

# TECHNICAL SPECIFICATIONS

Complete Rehabilitation of 16 Ex-SEPTA PCC Historic Streetcars

CONTRACT No. CPT 660  
(CCO No. 13-1241)

Volume II

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# TECHNICAL SPECIFICATIONS

## 1 General:

This specification describes the remanufacture of 13 SFMTA single-ended and three double-ended historic Presidents' Conference Committee (PCC) streetcars.

### 1.1 Deliverables

In addition to remanufacturing the PCCs, the Contractor will be required to submit a series of documents. These documents are known as Deliverables. The Contractor shall assign a unique title and tracking number to each deliverable. All Deliverables listed in this Technical Specification are to be signed by the Contractor, scanned in high resolution Adobe Portable Document Format PDF format and submitted to the Engineer for approval.

**Timeliness of the deliverable is of the utmost importance since the work or subsequent work associated with each Deliverable shall not begin until the Engineer has approved the Deliverable.**

Individual deliverables can initially be sent via email; however, the Contractor shall provide a DVD(s) with the complete set of deliverables at the time the final Car is delivered. The DVD shall also contain a Table of Contents listing each Deliverable by name, description, tracking number and submittal date.

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**1.1.1 Management Plan**

The Contractor shall provide a management plan describing the Contractor's project team organization listing the personnel responsible for the project's completion, their individual areas of responsibility, their qualifications, and their contact information. As the personnel resources change during the life of the project, the contractor will provide an updated management plan.

*DELIVERABLE: Management Plan*

**1.1.2 As-Built Drawings & Schematics**

The Contractor shall provide as-built detail & assembly drawings and electrical schematics for the entire Car in AutoCAD 2000 .DWG format. Each drawing will be assigned a unique drawing number and all drawings shall be arranged into a top-down tree structure drawing package.

Each assembly drawing and schematic shall have a parts list describing the appropriate sub-assemblies, detail drawings and all other components necessary to complete the assembly. Each item in the parts list shall have a unique name, part number and quantity used.

The Contractor shall require that sub-suppliers provide assembly drawings with part lists. The sub-supplier drawings shall be integrated into the drawing package.

Contact information for the relevant sub-suppliers or part manufacturers shall be provided in the Notes section of each drawing.

Any additional information necessary to complete the manufacture of the part or assembly such as materials, bolt torque values, lubrication requirements, etc. shall be included in the Notes section of the drawings.

Wiring diagrams/schematics shall be provided in AutoCAD 2000 .DWG format. The diagrams shall be organized in a top-down structure and each diagram shall be assigned a unique drawing number. The top level should be a block diagram with individual systems separated (doors, console, propulsion, aux power, etc.) and showing the interconnections between each block with wire numbers, multi-pin connector or terminal block numbers, and each block shall indicate the individual detail drawing numbers for that particular sub-system. Detailed wiring diagrams for each sub-system shall include all wire numbers, terminal block and connector numbers, and references to different pages and page sector where the wiring continues. Diagrams shall employ a sector reference method at the top and left side of the page in order to narrow down the location of continuing wires. Any time a wire connects to a component or junction point, the terminal block and/or connector pin numbers of that particular junction point or component shall be referenced. This includes all relay coils, contacts, cam switches, console switches, motor connections, DC converter connections, terminal blocks, and multi-pin connectors. Detailed wiring diagrams shall also indicate the names of all relays (new and reinstalled), and relay contacts shall include their name and indicate the coil location if it is located on a separate page. If each PCC is not wired the same way, the wiring diagrams shall indicate the applicability by Car number and change pages shall be provided.

Drawings & Schematics shall be delivered prior to delivery of the second car. Later revisions shall be delivered as quickly as possible and a complete final drawing/schematic package will be delivered when the last car is delivered.

*DELIVERABLE: As-Built Drawings*

### **1.1.3 Bill of Materials (BOM):**

The Contractor shall compile all of the parts lists from the assembly drawings and schematics into a single searchable, sortable Microsoft Excel file. Each entry shall provide the part name, manufacturer, and part number. The Bill of Materials shall be delivered prior to the delivery of the second car.

*DELIVERABLE: Bill of Materials*

### **1.1.4 Support Documentation:**

The Contractor shall provide component support documents such as sub-suppliers manuals, materials data safety sheets, catalog cuts, spec sheets, vendor drawings, wiring diagrams, etc. sufficient that the SFMTA will be able to properly use and maintain each component. Support Documentation shall be delivered prior to delivery of the second car.

*DELIVERABLE: Support Documentation:*

### **1.1.5 Instructions and Training for Maintenance and Operations:**

For any modification from the Car's existing configuration or part substitution performed by the Contractor or sub-supplier that requires periodic maintenance or special repair procedures, the Contractor shall provide detailed maintenance instructions and preventative maintenance schedules sufficient that the components can be properly maintained by the SFMTA.

For any modification that requires that the Cars be operated in any way different from original, the Contractor shall provide Operator's training manuals, training course and matching video course. Instructions and Training documentation shall be delivered prior to delivery of the second car.

*DELIVERABLE: Maintenance Instructions and Training*

### **1.1.6 Project Plan and Schedule:**

The Contractor shall provide a detailed Project Plan and Schedule. The plan shall list the project tasks such as engineering, production planning, parts procurement, facilities preparation, production stages, QA/QC inspection points, testing, delivery and commissioning.

The plan shall include a schedule showing the planned start and finish dates for each task. The schedule shall be provided in the form of a Gantt chart. If at any time during the life of the project, the Contractor determines the planned schedule is not accurate, then the Contractor shall promptly update the schedule in accordance with Section 59.2 of the Agreement.

*DELIVERABLE: Project Plan & Schedule*



**1.1.7 Manufacturing/Repair Procedures and Sign Off Sheets:**

The Contractor shall provide a complete set of manufacturing/repair procedures. These shall be the same procedures as supplied to the Contractor's work crew. The procedures shall describe in detail each step in the overhaul. If the Contractor farms out the remanufacture of any major subassembly to a sub-contractor, then the Contractor shall also require the sub-contractor to provide manufacturing procedures.

Processes for repair of the Carbody are to be described in especially thorough detail, describing any special tools that will be used: such as ultrasound, dye penetrant, X-ray, welding equipment, welding materials, welder's certifications, industry welding practices used, etc.

The Contractor shall provide sign off sheets for each of the procedures. As each of the procedures is completed, the Contractor shall sign and date the sign off sheet confirming the work has been completed.

*DELIVERABLE: Manufacturing/Repair Procedures*

*DELIVERABLE: Manufacturing/Repair Sign Off Sheets*

**1.1.8 Quality Assurance/Quality Control Plan and Reports:**

The Contractor shall provide a Quality Assurance/Quality Control (QA/QC) Plan to be approved by the Engineer. The plan shall describe the Contractor's quality control processes, material review procedures, and Quality Control inspection and test processes.

The plan shall allow the Engineer to perform his/her own inspections at any time during the manufacturing process to verify the work is being performed in accordance with the Technical Specification.

The plan shall include inspection points in which the work up to that point is inspected and determined to meet the QA/QC criteria or is otherwise dispositioned through the Contractor's Materials Review process before any additional work shall continue.

As each QA/QC Inspection is completed, the Contractor shall provide a signed and dated report documenting the results of the inspection

*DELIVERABLE: Quality Assurance/Quality Control Plan & Reports (QA/QCP)*

**1.1.9 Test and Commissioning Plan and Reports:**

The Contractor shall provide a plan to test and commission the Cars. The plan shall include procedures to verify if each of the remanufactured systems meets the performance requirements of the Technical Specification.

The Contractor shall provide reports documenting the results of each test and commissioning procedure. The Contractor shall sign and date each test report upon completion.

The Contractor should anticipate that the SFMTA will run a 1000-mile burn-in period before acceptance of each Car.

*DELIVERABLE: Test and Commission Plan*

*DELIVERABLE: Test and Commissioning Reports*

### **1.1.10 State and Federal Requirements:**

In addition to the requirements of the Technical Specification, the Contractor shall ensure that the Cars are compliant with all applicable State and Federal Regulations; including, but not limited to:

California Public Utilities Commission (CPUC) General Order 143-B: Safety Rules and Regulations Governing Light Rail Transit, Title 8: Special Provisions for Historical Streetcars.

California Public Utilities Commission (CPUC) General Order 172: Rules and Regulations Governing the Use of Personal Electronic Devices By Employees of Rail Transit Agencies and Rail Fixed Guideway Systems.

Code of Federal Regulations (CFR) Title 49, Part 38: Americans with Disabilities Act (ADA) Accessibility Specifications For Transportation Vehicles.

Code of Federal Regulations (CFR) Title 49, Part 238.103 Fire Safety

The Contractor shall submit a plan describing how the Cars will be made compliant with these requirements.

*DELIVERABLE: State and Federal Requirements Plan*

### **1.1.11 Other Deliverables**

In addition to the Deliverables list in this chapter, other Deliverables are listed throughout the Technical Specification.

### **1.1.12 Muni Furnished Drawings, Schematics, and Documents**

Copies of PCC related drawings, schematics and documents from the SFMTA's archives will be made available to the Contractor. They are to be used for reference purposes only and do not necessarily reflect the current or final configuration of the Cars.

### **1.1.13 Shipment & Possession**

#### **1.1.13.1 Contractor Taking Possession of the Cars**

The Contractor shall take possession of the Cars from the SFMTA's facilities in San Francisco, California (6:00am – 3:00pm Monday through Friday).

### **1.1.14 Pre-Shipment Inspection and Inventory**

The Contractor shall conduct a pre-shipment inspection and inventory to determine the condition and completeness of each Car prior to it being loaded onto the transport vehicle for shipment to the Contractor's facility. The Contractor shall prepare an inspection and inventory report for each Car.

*DELIVERABLE: Pre-Shipment Inspection and Inventory Report*

#### **1.1.14.1 Shipment**

The Contractor is responsible for all shipments of the Cars from the point the contractor takes possession of it at the SFMTA's facility to the point of which the SFMTA accepts the Car after its return to the SFMTA's facilities. The Contractor shall also provide shipping to the SFMTA

for all spare and salvaged parts. The Contractor shall be responsible for shipping all of the SFMTA -provided parts to its location. The Contractor is responsible for all damage or missing parts that occur during the shipments.

#### 1.1.14.2 Double Ended PCCs

Double ended cars require, and the Contractor shall provide, twice the number of certain components necessary to complete the overhaul, components such as the Operator's cab components, horn, bell, Life Safety Guard, destination signs, headlights, etc..

The Contractor shall install new Operator's cab enclosures with the rear panels relocated aftwards to accommodate Operator's knee clearance to the palm rest bar. The installation in PCC # 1009 can be used as an example.

### 1.2 Disassembly

The Cars shall be thoroughly disassembled to expose all structural, mechanical and electrical components to allow for complete rehabilitation of the Car. All components that are to be temporarily removed are to be cleaned, repaired if necessary, tagged and stored in a location dedicated to the project. The Engineer shall have access to the storage area for inspection. Items not being reused but deemed salvageable by the Engineer shall be delivered to the SFMTA.

#### 1.2.1 Hazardous materials:

The contractor shall remove all Hazardous materials from the Cars and dispose of them in accordance with all applicable laws, Federal and State regulations.

#### 1.2.2 Deferred Work:

If during any of the disassembly inspection processes, the parties determine and agree that a particular task doesn't need to be performed due to the good condition of the component, then the Contractor will credit back the SFMTA the monetary value of the task as agreed to by both parties.

#### 1.2.3 Missing or Unrepairable Historic Components:

Historic Components are defined as original parts that cannot be readily bought or duplicated without special tooling, molds, or metal forming by hand using methods such as hammer and anvil work.

Historic Components that are missing or damaged beyond reuse are to be replaced in kind with original substitute parts if available.

For Historic Components that cannot be readily bought or duplicated, the Contractor will provide suitable substitutes which duplicates the look and function of the original parts to the greatest extent possible. Substitute parts shall be submitted to the Engineer for approval prior to installation.

### 1.3 Carbody

#### 1.3.1 Cleaning and Grit blasting

The carbody shall be cleaned and grit blasted inside and out, down to the clean bare metal such that no paint, dirt, grease, or rust exists anywhere throughout the carbody. Care shall be taken during the grit blasting process to minimize warping of the carbody panels.

#### 1.3.2 Carbody Inspection and Repair Report

The Contractor shall inspect the stripped Carbody, also including the sub-structure, frame, ducts, channels, and equipment boxes and provide a report describing each item of damage found. The report shall include thickness measurements of the various sections of the carbody, sub-structure, frame, duct channels and equipment boxes. Included in the report shall be a condemning limit for the thickness of the various structural parts listed above. The check off sheet is to be included with the report.

*DELIVERABLE: Carbody Inspection and Repair Report*

#### 1.3.3 Primer Coating

The Contractor shall primer the carbody, interior and exterior immediately after inspection to prevent flash rusting.

The suggested primer materials are:

Chassis: PPG Zinc Rich Primer System no. ZNP101 followed by PPG Cora shield no. P7972 underbody protection (protects the Zinc Rich from abrasion and road wear)

All other body panels: PPG Epoxy Primer systems DEP351 or F3950C.

Although these are the suggested primer materials, responsibility for the effectiveness, suitability, and application of the primer materials remains with the Contractor. Primer materials to be approved by the Engineer.

*DELIVERABLE: Primer Materials*

#### 1.3.4 Carbody Repair Plan & Procedure

The Contractor shall provide a stand-alone repair plan and procedure to fix the damage or, where appropriate, reverse the modifications described in the Initial Carbody Inspection Report. The plan will describe the procedures, list the materials, and reference the applicable engineering documents to return the carbody to the original manufacturer's specification for carbody geometry, structural integrity, sheathing flatness, design tolerances, and general fit and finish. The repair plan will include the addition of any modifications performed by the Contractor. Any applicable engineering analysis or design drawings necessary to show the repairs will provide the original structural integrity are to be included.

*DELIVERABLE: Carbody Repair Plan*

### **1.3.5 Carbody Repairs**

The Contractor will make repairs in accordance with the approved Carbody Repair Plan. The Contractor shall inspect the repaired carbody to ensure that the Carbody Repair Plan has been followed.

The Contractor shall provide a Repaired Carbody Inspection Report based on the findings of the repaired carbody inspection.

*DELIVERABLE: Repaired Carbody Inspection Report.*

### **1.3.6 Front Step well**

The Contractor shall provide a new front step well. If not already modified, the step well shall be notched to accommodate inward swinging (bi-fold) doors.

### **1.3.7 Rear Step well**

The Contractor shall provide new rear step well. The step well shall be designed to accommodate a treadle switch.

### **1.3.8 Anticlimbers**

The Contractor shall remove, clean, repair or replace the anticlimber as necessary to regain the original form, fit and function.

### **1.3.9 Water Accumulation**

As necessary, the Contractor shall modify the carbody such that there are no places for water to accumulate, i.e. under the windshields or the headlight recess.

### **1.3.10 Flip Skirt**

The Contractor shall modify the body skirt forward of the Motor Generator compartment to flip up for access. The skirt shall have a continuous piano hinge along the top and gas struts to hold it open. Two square key locks shall hold the skirt down. The existing flip skirt installation on PCC #1057 shall be used as an example.

### **1.3.11 Prime and Paint**

The Contractor shall prime the entire carbody throughout. The exterior shall be painted with up to four colors on the carbody and an anti-slip coating on the roof walk area. The under floor area shall be painted white. Visible areas of the carbody interior ceiling are to be painted cream, and interior sides green. The following paint materials are to be used:

- PPG DPU217 Polyurethane Primer
- PPG NCP280 2.1 VOC Primer Surfacer
- PPG Delta DUHS Basecoat/Clearcoat
- Henkel Loctite Big Foot Heavy Duty Pedestrian Grade Anti-Slip Coating
- Interior Green- PPG #49408
- Interior Cream-PPG #29349

Paint shall be applied per the manufacturer's instructions. The carbody finish shall be glossy and free of flaws, runs, and sags or orange peel texture. The paint shall pass an adhesion test to be included in the Carbody Repair Plan. The Cars shall be painted in a historic paint scheme to be supplied by the Engineer. The anti-slip roof walk area coating shall cover the area previously covered by the rubber matting and extend forward to the front trolley pole mount on both sides of the trolley boards and extend to the trolley hook area.

### **1.3.12 Insulation**

After water testing, the contractor shall apply primer and a sound absorbing undercoating to the interior side of all external side sheets, end sheets and roof sheets. Materials to be approved by the Engineer.

*DELIVERABLE: Insulation Materials Submittal*

### **1.3.13 Subfloor**

The Contractor shall install a new sub floor. The subfloor shall be ply-metal made from 3/4 inch marine grade plywood with a .016" 430 stainless steel skin bonded to both sides. Marine grade plywood must meet the Engineered Wood Association APA 3/4" Marine Grade standard.

Stainless Steel skin must meet the American Iron and Steel Institute (AISI) 430 standard. The stainless steel skins shall be securely bonded to the plywood with epoxy adhesive and the edges epoxy sealed from moisture entry.

Tapping plates shall be incorporated into the floor system design to allow mounting of the seat pedestals. Neoprene anti-squeak tape shall be installed over all carbody structural cross members that support the floor prior to the installation of the floor panels. All panels shall be as long as possible, and shall extend the full width of the car with transverse joints located over structural members. All exposed panel edges, such as openings for conduits and joints between panels, shall be waterproofed and sealed. All floor panel joints shall be made on a supporting member and a non-hardening, polyurethane sealant/adhesive equal to Sikaflex 221 shall be applied between joints of the panels. The floor panels shall be attached to the carbody structure using stainless steel flat head countersunk fasteners. The entire floor is to be smoothed with an epoxy-patching compound.

Any water drainage camber built into the original floor design will remain intact.

### **1.3.14 Floor Covering**

The Contractor shall provide floor covering in the aisle way. The floor covering shall be black RCA Transit-Flor PGF Double Grooved Ribbed Transit Flooring with the ribs running lengthwise. The floor covering will be bonded to the sub floor with RCA epoxy adhesive. The step covering will be black RCA Transit-Floor Fiber Reinforced Rubber Step Treads with 22-gauge steel backing and straight ribbed yellow nosing. The floor covering in the area under the seats will be black RCA 1/8" thick Smooth Surface Transit Flooring. The floor covering at the front entrance shall be installed at 90 degrees to facilitate easy cleaning.

### **1.3.15 Passenger Seats**

The Contractor shall remove, renew, and reinstall all passenger seating. Seat frames shall be inspected, cleaned and stripped, repainted, repaired or replaced if necessary and reinstalled. New seat cushions with new back/bottom panels shall be upholstered with dark green Naugahyde type

vinyl and foam which meets ASTM E662 (suggest Naugahyde 2-200 Flame Blocker PH-51 Bottle Green). ¼”-20 Tee-nuts shall be used to attach the seat backs to the frames.

#### 1.3.15.1 Wheelchair Accommodation and ADA compliance

The existing ADA flip seats and wheelchair locks shall be refurbished to new condition or replaced with new and upholstered to match the passenger seating described previously.

*DELIVERABLE: Seating Area Design*

#### **1.3.16 Stanchions**

The Contractor shall refurbish or replace, and install all of the stanchions and grab handles.

#### **1.3.17 Modesty panels**

The Contractor shall replace the modesty panels with new panels.

#### **1.3.18 Interior Panels**

The Contractor shall renew or replace the interior panels, ceiling panels, and air diffusers to new condition.

#### **1.3.19 Side Destination Sign**

The Contractor shall refurbish to new condition or replace with new, the Trans-Lite Inc DMU 300 sign above the passenger window behind the front door. The Contractor shall provide new sign curtains with destinations to be supplied by the Engineer.

#### **1.3.20 Front Destination Sign**

The Contractor shall refurbish to new condition or replace with new the front destination sign, Trans-Lite DMU 200 and DMU 100. The Contractor shall provide new sign curtains with destinations to be supplied by the Engineer.

#### **1.3.21 Advertising frames**

The Contractor shall refurbish to new condition or install new interior advertising frames duplicating the existing frames.

#### **1.3.22 Glazing**

The Contractor shall provide all new laminated safety glass per ANSI Z26.1 throughout the Car.

##### 1.3.22.1 Windshields and Other Fixed Glass

On the windshields, destination sign windows and porthole windows, a new rubber extrusion, designed for easy glass replacement, shall be installed.

##### 1.3.22.2 Passenger Windows

The Contractor shall install all new glass, gaskets and seals. The Contractor shall refurbish the sash, guides and latches such that the windows open, close and lock properly. Chalking shall be

used between the rubber seals and the steel portal to prevent water ingress behind the carbody skin.

#### 1.3.22.3 Rear Windows

The rear windows shall be emergency escape windows. The Contractor shall propose a design to the Engineer for approval.

*DELIVERABLE: Rear Window Design*

#### 1.3.22.4 Operator's Side Windows

The large Operators side window shall be refurbished in the same manner as the passenger windows.

The small horizontal window shall be refurbished with new glass, seals and gaskets. The Contractor shall refurbish the sash, guides and latches such that the windows open, close and lock properly.

#### 1.3.22.5 Anti-Graffiti Shield

The Contractor shall provide a clear plastic film protection to minimize etching on the inside of all passenger windows, porthole windows, door windows, and rear windows. The contractor shall submit the film and its application to the Engineer for approval.

*DELIVERABLE: Anti-Graffiti Shield*

### 1.3.23 Wiring

All of the existing wiring shall be removed and disposed of in accordance with all appropriate laws and regulations.

The Contractor shall install all new wiring throughout the Car. Permanent individually coded wire markers are to be attached to both ends of each wire and again six inches inward on both ends. All exposed wiring is to be run through metal conduit with strain relief on the ends. Exterior conduit is to be watertight. The wire sheathing shall meet the fire, smoke and toxicity requirements of NFPA 130. Rockbestos Surprenant Cable Exane wiring or approved equivalent shall be used.

To the greatest extent possible, the wiring should use existing raceways and always be hidden from passenger view and protected from the elements. Wire ends shall have terminals approved by the Engineer. Friction fit terminals are prohibited. Only one wire per terminal lug is allowed, and there shall be no more than two terminal lugs installed per binding post.

Passive components in the low voltage bus shall be installed on terminal boards or other devices using connections which are easily accessible for testing and replacement. Floating components within wire bundles is not permitted. Hidden components installed within proprietary terminal blocks are not permitted.

The Contractor shall provide a wiring test plan for approval by the Engineer to test all of the wiring harnesses. The Contractor shall perform the wiring test on each Car upon completion of the wiring installation. The wiring test shall verify point-to-point continuity, and proper termination at binding posts and devices per the design drawings. The test procedure shall include steps to verify wire labels match the design drawings.

*DELIVERABLE: Wiring Test Plan and Report*



### 1.3.24 Horn

The Contractor shall refurbish or install a new electric horn; however, the Contractor shall show through testing that the horn will produce at least 85dBA at 100 feet away from the Car.

The Contractor shall install a momentary switch to operate the horn in a convenient location on the Operator's console. The Location shall be submitted to the Engineer for approval.

### 1.3.25 Bell (Gong)

The Contractor shall refurbish or install a new repeating bell (equivalent to Selective Transit Products 92037100010 or AnsaldoBreda R07492710); however, the Contractor shall show through test that the bell will produce at least 75dBA at 100 feet away.

If the Car is configured to energize the gong when the reverse direction is selected; the gong shall be silenced when the front door is opened.

*DELIVERABLE: Horn & Bell Test Results*

## 1.4 Operator's Area

### 1.4.1 Console

The Contractor shall completely refurbish the Operator's Console as set forth in this section.

#### 1.4.1.1 Speedometer / Odometer

The Contractor shall install a new combination speedometer/odometer on the Operator's console. The speedometer/odometer shall be wired to the Car for power and to the Tachometer Sensor (see Trucks). An approved speedometer is the AMETEK Dixson 500 Series 49522 5-B2-00050-MPH-12-BA--W-22. The Contractor shall calibrate the speedometer once installed.

*DELIVERABLE: Speedometer Calibration Report*

#### 1.4.1.2 Console Indicators

The existing incandescent indicator lights shall be replaced with LEDs.

The existing Center Door Open light shall be reconfigured into a green All Doors Closed light.

The Contractor shall install new LED console indicators lights.

- \* All Doors Closed                      Green
- \* Shaft Brake Applied                 Red
- \* Regular Stop Request                Yellow
- \* ADA Stop Request                    Blue

A new All Doors Closed and Shaft Brakes Applied label strip shall be configured as:

**“ALL SHAFT DOORS BRAKES CLOSED APPLIED”**

A new Stop Request light label strip shall be configured as:

**“REGULAR ADA STOP REQUEST”**

### 1.4.1.3 Gang Switch Assembly

The gang switch assembly shall be disassembled, rebuilt and modified-as-required with all new switch contacts, wire shunts, hardware, stationary contacts and return springs (sander switch return switch to be shunted). All other parts shall be cleaned, lubricated and reassembled. After replacing contact and cleaning, each switch shall be megohm meter tested at 1000 volts for 1 megohm resistance to ground. Any switch that fails the resistance to ground test shall be repaired or replaced as necessary. Contacts shall be rated for the load. Flexible shunt straps shall be replaced with appropriately sized wire shunts and terminal lugs.

All high voltage (600 VDC) circuits shall be removed from the console and the gang switch assembly. These high voltage circuits are the heater and lighting circuits, switch numbers 17, 18 and 19. The high voltage circuits shall be controlled by relays in an under floor box to be installed by the Contractor.

The interior lighting control switch shall be changed to a low voltage control circuit and shall be controlled separately.

The Contractor shall install new laminated plastic label strips to replace the current label strips for the Gang Switches and the indicator lights. The label strips shall be engraved to provide the designation of each of the switches or indicators. The engraving shall be Helvetica Medium font and shall be white lettering on a black background. Gang switch labels shall be as listed below:

#### Single-ended Cars:

<u>Switch No.</u>	<u>Label</u>
1	GONG
2	FRONT DOOR #1
3	FRONT DOOR #2
4	TREADLE
5	REAR DOOR #3
6	REAR DOOR #4
7	REAR DOOR TREADLE
8	FAN
9	M-G
10	TRACK BRAKE
11	BRIGHT/DIM
12	HEADLIGHTS
13	SAND
14	DOME LIGHT
15	MICROPHONE
16	CAB HEAT
17	(blank spacer)
18	(blank spacer)

- 19 INTERIOR LIGHT 1
- 20 INTERIOR LIGHT 2

Double-ended Cars:

Switch No.	Label
1	GONG
2	FRONT DOOR #1
3	FRONT DOOR #2
4	TREADLE
5	REAR DOOR #3
6	REAR DOOR #4
7	REAR DOOR TREADLE
8	FAN
9	(blank spacer)
10	TRACK BRAKE
11	BRIGHT/DIM
12	HEADLIGHTS
13	SAND
14	DOMELIGHT
15	MICROPHONE
16	CAB HEAT

Notes:

Switches 1 Gong, 4 Treadle, 10 Track Brake, 13 Sand, 15 Microphone and 18 Horn are to be momentary. 10 Track Brakes and 13 Sand are to have a coil spring extension.

**1.4.2 Cab Heater, Defroster And Fan**

The Contractor shall install a new cab heater. The heater shall be thermostatically controlled, it shall be ducted and have a fan to distribute the heat into the cab area. If necessary for safe operation, the fan shall continue to run after the heating element has been shut off until the heating element has sufficiently cooled. Areas of the heater too hot for human touch shall be isolated so they cannot be reached.

The Contractor shall replace the operator's ventilation fan with a new fan of the same type. If the new fan is of a different manufacture or part number, it shall be approved by the Engineer.

The Contractor shall install a new windshield defroster and control switch. Design to be submitted to the Engineer for approval.

*DELIVERABLE: Fan & Defroster Submittal*

### **1.4.3 Operator's Seat**

The Contractor shall install a new USSC Group 9200MLX operator seat. No adjustment lever shall interfere with the operation of the reverse lever or other parts critical to the Car's operation. Operator's seat upholstery shall be black cloth. The Operator's seat shall be installed with enough clearance to the gang switch wrist rest such that a 98% percentile male shall have clearance for his legs.

### **1.4.4 Clipper®**

The Contractor shall provide all new wiring for the installation of the Clipper® fare collection equipment. Clipper® equipment consists of a Drivers Display unit mounted in the Operator's compartment and Card Reader mounted on stanchions located at each doorway. Necessary technical information will be provided by the SFMTA.

### **1.4.5 Fare Box**

The Contractor shall refurbish the mounting provisions and 12 VDC circuits and conduits for the fare collection box.

### **1.4.6 Windshield Wipers**

The Contractor shall install new windshield wiper mechanisms. The motors and control system shall be replaced with new. Each arm to be powered by an individual motor. The speed of the wiper mechanism shall be variable and controlled through a rotary rheostat to be located on the Operator's console. The wiper control system shall include an intermittent operation position.

### **1.4.7 Radio And Public Announcement System (PA)**

#### **1.4.7.1 Contractor Supplied Items**

The Contractor shall supply the following items:

- \* Motorola Syntor Radio Cable TKN-8127B
- \* Motorola Alarm Cable TKN8130A
- \* Motorola Filter Tray Cable 30-5827T01
- \* Motorola Power Filter TLN5277B
- \* Motorola 15Amp Fuse Holder 0984277B01
- \* Motorola 15Amp Fuse 6500136969
- \* Motorola EA Switch 40-8260M03
- \* Motorola Transmitter/Receiver Radome Antenna RRA4738A
- \* Radio Engineering International 25" Microphone 480117BK
- \* Radio Engineering International Transit PA Amplifier 700168
- \* Atlas Sound Loudspeaker Assembly APF-15 & L20-100 & BX-3A
- \* DPDT Switch for the PA

The Contractor shall also provide any number of various brackets, hardware, connectors, or lengths of stranded oil/grease/abrasion resistant wire that are necessary to complete the installation.

#### 1.4.7.2 SFMTA Supplied Items

SFMTA will supply and install the following:

- \* Motorola Mobile Data Terminal T1941 (includes handset, speaker, mounting tray and Terminal head).
- \* Motorola Transmitter/Receiver T34RTA
- \* Power blocks and terminal strip

#### 1.4.7.3 Radio Installation Detail

The Contractor shall install all of the Contractor supplied components listed above except the Power Filter, 15-amp fuse and 15 amp fuse holder, which will be installed by the SFMTA. The Contractor will install the balance of the components necessary to complete the installation.

The Contractor shall refurbish, or install new, the watertight locking Radio Compartment near the Operator's console for mounting the Transmitter/Receiver, power blocks and terminal strip. The Contractor shall install threaded inserts to mount the equipment. The transmitter/receiver shall be serviceable without removal of handrails, stanchions, or other equipment.

The Contractor shall be responsible for the routing of all cables. To the maximum extent possible, the cables shall be hidden from view. If visible, they shall be enclosed in conduit. All undercar cabling shall be protected in waterproof conduit. The ends of all cables shall be labeled. All free lengths of wire shall have a 12" diameter service loop at both ends. Fixed length cables shall split any extra length evenly between the two ends.

The Contractor shall provide mounting provision and watertight locking box for the radio terminal head and headset on the interior panel to the left of the Operator and below the window. The Contractor shall install threaded inserts to mount the Terminal head. The Filter Tray Cable shall run from the Terminal head location into the Radio compartment with the white connector towards the Terminal head. The Syntor Radio Cable shall run from the Terminal head location into the Radio Compartment with the blue/white connector towards the Terminal head.

The Data Terminal speaker shall be mounted on the Operator console between the gang switch and the windshield. Two 16 AWG wires shall run from the speaker to the Terminal head location.

The PA microphone shall be mounted on the left corner of the Operator's console. The SFMTA will install the handset. The Contractor shall install the PA microphone and threaded inserts for the mounting of the handset. Two 16 AWG-shielded wires shall run from the microphone through the gang switch and to the audio input of the PA amplifier.

The PA amplifier shall be mounted in the cabinet below the Operator's console. The PA amplifier shall be serviceable without removal of the transmitter/receiver. A 12 VDC circuit shall provide power to the Motorola Transmitter/Receiver, PA amplifier, Farebox, and Next Bus GPS system. Each device shall be input protected with a circuit breaker.

Shielded 14 AWG positive (red) negative (black) and ground (white) wires for the Farebox shall run under the floor and extend 36" into the cab beyond the Farebox mounting location. The wires shall be terminated with an AMP connector to be designated by the Engineer.

12 AWG positive (red) and ground (black) wires for the Transmitter/Receiver shall run to the Radio Cabinet.

16 AWG positive (red) and ground (black) wires shall run to the PA amplifier.

The DPDT switch for the PA shall be mounted on the console and labeled "Interior," "Exterior," and "Both."

16 AWG wire shall connect the audio output side of the PA amplifier through the DPDT switch to the PA speakers and exterior loudspeaker.

A waterproof exterior PA loudspeaker shall be installed outside the car near the front door, similar to the installation on the SFMTA's PCC #1060.

The emergency call pushbutton (EA switch) shall be mounted on the underside of the Operator's console. The Alarm Cable shall be routed from the EA switch to the Terminal Head with the black/white connector towards the Terminal head.

The Radome Antenna shall be mounted on the roof of the PCC between the roof shroud and the front trolley pole, similar to the installation on the SFMTA's PCC #1060. An aluminum ground plane is required, size and design to be specified by the SFMTA. The RG58AU coaxial cable that comes with the antenna shall be snaked through the ceiling to the radio compartment. A removable cover on the ceiling shall provide access to the antenna.

The Contractor shall demonstrate that the PA functions properly, that there is power at the Transmitter/Receiver, and that there is power at the fare box mounting location.

#### **1.4.8 Next Bus Equipment**

The Contractor shall provide all new wiring for the Next Bus equipment. Technical information will be provided by the SFMTA. On double ended Cars, the GPS tracker electronics shall be powered regardless of end selection.

#### **1.4.9 Vetag, Remote Switch Operation**

The Contractor shall provide new and install the following Vecom/Peek Industries VETAG system components for remote operation of track switches and other possible future applications.

HP2 Transponders & Connector Assy	28836221-02
Cable XPDR – CCB	28826213-01
Cable CCB Input	28816192-02
TWC Code Control Box	28846134

The equipment for each car shall include the variable-code transponder, code control box, and multi-conductor connecting cables. The transponder shall be mounted according to the manufacturer's instructions under each cab, and shall be accessible and removable from under the car. The Transponder shall be connected via multi-conductor cable to the code control box to be mounted on the Operator's console. The receiver coil shall be mounted from the car body approximately 10 inches above the rail on the centerline of the car and in front of each truck.

Power for the VETAG equipment shall be taken from the car's low voltage DC power supply (36 VDC nominal) and protected by a 3 Amp circuit breaker. The low voltage power for the VETAG equipment shall be controlled by Gang Switch No. 9, the M-G set's control.

#### **1.4.10 Storage Locker**

The Contractor shall replace or refurbish the existing locker to new condition. On single enders, the locker shall be relocated to ten inches aft of the seat box. If necessary, the adjacent stop request switch shall be moved forward sufficiently that access to its mounting hardware is not

blocked by the locker. The stanchions shall be modified as-necessary to accommodate the new locker position. The locker shall have a new lock, keyed for SFMTA's standard key.

#### **1.4.11 Transfer Cutter**

The Contractor shall provide and install a new transfer cutter.

#### **1.4.12 Mirrors**

The Contractor shall install all new mirrors equivalent in size and location to the existing mirrors.

#### **1.4.13 Exterior Cameras**

The Contractor will install two exterior color cameras to provide the Operator with a view looking down the left and right sides of the Car. The camera output shall be displayed on one or more LCD displays on the Operator's console. The Contractor will provide a system design package to be approved by the Engineer.

*DELIVERABLE: Exterior Camera Design*

### **1.5 Digital Video Recording System (DVRS)**

The DVRS system equipment supplied by the Contractor shall include wiring, cabling, and software for the installation of DVRS system in the vehicles and all fixed-end information system components, including wiring, cabling, hardware, and software that are required for retrieval, viewing, and storage of recorded images. The DVRS system equipment shall provide the capability and expandability that allows for system additions and future technological upgrades.

The new DVRS systems shall be compatible with the video retrieval methods of the systems currently being installed by SFMTA on its revenue vehicles. In other words, the SFMTA must be able to either remove the Data Pack (hard drive) of the video system bring it to an off-site location where the contents can be viewed or download the contents wirelessly from the vehicle upon entering the maintenance site and view the contents at an off-site location.

The mobile DVR shall be a sixteen (16) channel video server and digital recorder providing access to live and recorded images via wireless or wired IP connections. The units shall be specifically designed for public and commercial transit applications and enclosed in a robust metal chassis. The DVR shall be capable of integration with accelerometer, intelligent power management, vehicle system data, and a driver silent alarm.

The Contractor shall install a new base station including servers, transmitters, receivers, antennas, wireless access points, and other accessories needed to download data from transit vehicles to a central management system located in the SFMTA Cameron Beach maintenance facility.

The Contractor shall install wireless network equipment on transit vehicles and at the maintenance facility capable of wirelessly downloading any selected video(s) via 802.11 wireless protocols. The new DVRS systems, utilizing transit vehicle GPS technology, shall have the ability to provide exact vehicle location to the SFMTA's Operations Control Center ("OCC") for transit operations and law enforcement purposes. The DVRS system equipment shall also provide the ability for law enforcement or other authorized SFMTA personnel to view real-time transit vehicle video and audio recordings from a distance of up to 500 yards away from the vehicle.

The Contractor shall comply with all applicable federal, state, and local laws and regulations. In addition, Contractor shall adhere to all applicable SAE, IEEE, and NTSC standards. It is the full responsibility of the Contractor to dispose of all removed material (cabling, electronic equipment, and other related equipment) according to all applicable environmental regulations.

The manufacturer shall provide all service and support within the continental U.S. without the need to ship products out of the country and/or overseas for service.

### **1.5.1 DVRS Definitions**

AGC:	Automatic Gain Control
CCD:	Charge Coupled Device
CCTV:	Closed-circuit Television
CIF:	Common Intermediate Format
Data Pack:	Hard drive in the DVR
DVR:	Digital Video Recording unit refers to the individual digital recording unit on each vehicle
DVRS:	Digital Video Recording System refers to the system in its entirety.
EMI:	Electromagnetic Interference
ETI:	Electrical Training Institute
GPS:	Global Positioning System
H.264:	A video compression format also known as MPEG-4 AVC.
HD:	High Definition 1280x1024 resolution
IEEE:	Institute of Electrical and Electronics Engineers
IP:	Internet Protocol
MRO:	Metro Rail Operations
MRU:	Mobile Response Unit
NTSC:	National Television System Committee
PDA:	Personal Digital Assistant
RFI:	Radio Frequency Interference
SD:	Secure Digital
UV:	Ultra Violet

### **1.5.2 DVRS SUBMITTALS**

The Contractor shall provide the following DVRS related documents:

### **1.5.3 DVRS Product Data**

The contractor shall provide for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, and related contract document section number, paragraph number, and referenced standards for each listed



product. The data package shall include manufacture's data for all materials and equipment, including sensors, local processors, and console equipment provided under this specification.

#### **1.5.4 DVRS Shop Drawings**

Provide system block diagram; console installation and wiring diagrams; local processor installation, typical block, and wiring diagrams; local processor physical layout and schematics; unit wiring and installation drawings; wire and conduit sizes for the complete system design; details of connections to power sources, including power supplies and grounding; details of surge protection device installation; and details of interconnections with radio/silent alarm and GPS media transmission sources.

The Contractor shall supply four (4) complete sets of system operation, parts, and maintenance manuals for each type and/or model of equipment purchased by SFMTA in both hard copy and electronic formats. The manuals shall cover all aspects of hardware and software, and address different needs from various users, such as maintenance technicians, security personnel and traffic control officers.

*DELIVERABLE: DVRS Deliverables*

#### **1.5.5 DVRS Equipment**

The DVR shall have programmable parameters embedded or otherwise non-corruptible operating system to the satisfaction of the SFMTA. The programmable parameters shall not be subject to corruption by environmental factors, powering down, power failure, transient power fluctuations, power surges, or other irregularities. The parameters shall be capable of being stored for a minimum of five years without power.

The DVR shall power down at a user selected time after switched power is removed. If it is unable to power down automatically, the unit shall tolerate having power removed suddenly with no negative effect on the DVR, system hardware, operating system, stored data/video/audio, or on the system's ability to function normally once power is restored. If the operating system stops or stalls during startup due to some power irregularity, it shall automatically restart once full power is restored.

The DVR shall be designed specifically for use in transit applications to the satisfaction of the SFMTA. It shall incorporate internal shock and vibration isolation systems that allow recording while the unit is subjected to the vibration and impacts that occur in a moving transit vehicle. The on-board system shall operate in humidity ranges between 10 percent and 85 percent and in temperature ranges between 31°F and 131°F.

The DVR shall capture high quality images in a digital format to the satisfaction of the SFMTA. The images shall be stored on removable hard disk drives described herein for review and playback at central viewing stations wirelessly or through an on-board connection to a laptop computer. The hard disk drive shall be housed in a rugged enclosure that locks to the recording unit. The hard drive shall be removable while the DVR is powered without corrupting data on the drive. When the hard drive is re-inserted, it shall automatically mount to the DVR operating system with no additional user interaction required. Each enclosure shall be keyed alike, and one key per enclosure shall be provided.

The DVR shall be designed to restrict access, prevent alteration of images, and prevent tampering with the unit to the satisfaction of the SFMTA. The DVR shall provide an external connection to off load data and run set-up diagnostics via a laptop computer. The DVR shall provide system status indicators on the front panel.

The DVRS shall interface with the existing GPS unit on the vehicle, and mapping software shall be provided for displaying transit vehicle location and time stamp at the viewing station during revenue service to the satisfaction of the SFMTA.

The DVRS shall be programmable to automatically tag events, or pre-programmed activities to the satisfaction of the SFMTA. Tagged and programmed events shall be stored, and when a recording is retrieved, the tagged events shall be easily identifiable.

The DVRS shall be able to retain time, date, and any user programmable data (i.e., vehicle number, etc.) without connection to the power source to the satisfaction of the SFMTA. The system shall have its own power supply connected to the power of the transit vehicle. The system must be able to withstand all transients, surges, and dips in power from the vehicle's electrical system without any deterioration of system performance. The system shall not be affected by electro-magnetic interference (EMI) or radio frequency interference (RFI). The system shall meet all applicable rules and regulations of the Federal Communications Commission (including FCC Part 15 Rules and Regulations) and the Department of Transportation.

At the discretion of the SFMTA, the SFMTA can request the Contractor to demonstrate and/or submit test reports that the DVRS system equipment can withstand failure injected conditions.

*DELIVERABLE: DVRS Test Reports*

## **1.6 Health Monitor Tool ("HMT")**

The Contractor shall provide application software for continuous monitoring of the health of remote DVRs to the satisfaction of the SFMTA.

### **1.6.1 HMT Capabilities**

The HMT shall be provided with the following:

Automatically monitors multiple remote connected DVRs at set intervals.

Ability to manually poll all DVRs for system health variables.

Provide an on-line report of all results.

Export reporting capability in 3 formats (Excel, HTML, and CSV).

Email notification of events to multiple recipients.

### **1.6.2 Monitored Events**

The HMT shall monitor the following events:

Connection: Network connectivity test.

Failed Drive Access: Each drive shall be verified.

Camera Failures during Defined Intervals: Cameras shall be continuously tested to ensure connectivity.

Reboots anytime a DVR is restarted or shutdown.

Time Since Recording: Verification that recording is continuing up to current time.

Protected Capacity Used % shall monitor space remaining for protected video and displaying percentage utilized.

Days of Storage shall display the number of days currently retained on the DVR for unprotected recorded video.

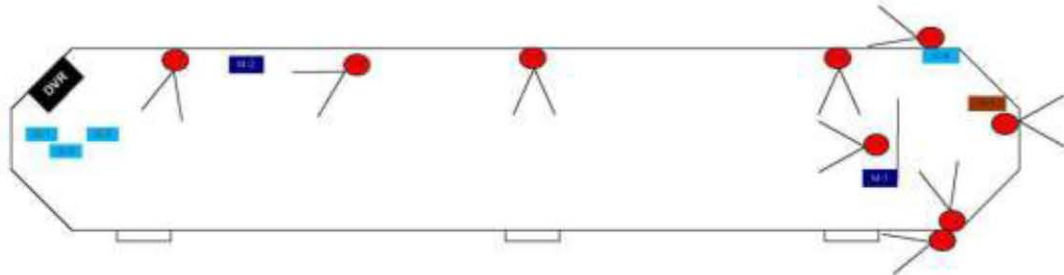
### **1.6.3 Cameras**

The DVRS installation shall include 2 360 degrees POE IP cameras, 1 forward facing POE IP camera and 2 side camera to view along the street and curb sides of the vehicle as shown in the attached PCC camera system layout. The side cameras outputs shall be displayed on one or more LCD displays on the Operator's console.

The cameras outside the vehicle shall be pointed towards the rear and at the doors of the transit vehicle to prevent damage to the lens from the transit vehicles washers or tree branches on the vehicle's route. Weatherproof housings shall be utilized to protect the cameras to the greatest extent possible. Exterior cameras shall not make any audio recordings outside of the transit vehicle including in the front of the vehicle or on the side of the vehicle.

All cameras supplied shall have a standard NTSC or IP color signal output. The NTSC cameras shall be capable of producing a 540 TVL high resolution undistorted wide dynamic image in all lighting conditions (auto back light compensation/auto or electronic iris or Pixim technology chip set required) without the need for manual adjustment to any equipment while the IP cameras shall be power over Ethernet (PoE) and capable of HD or greater resolution. The cameras shall also be capable of capturing face images with bright backgrounds within the transit vehicle. A Day/Night capability shall provide display images from 0.3 lux in day mode and 0.05 lux in night mode.

### Single Operator



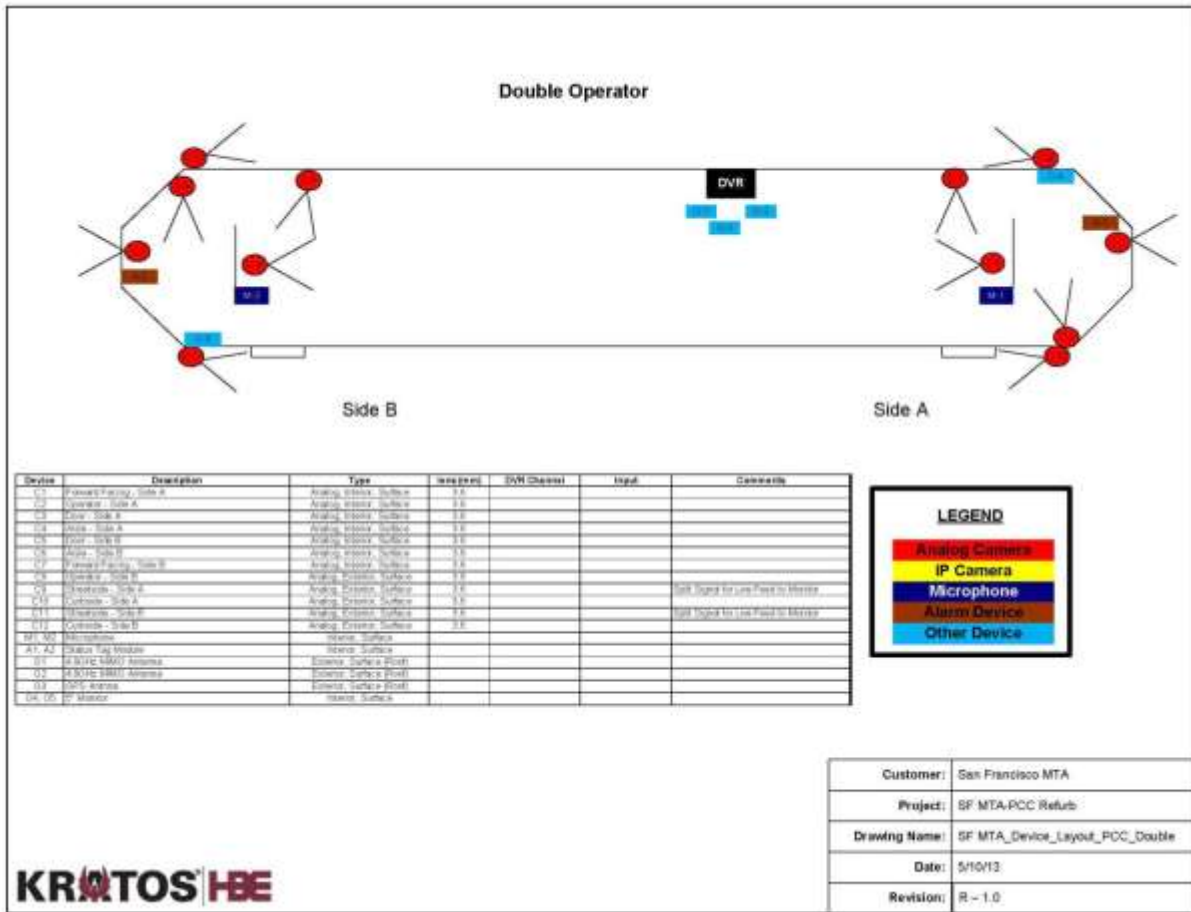
Device	Description	Type	Inst Stock	DWG Device	Instd	Comments
C1	Network Video Camera	Analog Video Camera	10			
C2	Camera	Analog Video Camera	10			
C3	IP Camera	IP Camera	10			
C4	Camera	Analog Video Camera	10			
C5	Microphone	Analog Video Camera	10			
C6	IP Camera	IP Camera	10			
C7	IP Camera	IP Camera	10			
C8	IP Camera	IP Camera	10			
C9	IP Camera	IP Camera	10			
C10	IP Camera	IP Camera	10			
C11	IP Camera	IP Camera	10			
C12	IP Camera	IP Camera	10			
C13	IP Camera	IP Camera	10			
C14	IP Camera	IP Camera	10			
C15	IP Camera	IP Camera	10			
C16	IP Camera	IP Camera	10			
C17	IP Camera	IP Camera	10			
C18	IP Camera	IP Camera	10			
C19	IP Camera	IP Camera	10			
C20	IP Camera	IP Camera	10			
C21	IP Camera	IP Camera	10			
C22	IP Camera	IP Camera	10			
C23	IP Camera	IP Camera	10			
C24	IP Camera	IP Camera	10			
C25	IP Camera	IP Camera	10			
C26	IP Camera	IP Camera	10			
C27	IP Camera	IP Camera	10			
C28	IP Camera	IP Camera	10			
C29	IP Camera	IP Camera	10			
C30	IP Camera	IP Camera	10			
C31	IP Camera	IP Camera	10			
C32	IP Camera	IP Camera	10			
C33	IP Camera	IP Camera	10			
C34	IP Camera	IP Camera	10			
C35	IP Camera	IP Camera	10			
C36	IP Camera	IP Camera	10			
C37	IP Camera	IP Camera	10			
C38	IP Camera	IP Camera	10			
C39	IP Camera	IP Camera	10			
C40	IP Camera	IP Camera	10			
C41	IP Camera	IP Camera	10			
C42	IP Camera	IP Camera	10			
C43	IP Camera	IP Camera	10			
C44	IP Camera	IP Camera	10			
C45	IP Camera	IP Camera	10			
C46	IP Camera	IP Camera	10			
C47	IP Camera	IP Camera	10			
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C57	IP Camera	IP Camera	10			
C58	IP Camera	IP Camera	10			
C59	IP Camera	IP Camera	10			
C60	IP Camera	IP Camera	10			
C61	IP Camera	IP Camera	10			
C62	IP Camera	IP Camera	10			
C63	IP Camera	IP Camera	10			
C64	IP Camera	IP Camera	10			
C65	IP Camera	IP Camera	10			
C66	IP Camera	IP Camera	10			
C67	IP Camera	IP Camera	10			
C68	IP Camera	IP Camera	10			
C69	IP Camera	IP Camera	10			
C70	IP Camera	IP Camera	10			
C71	IP Camera	IP Camera	10			
C72	IP Camera	IP Camera	10			
C73	IP Camera	IP Camera	10			
C74	IP Camera	IP Camera	10			
C75	IP Camera	IP Camera	10			
C76	IP Camera	IP Camera	10			
C77	IP Camera	IP Camera	10			
C78	IP Camera	IP Camera	10			
C79	IP Camera	IP Camera	10			
C80	IP Camera	IP Camera	10			
C81	IP Camera	IP Camera	10			
C82	IP Camera	IP Camera	10			
C83	IP Camera	IP Camera	10			
C84	IP Camera	IP Camera	10			
C85	IP Camera	IP Camera	10			
C86	IP Camera	IP Camera	10			
C87	IP Camera	IP Camera	10			
C88	IP Camera	IP Camera	10			
C89	IP Camera	IP Camera	10			
C90	IP Camera	IP Camera	10			
C91	IP Camera	IP Camera	10			
C92	IP Camera	IP Camera	10			
C93	IP Camera	IP Camera	10			
C94	IP Camera	IP Camera	10			
C95	IP Camera	IP Camera	10			
C96	IP Camera	IP Camera	10			
C97	IP Camera	IP Camera	10			
C98	IP Camera	IP Camera	10			
C99	IP Camera	IP Camera	10			
C100	IP Camera	IP Camera	10			

**LEGEND**

- Analog Camera
- IP Camera
- Microphone
- Alarm Device
- Other Device

Customer:	San Francisco MTA
Project:	SF MTA-PCC Refurb
Drawing Name:	SF MTA_Device_Layout_PCC_Single
Date:	5/10/13
Revision:	R - 1.0





### 1.6.4 Digital Video Recorder (DVR)

The DVR shall record at a speed of not less than five frames per second each along with the synchronous audio track and be identified with time, date, vehicle number, GPS location information, and time sync.

The DVR shall record the events from the video surveillance cameras inside and outside the transit vehicle on a hard drive. The hard drive shall have a minimum capacity of 1 terabyte. All hard drives shall be “hot swappable” (i.e., the hard drives shall be removable without corrupting the data even when the DVR is powered).

The DVR shall be integrated into the existing silent alarm system of the vehicle so that upon activation of the silent alarm switch, the recording system will protect a window of recorded data that extends to a point prior up to thirty (30) minutes to the activation of the silent alarm to a point after activation up to thirty (30) minutes and will not allow the recording to be erased. The software system shall allow the SFMTA to adjust the extent of the data to be saved through software without the need for contractor’s support. The activation of the silent alarm switch must be recorded on the video medium.

The DVR shall have the ability to automatically download selected video events in user selectable increments via a wireless connection to the satisfaction of the SFMTA. Specific transit vehicle and specific times shall be selectable.

The DVR shall have the capability to be pre-programmed to download recorded incidents that have not been “tagged” by the operator up to one (1) hour in length from all cameras recorded in the transit vehicle when the vehicle returns to the yard to the satisfaction of the SFMTA. The download shall continue until complete even if the transit vehicle is powered down.

The DVR shall have the capability to transmit live video, from inside the transit vehicle, upon demand to a laptop or PDA while the transit vehicle is still in revenue service to the satisfaction of the SFMTA. The live video feed shall be transmitted up to a distance of 500 yards from the transit vehicle.

The transmission of live video from inside the transit vehicle shall be compatible with the existing access points provided in SFMTA’s MRO/MRU vehicles to enable remote surveillance of the transit vehicle and allow for on-site viewing of event data to the satisfaction of the SFMTA.

The DVR shall be capable of continuous recording for a user-selectable period of up to thirty (30) minutes after the vehicle has been powered down to the satisfaction of the SFMTA. This capability shall be provided through a battery backup with a minimum of 30 minutes back-up capacity.

The DVR shall be capable of accepting both composite and IP camera inputs to the satisfaction of the SFMTA.

The DVR shall be able to retain time, date, vehicle number, and other user programmable data without connection to the power source to the satisfaction of the SFMTA. The system shall have its own power supply connected to the 36 VDC power supply of the transit vehicle and shall have a power management feature to shut down the DVR in 30 minutes or a user programmable amount of time after switched power is removed. The DVR shall continue recording during the time out period.

The DVR and cameras shall perform a managed shutdown sequence when the shutdown timer threshold is reached.

The DVR and cameras shall perform a managed power up when the input voltage to the unit exceeds minimum operating supply voltage and the switched power input receives a user defined positive voltage. The DVR shall be able to withstand all transients, surges, and dips in power from the vehicle’s electrical system without any deterioration of system performance to the satisfaction of the SFMTA.

The DVR shall provide recorded video capability to a storage unit at Cameron Beach maintenance facility, capable of storing at least one (1) month of video retention with H.264 compression algorithm to the satisfaction of the SFMTA.

The wireless system on the transit vehicle shall be the latest wireless bridge, currently 802.11N HauteSpot WRAPDXCi-MN or approved equal. The Contractor shall supply or use an existing antenna mounted on the roof of the transit vehicle of at least 3dbm gain, and if needed per the Contractor’s power configuration, an external power supply to power the bridge may be installed. The wireless bridge shall have the capability to turn on and off the DVR via a wireless switch or IP relay.

#### 1.6.4.1 Recording and Management Software

The recording and management software shall have the capability to be programmed by a maintenance technician at the server to be able to download recently recorded video for QA checks of equipment functionality of each transit vehicle on a daily, weekly, and monthly basis to the satisfaction of the SFMTA. The software shall have the ability to download the error/status log from the DVR every time the transit vehicle is back in the depot yard and shall include a “GPS Search” feature that will allow video search based on location to allow SFMTA staff to query the fleet based on the location of the incident.

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

#### 1.6.4.2 Video Channel Output

Shall support spot monitor for displaying images from cameras, full screen, or full screen sequence to the satisfaction of the SFMTA.

Shall allow advertising and customer information to be shown to commuters using two (2) monitor outputs located on the unit to the satisfaction of the SFMTA. The messaging can be location specific (via GPS integration) advertising shops or attractions along a vehicle’s route. User definable text can be layered on the monitors to add specific messages to customers.

#### 1.6.4.3 Audio Recording

The DVR shall be capable of audio recording and playback through the unit in real time to the satisfaction of the SFMTA. Recorded with images, audio shall be played back from the unit network converter or external docking station. The audio microphone will have automatic gain control and be shock mounted. The recorded audio shall be automatically copied when video is exported across a network to an FTP server.

Two channels of audio shall be recorded on the DVR: local and line out.

The DVR shall support simultaneous audio recording and playback in real time to the satisfaction of the SFMTA.

#### 1.6.4.4 Microphones

The Contractor shall provide two (1) microphone for each video surveillance system installation to the satisfaction of the SFMTA. The microphone shall have automatically adjustable gain. The installation shall be shock mounted to avoid panel noise.

#### 1.6.4.5 Security Enclosure

The mobile DVR shall be encased in a vented, rugged metal chassis with shock absorbers to withstand exposure to extreme shocks, vibrations, and temperatures to the satisfaction of the SFMTA.

A pick resistant "ACE"-type lock or better shall be used to the satisfaction of the SFMTA. The lock shall be quarter turn lock and unlock. Each enclosure shall be keyed alike, and one key per enclosure shall be provided.

The external assembly of the security enclosure shall be designed for secure encasement to prevent unauthorized access and/or removal, but upon access by authorized personnel, the assembly shall allow for ease of removal and repair of an internal subassembly and of the entire assembly to the satisfaction of the SFMTA.

Ease of and convenience of maintenance, changing user parameters and media removal and replacement are also important functional requirements for the DVRS system equipment.

The enclosure will have a system status indicator, and event button indicator located on the front panel.

Design of the security enclosure shall be reviewed and approved by SFMTA.

#### 1.6.4.6 DVR Physical and Environmental Properties

The Contractor shall be responsible for any filters, power stabilizers, rectifiers, and other devices that protect the DVR from spikes, drops, harmonic resonance, and other power issues routinely experienced in a transit environment to the satisfaction of the SFMTA.

The Contractor shall ensure that the DVR fully performs in the intended operational environments without being affected by, or causing harmful interference to other on-board systems to the satisfaction of the SFMTA. Protection shall be provided against radio frequency and electromagnetic interference (RFI/EMI) emission sources, as well as internal conductive or inductive emissions, and should be proven by testing during prototype demo. Contractor to provide test plan for review and approval by SFMTA.

### **1.6.5 Base Station**

The Contractor shall install a new base station including servers, transmitters, receivers, antennas, wireless access points, and other accessories needed to download data from transit vehicles to a central management system located in three SFMTA maintenance facilities. The wireless router for the base station shall be the latest wireless bridge, currently 802.11N, HauteSpot WRAPXC-N wireless router or equal.

#### 1.6.5.1 Base Station Wiring and Cabling

The Contractor shall submit wiring and cabling product information for review and approval by the SFMTA.

All wire sizes and insulation shall be based on the current carrying capability, voltage drop, mechanical strength, temperature and flexibility requirements, as well as fire resistance requirements for heavy duty transit applications to the satisfaction of the SFMTA.

Wiring shall be uniformly color coded and tagged to the satisfaction of the SFMTA. Wiring shall be prefabricated into standardized harnesses, wrapped and tied with “all weather UV type” nylon ties. All wiring harnesses over five (5) feet long shall include 15% excess wires for spares that are the same size as the largest wire in the harness.

The power source wires must be sized appropriately to meet specified requirements for unit to the satisfaction of the SFMTA. Wherever there is a possibility of interference, wiring and interconnecting cables shall be properly shielded. Video and audio cables shall be gauged to minimize signal loss.

A protective plastic or rubber grommet must be installed in every hole that provides passage for conduit or wiring to avoid chaffing or cutting of the conduit or wiring to the satisfaction of the SFMTA.

*DELIVERABLE: DVRS Base Station*

#### 1.6.5.2 DVRS Testing and Acceptance

The Contractor shall conduct testing to verify that all equipment and installations comply with the Technical Specifications to the satisfaction of SFMTA. All equipment provided by the Contractor shall be acceptable to SFMTA.

The Contractor shall submit a test procedure for review and approval by SFMTA. The test procedure must show the equipment complies with both the manufacturer’s product specifications and the Technical Specifications. This specifically must include RFI/EMI testing and prototype testing (see Section 5.6.8).

*DELIVERABLE: DVRS Test Procedure*



Acceptance of each installation shall be verified by SFMTA-designated staff after the Contractor and SFMTA-designated staff completes a visual inspection, vehicle identification, and test video review.

### 1.6.5.3 DVRS Spare parts and Special Tools

The Contractor shall provide spare parts as specified in Attachment 1: Price Proposal of the contract.

The Contractor shall provide special tools, test equipment, all necessary accessories and software that will be required for SFMTA to operate, maintain, and repair the proposed DVRS system to the satisfaction of the SFMTA. If computers are provided as the test equipment, the latest Panasonic Tough-Book model with the current software must be provided as specified in Attachment 1: Price Proposal of the contract.

*DELIVERABLE: DVRS Spare Parts & Tools*

## 1.7 Door System

The Contractor shall provide and install complete new doors and door drive assemblies.

The Contractor shall install new Vapor (Wabtec Corp) door operator assemblies #5796753600 and door motors #5772635700 or approved equal that will operate the doors using the pivot shaft at the fixed end of the doors. The Contractor shall install all new door panels, all door rods, pivot arms, tie rods, fittings, bearings and hardware.

The interface between the top of the door rod and the pivot arm shall be splined, not clamped.

New door panel clamps shall be welded to the door rod.

The door rod bearings shall be configured to be easily replaceable.

New door panels shall be made of 1" Marine grade plywood and sealed with epoxy primer. New glass, piano hinges, brushes and seals are to be installed. The short door stanchions are to be refurbished and reinstalled. The door panels shall be painted to the carbody livery instructions.

New rear door sensitive edges, tubing, tubing springs and air switches are to be installed.

New door relays are to be installed. The installation in PCC #1076 can be observed and considered as a developmental prototype.

All switches, bypass circuit and relays for the brake and propulsion interlocks shall be replaced with new.

The Contractor shall provide a door design package and an acceptance test procedure for the Engineer's approval.

*DELIVERABLE: Door System Design and Acceptance Test*

## 1.8 Air Comfort

### 1.8.1 Ventilation

The Contractor shall refurbish or replace the overhead ventilation diffusers. The diffusers shall be painted in the same color as the ceiling panels and reinstalled.

## 1.9 Lighting

### 1.9.1 Interior Lighting

The Contractor shall disassemble, clean, refurbish and polish all interior lighting fixtures. Broken parts are to be replaced with original type equipment. The beehive (bullseye) light fixtures above the passenger seats and over the stepwells shall be resocketed and rewired for use with the low voltage power supply and LED based bulbs. Bulbs shall be selected to provide an appropriate luminance at 36 VDC. Care shall be taken not to damage the surface of the reflectors when cleaning. Following buffing of the surface, the bezels shall be chrome plated. Fixtures shall be reinstalled using new bulbs, new heat resistant fiber seals, and new stainless steel fasteners.

The Emergency Lighting circuit shall receive power from the battery bus when the LVPS is not running.

All interior lighting circuits shall be rewired for parallel 36 VDC operation and LED based bulbs installed. Dropping resistors are prohibited.

Gang switch # 17 (INTERIOR LIGHT 1) shall operate the lamp directly behind the Operator, every other lamp on the street side behind that and the alternate lamps on the curbside.

Gang switch # 18 (INTERIOR LIGHT 2) shall operate all of the passenger lamps not operated by gang switch # 17.

#### 1.9.1.1 Fare Box Light

The Contractor shall provide a new ceiling mounted focused beam LED light fixture to illuminate the fare box area. The fixture shall provide a minimum of 10-foot candles at three feet above the floor at the fare box. The fixture shall be designed and placed such that the illumination is not directed into the Operator's vision. The fixture shall be connected through a circuit breaker to the car's low voltage 36 VDC distribution systems. The fare box light is to be on when either of the front doors are open. The light shall not be connected to Gang Switch No. 14. The Contractor shall submit catalog data for the fare box light fixture for approval by the Engineer.

#### 1.9.1.2 Operator's Dome Light

The Contractor shall provide a new ceiling mounted 36 VDC LED light fixture to illuminate the operator's console. The fixture shall be the same as the new fare box light and shall meet the same requirements. This fixture shall be switched by the "Dome Light" gang switch #14 on the operator's console.

#### 1.9.1.3 Step Well Light

The Contractor shall furnish and install two new LED light fixtures to illuminate each step well. These fixtures shall be switched on whenever either bank of the interior lights are on. Rear step well lights shall illuminate when the rear doors are opened.

*DELIVERABLE: Interior Lighting Plan*

### 1.9.2 Exterior Lights

All Exterior lighting fixtures shall be replaced. Exterior lighting fixtures shall be waterproof. All exterior lights shall be incandescent, unless agreed to by the Engineer, and shall operate from the

36 VDC power supply. All new and refurbished fixtures shall be installed using new lamps, new seals, and new stainless steel fasteners.

#### 1.9.2.1 Headlight

The Contractor shall fit a reproduction 1932 Ford headlight into the headlight well. The headlight luminosity shall meet G.O. 143B requirements. The well and headlight mounting & wiring shall be water tight. Headlight shall not require adjustment of its aiming position by SFMTA personnel.

#### 1.9.2.2 Tail Lights

The Contractor shall install new taillights. An LED lamp shall be used if it can be fitted into the fixture along with the stop light and meet the requirements of G.O. 143B. The Contractor shall recommend to the Engineer and install modification to meet those requirements. The contractor shall install a new socket, lamp, and hardware. The wiring shall be verified to assure that the taillights are energized whenever the headlight is on.

#### 1.9.2.3 Stop lights

Each tail light assembly shall house a combined stop and tail light and shall be an integral part of each tail light assembly. A two brightness tail/brake LED bulb shall be used if it can be fitted to the fixture. If not, a double filament bulb shall be used. Stoplights shall produce approximately 150 percent of the intensity of the taillights and must be activated whenever braking is selected.

#### 1.9.2.4 Rear Marker Lights

The Contractor shall install new rear corner LED marker lights located near the roofline.

#### 1.9.2.5 Front Marker “Eyebrow” Lights

The Eyebrow light fixtures shall be replaced with LED fixtures that provide downward facing illumination and forward illumination through the reflector with a luminosity similar to the existing incandescent fixture.

#### 1.9.2.6 Exterior Door “Active” Light

The exterior rear door active light shall be replaced with a red LED unit.

### **1.9.3 Emergency Lighting**

Seven interior lights, the over-the-stepwell lights, the headlight, the rear stop lights and the marker lights shall be able to remain lit together on battery power for at least five minutes after the loss of overhead power.

### **1.9.4 Ceiling Center Courtesy lights**

The courtesy light fixtures shall be rebuilt for 36 VDC and are to operate whenever the headlight is on.

*DELIVERABLE: Exterior Lighting Plan*

## 1.10 Auxiliary Electrical

The auxiliary electrical equipment includes the high voltage (600 VDC) electrical equipment, low voltage distribution equipment, trolley pole, and storage batteries.

### 1.10.1 Low Voltage Power Supply (LVPS)

The Contractor shall install a solid state 600 VDC to 37.5 VDC power supply (LVPS) to replace the MG set. The LVPS output shall be adjustable between 32 to 40 VDC.

The LVPS shall be able to fully charge a discharged battery at 25 VDC within 2 hours. It shall be sized to supply peak overloads of 20% above its max rated current output at 37.5 VDC. The unit shall be protected against output short conditions, starting inrush currents, and have an external input line filter for protection from the unregulated voltage transient swings in the overhead line 600 VDC power supply. The LVPS input and output(s) shall be protected with exclusive use protection devices.

The Contractor shall propose the LVPS design for approval of the Engineer, prior to production. The submission shall include an LVPS load analysis of normal and emergency connected loads, and information on the service history with at least 5 other transit agencies in the US. The Contractor shall perform a revenue service life-cycle test on the Car during revenue service. At least three Cars shall be considered and tested without failure for 2000 hours of revenue service time per Car. In the event of a failure, the Contractor shall provide a failure analysis and corrective action plan and the life-cycle test shall be restarted.

*DELIVERABLE: LVPS Design & Lifecycle Test Procedure*

### 1.10.2 Propulsion Blower and Blower Power Supply

The Contractor shall install a three-phase 208 VAC driven blower/motor assembly replacing the MG Set's blower and providing cooling to the Cars' propulsion system. A separate inverter, 600 VDC to 120/208 VAC 3 phase 60 Hz with a 30% power rating margin for extra loads, shall be provided and installed to provide power to the blower.

The blower functionality shall be interlocked with the line breaker and shaft brakes, preventing motoring in the event of a blower system failure. A bypass switch shall be provided to allow Car movement for short distances. The bypass switch shall be time limited to avoid propulsion equipment damage from long term use. The bypass system and time design shall be subject to approval by the Engineer.

The Contractor shall propose the 120/208 VAC inverter design for approval of the Engineer prior to production. The submission shall include an AC load analysis of all connected loads, and information on the service history with at least five other transit agencies in the US. The Contractor shall perform a revenue service life-cycle test on the Car during revenue service. At least three Cars shall be considered and tested without failure for 2000 hours of revenue service time per Car. In the event of a failure, the Contractor shall provide a failure analysis and corrective action plan and the life-cycle test shall be restarted.

*DELIVERABLE: Propulsion Blower Design*

#### 1.10.2.1 Cooling

The Contractor shall be responsible for assuring that the propulsion equipment and LVPS are adequately cooled and that cooling air is filtered. If feasible, the Contractor shall propose moving

the air intake locations to a point at least 3 feet above top of rail so that the equipment will not ingest dirt, debris, or water.

*DELIVERABLE: Cooling Air Location Design*

### **1.10.3 12 VDC Power Supply**

The Contractor shall provide and install a 12 VDC power supply nominal 13.6 VDC rated for 60 A continuous output in either a standalone DC to DC converter or as a separate output from the LVPS sized to provide power to the radios, PA, NextBus®, Clipper®, fareboxes, and headlight loads. Design shall be submitted to the Engineer for approval. The 12 VDC supply input and output(s) shall be protected with exclusive use protection devices.

The Contractor shall propose the 12 VDC supply design for approval by the Engineer, prior to production. The submission shall include a 12 VDC supply load analysis of normal and emergency connected loads. If a standalone supply is chosen, the 12 VDC supply chosen by the Contractor shall have a service proven history with at least 5 other transit agencies in the US. The Contractor shall perform a revenue service life-cycle test on the Car during revenue service. At least three Cars shall be considered and tested without failure for 2000 hours of revenue service time per Car. In the event of a failure, the Contractor shall perform a failure analysis and corrective action plan and the life-cycle test shall be restarted.

The Contractor shall be responsible to assure that the 12 VDC supply is adequately cooled with filtered air. If feasible, the Contractor shall locate the air intake at least 3 feet above top of rail so that the equipment will not ingest dirt, debris, or water from the track or roadway.

*DELIVERABLE: 12 VDC Power Supply design*

### **1.10.4 Battery**

The Contractor shall remove the existing Car battery and install a new Lithium Ion battery pack, regulated and with a voltage suitable for use with the LVPS. Technical specifications shall be provided to the Engineer for approval prior to final selection. An over-temperature sensor shall be installed in the battery compartment. The Contractor shall install a battery circuit breaker with shunt trip mechanism to activate on over-temp and low battery voltage. The low battery voltage trip point shall depend on the propulsion system chosen under this Contract, and its particular requirements or susceptibilities.

*DELIVERABLE: Battery Design*

### **1.10.5 Trolley Poles**

The Contractor shall install all new trolley poles and base assemblies including bases, poles, hooks, trolley boards, cleats, standoffs, braces, and hardware. All hardware including standoffs, braces, hook, etc. shall be stainless steel. Trolley poles are to be painted PPG DUHS 9000 Black in the middle with 16” of silver paint at the top end and 28” of silver paint at the bottom end.

All trolley boards, forward and end cleats shall be red oak. Center cleats shall be stainless steel. All wooden parts shall be painted with Pittsburgh Paint's 6-9 Exterior Oil Wood Primer 7-809 Safety Black high gloss paint.

A new power cable and conduit shall connect the trolley poles' power cable. The Contractor shall provide a design for the cable routing to the Engineer for approval.

The Contractor shall provide a safety harness lanyard on the trolley pole boards, per California OSHA standards.

*DELIVERABLE: Cable Routing*

### **1.10.6 Catchers**

A new catcher, rope and mounting plate shall be installed on each end of the car.

### **1.10.7 Battery Box**

The Contractor shall install a new battery box with new rollout trays to be approved by the Engineer.

*DELIVERABLE: Battery Tray Design*

### **1.10.8 Lightning Arrestor**

Contractor shall replace all lightning arrestors with new weatherproof units of the same electrical ratings. An appropriate approved ground connection shall be provided. If the old lightning arrestors are found to contain PCBs, the lightning arrestors shall be disposed using proper handling and disposal procedures for PCB- contaminated materials.

## **1.11 Propulsion Power and Braking System.**

### **1.11.1 Westinghouse Propulsion Power and Braking System.**

The Contractor shall install a new Bombardier Westinghouse type PCC propulsion system except for the traction motors, and foot pedal assembly, which shall be rebuilt. The Single-Ended Propulsion System shall be Bombardier PN# 8101800G01. The Doubled-Ended Propulsion System shall be Bombardier PN# 8101800G02.

The Contractor shall install a new main fuse in the 600 VDC collection circuit. The fuse and terminals shall be contained in a waterproof box located on the roof near the base of the rear pole.

The Contractor shall provide a propulsion system installation plan and a test plan for approval by the Engineer.

The Contractor shall be responsible for ensuring that the propulsion system functions properly. The Contractor shall assume liability for any damages caused during testing due to defects in the PCC wiring or propulsion equipment.

*DELIVERABLE: Propulsion & Braking Installation Plan*

*DELIVERABLE: Propulsion and Braking Test Results*

### **1.11.2 Foot Pedal Assembly**

The foot pedal assembly (deadman, brake, and accelerator) shall be rebuilt and made fully functional. All hardware, control rods, rollers, springs, bearings, bushings, cogs, contacts, wiring, and plastic parts shall be replaced with new. Linkages connecting the Operator controls to the master/brake controller box shall be replaced with new.

The Contractor shall provide and perform an acceptance test procedure for the Engineer's Approval.

*DELIVERABLE: Operator Pedal System Test Procedure*

### **1.11.3 Back Up Controller**

The Contractor shall provide a new back-up controller. It shall be fully functional with the propulsion system provided under this Contract. The back-up controller shall have an Operator controlled variable acceleration rate. Shaft brakes shall be fully released from the back-up controller in the 'coast' position. 600 VDC overhead voltage shall not be necessary to obtain full shaft brake release.

### **1.11.4 Traction Motor Overhaul**

The Contractor shall overhaul the traction motors: The armature, main field, and interpole coils are to be rewound and vacuum pressure impregnated. All coils and windings shall use fused Kapton insulation or equivalent winding insulation if approved by the Engineer. The commutator shall be replaced with new components. Motor shafts shall be replaced with new unless the Engineer agrees that the existing shafts are in satisfactory condition and may be reused. The armature core laminations shall be inspected and tested with a core loss tester for burnt and damaged laminations. The core is to be restacked as needed. All brushes and brush holders are to be replaced. Traction motor bearings shall be replaced with new bearings on all traction motors. Bearing shall be installed, lubricated, and adjusted. Salvageable coils, windings, commutators, and brush holders shall be returned to the SFMTA. The motor end bearing seats and matching bearing retainers shall be inspected and repaired as needed.

The motors shall be painted black. A motor overhaul plate with serial number, overhaul company name, and overhaul date shall be attached to each motor.

The Contractor shall burn-in test each motor including final shaft Total Indicated Runout (TIR), the commutator TIR and dynamic balance values. Motor build and test records are to be included in the CHB

*DELIVERABLE: Motor Build Records*

### **1.11.5 Tow Mode Feature**

The Contractor shall replace the Tow Mode wiring harness and show through testing that the PCC can successfully tow an inoperable PCC from the furthest street stop to the SFMTA Beach Car House at up to 25 mph. If 25mph is not possible, the contractor shall explain why, to the satisfaction of the Engineer, and provide recovery instructions in the Maintenance manual.

*DELIVERABLE: Tow Mode Test*

## **1.12 Other Electrical**

### **1.12.1 Sander System**

The Contractor shall provide and install a new sanding system complete with solenoid valves, stainless steel boxes, filler ports, and hoses.

Solenoid valves shall be wired in parallel and individually protected with an inline fuse.

Sanders shall be activated under the following conditions:

Deadman pedal in the fully released position.

Brake pedal in the emergency brake position.

Sander gang switch manually activated.

The design and testing of the sander system shall be submitted to the Engineer for approval.

*DELIVERABLE: Sander System*

### **1.12.2 Passenger Stop Request Light and Chime**

The Contractor shall install new passenger stop request lights and circuitry. The passenger stop request lights and circuit shall consist of two interior lighted signs, visible to the passengers, indicator lights on the Operator's Consoles, and the necessary circuitry to implement this function.

The passenger stop request light and the operator's indicator light in the active cab shall be illuminated when any one of the passenger stop pull cords are pulled (these pull cords currently sound the stop request chime) and it shall remain illuminated until Gang Switch Number 2, 3, 5, or 6 have been turned on (i.e. a door has been opened) in the active cab. This light shall be extinguished when the Door operator closes.

The passenger stop request lights shall be mounted from the car's ceiling approximately 8 feet from each front end of the car ceiling. The exact location is subject to approval by the Engineer. This light shall have an illuminated sign that reads "STOP REQUESTED". The sign shall essentially be a dead front type display, with a letter height of one-inch, a Helvetica medium font, white lettering on a red background. The sign's lights shall be incandescent bulbs, powered from the low voltage bus. There shall be a diffuser layer between the light bulbs and the imprinted layer to effectively diffuse the light from individual bulbs. The sign shall be equal in quality and performance to Flyer Co. Part No. 599097, or the SFMTA approved equivalent. The indicator light on the Operator's Console shall be of the same type and manufacture as the other indicator lights on the console, except that it shall be blue in color.

The Contractor shall install a new passenger stop request chime. The chime shall sound only once after one pull of the cord until the passenger stop request light has been reset by Gang Switch Number 2, 3, 5, or 6.

A circuit breaker shall be provided for protection.

The Contractor shall install new stop request pull cord switches, ferrules, and cords. The pull cords shall activate the stop request circuit.

An ADA stop request system shall be installed and include ADA approved stop request strip switches, integration with the ceiling mounted visual indicator, and a latching visual indicator and audible alarm in the Operator's area. The Operator's audible indicator shall consist of a continuous sounding alarm on a timer circuit; alarm and timer duration to be approved by the Engineer. The passenger and Operator annunciators shall release upon opening of the front door only

### **1.12.3 Towing Circuit**

The Contractor shall refurbish the towing circuit. The towing circuit is a control circuit to provide remote control of the track brakes of an inoperable PCC car when it is coupled to a functional PCC. When activated this control circuit shall apply the track brakes in the car being towed (or pushed). The remote track brake control shall be operated from the "Track Brake" gang switch on the towing Car's Operator's console. The electrical connection between the towing and the towed car shall be by the Emergency Inter-Car Cable. Electrical isolation shall be



maintained by using relays or contactors to electrically isolate the cars. The circuit shall be fully compatible and functional with the existing circuit in the SFMTA's existing PCC cars.

The track brake during towing circuit shall not interrupt the function of the track brake switch on the car being towed.

Relays or contactors used to implement this circuit shall be approved by the Engineer

*DELIVERABLE: Towing Circuit Design*

#### **1.12.4 Inter-Car Communication while Towing (PA)**

The contractor shall refurbish the inter-car communication circuitry. The inter-car communication circuit facilitates communications between cars while towing or pushing an inoperative car. The circuit shall be integrated as part of the PA system. Connection between the two cars shall be by the emergency inter-car cable. The circuit shall be fully compatible and functional with the existing circuit in the SFMTA's existing PCC cars.

#### **1.12.5 Emergency Inter-Car Cable**

The contractor shall provide new emergency inter-car cables at both ends of the Car to connect to another car during towing (or pushing) operations. This cable shall carry the necessary conductors for track brake and PA control from the towing car. The Contractor shall refurbish or replace the junction boxes installed near the tow bar connection. Cable connections inside the junction box shall be made on a terminal strip, in order to readily replace damaged cables. The cable entrance to the junction box shall use a seal tight, strain relief bushing.

A multi-pin connector equal to either a bayonet railroad type or Pyle National Star Line connector shall be provided on the other end of the cable. The cable shall be of sufficient length to reach between cars connected by the standard tow bar and connect to the forward end cable receptacle, with sufficient slack to permit operation over all curves and reverse curves; an initial estimate of the cable length is 16 feet. The cable shall be a fully jacketed multi-conductor cable suitable for use in a physically abusive environment and where a high degree of flexibility is required.

The Contractor shall replace the waterproof receptacle and junction box for connecting an emergency cable from another car at the each end of the Car. All exposed connectors shall be waterproof and have a spring cover installed.

#### **1.12.6 Track Brake Operator's Control**

The operator manually selectable track brake control shall be made functional from the Gang Switch assembly. This control shall allow the Operator to apply the track brakes independent of any other braking or powering action being taken, and shall apply the track brakes at the full level of effort.

### **1.13 Miscellaneous**

#### **1.13.1 Tow Bar, Pin, and Storage Tube**

The Contractor shall refurbish the tow bar or install a new tow bar. The Contractor shall add two strips of reflective tape to the sides of the tow bar. The Contractor shall furnish a new 1-1/8" diameter X 7" long tow bar pin with a 12" handle and chain on each anti-climber. The pin shall

be attached to the anti-climber by welding the tether chain to the anti-climber. The pin shall have a 3/8" hole 3/4" from the lower end to allow a hitch pin.

The Contractor shall install a new storage tube under the Car.

### **1.13.2 Flag holders and Rope Hooks**

On the cab front, the Contractor shall install two rope hooks on the right side to hold the reverse direction trolley pole rope the left side (Operator's view) of the windshield.

### **1.13.3 Life Safety Guard**

The Contractor shall refurbish or install new life safety guards at the front end of the Car.

A safety or pilot board shall be attached to the rear of the rear truck.

### **1.13.4 Trucks**

The Contractor shall rebuild the existing trucks

The truck frames, bolster and axle housings are to be stripped down to the clean, bare steel and inspected for damage, cracks and corrosion. Crack inspection shall be done through magnetic particle, dye penetrate or an x-ray process. The Contractor shall make all necessary repairs and paint the frames and axle housings with an epoxy primer and black top coat.

All other components like bellow guides, shields, guards, linkages, speed sensor wheel, etc. are to be stripped down to the clean bare steel, inspected, repaired if necessary, primed and painted black. If the existing parts are missing or irreparable, they are to be replaced with new.

All hardware, shock absorbers, universal joints, bellows, king pin bearing, all other bearings, traction motor cables, springs, and all rubber parts shall be replaced with new.

All new drive shafts, new bellows, and new sand funnels shall be installed.

Axle sets shall be rebuilt with new axles, gear sets, hubs, tires, cheek plates and king pin bearings. The axle gear sets shall include new wheels, ground bushes, axles, bearings, seals, shims, gears and cheek plates, and shall be assembled with new hardware.

New speed sensors shall be installed, of a type to be approved by the Engineer.

### **1.13.5 Inspection**

Prior to the axle/gear sets installation in the truck frame, the ring gear backlash shall be inspected to insure that it is within manufacturer's specification. The gear unit shall be run on a test stand and inspected to verify that no leaks are present and that the temperatures and noise levels are acceptable at slow speeds.

New wheels shall be installed on the completed assembly. Axle pressing records shall be maintained and provided to the SFMTA as part of the car history data. Wheel pressing pressure charts shall show a steadily increasing pressure until the final wheel position is obtained; no fall off in pressure or erratic pressure trace is acceptable.

### **1.13.6 Axle Assemblies**

Axle assemblies shall be assembled to established manufacturing methods:

- a. Axles shall have an exterior finish in accordance with Section 1 of the AAR Wheel and Axle Manual.
- b. Axles shall be made in accordance with AAR Specification M-101.
- c. Each axle shall be ultrasonically inspected per AAR Specification M-101 and magnetic particle inspected following finish machining.
- d. Axles shall be marked in accordance with the AAR Wheel and Axle Manual except.

### **1.13.7 Wheel Assemblies**

New wheel assemblies shall be furnished and installed onto the wheel, axle and gear assembly. Wheels shall be Super Resilient Wheel (Carnegie) or D2a-1a1 Super Resilient Wheel (NACO). All wheels furnished must be of the same type. New cheek plates shall be installed. Wheel assemblies shall be complete and ready for installation, including cheek plates, all rubber elements; spacer bolts, and shunt straps.

### **1.13.8 Ground Brush, Grounding Ring and Ground Brush Holder**

New ground brushes and grounding rings shall be provided and installed on each wheel, axle, and gear assembly. The grounding rings shall be fabricated from either hard copper or copper bearing bronze. Carbon ground brushes shall be of a carbon grade known to provide satisfactory service when operating against the material being used for the grounding ring. The ground brush shall be similar to the existing configuration. The ground brush holder shall be new, with new spring, gaskets, and insulating components.

### **1.13.9 Track Brake**

The track brakes shall be completely overhauled with new springs, hardware, armature rewinding, and replacement of the single pole piece to a segmented wear bar (pole piece) design. The mounting system shall be modified as necessary to account for the segmented design. The system shall be statically and dynamically tested on each Car and shall be capable of holding the car on a 10% grade.

*DELIVERABLE: Track Brake Design & Test Report*

### **1.13.10 Friction Brake**

The Contractor shall design, install, and test a new disc brake system. It shall be designed such that preventative maintenance servicing and replacement of the pads shall take less than 30 minutes per car.

If compatible with the new disc brakes, the Contractor shall rebuild the existing Westinghouse actuators, if not, the Contractor shall supply new actuators. All linkages shall be refurbished and receive new bushings, springs, hardware, bearings, cogs, and non-metallic parts.

The Contractor shall demonstrate that the new braking system meets the required brake rate (GO 143B), is serviceable once installed, and that spare parts are available.

*DELIVERABLE: Disc Brake Design & Test Report*

### **1.13.11 Drive Shaft**

The Contractor shall provide new drive shafts and connecting joints.

### **1.13.12 Truck assembly**

Once each truck has been assembled, the contractor shall inspect the truck to ensure that it has been properly assembled, lubricated and is in a condition to be installed under the car. After successful completion of the inspection, the contractor shall perform a spin test. The spin test shall be performed under power and will be used to evaluate wheel run-out, high temperatures, vibration, noise, electrical issues and leaks that were not detected in the axle spin test.

### **1.13.13 Truck Build Documentation**

The Contractor shall provide a detailed plan of how the trucks will be rebuilt and tested. Each truck's rebuild and testing shall be recorded.

*DELIVERABLE: Truck Rebuild Plan*

*DELIVERABLE: Individual Truck Build/Inspection Report*

## **1.14 Management**

### **1.14.1 The Engineer**

Throughout this Specification, the "Engineer" is defined as the SFMTA's Project Engineer or assigned representative.

### **1.14.2 The Contractor**

Throughout this Specification, the "Contractor" is defined as the prime Contractor.

### **1.14.3 Documentation**

For any components, or wiring that the Contractor installs, the Contractor shall provide dimensioned mechanical drawings, installation drawings, wiring diagrams and wire run list with bills of materials sufficient for review for the SFMTA's approval. The drawings and wiring diagrams will need to have sufficient information so that the items can be serviced and parts replaced in the future. The wiring diagrams shall be produced in a manner that is conducive for SFMTA maintenance personnel to use for circuit tracing and troubleshooting. The Contractor shall provide the written procedures for all work and testing to be performed on the Car. This documentation is intended to provide information to the SFMTA, and must also be provided by Contractor to Contractor's assembly crew and subcontractors to insure that all the Cars are modified in the same way and as engineered.

The documents will be submitted for the SFMTA's approval prior to the work being performed.

*DELIVERABLE: Procedure Package*

## **1.15 Material and Workmanship**

### **1.15.1 Material responsibility**

Unless otherwise noted, the Contractor shall supply all material and labor necessary to complete this remanufacturing project.

### **1.15.2 Test and Troubleshoot**

All new, modified, or serviced circuits and electrical components shall be tested to assure proper function. The testing of these circuits shall be described in the Test and Commissioning Plan.

### **1.15.3 Water Tightness Test**

The Contractor shall propose and conduct a water tightness test subject to the Engineer's approval. This test shall include an undercar test.

*DELIVERABLE: Water Tightness Test Procedure*

*DELIVERABLE: Water Tightness Results*

### **1.15.4 Subcontractors**

The name and contact information for all subcontractors and vendors shall be provided to the SFMTA.

*DELIVERABLE: Listing of Subcontractors and Vendors*

### **1.15.5 Alternate Parts and Materials**

All specific parts and materials called out for in this Specification are approved for use; however, the Contractor is encouraged to use alternates if those alternates are equivalent and interchangeable with the approved parts and materials. Alternates shall be submitted to the Engineer for approval.

*DELIVERABLE: Alternate Parts*

### **1.15.6 Salvageable Parts**

The Engineer shall have the right to review any and all parts removed from the Car but not reinstalled. All such parts deemed salvageable by the Engineer shall be cleaned, boxed, and delivered to the SFMTA by the Contractor at the Contractor's cost. Salvaged trucks do not need to be boxed.

## **1.16 Acceptance of the Cars**

### **1.16.1 Delivery Preparation**

The Cars shall be delivered to the SFMTA clean inside and out.

### **1.16.2 Procedure**

The Cars will undergo specification compliance acceptance tests and burn-in upon arrival at the SFMTA. The Contractor shall provide acceptance testing and burn-in procedures to be approved by the Engineer.

Along with the testing, the SFMTA will run the car for a 1000-mile burn-in period, not to exceed 90 days, prior to acceptance. The SFMTA will then issue a notification of acceptance or non-acceptance.

If a Car fails the acceptance tests, it will not be accepted until any and all deficiencies have been corrected and the Car has been retested and passes all applicable tests.

*DELIVERABLE: Acceptance Test Procedure*

### **1.16.3 Repairs Prior To Acceptance**

The Engineer may require the Contractor, or its designated representative, to perform repairs after non-acceptance, or the Contractor may request that the work be done by the SFMTA personnel with reimbursement by the Contractor. The SFMTA shall be informed in advance of any modifications made to the Car during the acceptance period. The Contractor is encouraged to provide an on-site representative to participate during the burn-in and acceptance tests.

### **1.16.4 Repairs by Contractor**

If the Engineer requires the Contractor to perform repairs after non-acceptance of a Car, the Contractor's representative must begin the repair within 5 working days after receiving notification from the Engineer of the failed acceptance test(s).

The Contractor shall provide, at its own expense, all spare parts, tools, and labor required to complete the repairs. At the Engineer's option, the Contractor may be required to remove, at its own expense, the Car from the SFMTA property while repairs are being affected. The Contractor shall then provide a space to complete the repairs, and shall diligently pursue the repairs.

If the Contractor becomes aware at any time before acceptance by the SFMTA that a Defect exists in a Car or with any material, equipment or services provided by Contractor, the Contractor shall (i) promptly correct the Defect and (ii) promptly notify the SFMTA, in writing, of the Defect.

### **1.16.5 Repairs by the SFMTA**

If the Engineer agrees to a request by the Contractor for SFMTA personnel to perform repairs on a Car prior to acceptance, the SFMTA shall correct or repair the defect using parts supplied by the Contractor specifically for this repair.

If the Contractor supplies parts for repairs being performed by the SFMTA before acceptance of a Car, these parts shall be shipped prepaid to the SFMTA by the Contractor within 10 working days after receipt of the request for said parts. The Contractor may request that defective components covered by this provision be returned to the manufacturing plant. The total cost for supplying and shipping such parts and the labor shall be paid by the Contractor.

The SFMTA shall be reimbursed by the Contractor for labor. The amount shall be determined by multiplying the number of man-hours actually required to correct the defect by the current top mechanic's hourly overtime wage rate, which includes fringe benefits and project overhead rate, plus the cost of towing or transporting the Cars if such action was necessary. The use of the SFMTA personnel will not

relieve the Contractor from the responsibility to ensure that repairs are carried out in accordance with proper procedures.

The SFMTA shall be reimbursed by the Contractor for defective parts that must be replaced to correct the defect. The reimbursement shall include taxes and shipping charges where applicable.

## **1.17 Warranties**

### **1.17.1 Definitions**

"Acceptance," as used in this Section, means the act of an authorized representative of the SFMTA Engineer to approve specific services rendered, as partial or complete performance of the Contract.

"Correction," as used in this Section, means the elimination of a defect.

"Defect," as used in this Section means any patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

"Material and/or Equipment," as used in this Section, means the completely rehabilitated PCCs (including all parts and equipment installed in them) and other deliverables furnished by the Contractor under the provisions of the Contract.

"Related Defect(s)," as used in this Section means damages inflicted on any component or subsystem as a direct result of a Defect.

### **1.17.2 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 Car and specific subsystems and components according to the following provisions:

The Contractor shall ensure 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 shall promptly provide complete copies of written warranties or guarantees and of documentation of any other arrangement relating to such warranties or guarantees extended by the Contractor's suppliers, sub-suppliers, vendors, and subcontractors covering parts, components, and systems utilized in the Coach. If any vendor/supplier to the Contractor offers a warranty on a component that is longer or more comprehensive than the requirement in Section 1.17.3.2, Warranty Provisions, the Contractor shall provide this information to SFMTA in their bid documents 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.

### **1.17.3 Warranty Provisions**

#### **1.17.3.1 Materials and Equipment**

The Contractor warrants that all Material and/or Equipment, and installation thereof, meets all requirements and standards set by the Specifications. All Material and/or Equipment shall be repaired /rehabilitated as specified in the Specifications. All new Material and/or Equipment shall be the best of its kind or quality, reasonably fit for its intended use as set forth in the Specifications, and of safe, substantial, and durable construction. All installation shall be performed in a good and workmanlike manner and shall be safe and installed to operate in the manner intended in the Specifications. The Contractor further warrants that any Material and/or Equipment, and installation thereof, shall conform to representations and descriptions, either oral or written, made by the Contractor, and to any literature, sample, or other Car information supplied by the Contractor in its Technical Proposal.

#### **1.17.3.2 General Warranty**

In addition to all warranties under or implied by law or required by the Specifications, the Contractor expressly warrants all work performed, Material and/or Equipment, including all parts and labor, installed or performed by Contractor to be free from Defects and Related Defects for two (2) years beginning on the date of final acceptance of each PCC, except for the paint and carbody warranty which shall be three (3) years. The Contractor shall make any necessary repairs to and any replacements of all or parts of the Material and/or Equipment, during the warranty periods set forth above, and in the Specification at no additional cost to the SFMTA and to the SFMTA 's sole satisfaction.

### **1.17.4 Additional Warranties**

1. If the customary standard warranties for the Material and/or Equipment, and installation thereof, exceed the period specified in Section 1.17.3.2, such warranties shall run to the SFMTA.
2. 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.
3. 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.

### **1.17.5 Voiding of Warranty**

The warranty shall not apply to any part or component of the Car that has failed solely as a direct result of misuse, negligence, or accident, or that has been repaired or altered in any way so as to affect adversely its performance or reliability, except insofar as such repairs were in accordance with the Contractor's maintenance manuals and the workmanship was in accordance with recognized standards of the industry.



The warranty on any part or component of the Coach shall also be void if 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.

#### **1.17.6 Detection of Defects**

1. If SFMTA finds Defects within the warranty period defined in Section 1.17.3.2 or 1.17.4, 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. Work necessary to commence the inspection or repairs, under the provisions of Section 1.17.8, 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 1.17.8 Repair Procedures.
2. 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 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.
3. 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.
4. 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.
5. 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) 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.

#### **1.17.7 Fleet Defects**

A Fleet Defect is defined as cumulative failures of any kind in the same new systems or 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 three of the Cars delivered under this contract. SFMTA shall have final approval of corrections or changes under these conditions, which may include requesting Failure Analysis Report (see Section 1.17.8.7) for the failed system.

##### **1.17.7.1 Correction of Fleet Defects**

The Contractor shall provide a corrective action plan within 10 Days of receipt of notification of a Fleet Defect under the procedures specified in this subsection. Unless SFMTA grants an extension, the Contractor shall provide SFMTA with a retrofit work plan, a Field Service Repair Procedure (FSRP) and schedule, to be reviewed and approved by SFMTA. The schedule shall specify how and when all Coaches with Defects shall be corrected.

Any proposed changes to an approved Fleet Defect work plan or program must be submitted to SFMTA for review and approval.

If Contractor does not provide a plan for correction within 10 Days (or as extended by SFMTA); or a specific declared Fleet Defect is not fully corrected within the time specified in the agreed upon schedule; or the remainder of the Cars are not corrected in accordance with the Contractor's work plan; then SFMTA will assess liquidated damages in the amount of \$500/Car per calendar Day as provided in 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.

#### 1.17.7.2 Fleet Defect Repairs

When SFMTA requires the Contractor to perform warranty-covered repairs under the Fleet Defect corrections, 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.

#### 1.17.7.3 Contractor-Supplied Parts

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

#### 1.17.7.4 Voiding of Warranty Provisions

The Fleet Defect provisions shall not apply to Car Defects solely caused by non-compliance with the Contractor's recommended preventive maintenance practices and procedures or caused solely by abuse of the equipment.

### 1.17.8 Repair Procedures

The Contractor shall reimburse SFMTA for labor, parts and administrative costs for warranty claims performed by SFMTA personnel or by any contractor(s) hired by SFMTA to perform warranty work.

Contractor shall reimburse SFMTA for warranty claims within 30 Days after each warranty 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 or will deduct the amount of the claim from the Retention.

#### 1.17.8.1 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.

#### 1.17.8.2 Defective Parts Return

The Contractor may request that Defective parts or components covered by warranty be returned to the Contractor. The Contractor is responsible for all costs associated with material return. Material will be returned in accordance with the Contractor's instructions. Contractor shall provide such instructions to SFMTA at the beginning of the project. The Contractor's representative shall meet with a SFMTA representative on as required basis to determine which parts need to be returned to the manufacturer for evaluation, or which parts may be discarded.

#### 1.17.8.3 Reimbursement for Labor

The 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 hourly overtime wage rate. The wage rate, and therefore, the warranty labor rate, is subject to adjustment each year. As of January 31, 2013, the warranty labor rate shall be based on the mechanic's wage rate of \$140.40/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. A 15% handling fee will be included on all outside invoices for warranty related services submitted to the Contractor.

#### 1.17.8.4 Reimbursement for Parts; Towing and Transportation

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 or otherwise transporting a Car or a Car change if either was necessary because of the failure of a warranted part. Towing or transportation 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. The cost of a Car change will consist of the actual time spent at the established warranty labor rate.

#### 1.17.8.5 Return of Material or Equipment

If the SFMTA returns Material and/or Equipment to the Contractor for correction or replacement under this Section, the Contractor shall be liable for transportation charges up to an amount equal to the cost of transportation by the usual commercial method of shipment from the place of delivery specified in the Contract (irrespective of the f.o.b. point or the point of acceptance) to the Contractor's plant and return to the place of delivery specified in the Contract. The Contractor shall also bear the responsibility for the supplies while in transit.

#### 1.17.8.6 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

#### 1.17.8.7 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 Cars under the terms of the warranty. The analysis shall commence with the approved corrective action plan and be documented and compiled into a report. Failure Analysis Reports shall be delivered to SFMTA within 60 Days of the receipt of failed parts.

#### 1.17.8.8 On-Site Support

From delivery of the first overhauled Car to the SFMTA until SFMTA's acceptance of the final Car, the Contractor shall have on-site at SFMTA's facility a minimum of at least one service technician, eight hours per day, Monday through Friday, major holidays excepted. The technician shall make warranty repairs, train SFMTA technicians and supply parts.

The Contractor shall maintain a supply of common warranty parts at SFMTA's facility during that period.