests by providing information, opinions, preferences, direction, and decisions as requested by the Contractor.

20.1.3 Construction Photographs

1. The Contractor shall submit to the SFMTA high-resolution digital photographs of the vehicle development, construction, and assembly progress, as well as the finished car.

20.1.4 Mock-up and Samples

1. The Contractor shall provide a full-size mock-up of a complete 1/2 vehicle including and of equipment arrangement details for design reviews. Mock-up shall be updated as necessary.
2. The mock-up shall have all components, hardware and equipment similar or identical in appearance to those to be used on the production vehicle to the greatest extent possible.
3. The mock-up shall show details of:
 - a. The front end,
 - b. Underfloor equipment arrangement,
 - c. Interior and exterior roof-mounted equipment locations,
 - d. Roof equipment arrangement,
 - e. Articulation,
 - f. Cab area.
4. The mock-up shall be finished in appearance, similar to an actual vehicle, and shall have operating exterior and interior lights and one set of operating side doors and moving steps.
5. The roof and undercar mounted equipment mock-up shall show the locations of all equipment including conduits, cable runs and piping.
6. Separate mock-up for roof and undercar equipment locations may be provided.
7. Existing vehicles may be utilized for demonstrating equipment arrangements.
8. The Contractor may alternatively propose, in lieu of the “physically” constructed full-scale equipment layout mock-up, full-scale 3D mock-up constructed with digitally accurate 3D design models. Software and any hardware required for this system and the latest revision of the 3D mock-up shall be available at SFMTA for internal reviews.

20.1.5 As-Built Drawings

1. The Contractor shall provide the SFMTA with As-Built Drawings, including drawings down to the sub assembly level.
 - a. As necessary for design review and vehicle maintenance, component level drawings shall also be included.
2. Contractor shall provide drawings in electronic format, fully compatible with AutoCAD, latest version or alternate software to be approved by SFMTA.

21	REQUIREMENTS MANAGEMENT, DESIGN VALIDATION AND VERIFICATION.....	21-1
21.1	General.....	21-1
21.2	Requirements Traceability Management.....	21-1
21.2.1	General.....	21-1
21.2.2	Requirements Traceability Matrix	21-2
21.3	Verification	21-2
21.3.1	General.....	21-2
21.3.2	Design Verification.....	21-3
21.3.2.1	General Requirements.....	21-3
21.3.2.2	Line Replaceable Unit (LRU) Level	21-3
21.3.2.3	System Level.....	21-3
21.3.2.4	Vehicle Level	21-3
21.3.3	Manufacturing Verification	21-3
21.3.4	Functional Verification.....	21-4
21.3.4.1	General Requirements.....	21-4
21.3.4.2	Line Replaceable Unit (LRU) Level	21-4
21.3.4.3	Vehicle Level.....	21-4
21.3.4.4	Acceptance Testing.....	21-4
21.3.4.5	Qualification Testing.....	21-4
21.3.5	System Safety Program Plan.....	21-4
21.3.6	Hazard Categories.....	21-5
21.3.6.1	System Safety Criteria	21-6
21.3.6.2	Acceptable Hazard Probability	21-6
21.3.7	Safety Analysis	21-7
21.3.7.1	Preliminary Hazard Analyses.....	21-7
21.3.7.2	Failure Modes and Effects Analyses.....	21-7
21.3.7.3	Sneak Circuit Analysis.....	21-7
21.3.7.4	Operating and Support Hazard Analyses	21-8
21.3.7.5	Fault Tree Analyses	21-8
21.3.7.6	Hazard Mitigation Traceability Matrix	21-8
21.3.8	Fire and Life Safety	21-8
21.3.9	Safety Certification	21-8

21.3.10	Reliability Program.....	21-9
21.3.11	Reliability Demonstration.....	21-9
21.3.12	Maintainability Demonstration.....	21-10

21 REQUIREMENTS MANAGEMENT, DESIGN VALIDATION AND VERIFICATION

21.1 GENERAL

1. This section requires a systematic approach for the Contractor to verify to the SFMTA that each of the requirements contained in the technical specification has been met.
2. Each requirement contained in the Technical Specification is clearly identified with a unique paragraph number tied to where that requirement occurs in the organization of the Technical Specification.
3. Below outlines a high level overview of the verification required by component, system and vehicle. The verification identified in this section is grouped by the following categories, detailed in 21.3:
 - a. Design Verification
 - i. Component Level
 - ii. System Level
 - iii. Vehicle Level
 - b. Manufacturing Verification
 - c. Functional Verification
 - i. Component Level
 - ii. Vehicle Level
 - iii. Acceptance Testing
4. The list above identifies typical verifications to be included in the Requirements Traceability Matrix (RTM).
5. The list above is in no way comprehensive. The Contractor shall develop and submit a comprehensive RTM that proposes a process for the verification of all requirements.
6. Although primarily verification of vehicle requirements, the verification process must include the appropriate verification of all deliverable equipment, including special tools, diagnostic equipment, portable test equipment, and bench test equipment.

21.2 REQUIREMENTS TRACEABILITY MANAGEMENT

21.2.1 General

1. The Contractor shall verify each requirement in this technical specification using the following process:
 - a. No more than 90 calendar days after NTP, the Contractor shall develop and submit for review and approval a master RTM that proposes a method of verification of each requirement.
 - b. The Contractor shall track and report progress on requirements verification to the SFMTA and submit a revised RTM at 30 day intervals.
 - c. No less than 90 calendar days prior to the scheduled date for verification of a requirement, the Contractor shall submit a verification procedure for that

requirement that describes the procedures, instrumentation, calibrations, measurements, tests and inspections to be used/done to accomplish the verification of that requirement.

- d. Within 30 calendar days of receiving a requirement verification procedure from the Contractor, the SFMTA shall either approve the plan or inform the contractor of the changes necessary to receive approval.
- e. Within 30 calendar days of receiving notification of necessary changes to a verification procedure, the Contractor shall make the changes and resubmit the plan to the transit system for final approval.
- f. Using the approved procedures, the Contractor shall conduct the verification of the requirement. The SFMTA has the right to witness all requirement verifications.
- g. If the acceptance criteria are not achieved, the Contractor shall make recommendations to the SFMTA on the corrective action to be taken. Within 30 calendar days of receipt of the recommendations, the SFMTA and Contractor will resolve what corrective action to take.
- h. After taking the corrective action the Contractor shall repeat the verification of the requirement. If acceptance criteria are not achieved, the steps set forth in Section 21.2.11.g shall be repeated until the acceptance criteria are achieved.
- i. No more than 30 calendar days after completing the successful verification of a requirement, the Contractor shall submit a requirement verification report to the SFMTA which clearly states the procedures used, the results of measurements, tests or observations conducted and a comparison of the results to the acceptance criteria for that requirement. The report shall draw a clear conclusion as to the acceptance criteria being achieved.

21.2.2 Requirements Traceability Matrix

1. At a minimum, the RTM shall include the following information:
 - a. Subsystem.
 - b. Test Type (e.g. LRU Design Verification).
 - c. Subject.
 - d. Verification method (e.g. analysis, test, etc.).
 - e. Test or process number.
 - f. Date Performed.
 - g. Status (e.g. passed, failed).

21.3 VERIFICATION

21.3.1 General

1. Contractor shall verify requirements through a measurement, a test, analysis, an inspection or by submittal of data obtained through any of these methods from previous procurements.

2. The requirements verification tracking table shall contain a column that describes how each requirement shall be verified.
3. All performed verifications shall be documented in the Requirements Traceability Matrix.
4. Documentation for all verification shall be maintained and made available on request.

21.3.2 Design Verification

21.3.2.1 General Requirements

1. The Contractor shall provide verification that the Contractor's design meets all of the requirements of this technical specification.
2. The Contractor shall successfully verify the design by way of a one-time analysis and test.
3. Verification shall be clearly listed in the Contractor's Requirement Traceability Matrix, which shall be submitted to the SFMTA for approval in accordance with Section 21.2.
4. The Contractor may submit verification of design on the basis of similarity to other projects that the contractor has completed.
5. Acceptance of verification on the basis of similarity will be at the discretion of the SFMTA.

21.3.2.2 Line Replaceable Unit (LRU) Level

1. The Contractor shall verify conformance to specification requirements as well as design parameters to satisfy system level requirements.

21.3.2.3 System Level

1. The Contractor shall verify conformance to specification requirements as well as design parameters to satisfy vehicle level requirements
2. In cases where it is not be feasible to perform an off-vehicle system level test, system level verification will be performed at the vehicle level.

21.3.2.4 Vehicle Level

1. The Contractor shall verify conformance to specification requirements as well as design parameters to satisfy operational level requirements

21.3.3 Manufacturing Verification

1. First Article Inspections (FAI) shall verify that the first item manufactured under the regular production processes and procedures meets the specification and design requirements.
2. Refer to Section 20 for detailed First Article Inspection requirements.

21.3.4 Functional Verification

21.3.4.1 General Requirements

1. The Contractor shall successfully verify by test that the equipment functions as required by the specification and to the final approved design.
2. Verification shall be by way of routine tests conducted at the LRU level or the vehicle level.
3. Verification shall be clearly listed in the Contractor's Requirement Traceability Matrix, which shall be submitted to the SFMTA for approval in accordance with Section 21.2.

21.3.4.2 Line Replaceable Unit (LRU) Level

1. The Contractor shall verify conformance to equipment functions as required by the specification and to the final approved design.
2. LRU level functional verification shall be carried out either at the supplier's facility or at the Contractor's final assembly facility.

21.3.4.3 Vehicle Level

1. The Contractor shall verify conformance to vehicle level operational requirements as required by the specification and to the final approved design.

21.3.4.4 Acceptance Testing

1. The purpose of acceptance verification is to confirm that each vehicle is fully functional, and safe and suitable for service on the SFMTA's system.
2. The Contractor shall submit for review and approval a comprehensive acceptance program.
3. Acceptance verification shall be performed after delivery of each vehicle to the SFMTA's property.
4. The Contractor shall include in the verification matrix all verification necessary for the acceptance of each vehicle.
5. Results of all Acceptance Testing shall be included in each vehicle's VHB

21.3.4.5 Qualification Testing

1. SFMTA does not have a test track and operates mainly in mixed traffic, therefore:
 - a. Qualification Testing of the first two (2) vehicles produced shall be at the Contractor's Facility or a location in which qualification through all of the propulsion and braking ranges can be verified and validated;
 - b. Qualification Testing for the first vehicle produced shall also include burn-in testing.

21.3.5 System Safety Program Plan

1. The Contractor shall submit for approval a System Safety Program Plan (SSPP) that defines the activities, management controls, and monitoring processes by which the Contractor shall ensure that safety considerations, compatible with other system

requirements, are incorporated into the design of the vehicle to minimize the potential for accidents.

2. The SSPP shall demonstrate that the Contractor has a clear understanding of system safety requirements and has an organization in place that is capable of identifying safety hazards and performing analyses to verify that they have been eliminated or adequately mitigated.

The SSPP shall be structured in accordance with MIL-STD-882, Task 102.

21.3.6 Hazard Categories

This section describes the hazard categories and corresponding acceptable probabilities that Contractor must meet for the design of the vehicle and its systems to be judged safe.

Category I (Catastrophic)

Equipment failures, human errors, and/or external circumstances that result in multiple fatalities, destruction of vehicles, or damage to stations or track segments such that affected segments of the transit system cannot operate for an extended period. Category I hazards result in a major accident or catastrophe, such as destruction of a train with fatalities. Effective or timely corrective action by the train Operator is not realistically possible.

Category II (Critical)

Equipment failures, human errors, and/or external circumstances that result in extensive damage to equipment, physical distress such that train Operators cannot be relied upon to perform their tasks accurately or completely, or adverse effects on the traveling public, including up to a few severe injuries or, exceptionally, a fatality. The train or affected fixed facility is in jeopardy unless proper corrective action occurs quickly enough and is effective enough to prevent the condition from progressing to Category I.

Category III (Marginal)

Equipment failures, human errors, and/or external circumstances that reduce the capability of the transit system or the ability of Operators to cope with adverse operating conditions to the extent that, for example, safety margins or functional capabilities are degraded; equipment sustains non-disabling damage; conditions occur which impair Operator efficiency; or the traveling public experiences some minor injury, discomfort, or danger. Although safety margins may be significantly reduced, for example because of loss of redundancy or forced operation on backup systems, trains, fixed facilities, or personnel are not in immediate danger. A subsequent increase in the severity of the hazard requires an additional failure or gross error by Operators.

Category IV (Negligible)

Equipment failures, human errors, and/or external circumstances that do not significantly reduce safety and that require a response well within the capability of the Operator. Negligible hazards may include, for example, a slight reduction in safety margins or functional capabilities; a temporary and slight increase in Operator workload, such as manual train operation; or some inconvenience to the traveling public. Category IV hazards are considered nuisance events, or at worst, hazards only when coupled with incompetent operation or action.

21.3.6.1 System Safety Criteria

The Contractor shall define design criteria to ensure that system safety objectives are implemented throughout all phases of design development, testing, delivery, operations, and maintenance.

The following criteria, as a minimum, shall be adopted by the Contractor:

1. Potential or actual hazards identified through analyses shall be mitigated in accordance with the following order of precedence:
 - a. Use of design techniques
 - b. Use of safety devices
 - c. Use of warning devices
 - d. Use of special procedures.
2. No single-point failure shall result in or produce the potential for a Category I or Category II hazard. Multiple, latent, undetected failure modes shall be considered as a single-point failure.
3. The vehicle design shall incorporate component interlocks wherever an out-of-sequence operation could cause a Category I or Category II hazard.
4. Emergency equipment shall be provided for public use and shall be clearly identified and readily accessible.
5. The following redundancy requirements shall be met:
6. Where redundancy is used in safety-critical areas, there shall be no single-point failure which could result in loss of safety
7. Redundant paths shall not contain a common mode failure
8. Failures in a redundant element or circuit shall be annunciated to the train Operator, or inspection intervals and procedures shall be specified to ensure that both paths are operational.

21.3.6.2 Acceptable Hazard Probability

The Contractor shall implement a process for determining acceptable hazards, based on hazard severity and probability of occurrence. In general, the more severe the hazard, the more unlikely it should be.

For the LRV4, the following requirements have been established:

1. Category I hazards shall not be expected to occur during the entire operational life of the vehicle. Based on the operating hours and life of the base-order fleet, the probability of Category I hazards shall be shown through analysis to be less than 1.0×10^{-9} per car-hour of operation for each hazard.
2. Based on the operating hours and life of the base-order fleet, the probability of Category II hazards shall be shown through analysis to be less than 5.0×10^{-7} per car-hour of operation for each hazard.
3. Category III hazards shall be resolved using standard fail-safe engineering practices.
4. No special safety measures are required for Category IV hazards.

5. Probabilities shall be based on all sources of the category hazard, not just individual sources.

21.3.7 Safety Analysis

The Contractor shall assess the effect upon safety of maloperation or failure of the vehicle and of vehicle systems, subsystems, and line replaceable units, including their interfaces. The effects of vehicle interfaces with other transit elements such as signaling, facilities, support equipment, operational procedures and environments, and maintenance programs shall be examined. The Contractor is fully responsible for the Integration, Function and Safety of LRV4. During the design phase, the safety analyses performed by the Contractor shall accomplish the following:

1. Identify potential hazards and establish appropriate safety criteria;
2. Assess the design, based on safety criteria;
3. Modify the proposed designs as necessary to satisfy the safety criteria;
4. Demonstrate compliance with the criteria.

21.3.7.1 Preliminary Hazard Analyses

1. The Contractor shall submit for approval a Preliminary Hazard Analysis (PHA). The PHA shall provide a systematic, high-level examination of all proposed system elements in order to identify and classify potential hazards to the overall transit system.
2. The PHA shall address the vulnerability of system functions, rather than assess any particular hardware or software design. The PHA shall be qualitative and shall be conducted using experienced engineering judgment.
3. The PHA shall develop safety design requirements for the system and establish the framework for subsequent safety analyses. It shall provide information about potential hazards and assign a hazard severity category to each.

21.3.7.2 Failure Modes and Effects Analyses

1. The Contractor shall prepare and submit for approval a Failure Modes and Effects Analysis (FMEA). The FMEA shall provide a systematic, comprehensive, bottom-up evaluation that analyzes the effects of potential component failures in a system, as installed, from design data.
2. The FMEA shall assess the impact of failures on subsystem and system operation, and consequently on the operational safety of the transit system. The FMEA shall assess all failures which could cause or contribute to Category I or II hazards.

21.3.7.3 Sneak Circuit Analysis

1. The Contractor shall perform a Sneak Circuit Analysis (SCA) to detect functional and/or Category I or II safety problems that could arise from wiring faults or errors, and shall submit the analysis for approval. The SCA shall ensure that there are no unintended circuit paths that will provide functions other than those intended.
2. The sneak circuit analysis shall be performed for the overall vehicle and shall consider interfaces with subcontractor-supplied equipment and coupler pin assignments.

21.3.7.4 Operating and Support Hazard Analyses

1. The Contractor shall submit for approval an Operating and Support Hazard Analysis (O&SHA). The analysis shall evaluate the operating and maintenance procedures of critical systems to ensure that neither Operator error nor incorrect maintenance gives rise to unwanted system effects. Critical systems are defined as those in which a failure could cause or contribute to a Category I or II hazard.
2. The O&SHA shall be carried out in a similar fashion as the FMEA, except that "tasks" and "error modes" shall be examined instead of "components" and "failure modes." The O&SHA shall be performed during the Preliminary Design Review process so that the results of the analysis can have a meaningful impact on final designs.
3. The O&SHA shall describe the procedure being analyzed and shall identify specific tasks within each procedure that are prone to critical human errors. Each task shall be systematically evaluated to identify potential errors and to assess their effects on the system and transit system. The O&SHA shall provide recommendations for reducing or eliminating the chances of those errors.
4. Any potential Category I and II hazards resolved through procedures shall be cross-referenced between the O&SHA and the appropriate operating or maintenance manuals.

21.3.7.5 Fault Tree Analyses

The Contractor shall perform and submit for approval Fault Tree Analyses (FTAs) that quantify the probability of each Category I and II hazard identified in the PHAs. The FTAs shall consider all interfacing items which in conjunction with the analyzed system could lead to the occurrence of the identified hazard.

21.3.7.6 Hazard Mitigation Traceability Matrix

The Contractor shall develop and maintain a matrix of all Category I and II hazards. The matrix shall describe each hazard and its ultimate resolution, and identify current status. The resolution of each hazard must be verified by identifying a specific drawing, procedure, analysis, or report.

21.3.8 Fire and Life Safety

1. The entire vehicle and its components, subsystems, and systems shall comply with the requirements of NFPA 130. Measures shall be adopted to minimize injury due to fire, smoke, explosion, or panic due to fire. Measures shall also be adopted to protect equipment from damage by fire or explosion.
2. The vehicle shall be designed to prevent penetration of an underfloor or roof fire to the vehicle interior. Fire stops shall be provided at floor and roof penetrations. Equipment shall, whenever practicable, be located outside of the passenger compartment. Enclosures for control and other critical equipment shall provide protection against environmental contamination and mechanical damage.

21.3.9 Safety Certification

The Contractor shall support SFMTA in the Safety Certification process.

21.3.10 Reliability Program

1. The Contractor's reliability program shall be submitted according to Project Delivery Schedule in Agreement Exhibit 3 for the SFMTA's approval, and shall contain the following information, as a minimum:
 - a. Reliability program objectives;
 - b. Reliability program schedule, which identifies specific tasks, with start and completion dates, and explains how these tasks are coordinated and integrated with major program milestones for design, manufacturing, and testing;
 - c. Methodology to be used in reliability analyses to predict compliance with the reliability requirements specified in Sections 2.8.1;
 - d. Organization of personnel responsible for managing the reliability program;
 - e. Controls for activities of subcontractors and equipment suppliers, to assure their compliance with reliability program methods and objectives;
 - f. Preliminary reliability demonstration testing plans for verification of compliance with reliability requirements when calculations and analyses are inconclusive, or when past performance records are incomplete or unavailable; and
 - g. Reliability Demonstration Procedures.
2. Reliability progress reporting, which details implementation of the approved reliability program, shall be submitted to the SFMTA on a monthly basis, beginning 30 calendar days after delivery of the first vehicle.

21.3.11 Reliability Demonstration

1. The Contractor shall submit a Reliability Demonstration Plan (RDP) 90 calendar days before delivery of the first car which defines the following for a demonstration to prove compliance with the specified MDBTD and MDBCF requirements and failure definitions in Sections 2.8.1.
 - a. Reliability demonstration schedule (including vehicle delivery and burn-in);
 - b. Reliability demonstration procedures and forms for recording and submitting data, which shall be approved by the SFMTA before the start of the reliability demonstration;
 - c. Success-failure criteria for measuring MDBCF values for individual equipment items and subsystems under demonstration;
 - d. Failure analysis of reported failures to identify the cause and need for corrective action. The Contractor shall establish a Failure Review Board to meet as required, to determine by consensus the categorization of failures and the need and depth of failure analyses. The Failure Review Board shall consist of members designated by the Contractor and by the SFMTA. When mutual agreement cannot be negotiated, the SFMTA's position shall prevail;
 - e. Change control procedures for implementing design changes during the demonstration program; and
 - f. Format and location of test records, test logs, and data records. During the demonstration, the vehicles shall be maintained by the SFMTA's maintenance

personnel according to the approved Maintenance Plan and Maintenance Manuals. The SFMTA shall be responsible for vehicle operating and the conduct of simulated or actual revenue service.

2. If, after the end of the demonstration, it cannot be determined that all of the specified reliability requirements have been met, the Contractor shall re-design, as needed, to achieve acceptable reliability.
3. Acceptable MDBTD data shall be obtained by another demonstration of at least six months duration on the modified vehicles, and the Contractor shall bear all costs associated with the re-design effort, including vehicle modifications and associated costs.

21.3.12 Maintainability Demonstration

1. As part of the training program for maintenance personnel, Contractor shall demonstrate all servicing and preventive maintenance.
2. Contractor shall demonstrate troubleshooting, change out of components, corrective maintenance, and use of special tools where special emphasis, instruction, or proficiency is needed.
3. Contractor shall demonstrate vehicle movement under disabling conditions.
4. The Contractor shall submit a Maintainability Demonstration Plan 90 calendar days before delivery of the first vehicle.

22	SYSTEM SUPPORT	22-1
22.1	General.....	22-1
22.2	Specific Requirements.....	22-1
22.2.1	Technical Documents	22-1
22.2.1.1	General.....	22-1
22.2.1.2	Operator's Manual	22-2
22.2.1.3	Running Maintenance Manual	22-3
22.2.1.4	Heavy Repair and Overhaul Manual	22-4
22.2.1.5	Illustrated Parts Catalog	22-5
22.2.1.6	Integrated Schematics	22-5
22.2.2	As-Built Drawings	22-7
22.2.3	Vehicle History Books.....	22-7
22.2.4	Diagnostic Test Equipment Manual.....	22-8
22.2.5	Technical Document Schedule of Submittals	22-8
22.2.6	Training	22-8
22.2.6.1	General.....	22-8
22.2.6.2	Intent	22-9
22.2.6.3	Program Content	22-10
22.2.6.4	Subject Content.....	22-10
22.2.6.5	Facilities	22-10
22.2.6.6	SFMTA Cooperation.....	22-10
22.2.6.7	Student Availability	22-10
22.2.7	Technical Support.....	22-11
22.2.7.1	Site Support.....	22-11
22.2.7.2	On-Site Personnel	22-11
22.2.7.3	On-Call Personnel.....	22-12

22 SYSTEM SUPPORT

22.1 GENERAL

1. This section defines vehicle system support requirements that shall be implemented to ensure that the operation, maintenance, and management of the fleet achieves the performance, reliability and availability requirements stated in this specification.
2. System support shall include:
 - a. Technical documents,
 - b. Training programs,
 - c. Spare parts,
 - d. Special tools,
 - e. Diagnostic test equipment,
 - f. Technical support services.

22.2 SPECIFIC REQUIREMENTS

22.2.1 Technical Documents

22.2.1.1 General

1. Documents shall be developed using editable publishing software that is commercially available.
2. Photographs shall be used in lieu of illustrations when applicable and appropriate.
3. Documents and binding method shall be designed for continuous, long-term service in a maintenance shop environment.
4. All printed material shall be clearly reproducible, without loss of resolution when copied using common high-contrast copying machines.
5. The Contractor shall submit a Technical Documents Program Plan
 - a. Outlining the methodology, schedule, and deliverables related to the Technical Documents required for the Contract.
 - b. Identifying how documents will be reviewed by the Contractor and subcontractor(s).
 - c. Specifying the review cycle, including both time intervals and anticipated reviewers for the SFMTA, Contractor, and subcontractors.
 - d. Identifying how Service Bulletins and revisions will be identified and distributed.
 - e. Providing strategies for repair and replacement, running repair and heavy repair, preventive and corrective maintenance.
6. A Design and Style Guide for all technical documents shall be submitted by the Contractor to the SFMTA no later than 60 calendar days after NTP.
7. Typical SFMTA requirements for technical documents are provided in Appendix D.

8. Contractor shall coordinate development of all technical documents with the Maintainability analyses, if provided.
9. All technical documents shall include any mitigation activities identified in Safety analyses.
10. Target Audience Analysis
 - a. The Contractor shall conduct a Target Audience Analysis that shall consider the background, theoretical knowledge and level of proficiency needed by maintenance personnel performing maintenance on new equipment. This analysis shall compare maintenance and operating personnel requirements, which are determined from the needs of the car design, to descriptions of available personnel provided by the SFMTA.
 - b. Special consideration shall be given to the skills and knowledge required to operate and maintain unit equipment of a design or function new to SFMTA, and to all special tools and test equipment specific to, or being delivered with, this equipment. The gap between current and newly- required skills and knowledge can be expected to be larger in the area of new unit equipment and special tools and test equipment. These deficiencies shall be enumerated by the Contractor in the approved Target Audience Analysis.
 - c. In the Contractor's Target Audience Analysis Report, all tasks on the Maintenance Allocation Chart (MAC) shall be sorted by craft. Each task group shall be analyzed to identify all specific, new skills and knowledge that shall be required of the craft. The report shall identify specific gaps between existing and required knowledge. Tasks that identify training shall be identified here and designated on the MAC. The Manuals and Training materials shall be written based on the Target Audience Analysis Report.

22.2.1.2 Operator's Manual

1. The Operator's Manual shall contain all information required for safe and efficient operation of the LRV, including the following:
 - a. A general description to familiarize the reader with the basic components and features of the vehicle,
 - b. Location, function, and operation of all:
 - i. Controls,
 - ii. Gauges,
 - iii. Indicators,
 - iv. Switches.
 - c. Procedures to prepare the vehicle for operation,
 - d. Procedures to operate the vehicle,
 - e. Procedures to secure the vehicle from operation,
 - f. Emergency procedures,
 - g. Safety-related notes, cautions, and warnings,
 - h. Trouble symptoms and diagnostic methods that allow the operator to recover the vehicle during a failure or other incident,

- i. Other features of the vehicle for which the operator should have some basic knowledge even if operator may not be in a position to control or adjust.
2. The Operator's Manual shall be pocket-sized.
 - a. The Contractor shall submit proposed size to the SFMTA for review and approval.
3. Submittals and schedule for their delivery are listed in Section 22.2.5

22.2.1.3 Running Maintenance Manual

1. The SFMTA shall confirm the scope of work to be covered in the Running Maintenance Manual (RMM). However, at a minimum, the RMM shall cover all running maintenance, and other maintenance not requiring more than two hours elapsed time.
2. The organization of the maintenance manuals shall treat the vehicle as an integrated system, not as a grouping of disassociated parts.
3. Contractor and Sub-contractor information shall be integrated into a unified presentation for each system addressed.
4. The RMM shall contain:
 - a. An overview of the vehicle operation,
 - b. Both general and detailed descriptions of each:
 - i. System;
 - ii. Subsystem;
 - iii. Major component of the vehicle.
 - c. The recommended schedule for the performance of all preventive maintenance procedures and shall include the frequency, tools, and materials required for each procedure;
 - d. Corrective Maintenance (Running Repair) - Shall include step-by-step removal, replacement and adjustment procedures to the line replaceable unit (LRU);
 - e. Troubleshooting - Shall include a list in tabular format of symptoms, causes of malfunction or improper operation, and probable remedies to the LRUs;
 - f. Inspection procedures, intervals, and criteria.
5. The RMM shall include a Scheduled and Preventive Maintenance Plan - Routine test, service and adjust
 - a. The Scheduled and Preventive Maintenance Plan shall identify all of the scheduled maintenance tasks to be performed and the intervals at which they need to be scheduled, including SFMTA-mandated daily and periodic inspections.
 - b. The Scheduled and Preventive Maintenance Plan shall outline all maintenance tasks required to keep the car in service during the operating period between scheduled maintenances and the person-hours required to perform each task.

- i. All service intervals up to vehicle overhaul shall be included. Additional or extended maintenance intervals may be presented at the discretion of the Contractor and with the approval of the SFMTA.
 - ii. During the development of the scheduled/preventive maintenance plan, Contractor should give consideration to service intervals of components and sub-systems that would require the disassembly and/or removal of other components or sub-components that recently required similar maintenance or would require such maintenance in the near future.
6. The Contractor shall make every effort to minimize redundant or related maintenance activity to optimize the maintenance effort and out-of-service time. Any remaining service interval conflicts that cannot be resolved by the Contractor will be reviewed with the SFMTA in an attempt to resolve possible duplication of disassembly, maintenance, and assembly of these components and sub-systems.
7. The use of Diagnostic Test Equipment (DTE), where applicable, shall be integrated into the appropriate section. The DTE shall not be added in as a stand-alone manual, but integrated as a tool to be used within documented maintenance procedures.
8. Submittals and schedule for their delivery are listed in Section 22.2.5.

22.2.1.4 Heavy Repair and Overhaul Manual

1. Heavy Repair and Overhaul, for the purposes of this Specification, is defined as maintenance up to and including major component overhaul, not included in the Running Repair Manual. Heavy maintenance tasks will generally, but not necessarily, require more than two hours elapsed time to complete
2. The HRM shall allow maintenance personnel to effectively:
 - a. Service,
 - b. Inspect,
 - c. Troubleshoot,
 - d. Repair,
 - e. Replace,
 - f. Adjust,
 - g. Overhaul each component, system and subsystem of the vehicle.
3. The manual shall provide criteria explaining when maintenance personnel should replace, rather than repair, a major component or subsystem, including condemning limits, adjustments and any other information necessary to maintain the vehicle.
4. The manual shall include a recommended schedule for the performance of all maintenance procedures and shall include the frequency, tools, and materials required for each procedure.
5. The HRM shall provide detailed troubleshooting procedures for the sub-assemblies as well as complete assemblies, and shall include step-by-step removal, overhaul, replacement, and adjustment procedures to the smallest repairable component.
6. Detailed test and adjustment procedures shall be provided for all sub-assemblies and for complete assemblies or units.

7. As part of the overhaul procedure, the HRM shall include details for rebuilding, reclaiming, or replacing all wearing or moving parts, with comprehensive information on the limits and tolerances sufficient to enable the SFMTA to determine the best approach to follow.
8. The HRM shall include complete instructions and procedures for the use of special tools including test benches.
9. Submittals and schedule for their delivery are listed in Section 22.2.5.

22.2.1.5 Illustrated Parts Catalog

1. Contractor and Sub-contractor supplied information shall be integrated into a unified presentation for each system addressed.
2. The Illustrated Parts Catalog (IPC) shall identify and describe every component with its related parts, including:
 - a. The OEM name and part number,
 - b. The Contractor's part number,
 - c. Quantities per assembly.
3. Diagrams, cutaways, and exploded drawings shall be used to identify and index every removable/replaceable part.
4. Each illustration shall be accompanied by a corresponding page listing every item in the associated diagram and providing complete ordering data for every item.
5. A part common to different components shall have the same OEM part number and, except for common hardware, cross-references shall be provided to other components in which the part is found.
6. Space shall be provided for separate Sub-Contractor part number.
7. Each part or component shall be associated with the next larger assembly by using an indented format.
8. The IPC shall be organized by the same chapter and system as the RMM and the HRM.
9. The IPC shall include separate sections for test equipment, portable and bench, and special tools supplied under the Contract.
10. Descriptions of parts, including size, material, and grade in the IPC shall be adequate to enable SFMTA to procure the parts independently.
11. The IPC shall include an appendix giving each system's OEM name, address, and telephone number for parts ordering.

22.2.1.6 Integrated Schematics

1. The Integrated Schematic (IS) shall be one which can be readily followed by anyone with basic electrical, pneumatic or hydraulic knowledge, as appropriate.
2. The IS shall be provided in both paper and electronic formats as approved by the SFMTA. The electronic format shall be fully searchable.
3. All necessary information to troubleshoot faults shall be provided on a single diagram, i.e.:

- a. Wire number,
 - b. Terminal number,
 - c. Component identification,
 - d. Alphanumeric grid location for diagram-to-diagram reference,
 - e. Other standard identification information.
4. The IS shall be clear and comprehensive and shall provide ample and detailed data that shall allow the SFMTA's vehicle maintenance personnel to troubleshoot and repair a problem down to a LRU.
5. The IS shall contain wiring connection diagrams including:
 - a. Wire code (schematic designation),
 - b. Origin (FROM device and terminal),
 - c. Destination (TO device and terminal),
 - d. Wire size,
 - e. Voltage rating,
 - f. Jacket color,
 - g. Harness designation.
 - h. All electrical devices,
 - i. Electro-pneumatic/hydraulic apparatus,
 - j. All microprocessor circuits,
 - k. Test points.
6. The IS shall be fully indexed and cross-referenced to enable locating any device or wire number or terminal point between each drawing schematic and part number.
7. All schematic drawings shall be printed on 11-in. x 17-in. sheets for issuance to SFMTA personnel. All text and other items on the drawings shall be clearly legible on the 11-in. by 17-in. sheets.
8. The IS diagrams shall include the following items:
 - a. Device symbols table,
 - b. Acronym and a cross-reference table providing acronym, equipment name and location by zone,
 - c. Trainline wiring diagrams with connector and wire designations,
 - d. Equipment arrangement drawing,
 - e. Pin-to-pin connector terminal designations and wire designations at both sides of each connection for connectors and terminal blocks,
 - f. Power distribution diagrams for:
 - i. Primary;
 - ii. Auxiliary;
 - iii. Low-voltage power.
 - g. Wiring diagrams for each subsystem;
 - h. Printed circuit board connections and pin-outs for each subsystem;
 - i. Point-to-point signal data for troubleshooting;

- j. Electric coupler pin arrangement drawing with table identifying the pin number and its corresponding trainline name and the vehicle to coupler connector pin number;
 - k. Pneumatic diagram;
 - l. Hydraulic diagram;
 - m. Refrigerant diagram.
9. The remainder of the IS shall be grouped into subsections.
- a. The subsections shall be divided as much as possible around the major systems.
 - b. All subsection sheets shall have an identifiable grid or zone system that allows easy referencing from one subsection page to another.
10. All signals that leave a page or come from another page shall show the destination or origination page.
11. Electronic LRUs shall be shown as empty boxes with the LRU schematic drawing number shown.
12. To the extent possible, where I/O of an LRU can be represented as a relay contact or relay coil it shall be done to facilitate the tracing of signals through the LRU equipment.
13. Graphic symbols for components, devices, and circuits shall conform to:
- a. IEEE STD 315
 - b. ANSI Y32
 - c. ASME Y14

22.2.2 As-Built Drawings

- 1. As-built drawings shall be provided as required by Section 20.1.5.

22.2.3 Vehicle History Books

- 1. A Vehicle History Book shall be provided for each car and shall record the following information:
 - a. Vehicle Number and Class
 - b. Written report of each test performed on the vehicle or its apparatus.
 - c. Serial numbers of all wheels, axles, motors and all other apparatus with serial numbers on the car.
 - d. Vehicle weight report, including:
 - i. Overall weight;
 - ii. Weight at each wheel (first car only);
 - iii. Weight at each axle (first car only);
 - iv. For serial cars, provide overall LRV weight and weight of trucks.
 - e. Wheel and axle mounting records
 - f. Modifications
 - g. Defects/Disposition and Repairs

- h. All vehicle, component and sub-component certifications (i.e. pressure test of air tanks)
- 2. The format of the Vehicle History Books shall be agreed upon jointly by the Contractor and the SFMTA.
- 3. It shall be the responsibility of the Contractor to employ an acceptable system of configuration control in keeping individual Vehicle History Books current.
- 4. The Vehicle History Book for each car shall be turned over to the SFMTA at the successful completion of conditional acceptance testing for that car and shall be updated by the Contractor until the end of warranty.

22.2.4 Diagnostic Test Equipment Manual

- 1. The Diagnostic Test Equipment Manual (DTEM) shall be provided to address all portable and bench test equipment, along with special tools, furnished under the Contract.
- 2. Each piece of test equipment shall include operating and maintenance documentation, including:
 - a. Complete diagrams,
 - b. Schematics,
 - c. Maintenance instructions for the device itself,
 - d. Calibration instructions for the device itself,
 - e. Troubleshooting and repair instructions for the device,
 - f. General instructions on use of the device.

22.2.5 Technical Document Schedule of Submittals

- 1. Refer to Agreement, Exhibit 3 for delivery schedule.
- 2. The Contractor shall provide, at a minimum, annual updates to the documents described in this section through the life of the Contract.
- 3. The Contractor shall provide Service Bulletins between document updates for corrections and changes.
- 4. The Contractor shall provide a form for the SFMTA to report errors, procedures changes, etc.
- 5. The Technical Documents shall be uniquely identified, including revision level and date of revision on each page. The Technical documents shall be subject to configuration control.

22.2.6 Training

22.2.6.1 General

- 1. The Contractor shall establish and maintain procedures to identify training needs as necessary to complete work successfully under this Contract.
- 2. Records of training needs and training completed shall be maintained.

3. The program shall include both formal and informal instructions using such training aids as PowerPoint presentations, mock-up, parts catalogs, videos, manuals, diagrams, CD-ROMs, etc., as may be appropriate to the subject. Slides and transparencies shall not be acceptable as visual training aids.
4. The training program shall include written examination or "hands-on" demonstration, as appropriate, to certify that each of the employees has the knowledge and skills necessary to perform the tasks to which they have been assigned.
5. The Contractor shall submit their proposed training program, including sub-component system training for review and acceptance. The Plan shall identify
 - a. The general topics to be taught,
 - b. The order in which modules shall be presented,
 - c. Each module of instruction,
 - d. The proposed schedule for instruction and training.
6. The Contractor shall prepare and submit to the SFMTA for review and approval a training schedule to be performed coincident with the delivery of the first vehicles.
7. The Contractor shall be responsible for providing all test equipment, diagnostic equipment, component parts, and special tools during the training program.
8. The Contractor shall be responsible for preparing copies of all manuals, drawings, schematics, troubleshooting guides, and other handouts for distribution to all students.
9. In addition to the initial training classes, the Contractor shall provide for one class per year through the warranty period, as well as classes for major modifications and field retrofits.
10. Sixty calendar days prior to the initiation of classroom instruction, all instructors shall attend a one-day orientation at the SFMTA's facility to become familiar with the SFMTA's safety regulations and facilities, and to be advised of student qualifications and expectations.
11. All training materials, such as training aids and lesson plans, shall become the property of the SFMTA at the completion of the training program.
12. The Contractor shall be responsible for the condition of all training materials for the duration of the training program, and shall replace all damaged materials unless the damage resulted from neglect by the SFMTA.

22.2.6.2 Intent

1. The Contractor shall assume that maintenance/operating personnel have no knowledge of the new vehicles, but have the skills required for their level of employment classification.
2. The Contractor shall design the instruction program to bring up the level of knowledge to perform the required maintenance procedures to ensure that:
 - a. The vehicles will operate safely,
 - b. Preventive maintenance requirements are understood,
 - c. The vehicles remain attractive to customers, both in appearance and function,
 - d. The reliability of the vehicles is maintained,

- e. Attendance at the program will include supervisory, operating, and maintenance personnel.

22.2.6.3 Program Content

1. The program shall cover scheduled/periodic maintenance, corrective maintenance, trouble-shooting, and heavy maintenance.
2. As a general guide, the program should be broken down into roughly three-quarter classroom and one-quarter hands-on training.
3. The program shall also include in-depth instruction covering all systems and sub-system on the vehicles, as well as general trouble-shooting techniques.
4. The first class shall be video recorded in as mutually agreed between the SFMTA and the Contractor.

22.2.6.4 Subject Content

1. Classroom instruction shall include both the design and function of the systems, components, and parts under discussion.
2. The program shall, at a minimum, include scheduled maintenance, including lubrication schedules, adjustments, consumable replacement, inspection and test frequency, trouble-shooting, removal, and replacement.
3. Classroom instruction shall include the use and maintenance of Diagnostic Test Equipment.

22.2.6.5 Facilities

1. The formal classroom instruction will be conducted in a suitable classroom furnished by the SFMTA in their facilities.
2. Informal field instruction may also be carried out in and around the cars at any of several maintenance facilities
3. The Contractor shall provide the following as part of the Training deliverables:
 - a. Full training mock-up for door and step system with door leafs for class use;
 - b. Any other training mockups that the Contractor feels will aid in achieving the training objectives.

22.2.6.6 SFMTA Cooperation

1. The SFMTA will lend its fullest cooperation to the carrying out of the program.
2. However the times and duration of the instruction period and the number of personnel available to attend class, must necessarily be at the discretion of the SFMTA.

22.2.6.7 Student Availability

1. The following numbers are furnished as a guide to the magnitude of effort required:
 - a. Trainers: 20
 - b. Supervisors: 17
 - c. Maintenance Staff: 225
 - d. Operators: 240

2. The Contractor shall work with the SFMTA to develop a mutually agreeable training schedule that will not unduly affect the ability of the SFMTA to deliver service.

22.2.7 Technical Support

22.2.7.1 Site Support

1. The Contractor's Product Support/SFMTA Service team at the SFMTA's facility shall be responsible for:
 - a. Vehicle inspections,
 - b. Product Introduction/Testing and Commissioning,
 - c. Warranty Administration,
 - d. Control of field modifications,
 - e. Procurement of materials required for modifications once the manufacturing activities are completed in the plant(s),
 - f. Coordination of site testing activities,
 - g. Execution of site required tests,
 - h. Management of site open items,
 - i. Technical support to the SFMTA's personnel,
 - j. Material Administration,
 - k. Daily meeting to review any outstanding issues on the vehicles,
 - l. Weekly open item meetings are held to discuss/resolve any technical/design issues.
2. Contractor shall station technical support personnel shall be stationed at the SFMTA maintenance facility from the time the first vehicle is delivered through the end of the warranty period on the last vehicle delivered.
3. Contractor shall also make periodic support shall also be available before the first vehicle is delivered to enable vehicle facilities criteria to be coordinated with vehicle requirements.
4. The Contractor shall provide additional technical assistance/support as required for any systems or components that are not of service-proven design.

22.2.7.2 On-Site Personnel

1. On-site Contractor personnel qualified to maintain the vehicles shall assist with testing and with resolving operational and maintenance problems.
2. These personnel shall:
 - a. Be thoroughly familiar with the operation of the vehicles,
 - b. Provide support during the warranty period by isolating failures,
 - c. Provide replacement parts and respond to any warranty claims, including initiation and follow-up of remedial actions,
 - d. Include field service engineers, technicians, and repair personnel as required,
 - e. Be fluent in the English language and fully familiar with all vehicle systems.

3. At least two technicians shall be on-site full time during the warranty period.
4. Contractor shall submit detailed résumés of the proposed support personnel to the SFMTA for approval.

22.2.7.3 On-Call Personnel

1. During vehicle testing on SFMTA's property and during the warranty period, additional on-call personnel shall be on SFMTA's property within two working days of a request to the Contractor for additional technical assistance, for resolution of warranty-related repairs, or for investigation of repetitive failure or design defects.

23	OWNER DEFINED EQUIPMENT	23-1
23.1	General.....	23-1
23.2	NOT USED	23-1
23.3	Owner Defined Equipment.....	23-1
23.3.1	Fare Collection.....	23-1
23.3.2	Signal System	23-1
23.3.3	Radio (Voice and Data)	23-2
23.3.4	CCTV.....	23-2
23.4	Specific Requirements.....	23-3
23.4.1	Design Review	23-3

23 OWNER DEFINED EQUIPMENT

23.1 GENERAL

1. This section provides requirements for equipment which is defined by the SFMTA and supplied, installed and tested by Contractor.
2. The LRV4 vehicle must interface and operate with certain systems already in place within the SFMTA LRT system. It is the responsibility of the Contractor to design, integrate, provide, and test equipment which is compatible with the current system in place at time of delivery.

23.2 NOT USED

23.3 OWNER DEFINED EQUIPMENT

1. General
 - a. Contractor shall supply, install and test SFMTA defined systems as specified below including to train control, fare systems and communications.

23.3.1 Fare Collection

1. Contractor shall supply and install a fare collection system compatible with the SFMTA LRT system per Section 23.1.2. Table below shows the current equipment on the existing fleet.

Table 23-1 Fare Collection

No.	Defined System	Equipment	Qty	Current Location
1-1	Fare Collection	Farebox	2	One in each cab
1-2		Drivers Console	2	One in each cab
1-3		Passenger Device	4	Two in each carbody half
1-4		Power Module	2	One for each carbody half

23.3.2 Signal System

1. Contractor shall supply and install a signal system compatible with the SFMTA LRT system per Section 23.1.2. Table below shows the current equipment on the existing fleet.

Table 23-2 Signal System

No.	Defined System	Equipment	Qty	Current Location
2-1	Signal System	Control Box	2	One in each cab
2-2		Transponder	2	One underneath each cab

23.3.3 Radio (Voice and Data)

- Contractor shall supply and install a radio system compatible with the SFMTA LRT system per Section 23.1.2. Table below shows the equipment currently being designed for the SFMTA as part of the radio replacement for the entire system.

Table 23-3 Radio

No.	Defined System	Equipment	Qty	Current Location
3-1	Radio (Voice and Data)	Radio	1	One in cabinet located in the middle of the car
3-2		Drivers Control Unit	2	One in each cab
3-3		Vehicle Logic Unit	1	
3-4		Bulk Data Wireless Transfer Unit	1	
3-5		DVAS	1	
3-6		Mobile Access Router / Switch	1	
3-7		Ethernet Switch	1	
3-8		Antennas	4	
3-9		Speed Sensors	1	
3-10		Switch Box	1	
3-11		Serial to Parallel Converter	1	

23.3.4 CCTV

- Contractor shall supply and install a CCTV system compatible with the SFMTA LRT system per Section 23.1.2. Table below shows the current equipment on the existing fleet.

Table 23-4 CCTV

No.	Defined System	Equipment	Qty	Current Location
4-1	CCTV	Digital Video Recorder	1	One in middle of the car
4-2		Camera (analog)	6	Four in exterior, two in interior
4-3		Camera (IP)	10	Ten in interior
4-4		POE Switch	2	
4-5		Wireless Bridge	1	
4-6		Antenna	3	Three on Roof
4-7		Power Module	1	
4-8		Microphone	2	Two in interior
4-9		Camera Mount Plate	1	
4-10		Camera Brackets	1	
4-11		Drivers Module	2	One in each cab

23.4 SPECIFIC REQUIREMENTS

23.4.1 Design Review

1. The Contractor shall be responsible for integrating all SFMTA defined equipment into the vehicles.

SPECIFICATION INDEX

A

abbreviations, 1-1-1-4
acceleration, 2-6
accessibility, 2-2
air filters, 17
aluminum, 9
arrangement
 seating, 2-1
ATC. See automatic train control
audio systems, 13-1
automatic train control. Section 14
 event recorder, 14-1
 general requirements, 14-1

B

braking. *Section 12*
 emergency, 2-6
 friction, 12-1
 hydraulics, 12-1
 maximums, 2-6
 performance requirements, 12-1
 service brake, 2-6
brazing, 10

C

cab. *Section 5*
cable, 23
carbody. Section 3
castings, 7
CCTV, 13-2
circuit protection, 9-1
clearance
 requirements, 2-2
climate, 2-4
coatings, 17
codes, 2-13
communications. Section 13
 performance requirements, 13-1
 signs, 13-2
 surveillance, 13-2
 train to wayside, 14-1
compatibility

 general, 1-13
conduit, 34
configuration
 GENERAL vehicle, 2-1
configuration control, 15
cooling system. *See* heating, ventilation,
 and air cooling
coupler. Section 4
crash energy management, 3-1

D

deadman, 5-3
definitions, 1-4-1-11
description of work, 1-12
design approvals, 9
design requirements
 GENERAL, 2-1
diagnostics
 cab display, 5-2
dimensions
 car body, 2-2
 critical, 2-2
 pantograph, 2-2
 truck, 2-2
 wheel, 2-2
documentation requirements, 9
doors. *see* passenger doors
drawings, 9
duty cycle rating, 2-7

E

elastomers, 13
electrical. *Section 9*
 connection, 9-1
 connections, 31
 controls, 9-3
 devices, 36
 hardware, 36
 junction boxes, 35
 printed circuit boards, 19-1, 39
 semi-conductors, 38
 wire, 23
 wire installation, 26

electromagnetic compatibility. *See*
EMI/EMC
electromagnetic interference. *See*
EMI/EMC
emergency lighting, 8-1
EMI/EMC, 2-10
event recorder, 14-1

F

fasteners, 3
fiberglass reinforced plastic, 22
filters
 air, 17
flammability, 19-1, 20
floor covering, 15
fordability, 2-5

G

glass
 safety, 14
glazing, 14
heating, ventilation, and air cooling.
 Section 7
 controls, 7-2
 cooling system, 7-1
 heating system, 7-1
 validation requirements, 7-2
 ventilation, 7-1

H

high strength low alloy steel, 7
human engineering, 1-13
HVAC. *See* heating, ventilation, and air
 cooling

I

identification
 vehicle, 2-2
illustrated parts catalog, 22-5
industrial design, 1-13
information signs, 13-2
infrastructure description, 1-12
interior. Section 15
 walls and ceilings, 15-1

J

jerk limits, 2-7
joining, 2
junction boxes, 35
lighting. *Section 8*
 emergency, 8-1
 exterior, 8-1

M

maintainability, 2-12
manuals, 22-1
manuals format, 1
maser controller, 5-2
materials and workmanship. *Section 19,*
 Section 19.
meetings, 7
mockups, 20-2
modification control, 15

N

noise, 2-8

O

operating environment, 2-3
operator's seat, 5-2
operator's cab. *Section 5*
Owner Furnished Equipment. *Section 23*

P

paint, 17
panels, 20
parking brake, 2-7
passenger doors. *Section 6*
 annunciations, 6-3
 bypass devices, 6-3
 control switches, 6-2
 obstruction detection, 6-2
 operator, 6-1
 panels, 6-1
Passenger Emergency Equipment.
 Section 24, Section 24, Section 24,
 Section 24
passenger loading, 2-3
performance

- acceleration requirements, 2-6
- CARBODY, 3-1
- general, 1-13
- GENERAL requirements, 2-5
- pipng, 15
- power
 - contact line voltage range, 2-6
 - primary power system, 9-1
 - wayside, 2-5
- printed circuit boards, 19-1, 39
- program management, 1
- Program Management and Quality Assurance. *Section 20*
- propulsion. *Section 10*
- performance, 10-1

R

- regulations, 2-13
- reliability, 2-11
- Requirements Management, Design Validation and Verification. *Section 21*
- requirements traceability management, 21-1
- ride quality, 2-8

S

- samples, 20-2
- sanding system, 12-1
- schematics, 22-5
- seats
 - cushion material, 23
 - upholstery, 23
- semi-conductors, 38
- slide correction. *See* wheel spin/slide
- smoke emission, 19-1, 20
- software systems. *Section 18*
 - documentation, 18-1
- spin correction. *See* wheel spin/slide
- stainless steel, 6
- structural castings, 7
- supply voltage, 2-5
- surveillance, 13-2
- System Support. *Section 22*

T

- technical documents, 22-1
- terms. *See* definitions
- thermoplastic sheet, 22
- train to wayside communications, 14-1
- training, 22-8
- truck. *Section 11*
 - performance requirements, 11-1
- trucks
 - component design, 11-2
 - design loads, 11-1
 - features, 11-2
- tubing, 15

U

- units of measure, 1-11

V

- vehicle history books, 22-7
- vehicle identification, 2-2
- ventilation. *See* heating, ventilation, and air cooling
- vibration, 2-8

W

- water tightness, 3-2
- weight, 2-3
- welding, 10
- wheel spin/slide, 2-7
- wire, 23
 - connections, 31
 - ducts, 34
 - installation, 26
- wood, 20
- work, description of, 1-12

APPENDIX A – EXISTING SYSTEM INFORMATION

A.1 WAYSIDE CHARACTERISTICS

The vehicle shall be designed for normal operation within the following wayside characteristics and constraints.

A.1.1 Track

The vehicle shall be designed for normal operation with no interferences over all track on the MUNI Metro system, which has the following general characteristics:

(a) Track gauge	4 ft., 8 1/2 in.
(b) Minimum lateral radius (to centerline)	45 ft., 0 in.
(c) Maximum superelevation	0 ft., 6 in.
(d) Minimum vertical radius, crest	310 ft., 0 in.
(e) Minimum vertical radius, sag	460 ft., 0 in.
(g) Maximum grade	9 percent
(h) Minimum combined lateral and vertical radius	
Lateral	45 ft., 0 in.
Vertical	410 ft., 0 in.

The MUNI Metro system incorporates both AREA and street railway type trackwork. The street railway trackwork includes such features as flange-bearing special work and single point turnouts.

The standard rail for all new tee rail track construction is 100 lb/yd ARA-B in mainline track and 90 lb/yd RA-A in yard track. The standard rails for all new girder rail track construction are 128 and 149 lb/yd RE-7A. Girder rail is used only where the system operates within paved streets. The 128 lb/yd RE girder rail is used on tangent track, and the 149 lb/yd RE girder-grooved rail is used as the inside rail on tight-radius curved track.

A.1.2 Structures

(a) Station platform height from top of rail	2 ft., 9 in.
(b) Distance, centerline track to finished edge of platform	4 ft., 8 in.
(c) Station platform length	(minimum) 300 ft., 0 in.
	(maximum) 400 ft., 0 in.

A.2 Current System Configuration

Current Equipment for SFMTA defined systems are listed in the following Table.

Table A.2-1 Current System Configuration for LRV

No	Defined System	Current Manufacturer	Current Model / Part Number / Information	Qty	Current Location
1-1	Fare Collection - Farebox	Cubic	827-1900-9	2	One in each cab
1-2	Fare Collection – Clipper Unit	Cubic/ERG	Driver's Console: ERG p/n DC4700.AAAA	2	One in each cab.
1-3			Passenger Device: ERG p/n 18186	4	Two in each carbody half.
1-4			DC-DC Converter: Schock p/n SDC144.1	2	One for each carbody half.
2	Signal System	Thales			
2-1	Train to Wayside	Vetag	Code Control Box: Vecom p/n 28846134	2	One in each cab.
2-2			Transponder: Vecom p/n 28836221	2	One underneath each cab.
3-1	Radio (voice and data)	Harris OpenSky II	M7300	1	cabinet located in the middle of the car
3-2	Driver control unit	ACS (Harris contract)	Xerox OrbStar 8400 MDT	2	One in each cab
3-3	Vehicle Logic unit	ACS (Harris contract)	Xerox IVU-3100	1	
3-4	Bulk Data wireless transfer unit		5.9 GHz GSRC radio	1	
3-5	DVAS system	Xerox	CCP, AVA Card, PA Amp, Audio Switch, 2 Phones, Cabling, 4 Next Stop Signs, AGC Microphone and 4 internal signs/bracket	1	
3-6	Mobile Access Router/switch	Cisco	10 ports with LTE	1	

No	Defined System	Current Manufacturer	Current Model / Part Number / Information	Qty	Current Location
3-7	LNx-500 Ethernet Switch			1	
3-8	Antennas		GPS, 700/800 MHz, 5.9 GHz, DSRC	1ea	
3-9	Speed Sensors	GE-Wabtec	Cable from gear box to IVU	1	
3-10	Switchbox	Xerox		1	Cabin A/B
3-11	Serial to Parallel Converter			1	
4-1	Digital Video Recorder	DTI	16 Channel DVR Dual Drive Unit	1	One in middle of the car
4-2	Camera (analog)	DTI	Mini Dome Camera Part No 1ZE0280	6	Four in exterior, two in interior
4-3	Camera (IP)	DTI	IP Camera Part No 1ZE0265	10	Ten in interior
4-4	POE Switch	KRATOS	POE Switch, 8-Port KTOS LNP-800AGH-24	2	
4-5	Wireless Bridge	Firetide	4.9GHZ Wireless Bridge 7010	1	
4-6	Antenna	MP Antenna	4.9GHz Antenna 08-ANT-0937	2	Roof
4-6	Antenna		GPS	1	Roof
4-7	Power Module	Kratos	DVS Enclosure Kit ENC-DTI-SF-XXX (Custom Part for each Vehicle Manufacturer)	1	
4-8	Microphone	Kratos	Microphone KTOS-MIC2688	2	Two in interior
4-9	Camera Mount Plate	Kratos	Camera Mounting Plate KTOS-CMP-001	1	
4-10	Camera Brackets	Kratos	Camera Brackets KTOS-CMB-XXX	1	
4-11	Drivers Module		Status Tag Module	2	One in each cab

A.3 Contract Drawings

The following drawings are provided for information. However the Contractor is required to verify existing conditions to ensure worst case conditions are identified and addressed in the design of the LRV, including actual conditions.

1. **Sample Design Criteria (Church and Duboce Design Criteria)**
This is a sample track design criteria for SFMTA. Contractor shall work closely with SFMTA for latest information regarding the design criteria.
2. **LRV Dynamic Envelope**
The current dynamic envelope diagram for SFMTA is provided. Per Section 2.2.6.2, it is Contractor's responsibility to verify the dynamic envelope.
3. **LRV System Outline**
The Muni Metro System details are provided here including System Diagram, substations, track tables, track drawings, and sample horizontal and vertical track tables. Contractor shall work closely with SFMTA for latest information regarding the design criteria.
4. **ATCS LRV2 On-Board Equipment**
This document provides details of the current on-board ATC equipment. Contractor shall work closely with SFMTA for latest information regarding the specification.
5. **Radio System**
SFMTA is in the process of replacing their entire radio system. This document provides details of new radio system currently being designed for the SFMTA. Contractor shall work closely with SFMTA for latest information regarding the equipment.
6. **CCTV Device Layout**
This document provides details of the current CCTV system on the LRV fleet. Contractor shall work closely with SFMTA for latest information regarding the layout.

**1. Sample Design Criteria
(Church and Duboce Design Criteria)**



12.0 DESIGN CRITERIA

12.1 Trackwork

The trackway design criteria shall be based on the following standard references:

- Local, state and federal laws and regulations
- Muni track design standards
- Industry guidelines (i.e. AREMA Manual of Railway Engineering)
- City & County of San Francisco (CCSF) utility standards
- American Public Transit Association (APTA) publications
- Private utilities standards, where applicable
- DPW Standard Specifications
- Federal Transportation Authority Noise and Vibration Criteria

1. Speed Limit – LRV shall travel at the legal speed limit of parallel traffic.
2. Track Support System – The trackway support structure should be designed to provide adequate support to the trackway superstructure over the anticipated life of the structure. Transition connections between trackway placed on subgrade of different strengths must be designed to anticipate possible differential settlement.
3. Rails – R160N rail shall be used in all embedded tracks, except for curves that are less than 300 ft radius. 115RE high strength/premium tee rail shall be used for all running and restraining rails for embedded tracks with curves that are less than 300 ft radius. Furthermore, 115 RE high strength/premium tee rail shall be used for non-embedded tracks

Restraining rail shall be installed continuous along each embedded tee rail.

4. Trackway Alignment

The track alignment and clearance will be determined by the parameters contained in this section to achieve the following objective:

- Patron Comfort & Safety
- System Safety
- Operational Efficiency
- Compatibility with the Characteristics of the Vehicle to be Used
- Minimize Wear on Rails and LRVs
- CPUC General Order No. 143B, "Safety Rules and Regulations Governing Light Rail Transit"

- 4.1 **Horizontal Alignment** – The horizontal alignment shall be designed to maximize the running speed of LRVs. Superelevation shall be



used to minimize wear on the rails where it does not interfere with street grades on shared right-of-ways. The balance speed for superelevation shall be based on the probable speed of the LRV taking into account speed restrictions, stop locations, pedestrian activities and other related parameters.

4.1.1 Horizontal Control – Horizontal control for track alignment shall be referenced to survey control points established for this project. The coordinates for control points are based on the California Coordinate System Zone III, using ground distances.

4.1.2 Tangent Section – The minimum length of tangent track between reverse curves should be 25 ft. The horizontal and vertical alignment should be tangent at station platforms throughout the entire length. A tangent should extend a minimum of 20 ft beyond either end of the platform, unless it can be demonstrated that the swept-path of the LRV will not endanger people or interfere with platform and doors will meet ADA requirements.

4.1.3 Nomenclature and Definition:

$E(\text{in})$:	Actual Superelevation – The height by which the outside rail is raised above the inside rail.
$E_e(\text{in})$:	Equilibrium Superelevation – The value of superelevation that eliminates lateral forces at a given vehicle speed.
$L_c(\text{ft})$:	Arc Length of Circular Curve, measured at track centerline.
$L_s(\text{ft})$:	Length of Spiral, measured at track centerline.
$L_{s \text{ min}}(\text{ft})$:	Minimum Length of Spiral, measured at track centerline.
$L_t(\text{ft})$:	Length of Tangent.
$R_c(\text{ft})$:	Radius of Circular Curve, measured at track centerline.



- R_{min} (ft): Absolute minimum radius of track centerline shall be 45 ft.
- Θ_c : Center angle of circular curve, radians.
- Θ_s : Central angle of spiral length L_s , radians.
- Θ : Deflection angle for distance l on spiral, radians.
- U (in): Unbalanced superelevation. The difference between E_c and E .
- V (mph): Probable LRV operating speed.
- V_{max} (mph): The maximum permissible speed of an LRV on the alignment unconstrained by traffic regulations and signals, scheduled stops and comfort requirements.

4.1.4 Circular Curves – Circular curves shall have spiral transitions wherever feasible. Circular curves shall be specified by the centerline radius (R_c), the center angle (Θ_c) and the arc length (L_c). The radius should be as large as possible within the physical restrictions.

4.1.5 Superelevation – Superelevation shall be designed to minimize the wear of the rails (unbalanced superelevation). For shared right-of-way, the maximum track superelevation shall be 2 in. Superelevation shall transition uniformly. Superelevation shall be accomplished by maintaining average of the tops of both rails at the profile grade, raising the outside rail by an amount equal to one-half the superelevation. However, superelevation in paved areas may be accomplished by either lowering the inside rail or raising the outside rail the full amount of the superelevation if it will provide better drainage or better conform to adjacent paved areas. Maximum rate of superelevation runoff shall not exceed 2 inches in 25 ft. The equilibrium superelevation shall be determined to the nearest 0.25 in by the following formula:

$$E_q = E + U = 4.0V^2/R_c$$

where E_q = Equilibrium superelevation in inches
 U = Unbalanced Superelevation
 Maximum recommended is 3.0"



Maximum permissible is 4.5"
E = Actual superelevation, in inches
R_c = Radius of curvature in ft
V = Probable speed in mph

4.1.6 Spiral – When the geometry allows, spiral curves are used to provide a smooth transition between tangent and curved track and between curves of different radii, thereby increasing rider comfort and minimizing rail wear. Spirals shall be 25ft minimum in length and satisfy the following requirements:

(a) Spiral Curves shall be Barnett spirals.

(b) $V = \sqrt{(E+U) R_c/4}$ where

U = Unbalanced Superelevation
Maximum recommended is 3.0"
Maximum permissible is 4.5"
E = Actual superelevation, in inches
R_c = Radius of circular curve, in ft
V = Probable LRV operating speed, in mph

(c) The recommended minimum lengths of spiral curve shall be the greatest of the following:

$L_s = 1.0EV$
 $L_s = 1.0UV$ where L_s is in ft
E and U are in inches
V is in mph

(d) The absolute minimum length of a spiral curve shall be the greatest of the following:

$L_{s \min} = 0.75EV_{\max}$
 $L_{s \min} = 0.5UV_{\max}$
 $L_{s \min} = 12.5E$ where L_s is in ft
E and U are in inches
 V_{\max} is in mph

(e) The basic equations defining the spiral are as follows:

$$L_s = 2R_c \Theta_s$$

$$\Theta = (l/L_s)^2 \Theta_s$$

If $L_s/R_c \leq 0.01$ or $L_s < 25\text{ft}$, then no spiral is required.



Where

- Θ_s = central angle of spiral length L_s ,
radians
- Θ = deflection angle for spiral length l ,
radians
- l = spiral length between any two
points on spiral (ft)
- R_c = radius of circular curve (ft)
- L_s = total length of spiral (ft)

4.2 Vertical Alignment

4.2.1 Introduction – Track shall conform to street surface profile grades unless otherwise revised for new street grades, or as needed to clear underground facilities. The profile grade is defined as the average of the elevations of both tops of rails of the same track.

4.2.2 Nomenclature and Definition

G (%): Vertical grade

ΔG (%): Change in grade over the length of the vertical curve

Δg (%): The rate of change of vertical grade, i.e., the change of vertical grade in a 100-foot station

Δg_{max} (%): See 4.2.4.

LVC (ft): The length of the vertical curve

4.2.3 Maximum/Minimum Gradients

The desired grade is less than 5 percent. The maximum grade allowed shall be 7 percent. This may be increased up to 9 percent for very short distances.

A minimum grade of 0.3 percent is required for drainage.

4.2.4 Vertical Curves

Vertical curves shall be parabolic curves having a constant rate of change of grade. The minimum radius of vertical crest curve and a sag curve shall be within the requirements of the selected vehicle. The absolute



minimum curve length is 40 ft. Vertical curves shall end at 25ft away from a stop unless it can be demonstrated that the vehicle doors will meet ADA requirements.

1. The minimum length of vertical curve shall be the greater of:
 - (a) $LVC_{min} = \Delta G / \Delta g_{max} * 100$
 - (b) $LVC_{min} = 15 * \Delta G$
2. Where possible, the maximum rate of change of vertical grade shall be as follows:
 - (a) For vertical curve crest on tangent $\Delta g_{max} = 3000/V^2$
 - (b) For vertical curve sag on tangent $\Delta g_{max} = 4500/V^2$

4.2.5 Reverse Vertical Curves

Reverse vertical curves may be used if (1) the sum of the rates of change of grade per 100 ft Station of the two curves does not exceed the values defined by Section 4.2.4.2, and (2) the minimum length of each curve is not less than that defined in Section 4.2.4.1.

4.2.6 Compound Vertical Curves

Compound unsymmetrical vertical curves may be used if Δg conforms to Section 4.2.4.2 and the LVC conforms to Section 4.2.4.1.

4.3 **Combined Horizontal and Vertical Curvature**

Where horizontal and vertical curves are combined, the desirable rate of change of vertical grade shall be computed as follows:

$$\Delta g_{max} = N/(V^2)(1-0.25U)(1-0.25E)$$

where:

E and U are in inches
V = Designed speed, in mph
N = 3000 for a crest
N = 4500 for a sag

5. Trackway Horizontal Clearance



Clearances between vehicles and stationary objects shall be as follows:

All clearances shall be measured from the dynamic envelope of the outermost surface of the largest vehicle on tangent track. The spacing of tracks and structures shall be increased proportionally for curved track to provide the minimum clearances, shall be such that no contact can take place due to any condition of design wear, loading, air spring deflation, and normal lateral vehicle motion.

6. Trackwork

a. Rail Joints

Rails should be joined together with welds to provide continuous strings.

Wherever a permanent connection is made between contiguous rails of dissimilar cross section, compromise bolted joints shall be used.

The use of un-welded joints shall be minimized during design.

Joint bonds shall be installed at un-insulated bolted joints to provide a continuous path for traction power negative return current and signal circuits.

b. Rail Braces

Rail braces shall be used in special trackwork for tie and ballast open track to minimize rail batter. Rail braces shall also be used on the outside rail in non-embedded open track with an unbalanced superelevation of 3 inches or more at probable speed.

c. Insulated Joints

Insulated joints of the epoxy bonded type shall be used wherever it is necessary to electrically isolate contiguous rails from each other in order to comply with track signaling criteria.

d. Timber Crosstie Spacing

In tangent and curved track of radius greater than or equal to 300 ft, timber crossties shall be spaced 2 ft on center. In curves of radius less than 300 ft, but not less than 100 ft, timber crossties shall be spaced not more than 20 inches on center. In curves of radius less than 100 ft, timber crossties shall be spaced not more than 18 inches on center.

e. Rail Fastenings



Running rail shall be fastened to its support in each type of track construction in a manner dependent upon the type of constructions.

- **Timber Crosstie Rail Fastenings:** The standard rail fastening for use on timber crosstie shall be Pandrol Clips, tie plate, neoprene tie pad and screw spikes.

Tie plates for restraining rail shall be sized and designed to support both running rail and restraining rail.

- **Direct Fixation Rail Fasteners:** Direct fixation rail fasteners shall be insert anchors, anchor bolts, shim pads, rail plates, rail clips and lock washers. Fasteners shall be spaced no more than 3 ft for tangent track, and curved track with radius of 300 ft or more, and 2ft for curved track with radius less than 300 ft. Spacing shall be reduced accordingly for special trackwork in accordance with AREMA Portfolio of Trackwork Plans, but not more than 2 ft.

f. **Gauge Rods**

Gauge rods shall be designed for attachment to the base of rail. Gauge rods shall be threaded with 2 insulated clips and 2 lock nuts at each end of the rod to provide restraint against gauge widening and narrowing.

Gauge rods shall be insulated from the rails.

Gauge rods shall be installed only in tie and ballast track on curves with a radius of less than 300 ft. Gauge rods shall be spaced approximately 6.5 ft on center. Gauge rods shall also be installed at each end of switches, frogs and crossings. Gauge rods shall not be used in direct fixation track.

g. **Unreinforced Track Concrete**

Unreinforced track concrete shall contain 100 percent virgin polypropylene, collated, fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. Fiber reinforcement shall be added to unreinforced track concrete at the rate of 0.56 lbs per cubic foot.

Control joints shall be provided in track concrete. Spacing between control joints for unreinforced concrete shall not exceed 6.5ft. Construction joints may substitute for control joints.

h. **Track Drainage**



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Church and Duboce Track Improvement Project

Track drains shall be designed accordingly at the low points of track alignment. Track profiles and cross slopes shall be coordinated to minimize track drains.

Drain shall be installed at track switches.

i. Engineering Fabric

Engineering fabric shall be placed under track ballast and shall be manufactured from polypropylene material. The fabric shall be non-woven, shall not act as a wicking agent, shall be permeable, and shall provide separation of the ballast from other material, filtration (restrict solids from passing into the ballast while allowing more water to dissipate) and tensile reinforcement.

Fabric shall conform to AASHTO Task Force 25 requirements for high road stabilization and the following:

Elongation, percent, min. ASTM Designation D 1682	50
Puncture strength, in pounds ASTM Designation D 751 (Modified)	120
Equivalent opening size U.S. Sieve No. minimum	70

7. Special Trackwork

All special trackwork shall be located on constant profile grades without any superelevation. Crossovers shall preferably be located in parallel tracks and semi-exclusive right-of-way. All special trackwork frogs and crossings shall be fabricated from solid manganese steel castings conforming to Muni specifications for special trackwork. All single crossovers shall be trailing crossovers, composed of two right-hand turnouts.

As all special trackwork is a source of noise and vibration, due consideration shall be given to noise and vibration in their design.

8. Trackway Characteristics

Trackwork shall be designed based upon the following Trackway and Wayside, and Muni vehicle characteristics:

Trackway & Wayside Characteristics	Value
Track Gauge/Tangent & Curve $R > 200$ ft	4'-8½"
Track Gauge/Curve 100 ft $< R < 200$ ft	4'-8¾"



Conceptual Engineering Report
Church and Duboce Track Improvement Project

Track Gauge/Curve ≤ 100 ft	4'-8 $\frac{3}{4}$ "
Flangeway Widths/Tangent & Curve $R > 200$ ft	1 $\frac{1}{8}$ "
Flangeway Widths/Curve $100 \text{ ft} < R \leq 200$ ft	1 $\frac{1}{2}$ " (inside); 1 $\frac{1}{8}$ " (outside)
Flangeway Widths/Curve $R \leq 100$ ft	1 $\frac{1}{8}$ " (inside); 1 $\frac{1}{4}$ " (outside)
Minimum Horizontal Radius (to Track Centerline)	45 ft
Minimum Desirable Horizontal Radius	50 ft
Maximum Trackway Superelevation in Shared ROW	2 in
Maximum Trackway Superelevation in Exclusive ROW	6 in
Maximum Unbalanced Superelevation	4.5 in
Minimum Vertical Crest Radius	310 ft
Minimum Vertical Sag Radius	460 ft
Absolute Minimum Vertical Curve Length	40 ft
Maximum Desirable Grade	5%
Maximum Allowable Grade	7%
Absolute Maximum Grade for a Short Distance	9%
Minimum Grade	0.3%

Clearance Requirement	Value
Centerline of Track to Edge of Platform	55 $\frac{1}{8}$ " + 0" - 1 $\frac{1}{8}$ "
Height of Platform from Top of Rail	33 $\frac{1}{2}$ " + 1 $\frac{1}{4}$ " - 0"

Breda LRV2 Vehicle Characteristics	Value
Car Length (over anti-climbers)	73 ft
Car Length (over couplers)	75 ft
Static Car Width (at threshold)	8'-8"
Static Car Width (at belt line)	9'-0"
Dynamic Car Width (at threshold)	9'-1 $\frac{1}{4}$ "
Dynamic Car Width (at belt line)	9'-8 $\frac{1}{4}$ "
Car Width (at mirror)	10'-2"
Floor Height (top of rail to floor)	2'-10"
Truck Wheel Base	6'-3"
Truck Centers	24 ft
Car Height (top of rail to top of roof equipment)	11'-6"
Empty Weight (exclusive of Muni equipment)	38 ton
Normal Weight (AW 1-62 passengers)	42.85 ton

Trackway & Wayside Characteristics	Value
Seated Weight (AW 2-155 passengers)	50 ton
Maximum Weight (AW 3-200 passengers)	55 ton
Weight Distribution (end trucks)	35%
Weight Distribution (center truck)	30%

9. Glossary of Trackwork Terms



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Church and Duboce Track Improvement Project

Approach Slab (Transition Slab) - A concrete slab under ballast located at the interface of ballasted track with direct fixation track or embedded track to provide a transition between ballasted track construction and the types of track with significantly higher track modulus.

AREMA - American Railway Engineering and Maintenance-of-way Association.

At-Grade Crossing - The crossing of track across a vehicular roadway at the same elevation; conventionally constructed of asphalt and concrete.

Ballast - An integral part of the track structure, generally composed of crushed stone in which ties are embedded and essential to good maintenance of track surface and alignment. Federal Railroad Administration (FRA) Track Safety Standards stipulate that: "Unless it is otherwise structurally supported, all tracks must be supported by material that will:

- a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;
- b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling equipment and thermal stress exerted by the rails;
- c) Provide adequate drainage for the track; and
- d) Maintain proper track cross-level, surface, and alignment.
- e) Track ballast is the conventional material that performs the above functions. In addition, ballast can retard the growth of vegetation.

Rail Bond - Copper bonding cable that attached by CAD-Welding to the rail on each side of the joint to assure a path for electrical current across the joint.

Closure Rails - The standard rails placed between components of any special trackwork unit, such as the rails between the switch and the frog in a turnout.

Crossing - A structure, used where one track crosses another at grade, and consisting of four connected frogs.

Crossover, Single - Two turnouts, with track located between the turnouts and arranged to form a continuous passage between two adjacent and generally parallel tracks.

Engineering Fabric - Non woven synthetic fabric that allows water to past through but prevents the passage of fine soil materials, Engineering Fabric prevents the fouling of ballast by the migration of subgrade fines.

Flangeway - The open way through a track structure which provides a passageway for wheel flanges.

Flangeway Width - The distance between the gage line and the guard line of a track structure, which provides a passageway for wheel flanges.

Flangeway Depth - The depth of the wheel flange passageway, or the vertical distance from the top of the tread surface to the top of the filter or separator introduced between the tread portion and the guard portion of a track structure.



Frog - A track device used at the intersection of two running rails to provide support for wheel treads and flanges, thus permitting wheels traversing either rail to cross the other.

Frog Angle - The angle formed by the intersecting gage lines of a frog.

Frog Number - The number used to designate the size of a frog, and being equal to one-half the co-tangent of one half the frog angle.

Girder Rail - Any one of several types of rail sections most commonly used in electric or street railway construction. Girder groove rails are unsymmetrical rails that provide a wheel flangeway adjacent to the gauge side of the railhead. Girder guard rails utilize a similar flangeway but with a raised lip to provide a guarding action similar to that provided by a separate restraining rail.

Guard Rail - A rail installed parallel to and inside of the running rails of a track to hold wheels in correct alignment to prevent their flanges from striking the points of turnout or crossing frogs or the points of switches. The term is sometimes applied to other track more properly referred to as restraining rail or emergency guard rail.

Guard Rail, Emergency - A rail or other structure installed parallel to and approximately one foot inside of the running rails of track to keep the wheels of a derailed vehicle reasonably adjacent to the running rails and following the general alignment of the track.

Gauge Rod - A steel bar or rod that clamps to the rail bases of the running rails and to hold the rails to proper track gauge. Gauge rod is used in turnouts and curves to maintain accurate gauge.

Inside Rail - On a curved track, the rail closer to the curve center; the rail with the shorter radius. On a curved track that is superelevated, it is sometimes referred to as the "low rail."

Joint Bar - Device used to join the abutting ends of contiguous unwelded rails.

Joint Bar, Compromise - A joint bar used to connect contiguous unwelded rails of different cross sections.

Joint Bar, Glued - Joint bar shaped with maximum surface-to-rail contact for adhesion to rail with epoxy adhesive.

Joint Bar, Insulated - An assembly of two special joint bars, track bolts, insulating sleeves, and insulated end post. The special joint bars are designed to stiffen the joint and prevent the passage of rail current across the joint.

Outside Rail - On a curved track, the rail further from the curve center; the rail with the longer radius. On a curved track which is superelevated, it is sometimes referred to as the "high rail."



Profile Grade Line (PGL) - The datum line which defines the vertical alignment of the track, and represents the average of the two rails.

Rail Brace - A bracing device used in combination with a switch or at other locations where rail is subject to batter.

Rail Fastener - A device used to secure running rails to ties in ballasted track, to a concrete trackbed in direct fixation track or to embedded track at the proper track gauge and to provide proper vertical, lateral and longitudinal restraint of the rail.

Rail, Compromise - A relatively short rail the two ends of which are of different sections, corresponding with the sections of the rails to which they are to be joined; it provides the transition from one section to a different rail section.

Rail, Tee - The common class of steel rail for track construction which is symmetrical in section and resembles an inverted letter "T". The term "standard" is commonly associated with tee rail sections.

Rail, Premium - Rail which has a Brinell hardness between 321 and 388 which is achieved by fully heat treating, or alloy composition.

Restraining Rail - A rail installed adjacent to and parallel with the running rail of curved track. It bears against at the back side of the wheels and steers the wheels of each truck around the curve, thereby preventing the wheel flange from climbing the rail. It also reduces gauge side wear on the running rail.

Special Trackwork - A generic term referring to turnouts, single and double crossovers, track crossings, and other such items.

Stock Rail - A running rail against which a switch rail operates in a turnout.

Subgrade - The finished surface of the roadbed below ballast or track slab.

Switch, Mate - A track structure having a fixed or immovable point and used on the opposite side of the track from a tongue switch, as its companion piece. (A mate is termed "outside" or "inside" depending upon whether it is placed on the outside or inside of the curve, the "inside mate" being comparatively little used.)

Switch, Tongue - A switch deflecting device consisting essentially of a movable tongue within suitable enclosing and supporting body structures. Used in a turnout in embedded track. Often used in conjunction with a non-moving deflection device called a mate.

Switch, Point of - The tip of the tapered end of a switch rail; end of a switch rail farthest from the frog or heel block.

Switch Rail (Switch Point) - The tapered rail of a split switch.



Top of Rail (T/R) - That portion of the running rail that follows the PGL; the top surface of the head of the running rail.

Track, Ballasted - Track constructed of rail and cross-ties on ballast.

Track, Direct Fixation - Track constructed of rail and rail fasteners attached by means of anchor bolts to a reinforced concrete track slab.

Track, Embedded - Track that is embedded in asphalt, concrete, or other such material to the elevation of the top of rail to facilitate pedestrian or vehicular traffic over the track.

Track Gauge - The distance measured between and perpendicular to the track gauge lines.

Track Gauge Line - A line 5/8 inch below the top of the center line of the head of the running rail or corresponding location of tread portion of other track structures along that side which is nearer the center of the track.

Track Slab - The reinforced concrete foundation that supports the track itself, generally in conjunction with direct fixation track.

Turnout - An arrangement of a switch and a frog with stock rails and closure rails, enabling rail vehicles to be diverted from one track to another.

Turnout, Lateral - A turnout in which the diversion due to the angle of the turnout, is entirely in one direction away from track from which the turnout is made.

12.2 Overhead

A. Overhead Contact System for LRV/PCC

Overhead hardware used should be products of manufacturers regularly engaged in the production of such material and equipment, and is of the manufacturer's latest design approved by Muni. This is to ensure compatibility and interchangeability with the current Muni overhead hardware and spare parts. The followings are specific hardware characteristics for the project:

1. Hardware Criteria

1.1 Overhead Contact System Type – Single wire direct suspension.

1.2 Contact Wire – Contact wire shall be bronze, grooved, alloy 80 conforming to ASTM B9-90. The following characteristics will be used:

Description	Muni Standards
Contact Wire for LRV/PCC	#4/0
#4/0 Contact Wire Tension @ 60°F	3750 lb per wire



Contact Wire Height at Surface	18.50 ft ± 0.26 ft
Maximum Unsupported Contact Wire Span	100 ft

- 1.3 **Frogs** – Leading and trailing frogs for PCC/LRV will be 10° shallow grooved solid body type. The leading PCC/LRV switch will be positioned to allow for optimal performance of LRV operation.

2. Contact Wire Alignment

- 2.1 **For Special Trackwork** – At track curves, crossovers and turnouts, OCS will be designed to maintain continuity of contact between the contact wire and the LRV pantograph. The contact wire will be offset from the track centerline to within the zones as shown on Standard Drawing K-41, “Transit Power Facilities” – Location of Contact Wire Above Track for Pole and Pantograph Operation” dated September 1978. Each track curve, crossover and turnout will require evaluation of the following parameters to determine the required contact wire offset.

- Minimum curve radius
- Radius of spiral curve entering
- Radius of spiral curve exiting
- Curve superelevation

- 2.2 **For Tangent Trackage** – At tangent trackage, the contact wire will be staggered from track centerline to allow uniform wearing of pantograph carbon collector strip. Stagers will be as shown on Muni Standard Drawing A-1530, Rev. 0, “Transit Power Facilities – Streetcar Overhead System – Stagger Diagram” dated August 1979.

B. Overhead Contact System for Trolley Coaches

Overhead hardware used should be products of manufacturers regularly engaged in the production of such material and equipment, and is of the manufacturer’s latest design approved by Muni. This is to ensure compatibility and interchangeability with the current Muni overhead hardware and spare parts. The followings are specific hardware characteristics for the project:

1. Hardware Criteria

- 1.1 **Overhead Contact System Type** – OCS shall be a rigid type system similar to Ohio Brass (OB) / Westinghouse Air Brake Company (WABCO) / Impulse N, Inc Contact System or a flexible system similar to Kummier & Matter System.



- 1.2 **Contact Wire** – Contact wire shall be bronze, grooved, alloy 80 conforming to ASTM B9-90. The following characteristics will be used:

Description	Muni Standards
Contact Wire for Trolley Vehicles	#2/O
#2/O Contact Wire Tension @ 60°F	2000 lb per wire
Contact Wire Height	19 ft ± 3 in
Contact Wire Spacing	2 ft
Axis of Trolleywire pair from curb unless otherwise noted	14 ft
Maximum Unsupported Contact Wire Span	100 ft

- 1.3 **Overhead Components and Trolley Wire Replacement** – Replace overhead components and trolley wires that have a service life of less than 50%.

- 1.4 **Leading Switch** – 15 ° Induction Controlled.

- 2. **Trolley Wire Alignment** in accordance with guidelines and criteria established by Municipal Railway High Performance Trolley Coach Overhead Minimum Standards.

C. Overhead Supports and Foundations

1. OCS Poles

Steel poles will be in accordance with Muni Standard Drawing CL-7971, Rev. 2. For all Standard applications, pole Types 761N, 765N, 767 and 770 shall be used.

New poles will be in line with property line between adjacent properties and avoid fronting doors, windows, and access ways wherever possible. Where an existing pole is replaced with a new pole, the new pole will be at approximately 4 ft away from the present location. At intersections adjoining side platforms the poles should be as clear of the corner as possible to avoid being hit by right turning trucks.

Wherever possible, poles will be combined with streetlight and traffic signals to reduce the number of poles. Poles with feeder risers inside will not be combined with traffic signals.

2. Pole Foundations

Existing foundations will be removed to a depth of 3 ft below the finished grade. Where a pole has to be replaced in place due to space constraint, the existing foundation will be removed entirely and new foundation installed in place.



New standard pole foundations will be in accordance with Muni Standard Drawing CL-7971, Rev. 2. Where special foundations are required, they will be designed according to the current codes and regulations.

3. Pole Replacement

Replace City owned wood poles, concrete poles, and steel poles that are bending, leaning, deeply pitted, or with rust and/or holes along the shaft or base.

4. Protection Devices

Wood troughs, preformed glass/epoxy shields, or approved apparatus of a custom design if necessary, will be used wherever the overhead support structure shall be protected against possible arcing conditions.

Guy wire span supports shall include tree guard or similar item to protect against trolley shoe snags during dewirement from a trolley vehicle.

5. Finish Treatment

Unless otherwise required by urban design requirements or streetscape master plan, new steel pole shall have a galvanized finish (Not Painted). Existing steel trolley pole shall be painted to match galvanizing or existing coating color. Anti-graffiti coating shall be applied to the bottom 8' of the pole.

6. All OCS poles should be grounded.

D. Design Codes and Guidelines

- California Public Utilities Commission (CPUC) General Order No. 95, Rules for Overhead Line Construction
- California Public Utilities Commission (CPUC) General Order No. 128, Rules for Construction of Underground Electric Supply and Communications Systems.
- Muni High Performance Trolley Coach Overhead Wire Minimum Standards
- California Code of Regulation (CCR), Title 8; Industrial Relation



12.3 Electrical

A. Track Switch and Signal Interlocking System

All track switches will be electrically controlled and shall be operated by track switch operators. Aspect signals to indicate the position of each track switch shall be provided. Interlocking of track switches and signals shall be incorporated into track switch control system.

1. Track Switch Operators

The track Switch operators for the track switches signal shall be solenoid type with position indications for single tongue and mate trailable track switches.

2. Track Switch Controller

Track switch controller shall be designed by utilizing conventional relay circuitry and Vital Programmable Logic Controller (VPLC) circuitry to provide the logic and interlocking functions for the control and signaling of all track switches. Major components of the track switch control such as relays, power supply and transformer, VPLC, Local Control Panel, shall be housed in the wayside cabinet. 120/240 VAC single phase 60 hertz utility shall be provided to track switch control and operation system.

3. LRV Train Signals.

8-inch four aspect LED type LRV signal shall be provided for each track switch. The stacking of the LRV signal heads, from top to bottom, shall be as follows: lunar white (confirm), vertical bar (Straight), diagonal left or right (diverge) and red cross-buck (stop).

4. Track Circuits

Each track switches shall have "Protective Track Circuit"(BT), which encompasses the switch itself. This track circuit prevents the track switch from moving when a train is occupying this circuit.

An "Approach Track Circuit" (AT) shall be provided at each track switch for initiating route request for the Normal route.

Insulated joints (IJs) shall be installed in strategic locations to electrically isolate rails in order to meet track switch signal interlocking requirements.

5. Routing Requests



Combined Approach Track circuit and Vehicle Tagging System (VETAG) shall be used for initiating routing requests for Normal moves. VETAG shall be used to set route requests for Reverse moves.

B. Streetlights

The streetlight luminaries and bracket arm shall be decorative tear drop type, high pressure sodium vapor lamps with operating voltage of 120/240 VAC. The streetlights shall meet the minimum standards that are recommended by the Illuminating Engineering Society (IES) for street lighting. The streetlights illumination level should be from 0.4 to 0.8 average foot-candles and the illumination uniformity ratio shall be 3:1 for average to minimum foot-candles and 5:1 for maximum to minimum foot-candles.

12.4 Civil

Refuge Area: A minimum personnel refuge area measuring 30" high and 30" deep shall be provided under high level platform.

Platform Height: The height is measured from the top-of-rail.

Platform Clearance from Train: The clearance between the boarding edge-of-platform is measured from the centerline of track. The clearance shall accommodate both moving and parked train. The clearance shall be adequate even when the train opens its doors.

Ramp Grade: The maximum grade of the ramp is 8.33 percent and its length shall not exceed 30 feet. The landing area length shall be five feet minimum. If longer, an intermediate landing area is required.

Ramp Width: The minimum clear width of the ramp shall be three feet. This width shall match landing area width.

Hand Railing:

- Handrail shall be provided along both sides of ramp and shall be continuous.
- The minimum handrail gripping surface shall be 34 inches above ramp floor and at least 1 ½ inches from any other surface.
- The required handrail thickness is 1 ¼ inches.
- Handrail shall extend at least 12 inches beyond the top and bottom of the ramp segment.
- The handrail frames shall resist at least lateral force of 200 lbs.

12.5 Roadway Pavement

Unless noted otherwise, new road pavement outside of track right of way or alteration to existing road pavement shall be designed to match the existing.

2. LRV Dynamic Envelope

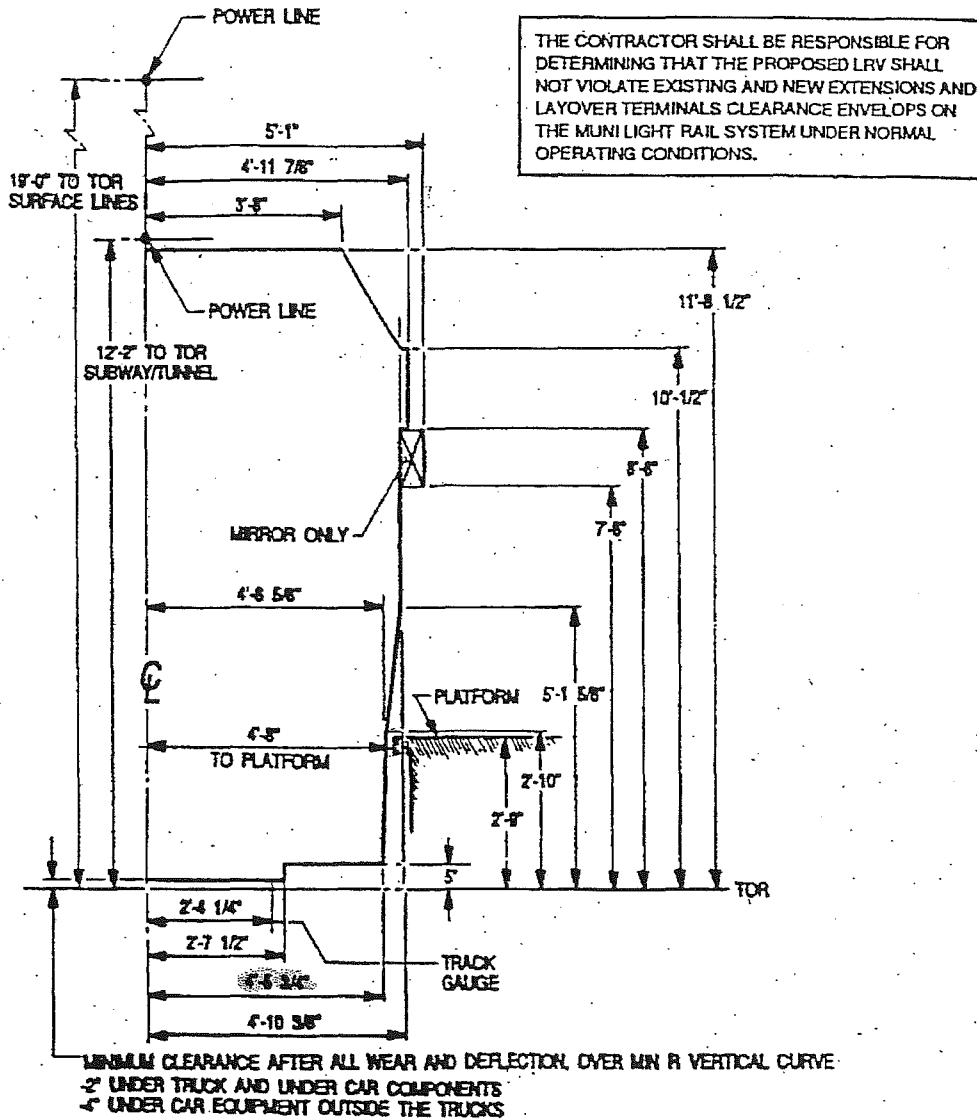


appendix forty-five
LRV Dynamic Envelope

for reference only

EXHIBIT 2-3

LRV2 DYNAMIC OUTLINE



- NOTES:
1. THE DYNAMIC OUTLINE REPRESENTS THE MAXIMUM ALLOWED EXCURSION WITH THE DOOR CLOSED, NEW WHEELS ON NEW TANGENT TRACK.
 2. THE DYNAMIC OUTLINE INCLUDES:
 - (a) LATERAL DISPLACEMENT OF PRIMARY AND SECONDARY SUSPENSION
 - (b) CAR BODY ROLL
 - (c) MANUFACTURING TOLERANCES
 3. THE DYNAMIC OUTLINE DOES NOT INCLUDE:
 - (a) TRACK TOLERANCES AND WEAR
 - (b) WHEEL FLANGE WEAR
 - (c) SUPERELEVATION

1092

CASE (I):

CLEARANCE ON BOARDING ISLANDS, IN YARDS AND ALONG SHOP AISLES, EMERGENCY WALKWAYS WHERE PASSENGERS, EMPLOYEES AND OTHER PERSONS ARE PERMITTED OR REQUIRED TO BE WHILE TRAINS ARE IN MOTION. (REF. 1, SEC. 9.06c(1)).

- A. MINIMUM SIDE CLEARANCE FROM VEHICLE TO OBSTRUCTIONS HIGHER THAN 203mm [8 INCHES] ABOVE TOP OF RAIL (T/R).

NOTES:

1. ALL CLEARANCES ARE TO BE MEASURED FROM THE DYNAMIC ENVELOPE OF THE OUTERMOST SURFACE OF THE LARGEST VEHICLE TO THE NEAREST POINT OF STRUCTURE.
2. ALL CLEARANCE CONDITIONS SHALL APPLY TO LIGHT RAIL VEHICLES AND STREETCARS OPERATED IN BOTH TANGENT AND CURVED TRACKS FOR NEW LIGHT RAIL TRANSIT AND TRACK REPLACEMENT PROJECTS.
3. CLEARANCE LESS THAN 762mm [30"] MAY BE FILED TO CALIFORNIA STATE PUBLIC UTILITIES COMMISSION FOR REVIEW / APPROVAL IF PROJECT DESIGN CAN DEMONSTRATE THAT:
 1. THE STRUCTURE (E.G CANOPY ROOF, LIGHTING ARM, SIGNAL PANEL) IS INACCESSIBLE TO PASSENGERS AND
 2. TRAIN OPERATION CONTROL IS PROVIDED AND MONITORED WHILE THE MAINTENANCE / REPAIR WORK OF THE STRUCTURE IS UNDERTAKING.

REFERENCE:

1. CALIFORNIA STATE PUBLIC UTILITIES COMMISSION GENERAL ORDER 143-B; JANUARY 20, 2000
2. CONTRACT PROPOSAL #309, PROCUREMENT OF LIGHT RAIL VEHICLES, SAN FRANCISCO MUNICIPAL RAILWAY, JANUARY 6, 1992.

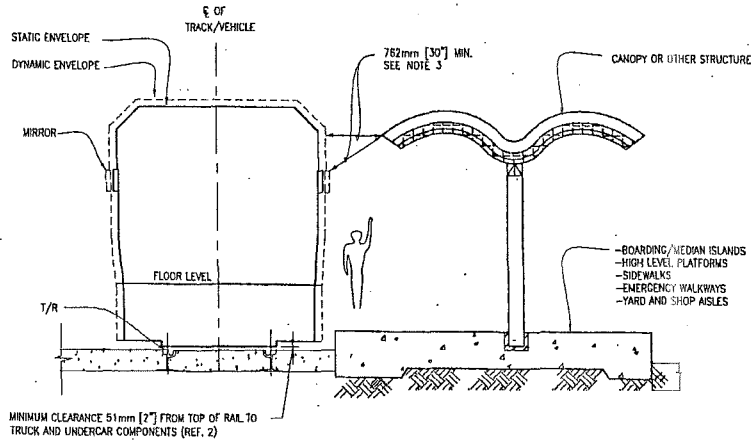


FIGURE I

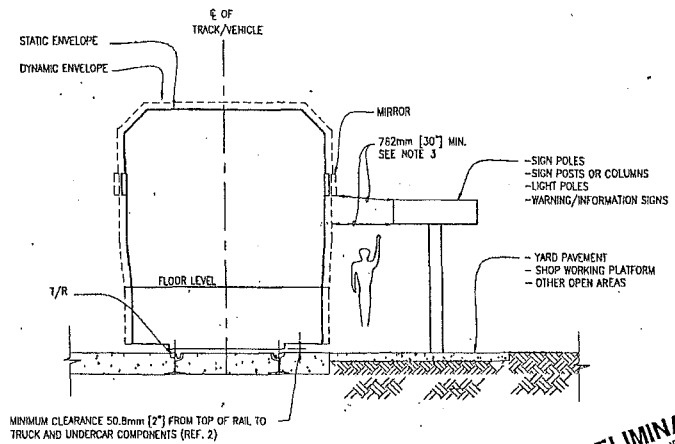


FIGURE II

PRELIMINARY DRAWING
SUBJECT TO CHANGE

NO.	DATE	DESCRIPTION	DESIGNED	CHECKED	APPROVED
REVISIONS					

DESIGNED	
CHECKED	
REVIEWED	
RECOMMENDED	
APPROVED	
DATE	



CITY AND COUNTY OF SAN FRANCISCO
MUNICIPAL RAILWAY

APPROVED
GENERAL MANAGER

LIGHT RAIL TRANSIT SYSTEM

VEHICLE CLEARANCES CASE (I)

CONTRACT	MR-XXXX
DRAWING	TR/CLR-01
REVISION	
NTS	0

CASE (II):

CLEARANCES AT LOCATIONS AND IN AREAS WHERE PASSENGERS, EMPLOYEES AND OTHER PERSONS ARE NORMALLY PROHIBITED WHILE TRAINS ARE IN MOTION. (REF. 1., SEC. 9.06c(2).)

A. MINIMUM CLEARANCE BETWEEN VEHICLES AND MINIMUM TRACK SPACING BETWEEN PARALLEL TRACKS.

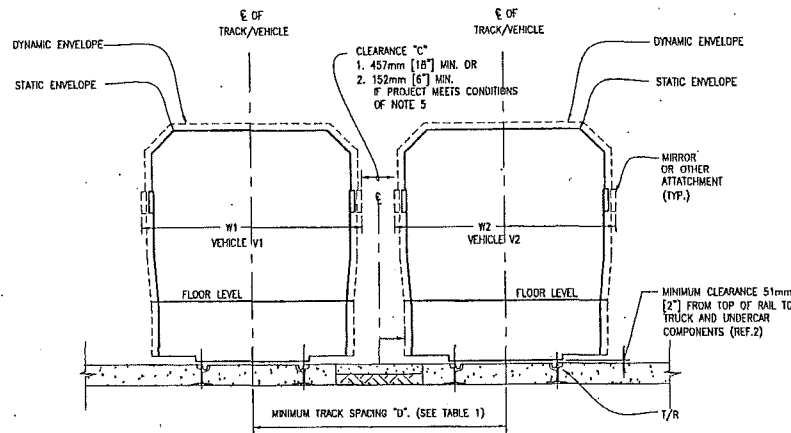


FIGURE II

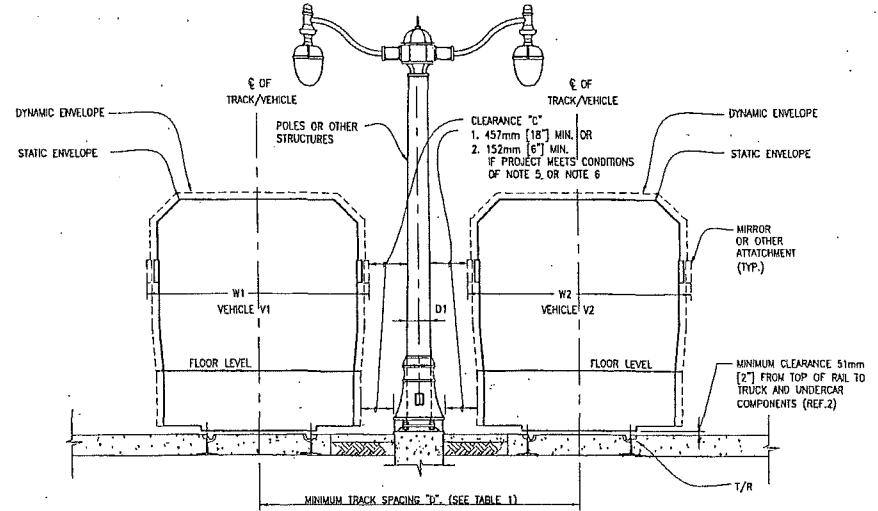


FIGURE III

TABLE 1. MINIMUM SPACING BETWEEN TANGENT TRACKS (SEE NOTE 4)

OPERATION		W1 m [FT]	W2 m [FT]	* MINIMUM TRACK SPACING "D" m [FT]					
				FIGURE I		FIGURE II			
				457mm [18"] CLEARANCE "C"	152mm [6"] CLEARANCE "C"	457mm [18"] CLEARANCE "C"		152mm [6"] CLEARANCE "C"	
LRV2	LRV2	3.100m [10.17']	3.100m [10.17']	3.557m [11.67']	3.252m [10.67']	4.319m [14.17']	4.471m [14.67']	3.709m [12.17']	3.882m [12.67']
LRV2	PCC	3.100m [10.17']	3.048m [10.00']	3.531m [11.59']	3.228m [10.59']	4.293m [14.09']	4.446m [14.59']	3.695m [12.09']	3.837m [12.59']
LRV2	LRV1	3.100m [10.17']	2.990m [9.81']	3.502m [11.49']	3.197m [10.49']	4.254m [13.99']	4.417m [14.49']	3.655m [11.99']	3.807m [12.49']
LRV1	LRV1	2.990m [9.81']	2.990m [9.81']	3.447m [11.31']	3.142m [10.31']	4.209m [13.81']	4.362m [14.31']	3.600m [11.81']	3.752m [12.31']
LRV1	PCC	2.990m [9.81']	3.048m [10.00']	3.476m [11.41']	3.476m [11.41']	4.235m [13.91']	4.392m [14.41']	3.630m [11.91']	3.783m [12.41']
	PCC	3.048m [10.00']	3.048m [10.00']	3.505m [11.50']	3.505m [11.50']	4.267m [14.00']	4.420m [14.50']	3.658m [12.00']	3.810m [12.50']

W1, W2 = MAXIMUM WIDTH OF LARGEST VEHICLE DYNAMIC ENVELOPE (IN METERS)
 D (FIG. II) = [(W1+W2)/24("C"/1000)]m
 D (FIG. III) = [(W1+W2)/24("C"+"C"+D1)/1000]]m
 "C" = MINIMUM ALLOWABLE CLEARANCE (IN MILLIMETERS)
 D1 = POLE DIAMETER OR LARGEST SIDE DIMENSION OF STRUCTURE; FOR TAPER-SECTION POLE, USE LARGEST DIAMETER AT BASE.
 LRV2 = BREDA LIGHT RAIL VEHICLE
 LRV1 = BOEING VERTICAL LIGHT RAIL VEHICLE
 PCC = PRESIDENT'S CONFERENCE COMMITTEE VEHICLE (USE 3.048m [10.00'] WIDTH OF "THE TORPEDES" IN CALCULATION)
 *TRACK SPACING SHALL BE ADJUSTED ACCORDINGLY TO ALLOW HISTORIC STREETCAR OPERATION (3.200m [10'-6"] WIDTH OF VEHICLE # 130 MAY BE USED FOR ADJUSTMENT).

NOTES:

- ALL CLEARANCES ARE TO BE MEASURED FROM THE DYNAMIC ENVELOPE OF THE OUTERMOST SURFACE INCLUDING ATTACHMENTS OF THE LARGEST VEHICLE.
- ALL CLEARANCE CONDITIONS SHALL APPLY TO LIGHT RAIL VEHICLES AND STREETCARS OPERATED ON BOTH TANGENT AND CURVED TRACKS FOR NEW LIGHT RAIL TRANSIT AND TRACK REPLACEMENT PROJECTS.
- THE TRACK SPACING SHOWN IN TABLE 1 APPLIES TO VEHICLES ON TANGENT TRACKS ONLY.
- FOR CURVED TRACKS, MINIMUM TRACK SPACING SHOULD BE INCREASED AND DESIGNED ACCORDINGLY BASED ON THE MOST CRITICAL VEHICLE DYNAMIC ENVELOPE INCLUDING ITS ATTACHMENTS (E.G. MIRRORS, ETC.), TRACK GEOMETRY, AND SUPERELEVATION.
- IN EXCLUSIVE RIGHT-OF-WAYS INCLUDING SUBWAYS, TUNNELS, AND PORTIONS OF SURFACE AND ELEVATED ALIGNMENT WHICH ARE EQUALLY INACCESSIBLE TO PERSONS, CLEARANCES MAY BE REDUCED TO THE DYNAMIC ENVELOPE OF THE LARGEST RAIL VEHICLE OPERATED, PROVIDED ALL LRVS AND STREETCARS MEET THE FOLLOWING CONDITIONS (REF. 1, SEC. 9.06c. (3)):
 ALL WINDOWS, EXCEPT THOSE ENTIRELY WITHIN OPERATOR'S CAB, SHALL BE DESIGNED AND CONSTRUCTED SO AS TO DETER A PERSON'S HEAD OR ARM FROM BEING READILY EXTENDED TO THE OUTSIDE FROM AN OPEN WINDOW.
- FIXED WAYSIDE STRUCTURES LESS THAN 1.524m [5'] IN LENGTH (e.g. CATENARY AND SIGNAL POLES, SWITCHING EQUIPMENT) SHALL BE EXCLUDED FROM 457mm [18"] CLEARANCE REQUIREMENT, PROVIDED APPROVED MEASURES ARE TAKEN TO GIVE WARNING OF RESTRICTED CLEARANCES. INSTEAD, 152mm [6"] CLEARANCE SHALL BE USED FOR DESIGN.

REFERENCE:

- CALIFORNIA STATE PUBLIC UTILITIES COMMISSION GENERAL ORDER 143-B; JANUARY 20, 2000
- CONTRACT PROPOSAL #309, PROCUREMENT OF LIGHT RAIL VEHICLES, SAN FRANCISCO MUNICIPAL RAILWAY, JANUARY 6, 1992

PRELIMINARY DRAWING
 SUBJECT TO CHANGE

NO. DATE DESCRIPTION REVIEWER _____ _____ _____		DESIGNED CHECKED RECOMMENDED APPROVED DATE	CITY AND COUNTY OF SAN FRANCISCO MUNICIPAL RAILWAY APPROVED REGIONAL MANAGER	LIGHT RAIL TRANSIT SYSTEM VEHICLE CLEARANCE CASE (II)	CONTRACT MR-XXXX DRAWING TR/CLR-03 REVISION NTS 0
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CASE (I) CONT:

CLEARANCES ON BOARDING ISLANDS, IN YARDS AND ALONG SHOP AISLES, EMERGENCY WALKWAYS WHERE PASSENGERS, EMPLOYEES AND OTHER PERSONS ARE PERMITTED OR REQUIRED TO BE WHILE TRANS ARE IN MOTION. (REF. 1., SEC. 9.06c(1))

B. MINIMUM CLEARANCE BETWEEN VEHICLES AND MINIMUM TRACK SPACING BETWEEN PARALLEL TRACKS.

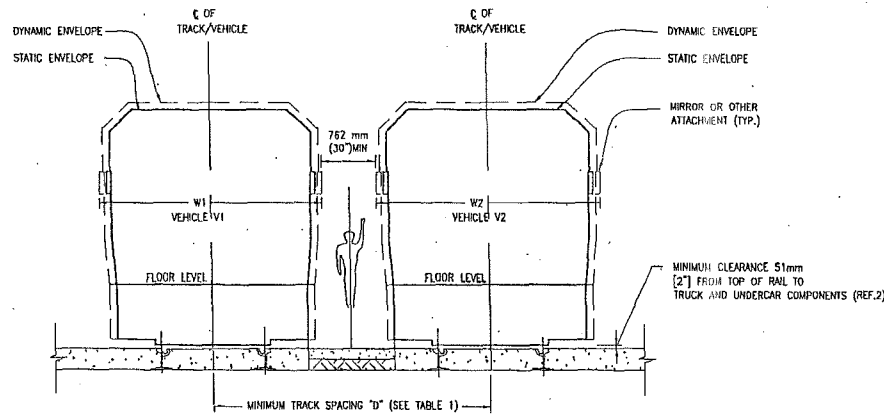


FIGURE 1

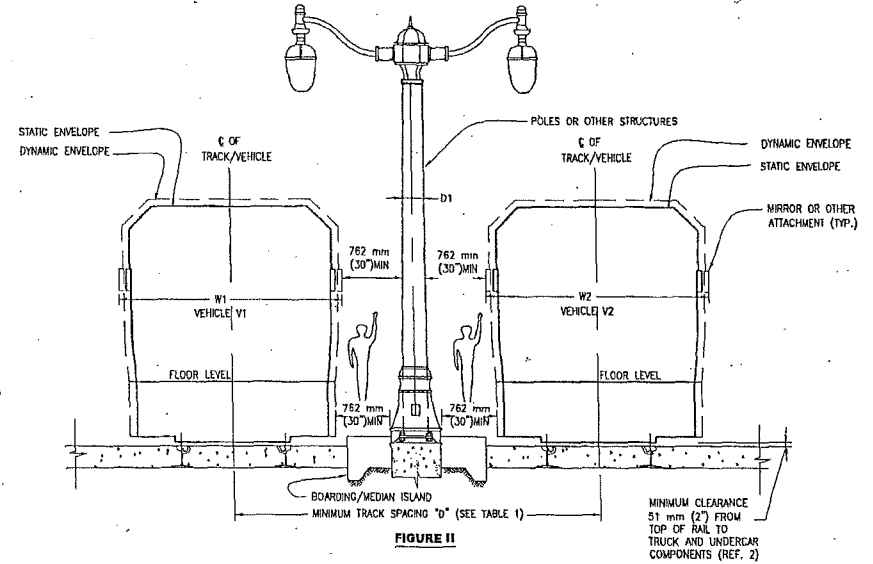


FIGURE 2

TABLE 1. MINIMUM SPACING BETWEEN TANGENT TRACKS (SEE NOTE 4)

OPERATION		W1 m [FT]	W2 m [FT]	* MINIMUM TRACK SPACING "D" m [FT]			
VEHICLE V1	VEHICLE V2			FIGURE 1	FIGURE 2		
					D1=305mm [12"]	D1=457mm [18"]	D1=508mm [20"]
LRV2	LRV2	3.100m [10.17']	3.100m [10.17']	3.862m [12.67']	4.929m [16.17']	5.081m [16.67']	5.133m [16.84']
LRV2	PCC	3.100m [10.17']	3.048m [10.00']	3.836m [12.59']	4.903m [16.09']	5.055m [16.59']	5.105m [16.75']
LRV2	LRV1	3.100m [10.17']	2.990m [9.81']	3.807m [12.49']	4.874m [15.99']	5.026m [16.49']	5.078m [16.66']
LRV1	LRV1	2.990m [9.81']	2.990m [9.81']	3.752m [12.31']	4.819m [15.81']	4.971m [16.31']	5.023m [16.48']
LRV1	PCC	2.990m [9.81']	3.048m [10.00']	3.781m [12.41']	4.848m [15.91']	5.000m [16.41']	5.051m [16.57']
PCC	PCC	3.048m [10.00']	3.048m [10.00']	3.810m [12.50']	4.876m [16.00']	5.029m [16.50']	5.081m [16.67']

W1, W2 = MAXIMUM WIDTH OF LARGEST VEHICLE DYNAMIC ENVELOPE (IN METERS)

D (FIG. 1) = ((W1+W2)/2+(762mm/1000))m

D (FIG. 2) = ((W1+W2)/2+((762mm+762mm+D1)/1000))m

D1=POLE DIAMETER OR LARGEST SIDE DIMENSION OF STRUCTURE; FOR TAPER-SECTION POLE, USE LARGEST DIAMETER AT BASE.

LRV2= BREDA LIGHT RAIL VEHICLE

LRV1= BOSTON VERTICAL LIGHT RAIL VEHICLE

PCC= PRESIDENT'S CONFERENCE COMMITTEE VEHICLE (USE 3.048m [10.00'] WIDTH OF "THE TORPEDOES" IN CALCULATION)

* TRACK SPACING SHALL BE ADJUSTED ACCORDINGLY TO ALLOW HISTORIC STREETCAR OPERATION (3.200m [10'-6"] WIDTH OF VEHICLE # 130 MAY BE USED FOR ADJUSTMENT).

NOTES:

- ALL CLEARANCES ARE TO BE MEASURED FROM THE DYNAMIC ENVELOPE OF THE OUTERMOST SURFACE OF THE LARGEST VEHICLE TO THE NEAREST POINT OF STRUCTURE.
- ALL CLEARANCE CONDITIONS SHALL APPLY TO LIGHT RAIL VEHICLES AND STREETCARS OPERATED ON BOTH TANGENT AND CURVED TRACKS FOR NEW LIGHT RAIL TRANSIT AND TRACK REPLACEMENT PROJECTS.
- THE TRACK SPACING SHOWN IN TABLE 1 APPLIES TO VEHICLES ON TANGENT TRACKS ONLY.
- FOR CURVED TRACKS, MINIMUM TRACK SPACING SHOULD BE INCREASED AND DESIGNED ACCORDINGLY BASED ON THE MOST CRITICAL VEHICLE DYNAMIC ENVELOPE INCLUDING ITS ATTACHMENTS (E.G. MIRRORS, ETC.), TRACK GEOMETRY, AND SUPERELEVATION.

REFERENCE:

- CALIFORNIA STATE PUBLIC UTILITIES COMMISSION GENERAL ORDER 143-B, JANUARY 20, 2000
- CONTRACT PROPOSAL #309, PROCUREMENT OF LIGHT RAIL VEHICLES, SAN FRANCISCO MUNICIPAL RAILWAY, JANUARY 6, 1992.

PRELIMINARY DRAWING
SUBJECT TO CHANGE

1094

NO.	DATE	REVISIONS	REVISOR	DRAWN	APPROVED

DESIGNED	
DRAWN	
CHECKED	
REVIEWED	
RECALCULATED	
APPROVED	
DATE	



CITY AND COUNTY OF SAN FRANCISCO
MUNICIPAL RAILWAY

APPROVED
GENERAL MANAGER

LIGHT RAIL TRANSIT SYSTEM

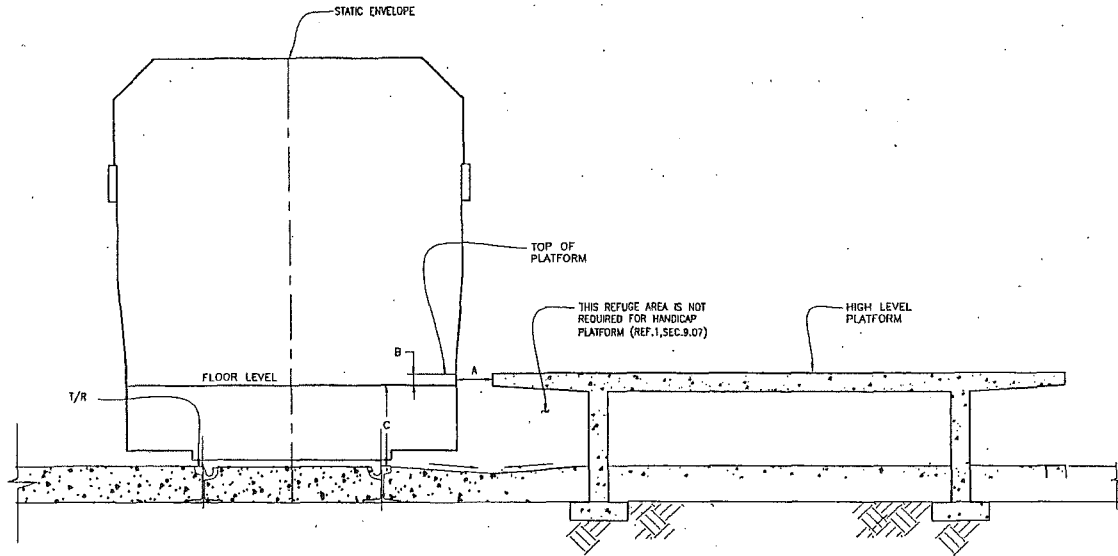
VEHICLE CLEARANCE CASE (I) CONTINUED

CONTRACT	MR-XXXX
DRAWING	TR/CLR-02
NOVBY	
NTS	0

1095

CASE (III):

CLEARANCES ON HIGH LEVEL BOARDING PLATFORM WHILE TRANS ARE AT REST.
(REF. 1, SEC. 9.07)



NOTES:

1. ALL DIMENSIONS ARE TO BE MEASURED WHEN TRANS ARE AT REST
2. "A" IS HORIZONTAL GAP BETWEEN VEHICLE DOORSILL AND PLATFORM.
"B" IS VERTICAL DIFFERENCE BETWEEN PLATFORM AND VEHICLE FLOOR, MEASURED AT TOP EDGE OF PLATFORM.
"C" IS THE HEIGHT OF CAR FLOOR FROM TOP OF RAIL:
864mm [2'-10"] FOR LRV1 (BOEING-VERTOL)
864mm [2'-10"] ± 6mm [± 1/4"] FOR LRV2 (BREDÁ)

REFERENCE:

1. CALIFORNIA STATE PUBLIC UTILITIES COMMISSION GENERAL ORDER 143-B; JANUARY 20, 2000
2. FEDERAL REGISTER PART IV, - DEPARTMENT OF TRANSPORTATION (49 CFR PART 27, 37 AND 38) TRANSPORTATION FOR INDIVIDUALS WITH DISABILITIES; FINAL RULE, SEPTEMBER 6, 1991.
3. FEDERAL REGISTER PART II, - ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD (36 CFR PART 1191) AMERICAN WITH DISABILITIES ACT (ADA) ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES; TRANSPORTATION FACILITIES; AMENDMENT TO FINAL GUIDELINES, SEPTEMBER 6, 1991

COORDINATION OF VEHICLE FLOOR WITH BOARDING PLATFORM AT TANGENT AND CURVED TRACKS

LIGHT RAIL VEHICLE (LRV1 & LRV2)	PLATFORM	"A"	"B"	REFERENCE
NEW	NEW	≤ 75mm [3"]	WITHIN ± 16mm [5/8"]	REF. 2, SEC. 38.73(d); REF. 3, SEC. 10.3.1(b)
NEW	EXISTING (KEY STATION)	≤ 75mm [3"] AT KEY STATIONS AT ONE DOOR OF EACH NEW VEHICLE	WITHIN ± 38mm [1 1/2"]	REF. 2, SEC. 38.73(d); REF. 3, SEC. 10.3.2(4)
RETROFITTED	NEW	≤ 100mm [4"]	WITHIN ± 50mm [2"] UNDER 50 % PASSENGER LOAD	REF. 2, SEC. 38.73(d);
RETROFITTED	EXISTING (KEY STATION)	≤ 100mm [4"]	WITHIN ± 50mm [2"] UNDER 50 % PASSENGER LOAD	REF. 2, SEC. 38.73(d); REF. 3, SEC. 10.3.2(4)

PRELIMINARY DRAWING
SUBJECT TO CHANGE

NO.	DATE	DESCRIPTION	DESIGNED	CHECKED	APPROVED
REVISIONS					

DESIGNED
CHECKED
REVIEWED
RECOMMENDED
APPROVED
DATE



CITY AND COUNTY OF SAN FRANCISCO
MUNICIPAL RAILWAY

APPROVED

GENERAL MANAGER

LIGHT RAIL TRANSIT SYSTEM

VEHICLE CLEARANCES CASE (III)

CONTRACT MR-XXXX

PROJECT TR/CLR-04

PERIOD

NTS 0

3. LRV System Outline

APPENDIX A

1/6/92 CONFORMED

A-i

S.F. MUNI LRV2
TECHNICAL SPECIFICATIONS

APPENDIX A

Table of Contents

MUNI METRO TRANSIT SYSTEM DIAGRAM

LOCATIONS OF MUNI TRANSIT POWER SUBSTATIONS

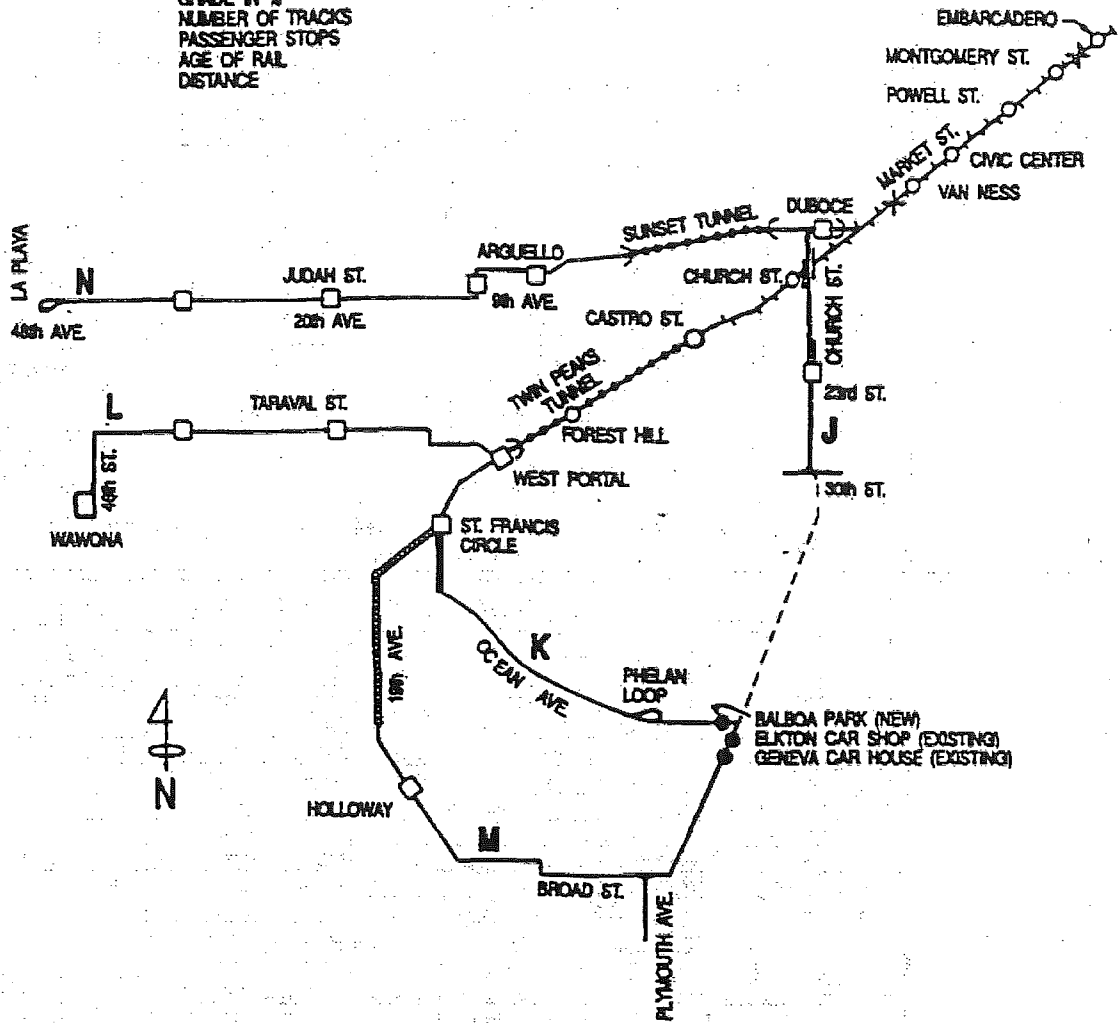
MUNI METRO TRACK TABLES

VERTICAL AND HORIZONTAL CURVES

CHORDS, DEFLECTION ANGLES AND OFFSETS

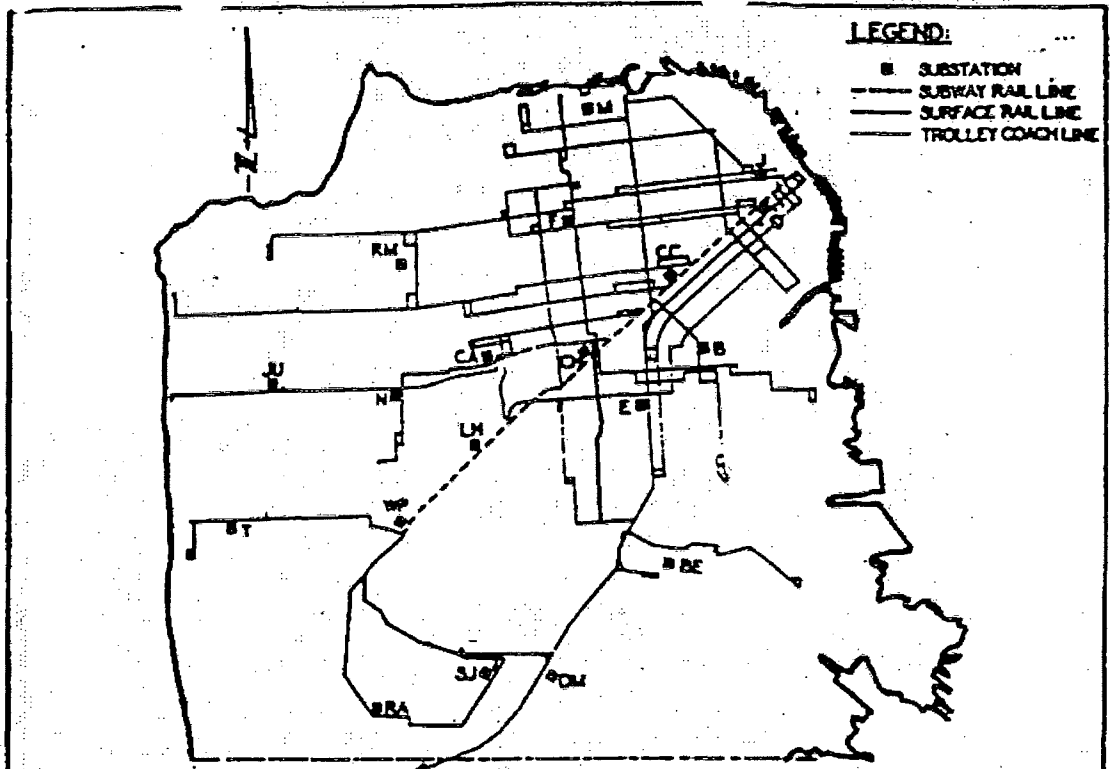
DETAILS OF EACH LINE SHOWN ON FOLLOWING PAGES, INCLUDE:

- CURVATURE IN FEET RADIUS
- GRADE IN %
- NUMBER OF TRACKS
- PASSENGER STOPS
- AGE OF RAIL
- DISTANCE



LINE DESIGNATIONS
J - CHURCH
K - INGLESIDE
L - TRAVAL
M - OCEAN
N - JUDAH

LEGEND	
○	SUBWAY STATION
□	CUTBACK POINT - EXISTING OR PROPOSED
—	EXISTING TRACK
- - -	TRACK UNDER CONSTRUCTION
—+—	SUBWAY
—X—	CROSS OVER - SUBWAY
—+—+—	TUNNEL
—+—+—+—	EXCLUSIVE RIGHT OF WAY



SUBSTATION TABULATION

SUBSTATIONS			RECTIFIER		SUBSTATION		FEEDER BUSSES				WORKS
CODE	NAME	LOCATION	NO.	RATING	RATING	2,000A	3,000A	4,000A	6,000A		
B	BAYVIEW	2508 ALAMEDA, S. OF BAYVIEW	1	4,000KV	4,000KV	6	-	-	-	-	T
BL	BURNAL	825 LINDEN, S. OF COVILAND	1	1,000KV	1,000KV	1	-	-	-	-	T
CL	CABLE	825 CLAYTON, E. OF CABLE	2	3,000KV	6,000KV	2	-	-	2	-	S,T
CH	CHURCH	2175 MARKET N. OF CHURCH	2	4,000KV	8,000KV	5	-	1	1	-	S,T
CC	CIVIC CENTER	1150 MARKET, AT U.S. PLAZA	2	4,000KV	8,000KV	6	-	-	6	-	S,T
D	DOWNTOWN	70 STEINBOCK, E. OF 7TH ST.	2	4,000KV	8,000KV	6	-	-	6	-	S,T
E	STATION E	200 MARKET, AT 15TH, ST.	2	4,000KV	8,000KV	6	-	-	6	-	S,T
F	FILLMORE	1825 FILLMORE, E. OF BUTLER	2	4,000KV	8,000KV	11	-	-	-	-	T
J	STATION J	420 SACRAMENTO, AT LEVINSON	2	1,000KV	3,000KV	1	-	1	-	-	T
JR	JONES	1710 JONES, E. OF 7TH, AVE.	1	4,000KV	4,000KV	-	-	1	-	-	S
LN	LAKESHORE	775 LAKESHORE, AT LAKESHORE BLVD.	2	1,000KV	6,000KV	-	-	-	1	-	S
M	MARINA	1575 MARINA POINT, E. OF RICHMOND	2	1,000KV	3,000KV	6	-	-	-	-	T
N	STATION N	3077 - VIL. AVE., S. OF JONES	1	3,000KV	3,000KV	1	-	1	-	-	S,T
ON	OUTER UNION	68 BERRY, AT LONDON	1	7,000KV	7,000KV	2	-	-	-	-	T
RA	RANDOLPH	8 RYAN, E. OF RANDOLPH	1	3,000KV	3,000KV	-	-	1	-	-	S
RE	REDFORD	874 - 8TH, AVE., S. OF CLAY	1	2,000KV	2,000KV	2	2	-	-	-	T
RJ	RAY JONES	2200 RAY JONES, AT OCEAN	1	4,000KV	4,000KV	1	-	1	1	-	S,T
T	TERRACE	1077 TERRACE, N. OF 40TH, AVE.	1	4,000KV	4,000KV	-	-	1	-	-	S
UP	NORTH POINT	145 LINDEN, S. OF WILSON	2	1,000KV	4,000KV	-	-	1	1	-	S

NOTES

- THIS DWG. SUPERSEDES DWG. X-7.
- S = STRUCTURE, T = TROLLEY COACH

CITY AND COUNTY OF SAN FRANCISCO PUBLIC UTILITIES COMMISSION
 HETCH HETCHY WATER AND POWER
 TRANSIT POWER FACILITIES
 TRANSIT SUBSTATIONS

CS - NONE
 RA - NONE

APR 83
 K-183 0

1' - Travel Line

Section 1: 46th Avenue - Wawona Street
 (0 Distance at Travel Street)
 Distance in 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	0.00			0.47	0.45	
Curve (at 46th Ave.)	0.00	50' - 1.5"	0.08			
Stop (Wawona at 46th Ave.)	0.00					
Curve (at 47th Ave.)	0.00	50' - 1.5"	0.08			
Tangent (Wawona St.)	0.00					0.20
Grade	0.45			2.90	0.22	
Stop (46th at Vicente St.)	0.63					
Curve (at 47th Ave.)	0.70	50' - 1.5"	0.80			
Curve (at 46th Ave.)	0.70	50' - 1.5"	0.80			
Stop (Vicente at 47th Ave.)	0.74					
Stop (Vicente at 46th Ave.)	0.74					
Tangent (Vicente St.)						0.16
Grade	0.74			0.87	0.50	
Tangent	1.33					0.08
Stop (TB, at Ulloa St.)	1.33					
Grade	1.41			0.87	0.63	
Stop (OB, at Ulloa St.)	1.43					

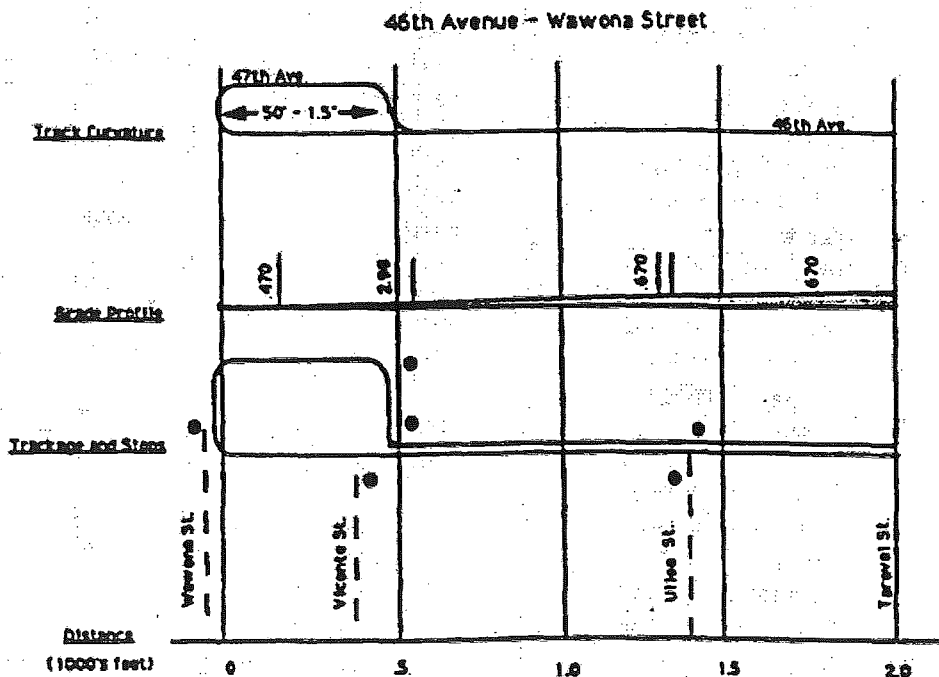
Distance from Travel Street to Wawona Street: 2,040 Ft.

Total Length of Track: 4,630 Ft.

Number of Stops: 6

Curves Length: 320 Ft.

Grade Length: 1,880 Ft.



L¹ - Taraval Line

Section 2: Taraval St. from 48th Ave. to 15th Ave.
(0 Distance at 48th Ave.)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	0.00			4.87	0.25	
End Single Track	0.00					
Beginning Double Track	0.11					
Tangent (at 47th Ave.)	0.25					0.09
Grade	0.34			3.75	0.26	
Turn Out (Wawona Loop)	0.80					
Tangent (at 46th Ave.)	0.80					0.06
Grade	0.88			5.00	0.25	
Stop (IB, at 46th Ave.)	0.88					
Stop (OB, at 46th Ave.)	0.88					
Stop (IB, at 45th Ave.)	0.88					
Tangent (at 45th Ave.)	0.97					0.07
Grade	0.98			5.00	0.25	
Tangent (at 44th Ave.)	1.25					0.06
Grade	1.31			5.00	0.25	
Stop (OB, at 44th Ave.)	1.32					
Stop (IB, at 43rd Ave.)	1.55					
Tangent (at 43rd Ave.)	1.56					0.08
Grade	1.67			5.00	0.20	
Stop (IB, at 42nd Ave.)	1.80					
Tangent (at 42nd Ave.)	1.87					0.07
Grade	1.88			1.50	0.23	
Stop (OB, at 42nd Ave.)	1.88					
Stop (IB, at 41st Ave.)	2.10					
Tangent (at 41st Ave.)	2.17					0.07
Grade	2.18			0.67	0.32	
Grade	2.50			4.83	0.24	
Stop (OB)	2.51					
Stop (IB, at 40th Ave.)	2.73					
Tangent (at 40th Ave.)	2.74					0.07
Grade	2.87			5.00	0.24	
Tangent (at 39th Ave.)	3.05					0.06
Grade	3.17			4.58	0.25	
Stop (OB, at 39th Ave.)	3.17					
Stop (IB, at 38th Ave.)	3.35					
Tangent (at 38th Ave.)	3.38					0.06
Grade	3.42			2.50	0.23	
Stop (OB, at 38th Ave.)	3.43					
Stop (IB, at 37th Ave.)	3.64					
Tangent (at 37th Ave.)	3.65					0.08
Grade	3.73			2.08	0.24	
Stop (OB, at 37th Ave.)	3.74					
Stop (IB, at 35th Ave.)	3.96					
Tangent (at 35th Ave.)	3.97					0.06

L^o - Terrel Line

Section 2: Terrel St. from 48th Ave. to 15th Ave. (continued)

(0 Distance at 48th Ave.)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	4.03			2.08	0.26	
Tangent (at 34th Ave.)	4.29					0.08
Grade	4.35			6.68	0.25	
Stop (OB, at 34th Ave.)	4.38					
Stop (IB, at 33rd Ave.)	4.59					
Tangent (at 33rd Ave.)	4.60					0.08
Grade	4.68			2.50	0.25	
Crossover	4.81					
Tangent (at 32nd Ave.)	4.83					0.09
Grade	5.02			6.25	0.23	
Stop (OB, at 32nd Ave.)	5.03					
Stop (IB, at 31st Ave.)	5.24					
Tangent (at 31st Ave.)	5.25					0.06
Grade	5.31			8.96	0.24	
Stop (IB, at 30th Ave.)	5.64					
Tangent (at 30th Ave.)	5.55					0.05
Grade	5.80			7.08	0.24	
Stop (OB, at 30th Ave.)	5.81					
Stop (IB, at 29th Ave.)	5.83					
Tangent (at 29th Ave.)	5.84					0.05
Grade	5.89			8.96	0.24	
Tangent (at 28th Ave.)	6.13					0.05
Grade	6.18			4.17	0.25	
Stop (OB, at 28th Ave.)	6.19					
Stop (IB, at 27th Ave.)	6.42					
Tangent (at 27th Ave.)	6.43					0.05
Grade	6.48			2.08	0.26	
Tangent (at 26th Ave.)	6.74					0.05
Grade	6.79			7.08	0.27	
Stop (OB, at 26th Ave.)	6.80					
Stop (IB, at 25th Ave.)	7.05					
Tangent (at 25th Ave.)	7.06					0.05
Grade	7.11			6.25	0.24	
Stop (OB, at 25th Ave.)	7.12					
Stop (IB, at 24th Ave.)	7.34					
Tangent (at 24th Ave.)	7.35					0.08
Grade	7.43			6.25	0.24	
Stop (OB, at 24th Ave.)	7.44					
Stop (IB, at 23rd Ave.)	7.66					
Tangent (at 23rd Ave.)	7.67					0.08
Grade	7.73			4.17	0.24	
Tangent (at 22nd Ave.)	7.97					0.08
Grade	8.05			4.17	0.25	
Stop (OB, at 22nd Ave.)	8.06					

7' - Taraval Line

Section 2: Taraval St. from 48th Ave. to 15th Ave. (continued)
 (0 Distance at 48th Ave.)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (IB, at 21st Ave.)	8.29					
Tangent (at 21st Ave.)	8.30					0.07
Grade	8.37			3.75	0.25	
Stop (IB, at 20th Ave.)	8.61					
Tangent (at 20th Ave.)	8.62					0.07
Crossover	8.62					
Turn Around	8.68					
Grade	8.69			7.00	0.25	
Stop (OB, at 20th Ave.)	8.70					
Crossover	8.83					
Stop (IB, at 19th Ave.)	8.93					
Tangent (at 19th Ave.)	8.94					0.06
Grade	9.00			7.00	0.24	
Stop (OB, at 19th Ave.)	9.01					
Tangent (at 18th Ave.)	9.24					0.07
Grade	9.31			5.80	0.26	
Stop (OB, at 18th Ave.)	9.32					
Stop (IB, at 17th Ave.)	9.56					
Tangent (at 17th Ave.)	9.57					0.06
Grade	9.63			7.10	0.25	
Tangent (at 16th Ave.)	9.88					0.05
Grade	9.90			8.60	0.27	
Stop (OB, at 16th Ave.)	9.94					
Stop (IB, at 15th Ave.)	10.19					
Tangent (at 15th Ave.)	10.20					0.03

Total Length of Section 2: 10,230 Ft.

Tangent : 2,040 Ft.

Grade: 8,190 Ft.

1" - Tareval Line

Section 3: 15th Ave. from Tareval St. to Ulloa St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (right)	10.23	42' - 7.5"	0.09			
Tangent (at 15th Ave.)	10.23					0.03
Grade	10.26			-0.70	0.65	
Tangent	10.81					0.07
Stop (OB, at Ulloa St.)	10.81					
Stop (IB, at Ulloa St.)	10.81					
Curve (left)	10.83	42' - 7.5"	0.10			
Grade				-5.80	0.05	

Total Length of Section 3: 800 Ft.

Tangent: 80 Ft.

Grade: 650 Ft.

1" - Tareval Line

Section 4: Ulloa St from 15th Ave. to Twin Peaks Tunnel

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	11.03			-5.80	0.19	
Tangent (at 14th Ave.)	11.22					0.05
Grade	11.28			-5.00	0.24	
Stop (WB, at 14th Ave.)	11.29					
Tangent (at Funston Ave.)	11.52					0.08
Grade	11.60			-4.17	0.51	
Stop (EB, at Forest Side)	11.60					
Stop (WB, at Forest Side)	11.70					
Curve (right)	11.76	375 Ft.	0.57			
Stop (EB, at Madrone Ave.)	11.79					
Crossover	12.10					
Grade	12.11			-1.52	0.43	
Turn Out (K&M Line)	12.28					
Curve (left)	12.28	42' - 7.5"	0.9			
Stop (EB, at Portal)	12.48					
Stop (WB, at Portal)	12.48					
Entry (Twin Peak Tunnel)	12.54					1.37

Total Length of Section 4: 1,510 Ft.

Tangent: 180 Ft.

Grade: 1,420 Ft.

SUMMARY
L^o - Taraval Line

Total Length: 46th Ave - Wawona St Loop:	2,040 Ft (Along 46th Ave.)		
Total Length: Sections: 2,3,&4:	12,540 Ft		
Tangent: 46th Ave - Wawona St Loop:	440 Ft (Along Wawona St & Vincente St)		
	150 Ft (Along 46th Ave.)		
Tangent: Sections: 2, 3 & 4:	2,260 Ft		
Grade Length: 46th Ave - Wawona St Loop:	1.89 Ft	up 1%	1,670 Ft
		2% to 3%	220 Ft
Grade Length: Sections: 2,3 &4:	up 1%	970 Ft	
	1% to 2%	660 Ft	
	2% to 3%	1,240 Ft	
	3% to 4%	510 Ft	
	4% to 5%	1,990 Ft	
	5% to 6%	1,950 Ft	
	6% to 7%	980 Ft	
	7% to 8%	1,250 Ft	
	8% up	750 Ft	
Curve Length: 46th Ave - Wawona St Loop:	320 Ft	Radius	50' - 1.5"
Curve Length: Sections 2, 3 & 4:	1,669, Ft	Radius	42' - 7.5" 1,090 Ft
			375 Ft 570 Ft
Number of Stops: 46th Ave - Wawona St Loop:	3	Min Distance:	187 Ft
		Max Distance:	830 Ft
		Avr. Distance:	755 Ft
In Bound	3	Min Distance:	238 Ft
		Max Distance:	663 Ft
		Avr. Distance:	482 Ft
Number of Stops: Sections: 2,3 & 4:	24	Min Distance:	263 Ft
Out Bound		Max Distance:	675 Ft
		Avr. Distance:	523 Ft

"K" - Ingleside Line

Section 1: West Portal Ave. to Junipero Serra Boulevard
Distance in 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Tangent	0.00			0.00		0.50
Turn Out (L Line)	0.20					
Stop (IB at Ulloa St.)	0.22					
Stop (OB at Ulloa St.)	0.25					0.08
Grade	0.50			-2.80	0.69	
Stop (OB at Santa Clara Ave.)	0.56					
Stop (IB at Santa Clara Ave.)	0.63					
Grade	1.19			-3.00	0.41	
Stop (OB at 14th Ave.)	1.41					
Stop (IB at 14th Ave.)	1.52					
Grade	1.60			-2.95	0.53	
Curve (right)	1.79	1270 Ft.	0.57			
Stop (OB at 15th Ave.)	2.10					
Grade	2.13			-3.30	0.09	
Stop (IB at 15th Ave.)	2.16					
Grade	2.22			-3.15	0.28	
Grade	2.50			-2.25	0.31	
Crossover	2.50					
Stop (IB)	2.54					
Curve (right)	2.77	190 Ft.	0.08			
Grade	2.81			-1.16	0.28	
Turn Out (M Line)	2.83					

Length of Section 1: 2,830 Ft.
Tangent Length: 500 Ft.
Grade Length: 2,330 Ft.
Curve Length: 650 Ft.

"K" - IngleSide Line

Section 2: Junipero Serra Boulevard from St. Francis Blvd. to Ocean Ave.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (IB at St. Francis)	3.03					
Grade	3.09			-1.87	1.21	
Stop (OB at St. Francis)	3.09					
Stop (OB at Darlen Way)	4.01					
Curve (right)	4.01	220 Ft	0.24			
Grade	4.30			3.00	0.29	
Stop (IB)	4.34					

Length of Section 2: 1,510 Ft.

Tangent Length: 0 Ft.

Grade Length: 1,510 Ft.

"K" - IngleSide Line

Section 3: Ocean Ave. from Junipero Serra Blvd. to Geneva Ave.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	4.50			2.86	0.41	
Stop (OB at St. Fernando)	4.71					
Stop (IB at St. Fernando)	4.78					
Grade	5.00			2.90	0.25	
Curve (left)	5.18	820 Ft	0.21			
Curve (left)	5.37	500 Ft	0.22			
Grade	5.25			1.13	0.18	
Stop (OB at Paloma Av)	5.40					
Grade	5.43			3.80	0.18	
Stop (IB at Paloma Av)	5.50					
Grade	5.61			2.95	0.15	
Stop (OB at Aptos Av)	5.73					
Tangent	5.78			0.00		0.33
Stop (IB at Aptos Av)	5.81					
Curve (right)	5.81	1386 Ft	0.48			
Grade	6.00			-4.00	0.29	
Stop (OB at Ceritos Av)	6.28					
Curve (right)	6.33	2813 Ft	0.28			
Stop (IB at Ceritos)	6.35					
Grade	6.38			-2.80	0.11	
Grade	6.49			-3.20	0.04	
Grade	6.53			-4.57	0.29	
Curve (right)	6.69	1103 Ft	0.33			
Grade	6.82			-3.30	0.07	
Grade	6.89			-0.78	0.85	
Stop (OB at Fairfield Dr)	7.13					

K - IngleSide Line

Section 3: Ocean Ave. from Junipero Serra Blvd. to Geneva Ave. (continued)

<i>Point of Change</i>	<i>Distance From Start</i>	<i>Curve Radius</i>	<i>Curve Length</i>	<i>Grade % (+ or -)</i>	<i>Grade Length</i>	<i>Tangent Length</i>
Curve (left)	7.28	3000 Ft	0.17			
Stop (IB at Fairfield Dr)	7.28					
Stop (OB at Keystone Wy)	7.74					
Tangent	7.74			0.00		0.09
Stop (IB at Keystone Wy)	7.83					
Grade	7.83			-0.60	0.23	
Curve (left)	7.83	5000 Ft	0.15			
Tangent	8.06			0.00		0.07
Stop (OB Ashton Ave)	8.09					
Grade	8.13			-2.65	0.23	
Curve (right)	8.16	1500 Ft	0.21			
Stop (IB at Ashton Ave)	8.16					
Grade	8.38			-0.87	0.10	
Grade	8.48			2.68	0.21	
Grade	8.67			0.87	0.08	
Grade	8.75			2.68	0.22	
Stop (OB at Capitol Ave)	8.94					
Grade	8.97			0.87	0.09	
Stop (IB at Capitol Ave)	9.06					
Grade	9.06			2.44	0.22	
Grade	9.28			1.15	0.07	
Grade	9.35			0.20	0.24	
Stop (OB at Granada Ave)	9.59					
Grade	9.59			1.15	0.07	
Grade	9.66			3.20	0.22	
Stop (IB at Granada Ave)	9.68					
Turn Out	9.88					
Grade	9.88			1.37	0.34	
Stop (OB at Lee Ave)	10.15					
To Balboa Park Sta.	10.22					
Turn Out (loop)	10.22					
Stop (IB loop)	10.29					

Length of Section 3: 5,950 Ft.

Tangent Length: 490 Ft.

Grade Length: 5,460 Ft.

SUMMARY
***K* - Ingreside Line**

Total Length of K Line: 10,220 FL (Double Track)

Tangent Length: 990 FL (Double Track)

Grade Length: 9,230 FL

up 1%	1,590 FL
1% to 2%	2,150 FL
2% to 3%	3,330 FL
3% to 4%	1,590 FL
4% to 5%	580 FL

Curve Length: 2,940 FL

up to 200 Ft	80 FL
200 Ft to 300 Ft	0 FL
300 Ft to 500 Ft	670 FL
500 Ft to 1K Ft	0 FL
1K Ft to 2K Ft	1,590 FL
2K Ft to 3K Ft	450 FL
3K Ft up	150 FL

Number of Stops: 17
(Outbound)

Min Distance Between Stops:	310 FL
Max Distance Between Stops:	1,010 FL
Avr Distance Between Stops:	600 FL

Number of Stops: 18
(Inbound)

Min Distance Between Stops:	360 FL
Max Distance Between Stops:	1,310 FL
Avr Distance Between Stops:	640 FL

"M" - Oceanview Line

Section 1: Right of Way from St. Francis Blvd to Ocean Ave
 Distance in 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (IB at St. Francis)	0.00					
Grade	0.00			-2.70	0.09	
Stop (OB at St. Francis)	0.06					
Turn Out (K Line)	0.06					
Grade	0.09			-3.50	0.13	
Grade	0.22			-3.20	0.06	
Grade	0.28			-2.64	0.07	
Stop (IB at Woodacre Cre)	0.30					
Stop (OB at Woodacre Cre)	0.31					
Grade	0.35			-3.50	1.85	
Stop (OB at Beaumont Dr)	1.21					
Stop (IB at Beaumont Dr)	1.25					
Stop (OB at Ocean Ave.)	1.50					
Stop (IB at Ocean Ave.)	1.54					
Curve (left)	1.60	1148 Ft	0.45			

Length of Section 1: 2,050 Ft.
 Tangent Length: 0 Ft.
 Grade Length: 2,050 Ft.

"M" - Oceanview Line

Section 2: 19th Ave. from Ocean Ave. to Randolph St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (OB at Rossmoor Dr)	2.05					
Stop (IB at Rossmoor Dr)	2.05					
Grade	2.20			-2.34	1.87	
Stop (OB at Mercedes Dr)	2.94					
Stop (IB at Mercedes Dr)	2.94					
Stop (OB at Serra Pkwy)	3.79					
Stop (IB at Serra Pkwy)	3.83					
Grade	4.07			-0.03	0.43	
Grade	4.50			2.00	1.21	
Stop (OB at SF State Univ)	4.85					
Stop (IB at SF State Univ)	4.85					
Curve (left)	5.50	300 Ft	0.35			
Stop (OB at Holloway Ave)	5.57					
Stop (IB at Holloway Ave)	5.57					
Grade	5.71			5.85	0.25	
Stop (OB at Banbury)	5.91					
Stop (IB at Banbury)	5.91					
Grade	5.96			4.85	0.40	
Crossover	6.00					

"M" - Oceanview Line

Section 2: 19th Ave. from Ocean Ave. to Randolph St. (continued)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (OB at Cardenas Ave)	6.28					
Stop (IB at Cardenas Ave)	6.28					
Grade	6.36			3.02	0.57	
Tangent B	6.83					0.18
Stop (OB at Junipero Serra)	6.88					
Stop (IB at Junipero Serra)	6.88					
Stop (IB)	7.05					
Grade	7.11			2.47	0.35	
Stop (IB at Sargent St)	7.42					
Grade	7.46			0.76	0.52	
Stop (IB at Montecello St)	7.81					
Grade	7.98			1.92	0.35	
Stop (OB at Byrbee)	7.98					
Stop (OB at Randolph St)	8.25					
Stop (IB at Randolph St)	8.25					

Length of Section 2: 6,200 Ft.
 Tangent Length: 180 Ft.
 Grade Length: 1,020 Ft.

"M" - Oceanview Line

Section 3: Randolph St. from 19th Ave to Orizaba Ave

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (right)	4.59			2.85	0.41	
Grade	4.71					
Grade	4.78					
Grade	5.00			2.80	0.25	
Stop (OB at Arch St)	5.16	820 Ft	0.21			
Stop (IB at Arch St)	5.37	500 Ft	0.22			
Grade	5.25			1.13	0.18	
Stop (OB at Head St)	5.40					
Grade	5.43			3.80	0.18	
Stop (IB at Head St)	5.50					
Grade	5.61			2.95	0.15	
Grade	5.73					

Length of Section 3: 1,940 Ft.
 Tangent Length: 0 Ft.
 Grade Length: 1,940 Ft.

"M" - Oceanview Line

Section 4: Orizaba Ave from Randolph St to Broad St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (left)	10.33	58 Ft	0.08			
Stop (OB at Ferallones)	10.37					
Stop (IB at Ferallones)	10.37					
Grade	10.35			-5.09	0.08	
Grade	10.43			-7.33	0.23	
Curve (right)	10.45	250 Ft	0.09			
Grade	10.66			-4.18	0.30	
Curve (left)	10.72	50 Ft	0.10			

Length of Section 4: 490 Ft

Tangent Length: 0 Ft

Grade Length: 490 Ft

"M" - Oceanview Line

Section 5: Broad St from Orizaba Ave to Plymouth Ave

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (OB at Orizaba Ave)	10.82					
Stop (IB at Orizaba Ave)	10.82					
Grade	10.98			3.00	0.22	
Grade	11.18			2.24	0.47	
Stop (OB at Capitol Ave)	11.65					
Grade	11.65			1.60	0.08	
Grade	11.73			1.25	0.27	
Stop (IB at Capitol Ave)	11.73					
Grade	12			-0.35	0.50	
Crossover	12.5					
Turn Around	12.6					
Stop (IB at Plymouth)	12.75					
End Track	12.85					

Length of Section 5: 2,030 Ft

Tangent Length: 0 Ft

Grade Length: 2,030 Ft

SUMMARY
"M" - Oceanview Line

Total Length of M Line: 12,500 Ft. (Double Track)

Tangent Length: 180 Ft. (Double Track)

Grade Length: 12,320 Ft.

up to 1%	2,020 Ft.
1% to 2%	880 Ft.
2% to 3%	4,060 Ft.
3% to 4%	2,980 Ft.
4% to 5%	1,240 Ft.
5% to 6%	330 Ft.
6% to 7%	600 Ft.
7% up	230 Ft.

Curve Length: 1,150 Ft.

up 250'	260 Ft.
200' to 300	440 Ft.
1K Ft up	450 Ft.

Number of Stops: 19
(Outbound)

Min Distance Between Stops:	250 Ft.
Max Distance Between Stops:	1,000 Ft.
Avr Distance Between Stops:	660 Ft.

Number of Stops: 22
(Inbound)

Min Distance Between Stops:	180 Ft.
Max Distance Between Stops:	1,000 Ft.
Avr Distance Between Stops:	580 Ft.

Twin Peaks Tunnel, K, L & M Lines

Section 1: From West Portal to East Portal
Distance In 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	0.04			-2.72	0.31	
West Portal	0.09					
Grade	0.35			1.50	2.89	
Curve (left)	1.73	5,729.65'	1.31			
Grade	3.00			-1.50	0.39	
Forest Hill Station	3.11					
Grade	3.39			-3.00	1.01	
Grade	4.40			-2.70	0.30	
Grade	4.70			-3.00	2.80	
Grade	7.50			-3.00	2.11	
Grade	9.61			-2.87	1.11	
Curve (left)	10.36	1,017.85'	0.45			
Grade	10.72			-2.10	0.50	
Grade	11.22			-1.40	0.14	
Grade	11.36			-5.00	0.39	
Curve (right)	11.49	1,000'	0.26			
East Portal	11.75					

Total Length of Section 1: 11,750 Ft.
Tangent Length: 0
Grade Length: 11,750 Ft.

SUMMARY
Twin Peaks Tunnel, K, L & M Lines

Total Length:	11,750 Ft	(Double Track)		
Tangent Length:	0 Ft	(Double Track)		
Grade Length:	11,750 Ft			
		up 1%		0 Ft
		1% to 2%		3,220 Ft
		2% to 3%		2,220 Ft
		3% to 4%		5,920 Ft
		4% to 5%		0 Ft
		5% up		390 Ft
Curve Length:	2,020 Ft	Radius	up 1K	0 Ft
		Radius	1K to 2K	450 Ft
			2K to 3K	0 Ft
			3K to 4K	0 Ft
			4K to 5K	0 Ft
			up 5K	1,310 Ft

J - Church Line

Section 1: Church Street from 30th St. to 22nd St.
Distance in 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	0.00			-2.80	0.27	
Stop (IB at 30th St.)	0.08					
Stop (OB at 30th St.)	0.08					
Tangent (at Day St.)	0.27					0.08
Grade	0.35			-1.30	0.23	
Stop (IB at 29th St.)	0.57					
Tangent (at 29th St.)	0.58					0.08
Grade	0.66			-1.10	0.22	
Stop (OB at 29th St.)	0.67					
Tangent (at Valley St.)	0.88					0.11
Grade	0.99			-1.50	0.18	
Stop (IB at 28th St.)	1.16					
Tangent (at 28th St.)	1.17					0.07
Grade	1.24			-3.50	0.24	
Stop (OB at 28th St.)	1.25					
Tangent (at Dunen St.)	1.48					0.06
Grade	1.54			1.30	0.20	
Stop (IB at 27th St.)	1.73					
Tangent (at 27th St.)	1.74					0.07
Grade	1.81			1.30	0.22	
Stop (OB at 27th St.)	1.82					
Tangent (at Army St.)	2.03					0.06
Grade	2.09			0.90	0.20	
Stop (IB at 26th St.)	2.28					
Tangent (at 26th St.)	2.29					0.05
Grade	2.34			1.30	0.22	
Tangent (at Clipper St.)	2.58					0.07
Grade	2.63			4.40	0.21	
Tangent (at 25th St.)	2.84					0.05
Grade	2.89			8.80	0.23	
Stop (OB at 25th St.)	2.90					
Tangent (at Jersey St.)	3.12					0.07
Grade	3.19			6.10	0.21	
Stop (IB at 24th St.)	3.39					
Tangent (at 24th St.)	3.40					0.06
Grade	3.46			4.60	0.54	
Stop (OB at 24th St.)	3.47					
Stop (IB at 23rd St.)	3.89					
Tangent (at 23rd St.)	4.00					0.06
Grade	4.08			3.40	0.44	
Stop (OB at 23rd St.)	4.07					

"J" - Church Line

Section 1: Church Street from 30th St. to 22nd St. (continued)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (IB at 22nd St.)	4.49					
Tangent (at 22nd St.)	4.50					0.08
Grade	4.58			1.90	0.02	
Stop (OB at 22nd St.)	4.59					
End (Section 1)	4.60					

Length of Section 1: 4,600 FL

Tangent Length: 970 FL

Grade Length: 3,630 FL

"J" - Church Line

Section 2: Private Right-of-Way from 22nd to 18th St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (left)	4.80	150 FL	0.10			
Grade	4.80			1.90	0.28	
Curve (right)		150 FL	0.10			
Grade	4.88			2.30	0.28	
Curve (left)	5.02	128	0.13			
Curve (right)		200 FL	0.18			
Grade	5.16			2.34	0.16	
Stop (IB at 21st St.)	5.27					
Grade	5.32			-7.80	0.28	
Stop (OB at 21st St.)	5.33					
Grade	5.58			-1.55	0.06	
Curve (right)	5.59	100 FL	0.14			
Grade	5.64			-7.50	0.20	
Curve (left)	5.78	120 FL	0.17			
Grade	5.84			-5.19	0.11	
Grade	5.85			-5.19	0.08	
Stop (IB at 20th St.)	6.03					
Grade	6.03			-1.55	0.06	
Grade	6.09			-9.00	0.48	
Stop (OB at 20th St.)	6.12					
Stop (IB at 19th St.)	6.53					
Grade	6.55			-3.00	0.06	
Grade	6.61			-8.79	0.60	
Stop (OB at 19th Ave.)	6.61					
Curve (right)	6.88	740 FL	0.22			
Curve (left)	7.16	95 FL	0.05			
Stop (IB at 18th St.)	7.20					
End (Section 3)	7.21					

J - Church Line

Section 2: Private Right-of-Way from 22nd to 18th St. (continued)

Length of Section 2: 2,610 Ft.

Tangent Length: 0 Ft.

Grade Length: 2,610 Ft.

J - Church Line

Section 3: Church St. from 18th St. to Duboce St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (left)	7.21	95 Ft.	0.04			
Tangent (at 18th Ave.)	7.21					0.04
Grade	7.25			7.70	0.30	
Stop (OB at 18th Ave.)	7.26					
Grade	7.55			4.60	0.26	
Stop (IB at 17th St.)	7.60					
Tangent (at 17th St.)	7.61					0.07
Grade	7.68			1.70	0.21	
Stop (OB at 17th St.)	7.69					
Tangent	8.09					0.03
Grade	8.12			1.00	0.29	
Stop (IB at 16th St.)	8.40					
Tangent (at 16th St.)	8.41					0.09
Grade	8.50			0.40	0.41	
Stop (OB at 16th St.)	8.51					
Stop (IB at 15th St.)	8.60					
Tangent (at 15th St.)	8.91					0.12
Grade	9.03			0.50	0.47	
Stop (OB at 15th St.)	9.04					
Stop (IB at Market St.)	9.30					
Grade	9.50			1.00	0.14	
Grade	9.64			3.00	0.31	
Grade	9.85			3.20	0.24	
Stop (IB at Duboce St.)	10.09					
Stop (OB at Duboce St.)	10.09					
Curve (left)	10.18	50 Ft.	0.10			
Tangent (at Duboce St.)	10.19					0.09
End of Line	10.28					

Length of Section 3: 3,070 Ft.

Tangent Length: 440 Ft.

Grade Length: 2,360 Ft.

SUMMARY
"J" - Church Line

Total Length of J Line: 10,280 Ft. (Double Track)

Tangent Length: 1,410 Ft. (Double Track)

Grade Length: 8,870 Ft.

up 1%	1,080 Ft.
1% to 2%	2,330 Ft.
2% to 3%	710 Ft.
3% to 4%	1,290 Ft.
4% to 5%	1,010 Ft.
5% to 6%	190 Ft.
6% to 7%	210 Ft.
7% to 8%	760 Ft.
8% to 9%	830 Ft.
9% up	460 Ft.

Curve Length: 1,250 Ft.

Radius	0' - 100'	190 Ft.
Radius	100' - 200'	640 Ft.
	200' - 300'	160 Ft.
	700' up	220 Ft.

Number of Stops (In Bound):	17	Min Distance	425 Ft.
		Max Distance	1,044 Ft.
		Avr Distance	605 Ft.

Number of Stops (Out Bound):	16	Min Distance	475 Ft.
		Max Distance	1,163 Ft.
		Avr Distance	642 Ft.

"N" - Judah Line

Section 1: From La Playa to 9th Ave.

Distance in 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Loop (at La Playa)	0.00					
Curve (Loop)	0.00	50' - 1.5"	0.10			
Tangent (at La Playa)	0.00					0.08
Stop (IB)	0.03					
Grade	0.08			3.00	0.23	
Stop (OB)	0.09					
End (straight track)	0.09					
Stop (IB)	0.03					
Tangent (at 48th Ave.)	0.31					0.08
Grade	0.39			3.30	0.24	
Stop (OB)	0.40					
Crossover	0.41					
Stop (IB)	0.60					
Tangent (at 47th Ave.)	0.63					0.05
Grade	0.68			5.40	0.23	
Stop (OB)	0.69					
Stop (IB)	0.80					
Tangent (at 46th Ave.)	0.81					0.07
Grade	0.88			6.20	0.23	
Stop (OB)	0.89					
Stop (IB)	1.20					
Tangent (at 45th Ave.)	1.21					0.05
Grade	1.26			3.70	0.24	
Stop (OB)	1.27					
Stop (IB)	1.48					
Tangent (at 44th Ave.)	1.50					0.06
Grade	1.56			3.70	0.25	
Stop (OB)	1.57					
Stop (IB)	1.80					
Tangent (at 43rd Ave.)	1.81					0.04
Grade	1.85			3.70	0.26	
Stop (OB)	1.86					
Stop (IB)	2.10					
Tangent (at 42nd Ave.)	2.11					0.05
Grade	2.16			4.50	0.25	
Stop (OB)	2.17					
Stop (IB)	2.40					
Tangent (at 41st Ave.)	2.41					0.08
Grade	2.47			6.70	0.28	
Stop (OB)	2.48					
Stop (IB)	2.72					
Tangent (at 40th Ave.)	2.73					0.06
Grade	2.79			6.50	0.26	
Stop (OB)	2.80					
Stop (IB)	3.04					

N - Judah Line

Section 1: From La Playa to 9th Ave. (continued)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Tangent (at 39th Ave.)	3.05					0.06
Grade	3.11			6.50	0.25	
Stop (OB)	3.12					
Stop (IB)	3.35					
Tangent (at 38th Ave.)	3.36					0.08
Grade	3.43			0.80	0.26	
Stop (OB)	3.44					
Stop (IB)	3.68					
Tangent (at 37th Ave.)	3.69					0.05
Grade	3.74			6.20	0.26	
Stop (OB)	3.75					
Stop (IB)	3.99					
Tangent (at 36th Ave.)	4.00					0.07
Grade	4.07			6.20	0.26	
Stop (OB)	4.08					
Stop (IB)	4.32					
Tangent (at 35th Ave.)	4.33					0.04
Grade	4.37			6.20	0.29	
Tangent (at 34th Ave.)	4.66					0.06
Grade	4.72			6.20	0.26	
Stop (OB)	4.71					
Stop (IB)	4.97					
Tangent (at 33rd Ave.)	4.98					0.05
Grade	5.03			-0.80	0.24	
Tangent (at 32nd Ave.)	5.27					0.05
Grade	5.32			-2.10	0.27	
Stop (OB)	5.33					
Stop (IB)	5.58					
Tangent (at 31st Ave.)	5.59					0.05
Grade	5.64			-4.10	0.27	
Stop (OB)	5.65					
Stop (IB)	5.90					
Tangent (at 30th Ave.)	5.91					0.05
Grade	5.96			1.20	0.28	
Stop (OB)	5.97					
Stop (IB)	6.21					
Tangent (at 29th Ave.)	6.22					0.06
Grade	6.28			2.90	0.23	
Tangent (at 28th Ave.)	6.51					0.05
Grade	6.56			3.80	0.25	
Stop (OB)	6.57					
Stop (IB)	6.80					
Tangent (at 27th Ave.)	6.81					0.04
Grade	6.85			0.80	0.26	
Crossover	6.94					

N^o - Judah Line

Section 1: From La Playa to 9th Ave. (continued)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Tangent (at 26th Ave.)	7.11					0.07
Grade	7.18			-5.00	0.28	
Stop (OB)	7.19					
Stop (IB)	7.43					
Tangent (at 25th Ave.)	7.44					0.08
Grade	7.50			-2.50	0.25	
Tangent (at 24th Ave.)	7.75					0.06
Grade	7.81			4.80	0.25	
Stop (OB)	7.82					
Stop (IB)	8.08					
Tangent (at 23rd Ave.)	8.08					0.07
Stop (OB)	8.08					
Grade	8.13			7.80	0.24	
Stop (IB)	8.36					
Tangent (at 22nd Ave.)	8.37					0.06
Grade	8.43			1.20	0.25	
Stop (OB)	8.44					
Tangent (at 21st Ave.)	8.68					0.05
Grade	8.73			2.50	0.26	
Tangent (at 20th Ave.)	8.99					0.05
Grade	9.04			4.70	0.26	
Stop (OB)	9.05					
Stop (IB)	9.29					
Tangent (at 19th Ave.)	9.30					0.05
Grade	9.35			-2.80	0.25	
Stop (OB)	9.59					
Tangent (at 18th Ave.)	9.60					0.06
Grade	9.65			5.40	0.25	
Stop (OB)	9.67					
Stop (IB)	9.90					
Tangent (at 17th Ave.)	9.91					0.06
Grade	9.97			7.10	0.26	
Tangent (at 16th Ave.)	10.23					0.06
Grade	10.29			7.80	0.26	
Stop (OB)	10.53					
Tangent (at 15th Ave.)	10.54					0.05
Grade	10.59			-5.10	0.25	
Tangent (at 14th Ave.)	10.84					0.05
Grade	10.89			5.00	0.27	
Stop (OB)	10.90					
Stop (IB)	11.15					
Tangent (at 13th Ave.)	11.16					0.06
Grade	11.22			4.20	0.24	
Tangent (at 12th Ave.)	11.46					0.08
Grade	11.54			0.40	0.27	

7^N - Judah Line

Section 1: From La Playa to 9th Ave. (continued)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Stop (OB)	11.55					
Stop (IB)	11.80					
Tangent (at 11th Ave.)	11.81					0.05
Grade	11.86			1.70	0.27	
Tangent (at 10th Ave.)	12.13					0.05
Grade	12.18			2.10	0.29	
Stop (OB)	12.19					
Curve (at 9th and Irving)	12.44	42' - 7.5"	0.03			
Stop (IB)	12.46					
Stop (OB)	12.46					
End (Section 1)	12.47					

Length of Section 1: 12,470 Ft.

Tangent Length: 2,280 Ft.

Grade Length: 10,190 Ft.

7^N - Judah Line

Section 2: 9th Ave. from Judah St. to Irving St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (left)	12.47	42' - 7.5"	0.07			
Tangent (at 9th Ave.)	12.47					0.07
Grade	12.54			-4.00	0.56	
Tangent (9th Ave.)	13.10					0.07
Curve (right)	13.10	42' - 7.5"	0.07			
End (Section 2)	13.17					

Length of Section 2: 700 Ft.

Tangent Length: 140 Ft.

Grade Length: 560 Ft.

N^o - Judah Line

Section 3: Irving Street from 9th Ave. to Arguello Blvd.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve	13.17	42' - 7.5"	0.04			
Grade	13.17			5.00	0.28	
Stop (IB)	13.18					
Stop (OB)	13.18					
Tangent (at 8th Ave.)	13.45					0.08
Grade	13.53			2.90	0.22	
Stop (IB)	13.74					
Tangent (at 7th Ave.)	13.75					0.05
Grade	13.81			0.40	0.27	
Stop (OB)	13.82					
Tangent (at 6th Ave.)	14.08					0.05
Grade	14.13			0.40	0.23	
Stop (OB)	14.14					
Stop (IB)	14.35					
Tangent (at 5th Ave.)	14.36					0.05
Grade	14.41			0.40	0.27	
Tangent (at 4th Ave.)	14.68					0.04
Grade	14.72			3.80	0.28	
Stop (OB)	14.73					
Stop (IB)	14.99					
Tangent (at 3rd Ave.)	15					0.04
Grade	15.04			5.40	0.27	
Tangent (at 2nd Ave.)	15.31					0.05
Stop (OB)	15.33					
Grade	15.36			4.90	0.15	
Curve (left)	15.5	42' - 7.5"	0.01			
End (Section 3)	15.51					

Length of Section 3: 2,340 Ft.

Tangent Length: 370 Ft.

Grade Length: 2,010 Ft.

N^o - Judah Line

Section 4: Arguello Blvd. from Irving St. to Carl St.

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Curve (left)	15.51	42' - 7.5"	0.09			
Grade	15.51			-4.30	0.26	
Curve (right)	15.69	42' - 7.5"	0.08			
Stop (OB, Arguello \ Irving)	15.77					
End (Section 4)	15.77					

Length of Section 4: 260 Ft.

Tangent Length: 0

Grade Length: 260 Ft.

7ⁿ - Judah Line

Section 5: Carl St. from Arguello Blvd. to Sunset Tunnel

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Grade	15.77			1.20	0.61	
Stop (IB, at Hillway Ave.)	15.91					
Grade	16.38			-1.80	0.25	
Stop (IB)	16.62					
Tangent (at Willard)	16.63					0.06
Grade	16.69			-3.40	0.43	
Stop (OB)	16.7					
Stop (IB)	17.11					
Tangent (at Saryan)	17.12					0.06
Grade	17.18			3.20	0.33	
Stop (OB)	17.19					
Tangent	17.51					0.08
Grade	17.59			-5.90	0.28	
Stop (IB)	17.86					
Tangent (at Cole)	17.87					0.06
Grade	17.93			-3.20	0.17	
Stop (OB)	17.94					
Curve (right)	18.08	50 Ft.	0.06			
Grade	18.1			-4.00	0.26	
Stop (IB, at Belvedere St.)	18.23					
Stop (OB, at Belvedere St.)	18.23					
Curve (left)	18.23	250 Ft.	0.13			
End (Section 5)	18.38					

Length of Section 5: 2,590 Ft.

Tangent Length: 260 Ft.

Grade Length: 2,330 Ft.

7ⁿ - Judah Line

Section 6: Sunset Tunnel

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
West Portal, Sunset Tunnel	18.38					
Grade	18.38			-4.00	0.20	
Grade	18.58			-3.00	3.03	
Grade	21.59			-3.20	0.27	
Tangent	21.86					0.07
Grade	21.93			-3.00	0.67	
Curve	22.44	511 Ft.	0.10			
East Portal, Sunset Tunnel	22.6					

Length of Section 6: 4,240 ft.

Tangent Length: 70 Ft.

Grade Length: 4,170 Ft.

N - Judah Line

Section 7: Duboce Ave. from Sunset Tunnel to Market Street Subway

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length
Tangent (at Noe St.)	22.60					0.20
Stop (IB at Pierce St.)	22.73					
Stop (OB at Pierce St.)	22.73					
Tangent (at Walter St.)	22.80					0.08
Curve (left)	22.86	200 Ft.	0.10			
Grade	22.88			-4.80	0.55	
Curve (right)	22.98	200 Ft.	0.10			
Stop (IB)	23.42					
Tangent (at Sanchez St.)	23.43					0.07
Grade	23.50			-2.10	0.53	
Stop (OB)	23.51					
Stop (IB)	24.02					
Tangent (at Church St.)	24.03					0.10
Turn Off (J Line)	24.03					
Grade	24.13			-0.80	0.03	
Stop (OB)	24.14					
Grade (OB)	24.16			-0.80	0.20	
Grade (IB)	24.16			-3.63	0.30	
Grade (OB)	24.36			-8.07	0.32	
Grade (IB)	24.46			-8.08	0.22	
Grade (OB)	24.68			-4.94	0.29	
Grade (IB)	24.68			-5.70	0.32	
Portal (Market Street Subway)	24.70					
Curve (right)	24.95	400 Ft.	0.27	-1.80	0.16	
Grade (OB)	24.97			-0.81	0.22	
Grade (IB)	25.00					
End of N Line	25.22					

Length of Section 7:
 2,620 Ft. (double track)
 950 Ft. (single track WB)
 1,060 Ft. (single track EB)

Tangent Length: 450 Ft.
 Grade Length:
 23,710 Ft. (double track)
 950 Ft. (single track WB)
 1,060 Ft. (single track EB)

Market St. Subway: J, K, L, M & N Lines

Section 1: From East Portal to Embarcadero Track End

Distance in 1000's of Feet

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length	Station Length	Distance Length	Trans. Length
Curve (right)	0.00	1,000'	0.10						
Grade	0.00			-5.00	0.10				
Curve (right)	0.10	2,500'	0.58						
Grade	0.10			-1.00	4.00				
Castro St. Station	0.10						0.40		
Grade	0.50			-1.63	0.94				
Grade	1.44			-5.00	0.94				
Church St. Station	2.38						0.40		
Grade	2.38			-1.00	0.50				
Grade (IB)	2.68			-1.00	0.13				
Grade (OB)	2.88			5.00	0.52				
Grade (IB)	3.07			1.23	0.32				
13' dist between tracks	3.27							2.70	
Grade (IB)	3.37			1.00	0.17				
Grade (OB)	3.40			4.83	0.10				
Grade (IB)	3.50			0.75	0.11				
Grade (OB)	3.50			3.64	0.11				
Track Transition	3.54								0.26
Grade (IB)	3.67			0.05	0.38				
Grade (OB)	3.67			2.28	0.09				
Grade (OB)	3.70			0.92	0.11				
Grade (OB)	3.81			0.44	0.09				
Grade (OB)	3.90			-1.68	0.10				
Grade (OB)	4.00			-1.80	0.11				
Grade (IB)	4.00			-0.20	0.31				
Grade (OB)	4.11			-2.00	0.12				
Turn Off (J&N Lines)	4.21								
Grade (OB)	4.23			-3.40	0.08				
Grade (OB)	4.37			-4.80	0.10				
Grade (IB)	4.37			-0.35	0.09				
Grade (IB)	4.40			-1.40	0.10				
Grade (OB)	4.41			-5.00	0.50				
Grade (IB)	4.50			-2.60	0.10				
Grade (IB)	4.60			-3.60	0.11				
Grade (IB)	4.71			-4.83	0.10				
Grade (IB)	4.81			-5.00	0.10				
Grade	4.91			-5.00	0.20				
Grade	5.11			-4.71	0.10				
Grade	5.27			-3.71	0.10				
Grade	5.37			-2.69	0.10				
Grade	5.47			-1.69	0.09				
Grade	5.50			-1.40	0.89				
17' dist between tracks	5.97							0.75	
Crossover (double)	6.00								
Track Transition	6.20								0.30

Market St. Subway: J, K, L, M & N Lines

Section 1: From East Portal to Embarcadero Track End (continued)

Point of Change	Distance From Start	Curve Radius	Curve Length	Grade % (+ or -)	Grade Length	Tangent Length	Station Length	Distance Length	Trans. Length
3rd Track	6.25								
Grade	6.39			-0.90	0.11				
Grade	6.50			-0.30	0.50				
Van Ness Station	6.59						0.38		
32' dist between tracks	6.68							1.97	
Grade	7.00			-4.00	0.11				
Grade	7.11			-0.70	0.10				
Grade	7.21			-0.30	0.29				
Grade	7.50			-0.30	0.88				
Track Transition	8.01								0.40
Grade	8.38			-0.65	0.12				
Grade	8.50			-1.00	1.00				
44' dist between tracks	8.63							5.70	
Chic Center Station	8.68						0.71		
Grade	8.50			-0.68	0.10				
Grade	9.60			-0.45	0.10				
Grade	9.70			-0.03	1.30				
Grade	11.00			0.14	0.10				
Grade	11.10			0.19	0.13				
Grade	11.23			0.53	0.08				
Powell St. Station	11.28						0.80		
Grade	11.31			0.70	0.79				
Grade	12.10			0.52	0.11				
Grade	12.21			0.49	0.10				
Grade	12.31			0.16	0.09				
Grade	12.40			-0.18	0.10				
Grade	12.50			-0.53	0.11				
Grade	12.61			-0.80	0.39				
Montgomery St. Station	13.61						0.77		
44' dist between tracks	14.33							0.67	
Track Transition	14.60								0.40
Grade	15.00			-1.00	0.15				
44' dist between tracks	15.00							1.12	
34' DIST	15.12							1.15	
Grade	15.16			-0.60	1.11				
Crossover (double)	15.18								
Embarcadero Station	15.59					0.68			
End of track	16.27								

Length of Section : 16,270 Ft.

Tangent Length: 0

Grade Length: 16,270 Ft.

SUMMARY

Market St. Subway: J,K,L, M & N Lines

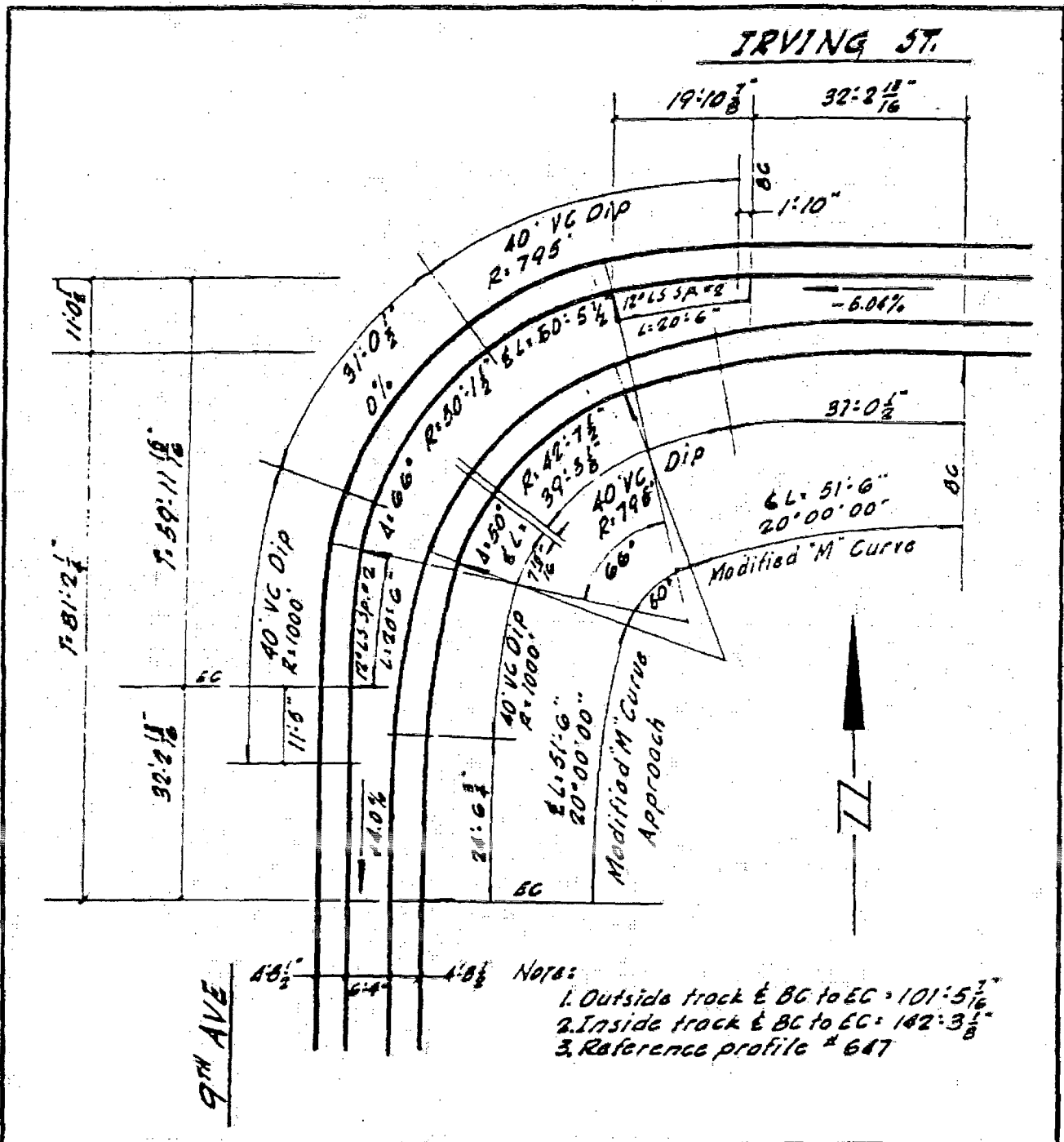
Total Length: 16,270 Ft. (Double Track)

Tangent Length: 0 Ft. (Double Track)

Grade Length:	16,270 Ft.		Double	Single
		up 1%	6,720 Ft.	1,100 Ft.
		1% to 2%	5,980 Ft.	930 Ft.
		2% to 3%	100 Ft.	310 Ft.
		3% to 4%	100 Ft.	300 Ft.
		4% to 5%	100 Ft.	300 Ft.
		5% to 6%	1,240 Ft.	0 Ft.
		6% to 7%	0 Ft.	1,120 Ft.

Curve Length:	690 Ft.	Radius	1,000'	100 Ft.
			2,500'	580 Ft.

Number of Stations: 7	Min Station Length	800 Ft.
	Max Station Length	380 Ft.
	Avr. Station Length	590 Ft.



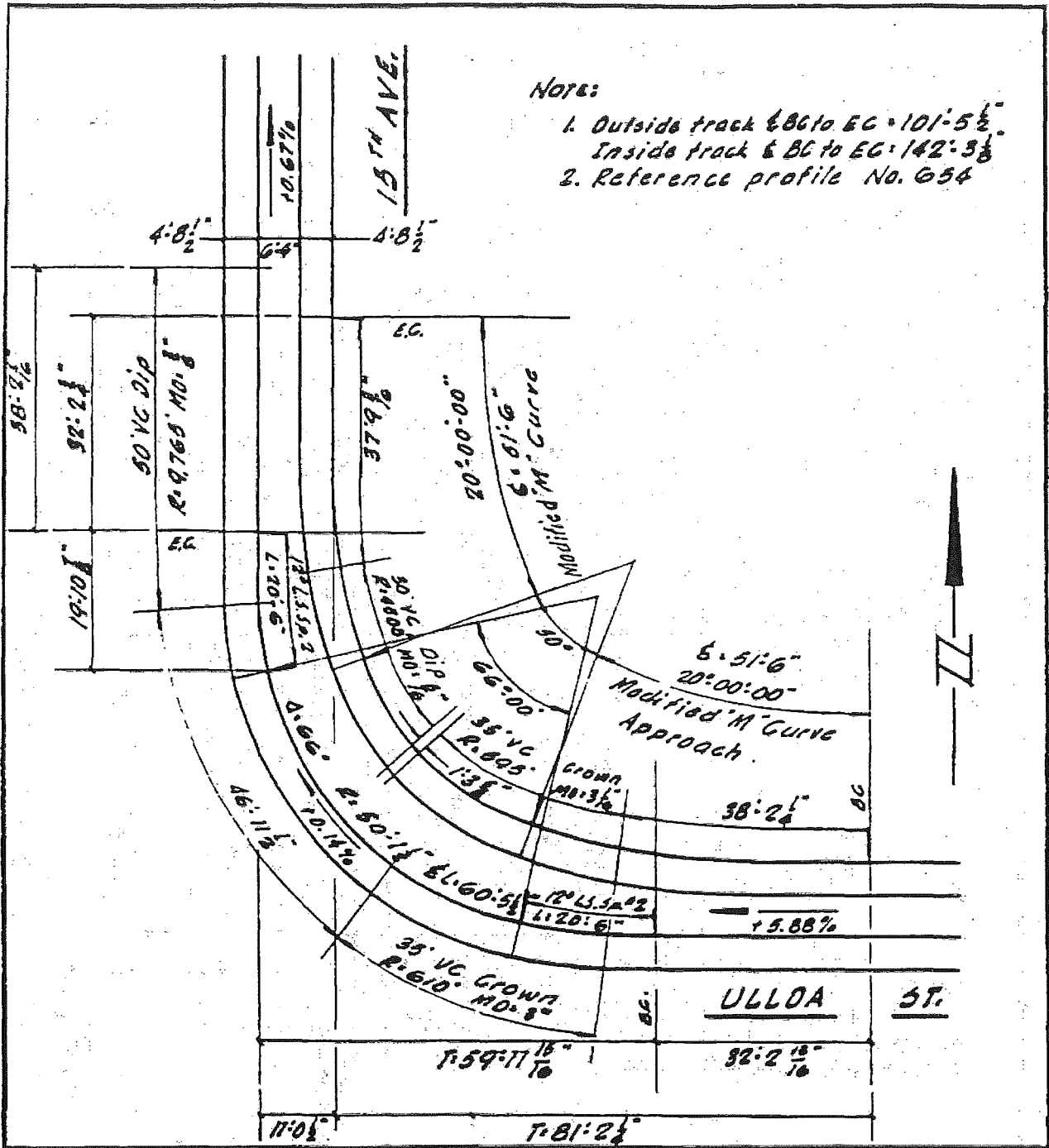
9th AVE

Notes:
 1. Outside track \bar{E} BC to EC = $101'5\frac{7}{16}''$
 2. Inside track \bar{E} BC to EC = $142'3\frac{1}{8}''$
 3. Reference profile # 647

CITY AND COUNTY OF SAN FRANCISCO PUBLIC UTILITIES COMMISSION
 UTILITIES ENGINEERING BUREAU

MUNICIPAL RAILWAY
 IRVING STREET & 9th AVENUE
 VERTICAL & HORIZONTAL CURVES

BY A.S.E.	TR.	APPROVED	SCALE 1"=20'	DATE 5-68	LATEST REVISION
DEL. NW	CR. A.S.E.	APPROVED		DRAWING NO. AL-2627	REVISION NO. 0



Notes:

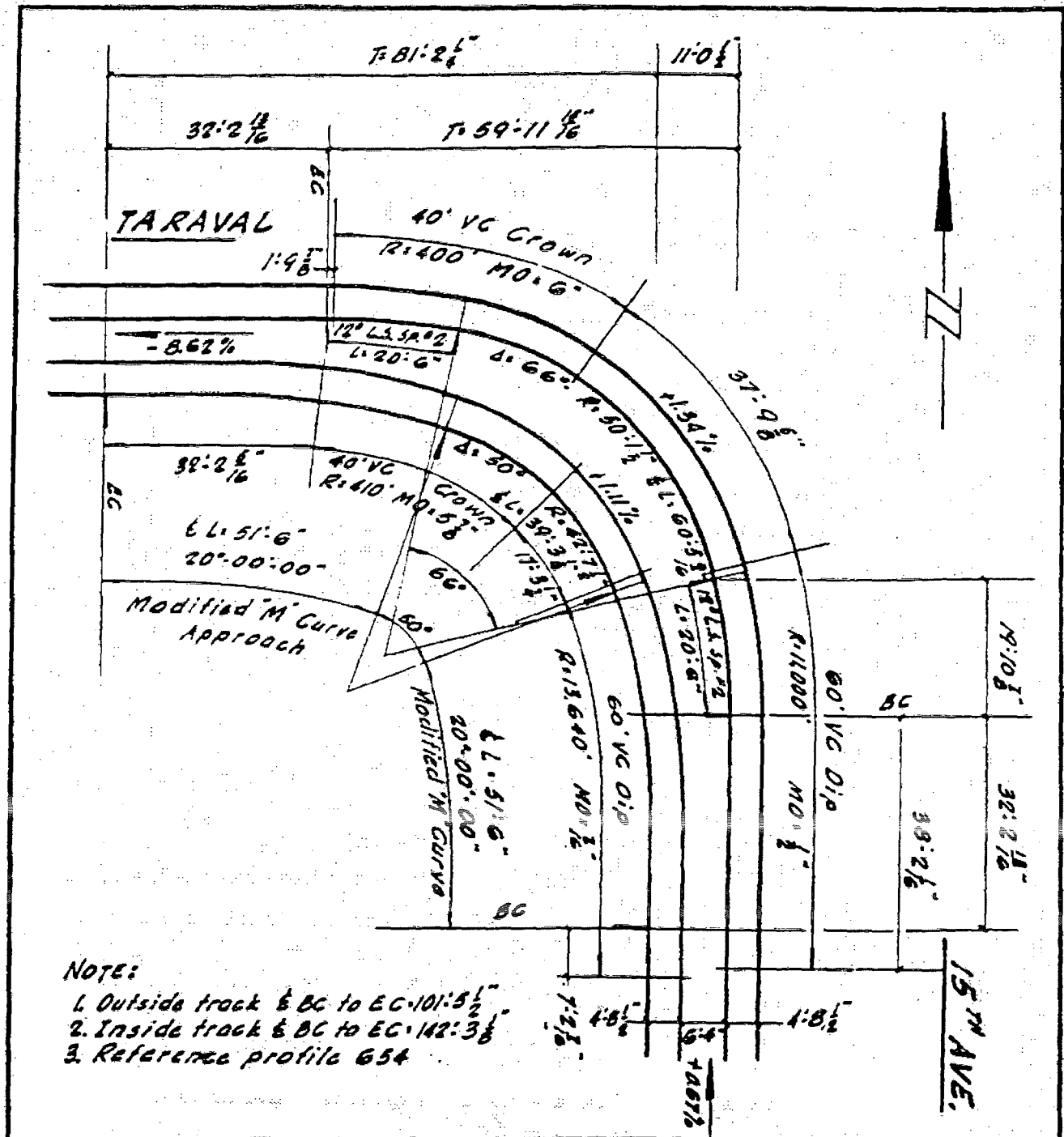
1. Outside track & BC to EC = 101'-5 1/2"
- Inside track & BC to EC = 142'-3 1/2"
2. Reference profile No. 654

CITY AND COUNTY OF SAN FRANCISCO PUBLIC UTILITIES COMMISSION
 UTILITIES ENGINEERING BUREAU

MUNICIPAL RAILWAY

**ULLOA STREET & 15TH AVENUE
 VERTICAL & HORIZONTAL CURVES**

BY ASE	TEL.	APPROVED	SCALE 1" = 20'	DATE 3-68	LATEST REVISION
CHK. WH	CEL. ASE	APPROVED	DRAWING NO. AL-2628	REVISION NO. 0	



NOTE:

1. Outside track & BC to EC 101:5 1/2"
2. Inside track & BC to EC 142:3 1/8"
3. Reference profile 654

CITY AND COUNTY OF SAN FRANCISCO

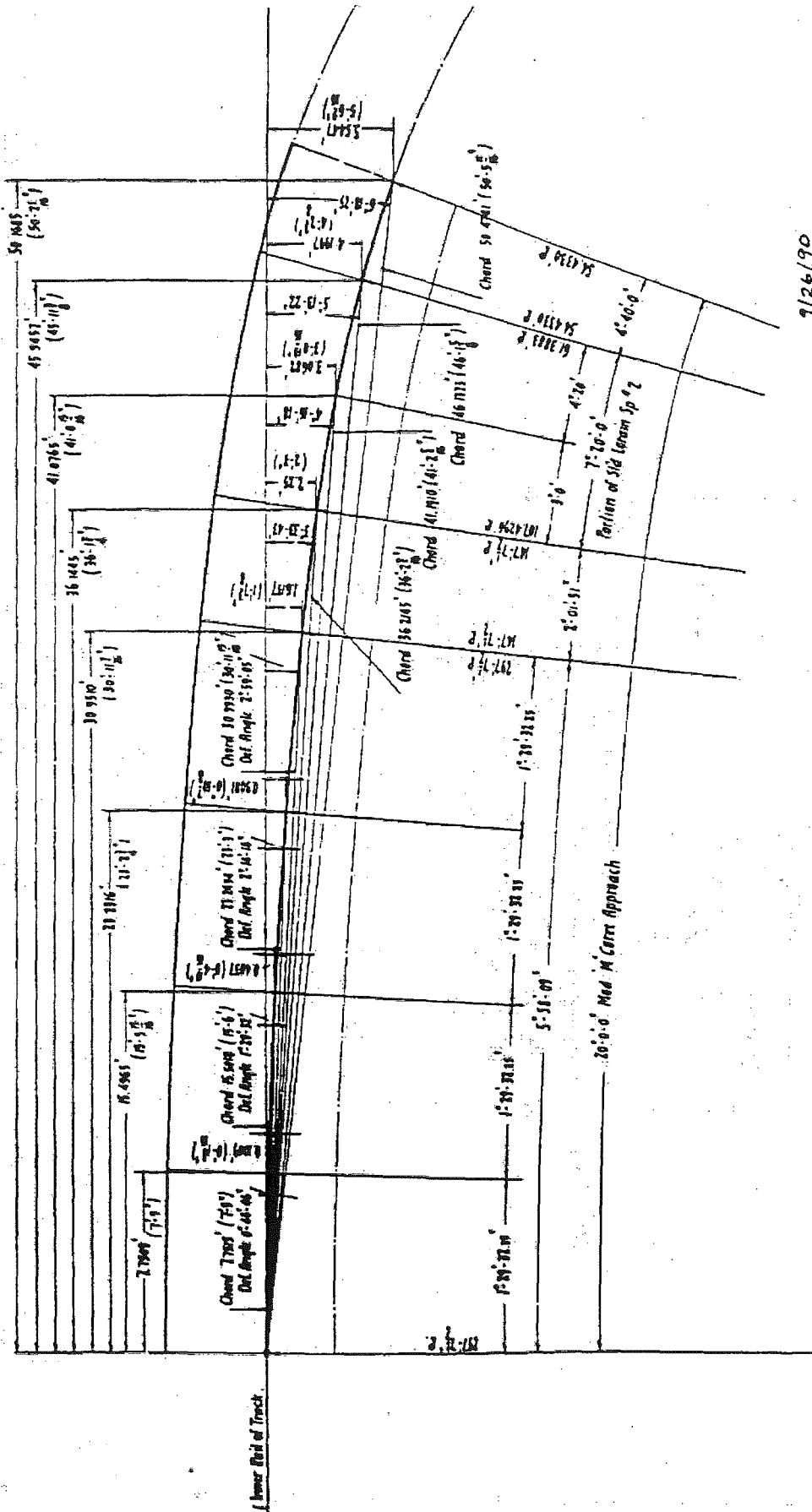
PUBLIC UTILITIES COMMISSION

UTILITIES ENGINEERING BUREAU

MUNICIPAL RAILWAY

**15TH AVENUE & TARAVAL STREET
VERTICAL & HORIZONTAL CURVES**

BY ABC	TL	APPROVED	SCALE 1"=20'	DATE 5-68	LATEST REVISION
W	CH. A.S.E.	APPROVED	DRAWING NO. AL-2629	REVISION NO. 0	
RECORDED	GENERAL MANAGER				



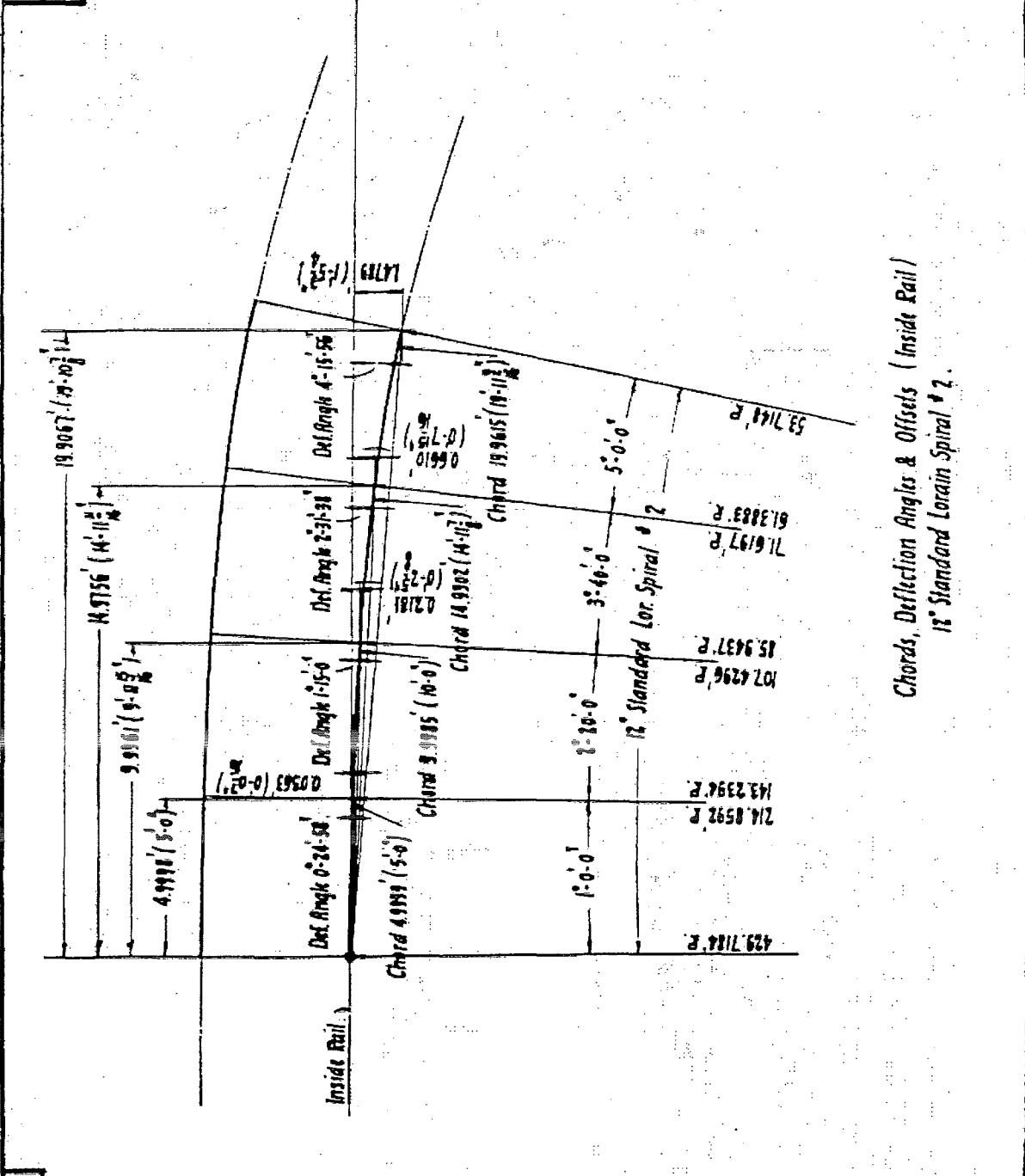
7/26/90
 COPY OF
 BL 2232

Chords, Deflection Angles & Offsets
 20° Modified M' Curve

Scale 1" = 10'

PATTERN No.
MATERIAL

AL 1097



Chords, Deflection Angles & Offsets (Inside Rail)
12° Standard Lorain Spiral # 2.

Scale: 1" = 1'-0"

App. By	
San Francisco	
Date: June 21, 1911	
Revision	
Checked	
Drawn	
Material	

4. ATCS LRV2 On-Board Equipment

MUNI ATCS LRV2 ON-BOARD EQUIPMENT

TABLE OF CONTENTS

		PAGE
1.	EQUIPMENT DESCRIPTION	1
	1.1 LRV2 VOBC Assembly	3
	1.1.1 Power Supply Unit 300-2-00157-AAB	4
	1.1.2 Electronics Unit 3CU 10001 ABAA	5
	1.1.3 Interface Relay Unit 3CU 10002 ABAA	7
	1.1.4 Communication Unit 3CU 10027 ABAA	9
	1.1.5 P. Signal Generator 300-3-00232	10
	1.2 VOBC Peripheral Equipment	11
	1.2.1 Tachometer 300-3-00208	11
	1.2.2 Antennas Receive 300-2-00120-AAC	12
	1.2.3 Accelerometer Assembly 3CU 10037 AAAA	13
	1.2.4 Driver's Control Box 3CU 10043 ABAA	14
	1.2.5 Train ID Unit 3CU 10022 ABAA	15
	1.2.6 Driver's Display Unit 3CU 10044 AAAA	16
	1.2.7 Disconnect Unit 3CU 10041 ABAA	17
	1.2.8 Destination Sign Interface Box 300-3-00246	18
	1.2.9 Digital Voice Announcement System 300-3-00278	19
	1.2.10 Cable Set	20
	Figure 4 LRV2 On-Board Equipment Location	2
	Figure 5 LRV2 VOBC Assembly	3
	Figure 6 LRV2 VOBC Rack Power Supply Unit	4
	Figure 7 VOBC Rack Electronics Unit	6
	Figure 21 Interface Relay Unit	8
	Figure 22 Communications Unit	9
	Figure 23 P. Signal Generator	10
	Figure 24 Tachometer	11
	Figure 25 Tachometer 1 and 2 Output Signals	11
	Figure 26 Loop Communications Antennas	12
	Figure 27 Accelerometer Assembly	13
	Figure 28 Driver's Control Box	14
	Figure 29 Train ID Unit	15
	Figure 30 Driver Display Unit	16
	Figure 31 Disconnect Unit	17
	Figure 32 Destination Sign Interface Box	18
	Figure 33 Digital Voice Announcement System	19

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
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1. EQUIPMENT DESCRIPTION

This section provides physical descriptions of the LRV2 On-Board Equipment in the MUNI ATCS. The On-Board Equipment consists of the following:

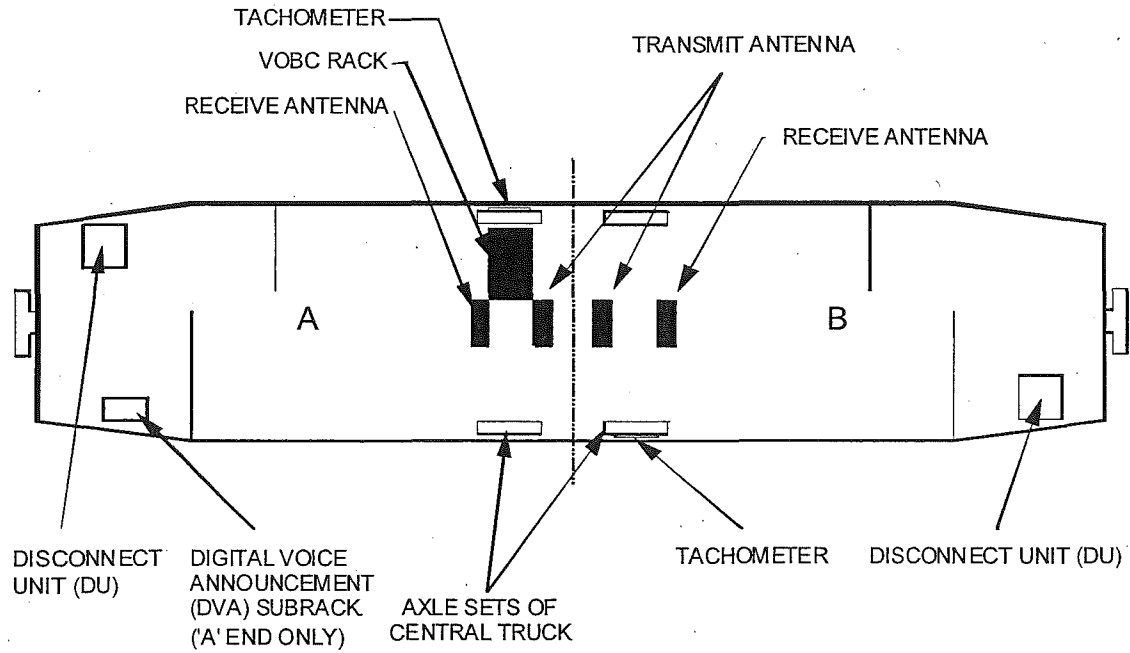
- Rack mounted equipment:
 - Power Supply Unit;
 - Electronics Unit (EU);
 - Communications Unit (CU);
 - Interface Relay Unit (IRU); and
 - P.Signal Generator.

- Peripheral Equipment:
 - Two Tachometers;
 - Two Receive Antennas;
 - Two Transmit Antennas;
 - Accelerometer (mounted to VOBC Rack);
 - Two Driver's Control Boxes;
 - Two Train ID Units;
 - Two Driver Display Units;
 - Two Disconnect Units;
 - Destination Sign Interface Box; and
 - Digital Voice Announcement.

- Cable Set.

Figure 4 shows the location of the On-Board Equipment in the LRV2 vehicle.

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			1



lrv2-veh.pre

Figure 1 LRV2 On-Board Equipment Location

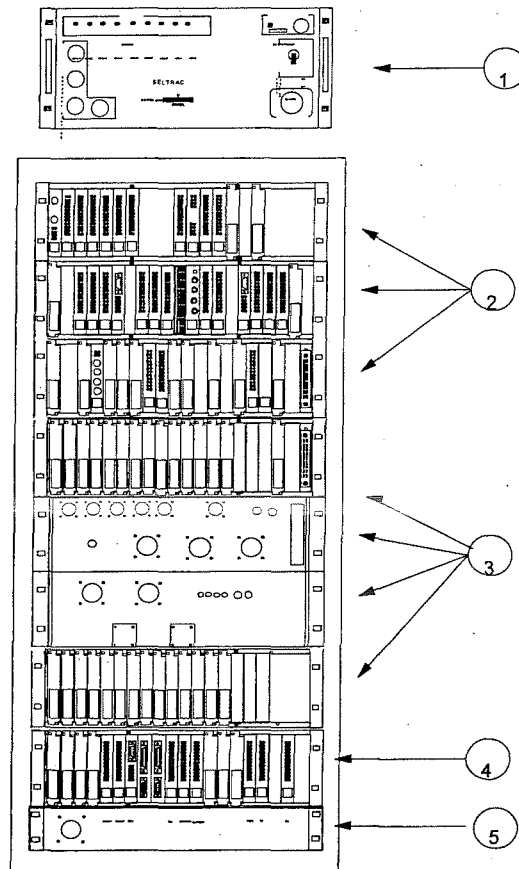
REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		2

1.1

LRV2 VOBC Assembly

The LRV2 VOBC Rack is shown in Figure 5 and consists of the following equipment:

Item	Description	ATA Part Number
1	Power Supply Unit (PSU)	300-2-00157-AAB
2	Electronics Unit (EU)	3CU 10001 ABAA
3	Interface Relay Unit (IRU)	3CU 10002 ABAA
4	Communications Unit (CU)	3CU 10027 ABAA
5	P. Signal Generator	300-3-00232



muni_lv2.ppt

Figure 2 LRV2 VOBC AssemblyNote:

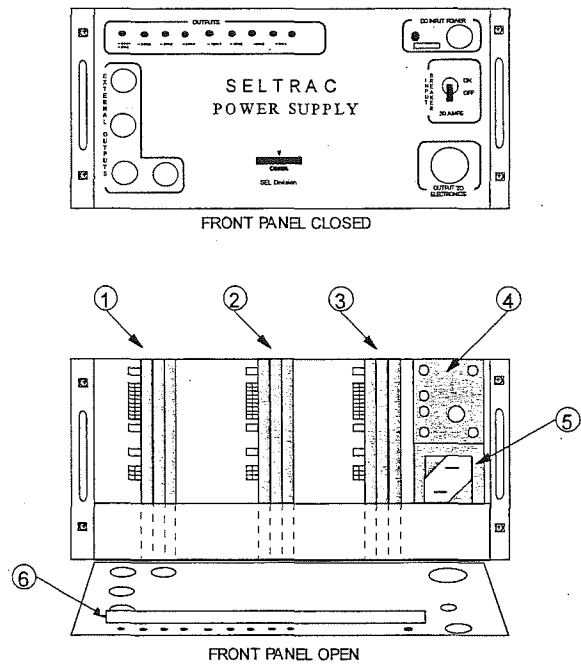
The PSU (Item 1) is housed under the back-to-back seats and is connected to the rack housing (items 2, 3 and 4) by cable. The LRV2 On-Board Equipment location is shown in Figure 4.

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		3

1.1.1 Power Supply Unit

300-2-00157-AAB

Item	Description	ATA Part Number
1	Power Supply Assembly 1	401-2-00323-AAC
2	Power Supply Assembly 2	401-2-00323-AAC
3	Power Supply Assembly 3	401-2-00324-AAB
4	Over Voltage Board Assembly	401-2-00327
5	Metal Oxide Varistor	601-3-00171
6	PBA LED Mount (p/o 403-2-00202 Cable Assy PSU)	401-2-00326



psu_assm.pre

Figure 3 LRV2 VOBC Rack Power Supply Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		4

1.1.2 Electronics Unit

3CU 10001 ABAA

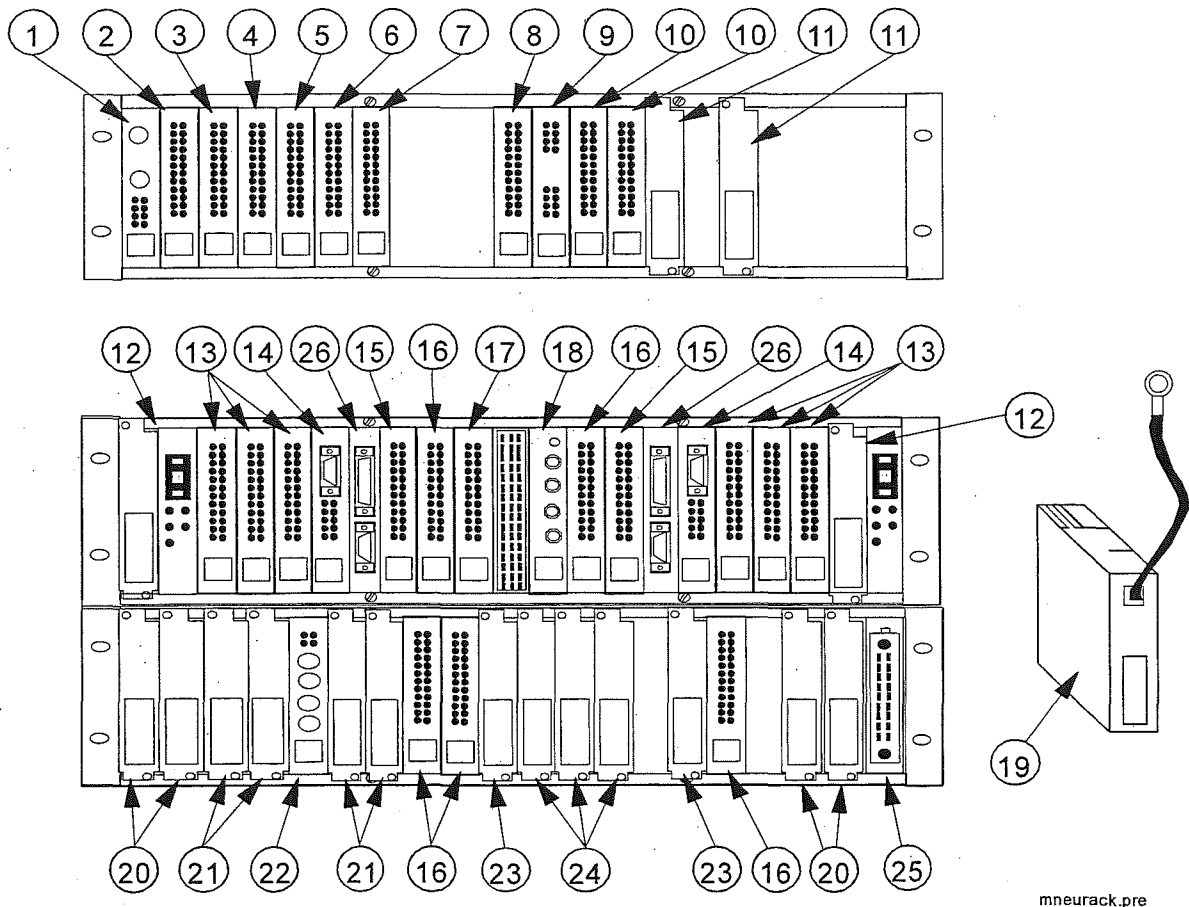
The EU, shown in Figure 7, is the vital controller of the VOBC. The EU is responsible for monitoring all on-board status signals, the control of vehicle subsystem, the processing of incoming VCC telegrams and the generation of VOBC response telegrams.

The EU subrack, P/N 400-2-00185 AAC, houses the following modules:

Item	Description	ATA Part Number
1	Antenna Filter	58222-03320
2	High Frequency Receiver A	58222-03270
3	High Frequency Receiver B	58222-06850
4	High Frequency Receiver C	58222-03290
5	High Frequency Receiver D	58222-03301
6	Digital Receiver A	58222-04590
7	Digital Receiver B	58222-06860
8	Data Transmitter	58222-06880
9	High Frequency Transmitter A	58222-03240
10	High Frequency Transmitter B	58222-03250
11	High Frequency Transmitter C	58222-08660
12	Positioning Computer (TWR)	401-2-00356-AAC
13	Computer Input	401-2-00167
14	Central Processing Unit	3CU 10035 AFAA
15	Temporary Latch 'A'	401-2-00163-AAA
16	Output Port	401-2-00170
17	Interrupt Controller	401-2-00221-AAE
18	Vehicle Identity	401-2-00341-AAB
19	Vehicle Identity Plug In	300-2-00172-XXX*
20	Force Actuated Relay	3CU 20015 AFAA
21	Output Relays 'A'	3CU 20053 AAAB
22	D/A Isolation Amplifier	3CU 20000 AAAA
23	Interval Measurement Control	401-2-00176
24	Input	401-2-00168
25	Power I/P Connector	N/A
26	Transmitter/Receiver (T/R)	401-2-00368-AAD

The '*' in Item 19 indicates that there are multiple variants used for the Vehicle Identity Plug In.

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		5



mneurack.pre

Figure 4 VOBC Rack Electronics Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
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1.1.3 Interface Relay Unit

3CU 10002 ABAA

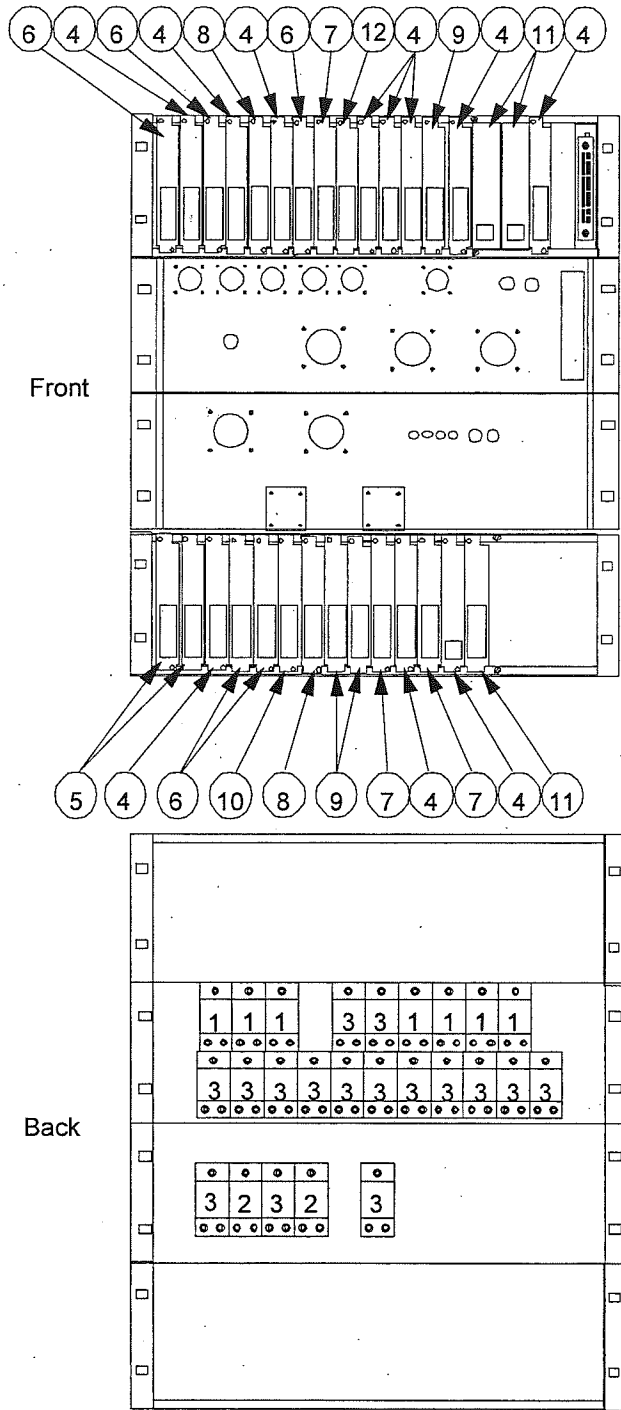
The Interface Relay Unit (IRU) is responsible for the following:

- Train integrity function;
- Selection of common train power in the vehicle with an active VOBC in AUTO mode; and
- Emergency Brake control in AUTO and Cab Signal modes.

The IRU is shown in Figure 8 and consists of the following:

Item	Description	ATA Part Number
1	Latching Relay 4 Pole Double Throw	400-3-00328
2	Power Relay	400-3-00008
3	Relay 4 Pole Double Throw	400-3-00329
4	Cable Connector	401-2-00342-AAA
5	Cable Connector	401-2-00342-AAN
6	Trainline Filter Board	401-2-00339-AAM
7	Trainline Filter Board	401-2-00339-AAN
8	Trainline Filter Board	401-2-00339-AAP
9	Trainline Filter Board	401-2-00339-AAQ
10	Trainline Filter Board	401-2-00339-AAR
11	Trainline Filter Board	401-2-00339-AAU
12	Trainline Filter Board	401-2-00339-AYY

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			7



iru_inv.pre

Figure 5 Interface Relay Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		8

1.1.4 Communication Unit

3CU 10027 ABAA

Communications between the train EUs, passenger information equipment and train-end equipment is a function of the Communications Unit (CU). The CU is shown in Figure 9 and consists of the following:

Item	Description	ATA Part Number
1	Input Card	401-2-00264-BAJ
2	Computer Input Card (Inport)	401-2-00167
3	CPU Card	3CU 10035 AAAA
4	TX/RX Card	401-2-00368-AAK
5	TX/RX Card	401-2-00368-AAN
6	TLA Card	401-2-00163-AAB
7	Output Port Card (Outport)	401-2-00170
8	Output Relays	3CU 20053 AAAB
9	CU Processor	3CU 10036 ABAA
10	Transmitter Card	401-2-00318-AAC
11	Receiver Card	401-2-00320-AAD
12	DC/DC Converter (backplane mounted)	400-3-00493

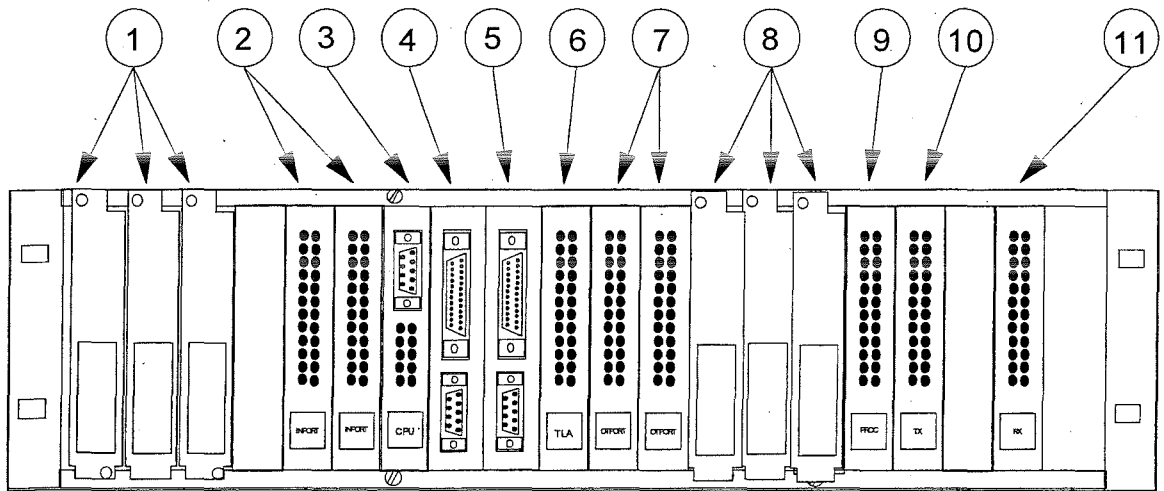


Figure 6 Communications Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		9

1.1.5

P. Signal Generator

300-3-00232

The P. Signal Generator converts the 0-10 volt analog output from the D/A Isolation Amplifier in the EU to a current signal compatible with the propulsion system interface. It is located in the bottom position in the VOBC Rack. Refer to Figure 23.

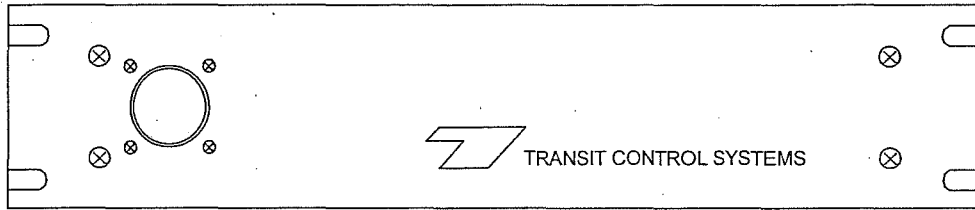


Figure 7 P. Signal Generator

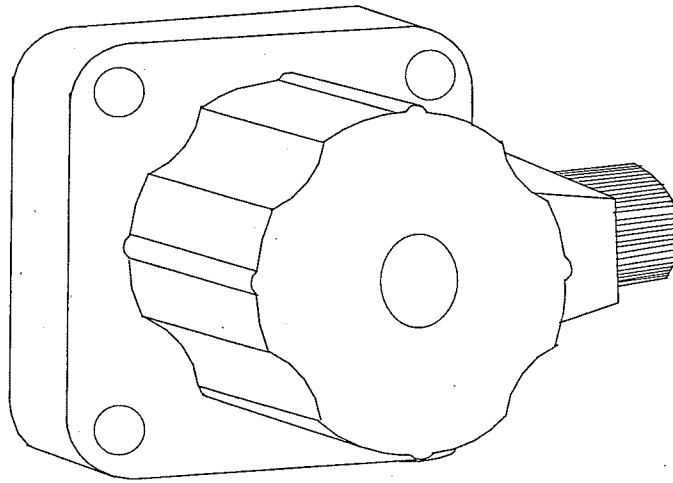
REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			10

1.2 VOBC Peripheral Equipment

1.2.1 Tachometer

300-3-00208

The four-channel Tachometer is shown in Figure 24. One Tachometer is mounted on each of the center truck axles on opposite sides of the vehicle.



epg2.pre

Figure 8 Tachometer

Figure 9 Tachometer 1 and 2 Output Signals

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			11

1.2.2 Antennas

Receive 300-2-00120-AAC

Figure 26 shows the transmit/receive Antenna. There are two transmit and two receive Antennas on each vehicle mounted on the center truck.

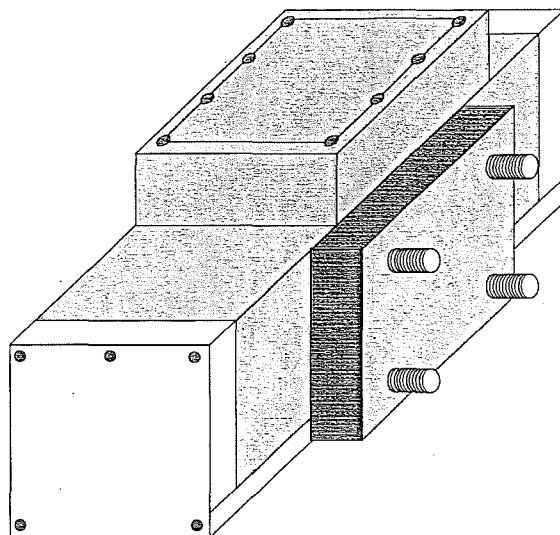


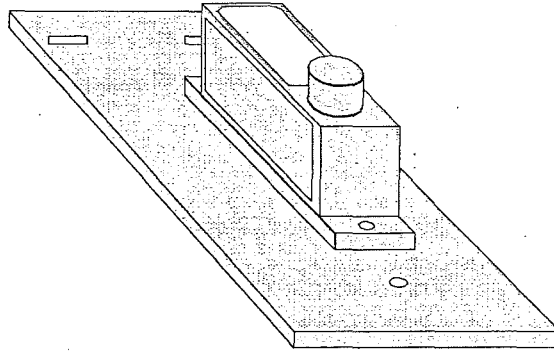
Figure 10 Loop Communications Antennas

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			12

1.2.3 Accelerometer Assembly

3CU 10037 AAAA

The Accelerometer Assembly is shown below. It is mounted in the Electronics Rack on a level adjustment plate. It.



acc001r.ppt

Figure 11 Accelerometer Assembly

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		13

1.2.4

Driver's Control Box

3CU 10043 ABAA

The Driver's Control Box (DCB) is shown below. It is integrated into the operator panel in each cab. It enables the Train Operator to select the mode of operation and door control.

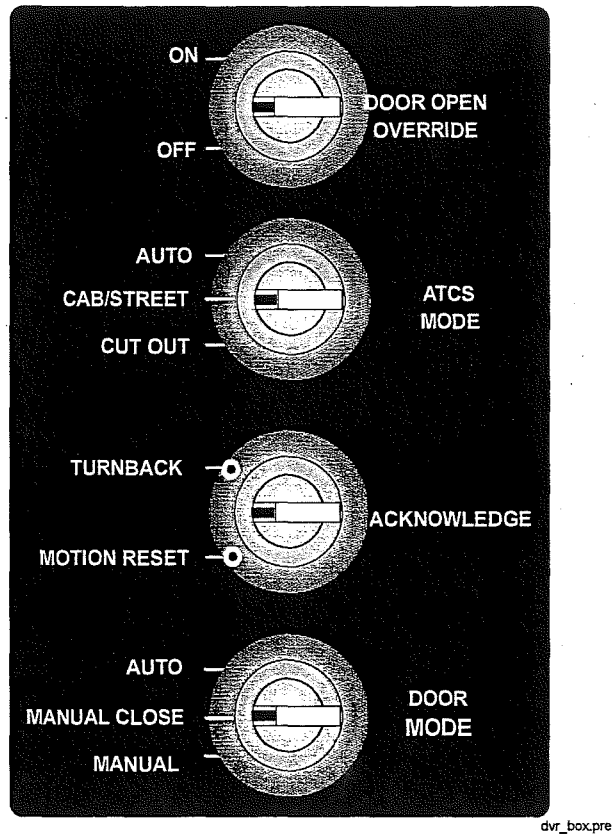


Figure 12 Driver's Control Box

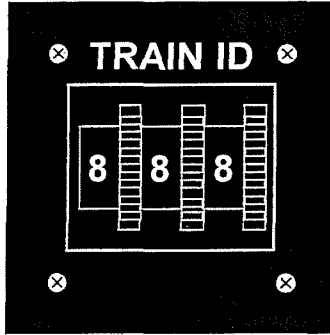
REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			14

1.2.5

Train ID Unit

3CU 10022 ABAA

The Train ID Unit is shown below. It is integrated into the operator's panel in each cab. It has three ten-position thumbwheel switches for operator entry of the RUCUS train ID.



train_id.pre

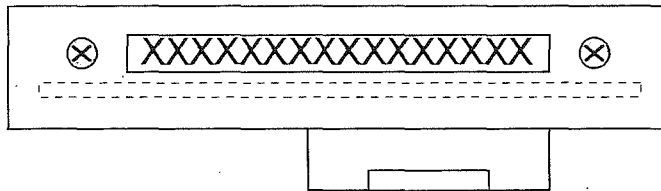
Figure 13 Train ID Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			15

1.2.6 Driver's Display Unit

3CU 10044 AAAA

The Driver's Display Unit (DDU) is shown below. A DDU is integrated into the operator's Panel in each cab.



display2.pre

Figure 14 Driver Display Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			16

1.2.7 Disconnect Unit

3CU 10041 ABAA

The Disconnect Unit (DU) is shown below. One DU is installed in each Cab (in the 'A' and 'B' Ends).

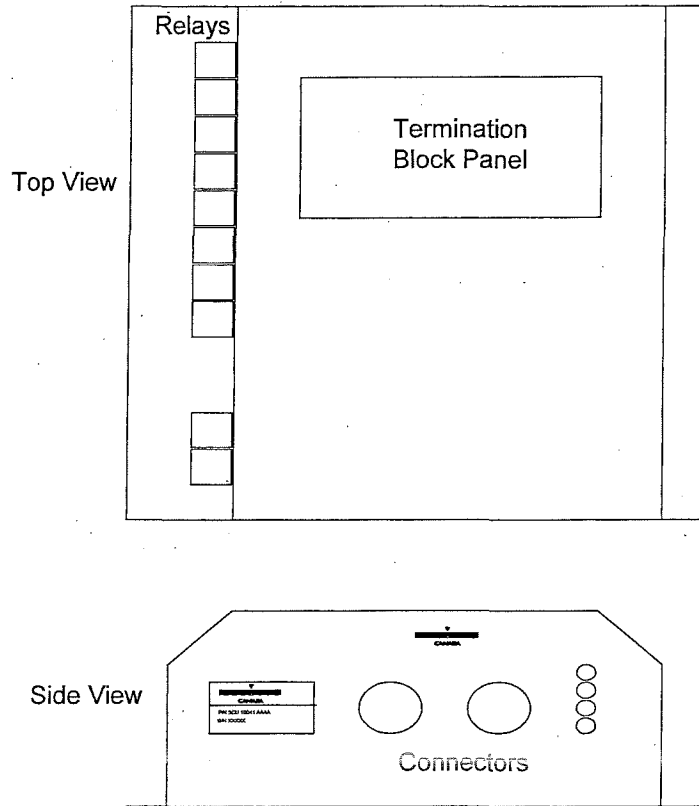


Figure 15 Disconnect Unit

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			17

1.2.8 Destination Sign Interface Box

300-3-00246

The Destination Sign Interface Box translates the 8-bit parallel signal into a 'LonWorks' compatible code to display a route and destination combination. The codes have been programmed into the interface box and sent to the signs over the 'LonWorks' twisted pair network. The interface is mounted in the VOBC Rack. See the LRV2 VOBC

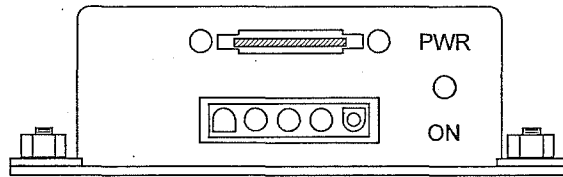


Figure 16 Destination Sign Interface Box

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			18

1.2.9 Digital Voice Announcement System

300-3-00278

The Digital Voice Announcement (DVA) is located in the 'A' cab of the LRV2. The DVA interfaces the VOBC CU to the vehicle Passenger Announcement (PA) system.

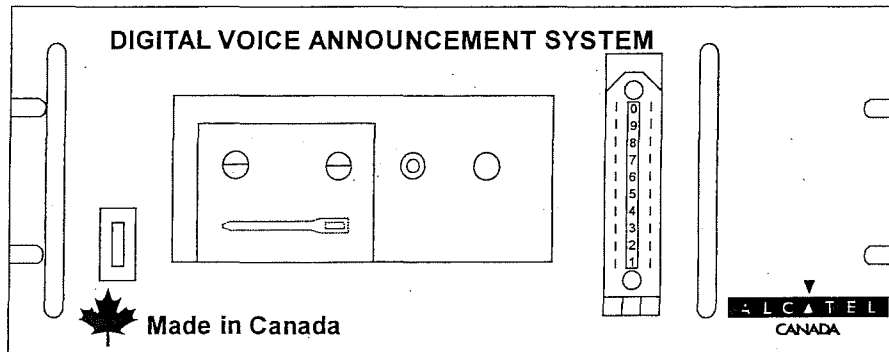


Figure 17 Digital Voice Announcement System

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT
		19

1.2.10 Cable Set

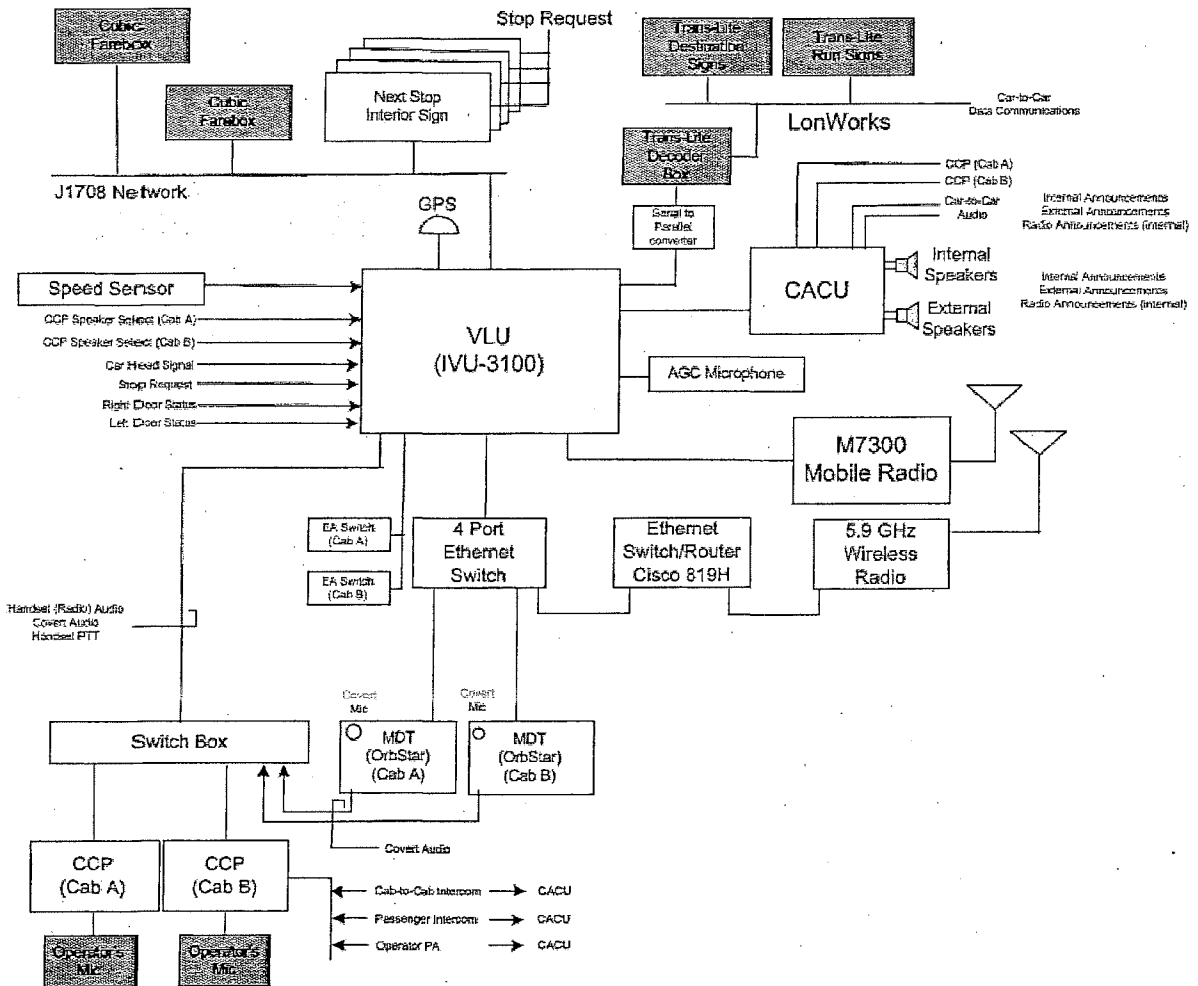
The following cables are part of the On-Board Equipment:

- Cable Assembly Output 1 2/CC 2 3CU 30001 ACAA
- Cable Assembly Input 1/2/3 CC4/5/6 3CU 30004 AAAA
- Cable Assembly Output 3/CC 3 3CU 30000 AGAA
- Cable Assembly FAR 3 4/CC 8 3CU 30001 AEAA
- Cable Assembly IMC 1 2/OP 4/CC 7 3CU 30002 ACAA
- Cable Assembly FAR 1 2/CC 1 3CU 30001 ADAA
- Cable Assembly TWR 1 2/IRU/ACCEL 3CU 30005 ABAA
- Cable Assembly Input 1/CC 9 3CU 30010 ADAA
- Cable Assembly Input 2/CC 10 3CU 30010 AEAA
- Cable Assembly Input 3/CC 11 3CU 30010 AFAA
- Cable Assembly CU IRU I/F 3CU 30014 AAAA
- Cable Assembly EU Power 403-2-00284-AAC
- Cable Assembly EU IRU RX F1 3CU 30081 AGAA
- Cable Assembly EU IRU RX F2 3CU 30081 AHAA
- Cable Assembly TX/RX RS232 EU/CU 3CU 30050 AAAA
- Cable Assembly Power Signal I/F 3CU 30100 ABAA
- Cable Assembly EU/IRU Propulsion 3CU 30052 AAAA
- Cable Assembly RS232 25S/Free End 3CU 30050 BVAA
- Cable Assembly RS232 9P/Free End 3CU 30050 BWAA
- Cable Assembly Power Signal I/F DVAS 3CU 30100 AHAA

REV.	00	MUNI ATCS LRV2 ON-BOARD EQUIPMENT	
			20

5. Radio System


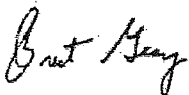
The figure provides a block diagram of the Radio and CAD/AVL System configuration for current LRVs.



Radio-CAD/AVL System Interfaces (Source Harris Contract 1240 Submittal 1-00048A_Interface Control Documentation_CDRL_Rev02)



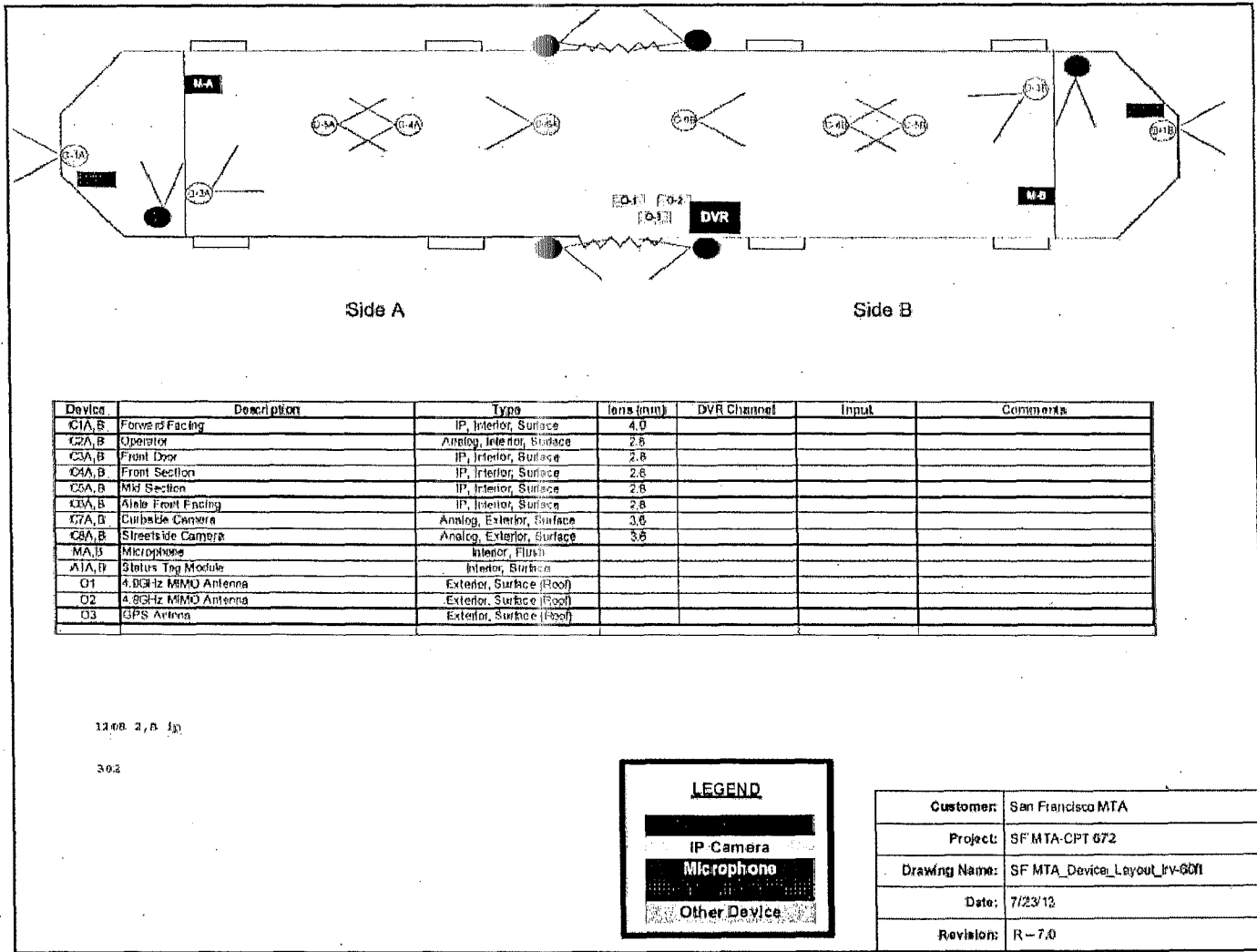
February 28, 2013

Contract title and number: Radio System Replacement Contract No. 1240	
Contractor's name, address, and telephone number: Harris Corporation 33 New Montgomery Street, Ste. 1420 San Francisco, CA, 94105 (415) 869-5500	
Submittal number: 1-00048A_Interface Control Documentation_CDRL_Rev02	
Category: CDRL	Date: 2-26-2013
Subject Identification: CDRL 12-1-05 Interface Control Documentation	
Specification section and subsection numbers: Appendix 12, 00900 Documents	
SFMTA response due: 3-21-2013	
Document Originator: Abhinav Jain, Chris Kardish	Date: 2/15/2013
Engineering Peer Review: Graham Buckberger	Date: 2-26-2013
Design Manager Review/Approval: Daniel Buckley	Date: 2-26-2013
Project Management Peer Review: Sean Munjal	Date: 2-21-2013
Contracts and Compliance Review: Cynthia Bucci	Date: 2-27-2013
Back-check and Verification: Personnel as noted above	Date: 2-28-2013
Contractor's approval stamp: 	Approval signature: 

Upon SFMTA approval of this CDRL, please fill out the below fields.

Action:	Print Name:	SFMTA reviewer's signature:	Date:

Action Column Key - (A - Approved) (B - Conditionally Approved as Noted) (C - Disapproved - Resubmit) (D - Rejected) (N - No Action Required)



Device	Description	Type	lens (mm)	DVR Channel	Input	Comments
C1A, B	Forward Facing	IP, Interior, Surface	4.0			
C2A, B	Operator	Analog, Interior, Surface	2.8			
C3A, B	Front Door	IP, Interior, Surface	2.8			
C4A, B	Front Section	IP, Interior, Surface	2.8			
C5A, B	Mid Section	IP, Interior, Surface	2.8			
C6A, B	Aisle Front Facing	IP, Interior, Surface	2.8			
C7A, B	Curbside Camera	Analog, Exterior, Surface	3.6			
C8A, B	Streetside Camera	Analog, Exterior, Surface	3.6			
M-A, B	Microphone	Interior, Flush				
A1A, B	Status Tag Module	Interior, Surface				
O1	4.8GHz MIMO Antenna	Exterior, Surface (Roof)				
O2	4.8GHz MIMO Antenna	Exterior, Surface (Roof)				
O3	GPS Antenna	Exterior, Surface (Roof)				

12/08 2, 6 1g

302

LEGEND

IP Camera

Microphone

Other Device

Customer:	San Francisco MTA
Project:	SF MTA-CPT 672
Drawing Name:	SF MTA_Device_Layout_1rv-601
Date:	7/23/12
Revision:	R-7.0

6. CCTV Device Layout

APPENDIX B – MATERIALS AND WORKMANSHIP

This section is intended as an example of standard materials and workmanship requirements. It is SFMTA's intention that, at the Proposal stage, each bidder proposes its own criteria, where different, for approval. Upon completion of negotiations with the winning bidder, the agreed content will form Section 19 of the Specification document.

B.1 GENERAL

B.1.1 Standards

1. The latest version of all Standards, Specifications, and documents at the time of Contract Award shall apply.
2. When the Contractor proposes to use a standard other than those specifically applied herein, the Contractor shall submit documentation for SFMTA review and approval demonstrating the proposed standards are the equivalent of the foregoing standards and specifications.
3. Any testing required by this specification to confirm physical properties shall have been performed on materials representative of that used in the construction of this car
4. All finishes shall be vandal resistant and easily cleanable.

B.1.2 Prohibited Materials

1. The following materials are prohibited for use in the construction of these cars, except where specifically permitted:
 - a. PVC
 - b. Asbestos
 - c. Lead in brake shoes
 - d. Urethane Foam
 - e. Cadmium (except for battery)
 - f. Aluminum Threaded Fasteners
 - g. PCB's
 - h. Materials listed in 29 CFR 1910.19

B.1.3 Dissimilar Materials

1. In this context, dissimilar material refers to materials that corrode or otherwise become damaged when in contact with each other.
2. Connection of dissimilar materials is permitted only at permanent connections and with suitable electrochemical isolation. All such isolation treatments shall be permanent and not require maintenance or replacement for the life of the car. As an option, permanent sealing at the contour of the connection may be used in lieu of electrochemical isolation.

3. Dissimilar materials are not permitted at electrical connections or connections requiring disassembly for maintenance or for removal and replacement of equipment.

B.1.4 Safety Reporting Requirements

1. The Contractor shall supply SFMTA with copies of Material Safety Data Sheets for all materials, including lubricants and preparation substances used in the fabrication of the vehicles. Information shall be in a form compliant with ANSI Z400.1-1993.

B.1.5 Requirements for Non-Conforming Material

1. Any Materials found to be non-conforming shall be brought into conformance or destroyed at the Contractor's expense.

B.1.6 Verification of Conformance with Requirements

1. Except where a specific test or inspection is called out in this section, the primary means of verifying conformance with the materials and workmanship requirements given in this section shall be the quality control and quality assurance programs required as part of Section 20 of this specification.

B.2 JOINING AND FASTENING

B.2.1 Applicability

1. The provisions of this section do not apply to welded or bonded joints, for such joints refer to Section B.7 (welded) or Section B.2.3 (bonded).

B.2.2 Joining

B.2.2.1 General

1. Certain combinations of materials require particular care in joining to avoid the possibility of corrosion (refer to Section B.1.3). The contractor shall design the vehicles to minimize the number of such combinations, and to minimize the accumulation of water, cleaning chemicals, and chemicals present in the environment, at or near joints. Isolating, sealing and/or moisture-proofing materials, appropriate to the materials being joined, shall be used at all times where these combinations exist.

B.2.2.2 Joint Fitting

1. Joints shall be properly fitted, whether exposed or concealed.
2. The edges of panels shall have a smooth, finished appearance.
3. Where excessive gaps (greater than those permitted by approved drawings or standards) are found to exist at the faying surfaces of structural bolted or riveted connections, metal shims of the same material as that of the deficient part may be used, but only with the written permission of SFMTA.
4. Shims, if used, in connections requiring disassembly for maintenance or for removal and replacement of equipment, shall be permanently fastened to one of the base parts

being joined. The use of epoxy or other plastic filler at such locations is expressly prohibited.

B.2.2.3 Metal-to-Metal Connections

1. Where metals contact each other, the contact surfaces shall be free of dirt, grease, rust, and scale.
2. Unless specified otherwise, the contact surfaces shall be coated with a metal-based primer which conforms to the latest version specification from the Society for Protective Coatings Specification SSPC-Paint 25, at the time of NTP.
3. Metal primer may be omitted for austenitic stainless steel to austenitic stainless steel joints.

B.2.2.4 Wood-to-Metal Connections

1. The provisions of this Section do not apply to ply metal panels and their installation (refer to Section B.15.2).
2. Where wood and ferrous metal surfaces are placed together:
 - a. the wood shall be coated with aluminum paint conforming to the latest version of Federal Specification TT-P-38, related to aluminum paint.
 - b. the metal shall be coated with a primer which conforms to the latest version from the Society for Protective Coatings Specification SSPC-25 at the time of NTP.
3. All bolts or rods passing through wood shall be coated with aluminum paint conforming to the latest version of Federal Specification TT-P-38 related to aluminum paint at the time of NTP.

B.2.2.5 Wood-to-Wood Connections

1. Where wood and wood are placed together, both abutting surfaces shall be coated with aluminum paint conforming to the latest version of Federal Specification TT-P-38 related to aluminum paint.

B.2.3 Fasteners

B.2.3.1 General

1. The Contractor and suppliers are responsible for selecting fastener types, sizes, styles, lengths, materials, grades, and finishes that shall meet the requirements of this Specification.
2. The Contractor shall minimize the number of different sizes and styles of fasteners used.
3. All fasteners used can be classified under one of four categories: critical; electrical and electronic; decorative; or general purpose. The criteria for classification are expressed below. All fasteners must meet the general requirements for design and material in addition to any requirements contained in the section specific to the particular

category. All fasteners, in any category, which attach to car structure shall be in accordance with Technical Specification.

4. Critical fasteners include, but are not limited to, all fasteners applied to carbody structure, trucks, bolsters, truck-mounted brake equipment, couplers, and power collection devices. Additionally, any fastener is considered critical if failures cannot be tolerated, that is, if even a single fastener fails there is a possibility of brake failure, derailment, accident or injury or equipment falling. In the event of a dispute, SFMTA shall be the final arbitrator on which fasteners are classified as critical.
5. Fasteners used to secure wire terminations to an electrical or electronic device are considered Electrical and Electronic, and are specified in appropriate Materials and Workmanship subsections for electrical devices and wiring.
6. Fasteners used to attach interior lining or trim and exposed to passenger view are specified under Decorative Fasteners.
7. Fasteners not falling into one of the other three categories are classified as General Purpose.

B.2.3.2 Inch-Standard Fasteners

1. All inch-standard threaded fasteners shall conform to ASME B1.1 Standard, Unified Inch Screw Threads, (UN and UNR Thread Form) or Industrial Fasteners Institute "Inch Fastener Standards".

B.2.3.3 Metric Fasteners

1. All metric threaded fasteners shall conform to the latest version of ANSI or (ISO-metric) Standards.
2. For either inch-standard or metric fasteners, all repair and maintenance manuals shall be conspicuously marked on each page which fasteners were used within the unit.
3. Replacement, repair, or maintenance parts supplied under this Specification shall contain all necessary replacement fasteners of the correct size and grade.
4. Metric and inch-standard hardware shall not be mixed within an assembly.

B.2.3.4 Fastener Materials and Coatings

1. When making connections to heat producing apparatus, thermal expansion of the components shall be taken into consideration for selection of fastener materials.
2. All fastener materials and coatings shall be approved by the SFMTA.

B.2.3.5 Joint Design

1. All screws or bolts used to secure access panels to the interior, undercar, or roof equipment shall be made captive to the panel in which they are used.
2. All fasteners used to secure access covers, doors, or panels to equipment boxes or interior panels shall be made captive to the panel in which they are used.
3. Unless otherwise approved by SFMTA, threaded fasteners shall not be threaded directly into non-metallic materials. Metal thread inserts shall be used when a threaded fastener is secured to a non-metallic material.

4. When bolts are used to secure apparatus where the bolt head is not accessible, a reusable mechanical locking device shall be used to prevent the bolt head from turning when the nut is being turned.
5. At least 1-½ screw threads shall be visible beyond all nuts. When used without elastic stop nuts, bolts shall not project more than 1-½ threads plus 0.25-inch for bolts 0.25-inch diameter or less and shall not project more than 8 threads for larger diameter bolts, unless otherwise approved.
6. With elastic stop nuts, bolt threads shall not project more than 0.25-inch, regardless of bolt size.
7. Undercar equipment shall not be supported by bolts in tension.
8. All fasteners shall be torqued to a value appropriate to the application, so that they do not loosen in service. Critical fasteners and general purpose fasteners used to secure equipment to the carbody, including truck and brake equipment bolts and all fasteners exposed to fatigue loads, shall be "torque sealed" or "torque striped" after torquing by paint or other approved means.
9. Locknuts shall be torqued in accordance with their manufacturer's recommendations or the Contractor may conduct tests to determine installation torque.

B.2.3.6 Critical Fasteners

1. All critical fasteners shall have documentation identifying manufacturer and purchase specifications available for examination by SFMTA at the Contractor's QA department.
2. This documentation shall include the fastener material or grade, and finish including plating material and specifications, when applicable. Whether the buyer is a sub-contractor, supplier, or the Contractor, the Contractor shall obtain and hold this documentation for a period of not less than termination of the last car's warranty period. After this period, all documentation shall be provided to SFMTA.
3. All critical fasteners shall be manufactured, tested, and distributed in accordance with ASME FAP-1-1990 or equivalent approved by the SFMTA.
4. Testing of critical fasteners shall be performed using sample quantities as proposed by the Contractor and approved by SFMTA. Tests conducted shall confirm that fastener material meets specified chemistry and strength requirements.
5. The buyer shall obtain certified test results for critical fasteners from the testing laboratory and hold the documents for a period at least until the termination of the warranty period of the last car. After this period, all documentation shall be provided to SFMTA.
6. All critical fasteners that are plated or chemically cleaned shall have certifications showing freedom from hydrogen embrittlement.

B.2.3.7 General Purpose Fasteners

1. As much as possible, Grade 5 bolts and Class A nuts shall be used for installation of equipment and/or structures.

2. Fasteners used within equipment shall meet all requirements of this Section other than the requirements specifically listed for critical fasteners or decorative fasteners, and shall be sized as appropriate for the application.

B.2.3.8 Decorative and Appearance Fasteners

1. All interior fasteners exposed to passengers shall be either bright or finished to match the surfaces being joined, and installed such that the fastener head is flush with the mating surface.
2. Fasteners on access panels, plates, covers, or other components accessible by passengers shall be of a single style tamperproof type approved by SFMTA.

B.2.3.9 Rivet and Bolt Holes

1. Rivet and bolt holes shall be accurately located and aligned, and, when necessary during assembly, holes shall be reamed round to specified size in position. Hand-driven steel rivets shall be driven hot and shall completely fill the holes. Mechanically driven rivets may be driven cold. Heads shall be concentric with the shank of the rivet. Exposed heads shall be free from rings, fins, pits, and burrs. All removed and replaced rivets shall have the holes reamed to the size required such that the next larger rivet may be driven securely.

B.2.3.10 Quarter-Turn Fasteners

1. Quarter-turn fasteners can be used in areas where access is needed to service equipment or perform emergency functions. Quarter-turn fasteners shall have a minimum shank diameter of 1/4-inch, and shall be of adequate strength. All quarter-turn fasteners shall be made captive to the panel in which they are used.

B.2.4 Bonding

1. All adhesive applications shall be suitable for the materials being joined and the environmental exposure to be expected. The Contractor shall submit to SFMTA manufacturer's data for all proposed adhesive applications prior to first use of the adhesive system.

B.3 STAINLESS STEEL

B.3.1 General

1. General requirements for delivery of stainless steel shall be as defined in ASTM A480.
2. In order to avoid difference in appearance, abutting or closely spaced unpainted parts exposed to passengers shall be made of the same grade of stainless steel and shall have matching surface finish, except where the design specifically calls for contrasting appearance.
3. For welded applications, only low carbon stainless steels grades shall be used.
4. Connections of stainless steels to carbon/HSLA steels shall be protected against galvanic corrosion.

B.3.2 Application

B.3.2.1 Austenitic Stainless Steel

1. Austenitic stainless steels used in structural applications shall conform to APTA SS-C&S-004-98 Standard for Austenitic Stainless Steel for Railroad Passenger Equipment.
2. Austenitic stainless steels may be unpainted.

B.3.2.2 Ferritic and Martensitic Stainless Steel

1. Ferritic and martensitic stainless steels shall conform to ASTM A176 and/or A240. Other grades may be used if approved by SFMTA. Structural applications of ferritic and martensitic steels shall be submitted to SFMTA for approval. Depending on application, SFMTA may require proof of ductility and/or crashworthiness of selected base metals and of their welded joints. Details of required tests and acceptance criteria shall be agreed between the supplier and SFMTA.
2. Low-chromium ferritic and martensitic stainless steels, which depending of application may be subject to corrosion, shall be painted.

B.4 HIGH STRENGTH LOW ALLOY STEEL

1. High Strength Low Alloy (HSLA) steel may be used in the carbody structure to the extent defined by the supplier. General requirements for delivery of HSLA steel shall be in conformity with ASTM A6 for plate steel and A568 for sheet steel.
2. Characteristics of selected plate steel shall ensure meeting welded joints impact strength per 19.7.10. Only material with certified impact strength shall be used. Base metal toughness shall be certified on a heat basis by the steel manufacturer or steel supplier; if these data are not available, the Contractor shall perform tests on each heat of as-received base metal.
3. Depending on application of sheet steel, the customer may require proof of ductility and/or crashworthiness of the selected base metal and of its welded joints. Details of required tests and acceptance criteria shall be agreed between the supplier and SFMTA.
4. All HSLA steels shall be primed and painted.

B.5 STRUCTURAL CASTINGS

B.5.1 General

1. The Contractor shall be responsible for selecting casting grade, composition, strength, and finishing. Mechanical properties of steel castings, used in the carbody structure and truck assemblies shall meet or exceed the strength required by the specified application, as determined by the SFMTA.
2. Steel castings used for coupler, drawbars, and anchors shall meet AAR Specification M-201, latest revision, Grade "C" or "E", quenched and tempered.

3. Where cast steel of superior properties is required for a specific application, the Contractor may propose such castings for review and approval of SFMTA.
4. The chemical composition and processing of stainless steel castings must be selected such that the castings shall be able to meet or exceed the strength required by the specified application, as determined by the SFMTA. Stainless steel castings shall be made in accordance with appropriate ASTM standard(s), depending on the type of stainless steel used. Other standards may be used upon SFMTA approval.

B.5.2 Design Qualification of Structural Castings

1. One steel casting, selected by SFMTA from the first lot of production steel castings, shall be subjected to a qualification test of the casting design by the Contractor. A statistical sample of stainless steel castings, as agreed upon by the SFMTA and the Contractor, from the first lot of production stainless steel castings, shall be subjected to a qualification test of the casting design by the Contractor.
2. Qualification tests shall include radiographic examination for material soundness using reference radiographs to ASTM E 446 and any mechanical testing.
3. Acceptance levels for the design qualification radiographic examinations shall be selected by the Contractor as appropriate for the service intended, subject to the approval by SFMTA before any castings are produced. Radiographs shall meet the requirements of ANSI/ASTM E 94 and E 142 for steel castings, and ASTM E 1742 for stainless steel castings, and the quality level in the area of inspection shall be at least two percent (2-2T).
4. Once a design is qualified and accepted by SFMTA, no changes shall be made in the casting pattern, technique, heat treatment, or material composition without requalification in accordance with the requirements of this Section.

B.5.3 Structural Casting Inspection

B.5.3.1 Magnetic Particle Inspection

1. Magnetic particle inspections of all surfaces of each casting shall be conducted, in accordance with ASTM E 709, by personnel certified to MIL-STD-410. With respect to structural castings, including coupler castings, the maximum permissible magnetic particle indications shall be not more than ¼-inch in the direction transverse to the usual direction of loading, and no more than ¾-inch in the direction parallel to the usual direction of loading.
2. For martensitic and ferritic stainless steel castings, acceptance criteria shall be in accordance with ASTM A 903.

B.5.3.2 Radiographic Inspection

1. Radiographic inspection of steel castings shall be conducted according to the requirements of ASTM Standards E 94 and E 142, using reference radiographs to ASTM E 446. Radiographic inspection of stainless steel shall be conducted according to the requirements of ASTM Standards E 94, E 1742 and E 1030. A sampling frequency shall be proposed by the Contractor and submitted for approval by SFMTA.

2. Structural castings shall not exceed severity level 3 of ASTM E 446 in all critical areas of such castings and shall not exceed level 5 in all other areas of the castings. During demonstration that the stated severity level requirements of ASTM E 446 have been met, successively produced castings shall be re-inspected by radiography in the defective areas shown in the prior radiographic inspection. After such severity levels have been proved, the sampling frequency for structural castings shall be one casting out of each 10 produced. If no castings are rejected by radiographic inspection, this frequency may be extended to one casting in 25.

B.5.3.3 Liquid Penetrant Inspection

1. When required for non-magnetic stainless steel castings, liquid penetrant inspections of casting surfaces shall be conducted according to ASTM E 165, by personnel certified to MIL-STD-410. Acceptance criteria shall be established in accordance with ASTM A903.

B.5.4 Repair Welding

1. Repair welding of steel castings is permitted, provided the casting supplier performs all repair welds according to the structural welding requirements of this specification. Repairs or modifications by welding of castings after completion of heat treatment shall require precautions such as preheat or stress-relief heat treatment. Either operation may be applied to the whole part or locally. The temperature of the stress relief treatment shall not be above tempering temperature of the original heat treatment. Manual torch stress relief shall not be permitted except for cosmetic welds and only then after the procedures have been submitted for review and approval.

B.5.5 Cast-Weld Design

1. For cast-weld designs, the entire length of all assembly welds on any welded assembly of several separate castings selected for design qualification shall be radiographically inspected to ANSI/ASTM E 94 and E 142, using reference radiographs from the International Institute of Welding's "Collection of Reference Radiographs of Welds," quality level Green. Portions of assembly welds stressed in tension by service loads shall meet quality level Blue.
2. No repair welding of stainless steel castings is permitted without express written approval of the SFMTA.

B.6 ALUMINUM

B.6.1 General

1. Aluminum alloy mill products shall be identified by Unified Numbering System designations and shall conform to The Aluminum Association specifications contained in the Association's publication "Aluminum Standards and Data".
2. Aluminum alloy castings shall conform to ASTM B26, B85, or B108 for, respectively, sand, die, or permanent mold castings.
3. Aluminum alloy forgings shall conform to ASTM B247.

4. Copies of all test reports for sheet, extrusion, castings, and forgings used in the car structure shall be submitted to SFMTA.

B.6.2 Fabrication and Fastening

1. The forming of aluminum parts; joining of parts by bolting, riveting, and welding; and the protection of contact surfaces shall, as a minimum, conform to the requirements of this specification.
2. Fabrication techniques shall be such that the strength and corrosion resistance of the aluminum shall not be impaired nor the surface finish permanently affected during construction.

B.6.3 Interior Trim

1. Unpainted aluminum used for interior trim shall have a clear (natural) anodic finish. The finish process shall be the Aluminum Company of America's "Alumilite 204" with a minimum coating thickness of 0.0004 in and a minimum coating weight of 21 mg/in², or approved equal.

B.7 WELDING AND BRAZING

B.7.1 General

1. The Contractor shall be responsible for the quality of its welding and brazing as well as that of its suppliers and subcontractors.

B.7.2 Structural Welding

1. All structural welding practices shall be according to the latest requirements (at the time of NTP) of the American Welding Society or International Standards related to the materials submitted and approved by the SFMTA. All Welding will be performed by AWS certified welders, or other recognized international standard, subject to approval of the SFMTA.
2. Structural fusion welding practices, including establishment and qualification of welding procedure specifications, shall be according to the requirements of the following American Welding Society standards:
 - a. AWS D1.1, "Structural Welding Code-Steel".
 - b. AWS D1.2, "Structural Welding Code - Aluminum".
 - c. AWS D1.3, "Structural Welding Code - Sheet Steel".
 - d. AWS D15.1 "Railroad Welding Specification for Cars and Locomotives".
3. Cast steel welding shall be according to AWS D15.1 or ASTM A 488/488M, "Steel Castings, Welding, Qualification of Procedures and Personnel".
4. AWS D1.1 and AWS D15.1 shall apply to steel of 1/8-inch and greater thickness. AWS D1.3 shall apply to steel less than 1/8-inch thickness.
5. Alternative standards may be submitted to SFMTA for approval.

6. Welding procedure specifications and procedure qualification records shall be made available to SFMTA for review.

B.7.3 Welder Qualification

1. Welders shall make only those welds for which they have been qualified according to the requirements of the applicable AWS standards listed in Section B.7.2. Alternative standards may be submitted to SFMTA for approval. Records of welder qualification tests shall be made available for review.

B.7.4 Inspection of Welds

1. The Contractor shall visually inspect all structural welds in accordance with requirements of applicable standards.
2. Nondestructive surface inspection (liquid penetrant or magnetic particle methods, as appropriate) shall also be used to inspect all first-production welds. The Contractor shall specify a nondestructive surface inspection sampling plan for all subsequent welds. A record of all NDT inspections shall be included in the Car History Book.
3. On the first structure, and where practicable, all complete joint penetration welds shall be nondestructively, volumetrically inspected (ultrasonic or radiographic methods) according to requirements of applicable standards. For subsequent welds, the Contractor shall specify a volumetric inspection sampling plan which shall be submitted to SFMTA for approval. The proposed test welds shall be selected from welds that are most critically loaded as determined by calculation or load test. With approval of SFMTA, destructive sectioning and metallographic examination may be substituted for some or all of the required volumetric inspection requirements for production welds.

B.7.5 Post-Weld Cleaning Requirements

1. All welds visible to passengers or on sliding contact surfaces of truck frames and bolsters shall be completely cleaned of spatter.

B.7.6 Dissimilar Metal Welding

1. In dissimilar metal welding, recommended practices of AWS D1.6, Annex I, shall be followed.
2. Galvanized steel shall not be welded to stainless steel.

B.7.7 Resistance Welding

1. Resistance welding practices, including establishment and qualification of welding procedure specifications, shall be according to the requirements of the following American Welding Society standards:
 - a. AWS D17.2 "Specification for Resistance Welding for Aerospace Applications".
 - b. AWS C1.1 "Recommended Practices for Resistance Welding".
 - c. Alternative standards may be submitted to SFMTA for approval.

2. Resistance welds steels shall be according to AWS D17.2, Class B for structural applications and Class C for non-structural applications. All resistance welding procedures shall be qualified per AWS D17.2. Welding procedure specifications and procedure qualification records shall be made available to SFMTA for review. Contractor-proposed deviations from AWS D17.2, including, but not limited to, weld nugget diameter, tension shear strength, and minimum spacing, shall be submitted to SFMTA and approved before application in production.
3. Surface indentation shall not exceed 20 percent of material thickness (t) or 0.01-inch, whichever is greater. However, for exterior resistance-welded areas exposed to passenger view, indentation shall not exceed 10 percent of t or 0.005-inch, whichever is greater. For exposed welds, the Contractor shall vary welding parameters and conditions within their acceptable ranges to minimize indentations. Surface burn and discoloration shall be removed by chemical cleaning, or an approved equal method, and sanding or polishing to match the surrounding surface.
4. Production witness welds shall be made and tested once each day and, in addition, whenever otherwise necessary such as by change in any of the following:
 - a. Operator.
 - b. Material, material thickness, or combination of thicknesses.
 - c. Electrodes.
 - d. Settings.

B.7.8 Resistance Spot Weld Spacing

1. Spacing of resistance and spot welds shall be according to approved structural drawings. Spacing of welds contributing to carbody stiffness shall not exceed 2 inches plus twice the weld nugget diameter for any structural application, including carbody side sheets, roof sheets, and corrugation. For any application to corrugations, if the pitch of the corrugation nodes does not allow the above weld spacing, there shall be two (2) spot welds between each node.

B.7.9 Intermittent Fusion Welds

1. Total length of weld segments in intermittent structural welds shall represent at least 40% of the total joint length.

B.7.10 Toughness of Welded Assemblies

1. In the absence of prior operating history, and if the Contractor's approved design does not require greater toughness, the minimum impact value for Charpy V-notch welded joint specimens tested to AWS D1.1 Code shall be 15 foot-pounds of absorbed energy at -20°F.
2. SFMTA shall have the right to require impact tests to verify the specified toughness. If tests are required, verification of HAZ toughness shall be done on a test sample welded according to Procedure Qualification Record (PQR) parameters.

B.7.11 Torch Brazing

1. All brazing shall follow the recommendations of the AWS Welding Handbook, Volume 2, latest issue. Procedures and personnel who perform brazing work shall be qualified in accordance with AWS B2.2, "Standard for Brazing Procedure and Performance Qualification". Brazing procedures and records of brazing procedure and performance qualification shall be available to the SFMTA.

B.7.12 Torch Soldering

1. All structural (not electrical) soldering shall follow the recommendations of the AWS Welding Handbook, Volume 2, latest issue. Procedures and personnel who perform torch soldering shall be qualified through the preparation and testing of samples of production torch soldering. Soldering procedures and records of soldering procedure and performance qualification shall be available to the SFMTA.

B.8 ELASTOMERS

B.8.1 General

1. Elastomers shall be compounded and cured to perform satisfactorily in the environment specified in Section 2. The elastomers shall have high resistance to ultraviolet radiation, weather, and all SFMTA car washing and other cleaning fluids. All elastomeric parts shall be resistant to ozone, oxidation, heat, oil, grease, and acid, and have the longest possible life consistent with the other characteristics specified.
2. The following elastomeric parts shall be of neoprene and shall have a minimum service life of ten (10) years, unless otherwise specified or approved:
 - a. Glazing Rubber.
 - b. Door Seals.
 - c. Door Nosing.
 - d. Isolation Tapes/Pads.
 - e. Other parts exposed to the outdoor ambient environment, except where otherwise specified.
3. All resilient mounts and elastomeric truck components shall be of natural rubber. Synthetic rubber compounds may be substituted for natural rubber only when approved by SFMTA for a specific application.
4. Elastomeric parts within pneumatic or hydraulic equipment shall be as necessary to meet the performance requirements of this Specification for the pneumatic or hydraulic device.

B.8.2 Life Expectancy

1. All resilient parts shall have a design life no less than the required overhaul period.
2. For all parts made by vulcanizing an elastomer to metal, any premature failure (before the replacement period specified in the maintenance manual) between metal and the elastomer or in the elastomer, occurring when the parts are used in normal service and

according to the provisions of this Specification, shall be considered as having been caused by defect of materials or workmanship.

B.8.3 Bonded Steel Parts

1. Steel parts to which neoprene or other such material is cured shall be made of SAE 1020 or 1045 hot-rolled steel or approved equal, suitable for brass plating after pickling.

B.8.4 Bonding

1. The joining of elastomeric pieces shall be conducted by the hot vulcanization process. Bonding of elastomers by other processes shall not be allowed unless the Contractor submits the application, bonding procedure and bonding agent technical data for approval.

B.8.5 Seals

1. Glazing strips shall be of neoprene conforming to ASTM C 542, or approved equal material.
2. All door mating edges, door and window seals, and glazing strips shall be of neoprene material and shall be free of defects of material and workmanship.

B.9 GLAZING MATERIALS

B.9.1 General

1. Safety glass shall meet the requirements under Item 1, Table 1 of ANSI Z26.1, "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways – Safety Code," or 49 CFR 223 and 238 FRA Type I or II test as appropriate for the application.
2. Windows shall be covered with graffiti-resistant film on the interior after installation.

B.9.2 Flatness

1. When an individual light of glass is laid on a truly flat surface such as a surface plate, the glass shall not indicate a bow of more than 0.030-inch per linear foot in any direction.

B.9.3 Overlap Tolerance

1. The overlap of one laminate of the light with respect to the other at an edge shall not exceed $\frac{1}{32}$ -inch. Corners and burrs shall be ground smooth and all edges shall be treated in accordance with ANSI Z26.1, Section 6.

B.9.4 Tint/Color

1. The color of the glass shall be a tint similar to what is currently used and shall not allow more than 76% transmission of light and 77% transmission of energy or as accepted by SFMTA. When new, there shall be no more than +/- 4 percent variation in

the color of individual lights of laminated sheet glass when examined over a white background.

B.9.5 Haze

1. All the laminates of the safety glass shall be so nearly free from haze that the glass shall have approximately the same clarity as a light of the same nominal thickness of plate glass when viewed against a north light.

B.9.6 Specks and Scratches

1. Occasional specks of foreign material and scratches will be permissible, provided such specks do not exceed 0.020-inch in greatest dimension and scratches do not exceed a total of 3 inches in length, and neither are within the central three-quarters area of the light.

B.9.7 Bond Separation

1. The bond between two sheets of glass and the membrane shall be of such quality that when the glass is broken by twisting or by direct impact, there will be no separation between the glass sheets. Lights that contain unbonded areas shall not be used.

B.9.8 Light Transmission

1. Average visible light transmission through clear safety glass shall be a minimum of 85%.

B.10 FLOOR COVERING

B.10.1 General

1. Floor covering shall be non-staining, non-discoloring and non-slip.
2. If used, rubber flooring material shall be fully homogeneous throughout and shall meet the requirements of ASTM F 1344 or equivalent standard approved by SFMTA.

B.11 PIPING AND TUBING

B.11.1 General

1. All piping shall be sized in accordance with the function intended.
2. All piping, valves, fittings, installation methods and testing shall be in accordance with the latest edition of ANSI B31.1 Pressure Piping or equivalent standard approved by SFMTA.
3. Following installation, all piping systems shall be cleaned to remove dirt, metal chips, oily contamination, and moisture. After cleaning, all piping systems shall be pressure tested in accordance with the latest edition of the Code for Pressure Piping, ANSI B31.1 or equivalent standard approved by SFMTA. All leaks shall be repaired and the system retested until leak free.

4. At all locations where pipe or tubing passes through holes in the floor, bulkheads, structure, or any fixed member, it shall be rigidly clamped to protect against possible damage or noise due to bearing, abrasion, or car dynamics-induced rattling. Clamps shall not be welded, brazed or otherwise permanently fastened to any pipe or tubing.
5. Wherever carbody piping interfaces with vibration-isolated rotating equipment such as the air compressor and air conditioning compressor-condenser unit, approved flexible vibration eliminators shall be used. All clamps shall be of a suitable material for the application.

B.11.2 Air Piping, Tubing, and Fittings

1. All air piping shall be installed in a manner to provide drainage away from devices, or branch pipes leading to devices, when the function of those devices could be impaired by the accumulation of water or ice.

B.11.3 Air Conditioning System Piping and Fittings

1. Air conditioning refrigerant lines and condensate drain lines shall be type "K", seamless copper tubing with wrought copper sweat type fittings. Finned tubing in evaporators and condensers need not be type "K". Tubing shall be bent with an appropriate tube bending tool.
2. All condensate drain lines and suction line piping shall be insulated with an approved insulation that meets the smoke and flammability requirements of this section. The liquid line shall be insulated in all areas where required to provide additional mechanical or thermal protection. The insulating material shall be applied to the piping with a suitable contact cement. All joints and directional changes in the insulation shall be appropriately mitered and sealed with an approved material.
3. All piping shall be deburred after cutting and thoroughly cleaned after installation in accordance with this section. All piping and pipe sub assemblies shall be cleaned, dried (if required) and capped on all openings after fabrication. Caps shall remain in place until immediately prior to incorporation into the final assembly.

B.11.4 Brazing and Soldering of Piping and Fittings

1. All refrigerant and air system copper piping shall be joined using silver-based or silver-copper-phosphorus filler metals conforming to the AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding, classifications BAg-5 or BCuP-5, or equivalent filler metals approved by SFMTA. During brazing, inner side of refrigeration tubing shall be protected with a continuous flow of an inert gas such as dry nitrogen.
2. Condensate drain tubing and air piping shall be joined using 95-5 solder or silver-based filler metal as above.
3. After fabrication, the system shall be cleared of all dirt and foreign matter, evacuated, dried and charged according to an approved procedure.
4. Brazed and soldered joints shall be wiped and have flux cleaned.

B.11.5 Pressure Vessels

1. All pressure vessels shall conform to the latest revision of Section VIII of the ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels or equivalent standard approved by SFMTA. Reports shall be provided demonstrating compliance.

B.12 AIR FILTERS

B.12.1 High Pressure Air Filters

1. Air filter assemblies with replaceable filter elements shall be provided in the air line that connects each subsystem to the air supply system. The filtering capability, flow rate capability, and overall size shall be appropriate for the application.

B.13 PAINTS AND COATINGS

B.13.1 General

1. The portion of the car body, or any of its components, receiving paint shall be painted as required by the Specification and in accordance with the specified color scheme and procedures recommended by the paint manufacturer for the application. The Contractor and its paint supplier shall supply a touch-up procedure and assure that a continuing supply of touch-up paints in colors used on the car, suitable for spot application by spray or brush, will continue to be available.

B.13.2 Materials and Preparation

1. Preparation of the substrate surface and application of painting materials shall be in accordance with the paint supplier's recommendations. All paint materials shall be used at the consistency recommended by the paint supplier. If thinners are necessary, they shall be approved by the paint manufacturer and shall be used only to the extent recommended.
2. The supplier shall submit color samples for approval.

B.13.3 Underfloor Paint

1. All undercar metallic parts, except stainless steel, which may be left unpainted in accordance with this specification, shall receive an epoxy finish or equivalent approved by the SFMTA.

B.13.4 Exterior Finish Painting

1. All exterior surfaces that are to be painted shall be prepared and the paint shall be applied according to the paint manufacturer's recommendations. The paint shall be uniformly applied over all surfaces to be covered and shall be free from runs, sags, or other application defects. Painting shall be done in a clean, dry atmosphere at an ambient temperature as recommended by the paint manufacturer.
2. Before painting any car surface that is exposed to view, all dents, gashes, nicks, roughness, or other surface imperfections or depressions shall be removed so far as

possible by straightening and shall be properly prepared to receive the filler material. These surfaces shall be properly cleaned and wash primed following straightening. Any remaining dents or other surface imperfections shall then be filled with an approved filler and sanded smooth.

3. The finished exterior shall present a high quality appearance free from sags, drips, scratches, variations in gloss, and other imperfections.

B.13.5 Apparatus and Equipment Enclosures

1. All underfloor and roof mounted apparatus and equipment enclosures (motors, control boxes, junction boxes, brake valves, and other equipment as specified) shall be primed and painted.
2. The interior and exterior surface of all propulsion control equipment enclosures shall be coated with an insulating paint system. The interior of the boxes, including insides of covers, shall be white and the exteriors shall match the surrounding paint scheme.

B.13.6 Miscellaneous Painting and Finishing

1. Exterior stainless steel shall be cleaned with an approved alkaline cleaning solution, which shall not damage any previously painted surfaces. Other than framing structures, all hidden aluminum or ferrous materials, except stainless steel, shall be given 1 coat of a primer and 1 coat of an approved sealer.

B.13.7 Painting Restrictions

1. Any equipment or parts of equipment which would be damaged or suffer impaired operation from painting shall not be painted and shall be corrosion resistant.
2. The following undercar items shall not be painted:
 - a. Flexible conduit and fittings.
 - b. Copper tubing, piping and fittings.
 - c. Wire and cable.
 - d. Power resistors.
 - e. Heat transfer surfaces.
 - f. Electrical insulators.
 - g. Elastomeric parts.
 - h. Grounding pads.
3. The following truck-related items shall not be painted:
 - a. Elastomeric parts.
 - b. Grease fittings.
 - c. Linkages.
 - d. Threaded parts used for adjustments.
 - e. Electrical equipment.
 - f. Current pick-up devices.

- g. Wearing surfaces.
- h. Grounding pads.
- i. Wire and cable.

B.13.8 Interior Painting

1. Interior surfaces requiring paint shall be painted in accordance with the recommendations of the paint manufacturer.

B.13.9 Corrosion Protection

1. Concealed surfaces which may be subject to corrosion such as open-section beams of the structure frame shall be properly cleaned, receive a wash primer, then primed with an epoxy paint or equivalent approved by SFMTA.
2. Where arc welding is performed on joints between stainless steel and other materials, the joint shall be painted in accordance with this Section.

B.13.10 Acoustic Insulation

1. Acoustic insulating materials shall be applied to properly cleaned and primed underframe, sides, ends, roof and floor members, as required in accordance with the supplier's recommendations. The materials shall be resistant to dilute acids, alcohols, grease, gasoline, aliphatic oils and vermin and shall meet the smoke and flammability requirements.
2. The material shall be unaffected by sunlight and ozone and shall not become brittle with age.

B.13.11 Truck Painting

1. All truck components to be painted shall be given a full coat of primer prior to assembly.

B.13.12 Lettering and Numbering

1. Lettering and numbering shall be applied to the interior and exterior of the car by means of decals approved by the SFMTA. Decals shall be applied and edge sealed in accordance with manufacturers' recommendations.
2. All decals shall be formulated and applied such that removal does not damage the underlying paint or surface.

B.14 FLAMMABILITY AND SMOKE EMISSION REQUIREMENTS

B.14.1 General

1. All combustible material used in the construction of the car shall satisfy the flammability, smoke emission, and toxicity requirements, NFPA 130 or a standard approved by the SFMTA. A report of all materials used and a Smoke, Flame, and Toxicity Matrix shall be submitted to SFMTA for acceptance.

B.14.2 Toxicity

1. Those materials and products generally recognized to have highly toxic products of combustion shall not be used.

B.14.3 Electrical Fire Safety

1. Electrical equipment, wiring and apparatus shall conform to NFPA 130, Section 8, except where more restrictive requirements are imposed by this Technical Specification.

B.15 WOOD AND PANELS

B.15.1 Lumber

1. The use of wood in the car shall be limited to specifically approved applications.

B.15.2 Plymetal

1. The term “plymetal” as used in this Specification covers metal-faced plywood. All plymetal panels shall conform to following requirements:

Table 0-1 1 Plymetal Specifications

Test Conditions	Minimum Metal to Wood Average Shear Value (or 80% Wood Failure)
Dry shear	250 psi
Boil shear, 3 h boil, tested wet at room temperature	150 psi
Soak shear, 48 h soak wet at room temperature	150 psi
Creep or cold flow, under static load for 48 h, at room temperature	250 psi

2. In fabrication of melamine-faced plymetal panels with aluminum sheets, melamine shall be applied onto the sheet before it is laminated to the plywood core. Aluminum sheets and their fabrication shall conform to 19.15.6.

B.15.3 Plywood

1. All plywood shall be manufactured to conform with the requirements of Grade Structural I of the National Institute of Standards and Technology / APA-Engineered

Wood Association Voluntary Product Standard PS 1-95 or equivalent standard approved by SFMTA, and then stored under cover. Scarf or finger jointed panels shall not be allowed. All plywood shall be sealed with two coats of an epoxy paint on all edges and cutouts as soon as possible after fabrication. All exposed edges of panels, joints between panels, fastener heads, and openings of panels used in areas accessible to moisture shall be water-proofed and sealed with an approved coating.

B.15.4 Honeycomb Panels

1. The term "honeycomb panels" as used in this Specification refers to an assembly of honeycomb material bonded to melamine-faced metal panels or to metal panels. The materials selected for the construction of honeycomb panels shall be appropriate for the intended application and environment.
2. All "honeycomb" panels are subject to SFMTA approval.

B.15.5 Panel Contour Tolerance

1. Surfaces exposed to passengers shall not deviate from the specified contour by more than $\frac{3}{32}$ -inch any 36-inch distance. The slope of any such deviation shall not exceed $\frac{3}{32}$ inches in 12 inches.

B.15.6 Melamine Faced Aluminum

1. Melamine faced aluminum panels shall be appropriate for the intended application and environment and subject to SFMTA approval.

B.15.7 Melamine Panels

1. Unbacked melamine panels may be used in the vehicle interior. The panels shall be appropriate for the intended application and environment and subject to SFMTA approval.

B.15.8 Phenolic Composite Floor Panels

1. Phenolic composite floor panels shall withstand the requirements of the intended application and environment with no visible or audible indications of delamination of the panel skin from the core, and permanent deformation of the top surface.
2. There shall be no puncture or damage to fibers of the top surface of Phenolic Composite Floor Panels.
3. There shall be no separation of any internal core from the top or bottom skin of Phenolic Composite Floor Panels.
4. There shall be no fracture of the core of Phenolic Composite Floor Panels.

B.16 FIBERGLASS REINFORCED PLASTIC

B.16.1 General

1. Fiberglass-reinforced plastic (FRP) shall be a laminated material, consisting of a gel coated surface and a combination of reinforced fibers in a thermoset polymer resin

matrix, where the reinforcement has an aspect ratio that enables the transfer of load between fibers, and the fibers are chemically bonded to the resin.

2. FRP shall withstand the requirements of the intended application and environment without any physical deformation or structural damage.

B.16.2 Resin

1. Resin shall be of good commercial grade, thermosetting, polyester, phenolic, vinyl-ester or acrylic material.

B.16.3 Reinforcement

1. The fiberglass reinforcement shall be mat, fabric, woven roving, continuous roving, spun roving, or swirl mat.
2. The proposed glass content shall be a minimum 20% by weight.

B.16.4 Gel Coat

1. A gel coat shall be provided on all finished surfaces of FRP. The gel coat shall be resistant to scuffing, fire, weather, and cleaning agents.
2. If the surface of the FRP panel is to be painted, a primer gel coat shall be used and the part shall be painted in accordance with Section B.13. If the FRP panel does not receive paint, then the gel coat shall be pigmented to match the color scheme selected by SFMTA.
3. Finished gel coated surfaces shall exhibit no print through of the reinforcements or have any appreciable orange peel.

B.16.5 Additives

1. Antimony trioxide is prohibited as a component.

B.17 THERMOPLASTIC SHEET

B.17.1 General

1. Thermoplastic sheet shall withstand the requirements of the intended application and environment without physical deformation or structural damage and shall be resistant to all recommended cleaning solutions. Thermoplastic sheet shall be used as extruded or vacuum-formed and shall not contain plasticizers in polymer blend.
2. Thermoplastic sheet shall be homogeneous and extruded from virgin stock which does not include any regrind of vacuum formed parts. The exposed surface of this material shall conform to the color, texture, and gloss characteristics of the approved color scheme. Only UV stabilized pigments shall be used to create the specified color of the thermoplastic sheet.
3. Finished parts shall be free of waves and quilting on both sides. Degraded polymer in the sheet shall not be allowed, and if present, shall be cause for rejection of the piece. Voids, lumps, and contamination shall also be cause for rejection of parts if the defects

are larger than 0.010-in, and the population of these defects is greater than 1 defect in 4 ft².

B.18 SEAT CUSHION MATERIAL

1. Seat cushion fill material shall be low-smoke flexible foam constructed of inherently fire-retardant materials.
2. The cushion fill material shall have a polymerized or vulcanized homogeneous (free from foreign material), cellular structure with a porous surface and open cells.
3. The cushion fill cells shall be interconnecting and uniform in size. Cellular material may be molded in one piece or may be assembled by laminating to achieve the required thickness. Laminated cushions shall be bonded together.
4. Cushion material shall be properly cured to prevent any objectionable odor.

B.19 SEAT UPHOLSTERY MATERIAL

1. Fabrics used for seat upholstery shall be made of woven, transportation grade fabrics. The maximum fabric shrinkage shall be two percent in either the warp or fill direction.

B.20 WIRE AND CABLE

B.20.1 General

1. The Contractor's design and construction shall ensure that the minimum number of wire types and sizes shall be used in the vehicle.
2. Selection of wire sizes and insulations shall be based on the current-carrying capacity, voltage drop, mechanical strength, temperature, and flexibility requirements in accordance with applicable APTA, ICEA, ASTM, NEC, and MIL Specifications. Extra-fine wire stranding shall be utilized on applications subject to repetitive motion.

B.20.2 Conductors

1. Conductors for irradiated, cross-linked polyolefin wire shall be soft, annealed tinned copper.
2. The use of solid wire shall not be permitted except for approved wire wrap applications.
3. Wiring shall be sized for the intended load, voltage drop, installation method, and applicable codes. Wire sizes shall be in accordance with APTA-RP-E-009-98, "Recommended Practice for Wire Used on Passenger Equipment". When the free air rating is used, the Contractor shall furnish data to show that the cables will not exceed their rated temperature at the rated current. Wire ampacities shall be de-rated to meet the temperature requirements of all devices to which the wire connects. When short-time ratings, short-time overload temperatures, and thermal time constants are used to determine cable size, the parameters used shall be submitted for approval.
4. SFMTA may approve smaller wire sizes for selected applications upon submission of appropriate applicable data for justification.

B.20.3 Insulation

B.20.3.1 General Wiring Insulation

1. For all general car body wiring, the insulation shall be a flame retardant, flexible, irradiated cross-linked polyolefin material having a continuous temperature rating of 230°F. The insulation shall be rated at 2000 volts, ac and dc, in the case of wires carrying a nominal voltage greater than 150 volts ac or dc, and rated at 600 volts, ac and dc, in the case of wires carrying a nominal voltage of 150 volts or less, ac or dc. For wire sizes AWG No. 6 and larger, the insulation material shall be formulated for extra flexibility.
2. Cross-linked polyolefin insulation shall not be permitted for use on wires connected to heater elements or any other high-temperature device.

B.20.3.2 Wire Insulation for High Temperature Applications

1. Teflon, mineral-filled, abrasion-resistant insulation may be used on wire sizes AWG No. 12 to AWG No. 28. Otherwise, high temperature insulation shall be used where wiring is connected to heat-generating apparatus, where the ambient temperature can exceed 257°F, or where Teflon is specified as a requirement. The insulation shall be rated at 1,000 volts, ac and dc, in the case of wires carrying a nominal voltage greater than 150 volts, ac or dc, and rated at 600 volts, ac and dc, in the case of wires carrying a nominal voltage equal to or less than 150 volts, ac or dc. The insulation shall have a continuous temperature rating of 302°F or greater and shall be in accordance with the following requirements:
 - a. For wire sizes AWG No. 16 and larger: abrasion resistant Teflon (Polytetrafluorethylene – PTFE) meeting MIL-W-22759/6B or 10B, as appropriate for the voltage level used, or silicone rubber meeting AAR RP-587C. Conductors for high temperature wire AWG No. 12 and smaller shall be soft, annealed nickel-plated copper constructed in accordance with MIL-W-22759/6B.
 - b. For wire sizes AWG No. 18 and smaller: abrasion resistant Teflon (PTFE) meeting MIL-W-22759/6B or 10B, as appropriate. When used for interconnecting of apparatus, this type wire shall be in bundles with a protective covering of high temperature-rated, low smoke-generating insulation.
2. For the wire insulation for high temperature applications, the Contractor shall propose insulated wire that meets the requirements of the intended application and environment and submits specifications for approval. The specific high temperature application shall include the design ambient temperature, routing, rms ampere value, worst-case ampere value, worst-case temperature rise, stranding, and insulation material.

B.20.4 Multi-Conductor Cables

B.20.4.1 General

1. Multi-conductor cables shall be constructed using wiring as described above. All conductors in multi-conductor cables shall be color coded or otherwise permanently identified as approved. Materials used in the construction of multi-conductor cables shall meet the requirements below.
2. For multi-conductor cables carrying low-voltage, high-speed, serial data, exceptions to the wiring requirements may be submitted for approval, based upon availability of wire to meet the application requirements.

B.20.4.2 Fillers

1. Where required to obtain a circular cross-section, fillers shall be used of materials compatible with the wire insulation and jacket and shall be of the same or of a higher temperature rating than the wire insulation.

B.20.4.3 Tape

1. A binder tape may be employed over the assembly of conductors in multi-conductor cables if needed to assist in cable manufacture, or as required to permit the cable to function as intended in its application. The binder tape material shall be of the same (or better) temperature class as the wire insulation, and shall be of a compatible material.

B.20.4.4 Shield

1. The shield, if required, shall consist of either copper braid, concentrically served copper, or aluminum/polyester tape with a drain wire, as is appropriate for the application.

B.20.4.5 Jackets

1. The overall jacket of multiconductor cables shall be of flame retardant, cross-linked, modified polyolefin, ETFE Tefzel, or TFE Teflon to match the wire insulation and application as approved. The coupler cable shall have a jacket of low temperature arctic grade neoprene per MIL-C-13777, with a wall thickness suitable for 600 volts. The jacket shall be extruded and vulcanized over the cabled conductors, and shall be well centered, with a smooth appearance without objectionable roughness or irregularities, consistent with good industry practice.

B.21 WIRING INSTALLATION

B.21.1 General

1. All car wiring shall be in conformance with APTA RP-E-002-98, "Recommended Practice for Wiring of Passenger Equipment," and the AAR Manual of Standards, Section F S-538, "Wiring Practice and Rolling Stock Standard", except where

otherwise specified, and except that all wire shall be as required in this Specification. Circuit protection shall be in conformance with Chapter 2 of NFPA 70, Article 240.

2. All equipment enclosures and junction boxes, except primary power circuits, shall be fitted with terminal boards or connectors. Primary power circuits shall be fitted with compression terminals and knuckle joint connectors as described herein.
3. All wire passages into equipment enclosures junction boxes, equipment boxes shall be protected and support to prevent any damage from chaffing and rubbing on surfaces.

B.21.2 Wire Handling

1. All wiring shall be performed by qualified, experienced wiring personnel using appropriate tools for stripping insulation, cutting, tinning, soldering, harness making, attaching terminals, and other wire fabrication tasks. All wiring tools and equipment shall be used as recommended by the tool and equipment manufacturer.
2. Wire shall be protected from damage during all phases of equipment manufacture. Wire shall not be walked on, dragged across sharp or abrasive objects, kinked or twisted, or otherwise mishandled. The ends of wire shall not be permitted to lay on wet floors or other damp areas where moisture may be absorbed into the conductors.
3. When removing insulation care shall be taken to avoid nicking or breaking wire strands.
4. Longitudinal scratches in a copper strand are not considered cause for rejection.

B.21.3 Wiring Layout and Installation

B.21.3.1 Circuit Separation

1. Circuits shall be physically separated to reduce the possibility of unsafe conditions, interference, or equipment damage.
2. The following major circuit groups shall not be harnessed or bundled together, shall not run in the same conduit, and shall be physically separated and secured in enclosures, wire ducts, junction boxes, or other wire routing devices:
 - a. High voltage circuits,
 - b. AC circuits,
 - c. Communication circuits,
 - d. Battery voltage level circuits,
 - e. Semiconductor gating voltage level circuits, and
 - f. Conductors carrying in excess of 100 Amperes.
3. Wires which are connected in circuits with potentials differing by 50 Volts or more shall be separated by a physical barrier. The wires shall not be cabled together and shall not be placed in the same conduit, junction box, or enclosure. Where a raceway, duct, junction box or enclosure is divided into two or more distinct areas by metallic partitions, each area may be considered separately in the application of this rule.
4. Where it is impossible to avoid having wires at different voltages in the same equipment enclosure, the wires shall be physically separated, bundled, and secured

separately such that contact between wiring is not possible. All wiring within an enclosure shall be insulated for the highest voltage in the enclosure, unless approved otherwise. All wiring connected to a piece of apparatus shall be insulated for the highest voltage connected. Wiring connected to transient-generating apparatus, such as unsuppressed contactor coils, shall not be run adjacent to wiring carrying signals to, from, or between semiconductor circuits, logic circuits, vital no-motion circuits, or communication circuits. In cases in which adequate physical separation is impossible, shielded wire shall be used for all conductors involved.

B.21.3.2 Wire and Cable Runs

1. Wire runs shall be continuous and unbroken between connection points, shall be supported at no greater than 2 foot spacing, and be protected at each support point against mechanical crushing and abrasion. A watertight bushing and drip loop shall be provided on all exposed cable entries. All cable bundles and wires shall be routed a minimum of 1 inch above the bottom of equipment enclosures.
2. All undercar wiring smaller than AWG No. 6 shall be run in closed wire ducts, conduits, or open wire mesh wireways in an approved manner. Wire and cable shall be secured within ducts or open wireways, including each entrance and exit point, to prevent chafing movement. Wire ducts and conduits shall be of waterproof construction. Permanently retained watertight strain relief bushings, with insulated throat liners, of an approved design, shall be used at locations where wires, cables or harnesses enter or exit conduit, ducts, apparatus and equipment enclosures. In addition, strain relief bushings on equipment enclosures shall include a permanently retained O-ring type seal.
3. Lead wires to resiliently-mounted electrical apparatus shall be carried in conduit to a point as close to the apparatus as possible. The length of the leads between the end of the conduit and each piece of apparatus shall be as approved. Short runs of cables or harnesses entering or leaving conduit and apparatus shall have an approved guard mounted to the car body to protect the wires from mechanical damage. Lead wires to solidly-mounted, electrical apparatus and equipment enclosures shall run in conduit connected to the apparatus or enclosure.
4. All wiring routed from enclosed areas of the carbody to areas exposed to the elements (including underframe and roof areas) or between interior levels shall be run in ducts or conduit. Wiring, even if enclosed in loom, must not be run through partitions without suitable bushings being provided at such points of passage.
5. Cables shall be laid in place with sufficient slack at the bends so that cables shall clear the inside bend surface of the wireway/wire duct.
6. All wire and cable shall be free of kinks, insulation damage, insulation abrasions, and nicked strands. Wire installation shall not be subject to accumulations of water, oil, or other foreign matter.
7. Wires or cables shall not pass through or over the battery compartment and shall not pass over heat generating equipment such as acceleration and braking resistors, even if the wires or cables are in conduit.

8. Exposed harnesses, short cable runs or harness entering or leaving exposed raceways shall have approved, fire-resistant flexible dielectric sleeving over the raceway edges and grommet-type insulation of any penetration holes. Wiring shall be retained to the sleeving with tie-wraps.

B.21.3.3 Cable Cleating and Support

1. All cable and wiring exiting wireways/wire ducts, or that which is not installed in conduit, shall be cleated. In no case shall nylon wire ties be used as the means of supporting the weight of wire bundles and cables. Cables shall be cleated and bushed when passing through bulkheads and structural members. The Contractor shall minimize the quantity of different configuration cable cleats.
2. AWG No. 6 or larger insulated wire may be cleated in place without conduit, duct or open wireway. However, in the areas over the truck, in the wheel wash and not protected by underfloor-mounted equipment, the wire shall be mechanically protected by an open mesh, expanded metal or other type of approved guard. The guard may be attached to the bottom of each cleat with the cleat clamping bolts or other approved arrangement.
3. Cleats shall grip each cable individually and firmly, but without causing any damage to cable insulation, including cold flow of the insulation. Each cable in the cleat shall have its own cutout sized to the correct wire diameter. The cleat openings shall be chamfered to 45 degrees. Cleated cables shall be routed and supported such that they cannot, under any combination of forces and car movement, touch each other or any other part of the car, except the cleat cushioning material.
4. Wire and cable runs shall be continuous and unbroken between terminations and shall be supported at not greater than 24-inch intervals in ducts, open wireways or when cleated. The wire shall be protected at each support point against mechanical crushing and abrasion.
5. Concealed wires, such as within conduits and wire ducts, shall be such that wires may be replaced or added to without the removal of other than access panels. It shall not be necessary to disconnect or disassemble conduit to accomplish this task.
6. Wiring run in loom shall not be carried over a potential chafing hazard. Wires entering any removable box shall be harnessed and secured to facilitate removal of the box.
7. All wires and cables shall be fully protected against any contact with any surface other than that designed specifically to support or protect them. This applies to all current carrying wires, cables or buses on the vehicle.

B.21.3.4 Wire Securement and Termination

1. All wiring shall be secured and protected against movement, chafing, and any contact with conductive, sharp, or abrasive objects including the inside surfaces of wire runs.
2. All wiring shall be located and secured such that normal equipment motions, maintenance access, heat sources, and the environment do not damage or reduce the life of the wiring.

3. Junction boxes, with terminal boards, shall be used, as required, for wire terminations. Exterior junction boxes shall be weather tight.
4. Wire and cable dress shall allow for sufficient slack at equipment terminals to provide for movements induced by shock and vibration, equipment shifting, alignment, cover removal and component replacement. Sufficient lengths shall be provided at points of termination for additional re-terminations without applying tension to the wire and without splicing the wire, as follows:
 - a. AWG No. 10 and smaller - Three re-terminations
 - b. AWG No. 8 and larger - Two re-terminations
 - c. A drip loop shall be provided on all exposed wires and cables to prevent fluid runoff into connected equipment.
5. Spare wires, which are part of a wire harness, shall be bundled separately inside of the equipment box to which the harness is being terminated. Spare wires shall have enough length to reach any location within the box, including sufficient slack for the required number of re-terminations. The spare wire "break-out" bundle may be ty-wrapped to the main harness, but shall be easily removed from the main harness without disassembling it. The ends of the spare wires shall be insulated against inadvertent contact with any nearby conductive surfaces or terminals.
6. Wire tying devices shall be of such material and construction that they shall adequately retain the wires for the life of the wiring and shall be resistant to ozone and ultraviolet light. Wire and cable ties shall be trimmed and located to eliminate any hazard to personnel from sharp edges. Wire tying devices shall be snug, but shall not be so tight as to cause indentation and cold flow damage to the insulation. Wire tying devices shall be mechanically fastened to a permanent structure. Adhesive-installed mounting bases shall not be used for ties or for cable support.
7. All wire bundles and cables within an enclosure shall be supported by the use of tape rails, shall be spaced away from the equipment box structure, metal edges, bolt heads, and other interference points, and shall have electrical clearance from the covers, regardless of the insulation properties of covers. Wire bundles shall be located above or alongside the apparatus rather than at the bottom of the box wherever possible. In all cases, wire shall be a minimum of 1 inch above the bottom of the box, unless otherwise approved by SFMTA. Wire entry into control or junction boxes shall not be permitted through the bottom of the box.
8. All jumpers, jumper heads, and jumper receptacles shall be sealed in an approved manner to prevent the entry of water at any operational speed of the car.
9. Any wiring needed to calibrate and test car functions shall be a part of the permanent car wiring to enable SFMTA to conveniently maintain the equipment. This wiring shall terminate in connectors in the respective control groups and cabinets.
10. Wire and cables that are subject to high currents in fault conditions or normal operation must be secured against secondary damage due to the high magnetic forces that are developed. Propulsion inverter circuits are a typical example. This includes damage to bus bars or devices to which the cables terminate.

B.21.3.5 Circuit Shielding

1. Wire shields used in trainline circuits shall be continuous up to the car's electrical coupler contacts, including contacts of the jumper cable connector at the intermediate couplers. The wire shields shall be connected through all applicable connectors and junction boxes. Circuits shall be categorized. Shields contained in one circuit category shall not be interconnected with shields contained in another category. Shields used to protect against interference shall not carry signal current.
2. Shields on low-level signal wires shall not be interconnected with shields on high-level signal wires in the same category. Each group of shields (other than at the electric couplers, including the jumper cable connectors at the intermediate coupler) shall be carried through on a connector pin or pins, or on terminal strips which shall be in the immediate proximity of the categorized group of circuits. Loops due to interconnections of shields shall not be permitted.
3. Coaxial cables used as constant impedance transmission lines shall be terminated as dictated by the circuit termination design and shall not be considered to be shielded conductors. Tri-axial cables may be used as coaxial impedance transmission lines with the outer conductor employed as an RF shield.

B.21.4 Marking and Designation

1. The Contractor shall devise a wire and terminal marking and designation system that shall coordinate all electrical circuits in the car into a unified system. The system shall identify all wiring, including circuit return wiring, and terminals according to their respective circuit function(s) and shall accurately correlate these designations with the car schematic diagrams. Each circuit shall be individually designated from point to point. Common designations for return circuits are not permitted.
2. Each wire and cable shall be permanently and legibly marked along its entire length on the outer surface, the manufacturer's identification, conductor size, temperature rating, and voltage rating. For wire size 1/0 and larger, stranding shall be given in addition to the other parameters. A circuit designation shall remain unchanged when it goes through a terminal strip or junction box stud regardless of how many wires of that circuit are common to that point. A Wiring Plan shall be submitted for SFMTA acceptance and include documentation for provisional spare wiring.
3. Wires in multiple-conductor cables shall be color-coded.
4. Wire markers shall meet the adherence and solvent resistance requirements as specified by MIL-M-81531 Sections 3.4.2 and 3.4.3, and shall withstand all combinations of ambient and equipment temperatures. Hand printing is prohibited.

B.21.5 Pulling Compound

1. Pulling compound shall be non-conductive, non-hygroscopic, non-odorous, shall not support bacterial activity, and shall not attract vermin.

B.21.6 Solder

1. Solder shall be in accordance with ASTM B32, Grade Sn60. A flux of non-corrosive type shall be applied immediately before soldering.

B.21.7 Primary Power Wiring

1. The primary power feed shall be installed without taps or splices from the High Speed Circuit Breaker (HSCB) directly to the primary power switch. This wire shall be run in a conduit containing no other wiring.
2. Primary power wiring installed within the car body shall be run in conduit or wireways. Conduits or ducts that penetrate the car body shall be terminated in a waterproof entrance box or with a waterproof fitting. Primary power wiring, except for heater wiring, shall not terminate within the car body.

B.21.8 Articulation Connections (if equipped)

1. Flexible hoses, wiring and cabling routed across the articulation shall be run in ducting with non-conductive inserts. The routing shall minimize excess length and unnecessary flexing. All primary power wiring shall be run on the vehicle roof. Low voltage wiring may be run below or above the floor line, or on the roof.
2. Quick disconnect cable connectors shall be provided for low voltage circuits and high voltage circuits on both sides of the articulation. The quick disconnect arrangement shall be: A bracket on both A and B car ends holding bulkhead connectors, located as either as close to the centerline as possible or on the sides to allow cables to droop between the bellows and car enclosure. A quick disconnect connector shall be provided on both ends of the jumper cables. A cable clamping arrangement shall be provided to protect the cable motion from placing stress on the connectors.

B.22 WIRING CONNECTIONS

B.22.1 Terminal Boards & Terminal Points

1. As used in this document, the term "terminal board" refers to all devices commonly called terminal blocks, terminal strips, terminal studs, or similar items to which wires are connected.
2. Each terminal board shall have a minimum of 10%, but no fewer than one, unused terminals. For terminal boards with more than 100 terminals, the minimum number of unused terminals shall be 10 plus 2 for every 50 additional terminals above 100. Jumpers between adjacent terminals shall be plated brass or copper.
3. The terminal board insulation shall be a strong, high temperature rated, tracking resistant material that is not brittle.
4. Adequate space shall be provided to permit connecting wire terminals with standard tools.
5. A maximum of four terminals shall be connected to any single terminal stud, provided that there is no interference between terminal barrels and sufficient threads protrude

- beyond the nut. On terminal boards, the wiring shall be arranged so that no more than two terminals are connected to a stud, from each side of the terminal board.
6. On compression clamp terminal boards, a maximum of two terminals shall be connected to any one binding terminal. All connected wires shall be terminated with mechanical crimp type terminals as specified in Section B.22.2.
 7. Threaded studs shall have a minimum of 2-1/2 threads exposed beyond the final nuts. Adequate space shall be provided to permit connecting wire terminals with standard tools. All terminals shall be properly torqued to assure sound connections. Spacers shall not be used.
 8. A maximum of two terminals shall be connected to any one binding screw. A maximum of four terminals shall be connected to any one threaded stud, provided that there is no interference between terminal barrels. On terminal boards, the wiring shall be arranged so that no more than two terminals are connected to a stud, from each side of the terminal boards.
 9. Terminal blocks which utilize a spring clamp to hold the wire may be used for low voltage circuits. Each terminal block shall be properly identified with a permanent marking and each assembly shall be secured to the mounting (DIN) rail by end clamps which incorporate metallic hardware. All wires AWG 12 and smaller shall receive a ferrule.
 10. Jumpers between terminal board points shall be brass or plated steel. Wire jumpers between adjacent terminals of terminal boards shall not be permitted.
 11. An approved permanent marking strip on each terminal board shall be provided and attached adjacent to the wire junction point to identify the wires attached thereto and/or the wires connected to terminal boards shall have the terminal point location printed on the wire.

B.22.2 Wire Terminations

1. Terminals and connections used throughout the car shall be the mechanical, solderless, crimp type. The Contractor shall minimize the total number of crimping tool types needed for all crimp connections.
2. Terminals and connections shall be attached to the wiring with proper crimping tools and dies as recommended by the manufacturer. For components that do not accept ring tongue or Faston terminals, appropriate alternate terminations such as ferrules, locking forks or quick disconnects may be used subject to approval by the SFMTA. Corrosion protection shall be provided for all base materials.
3. Conductors subject to motion relative to the terminal shall be protected by suitable means to prevent breakage of the conductor at or near the terminal. Sufficient slack shall be provided in all wires and cables to prevent breaking or pulling out of bushings and terminals. A maximum of one wire shall be crimped in any one terminal.
4. Wherever several wires are connected to terminals of a terminal strip on a device which is removable from the car for maintenance, the wires shall be terminated, with double ring terminations which shall be screwed to an insulating fanning strip which

shall serve to keep the terminations in the correct relative locations while removed from the device.

B.22.3 Power Cable Terminations

1. Power cables shall be terminated with compression terminals. Cable slack shall be provided to preclude breaking or pull-out from bushings or terminals and to allow two terminal changes. Cable conductors shall be clean prior to installation of terminals. Compression terminals shall be applied using tools and procedures recommended by the terminal manufacturer for that purpose.
2. Double bolted terminals shall be used at all locations where rotation of a single bolted terminal would result in contact or unacceptable clearance with other conductors or the enclosure.
3. Power wire terminals on the traction motors shall be a waterproof.

B.22.4 Cable Connectors

1. All cable connector shall meet the requirements of the intended application and environment.

B.22.5 Quick-Disconnect Terminals

1. Quick-disconnect terminals shall be utilized to facilitate maintenance and inspection. They shall provide positive terminal engagement and be shock and vibration proof. All terminals shall be provided with insulation equal to that of the wire.

B.22.6 Grounding Return Connections

B.22.6.1 Grounding

1. Grounding connections to the car body and equipment shall be made through copper pads of an adequate area, silver soldered or brazed. Anti-corrosive grease shall be applied over the connection.
2. Braided, strap-type leads shall be used where there is relative motion between the two items being connected.
3. Low voltage and high voltage circuits shall not be grounded to the same ground.

B.22.6.2 Bonding

1. The bonding method employed shall not produce a DC resistance in excess of 0.0025 Ohms, or more than 0.025 Ohms at 150 kHz for any applied AC voltage. Grounding and bonding jumpers, and brazed shunt straps shall be "extra-flexible".

B.22.7 Wire Splicing

1. Wire splicing is prohibited.

B.23 CONDUIT

B.23.1 General

1. Where possible, all conduit shall be rigid aluminum alloy or galvanized rigid steel as described below. Flexible conduit may be used where necessary.
2. All conduit ends shall be deburred inside and out to remove sharp edges and all pieces shall be cleaned before installation to remove filings and other foreign material.
3. All conduit bends and offsets used shall be made by the use of special forms or tools and shall have the largest radius possible so that wires can be drawn in by, and without, the use of tackle or power.
4. Conduit shall be securely clamped with all runs electrically grounded to make a continuous ground. Electrical continuity of joints shall be provided by the use of conductive joint compound.
5. All conduit shall be arranged to prevent moisture traps and shall drain toward control boxes.
6. Conduit fittings that mate with wire ducts, enclosures or junction boxes shall be fitted with resilient seals.

B.23.2 Aluminum Conduit

1. All threads shall be covered with an oxidation inhibiting compound.
2. Aluminum fittings shall be used to assemble aluminum conduit. Elbows, nipples and couplings shall be made of the same grade of aluminum and alloy as that employed in the straight length of conduit.

B.23.3 Steel Conduit

1. Steel conduit shall be mild steel in standard lengths with threaded ends and hot-dipped zinc-coated exterior and interior surfaces. It shall be free of burrs and projections, circular in cross-section, of uniform wall thickness.
2. Steel fittings shall be used to assemble steel conduit. Elbows, nipples and couplings shall be made of the same grade of steel as that employed in the straight length of conduit.

B.23.4 Flexible Conduit

1. Flexible conduit shall have a waterproof, abrasion resistant covering. The flexible covering shall not contain polyurethane or PVC.
2. Fittings for flexible conduit shall be as supplied or recommended by the flexible conduit manufacturer.

B.24 WIRE DUCTS

1. Wire ducts shall be fabricated from galvanized mild steel or stainless steel.

2. Steel ducts and covers shall be galvanized after all welding, cutting and drilling operations. The inside of steel shall be primed and painted with white paint. Exteriors and covers shall be painted according to the color scheme. Seals shall not be painted.
3. Wire ducts shall incorporate wire support hardware sufficient to support wiring every 24 in or less, and if required, rigid barriers for circuit separation.
4. Undercar, roof, and other exterior wire ducts shall have waterproof covers with resilient seals. The covers shall be stiffened such that the seals are compressed evenly over the seal length when fastened. Undercar duct covers shall be on the bottom of the duct.
5. Interior wire duct covers need not be sealed.
6. All wire ducts shall be located such that it will be possible to remove covers and reach the wiring within.
7. The sum of the cross-sectional areas of all conductors contained at any cross-section of a wire duct shall not exceed 50 percent of the interior cross-sectional area of the wire duct.

B.25 JUNCTION BOXES

1. Junction boxes are defined as enclosures used only for the termination of wiring and do not contain electrical equipment.
2. All exterior and interior junction boxes shall be constructed to NEMA 4 and NEMA 12 standards respectively and as described below. Where conflicts exist, this document shall prevail.
3. The interior of all junction boxes and covers shall be primed and painted. Seals and cover hardware shall not be painted.
4. Terminal boards or other equipment shall not mount directly to the enclosure. All equipment shall mount to rails, brackets or standoffs fastened to the enclosure. No equipment shall be mounted to the enclosure bottom or within 1 in of the bottom.

B.26 ELECTRICAL DEVICES AND HARDWARE

B.26.1 Contactors and Relays

1. Contactors and relays shall comply with the requirements of MIL-R-6106 (for ratings of 10 Amperes or greater) and MIL-R-5757 (for ratings of less than 10 A) but need not be qualified to these documents if all of the following requirements are met:
 - a. The device is service proven in the exact same application.
 - b. The device is service proven in transit service.
 - c. All other requirements of this Specification are met.
 - d. SFMTA approves of this application.
2. All devices shall be constructed and utilized in a fail-safe manner; that is, all failures shall be in a direction so that neither the passengers, the crew nor the equipment are placed in jeopardy.
3. All devices shall be installed so that they are fully accessible for inspection, repair-in-place, or removal and replacement.
4. All contactor terminals shall be fully accessible for trouble shooting purposes.
5. Contactors and relays shall incorporate means of visually determining whether they are picked up or dropped out.
6. Relays on printed circuit boards or within electronic assemblies are exempted from the requirement for a visual indication.
7. There shall be a maximum of two wire terminations on any one contact of the device.
8. The coils of all devices shall be suppressed to protect the low-voltage network from generated transients.
9. Contact tips of the devices shall meet or exceed the manufacturer's recommended contact tip rating.
10. Contactor installation shall be such that the arc spray is directed by an arc chute away from ground and any other electrical devices proximate to the contactor.
11. All contactors shall be constructed so that the main contact tips make and break with a motion (wipe) that prevents deposits and pitting.
12. All time delay relays shall be of the R-C delay or solid state type. No mechanical or pneumatic time delay devices shall be permitted.

B.26.2 Switches

1. Under no circumstances shall poles of switches be placed in parallel in order to carry currents in excess of the contact pole rating given by the manufacturer.
2. Switches shall be provided with a "keying" feature so that after installation, the body of the switch is constrained from mechanical rotation.
3. There shall be a maximum of two (2) wires connected to each terminal of the device.
4. Switches shall be individually replaceable without disconnecting or removing anything other than the mounting fasteners and electrical connections of the switch to be replaced.

B.26.3 Circuit Breakers

B.26.3.1 General

1. All circuit breakers provided shall be extremely rugged and shall meet the requirements of the intended application and environment.
2. The "ON", "OFF", and "TRIPPED" positions of all circuit breakers shall be permanently marked on the handle or the case of the circuit breaker. The circuit breaker, when tripped, shall assume a distinct position between the "ON" and "OFF" positions to permit determination of the fact that it has been tripped by either its over-current or shunt trip elements. All circuit breakers shall be mounted in the vertical direction with the "ON" position up.
3. Each circuit breaker pole shall be equipped with adequate means of arc extinction to prevent flashover.
4. Circuit breaker current rating shall be clearly and permanently marked and shall be completely visible after installation.

B.26.3.2 High-Voltage Circuit Breakers

1. All high voltage circuit breakers shall be devices with not less than 3 poles connected in series.
2. The trip elements shall be thermal-magnetic, or magnetic, connected in series.
3. The circuit breaker handle shall protrude from the circuit breaker panel cover sufficiently to be manipulated in all positions.

B.26.3.3 Low-Voltage Circuit Breakers

1. Low voltage circuit breakers shall be either one-pole or two-pole devices depending on the intended function. Trip elements shall be thermal-magnetic, or magnetic, as is appropriate for the application.

B.26.4 Fuses

1. Fuses shall be used only where the use of circuit breakers is not technically feasible.
2. High voltage fuses shall be mounted in totally enclosed, dead front fuse holders, with no exposed high voltage connections. The fuse shall be extracted from the circuit when the fuse holder is opened and the exposed fuse shall be safely isolated from any circuit connection.

B.26.5 Buss Bars

1. Current densities, other than at joints, shall not exceed 1,000 Ampere per square inch, and in any case shall not exceed a value which would cause a bus bar temperature rise greater than 96°F. Current densities in joints shall not exceed 150 Ampere per square inch.
2. Bus bars shall be properly brazed together at joints unless bolted connections are found to be absolutely necessary for maintenance purposes and are approved. The

overlap at bus bar joints shall be no less than 10 times the thickness of the bus material.

3. Except for connection areas, bus bars shall be safety-insulated, using a high-dielectric powder coating, heat shrink tubing or other approved means. Tape is not acceptable. Bus bars that are behind insulating panels are exempt from this requirement.

B.26.6 Capacitors and Resistors

1. Capacitors shall be derated 20 percent for voltage based on the nominal supply voltage and maximum case temperature.
2. Except for braking power resistors, all resistors shall be derated 50 percent for power dissipation.

B.26.7 Transformers and Inductors

1. Transformers and inductors shall be derated 10 percent for current.

B.26.8 Switch, Circuit Breaker, and Fuse Panels

1. Each switch and circuit breaker panel shall carry the necessary apparatus, arranged to be easily accessible to connections and shall prevent operating or maintenance personnel from coming in contact with live parts when operating the switches or circuit breakers. Furthermore, all live portions of the protected circuitry shall be completely concealed so that no danger of electrocution or shock exists from the touching of the panel or any appurtenances or devices mounted thereto.
2. All switches, breakers, fuses, and indicating lights shall be provided with a nameplate of raised or recessed lettering on the dead front, clearly identifying the circuit which each controls and its circuit designation. The dead front panel shall conform to NFPA 70, Article 384. The dead fronts shall be made of moisture-proof, electrically insulating, laminated phenolic or fiberglass, of approved quality suitable for switchboards. Asbestos shall not be used.
3. The panel shall be secured by captive fasteners and shall be configured for easy removal so that maintenance and repair action is not impeded.

B.27 SEMI-CONDUCTORS

B.27.1 General

1. Semiconductors shall be selected to withstand all continuous and transient voltage and power demands present in the circuit application without damage or reduction in life. All circuit designs shall provide for the presence of high current switching equipment on the vehicle and the resultant induced voltages and currents in electrical equipment.
2. Discrete semiconductors shall have the following minimum voltage breakdown ratings:
 - a. Semiconductors, except diodes (see below), operated from the battery supply, or those connected to trainlines, shall have minimum breakdown ratings of 4

- times the maximum achievable circuit voltage. Suppression devices shall be provided as necessary to protect the devices and limit the circuit voltage.
- b. Diodes operated from the battery supply, used as suppression devices, or connected to trainlines shall have a minimum breakdown rating (PIV) of 1000 V. Diodes with less than 1000 V PIV rating may be used if adequate circuit transient protection is also provided.
 - c. All discrete semiconductors operated from inverters or other isolating devices shall have a minimum breakdown rating of 2 times the maximum circuit voltage, except where specifically detailed otherwise. Suppression devices shall be provided as necessary to protect the devices and limit the circuit voltage.
3. All Gallium Arsenide and similar optical semi-conductors shall be rated for operation over the temperature range of -40°F to +185°F.
 4. Germanium semiconductors shall not be used.

B.28 PRINTED CIRCUIT BOARDS

B.28.1 Marking

1. All circuit boards shall be labeled with a part number and descriptive nomenclature.
2. Integrated circuits and other multi-terminal devices shall have an index mark on the component side of the board, visible with the component inserted, to indicate proper keying and insertion; the first pin on all IC packages shall be identified on the wiring side of the board.

B.28.2 Component Mounting

1. Components shall be fastened to the board in such a manner as to withstand repeated exposure to shock and vibration. Power resistors shall be mounted on standoffs so that the resistor bodies do not contact the board, spaced far enough away from the board so that resistor-produced heat will not discolor or damage the board.

B.28.3 IC and Device Sockets

1. IC and device sockets are prohibited except for components that must be removed for reprogramming or initial calibration procedures or devices that are available only in mounting in sockets. All other components shall be soldered in place.

B.28.4 Conformal Coating

1. Both sides of assembled printed circuit boards shall be coated with a clear insulating and protective coating material conforming to MIL-I-46058 latest revision, or approved equal.

B.28.5 Keying and Interlocks

1. All circuit boards mounted in a rack shall be keyed to prevent insertion into the wrong location.

B.28.6 Circuit Board Connectors

1. Printed circuit board connectors shall be heavy duty, high reliability, 2-part type with a history of successful service in rail applications.

B.28.7 Enclosures and Circuit Board Hardware

1. All circuit boards that are rack mounted shall plug into racks containing the mating half of the circuit board connector.

APPENDIX C – PROGRAM MANAGEMENT AND QUALITY ASSURANCE

This section is intended as an example of standard program management and Quality Assurance requirements. It is SFMTA's intention that, at the Proposal stage, each bidder proposes its own criteria, where different, for approval. Upon completion of negotiations with the winning bidder, the agreed content will form Section 20 of the Specification document.

C.1 GENERAL

C.1.1 Program Management

1. Program management shall be sufficiently comprehensive to enable meeting, with a high degree of confidence, the requirements of this Technical Specification and meet the delivery of the agreed contractual schedule and cost.
2. Specification shall be conformed to agreements reached during pre-Contract negotiations so that it contains requirements consistent with Contractor and SFMTA understandings at Contract signature.
3. Contractor shall make available to the SFMTA's technical representatives the physical facilities and the details of the designs as they progress in order to take maximum advantage of the intended approach.

C.1.2 Program Management Plan

1. A Management Plan shall be developed, negotiated, agreed to during pre-contract negotiations, and included in the Contract.
2. The Management Plan shall include Preliminary Design Review (PDR), Final Design Review (FDR), required audits, and shall also include, but shall not necessarily be limited to:
 - a. The agreed organization chart including names and a definition of the responsibilities and qualifications of all personnel therein, for the SFMTA and Contractor. As appropriate, location of SFMTA and Contractor staff shall be identified at:
 - i. Design facilities,
 - ii. Manufacturing facilities,
 - iii. Assembly facilities,
 - iv. Project installation facility.
 - b. The internal methods, communications, correspondence coding system, and correspondence control to be used to monitor, oversee, and manage the:
 - i. Requirements,
 - ii. Schedule,
 - iii. Program changes,

- iv. Sub-contracts,
 - v. Purchase orders,
 - vi. Material procurement,
 - vii. In-service support,
 - viii. Warranty,
 - ix. Systems assurance analysis,
 - x. Tests,
 - xi. Demonstrations.
- c. A Master Program Schedule (MPS) in Critical Path Method (CPM) format showing key milestones and events, and the details of Program design, test and inspection, manufacturing, and delivery activities.
 - d. Necessary points of required input from the SFMTA shall be included in the Schedule.
 - e. Schedule shall show drawings, procedures, functional descriptions, and other documents required to be prepared by the Contractor, and reviewed and accepted by the SFMTA.
 - f. Payment milestones shall be shown on the Schedule.

C.1.3 Project Documentation System

- 1. Correspondence control shall be administered by a mature, proven Project Correspondence System, which shall:
 - a. Maintain electronic copies of all correspondence,
 - b. Support assignment of responsible responders,
 - c. Support e-mail for:
 - i. Document announcement,
 - ii. Response assignment,
 - iii. Due date reminder,
 - d. Provide the ability to search and generate reports.
- 2. Each submittal shall be coded to allow tracking in the system throughout the process of review, from posting by the Contractor through the process of review/approval by the SFMTA.
- 3. The initial posting by the Contractor shall provide a brief description of the purpose of the submittal along with a list of:
 - a. Drawing titles,
 - b. Document titles,
 - c. Document numbers,
 - d. Revisions for drawings,
 - e. Data included in each posting.

4. The System shall maintain a record of Contractor and Sub-contractor drawing and document status.
5. The CDRLs listed below are meant to be a guideline for proposers to consider. The reference section provides the location within the technical specification that further information can be found:

Table C-1 2 Contract Deliverables Requirements List

Description	Reference in Technical Specification
Interface Control Plan	1.4
Test Plan	1.4.2
Interoperability & Compatibility Report	1.4.3
ADA Compliance Certification	2.2.6
Civil Interfaces PDR	2.2.6
Civil Interfaces FDR	2.2.6
Vehicle Dynamic Clearance Envelope Analysis	2.2.6.2
Vehicle Dynamic Analysis	2.3.2
Traction Motor Fordability Analysis	2.3.4
Noise Control Plan	2.5
Noise Control Analysis	2.5
Ground Borne Vibration	2.5.5
Ride Quality	2.5.8
Curving and Derailment Safety	2.5.9
Stability Analysis	2.5.10
EMC Plan	2.6.2
EMC Emissions Report	2.6.7
EMC Susceptibility Report	2.6.7
Reliability Analysis	2.8.1
Maintainability Program Plan	2.9.1
Lifting and Jacking Design	3.1.2
Welding Procedures & Welder Qualifications	3.1.5.2
Water Drainage Scheme	3.1.6
Carbody Fatigue Analysis	3.2

Draft Gear Absorption Energy Absorption Analysis and Test Results	4.2.1.4
Cab Area Human Factor Compliance Analysis	5.2.1
Car Level Thermal Load Analysis	7.1
Air Flow Design Calculations	7.2.2.1
Emergency Lighting Design Report	8.3.1
Exterior Lighting Design Report	8.3.2
Short Circuit Analysis	9.1
Battery Sizing Analysis	9.2.5
Propulsion Performance and Duty Cycle Rating	10.1.2
Event Recorder List of Monitoring	14.1.1
Software and System Documentation Requirements Document	18.1.1
Software Deliverable	18.1.1
Vehicle Production Photographs	20.1.3
Component, Subsystem and Whole CAR FAI Procedures	20.1.6.3
Component, Subsystem and Whole CAR FAI Reports	20.1.6.3
Requirements Traceability Matrix	21.2.1
Reliability Program Plan	21.3.10
Maintainability Demonstration Test Plan	21.3.11
System Safety Program Plan	21.3.5
Safety Analysis	21.3.7
Preliminary Hazard Analysis	21.3.7.1
Failure Modes Effects Analysis	21.3.7.2
Sneak Circuit Hazard Analysis	21.3.7.3
Operating and Support Hazard Analysis	21.3.7.4
Fault Tree Analysis	21.3.7.5
Hazard Mitigation Traceability Matrix	21.3.7.6
Fire Safety Analysis	21.3.8
Reliability Program	21.3.10
Reliability Demonstration Test	21.3.12
Manuals Program Plan	22.2.1
Design Style Guide	22.2.1.1

Manuals	22.2.1.2
Running Maintenance Manual	22.2.1.3
Heavy Repair and Overhaul Manual	22.2.1.4
Illustrated Parts Catalogs	22.2.1.5
Integrated Vehicle Level Schematics and Description	22.2.1.6
As Built Drawings	22.2.2
Car History Book Format	22.2.3
Car History Books	22.2.3
Trainings Program Plan	22.2.6
Training	22.2.6
Training Mock-up	22.2.6.5
Carbody Stress Analysis	C.2.4.1
Carbody Stress Analysis Test Plan	C.2.4.1
Carbody Finite Element Analysis	C.2.4.1
Carbody Stress Analysis	C.2.4.1
Carbody Finite Element Model	C.2.4.1
Carbody Linear Elastic Analysis Validation	C.2.4.1
Carbody Crashworthiness Analysis Report	C.2.4.1
Truck Stress Analysis Report	C.2.4.1
Subsystems PDR	C.2.4.1
Subsystems FDR	C.2.4.1
Subsystem Qualification Test Procedures	C.2.4.1
Subsystem Qualification Test Reports	C.2.4.1
Vehicle Qualification Test Procedures	C.2.4.1
Vehicle Qualification Test Reports	C.2.4.1
Pre-shipment Test Procedures	C.2.4.1
Production Acceptance Test Procedures	C.2.4.1
Vehicle Acceptance Test Procedures	C.2.4.1
Quality Assurance Manual	C.2.7.1
Radiographic Inspection Reports	B.5.2
Casting Test Reports	B.5.2
Pressure Vessel Test Reports	B.11.5

Smoke, Flame & Toxicity Matrix	B.14.1
Spare Wiring Descriptions	B.21.4
Wiring Plan, Identification System, Connections and Terminations	B.21.4
Conduit & Cable Run Plans	B.21.4

C.2 SPECIFIC REQUIREMENTS

C.2.1 Interface with Sub-contractors, Designers and the Contractor

C.2.1.1 General

1. The Contractor shall ensure that all designers and Sub-contractors are informed of all specified requirements and that appropriate engineering management tools are utilized to coordinate and provide communication between the designers of interrelated systems.
2. The Contractor shall have all relevant designers and Sub-contractors available when required for:
 - a. Meetings,
 - b. Production problems,
 - c. Testing,
 - d. Resolution of design deficiencies,
 - e. All other similar situations.
3. During all phases of this project, the SFMTA shall have access to all designers and Sub-contractors through coordination with the Project Manager.
4. The Contractor shall coordinate all sub-contractor design and installation activities.

C.2.2 System Integration

C.2.2.1 General

1. The Contractor shall actively employ system integration principles throughout the:
 - a. Design,
 - b. Production,
 - c. Test phases of the Contract.
2. The practiced principles will control and coordinate the interfaces among the vehicle's systems as well as uphold the requirements between the vehicle the operational and the maintenance systems.

C.2.2.2 Systems Integrator

1. The Systems Integrator shall have an understanding of the interaction of all vehicle systems and parameters as well as possess experience in coordinating interface requirements.
2. The Systems Integrator shall participate in the design review process.

C.2.3 Meetings

C.2.3.1 Project Meetings

1. Jointly led project meetings, including pre-production, periodic, and special meetings, shall be conducted according to Schedule throughout the progress of the work.
2. Agendas for the meetings may include any topics that the Project Managers determine to be relevant to the project such as:
 - a. Discussions of progress observations,
 - b. Problems,
 - c. Conflicts,
 - d. Production schedules,
 - e. Delivery schedules,
 - f. Sub-contractor fabrication,
 - g. Quality standards,
 - h. Design review,
 - i. Contract modifications.

C.2.3.2 Kick-Off Meeting

1. The first project meeting shall be within 30 calendar days after NTP for the purpose of discussing with the Contractor all essential matters pertaining to the successful prosecution and completion of the Work.
2. At this meeting, as a minimum the following shall be accomplished:
 - a. Introduce key personnel of the Team,
 - b. The Contractor shall submit for joint review document coding schemes, Schedule and monthly report format,
 - c. Confirm project control methodology and plans for initial activities before the start of formal progress reporting,
 - d. Confirm that the Contractor is familiar with SFMTA's intended operations and maintenance environment,
 - e. Identify the early information needs and decisions required by the Contractor from the SFMTA,
 - f. As an option, product familiarization presentation for the benefit of SFMTA's operations and maintenance staff to afford them an opportunity to comment on the vehicle from their perspective,

- g. SFMTA alerts Contractor to external pressures that will drive SFMTA expectations.

C.2.3.3 Schedule-Based Project Management Meetings

1. Meetings shall be held between the Contractor and the SFMTA on a regular basis for the purpose of reviewing project progress and other activities.
2. An agreed number of days prior to a project review meeting, the Contractor shall submit the agenda and a data package covering information to be addressed in the meeting.
3. These meetings are intended to serve as a forum to discuss design problems and issues, to answer questions raised by the agency, the Contractor or its Sub-contractors:
 - a. To discuss contractual matters,
 - b. Any other topics that the Project Manager determine to be relevant to the project to review schedule and payment issues,
 - c. To witness tests and discuss their results,
 - d. To review:
 - i. Design,
 - ii. Fabrication,
 - iii. Assembly status,
 - iv. Vehicle weight status.
4. The Contractor shall ensure that persons knowledgeable in the topics to be discussed, including appropriate Sub-contractors, are present as required at these meetings.
5. SFMTA shall ensure that SFMTA Team members with authority to make approval decisions about subjects discuss and attend each meeting as appropriate.

C.2.3.4 Progress/Design Review Meeting Reports

1. Meeting minutes of Progress/Design Review meetings shall be recorded alternately by the SFMTA and the Contractor and will be circulated among the attendees for agreement.
2. Draft minutes shall be provided within 5 working days after each meeting.
3. Attendees shall respond with comments or acceptance within 5 working days of receipt. If no comments are received during that time, full concurrence will be assumed.
4. The Contractor shall submit for SFMTA approval monthly progress reports that assess actual progress against planned progress. The report shall include the following information:
 - a. An updated Master Schedule showing progress as of the reporting date,
 - b. A schedule report listing all activities, elapsed and remaining duration of activities, early start/early finish dates, late start/late finish dates, predecessor and successor activities, and float,
 - c. A narrative report that, as a minimum, describes:

- i. Work accomplished during the reporting period,
 - ii. Percent of design, manufacturing, delivery, testing, and system support elements completed during the reporting period, and percent of overall work completed,
 - iii. Delays incurred during the reporting period, their causes and effects, and the corrective actions proposed or taken to mitigate those delays,
 - iv. Changes in activity duration,
 - v. Changes in activity logic,
 - vi. Failure statistics, along with corrective actions taken,
 - vii. Changes in the agency approved design plans and layout, any other topics that the Project Manager determine to be relevant to the project,
 - viii. Changes in vehicle construction methodology and consistency,
 - ix. Updated drawing list,
 - x. Updated vehicle weight estimate,
 - xi. Updated hazard analysis,
 - xii. Assignment of action items from the meeting with date of expected resolution,
 - xiii. Update of progress in closing existing action items.
5. The Contractor shall submit monthly progress reports to the SFMTA no later than five (5) working days following the last calendar day of the reporting month.
 6. The status of correspondence submittal and review shall be updated and submitted to the SFMTA as a part of the monthly progress report.
 7. The Contractor shall submit special reports and/or shall hold special topical reviews as requested by the SFMTA to address special concerns or problem areas.
 8. Documentation of all work, repairs, parts used and purchased, warranties, configuration control of serialized components, and reliability reports shall be submitted to the PMs and VMMs in the form of a report on a monthly basis.

C.2.4 Design Acceptance, Drawings, Documentation and Data Requirements

C.2.4.1 Design Review Procedure

1. Design reviews shall be conducted to evaluate the progress and technical adequacy of the design and compatibility with the performance requirements of the Technical Requirements.
2. The basic method of design review shall be by collaboration of the members of the Team as a continuous process driven by the Schedule.
3. Design review shall include both Preliminary Design Review (PDR) and Final Design Review (FDR).

4. The PDR shall confirm the design concept as well as verify that the activities necessary for production have been collaboratively presented, reviewed, and approved such that they can be released for manufacturing.
5. Acceptance may be subject to conditions provided the conditions can be addressed concurrent with manufacturing.
6. To the extent possible, design reviews of major subsystems and components shall be conducted at the Sub-contractor's facility.
7. As the design progresses, a continuous series of on-going, concurrent reviews of the design, and the work performed in making the transition from concept to production design, shall be conducted.
8. Collaborative meetings shall be conducted to discuss and evaluate design progress, technical adequacy of the design, system interfaces, and the compliance with the performance requirements of the Contract.
9. During these on-going review meetings, action items shall be identified, with each action item assigned to an individual for disposition by a pre-determined response date.
10. Reviews shall also evaluate compatibility of the functional interfaces between the vehicle subsystem components and between the vehicle and other wayside systems and facilities.
11. Upon reaching agreement between the Contractor and the SFMTA, the Contractor shall prepare and submit the vehicle design drawings and documents for formal review and acceptance by the SFMTA.
12. Technical data shall be handled in accordance with this design review procedure, including:
 - a. Management Plans,
 - b. Quality Assurance programs,
 - c. Production schedules,
 - d. Test procedures,
 - e. Test schedules,
 - f. Test results,
 - g. Progress schedules and reports,
 - h. Drawing lists,
 - i. Samples and other data submitted by the Contractor and requiring review by the SFMTA.
13. Designs and systems that can be proven to have been previously tested and accepted by other authorities with similar specification requirements may be accepted by the SFMTA.
14. FDRs are conducted at the end of each sub-system design.
15. FDRs shall:
 - a. Confirm that the design is complete,

- b. Confirm that the design is in compliance with the Technical Specification,
 - c. Confirm that the design is acceptable with regard to the related activities shown on the Schedule,
 - d. Verify that conditions for approval at PDR have been satisfied and signed for acceptance,
 - e. Confirms the exact interface relationships between the systems and other related equipment and infrastructure.
16. A FDR shall be conducted when detailed design of a sub-system is complete.
 17. The FDR shall determine that detailed design of the system under review will satisfy the design requirements established in these Specifications and shall confirm the exact interface relationships between the systems and other equipment or infrastructure.
 18. The FDR shall be considered complete when the Baseline Production Vehicle Design Configuration is fully documented with appropriately revised drawings and documentation as accepted by the SFMTA.
 19. Sub-assembly drawings shall also be submitted for information to facilitate the review of assembly and installation drawings.
 20. The SFMTA reserves the right to view additional drawings to support the review process of assembly and installation drawings.
 21. The Schedule shall provide for time for SFMTA review and disposition of submittals in accordance with the requirements of this section. The following review times (calendar days) are required:
 - a. 15 calendar days for submittals unless otherwise noted,
 - b. 30 calendar days for structural stress analysis and reports,
 - c. 60 calendar days for documents related to:
 - i. Manuals,
 - ii. Training,
 - iii. Parts catalogs.
 22. No extension of Contract time will be allowed for revision of Contractor's drawings or documents that have been either "rejected" or "accepted with comments".
 23. Such drawings and documents shall be resubmitted and will be reviewed and returned to the Contractor within the time intervals stated above.

C.2.4.2 Disposition of Drawings, Documentation, and Data

1. SFMTA review shall provide one of the following dispositions:
 - a. Accepted:
 - i. "Accepted" is defined as SFMTA concurs with the information in its submitted form.
 - ii. Work shall be performed in accordance with the information submitted.
 - iii. An acceptance shall not be construed as permitting any departure from the Contract, unless the submittal requests a deviation and

SFMTA issues a Waiver or a Change Order, or relieving the Contractor of any responsibility for the design.

- b. Accepted with Comments:
 - i. "Accepted with Comments" is defined as SFMTA conditionally agrees with the submitted information in principle, but some details must be changed as indicated by the comments.
- c. Rejected:
 - i. "Rejected" is defined as SFMTA not accepting the design, requiring the Contractor to revise and resubmit the document, drawing, or data for the SFMTA's review based on the comments provided by the SFMTA. Any physical work performed using "rejected" design data shall be at the Contractors risk.

C.2.4.3 Requirements for Drawings, Documents, and Data

1. The Contractor shall provide all drawings and data required by the Contract Documents, and the SFMTA may request such other drawings and data as needed.
2. Contract documents provided by the Contractor shall be sufficiently detailed to enable the SFMTA to determine with a high degree of confidence (based on applicable industry standards and practices) that the Contractor shall deliver vehicles conforming to the Contract Documents that are suitable for the environment in which they will be used.
3. Drawings submitted by the Contractor shall be in a format approved by the SFMTA and shall include:
 - a. A title block,
 - b. Drawing number,
 - c. Title,
 - d. Date,
 - e. Revision number,
 - f. Contract number,
 - g. Reference to next higher assembly,
 - h. Signature of the Contractor's responsible engineer.
4. The Contractor shall provide the following documentation for review:
 - a. Documents, data, calculations, assembly and installation drawings required to convey:
 - i. Concept,
 - ii. Design,
 - iii. Dimensions,
 - iv. Maintenance,
 - v. Operation,
 - vi. Overall assembly aspects and interfaces.

- b. A narrative description of each major system proposed by the Contractor and Sub-contractors, including arrangement, major components and functional description,
 - c. Sub-assembly drawings to facilitate the review of assembly and installation drawings,
 - d. A dynamic outline of the vehicle that accounts for the worst-case conditions of wear and failures.
5. All dimensions shall be expressed in the English system. Where other dimensional systems are used, the equivalent English measurements shall be added, leaving the original intact and readable.
6. All terminology used shall be conventional to the U.S. transit and railway industries.
7. Contractor and drawings shall be in a suitable scale in order to accurately convey content.
8. Drawings shall be accompanied by documentation that supports review and acceptance, such as:
 - a. Drawings,
 - b. Calculations,
 - c. Material specifications,
 - d. Process specifications,
 - e. Flammability and smoke emissions data,
 - f. Test data.
9. Detailed parts drawings need not be provided unless requested by the SFMTA to support the review of another drawing.
10. Drawings, documents, and data provided by the Contractor shall be listed in numerical sequence.
11. Drawings shall be prepared in a manner that permits the SFMTA to readily determine and view the interface relationships between major structural elements and their subassemblies, and also between the structural elements and the attached:
 - a. Apparatus,
 - b. Equipment,
 - c. Wiring,
 - d. Piping,
 - e. Hardware.
12. Drawings shall be made to the third-angle projection system.
13. Structural drawings shall be of sufficient scale and size to clearly delineate the shape and size of all assemblies, members and components.
14. The drawings shall be completely dimensioned.
15. Build-up of materials shall be shown and identified (thickness fully dimensioned).
16. Full and complete information regarding location, type, size and extent of all welds shall be clearly shown on the drawings.

17. All joints and connections shall be detailed, with all dimensions, showing the size of the fasteners, and complete American Welding Society (AWS), or equivalent, weld symbols (including size and process).
18. The list of materials shall include the material's specification including:
 - a. Grade,
 - b. Temper,
 - c. Thickness,
 - d. Nominal size.
19. Requirements for vehicle schematics and the Integrated Schematic Package are presented in Section 22.2.1.6.
20. Drawings shall be complete and shall include all interface and complementary drawings, including those for lower order assemblies.
21. If the SFMTA deems a drawing essential and a Sub-contractor claims that the drawing is proprietary, the Sub-contractor shall prove to the mutual satisfaction of the Contractor and the SFMTA that the claim is valid. However, if certain information is necessary for design review or maintenance, the Contractor or Sub-contractor shall supply this information to the SFMTA.
22. The Contractor shall submit design drawings, calculations and system descriptions both to demonstrate that the equipment to be supplied shall fully satisfy all specified requirements and to obtain the SFMTA's agreement.
23. SFMTA and Contractor shall work through the described collaborative review and revision process to arrive at a design of all systems, subsystems and components which is acceptable to the SFMTA.
24. Unless otherwise accepted by the SFMTA, every drawing shall include a complete list of materials and parts lists, including the Contractor's part number, on the field of the drawing or on a separate sheet of the same drawing, describing all parts or subassemblies, and including Sub-contractor-furnished items, which form a part of the assembly, sub-assembly, or piece depicted.
25. All documents, drawings, and data shall provide for a revision block, which shall identify:
 - a. The revision letter,
 - b. Date of revision,
 - c. The initials of the Contractor's responsible engineer authorizing the revision,
 - d. A description of the change,
 - e. The reason for making the change.

C.2.4.4 Material Samples

1. Material samples of actual decorative and other materials proposed for use on the vehicle shall be provided for SFMTA's review no later than acceptance of the vehicle mock-up or at the time of viewing an existing vehicle.

2. Decorative items such as samples of exterior finish, windows, wall linings, window masks, partitions, interior trim, handholds, upholstery, paint chips, floor covering and any other materials used for decoration shall be supplied in no larger than 8½” by 11”.
3. Decorative items shall be mounted to a backing as necessary and assembled into binders.
4. Each sample shall include Manufacturer name, address, telephone number and all other contact information.

C.2.5 Modification and Configuration Control

C.2.5.1 Configuration Management Plan

1. The Contractor shall submit for review a Configuration Management Plan that describes the method to be used to track and control all component model number; serial numbers; submittals; drawings and revision levels.

C.2.5.2 Drawing List

1. The Contractor shall submit a drawing tree and list of drawings.
2. Based on the guidelines given below, the Contractor shall indicate on this list the drawings intended for submittal and agency approval.
3. The list shall provide space for tracking the submittal status of each drawing.
4. Updates of the drawing list shall be provided with each monthly Progress Report.
5. As part of the drawing tree submittal, the Contractor shall include a description of the primary drawing numbering system including the significance of characters.

C.2.5.3 First Article Inspection

1. First article inspections (FAI) are considered the final step in FDR.
2. The successful completion of an FAI shall be a prerequisite for the completion of the FDR process for those systems and components subject to an FAI.
3. Changes after FDR, and therefore FAI, shall be documented in the form of engineering change proposals and shall be submitted for approval.

C.2.5.4 Design Baseline

1. Production may commence once a PDR acceptance or acceptance with comments is achieved.
2. For the purposes of SFMTA change control, the design baseline for each system shall be established when design acceptance is granted at the FDR.
3. Changes beyond FDR that affect the accepted design or production baseline as presented at the FDR, shall be submitted for acceptance.

C.2.5.5 Documentation

1. The Contractor shall maintain accurate and current configuration documentation, which shall be made available to the agency upon request.

2. The configuration documentation shall have the capability of identifying the following:
 - a. The composition of any of the following at any level, in terms of subordinate and next part numbers:
 - i. Part,
 - ii. Component,
 - iii. Sub-assembly,
 - iv. Assembly.
 - b. Engineering changes and records of superseded configuration requirements,
 - c. Configuration of spare parts and any retrofit/replacement requirements.

C.2.6 Component Serialization

C.2.6.1 Serial Numbers

3. The Contractor shall assign discrete serial numbers in sequence, including, but not limited to the following equipment and components:
 - a. Axles,
 - b. Batteries,
 - c. Converters,
 - d. Couplers,
 - e. Door operators and controls,
 - f. Gear units,
 - g. Journal bearings,
 - h. Auxiliary system motors,
 - i. Principal units of communications system equipment,
 - j. Principal units of traction and braking apparatus,
 - k. Temperature control apparatus,
 - l. Traction motors,
 - m. Truck castings and/or weldments,
 - n. Wheels,
 - o. Brake control units,
 - p. Current collector,
 - q. Any other item of equipment customarily assigned serial numbers or that will be rebuilt and/or overhauled.
4. The Contractor shall submit for approval a list of items to be serialized and a description of the serialization method to be used.
5. The Contractor shall provide a completed list of serialized items for each vehicle within the respective Vehicle History Book.

6. Location of serial numbers shall be approved by the SFMTA.

C.2.6.2 Component Identification

1. Format of identification of assemblies, subassemblies, and components shall be in the following format:
 - a. Part number (“P/N Abc1234...”),
 - b. Serial number (“S/N Abc1234...”).
2. The life expectancy of labels shall be the same as that of the part to which it is attached.

C.2.7 Quality Assurance and Audits

C.2.7.1 General

1. The Contractor shall submit a Quality Assurance Manual (QAM) with the Management Plan following award of the Contract. The QAM shall list the Contractor’s procedures that describe the methods for planning, implementing, and maintaining quality.
2. The Contractor shall develop a Quality Assurance (QA) program accepted by the SFMTA to oversee the work of the Contract.
3. The goal of the QA program is to explicitly plan for the quality related activities needed to ensure that the product and manufacturing process meet all the requirements of the Contract documents.
4. QA activities and responsibilities include:
 - a. Establishing and maintaining a QA program,
 - b. Satisfying all requirements identified in the program,
 - c. Conducting timely QA audits of the program.
5. The Contractor shall impose its own SFMTA accepted quality assurance program plan requirements on all Subcontractors and Suppliers for this Project.
6. The Contractor shall maintain a surveillance program to monitor all Subcontractors and Suppliers. The requirements of this section shall have precedence in all matters pertaining to program management.
7. The Contractor shall make available for the SFMTA’s review and inspection all required procedures, plans, manuals, and any other documentation to be used to ensure conformance.
8. The Contractor’s QA program shall, at a minimum, adhere to the guidelines presented in the most current revision of FTA publication FTA-IT-90-5001-02.1 Quality Assurance and Control Guidelines and adhere to ISO 9000 (or QS-9000) series quality standards. Alternate comparable quality assurance and quality control guidelines may be submitted for acceptance by the SFMTA.
9. The Contractor’s QA Program shall include the 15 quality elements specified in FTA publication FTA-IT-90-5001-02.1 Quality Assurance and Control Guidelines:
 - a. Management Responsibility,
 - b. Documented Quality Management System,

- c. Design Control,
 - d. Document Control,
 - e. Purchasing,
 - f. Product Identification and Traceability,
 - g. Process Control,
 - h. Inspection and Testing,
 - i. Inspection, Measuring, and Test Equipment,
 - j. Inspection and Test Status,
 - k. Nonconformance,
 - l. Corrective Action,
 - m. Quality Records,
 - n. Quality Audits,
 - o. Training.
10. In addition to the 15 FTA QA/QC elements, the contractor's QA/QC program shall specifically and clearly address the following:
 - a. How the quality of the Operator's and the Maintenance Manuals required by Section 22 of this Specification will be assured and demonstrated,
 - b. How the quality of the training courses required by Section 22 of this Specification will be assured and demonstrated,
 - c. How compliance with the software quality requirements given in Section 18 of this Specification will be assured and demonstrated.
 11. Elements may refer to QA/QC activities.
 12. QA activities shall include a documented plan for quality activities and verification that those activities were carried out.
 13. QC activities shall include the actual implementation of quality activities and the documentation thereof.

The QA program shall remain effective throughout the duration of the Contract.

C.2.7.2 QUALITY ASSURANCE ADDITIONAL REQUIREMENTS

1. The quality assurance program shall include the following elements of the SFMTA quality system and consistent with the Work. The Contractor shall extend to SFMTA its full cooperation and, at no cost to SFMTA, provide facilities at the LRV manufacturing and assembly plants, including final assembly site. These facilities shall enable convenient inspection of materials, work, and equipment. The provisions shall provide for separated, securable office space, desks, locker facilities, file cabinets, free access to a fax machine, free access to a reproduction machine, and free high-speed access to the internet. Copies of all drawings, diagrams, schedules, changes, deviations, and data shall also be furnished. Data shall be sufficient to verify design, construction, assembly, installation, workmanship, clearance, tolerance, and functioning of the LRVs and System Components.

2. SFMTA's in-plant representatives shall be provided with a heated, cooled, and adequately lighted private office for a minimum of three people, with convenient access to restroom facilities. Telephones with an outside line and a fax machine shall be available and dedicated to SFMTA's use within the private office space. The Contractor shall supply three dedicated telephone lines for this use. The Contractor shall provide high speed (100 Mbps or faster, or approved WiFi) access to all on-line project documents and information and the internet. Access to project documents may be by means of a dedicated Internet access line, or through the Contractor's Local or Wide Area Network, provided adequate security measures are implemented to ensure the confidentiality of SFMTA data on computers connected to such a network.

C.2.7.3 FIRST ARTICLE INSPECTIONS

1. A First Article Inspection (FAI) shall take place at the point of assembly, whether at the Supplier's or Contractor's facility, after completion of factory acceptance tests on the first production unit of every component and subsystem to verify proper configuration, materials, operation, and production methods. Major components and systems for which an FAI is required are listed below (SFMTA reserves the right to add to this list):
 - a. Car shell,
 - b. Vehicle interior,
 - c. Completed Cab,
 - d. Coupler and draft gear,
 - e. Seating,
 - f. Door system,
 - g. HVAC system,
 - h. Lighting components,
 - i. Pantograph,
 - j. Auxiliary electric components and system,
 - k. Propulsion components and system,
 - l. Master Controller,
 - m. Truck frames, machined,
 - n. Completed truck assemblies,
 - o. Wheel and Axle assembly,
 - p. Friction braking components and system,
 - q. Communications system and components, including signs,
 - r. Vehicle Monitoring components and system,
 - s. Event Recorder,
 - t. Train control components and system,
 - u. Complete Vehicle prior to pre-shipment.

2. SFMTA shall be notified in writing of the proposed FAI date. The FAI shall be scheduled for a date that is mutually acceptable to both the Contractor and SFMTA. The FAI shall verify that production hardware complies with design configuration and drawings as agreed upon during the FDR. The factory acceptance test procedures and results shall be available for review at the FAI. SFMTA may request the Contractor to repeat the factory acceptance test or parts of it at the FAI. The Contractor shall submit to SFMTA for review and approval the latest approved drawings, test procedures, specifications, quality documentation, and a list of drawings required for adequate evaluation of the equipment under inspection. The list of drawings shall be identified by revision and shall be complete to the line replaceable unit. The FAI report shall be submitted to SFMTA for review and approval after the performance of any FAI. The FAI shall remain open until all FAI items are closed and the Contractor submits a final SFMTA-approved FAI report.

C.2.7.4 SFMTA AUDITS

1. SFMTA may audit the Contractor, or any Subcontractor, at anytime during the term of the Contract. SFMTA may perform quality assurance functions during the life of the Contract. These functions may be performed independently and in addition to the Contractor's activities. These activities will help to ensure that the Contractor is performing the quality assurance functions as defined and agreed to by SFMTA and verify that all services and products delivered to SFMTA conform to the requirements of the Contract Documents. The quality assurance activities of SFMTA will in no way lessen, negate, or replace the quality assurance responsibilities of the Contractor.

APPENDIX D – SFMTA TECHNICAL DOCUMENTS INFORMATION

This section is intended as an example of the standard manual formatting that SFMTA currently receives from contractors for procurement of new vehicles.

D.1 GENERAL

D.1.1 Manuals Format

1. The supplied manuals shall provide complete, concise and clear documentation for all equipment on the vehicle and shall not include superfluous documentation for equipment that was not provided with the vehicle. As well as the printed copies of the manuals, all maintenance operations and illustrated parts manuals shall be provided in digital format on standard CD-ROM media.
2. All such electronic documentation shall be viewable using modern, basic office and multimedia software such as Microsoft Office (minimum compatibility with Office 97 through Office XP) and Windows Media Player. In addition, all materials will be provided in a format that allows their use in the SPEAR Technologies 3i software Image Manager and/or Document Manager modules. SFMTA reserves the rights to electronic reproduction of all such information mentioned herein for its own internal uses, where such electronic reproduction is not already specifically provided for by the Contractor as part of this contract. Within the relevant vehicle warranty period provided for by the Contractor, 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 SFMTA and the Contractor. Where such changes are made, both 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. The Contractor shall provide such changes in the same digital format as used for the initial delivery of the manuals. At the expiration of the time periods for Contractor maintenance of the documentation, or upon default of the Contractor in providing such document maintenance, SFMTA shall have the right to reproduce copies of such documentation for internal use only, subject to the warranty concerns expressed herein.
3. All system modifications, retrofits, parts, defect and factory recalls done must include full documentation for recordation into SPEAR Technologies 3i software, plus all parts, service and engineering manuals must be updated regularly.
4. All maintenance documents in electronic form shall be generated for best readability on a 15" video graphics computer monitor at a resolution of 800 by 600 lines per inch, and may exceed the display area in size as required for readability if zooming and/or scrolling is available. 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. An emphasis should be placed on durability and portability. In the interest of readability and clarity, SFMTA may dictate that the Operator's Manual be printed in color.

5. Maintenance, Preventive Maintenance work functions and Illustrated Parts shall include two and three dimensional and exploded view graphics. In addition to providing hard copies and diskettes of these manuals as specified above, the Contractor shall provide required technical services to integrate these items into the SPEAR Technologies 3i maintenance and materials management system. SPEAR Technologies 3i software includes the following applications to support this integration:
 - a. Image Manager – Used for providing Illustrated Parts Catalog on-line. Displays images and parts lists, automatically cross-references manufacturer part numbers to SFMTA part numbers and allows users to fill a “shopping cart” with parts requests to perform maintenance activities. Includes Parts Catalog Manager, an easy to use development tool to import and manage graphic and parts list files. Image Manager can also be used for any other graphical documentation, such as wiring schematics, technical illustrations, etc.
 - b. Document Manager – Used to link records in SPEAR Technologies 3i software (such as Equipment Asset records, Preventive Maintenance Work Order Templates, Equipment Configurations) to electronic files. System opens the referenced file in its native application using the Windows Registry information for the file extension. Common applications of this module are linking complete technical manuals to coach records, associating digital photos or videos with equipment, and linking troubleshooting guides to template work orders.
 - c. Interface Manager – Used to import data into SPEAR Technologies 3i software (such as the Car History Book, Serialized components, Warranty Conditions, etc.) The Interface Manager uses a standard format for data imports.

BOARD of SUPERVISORS



City Hall
Dr. Carlton B. Goodlett Place, Room 244
San Francisco 94102-4689
Tel. No. 554-5184
Fax No. 554-5163
TDD/TTY No. 554-5227

August 15, 2014

File No. 140882

Sarah Jones
Environmental Review Officer
Planning Department
1650 Mission Street, 4th Floor
San Francisco, CA 94103

Dear Ms. Jones:

On July 29, 2014, Supervisor Breed introduced the following legislation:

File No. 140882

Resolution approving a contract with Siemens Industry, Inc., to procure up to 260 light rail vehicles, associated services, spare parts, special tools, training, and documentation in an amount not to exceed \$1,192,651,577 for a term not to exceed 15 years, to commence following Board approval; and making environmental findings.

This legislation is being transmitted to you for environmental review.

Angela Calvillo, Clerk of the Board

A handwritten signature in cursive script, appearing to read "Linda Wong".

By: Linda Wong, Assistant Clerk
Budget and Finance Committee

Attachment

c: Joy Navarrete, Environmental Planning
Jeanie Poling, Environmental Planning

BOARD of SUPERVISORS



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By: Linda Wong, Assistant Clerk
Budget and Finance Committee

Attachment

c: Joy Navarrete, Environmental Planning
Jeanie Poling, Environmental Planning

SAN FRANCISCO DEPARTMENT OF CITY PLANNING
EXEMPT FROM ENVIRONMENTAL REVIEW

*Statutorily exempt under CEQA Guide -
lines section 15275(a), increase of
service on rail lines already in use. New LRVs
for Central Subway covered under Central Subway
EIS/EIR, Case No. 1996-0281E. Also per Case No.
2014.0929E. Lisa Gibson 8/29/14*



SFMTA
Municipal
Transportation
Agency

2014.0929E

Edwin M. Lee, Mayor
Ivan Norian, Chairman
Malcolm Henricks, Director
Joel Hanson, Director
Edward D. Messerle, Director of Transportation
Cheryl Brinkman, Vice-Chairman
Jerry Lee, Director
Christina Russo, Director

LIGHT RAIL VEHICLE PROCUREMENT

As part of its regular daily passenger transit service, the SFMTA has a fleet of 151 light rail vehicles (LRVs). Vehicles in service operate 21 hours per day, 365 days a year, on the Muni Metro system. These vehicles typically have a lifespan of 25 years, and will be scheduled for retirement starting in 2021.

The planned procurement will provide up to 260 new LRVs, together with associated services, spare parts, special tools, training and documentation. The new LRVs are expected to have a 25-year life, which assumes that the cars will undergo a mid-life overhaul. SFMTA requires new LRVs for three purposes:

- (1) 24 LRVs for increased service demand for the Central Subway Project and Mission Bay, and system-wide growth along those corridors. These vehicles would be scheduled for delivery from 2016 through 2018;
- (2) the replacement of the existing fleet of 151 LRVs, with deliveries projected to start in 2021 and continue through 2028; and
- (3) Up to 85 LRVs to meet additional projected growth in ridership and system capacity expansion needs through 2040.

These cars will be housed at Muni Metro East Facility and Green Facility.

Statutorily exempt
under CEQA Guidelines
Section 15275(a) -
increase in service on
rail lines already in use.
New LRVs for Central
Subway covered under
Central Subway EIS/EIR
Final Supplemental
Case NO. 1996.281E

~~Categorically exempt from Environmental Review
CEQA Guidelines 15301 Class 1 (e): Additions to
existing structures provided that the addition will
not result in an increase of more than 50 percent
of the floor area of the structures before the
addition, or 2,500 square feet, whichever is less.~~

~~Gerald Robbins~~

Gerald Robbins Date

- Jeanie Poling 6/19/14

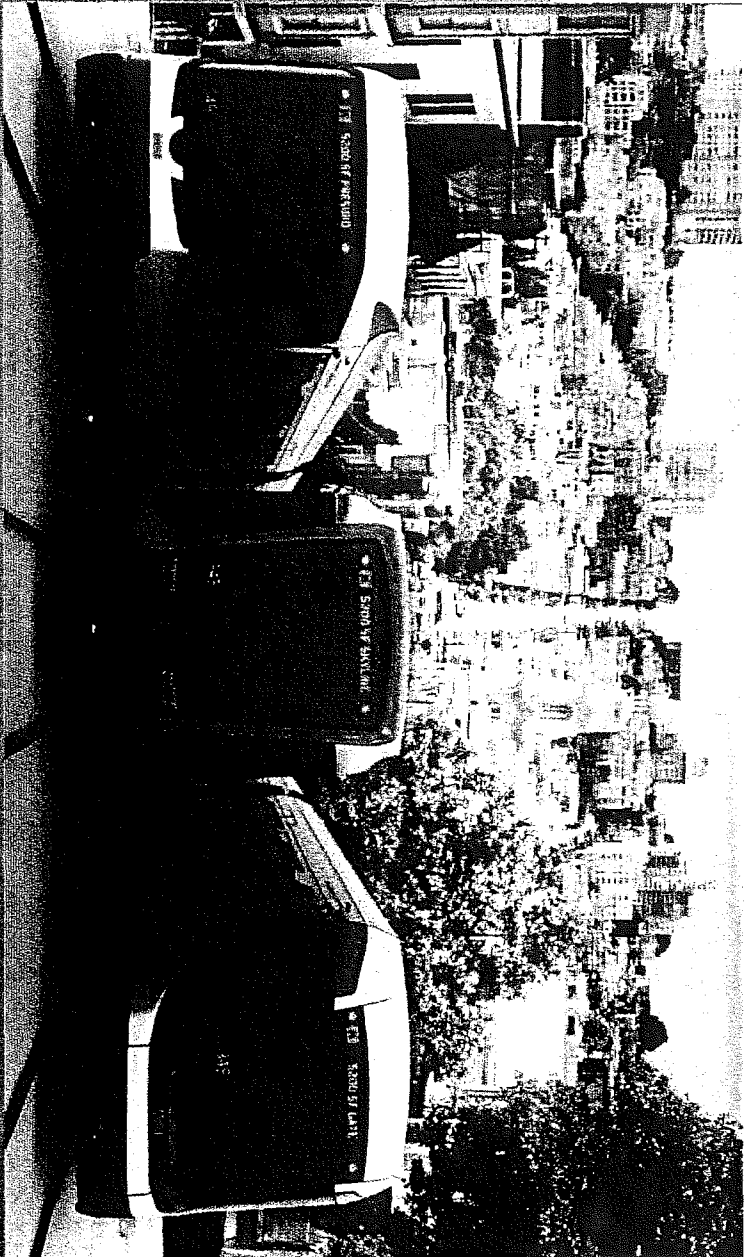


SFMTA
Municipal
Transportation
Agency



CALIFORNIA REPUBLIC

Muni Forward: Get On Board!



Siemens S200 SF Light Rail Vehicle

09 | 03 | 2014

SAN FRANCISCO, CALIFORNIA

Word in Spanish: *alabado* Es. M. 1100-00

The Right Vehicle to Meet Increasing Demand for *Rail Transit in the City*

- Competitively bid
- Emphasis on technical qualifications and improving vehicle reliability
 - Directly addresses the doors/steps issue – our current #1 failure component
- Meets Central Subway timeline
- Exceeds reliability requirements
- Proven manufacturer
- Competitive price
- Manufactured in Sacramento, CA
- Prototype due in December 2016

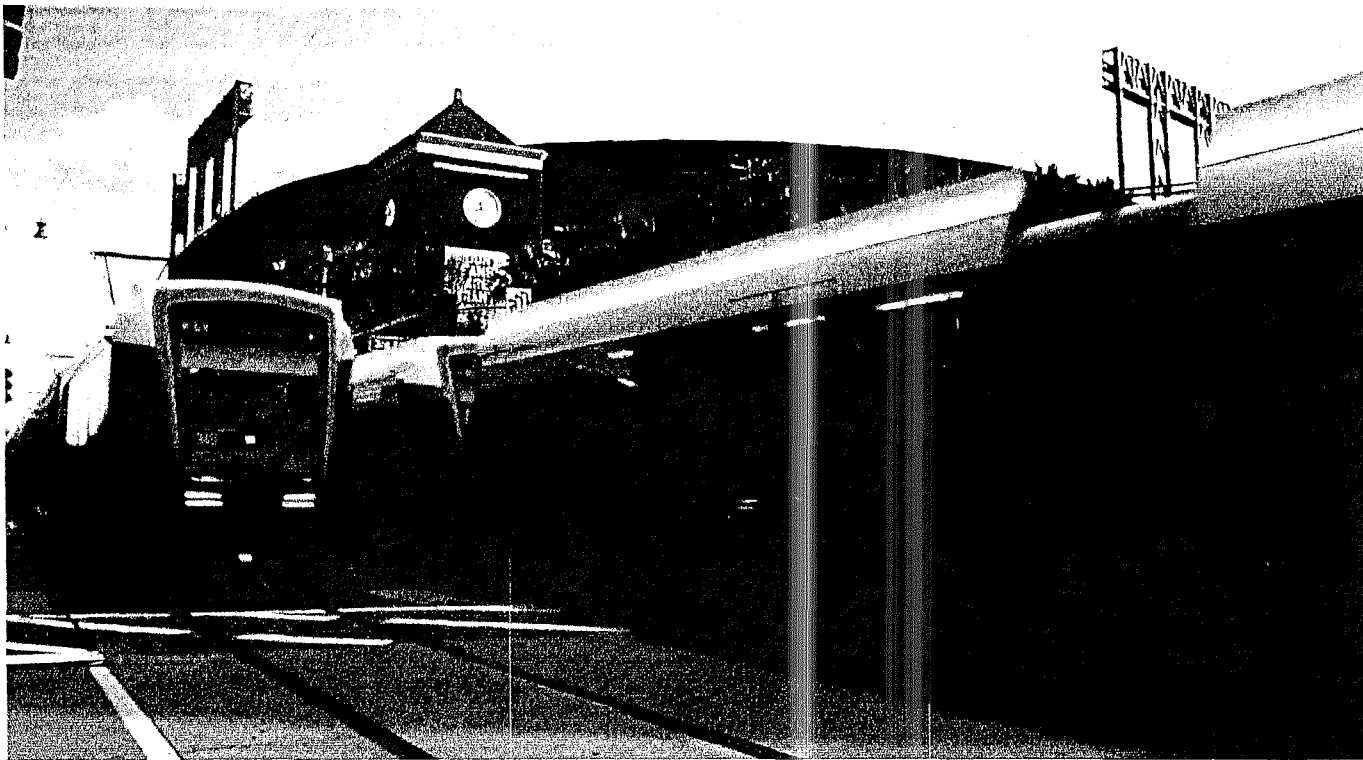


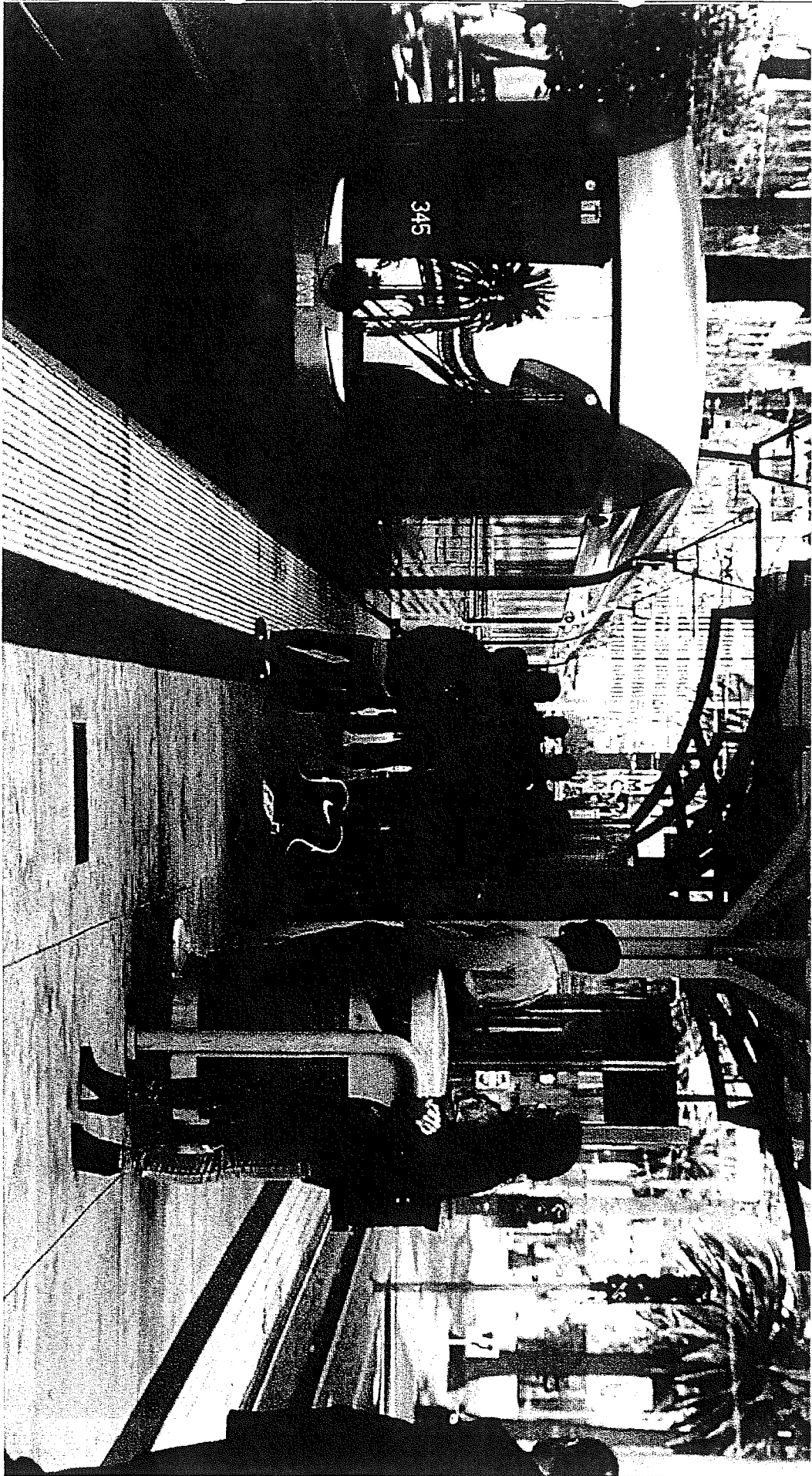
Exceed All Our Procurement Objectives

- **ON TIME:** Car builder has solid history of delivering **Quality** cars on time
- **LOCAL :** The project to be delivered (including support) within 90 miles of San Francisco
- **EXTENDED LIFE:** Offering 30 year design life vs. 25 years required
- **EXCEED RELIABILITY REQUIREMENTS :** Offering safe, attractive vehicles with reliability more than twice specified values in the RFP
- **FASTER DELIVERY:** Committed to deliver vehicles earlier than required, and also offering expedited delivery rate
- **COMPETITIVE PRICE:** High value low cost cars provide the Agency the opportunity to get 215 cars with the original budget for 175 cars
- **FINANCIAL SOLUTION:** Offering financing solutions to address SFMTA cash flow challenge

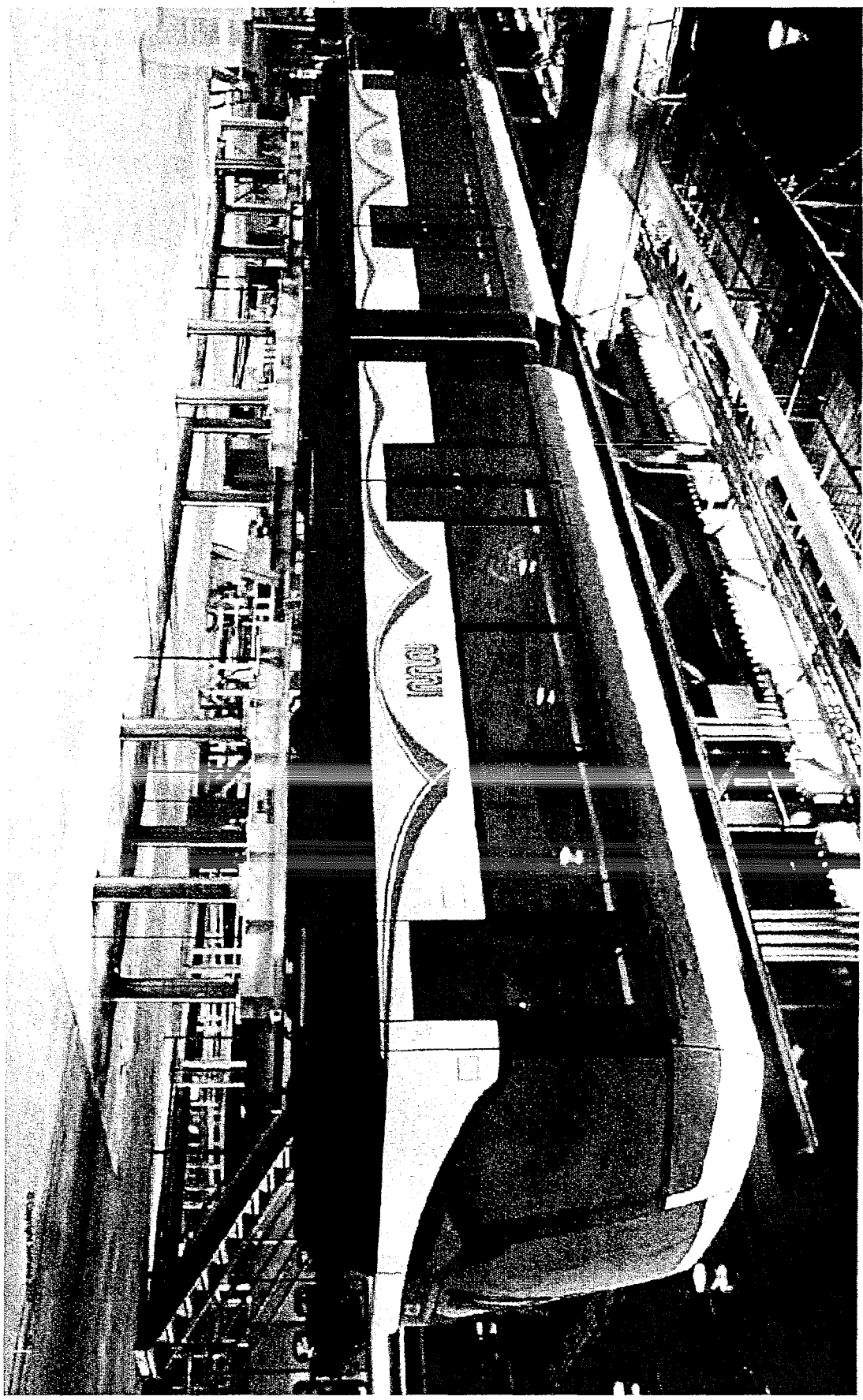
Light Rail Procurement – The Right Vehicle to Meet Our Demands

- SFMTA Board conditionally approved award of contract on July 15, 2014 to Siemens for up to 260 cars



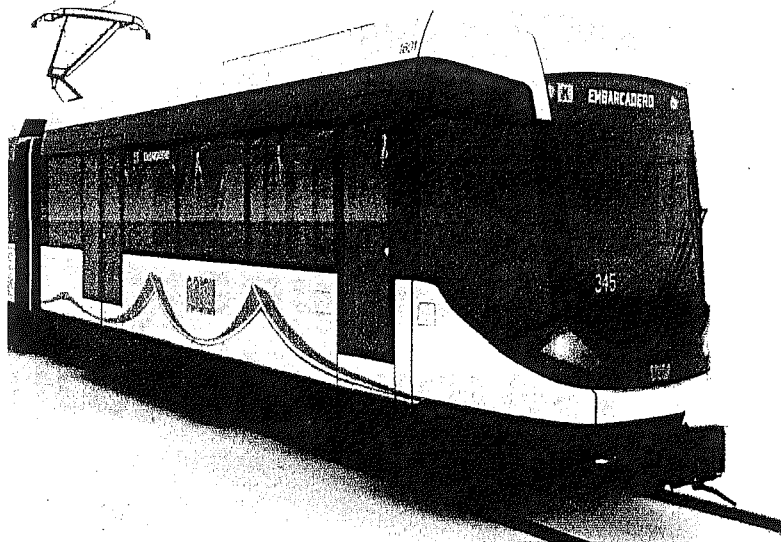


New LRV4 train on the lift at MUNI Metro East Facility



State of The Art Features in the New LRV To Improve Safety and Performance

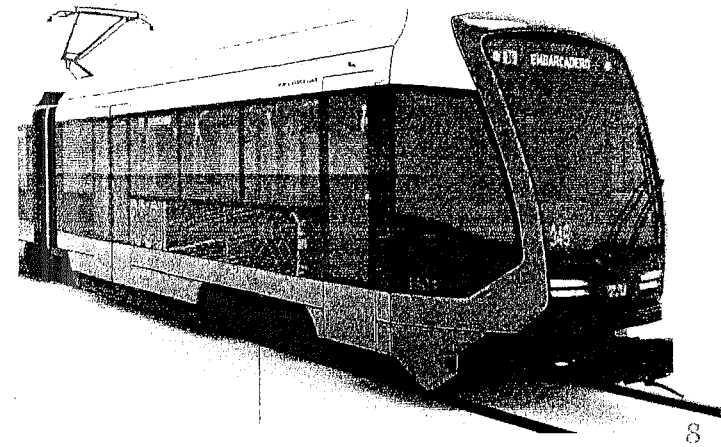
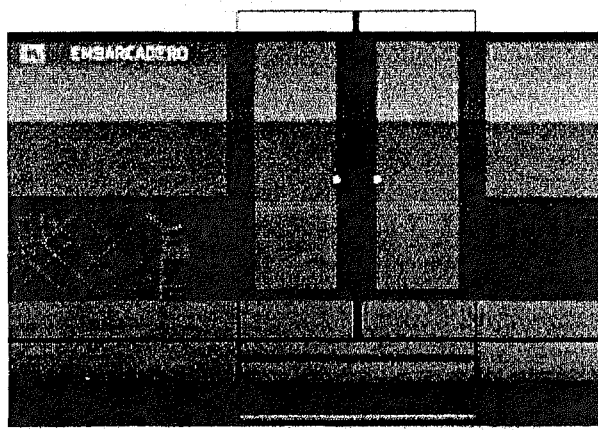
- Lightweight car body features a crashworthy design – meeting CPUC requirements
- Meets stringent weight requirements
- Designed to allow easy access for inspections, maintenance and repairs to minimize time out of service



- Improved passenger amenities, fully ADA compliant
- Modern information system with crystal clear audio announcement and camera surveillance system

Directly Address Component That Most Negatively Impacts Rail Service

- Improved passenger door system - higher reliability – fewer moving parts
- Dramatic reduction in maintenance
- Improved passenger door obstruction detection system
- Electrically operated steps for higher reliability and smoother operation

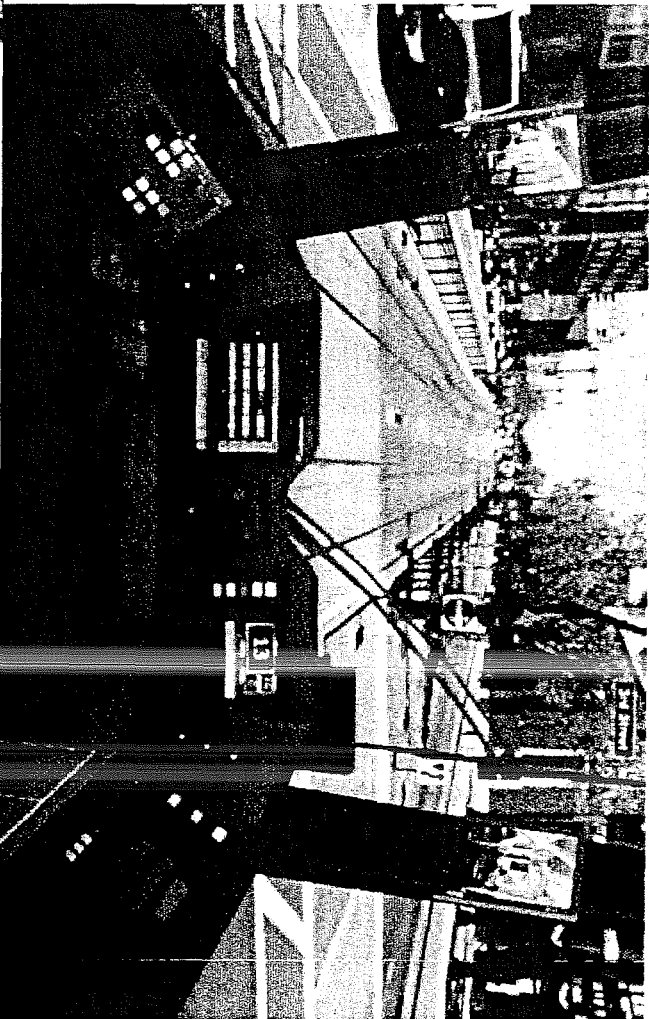


Longitudinal Seating: Wide, Open Interior

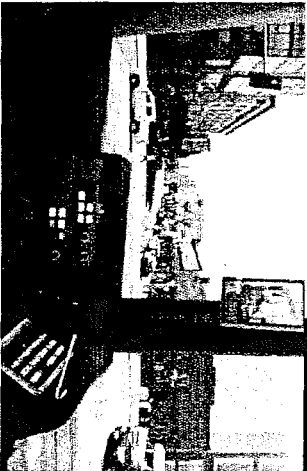


Final layout will be determined via public process/vetting with stakeholders such as CAC and MAAC

Operator's Cab

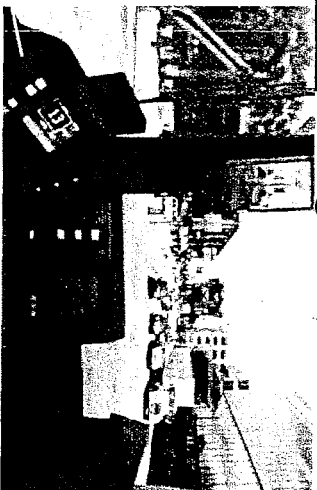


Center View



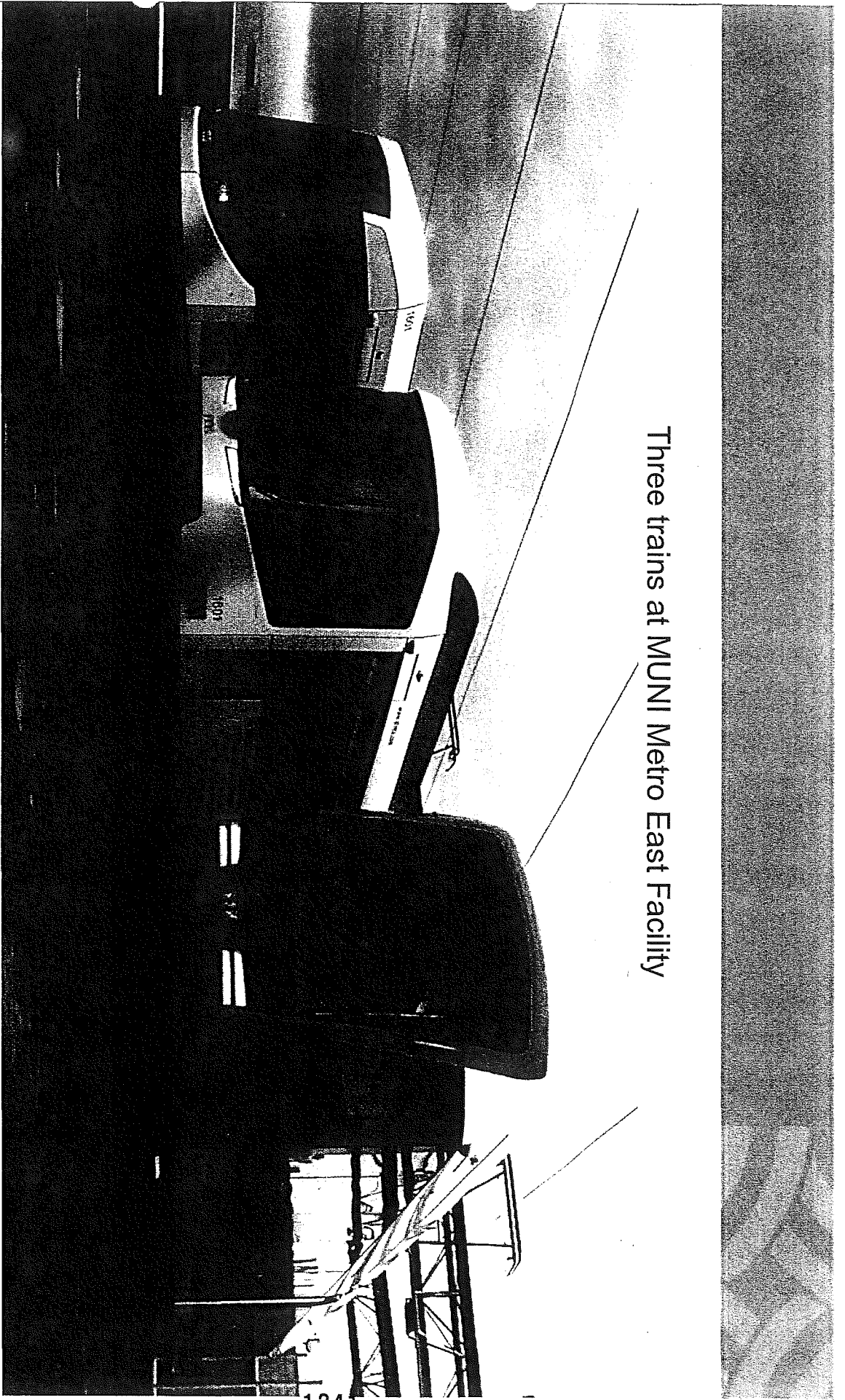
Left View

Ergonomic, High Visibility Design



Right View

Three trains at MUNI Metro East Facility



Meeting Transportation Goals of Current and Emerging San Francisco

Need	No. of Cars	Delivery
Central Subway Extension and near term service expansion	24	2017 – 2018
Fleet Replacement	151	2021 – 2027
Expansion Needs (Travel Demand Study)	85	
Short Term	40	2018 – 2021
Long Term	45	2027 – 2030

- Funding for the base order for CS and fleet replacement is programmed
- Funding for the needed short term expansion is being determined

Vehicle costs

NEEDS	NO. OF CARS	DELIVERY SCHEDULE	COST PER CAR
CURRENT NEEDS	Base Order = 175 cars		
Central Subway and near term service expansion	24	2016 – 2018	\$3.3M
Fleet Replacement (including escalation)	151	2021 – 2027	\$4.2M
EXPANSION NEEDS	Option Order = 85 cars		
Alternative #1	Short Term (40) (Price break due to escalations)	2018-2019	\$3.3M – \$3.6M
	Long Term (45)	2027 - 2030	\$5.1M
Alternative #2	85 (order later)	2027 - 2030	\$5.1M

1243

Selecting Alternative #1 and to exercise the option of 40 cars now would allow us to purchase cars at the best price and provide early delivery to meet service demand.

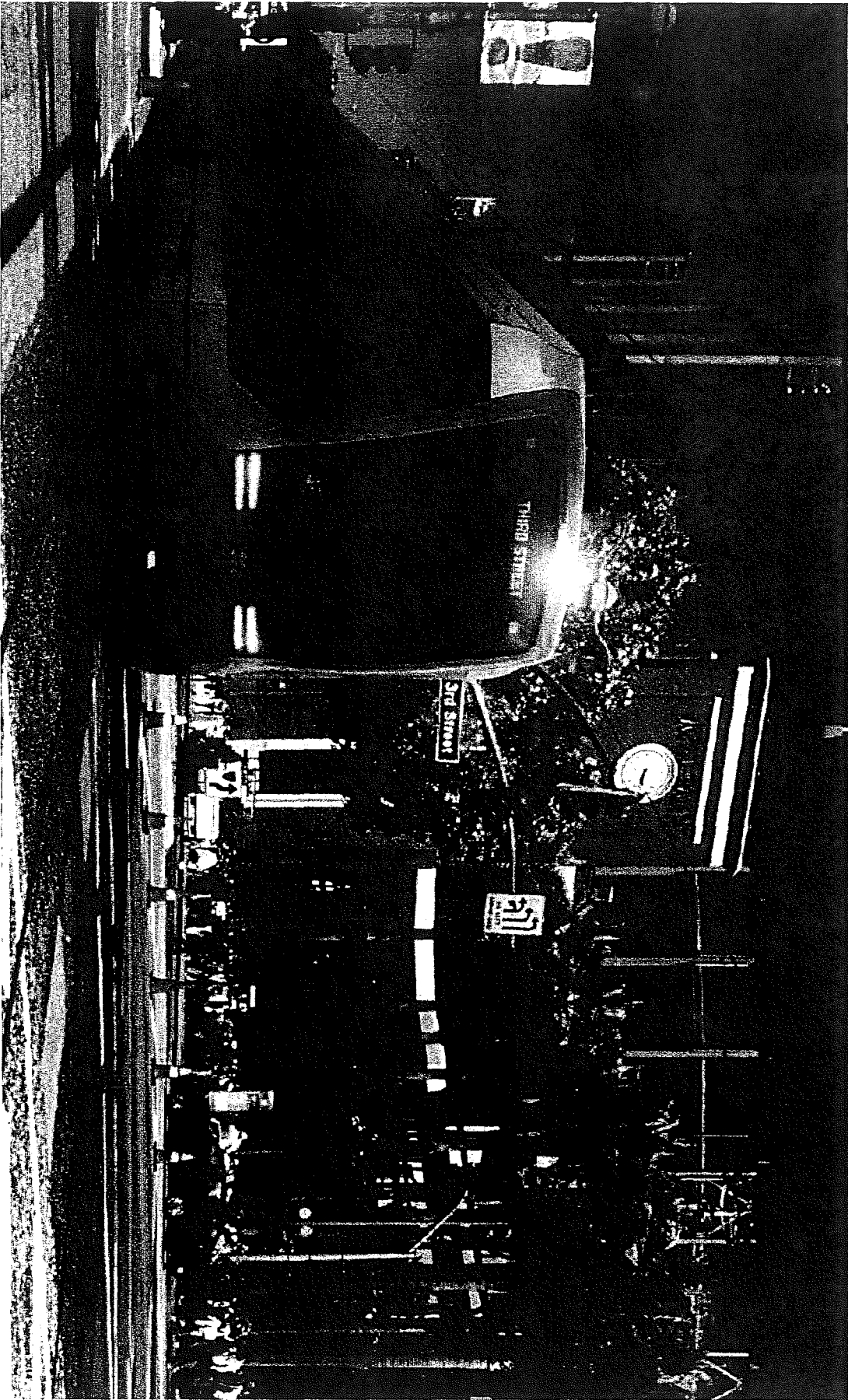
Requesting approval from the Budget and Finance Committee today for the following:

- Execute the Contract to procure up to 260 vehicles
- Recommend that the Full Board of Supervisors approve the contract
- Action is required today to meet the project schedule

1244

SFMTA Board Approved	- July 15, 2014
Recommended Board of Supervisors Approval	- September 2014
Notice to Proceed	- October 2014
First prototype car delivered	- December 2016

New LRV4 at 3rd and King



FORM SFEC-126:
NOTIFICATION OF CONTRACT APPROVAL
 (S.F. Campaign and Governmental Conduct Code § 1.126)

City Elective Officer Information <i>(Please print clearly.)</i>	
Name of City elective officer(s): Members, SF Board of Supervisors	City elective office(s) held: Members, SF Board of Supervisors

Contractor Information <i>(Please print clearly.)</i>	
Name of contractor: Siemens Industry, Inc.	
Please list the names of (1) Dulaney, Daryl Dean; Hislip, Daniel Wayne; Ludwig, Helmuth; Meier, Axel; (2) CEO: Daryl Dulaney, CFO: Axel Meier, and COF: Steven Mitchell Flanagan; (3) Siemens Corporation; (4) any subcontractor listed in the bid or contract: INIT (APC), Thales (ATCS), Kratos (CCTV), Hasler Rail (Event Recorder), Thermo King (HVAC), Harris (Radio) and (5) any political committee sponsored or controlled by the contractor: Siemens Corporation Political Action Committee	
Contractor address: 7464 French Road, Sacramento, CA 95828	
Date that contract was approved:	Amount of contract: Not to Exceed: \$1,192,651,577

Describe the nature of the contract that was approved: SFMTA: Procurement of New Light Rail Vehicles (LRV4)
Comments:

This contract was approved by (check applicable):

the City elective officer(s) identified on this form
 a board on which the City elective officer(s) serves San Francisco Board of Supervisors
Print Name of Board

the board of a state agency (Health Authority, Housing Authority Commission, Industrial Development Authority Board, Parking Authority, Redevelopment Agency Commission, Relocation Appeals Board, Treasure Island Development Authority) on which an appointee of the City elective officer(s) identified on this form sits

Print Name of Board

Filer Information <i>(Please print clearly.)</i>	
Name of filer:	Contact telephone number: 0
Address:	E-mail:

 Signature of City Elective Officer (if submitted by City elective officer)

 Date Signed

 Signature of Board Secretary or Clerk (if submitted by Board Secretary or Clerk)

 Date Signed

Introduction Form

By a Member of the Board of Supervisors or the Mayor

Time stamp
or meeting date

I hereby submit the following item for introduction (select only one):

- 1. For reference to Committee. (An Ordinance, Resolution, Motion, or Charter Amendment)
- 2. Request for next printed agenda Without Reference to Committee.
- 3. Request for hearing on a subject matter at Committee.
- 4. Request for letter beginning "Supervisor [] inquires"
- 5. City Attorney request.
- 6. Call File No. [] from Committee.
- 7. Budget Analyst request (attach written motion).
- 8. Substitute Legislation File No. []
- 9. Reactivate File No. []
- 10. Question(s) submitted for Mayoral Appearance before the BOS on []

Please check the appropriate boxes. The proposed legislation should be forwarded to the following:

- Small Business Commission
- Youth Commission
- Ethics Commission
- Planning Commission
- Building Inspection Commission

Note: For the Imperative Agenda (a resolution not on the printed agenda), use a Imperative Form.

Sponsor(s):

Breed; Wiener, Chiu, Mar, Tang, *Cohen*

Subject:

Contract with Siemens Industry, Inc. for Procurement of New Light Rail Vehicles

The text is listed below or attached:

Resolution approving a contract with Siemens Industry, Inc., to procure up to 260 light rail vehicles, associated services, spare parts, special tools, training and documentation, in an amount not to exceed \$1,192,651,777, and for a term not to exceed 15 years; and making environmental findings.

Signature of Sponsoring Supervisor:

For Clerk's Use Only:

140882