

PART B - Technical Proposal

(Forms B-63 to B-68)



Photo/Rendering is only a partial representation of actual proposed configuration. See proposal text and drawings for official Proposal.

Presented to Massachusetts Bay Transportation Authority
By Bombardier Transit Corporation

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TECHNICAL APPROACH

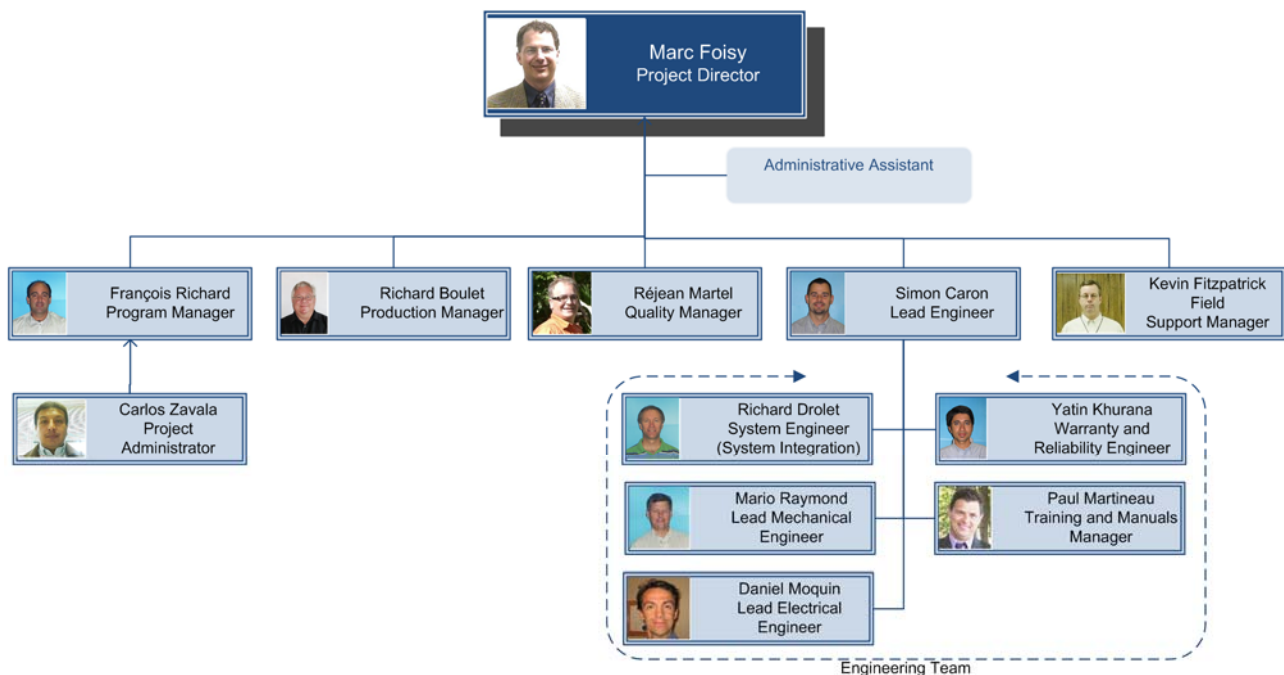
1. TECHNICAL APPROACH

a) Organization Chart

Provide a detailed organization chart (with names) of the project staff including, but not limited to Program Manager, Production Manager, Lead Electrical Engineer, Lead Mechanical Engineer, System Engineer (System Integration) Quality Engineer, Warranty and Reliability Engineers, Field Support Manager, Training and Manuals Manager. Include a detailed one-paragraph resume of each individual's experience, which directly applies to this project. A matrix of the responsibilities, location, and decision making authority, of the key staff shall be included.

The proposed staff must be the staff which will actually fill each identified role and deliver the services defined in the contract and the proposal. Changes of key individuals require the prior approval of the Authority.

Bombardier is pleased to assign the following staff to this key project. All selected personnel are experienced and eager to work with MBTA on delivering quality cars that will meet and exceed MBTA's performance requirements.



Project Staff	Name	Location
Project Director	Marc Foisy	Boston
Project Director has overall responsibility for Project success, including but not limited to: Profit & Loss accountability and Customer satisfaction. He will be the first contact point with the Customer and dedicated to this project.		
Program Manager	Francois Richard	Montréal
Program Manager will be responsible for coordinating activities at the Montréal Design Center ² .		
Project Administrator	Carlos Zavala	Boston¹
Project Administrator is fully responsible and accountable for ensuring that all contractual requirements (vis-à-vis Customer and Suppliers) are met.		
Production Manager	Richard Boulet	Massachusetts
Production Manager is fully responsible and accountable for all manufacturing activities, both for the Massachusetts Final Assembly plant as well as for other Bombardier manufacturing plants involved in this Project.		
Lead Engineer	Simon Caron	Boston¹
Lead Engineer will be fully responsible for all design matters, internal to Bombardier or with Suppliers and will have full design orientation and integration of design authority in the Project Team.		
Lead Electrical Engineer	Daniel Moquin	Boston¹
Lead Electrical Engineer will be fully responsible for all electrical design matters, including interface with internal Functions such as Methods or with Suppliers and will have full design authority in the Project Team on electrical design matters as well as for overall electrical integration. One of the key responsibilities of the Lead Electrical Engineer is to ensure that the proposed design meets MBTA's Specifications and is approved by the MBTA.		
Lead Mechanical Engineer	Mario Raymond	Boston¹
Lead Mechanical Engineer will be fully responsible for all mechanical design matters, including interface with internal Functions such as Methods or with Suppliers and will have full design authority in the Project Team on mechanical design matters as well as for overall mechanical integration. One of the key responsibilities of the Lead Mechanical Engineer is to ensure that the proposed design meets MBTA's Specifications and is approved by the MBTA.		
System Engineer (System Integration)	Richard Drolet	Montréal
System Engineer Manager (System Integration) is responsible for managing the design interface with the Suppliers, once defined by the Lead Engineer and Lead Electrical & Mechanical Engineers.		
Quality Manager	Réjean Martel	Montréal
Quality Manager is fully accountable to ensure that the Bombardier QA Manual directives are applied by all sites and functions (e.g. Operations, Engineering, etc.). The Quality Manager is also the prime Bombardier QA staff member responsible on QA matters vis-à-vis the MBTA.		

Project Staff	Name	Location
Warranty and Reliability Engineer	Yatin Khurana	Montréal
Warranty and Reliability Engineer is responsible for following warranty failures, analyzing defaults, driving failure analysis reports, defining reliability growth plans, and for ensuring proper follow-through of all these phases / processes.		
Training and Manuals Manager	Paul Martineau	Montréal
Training and Manuals Manager is fully responsible and accountable for the preparation and the delivery of all manuals and training deliverables.		
Field Support Manager	Kevin Fitzpatrick	Boston
Field Support Manager is fully responsible and accountable for commissioning of Vehicles, warranty, spare parts and overall warranty support. This Manager also acts as the Warranty Coordinator required under C4.02.I.		

1. *These representatives will spend much of their time in Boston. In order to ensure seamless coordination of the Project activities, their presence is equally important at the supplier sites, the manufacturing plants and at the Headquarters in Montréal.*
2. *Please note that the Design Center is part of the Montréal Headquarters.*

Marc Foisy, a Professional Engineer, is an experienced Program Director. He has been with Bombardier since 1989 and has been managing complex projects such as AMT Multi-Levels (Agence Métropolitaine de Transport), New Jersey Multi-Levels and Maryland Multi-Levels. Mr. Foisy has also occupied other senior positions with Bombardier Transportation and Aerospace, in North-America and in Europe. He has demonstrated his professionalism as a Key Account Manager for New-Jersey Transit Agency for more than three years managing the 2012 Sandy Hurricane Recovery Team to ensure Rolling Stock would be back in revenue service quickly.

Francois Richard, a Professional Engineer, has been with Bombardier since 1998 and has been managing large project teams in the Technical Publications and Training Group. As such, Mr Richard has been frequently interfacing with all Suppliers and Design Center Engineers. He further coordinates design activities at the Design Center.

Carlos Zavala, who holds a Bachelor's Degree in Electrical Engineer, joined Bombardier in 1996 and spent the first 11 years in Engineering and the last 7 in Project Management both in Mexico and in Kuala Lumpur. His rigor and leadership make him an excellent candidate for the Project Administration function.

Richard Boulet, who holds a degree in Industrial Engineering, has joined Bombardier in 1981, in Operations (Manufacturing and Methods). Mr. Boulet has worked most of his life in La Pocatière, Québec but also spent approximately 8 years in other Bombardier sites such as Barre Vermont, Plattsburgh New York, Crespin France. His vast experience in Operations makes him the ideal Production Manager candidate.

Simon Caron, a Professional Engineer with 20 years of experience, has joined Bombardier in 1996 and has a vast and solid experience in Production, System and Field Engineering. Starting as a Design Engineer, Mr. Caron has reached a Management role while working on several key projects, and is now leading all production and system engineering activities related to the Bombardier Sahagún site's responsibility.

Daniel Moquin, a Professional Engineer with 27 years of experience and with Bombardier since 1987, has spent his entire career in electrical engineering, either in Bids and Proposals, as Functional Integrator or as Manager. Mr. Moquin has worked on numerous projects including on the MBTA No. 3 Red Line.

Mario Raymond is a Professional Engineer that has 20 years of experience in transit and started working at Bombardier in 2001. Mr. Raymond, a Professional Engineer, has held several senior positions in Engineering such as Director, Structure & Truck Engineering and Mechanical Integrator for the BART Fleet of the Future.

Richard Drolet, a Professional Engineer with 28 years of solid experience, joined Bombardier in 1991 and has spent the vast majority of his career in Systems Engineering and in the RAMS (Reliability, Availability, Maintainability and Safety Engineering) Engineering group, which he managed for 15 years, ensuring that Bombardier's Vehicles, as proposed, designed and manufactured, include and meet the RAMS requirements set by Specifications on Bombardier's projects in North America, such as NYCT R142, LIRR M-7, and Amtrak NEC High Speed trainsets and locomotives.

Réjean Martel, a Professional Engineer who graduated in 1996 has been with Bombardier ever since, occupying several roles in Quality Assurance. Mr. Martel currently holds a position of Manager, Quality Assurance. His vast and solid experience constitutes an asset to the MBTA Project for the lead and coordination of all QA activities with all Plants and Functions (Engineering, Supply Management, Operations, etc.). This makes an excellent candidate to be the Quality Manager for the MBTA Orange and Red Line project.

Yatin Khurana holds a Master's Degree in Engineering and worked in reliability engineering for 5 years at GE and at Eaton Corporation and has been with Bombardier since 2011 in the same function. He has a key role in NYCT R179 project in Bombardier and has demonstrated his leadership in this position.

Paul Martineau, who holds a Bachelor's Degree in Design, has worked for Bombardier for over 16 years. During these years, Mr. Martineau has worked as a Structural Designer and Team Lead within the Structure and Truck Engineering department on the CTA and Société de Transport de Montréal (STM) projects. Prior to joining Bombardier, he also worked as an Industrial Designer for different companies and in technical publications for Bombardier Recreational Products. Finally, he has been Manager in Technical Publication since June 2012, where he is in charge of all technical publications and training for all Bombardier *BiLevel*TM contracts.

Kevin Fitzpatrick graduated from the Massachusetts Maritime Academy in 1978 and has 36 years of professional experience in Engineering. During the last 25 years, Mr. Fitzpatrick has been with Bombardier and has occupied several roles in the Field Support related to management of site

operations at our customer locations, taking charge of commissioning and warranty of Vehicles as well as managing spare parts, modifications on Vehicles, etc. He has worked on the MBTA's push-pull cars and the rebuild of F-40 locomotives, as well as with most of our US customers such as NJ Transit, NYCT, LIRR, MNR and Amtrak.

b) Technical Specification, Design & Manufacturing Standards Requirements

Provide a statement that confirms that the Offeror fully understands and will adhere to the requirements of the technical specification and all design and manufacturing standards referenced or otherwise applicable.

Bombardier confirms its understanding of the MBTA Technical Specification and all addendum requirements. Throughout the questions and clarifications request process, Bombardier acknowledges and understands the clarifications and specification changes included with the released MBTA Addendums. For the questions that remained unanswered, Bombardier believes that our Proposal presents the most advantageous technical offer to the benefit of the MBTA based upon our rolling stock design experience using “state of the art” and highly reliable service proven solutions.

Bombardier also fully understands and will adhere to the referenced design and manufacturing standards noted in the Specification and other standards otherwise applicable to Bombardier. In addition, because of our knowledge of the worldwide transportation industry, we are confident that we can actively address all the MBTA requirements and, upon request, can also present equivalent alternate design and manufacturing standards that fulfill the Authority's expectations. References to "Vehicles" in our Proposal include an individual car or married pairs as the context requires.

c) Heavy Rail Transit Vehicles Stainless Steel Carbodies Experience

Indicate the Offeror's experience with the design and manufacture of stainless steel carbodies for heavy rail transit vehicles, with emphasis on North American projects. To do this, provide a matrix that includes: the transit property; number of cars; date of contract; and carbody manufacturer (in-house or sub-contractor).

Bombardier has vast experience in designing and fabricating stainless steel Vehicles and has the most modern and extensive production facilities in North America. Over the course of the last 32 years, Bombardier has developed its expertise through the acquisitions of Pullman Technology and Transit America (formerly the Budd Company), and also through research and fabrication of new Vehicles for different customers worldwide, including many located in North America.

Bombardier's efforts to constantly refine its design, fabrication review processes and development of new technology have proven effective.

These efforts have improved manufacturability, reliability, finish, and resistance of the stainless steel Vehicles thereby increasing popularity of stainless steel Vehicles with more than 3,000 units sold by Bombardier during the last 20 years.

The implementation of the laser welding technology at our La Pocatière plant, Quebec, has been an important development of the last 6 years. This automated process has enhanced manufacturability while improving the aesthetic value of the side face of the Toronto Transit Commission (TTC) Rocket metro Vehicles, and has, as well, allowed us to re-evaluate and optimize design practices. The same welding technology was used with great success for the fabrication of components of the Société de Transport de Montréal (STM) MPM-10 metro Vehicles and the latest generation of New Jersey Transit / MARC Multi-Level Vehicles.

Transit Property	Vehicle	Number of Vehicles	Contract Award	Carbody Manufacturer	Carbody Material
NYCT - New York City Transit	R179	300	2012	Bombardier	SS/HSLA
STM – Société de Transport de Montréal	MPM-10	468	2010	Bombardier	AL/SS/HSLA
NJT – New Jersey Transit	Multi-Level	100	2010	Bombardier	SS/HSLA
TTC – Toronto Transit Commission	Rocket	420	2006	Bombardier	SS/HSLA
CTA – Chicago Transit Authority	Series 5000	706	2006	Bombardier	SS/HSLA
AMT – Agence Métropolitaine de Transport	Multi-Level	160	2007	Bombardier	SS/HSLA
NJT – New Jersey Transit	Multi-Level	329	2002	Bombardier	SS/HSLA
LIRR/MNCR – Long Island Rail Road / Metro North Railroad	M-7	1,172	1999	Bombardier	SS/HSLA
NYCT - New York City Transit	R142A	1,030	1997	Bombardier	SS/HSLA
Amtrak	Acela	160	1996	Bombardier	SS/HSLA
Amtrak	Superliner II	140	1991	Bombardier	SS/HSLA
MBTA – Massachusetts Bay Transportation Authority	Red Line	86	1990	Bombardier	SS/HSLA
NYCT - New York City Transit	R62A	825	1982	Bombardier	SS/HSLA

Note: AL = Aluminum, SS = Stainless Steel, HSLA = High Strength Low Alloy Steel

The above matrix addresses our experience in North America with stainless steel carbodies. Bombardier also has an important list of worldwide stainless steel projects delivered or currently in production such as the New Delhi Metro Vehicles (340 RS2 Vehicles and 74 RS5 Vehicles). Upon request from the MBTA, Bombardier will be pleased to provide a worldwide Heavy Rail Transit Vehicles Stainless Steel Experience matrix.

Potential subcontractor(s)

Identify the potential subcontractor(s) for [...]. Identify the type of equipment being considered and where and in what quantities similar equipment is in use. Indicate where this equipment will be manufactured and assembled. The authority places special emphasis on the use of equipment that is service proven in a similar application in the North American market.

In the table below, Bombardier has identified potential preferred Suppliers for major systems as defined on page B-64 of the specification, types and quantity of equipment as well as assembly location of equipment for use on the MBTA contract. The great majority of the equipments identified below have similar service proven applications in the North American market.

Bombardier fully understands the Authority's need for special emphasis on "service equipment in similar applications in the North American Market". We have noted your request in this area and have provided the references in the Table below.

Systems	Subcontractor	Type Considered	Similar Equipment Used (Qty & Location)	Manufacturing & Assembly Location
Propulsion	Bombardier Transportation (Holdings) USA Inc. (BTPC)	AC Propulsion System	Over 3,000 propulsion systems for Metros and LRVs in North America	Pittsburgh, Pennsylvania
Trucks and Major Truck Components	Bombardier (Contractor)	Inboard bearing truck with chevron primary suspension and air bag secondary suspension	Close to 600 trucks in service on the Toronto Rocket Metro line	Sahagún, Mexico, and Plattsburgh, NY
Auxiliary Power and Low Voltage DC Power	Transtech Corp. USA	Auxiliary Power Supply	1,600 units Worldwide over the last 10 years (20-25% in North America)	Ball Ground, GA USA 30107
HVAC	Mitsubishi Electric power Products, Inc. (Melco)	Roof mounted with 2 compressors	8,500 units as of end of 2012 in North America	Pittsburgh, PA
Carbody	Bombardier (Contractor)	Fully welded stainless steel monocoque carbody structure	Over 3,000 stainless steel Metro carshells in North America	La Pocatière, Québec / Sahagún, Mexico
Couplers & Draft Gear	Wabtec Passenger Transit	Mechanical and Electric Pneumatic Coupling, Drawbar, Cables	Over 5,100 Carsets in North America (92% in USA)	Duncan, South Carolina
Wheel Sets	UTCRA (UTC)	Wheel sets	More than 8,100 wheel sets for US Authorities	Morton, PA

1) Technical Approach

Systems	Subcontractor	Type Considered	Similar Equipment Used (Qty & Location)	Manufacturing & Assembly Location
Air Brake Equipment and Controls	Wabtec Passenger Transit	Friction Brake System Metro Pneumatic	Over 770 Brake systems for Washington and Toronto	Westminster, MD
Cab Signal Equipment	Ansaldo STS USA Inc. (US&S)	Ansaldo STS – “Microcab” system	about 1,200 units for Authorities all over the world including North America	Batesburg, South Carolina
Door Systems	Nanjing Kangni Mechanical & Electrical Co. Ltd. (Kangni)	Door R179 style	28,946 sets distributed in Asia (76%), South America (6%) and North America (18%)	Nanjing, China
Seats	Freedman Seating Co.	Metro Seat	Over 80,000 seats for metro Vehicles in Europe	Barcelona, Spain
Vehicle Monitoring System	Bombardier Transportation (Holdings) USA Inc. (BTPC)	Ethernet-based Train/Vehicle Network Solution	CTA 5000-Series; 714 Vehicle sets Toronto Rocket; 420 Vehicle sets	Pittsburgh, Pennsylvania
Network Equipment and Integrator	Bombardier (TCMS)	TCMS <i>MITRAC</i> product	Over 2,000 units for Metros and LRVs in North America	Pittsburgh, Pennsylvania
Communications Equipment including LED and LCD Signage	Singapore Technologies Electronics (Shanghai) Co., Ltd. (STE)	Communication Control Rack, Ethernet Switch, PACU, CCP (Communication Control Panel), Loudspeakers, Handset, microphone, Passenger Emergency Intercom, Ambient Noise Monitor, Electronic Signs, Camera, Network Video Recorder (NVR).	Communication: 2,388 Vehicles in use 1% in USA 13% in South America 86% in Asia LED & LCD Signage: 3,056 Vehicles in use 1% in USA 10% in South America 89% in Asia CCTV Camera, NVR: 2,346 Vehicles in use 1% in USA 13% in South America 86% in Asia	Shanghai, China

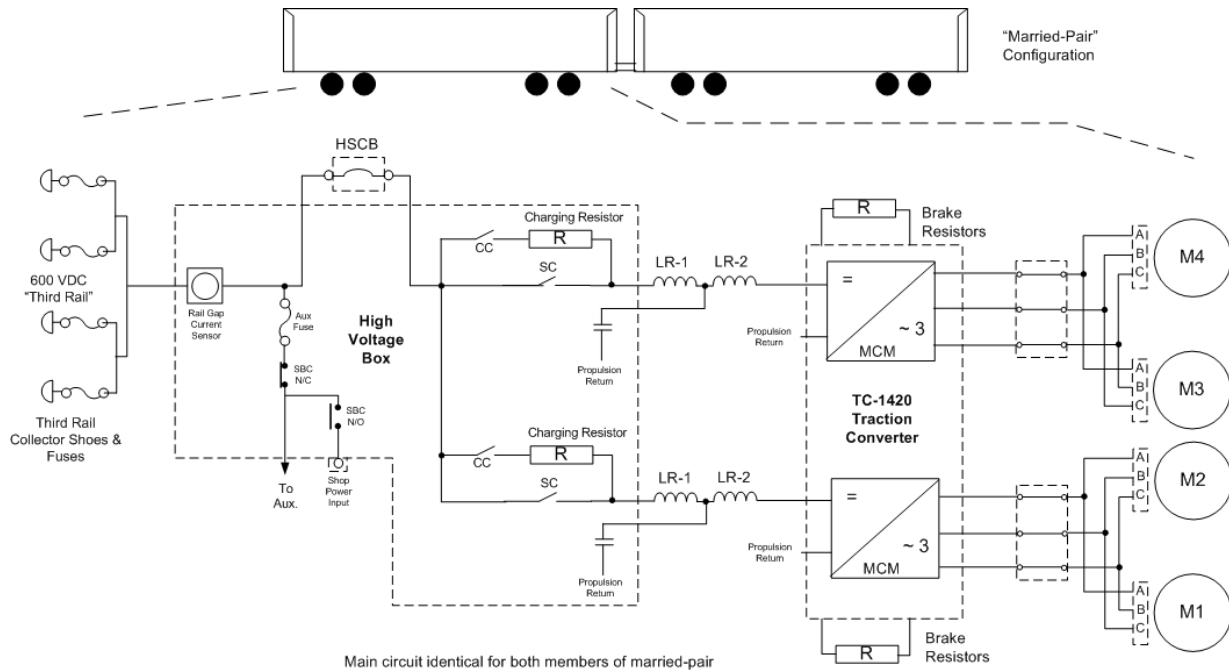
Systems	Subcontractor	Type Considered	Similar Equipment Used (Qty & Location)	Manufacturing & Assembly Location
Lighting	TDG Transit Design Group	LED Lighting	In use in over 600 North American Vehicles in all types of vehicles	Niagara Falls, NY and Mississauga, ON
Option V: CCTV Operator Display screens and other items as applicable	Singapore Technologies Electronics (Shanghai) Co., Ltd. (STE)	12.1" Touch LCD	2,346 Vehicles in use 1% in USA 13% in South America 86% in Asia	Shanghai, China
Option VI: GAP Mitigation Devices and other items as applicable	Nanjing Kangni Mechanical & Electrical Co. Ltd. (Kangni)	Gap filler	Over 12,000 produced since 1998 95% in Asia and 5% in Argentina	Nanjing, China
Option VII: Internal and external passenger door open pushbuttons and other items as applicable	Nanjing Kangni Mechanical & Electrical Co. Ltd. (Kangni)	Doors	28,946 sets distributed in Asia (76%), South America (6%) and North America (18%)	Nanjing, China
Option VIII: LCD monitors and other items as applicable	Singapore Technologies Electronics (Shanghai) Co., Ltd. (STE)	18.5" LCD & Media Controller	3,056 Vehicles in use 1% in USA 10% in South America 89% in Asia	Shanghai, China
Option IX: Active Route maps and other items as applicable	Singapore Technologies Electronics (Shanghai) Co., Ltd. (STE)	Active Route Map Display (ARMD)	2,897 Vehicles in use 10% in South America 90% in Asia	Shanghai, China
Option X: Automatic passenger counting system and other items as applicable	Dilax Systems Inc.	PCU-210, M12 IRS-320 SSL Cables	145 units in North America, and more than 1,600 units in Europe	Berlin, Germany
Option XI: Training Simulator	Corys T.E.S.S.	Softsim or Desktop Sim (option)	700+ worldwide 100+ in USA	Corys Thunder Inc. Jacksonville, FL

Bombardier also foresees additional potential suppliers as alternates for certain Major Equipment as listed in Form B-94 included herein. Please refer to Section B – Part B Technical Proposal and Statements and Certifications regarding Eligibility, Form page B-94.

Propulsion

Bombardier fully understands the mission critical role of a rail transit vehicle propulsion system and is fully committed to delivering equipment that fulfills this responsibility. Bombardier Transportation (Holdings) USA, Inc. (Propulsion and Controls North America (BTPC)), which is part of the Bombardier Transportation group of companies, located in Pittsburgh Pa, is the selected Supplier, and proposes the same propulsion system for both the Orange and Red Line Vehicles.

Bombardier (BTPC) proposes to the MBTA a service-proven, reliable AC propulsion system consisting of an AC traction motor/gear unit arrangement for each axle powered on a per-truck basis by an IGBT-based, three-phase traction inverter with forced-air cooling. Hereafter, is shown a power circuit diagram of the propulsion system, followed by a brief description of each element:



A standard Bombardier TC-1420 dual propulsion inverter enclosure for undercar mounting will be provided for each car. The TC-1420 stainless-steel enclosure contains two 3-phase inverters. Each inverter is provided with battery voltage DC-DC power supply, voltage/current sensors, filter capacitors, IGBTs, IGBT gate drivers, and a truck inverter controller using the service-proven and highly-evolved Bombardier *MITRAC* DCU2. The TC-1420 internal components are mounted in modular form and readily accessible for repair or replacement. The layout of the TC-1420 is such that the components of highest demonstrated reliability are located towards the rear of the enclosure while the components which require periodic maintenance are located towards the front of the enclosure. The TC-1420 propulsion inverter has been designed to handle input voltage fluctuations in both power and brake mode. In brake mode, the dynamic brake circuit continuously regulates the filter capacitor voltage.



In power mode, the inverter has been designed to handle any voltage transient that might exist on the filter capacitors. The TC-1420 is cooled using one forced air blower powered from the car's auxiliary inverter three-phase output.

One customized High Voltage Box (HVB) undercar enclosure will be provided for each car in order to regroup different standard components required for the specific car and Project requirements. The customized HVB aluminum enclosure contains two sets of the following components for independent control on a per-truck basis: input contactors, line/return current sensors, line voltage sensor, filter charging resistor and emergency brake relay. The HVB also houses the shop power interface, which includes one shop power receptacle, the auxiliary fuse, and a contactor arrangement for automatic changeover from collector shoe input to shop power with interlocking. Please note that a second remote shop power receptacle for mounting on the opposite side of the car will be installed. The HVB includes a current sensor for rail gap detection, substation ripple detector, battery voltage DC-DC power supply, *MITRAC* I/O modules, Brake Valve Driver Relay Panels and a service proven Bombardier *MITRAC*-VCU-C propulsion per car controller. The VCU-C receives, validates, and decodes the motoring/braking commands obtained from the trainlines and train networks. It also transmits the request to the inverter controllers (DCU2) via the propulsion system's dedicated MVB (Multi-function Vehicle Bus – per IEEE-1473) link. The VCU-C unit provides user (PTU) interface to allow access to the propulsion system event logger, data logger, parameter adjustability, system monitoring, system set-up, and self-test functionality provided by the Bombardier propulsion control system.

Each car will be provided with one standard High Speed Circuit Breaker (HSCB) as a stand-alone unit for undercar mounting, one customized brake resistor assembly containing the dynamic brake resistors required for two inverters, and two customized dual line filter inductors (natural convection). Those line filter inductors are light weight construction with aluminum conductor over an air core.

Bombardier proposes to supply the same service-proven traction motor/gear drive arrangement that was supplied for the MBTA #8 Green Line LRV's. It consists of the 1507D AC traction motor (140 HP) and the WR441-1C single reduction (113/17: 6.6471) gear unit. The required specific modifications for this application include the interface of the traction motor to the truck frame and the removal of the brake disc mounting provisions on the gear unit.

In addition to the above main components, the proposed propulsion system features integrated functionalities and controlled service proven approach, which improve the reliability by reducing the number of trainlines (and associated hardware), and onboard controllers by taking full benefit of the IP network capabilities:



- Safety commands kept on trainline (No-Motion and Emergency Brake)
- Train Motion (propulsion and brake) commands throughout IP network (as used on Chicago CTA-5000, Toronto TTC Rocket, NYCT R179 and BART projects)
- Integrated service friction brake control (by VCU-C on a per truck basis) for brake blending, slide control and friction brake system diagnostics

- Electric Brake Unit Line (BUL) within a married pair to provide friction brake control in case of the failure of one propulsion controller (VCU-C).

Trainline Controls over Ethernet Network

Since 2006, Bombardier has developed and implemented Ethernet-based train and vehicle networks. Through the projects, use of Ethernet networks has proven to be very beneficial for the train design as it permits to integrate more functions on a single medium. For the MBTA Orange and Red Line project, listed below are the proposed trainline control functionalities considered to be implemented as network commands.

Trainline control over the Ethernet is also being implemented currently on the San Francisco BART and NYCT R179 subway vehicles. The trainline controls are mainly a combination of network commands (carried by the train networks), and of limited hardwired discrete trainlines, especially for critical functions. The traction and braking commands are IEEE-std-1475 type 3 commands, transmitted on the IP-based Networks. For critical or safety related signals, the commands are carried out by both means (hardwire and Network), thus ensuring that no single point failure are present for transmission and assuring a default minimal control.

✓ *Class of Train Functionalities*

Conventional Trainline Controls – With the proposed MBTA Orange and Red Line Vehicles, since redundant network topology is proposed as described in the Network Equipment subsection, it is possible to transmit over the network right and left commands or directional commands (such as reverse, forward, door close, etc.). The system is based on standard Bombardier *MITRAC* network devices that have been and are currently used in many projects. It has the advantage of not requiring a trainline controller since it uses distributed network architecture. In the case where one network component fails, the network will dynamically and seamlessly work around the defective unit until normal operation resumes. The signal transmission reliability is maximized due to the multiple levels of redundancy (vehicle and train redundancy scheme) of the system. The trainline control configuration will be defined in Project, but preliminary numbers indicate that approximately half (48 signals) of the hardwired trainlines could be removed, implying weight and cost reduction.

Train Motion Commands – Most of the train motion commands may be transferred to the traction and braking system over the Ethernet network. Typically, direction and motoring/braking efforts, train configuration and non-vital brakes, and propulsion interlock statuses will be sent over the network. For train movement controls, arbitration will be done by the propulsion control unit. Task queues are dynamically managed using IEEE 802.1q VLAN methodology. The train configuration is managed through train inauguration at train start-up. The safety critical commands, such as Emergency Brake Loop circuit will remain on hard discrete trainlines, so no compromise is made on safety.

Passengers Access Control – The side doors open and close commands can be sent over the Ethernet network. The Door Unlock commands will remain on hard discrete. For the MBTA specific crew door operation, discrete signals to the local door controller would also remain.

Passengers Comfort Control – Lighting, Heating and Air Conditioning may be controlled through network commands. Such control allows commands (for setting temperature or lighting intensity) from any Vehicle or section of the train. This part of the network may also include passenger services such as display of multimedia information.

The implementation of the above train functionalities over the Ethernet maximizes the utilization of the Ethernet network capabilities while minimizing the number of cables and associated hardware.

Listed below are the main advantages of sending train control commands over the Ethernet:

- **Simpler Design, Lower Complexity, Better Reliability:** Moving trainline functions to the train network allows for the reduction of trainlines, relays, contactors, and other hardwire logic. And there is nothing to add: all systems are already equipped with a network connection. The design is simpler, with fewer parts, and therefore, combined with full network redundancy, offers better reliability.
- **No Compromise on Safety:** Since all the safety critical trainlines are run conventionally, the safety of the train still relies on service-proven and well-mastered topology. There is no compromise on safety.
- **Lighter and Smaller:** With the removal of as much as 48 hardwired trainlines (number to be confirmed during design phase), the associated wire weight can be saved. In addition, fewer trainlines means smaller wire trays. This will also contribute to reduce weight.
- **Flexible and Expandable:** The use of VLAN, which is a standard function of Ethernet networking, allows reserving bandwidth to specific type of traffic. High priority propulsion commands can be sent along with lower priority multimedia streaming without affecting each other's performance. The priority and the bandwidth can be reconfigured on-demand which provides flexibility and expandability for future needs.
- **Easier Maintenance:** With fewer trainlines, relays, contactors and the availability of detailed diagnostics information directly from the operator's screens, the Vehicles are easier to troubleshoot and maintain.
- **Cost Savings:** Fewer parts means less cost. Removal of analog inputs and digital inputs reduces wiring and connections to systems. No additional network connections need to be added on equipment since all microprocessor-based systems already have a network interface. Also, impact to add network functions is limited.

In summary, the ability to send train control commands over the Ethernet networks offers many advantages: simplicity, reduced weight, increased commonality of parts, and reduced volume while ensuring safety.

This control architecture allows optimizing the usage of the Ethernet network and uses state-of-the-art service-proven technologies. Design approaches that are in place and service proven can be applied readily for the Orange and Red Line Vehicles.

Trucks and Major Truck Components

Bombardier proposes its own truck assembly which is described in section 1d. The same 82" wheelbase truck will be used for both the Orange and Red Lines Vehicles. More than 160 years of experience in the rail business has made Bombardier internationally renowned for the quality and reliability of its trucks. As the global market leader in the rail industry, Bombardier offers a complete range of trucks and running gear solutions for trams, subways, locomotives, diesel and electric multiple-units, whether conventional or tilting, passenger coaches and specialized freight applications.

Auxiliary Power and Low Voltage DC Power

The proposed architecture for the Orange and Red Line Vehicles integrates the auxiliary power inverter (API) and the low voltage power supply (LVPS) into a single enclosure. Each car of the married pair will be equipped with the same unit. The API/LVPS units installed on Orange and Red Line Vehicles will be interchangeable. The API and the LVPS will have independent controllers and will share common PTU interface and network interface.

The API continuous capacity is estimated at 69kVA for 120Vac/230Vac loads. All AC equipment which has potential contact with passengers, crew or operators will be powered from the 120Vac. As a result, in order to reduce weight and costs, galvanic isolation is installed only on the 120Vac and not on the 230Vac circuits. On the 230Vac, the equipment and associated wiring will be selected to ensure that dielectric insulation is sufficient for safe operation. Bombardier has delivered API's with no AC voltage galvanic isolation on Chicago Transit Authority 5000 series vehicles which are operating in service since 2010. Forced air cooling will be used for magnetic components (coils, transformers) mounted directly in the air duct. Removal of the 230Vac galvanic isolation combined with forced air cooling will result in a compact and lightweight unit.

The API/LVPS units installed on each car of the married pair will have identical LVPS's. The LVPS power supply is estimated at 10kW to feed all loads of the married pair upon failure of one LVPS. Battery charging is provided by the LVPS.

The proposed battery includes 25 nickel cadmium cells mounted in stainless steel containers. There is one battery per car and the nominal capacity to supply low voltage power loads described in the emergency load schedule is actually estimated at 230Ah.

The API/LVPS suppliers actually considered by Bombardier are Transtechnik Corp. USA, PCS Power Converter Solutions GmbH and ABB Inc.

HVAC

Bombardier proposes a self-contained, roof mounted HVAC unit that is fully compliant with all the requirements of the Contract Specification. The units will be completely interchangeable between each end/Vehicle/line. This interchangeability is possible since units will be designed to have the same mounting interface with the carbody, ducting and electrical connections. These units are also physically and functionally the same (using same components) for each line. For the Orange and Red Line Vehicles, covers will be installed over the HVAC units to assure seamless continuation of the vehicle roof lines.

Each car will be equipped with two identical HVAC units, using R407C refrigerant, each providing one-half (32.5 kW) of the car's total required cooling capacity, and each equipped with 2 horizontal scroll compressors in a dual circuit configuration, thus providing additional redundancy. Each HVAC unit contains a control panel enclosure, housing the controller as well as all required contactors, circuit breakers, sensors, etc., mounted inside the mixed air plenum and accessible through a hinged return air grille on the ceiling. The HVAC controller will follow a similar control scheme as developed by Bombardier for recent projects such as NYCT R-179 subway vehicles, Bay Area Rapid Transit vehicles (San Francisco) and Toronto *BiLevel™* vehicles. It includes the temperature control logic, monitoring and diagnostics, as well as communication between units and the Monitoring and Diagnostic System. All unit components are carefully selected for their proven rail service and their availability, and use of off-the-shelf parts is maximized to facilitate availability during the life of the vehicle.

For best passengers comfort and riding experience, attention has been put on providing even distribution of air and heat in the Vehicle, as well as a proper level of fresh air. Each HVAC unit is equipped with 22.1 kW of heating capacity, while an additional 13.6 kW is provided through floor heaters along the Vehicle walls, assuring a uniform ambient temperature in each car. Ductwork and diffusers are carefully sized and selected to assure minimal noise level in the car.

The cab will be configured to ensure driver comfort with the provision of an independent duct line from one of the HVAC unit feeding the cab compartment. The cab is also equipped with floor heaters which are independently controlled by the driver. Other cab features also include 2 defrost units (windshield and driver side window).

The HVAC unit suppliers actually considered by Bombardier are Mitsubishi Electric Power Products, Inc., and Bombardier in partnership with Shijiazhuang King Transportation Equipment Co., Ltd.

Carbody

The proposed carbody structure will be designed and manufactured by Bombardier to meet the requirements of the MBTA Technical Specification (TS) Part T 03.00. Bombardier is the leader in stainless steel carbody design and has acquired in-depth knowledge of carbody design and assembly/ welding processes including the process for the aesthetic laser welded structures.



Laser Welding Apparatus
at Bombardier

The carbody structural design will have contoured sides and general dimensions similar to those of the actual vehicles. For subsystems standardization optimization, both new Orange and Red Lines Vehicles' side wall profiles will be identical, as shown below. Both profiles will fully satisfy the dynamic clearance requirements.

The end frame, underframe, and roof will be based largely on Bombardier's proven designs. The side frame of both Orange and Red Line Vehicles will have the same profile and general construction. The side sills will be designed for maximum stability and ease of assembly. Stiffening members and doublers will be added to sustain static and fatigue load cases and crash scenarios.

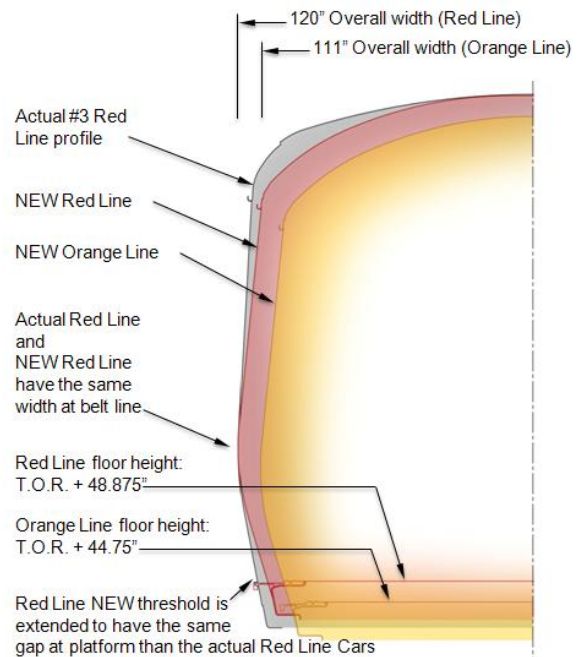
The crash energy elements will be designed to absorb 814 kJ, including the energy absorbed by the coupler. The elements will be dedicated crash boxes that maximize the energy absorption and minimize the deceleration of the car during impact, in order to minimize potential injuries to passengers. Bombardier has great experience in designing, modeling, and testing crash structures, for example: NYCT R-142 and R-179 subways, San Francisco's BART train and Bombardier's *BiLevel™* platform, as well as many other projects in Europe and Asia. These designs comply with various standards: ASME RT-2-2008, APTA SS-C&S-034-99, FRA 49 CFR part 238, etc., as aligned with the requirements of the MBTA.

The proposed carbody will be designed according to loads and deflections stated in the Technical Specification for a minimum design life of 30 years. Also the proposed Vehicles will comply with all of the requirements specified in ASME RT-2-2008.

The carbody will be built with a modular approach. All modules will be attached together by arc welding, resistance welding, and mechanical fasteners in accordance with Technical Specification requirements.

All welding visible from the exterior, such as the side walls, will be laser welded. Resistance spot welding will be used on non-visible surfaces and where laser welding cannot be performed. Skin flatness will meet the requirements of Technical Specification Section 3.04.04.

Carbody bolsters, end underframes, collision post, corner post, structural shelf and anti-telescopic plate will be constructed of HSLA-50 (ASTM A 572 Grade 50), HSLA-80 (ASTM A 656 Grade 80) and/or HSLA-100 (DOMEX 100). These steel grades are preferred by Bombardier for their corrosion resistance, weldability and mechanical properties. Side frames, roof structure and central underframe will be constructed of cold worked austenitic stainless steel 201LN (ASTM A 666). Low alloy high strength steel and austenitic stainless steel will meet the material requirements of Technical Specification Section 3.02.01 and Part T 18.00.



Proposed Vehicle Profiles

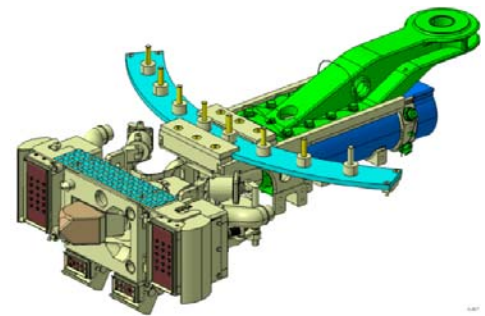
All connections of primary structural members that resist specified over loading conditions, including front end collisions, will be designed so that the ultimate strength of the connection exceeds the strength of the weakest member joined. These primary members include, but are not limited to, the end sill, collision post, bolster, side sill, and draft sills. The resistance and laser welding patterns will be uniform and will be submitted to the Engineer for approval. All welding and fastening will be in accordance with the Technical Specifications Part T 18.00. Welding procedures will meet AWS D1.1 and AWS D1.3. All connection methods using mechanical fasteners will be submitted to the Engineer for approval.

Couplers / Draft Gear

Bombardier proposes Wabtec Passenger Transit (WPT) for the supply of the Coupler and Draft Gear system. The proposed coupler system is largely based on the NYCT R-160 and R-179 coupler designs. Below is a short description of the proposed solution.

The mechanical coupler for the new Orange and Red Line Vehicles is a Tomlinson style tightlock flat face hook type RT-119. It is designed to mechanically and pneumatically couple married pair Vehicles. The couplers automatically join when buffed together. The mechanical coupler will include a pneumatic coupling for the Main Reservoir trainline. Side mounted electric coupler heads are also provided (one on each side of the coupler mechanical head)

and are designed with a pneumatic advance/retract feature. As indicated previously with the present project, Bombardier has elected to maximize the utilization of the Ethernet network capabilities by implementing the non-safety related trainline controls over the Ethernet and thus was able to reduce considerably the number of coupler pins. Therefore, it is anticipated that each side mounted electric coupler will only contain 15 contacts (including spares). In addition, for space constraint consideration and to improve the maintainability, the drum switch functionalities will be performed by a reliable latching relay solution.



Wabtec Proposed Coupler

The coupler will also contain 2 additional electrical coupler heads mounted under the mechanical coupler. Per the Contract Specification section 4.02.11. B, each bottom mounted electrical coupler head will maintain specific trainline connections regardless of the 2 side electrical coupler heads position, and will have a protective cover.

The couplers will be fitted with a radial carrier, draft gears, primary shear bolts, and a secondary shear out feature.

The proposed draft gear is a double acting mechanism, composed of rubber elements, that provides normal buff and draft shock absorption. In order to allow two six-car AW2 loaded trains to couple at 5 mph (one with brakes applied), the proposed draft gear assembly will require a deflection of 5.00 inches under 200,000 pound buff or draft load. Considering the deflection necessary for the integration of the coupling function at 5mph, we would need to define and agree with the MBTA on possible alternatives in regards to the recommended Vehicle dimensions specified in section T2.01.02.A.

The drawbar also has an emergency release feature to manage collision situations. 4 primary emergency release bolts support the emergency release block. The emergency release block is the buff load bearing block for the draft gear. When buff forces are exceeded, the primary emergency release bolts function to shear and permit the draft gear to freely telescope into the drawbar housing pocket. The mechanical coupler attaches to the clevis portion of the draft gear so it also moves with the draft gear to permit the end of car anticlimbers to engage and bear the collision forces.

The drawbar also contains a secondary release mechanism in the form of shear bolts that attach the draft gear housing portion to the tail stock portion of the drawbar. Shearing of these bolts allows for an extended travel beneath the car in order not to interfere with the carbody CEM.

A two piece link bar will be used on the No. 2 end of each car type. It will be composed of two link bar heads which will have the same length as two coupled mechanical couplers and will have the same drawbar clevis interface as the Cab end mechanical coupler. At the intercar, the electric couplers are replaced with trainline cables/connectors arrangement. The same carrier, draft gears, primary shear bolts, and secondary shear out feature components as used at the Cab end will be used at the No.2 end of the Vehicle's cars.

Dellner and Voith Turbo Scharfenberg are also potential coupler system suppliers for this project.

Air Brake Equipment and Controls

The proposed Friction Brake system is a pneumatically operated, load compensated, braking system designed to provide service and emergency braking controlled on a per truck basis. The same system will be used on all the new Orange and Red Line Vehicle types with the exception of the pneumatic variable load valve since its setting is Vehicle weight dependent. Two Brake Valve Manifold Units will be provided per car (one per truck) which will include the slide control valves. As allowed by the Contract Specification section 12.02.01.E, the propulsion system will provide service friction brake control, brake blending, slide control and friction brake system diagnostics on a per truck basis. This approach offers the advantages of having fewer electrical/electronic components/parts, reducing control wiring and improving the reliability and the maintainability. This solution has been successfully used by Bombardier on NYCT R142 subway vehicles, CTA 5000 series vehicles, TTC Toronto Rocket vehicles, LIRR & MNR M-7 vehicles, and is used for the new NYCT R179 subway vehicles.

Emergency brakes will be initiated by de-energizing the Emergency Brake Trainline which will result in an irreversible fail safe brake application. Per Contract Specification, no Brake Pipe will be provided and therefore, trip switches (two per car, one on each side of the truck No. 1) will be used as opposed to trip cocks utilized on the existing MBTA cars. This solution has been successfully used on the TTC Toronto Rocket vehicles and the CTA 5000 series vehicles.

The proposed Master Controller (MC) will be side mounted and will be located on the right side of the Operator's Cab. The MC will include an "ON-OFF" transfer switch, an over-travel button, a three position direction switch and a dead-man feature which will be connected to the Emergency Brake Trainline. Two independent and redundant encoders will be used to detect the MC handle position. As allowed by the Contract Specification section 24.05.01.B, two independent Ethernet networks will be utilized to communicate the train motion commands to the propulsion system instead of using a

P-wire loop. Bombardier has successfully implemented trainline control using Ethernet Networks on the TTC Toronto Rocket vehicles and Chicago 5000 Series vehicles. Trainline control over the Ethernet is also currently being implemented on the San Francisco BART and NYCT R179 subway vehicles. More details on the proposed train control topology are provided in above section *“Trainline Controls over Ethernet Network”*.

Hostler panel controls will include a compact Master Controller compliant to the Contract Specification. Communication of train motion commands will also be performed through the Ethernet networks.

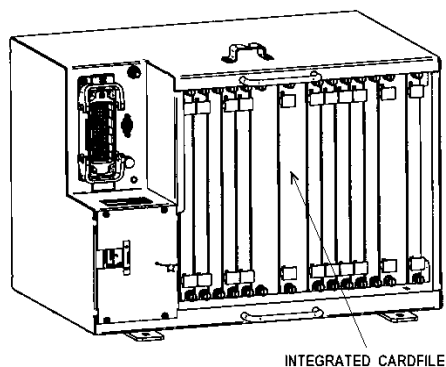
Service proven tread brake units will provide the friction braking of the Vehicles. The No. 1 Truck will be equipped with spring applied, air released parking brake units. Parking brake mechanical release which can be operated from inside the car as well as outside of the car will also be provided. In addition, a parking brake reservoir will be provided for re-applying parking brakes after mechanical release when no air is available.

Each married pair will be equipped with one service proven Air Supply Unit. The capacity of the compressor will be sized to supply all the pneumatic loads for the friction/parking brake, air suspension, coupler controls, sleet scraper and air horn. Each car will be provided with one Main Reservoir and two Supply Reservoirs. Main reservoir pressure will be transmitted from one Vehicle to the adjacent Vehicles via the main reservoir pipe and the coupler. The proposed Friction Brake and Air Supply system will be completed with service proven in-line pneumatic devices such as duplex air gauges, cutout cocks, air filters, magnet valves, check valves, etc.

The Friction Brake system suppliers actually considered by Bombardier are Wabtec Passenger Transit, Knorr Brake Company, LLC and Faiveley Transport North America.

Automatic Train Protection / Automatic Speed Reduction (ATP/ASR)

Bombardier proposes ASTS's MicroCab ATP/ASR system for the supply of both the Orange and Red Line Vehicles. The ATP/ASR system will provide redundant ATP and ASR functions. One redundant set of ATP/ASR systems will be supplied for each Vehicle and will be housed in the cab car electrical locker. The ATP system can be easily upgraded to work on mixed analog and digital FSK (frequency-shift keying) track circuit territories. The Cab Signal Receiver Demodulator sub-system is designated at Safety Integrity Level 4 (SIL 4) and therefore, communicates fail safe vital decoded signaling information to the ATP. Vital relays will be minimized using only one per both redundant ATP/ASR systems. The ATP will utilize brake assurance banking which will reduce nuisance emergency brake applications. External wiring will be connected to the case through a multi-conductor connector that allows for easy insertion and quick change out of the ATP/ASR metal case. Each ATP/ASR metal case will have an integral decelerometer that can be leveled and will be used for ATP brake assurance.



Siemens (formerly PHW) and GE Transportation Systems are also potential ATP/ASR system suppliers for this project. All proposed suppliers, together with Bombardier, have previous experience in North American similar environment and propose standard service proven products.

Door Systems

For the supply of the side door system and the body end door (cab and non-cab), Bombardier proposes its own system (in partnership with Nanjing Kangni Mechanical & Electrical Co. Ltd.) and also Vapor Stone Rail Systems (VSRS) as potential Supplier.

The bi-parting, sliding pocket type side door systems consists of an overhead screw drives electric door operator for each Right Hand (RH) and each Left Hand (LH) side door panel. Each sliding pocket style panel operates independently. Each modular side door operator will be mounted above each side door opening. Sensors are installed to monitor the door position. Each door panel is held shut by a door closed latch which is independent from the door operator. The unlocking is performed through a release solenoid on the latch system.

The proposed door system will be provided with a release lever located closed to the door operator behind a hinge panel.

The side door panels have stainless steel skins both inside and outside that are fixed to a stainless steel frame and aluminum honeycomb filler is bounded to the skins. The body end door will have stainless steel skins (inside and outside) that are fixed to stainless steel frame and will have stainless steel honeycomb filler bounded to the skins. For the Orange and Red Line Vehicles, the side door panels will be identical.

Bombardier proposes a Door Control Unit (DCU) per door operator. It is a microprocessor based unit with hardware assistance for the safety critical functions. In compliance with the Technical Specification, there will be two Door Control Panels (DCP) in the cab, adjacent to the left and right side cab windows. There will be also a Door Control Relay Panel.

The DCU exercises closed loop control on its associated door operator via feedback from the motor encoder. A proprietary algorithm control throughout the local door opening & closing motion, maintaining door speeds, providing obstruction detection, and latch control. It also has adaptive proprietary algorithm to self-adjust door operation for climate conditions, component wear, and door drag variations. The DCU requires discrete NO-MOTION, ENABLE/UNLOCK, and OPEN signals to open the local door. It uses a discrete CLOSE signal to close the doors.

The local conditions include information and commands from local devices as the Crew Key Switch, the Mechanical Lock Switch and the Emergency release device. The DCU has control (under conditions) over the door motor and lock to unlock and/or move the door panel when the proper conditions are met. It provides local Fault Light and Warning Light indications, and Closed and Locked status.

The DCU is using an internal trainline network generated by the Door Control Relay Panel (DCRP). The DCRP provides discrete control signal to each DCU on a dedicated side. The DCRP received control signal from the Door Control Panel through trainline.

Each DCU through a local CAN Bus network will provide diagnostic information to the DCRP. The DCRP will perform the gateway to the IP network.

Bombardier has designed the DCP and the DCRP for NYCT and BART subway projects. The DCRP uses electronic solid state devices instead of electro-mechanic relays. However, Bombardier can offer both types of technologies.

VSRS proposes a different architecture to fulfill the required Vehicle and train functions. The main difference with Bombardier door system is that the DCU receives control signals from the DCP through trainlines. Each DCU is connected to the Vehicle IP network through the Ethernet switches. VSRS supplies a Door Control Relay Panel (DCRP) using only electro-mechanic relays.

Interiors & Seats

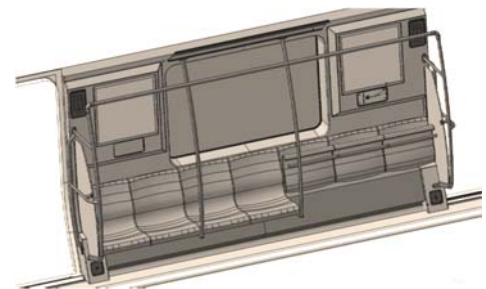
Bombardier will deliver state of the art interior concepts designed for passenger safety, maintainability and 100% compliant with the MBTA's specification requirements. The interior design will emphasize commonality of parts between Orange and Red interiors. The following interior appointments will be fully interchangeable between the two Vehicle types:

- Seat inserts
- Passenger flip-up seats
- Door Pockets
- Door Headers
- Windscreens
- Elliptical hand rail
- Trims & Moldings
- Ad card frames
- Operator seat
- Instructor seat
- Cab Sliding Sash window
- Decals

Bombardier will provide experienced industrial design services to create and realize a modern appearance encompassing functionality, ergonomics, and accessibility as the basis of the design. The Vehicle Interior concept will focus on the passengers' experience by harmonizing contours, colors, and appearance.

Bombardier proposes to team up with Freedman Seating as the preferred seat Supplier. Located in the US, they will develop and design a modular passenger seat system enhancing ergonomics and public appeal while meeting the Authority's specification requirements. The seat will be fully cantilevered and longitudinally mounted.

The floor covering will be Baultar's Abrastop with integrated emergency floor strips (HPPL) and will also include molded Abrastop floor coves to transition with the wall linings. Bombardier has had extensive experience with the installation of the Abrastop floor covering on past and current projects.



The operator's cab interior design will be a projection of the passenger area concepts while considering the operator's ergonomics, equipment accessibility, and maintainability features. An emergency egress chair, a foldable stretcher and a collapsible ladder have been appointed within the cab area.

Bombardier proposes Seats Inc. to supply the train operator seat and the instructor seat. Seats Inc. currently supplies the MBTA with an Operator and Helper seat on its HSP46 fleet. The proposed seat will incorporate EVC (Elastomeric Vibration Control) Cushion System, which provides increased comfort and can be adjusted to comply with the Specification ergonomics requirements.

OSG (Oran Safety Glass) is proposed to supply all windows and windshields. OSG has a reputation for innovative solutions and is well experienced with the FRA testing and performance criteria required for the US market.

Vehicle Monitoring System

Bombardier proposes a vehicle monitoring system based on Bombardier's *MITRAC* TCMS platform. This platform is composed of the following products:

- For Control: Vehicle Control Unit (VCU)
- For Visualization: Human-Machine Interface (HMI)
- For Input/Output: Modular I/O
- For Communication: Ethernet Switches
- For Tooling: Software tools

This platform is service proven as it is used on all Bombardier projects worldwide since 2002. The *MITRAC* TCMS products are stable, powerful, and secure. The proposed monitoring system is a fully integrated solution that provides diagnostics of all subsystems, simple train to wayside integration and very high service proven technology. Because the *MITRAC* is a standard product, it is designed to support a Long Life Cycle. More importantly, all parts of the monitoring system equipment are fully interchangeable between both Orange and Red Line Vehicles.

The proposed Vehicle Monitoring System (VMS) is a centralized system. Each married pair has its own VMS with all sub-systems within a married pair report their statuses and failure data to the local Vehicle Monitoring Unit (VMU). Any failure data or status from any sub-system on a train may be viewed from any available Vehicle Monitoring Display (VMD) on that train.

The VMD is a robust 10.4" CPU based touch screen that has been widely used on Bombardier projects. The glass portion of the VMD is easily replaceable. The VMD is also fitted with ruggedized power and network connectors. The VMD display screens are fully customizable and Bombardier will work extensively with the Authority to provide display screens and screen navigation that fit to the MBTA standards. The VMD displays live status information as well as live train configuration. The communication of the VMD with local and/or remote VMU's is done through the married pair and train network in a transparent way.

The proposed VMS integrates a robust and service proven fault management system which includes:

- Fully configurable fault triggering using attributes and equations
- Fault isolation, detailed description, and recommended corrective action

- Automatically sending of faults and train status to the wayside control center
- Fully configurable snapshot data recording with chart viewing
- Fault counters and
- Non related fault events

The proposed VMS manages the system time on the married pair. The VMS uses the GPS to synchronize its internal clock and to synchronize all systems in the Vehicle.

Network Equipment and Integrator

For the onboard Network Equipment, Bombardier proposes a complete IP network architecture. The IP architecture is based on Bombardier's *MITRAC* TCMS platform and is composed of Vehicle Switches (VS) as well as Train Switches (TS) as defined in the IEEE 1473 Type E standard. The proposed VS and TS are used on all Bombardier IP based projects worldwide. These switches are also fully interchangeable between the Orange and Red Line Vehicles.

The VS and TS support all standard functions such as:

- Network prioritization (IEEE802.1P – Quality Of Service)
- Network segmentation (IEEE802.1Q – VLAN)
- Automatic reconfiguration on married pair coupling; Automatic system change detection and recovery using Link Aggregation Control Protocol (LACP)
- Dynamic Host Configuration Protocol (DHCP)
- Domain Name Service (DNS)
- File Transfer Protocol (FTP), HyperText Transfer Protocol (HTTP), Secure SHell (SSH)

Bombardier proposes its standard network architecture. This architecture supports the transmission of the following data:

- Monitoring and Diagnostics (all systems, local or remote)
- Communication:
 - Audio (PA, Cab-Cab)
 - Passenger Information System
 - Video
- Control:
 - Train Motion commands
 - Input/output

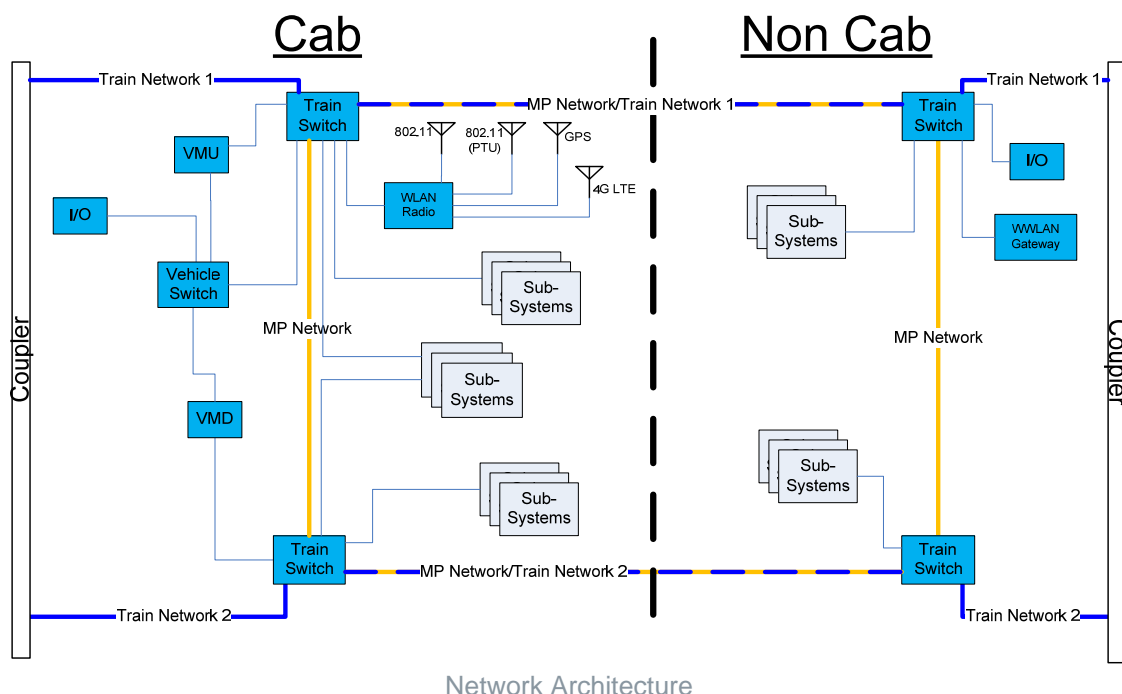
The proposed architecture enables full redundancy and very fast recovery in the event of a link failure. The proposed architecture will be exactly the same for both the Orange and the Red Lines. The only difference is the amount of systems connected to the network.

The Ethernet protocol (IEEE 802.3u 100 BASE-TX) used for the Train Network has proven to be reliable and robust through extensive tests and analysis, and is successfully running in service on the Chicago CTA 5000 series and Toronto Rocket cars since 2010. The Ethernet trainline and coupler arrangement has shown very good performance and stability. On the CTA 5000 series, measurements have shown that on 3.6 billion packets received through the electrical coupler connections, only 254 packets were lost, which shows a close to perfect reliability. The only packets that were lost occurred during train decoupling, when the couplers electrical heads were disconnected, which was to be expected.



Vehicle/Train Switch

The married pair Network and Train Network form the backbone of all types of communication on the train. It will consist of an IEEE 802.3 (ETHERNET) base switched network in a ring topology as shown in the figure below. This network will permit seamless communication between all systems of the train and with the wayside. The network will contain two Train-Switches (TS) per car for systems requiring communication with other married pairs in the train. The TS will automatically reconfigure themselves when two or more married pairs are coupled together. All TS's of a married pair create a redundant logical gateway for systems needing a redundant communication with other systems in a remote Married Pair (MP). This logical gateway performs IP address translation between the MP Network and the Train Network. All TS's of a married pair mutually monitor and supervise themselves in case of a failure. The proposed network architecture is also used on the New-York R-179 and the San Francisco BART projects.



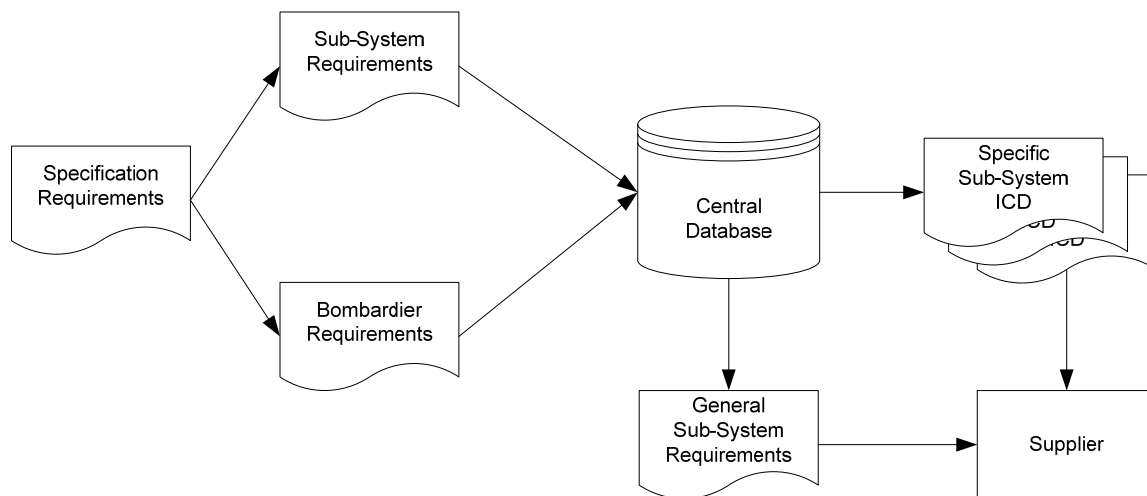
Network Architecture

Bombardier will be the integrator of all onboard network interfaces and devices. Bombardier has a very well defined process for the validation and testing of subsystem network interfaces.

The integration is divided into four general levels:

1. Conduct general description of the network interfaces with each Supplier
2. Build a database containing all network data interfaces between each system
3. Elaborate with the help of each Supplier the Interface Control Documents (ICD) which document and describe the Suppliers network interface
4. Validate the systems through the following test process:
 - a. Test level 1: Network interface hardware validation
 - b. Test level 2: Low level network protocol validation
 - c. Test level 3: High level application layer validation
 - d. Test level 4: Integration and validation of systems within the Vehicle

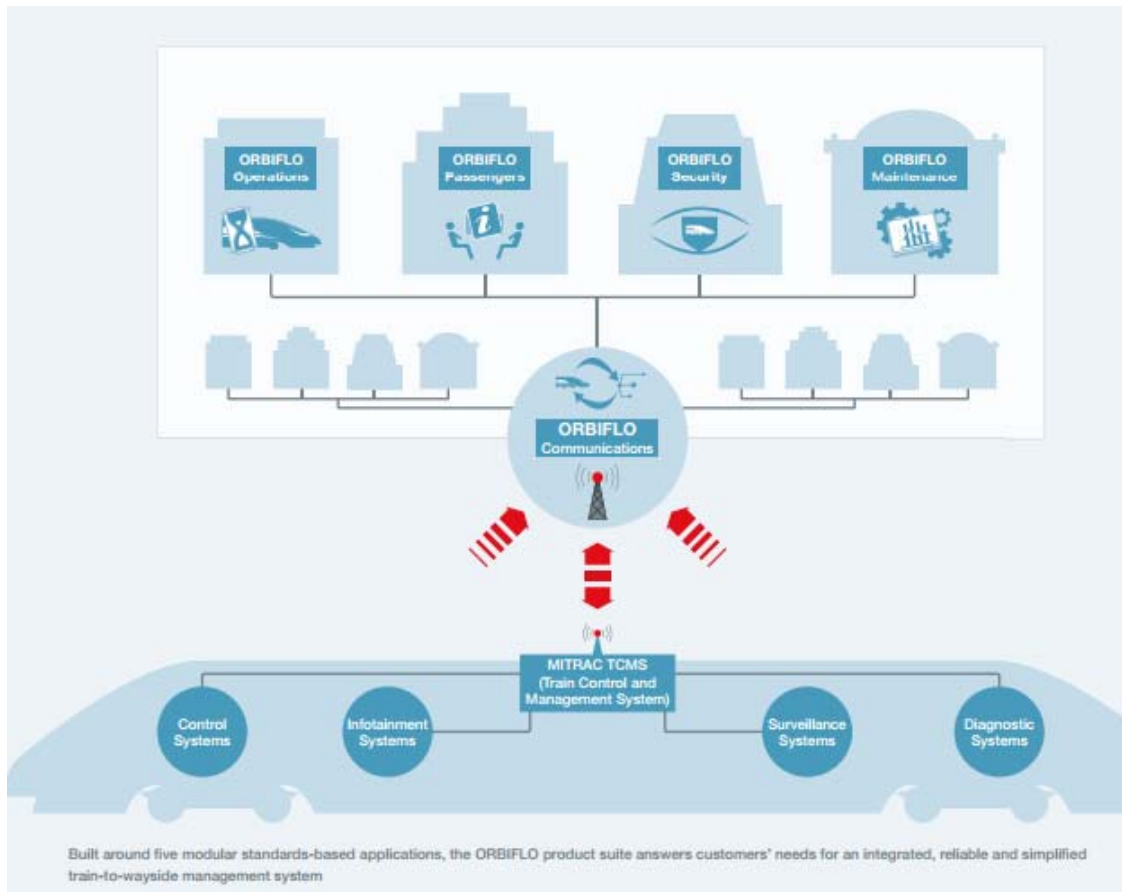
As the integrator, Bombardier manages the network interfaces between all systems onboard using a central database. All Interface Control Documents (ICD) and pertinent configuration files are generated from this database, as shown below:



Suppliers Network Interface Management Process

The communication between the married pairs and the Wayside is done through Bombardier's Wireless Data Link (WDL) equipment. The WDL acts as a router/gateway for all onboard systems with the wayside network infrastructure. The WDL will connect to the MBTA network using Mobile 4G and/or Wi-Fi technology and provide seamless and secure communication with any onboard system. The supply and operation including certification of the Verizon 4G LTE wireless network shall be the responsibility of the Authority. The WDL can simultaneously handle secure train system data as well as live streaming of voice and video.

Bombardier will provide a Wayside Server System which includes the complete installation of a wayside Wireless Local Area Network (WLAN) infrastructure as well as all servers and network related hardware. The Wayside Server System will also include Bombardier's ORBIFLO wayside fleet management system software. The ORBIFLO software coupled with the onboard VMS form a complete data management package for Operation and Maintenance processing. Bombardier's ORBIFLO is a complete, reliable and world renowned system for total fleet data communication. This software is service proven and offers many modular functions that can be added to increase operations and maintenance efficiency.



ORBIFLO – Integrated Wayside Application to enhance Train Capability

ORBIFLO will be provided with the following modules:

- **Operations** – Enables remote monitoring and controlling of selected onboard train systems by displaying faults, events, and alerts. Also manages all software versions of all onboard systems. This dramatically reduces the need for conventional manual access of individual train systems, saving time and increasing efficiency.
- **Maintenance** – Provides powerful data visualization tools for the diagnostic of faults. Also retrieves snapshot data that is related to a fault of any system of a selected married pair. The information is provided through an intuitive interface for engineers, maintenance specialists and operational management personnel to improve reliability and reduce maintenance costs.

Communications Equipment including LED and LCD Signage

Bombardier has a standardized approach for the implementation of the communication system on its vehicles. Since 2002, Bombardier has developed this standardization internally and implemented the following communication and video systems functions:

- Ethernet based train and vehicle networks
- Network interfaces for communication system IP equipment
- Integration of a passenger information controller and a multimedia controller into the vehicle monitoring system
- Passenger information control (route selection, special messaging, etc.), video viewing and multimedia system control integrated into the vehicle monitoring display screen
- Wayside passenger information database management tool

As a result of this standardization, solutions were developed and have been running in passenger service since 2010 on Toronto Rocket vehicles and Chicago CTA 5000 series vehicles. New projects such as NYCT R179 and San Francisco BART subways are based on the same IP based approach. Therefore, vehicle and train network integration is already developed for communication system IP equipment interfaces and functions. The communication system required by the MBTA Technical Specification is in line with this approach and the proposed system has a high level of re-use.

The communication system will use identical equipment in both the Orange and Red Line Vehicles with quantities adjusted to the Technical Specification requirements. The communication system uses the married pair network (MPN) for data, audio and video transmittals within the married pair and the train network (TN) for the train wide communication. The following equipment will have an Ethernet based interface: controllers, communication control panel (CCP), passenger emergency intercom (PEI), signs, optional route map displays and LCD displays.

For the audio, two separate amplifiers per married pair ensure redundancy. Each amplifier has three separate channels: one for interior speakers, one for right side exterior speakers, and the last one for the left side exterior speakers. Upon failure of an amplifier, half of the interior speakers in each car will remain functional. In each car, PEI's, signs and cameras are also split into two groups each connected to a separate Ethernet switch, therefore assuring that half of the communication system equipment remains operational in a Vehicle in case of a switch failure.

The Communication system and the CCTV system will share common enclosures and Ethernet switches, thus optimizing space requirements. Cameras are of Power over Ethernet (PoE) type. Remote video streaming is provided by the CCTV system in live mode and playback mode and split screen viewing can be provided. Bombardier has experience in the supply of onboard video recording, onboard viewing, transfer to wayside, viewing and archiving on wayside servers on the Toronto Rocket vehicles and Chicago CTA 5000 series vehicles.

The Communication and Video system suppliers actually considered are Bombardier in partnership with Singapore Technologies Electronics (Shanghai) CO., Ltd. , Technologies Axion Ltd, CA and ISC Applied Systems Corp.

Lighting

Bombardier has developed internal expertise in the design of main lighting and emergency lighting systems through partnerships with the proposed suppliers Transit Design Group (TDG) and Shenzhen Hengzhiyuan Electric Appliances Co. Ltd.(HYZ). Bombardier's specialized Engineers in electronics and in mechanical designs have participated in the development effort for standardization and manufacturing of LED light systems for passenger rail vehicles. The combined experience of the Suppliers and Bombardier has resulted in high performance solutions. Bombardier is not only offering quality and performance, but also its expertise in the development, installation, and qualification of LED lighting systems.

Bombardier is pleased to propose passenger area interior LED main lighting system which will use standardized components wherever possible and maximize interchangeability between the new Orange and Red Line Vehicles to the maximum extent possible. The system will consist of LED fixture extrusions mounted in 2 continuous rows to the car ceiling, one on each side of the aisle, and then connected to one another in a continuous arrangement using reliable printed circuit boards (PCB) mounted connectors at each end allowing for quick and easy removal/installation of any module in the middle of a row. This approach also simplifies the wiring by only having one car harness input at the end of each row/section with the adjacent fixtures transferring the power and dimming function signals to the next fixture to the other end of the row/section. The main lighting fixture body will be made from an aluminum extrusion providing lightweight and excellent thermal management capabilities.



Example of LED PCB Strip Modules
from TDG

The passenger interior area main lighting system will also provide APTA RT-VIM-S-020-10 standard compliant 90 minutes emergency lighting with the possibility of having a uniform emergency lighting by dimming all lights to a reduced level which avoids presence of dark spots. For this purpose, capacitive storage units are proposed to maintain APTA standard emergency light levels during 60 minutes. Per Contract Specification section 9.08.02.D, the Vehicle battery will provide the initial 30 minutes of emergency lighting. The advantages of the capacitive storage unit approach are the 15 minutes charge period, the 500,000 charge cycle life that will last for the entire Vehicle life and the fact that capacitors require no maintenance.

The main lighting system will easily achieve a service life of more than 50,000 hours. This is obtained by the use of good thermal design practices and proper LED current derating. In addition, high efficiency LEDs, selected from leading LED manufacturers will be used.

The passenger interior main lighting modular solution also allows installation of speaker modules in between main lighting PCB. Speaker PCBs include bridge traces for lighting signals (including dimming) and audio signals continuity. This eliminates the need for traditional discrete speaker fixture arrangements.

The proposed lighting system is completed with service proven LED lights for tail lights, marker lights, body end door vestibule lights, loop step lights, cab reading lights, lighting for equipment lockers, cab/hostler panel console light and all exterior and interior indicators. The head lights will be state of the art LED or High Intensity Discharge (HID) headlamps depending on the Supplier selected.

Event Recorder

The proposed event recorder for Orange and Red Line Vehicles is a standard service proven unit from Bach Simpson or Hasler Rail featuring compact dimensions which will ease integration, compliance with FRA and IEEE-1482.1 standard (with a data recording capacity in excess of 48 hours) and memory content download using a USB 2.0 port or a PTE port. All recorded signals will be received from the Married Pair Ethernet Digital Network.

Bombardier already has experience in North America with full Ethernet event recorder on Chicago CTA 5000 vehicles, BART and on NYCT R179 subway vehicles.

Options Description – Find below preliminary descriptions of the required technical Options. Please note that for this current proposal, Bombardier assumes that the related equipment for the options to be exercised will be installed at Bombardier manufacturing site during the series car production.

✓ *Option V – CCTV Operator Display Screens*

Proposal – Bombardier proposes to display camera views on the vehicle monitoring display (VMD) thus avoiding additional equipment installation in the cab and optimizing our price. If this suggestion is accepted by the Authority, the VMD would be changed from a 10.4" LCD screen to 12.1" LCD screen as required by Technical Specification section 5.03.11.A. Camera views are available in the operator's cab only when the train is stopped (as defined in Technical Specification section 13.02.21.E) and do not interfere with VMD operation information while the train is moving. This approach was implemented successfully on Chicago CTA 5000 series and Toronto TTC Rocket metro Vehicles running in service since 2010.

Alternative – The proposed option described above saves the costs related to a supplementary display, but if the Authority still sees the need for having a dedicated CCTV operator display as requested, it will be provided by Bombardier with an increase in our proposed price. All CCTV Suppliers and Bombardier have an existing product meeting the Technical Specification. However, Bombardier would like to highlight that implementation of an additional display would limit cab space, create additional parts and would decrease overall reliability.

✓ *Option VI – Gap Mitigation Devices / Bridging Mechanism*

For the supply of the bridging mechanism, Bombardier proposes its own system and also Vapor Stone Rail Systems (VSRS) as potential Supplier.

Bombardier and VSRS will provide a similar type system. A layout of the proposed bridging mechanism is shown on the figure below (shown with closed/open bridge plate).

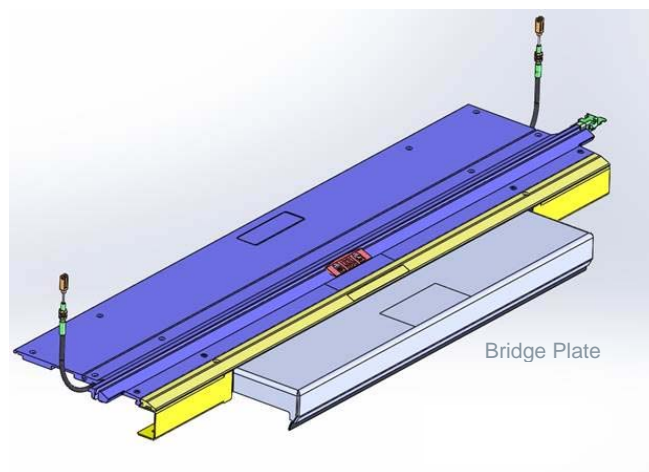
A platform to Vehicle floor threshold bridging mechanism will be provided for the left and right doorways nearest to the cab only for both the Orange and Red Cab Cars. The left and right hand bridging mechanism will be identical and interchangeable. The bridging mechanism assembly is mounted directly beneath the floor structure at the door openings.

The bridge plate retracts and extends by the action of a single DC motor drive mechanism with encoder. The systems and drive motor will operate at the same supply voltages as the door operator. Obstruction detection will be done by motor current sensing (for force control) and encoder position sensing. The powered bridging mechanism is controlled by a dedicated microprocessor controller similar to the one used for door operator control.

The bridge plate is supported by multiple guides and rails. The drive mechanism will be greaseless and not prone to increased friction due to dirt accumulation. This will have the overall result of providing a simpler and more robust system.

The bridging mechanism is also provided with a solenoid actuated locking system operating in failsafe mode with mechanical locking, which locks the bridge plate in both the extended and retracted positions. Manual unlock mechanism and retraction system is provided to allow the bridge plate to be retracted, stowed and locked in place when the power is off. Manual retraction, without special tooling, is also possible in the event of a malfunction via a floor access panel.

The bridge plate will not deploy automatically. A request must be made by pushbuttons located both inside and outside of the Vehicle adjacent to the doorway, which is then deployed by the conductor, from within the cab, using the Bridge plate Deploy Pushbutton on the Door control Panel. Retraction is done by the conductor within the cab using the Bridge plate Retract Pushbutton. Note that the bridge plate will deploy and retract while the doors are closed. The bridging mechanism will be interlocked with the door system and trainline in a failsafe manner, so as to preclude train motion while bridge plate is deployed.



Bridging Mechanism Shown with Open Bridge Plate

However, the implementation of the bridging mechanism requires important Vehicle body redesign: more specifically, it will have a major impact on the design of the side sill and the carbody bolster. Our Proposal assumes that Option VI is exercised at NTP. It is critical that the MBTA confirms its decision at NTP in order to avoid delaying the carbody design process.

✓ *Option VII – Internal and External Passenger Door Open Pushbuttons*



Typical Pushbutton

Bombardier proposes to supply rail transit service proven illuminated passenger pushbuttons to be installed adjacent to each door panel both on the interior and exterior of the Orange and Red Line Vehicles. When enabled by the driver from the cab door control panel, LEDs surrounding the pushbutton illuminate, allowing the local door to be opened by a passenger. After a passenger pushes the button, the door opening annunciation will occur, the local door will open, remain open for an adjustable period of time (via PTU), the audible and visual door closing annunciation will be activated and the door

will close. The figure below shows a typical pushbutton used by Bombardier on several previous contracts.

✓ *Option VIII – LCD Monitors*

The proposed LCD display system is provided by the communication system supplier who will also provide the displays and power supplies, which will be identical for both Orange and Red Lines Vehicles. Control of information to display on LCD monitors will be managed by Bombardier's Multimedia Information System (MIS) controller. Bombardier has developed Multimedia Information System (MIS) controllers in Europe and these applications are gradually implemented on North American projects. Currently, Toronto Rocket metro vehicles running in service since 2010 (312 cars in service) and BART subway vehicles are using Bombardier's MIS controllers integrated into the vehicle monitoring system.

The multimedia system can be used for multiple applications from passenger train information, to general information, animation, advertisement and dynamic route map display. These various features to be displayed on the LCD monitors improve passenger experience while providing the opportunity to increase advertisement incomes. Passenger information system and multimedia information system are both part of the monitoring system; therefore interface management between automatic station announcement, advertisement, and passenger information is provided by a centralized controller. Integration of LCD monitors is service proven since multimedia controller, vehicle network and wireless data link interfaces have already been developed and implemented on current Bombardier projects.

The proposed LCD monitor has Ethernet interface, a 16GB solid state drive, will operate at 10°C and support storage temperature down to -20°C. The weight increase for addition of the LCD display system, including DC/DC converters, is estimated at 140lbs for the Red Line Vehicles and 110lbs for the Orange Line Vehicles.

✓ Option IX – Active Route Maps

Proposal – Bombardier has developed service proven modules in the monitoring system's passenger information system (PIS) controller to specifically drive active route map displays. The active route map control requires information from different sources to display reliable status to passengers: train location, rail tag information, route selection, automatic announcements, and door status. All these sources of information are captured by the monitoring system, therefore control of the active route map displays can be well coordinated with other visual and audio announcements and well synchronized with the train location. This approach has been implemented on Toronto Rocket metro vehicles (actually 312 cars delivered), Chicago CTA 5000 series (actually 450 cars delivered) , NYCT R179 and BART projects.



Toronto Rocket Active Route Map Display

The active route map display itself will be provided by the communication system Supplier. The display that will be supplied is compliant to the Technical Specification requirements with bicolor LEDs at stations and a method of highlighting the stations. The LED layout will be adapted to the Orange and Red Lines configuration. The estimated weight impact is similar to the LCD monitor; DC to DC converters can be shared between both sets of equipment.

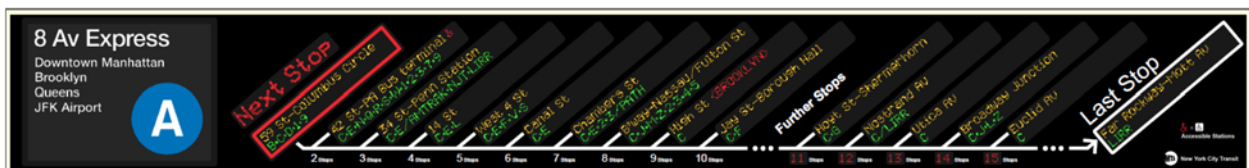
Alternative Active Route Maps – Active route map displays can be combined with LCD displays into a single enclosure. The same LCD display can be used for the Orange and Red Lines which is an advantage over the LED version that has to be adapted to the route layout. As a result, if the MBTA decides to change its requirements to have combined displays, Bombardier can offer different solutions. Bombardier is currently supplying on the NYCT R179 and San Francisco BART subway vehicles new types of active route map displays as described below.

In the BART subway vehicles, a single 27" LCD display is used to provide text messages, dynamic route map, and animation content. This solution has the advantage of combining the LCD monitor and the active route map display into a single display and makes it possible to reconfigure the routes if they change in the future.



San Francisco BART Interior Information Display

In NYCT R179 subway vehicles, the active route map display includes an LCD monitor and an LED section combined into a single display. The 15" LCD monitor displays route information of the current line, service information, and animated media messages. The LED portion displays station names and accessibility logos with multi-colored LED matrix and mono-colored LED matrix for station transfers. Back lighted LED rectangles can be turned ON around any station name.



NYCT R179 Flexible Information and Notice Display

These alternative solutions are presented for information only; the MBTA shall revise requirements for LCD display and active route map display for Bombardier to evaluate the cost benefit.

✓ Option X – Automatic Passenger Counting Systems

The Automatic Passenger Counting (APC) System required in option is provided by a Supplier specialized in mobile transit products. The proposed product is service proven on train vehicles in North America as well as on Bombardier vehicles. The automatic passenger counting system will use the same components for the Orange and Red Line Vehicles and these components will be interchangeable.

The active passenger counting system includes:

- Active infrared sensors installed at each doorway
- Integrated on-board data logger including data logging and wayside data transmission
- A comprehensive data management and reporting solution validating data, providing comprehensive data quality filters and generating APC reports and tables. A schedule import facility (Fleet Data management) is also included.

The sensor is made of 2 optical arrays and a control board. The sensor offers bidirectional counting and the ability to capture sensor errors. The sensor can be adjusted such that it does not see objects passing below an adjustable height. This lowers the false count resulting from strollers, luggage, animals, etc. The infrared sensors will not require extensive calibration or configuration for implementation on the MBTA's Orange and Red Line Vehicles.



Typical Bi-Parting Door Sensor Installation

A passenger counting control unit is installed on each side of the Vehicle to collect data from all doors on that side. It performs 3 primary tasks: collecting counting data and related door-open/closed information, storing data along with time stamps and GPS coordinates, and transmitting the data to the vehicle monitoring system and remotely through the WLAN/WWLAN (Wayside Wireless Local Area Network) radio to the wayside servers. The control unit has an Ethernet interface and discrete inputs/outputs for sensors and door status inputs.

For wayside data analysis, a web-based solution is supplied for raw data diagnosis and reporting. The following functions are supplied with the package.

Monitoring of Data Quality in a web-based user interface:

- Vehicles raw data overview
- Dates at which Vehicles have delivered raw data (completeness check)
- Warnings and errors of on-board APC equipment for fleet maintenance

Reports to Analyze Passenger Counting Data:

- Reports on passenger boarding and alighting per stop sequence, arrival and departure times at each station
- Filters allowing defined views on data (e.g. by Vehicle, by day or time period)
- Association of GPS coordinates with station names
- Passenger reports created as CSV files which can be analyzed in Excel

✓ Option XI – Training Simulators

The potential Supplier for the Training Simulator is Corys TESS, Grenoble, France. Corys Tess is responsible for the management, Project follow-up, and design activities. Corys TESS subsidiary, named Corys Thunder Inc. (CTI), located in Jacksonville Florida, USA, would be responsible for the manufacturing, testing, delivery and support.

The proposed simulator system will be based on the Corys North American passenger simulation platform, which has been successfully delivered, supported and maintained at Amtrak (Qty:1 Full-size, 10 Networked), METRA (Qty: 5 haft-cab), Long Island Rail Road (Qty: 1 Full-motion), Metro North Rail Road (Qty: 1 full-cab) and many others.

Corys has proven and comprehensive track record as a Supplier to Bombardier having successfully supplied the following cab simulators: Chicago CTA USA (Qty: 1 full motion and 8 compacts), Toronto Transit Commission Canada (Qty: 2 full cabs), San Francisco BART USA (In progress, Qty: 1 full cab) and many others.

The propose Training Simulator will include 2 SoftSim trainee stations and 1 Simulator Instructor Station as per section 22.02.08 of the MBTA Technical Provisions, including Addendum 8. The SoftSim trainee stations are based on laptop and touch screen technology to provide an affordable individual simulation training platform.

Each SoftSim trainee station contains:

- One laptop computer, which is configured with a network interface for connection to the Instructor Station within the classroom.
- One 22" touch screen for train operation and controls.
- One 24" LCD screen for the CGI forward view.
- A speaker system with a headphone jack which is also provided to properly operate in a classroom environment.
- The SoftSim desk is a painted metal case to allow reasonable cooling for the laptop and has fans to further enhance heat exchange.

The proposed SoftSim trainee station is self-contained and is designed to be placed on a desk or table in a training classroom. A view of its configuration is shown below.



SoftSim Trainee Station



Layout for the Proposed Softsim

The Simulator Instructor Station consists of the following hardware components:

- One 24" screen displaying the main Instructor Human Man Interface (HMI)
- One 24" screen to select the simulator to control
- One 24" screen displaying a copy of the Computer Generated Images seen by the selected operator
- One 24" screen displaying the desk report and the report of the Virtual Train Display for the selected simulator
- One keyboard and mouse for the Instructor to supervise the simulation
- An intercommunication system (microphone, with mute mode, and loudspeaker), allowing the Instructor to dialogue with the trainees and to select the different roles
- All screens are high-quality 24" LCD monitors, full HD 16:9 (1920 x 1080). The screens are mounted on a frame, with orientation adjustment, to optimize the ergonomics of the Simulator Instructor Station.
- The main Simulator Instructor Station is provided with one table and ergonomic chair
- One color laser printer



Example of Instructor Station (London Midland UK Simulator)

The proposed Training Simulator is based on the CORAIL software environment developed by Corys. It has been designed specially around the Computer Generated Images of train/train simulators and integrates train specific concepts of tracks, other trains, time tables, etc., as basic features in C++ object oriented programming language.

The CORAIL software is a design proven environment already tested and implemented on many existing projects.

The supplied software includes:

- A modeling of the new Bombardier train
- Simulated train driven by the trainee
- Control train driven by the instructor
- Automatic trains
- Train Dynamics, Train subsystems, Communication, Sound environment, etc.
- Train faults
- A virtual desk and train display



Computer Generated images:

- Overall lighting (tunnel, open section, platform, surrounding building, etc.)
- Animated features (signals, switches, time of day, visibility, etc.)
- Removable objects (people on platform, temporary signals, obstacle on tracks)



The standard Corys Human Machine Interface will be supplied on the Simulator Instructor Station desk monitor. This interface has proven extremely intuitive to use by transportation personnel as it applies the Windows points and click principles.

This interface enables the instructor to build and test scenarios offline in preparation mode (route, attendances at station, overall parameter, weather and time of day conditions, removal items, malfunctions on the train, etc.) and then run them for operator training in simulation mode.

A replay mode is also available allowing the instructor to replay all or part of a training session with the trainee for debriefing and lessons learned.

We believe that the above proposed solution will fully meet MBTA's expectations. Should MBTA have any question, Bombardier and Corys will be please to provide additional information.

d) Proposed Trucks

Describe the proposed trucks for this contract. Include such information as, but not limited to, structural material description, suspension (primary or secondary) description, allowable static and dynamic movement, and fully assembled weight. Provide a listing of the past experience of the basic design of the proposed trucks. Indicate where the major truck structural components will be manufactured (cast or fabricated) and where the trucks will be assembled.

Bombardier has an extensive experience of designing trucks for North American authorities for more than 25 years. Also, the proposed manufactured inboard truck for both the Boston Orange and Red Line Vehicles has been used successfully on the Toronto Rocket metro project. Currently, 588 of these trucks are in revenue service (252 additional trucks will be delivered this year) and, over the course of the last 4 years, they have cumulated more than 400,000 miles.

Bombardier has also a solid and vast experience in truck manufacturing, providing North American fabricated trucks in Bombardier's plants for several customers, such as the AMT (Agence Métropolitaine de Transport), BART (San Francisco), CTA (Chicago Transit Authority), LIRR (Long Island Railroad), MNR (Metro-North Railroad), the MTA (Maryland Transit Authority), NJT (New-Jersey Transit), NYCT (New-York Transit Authority), TTC (Toronto Transit Commission) and Translink (Vancouver).

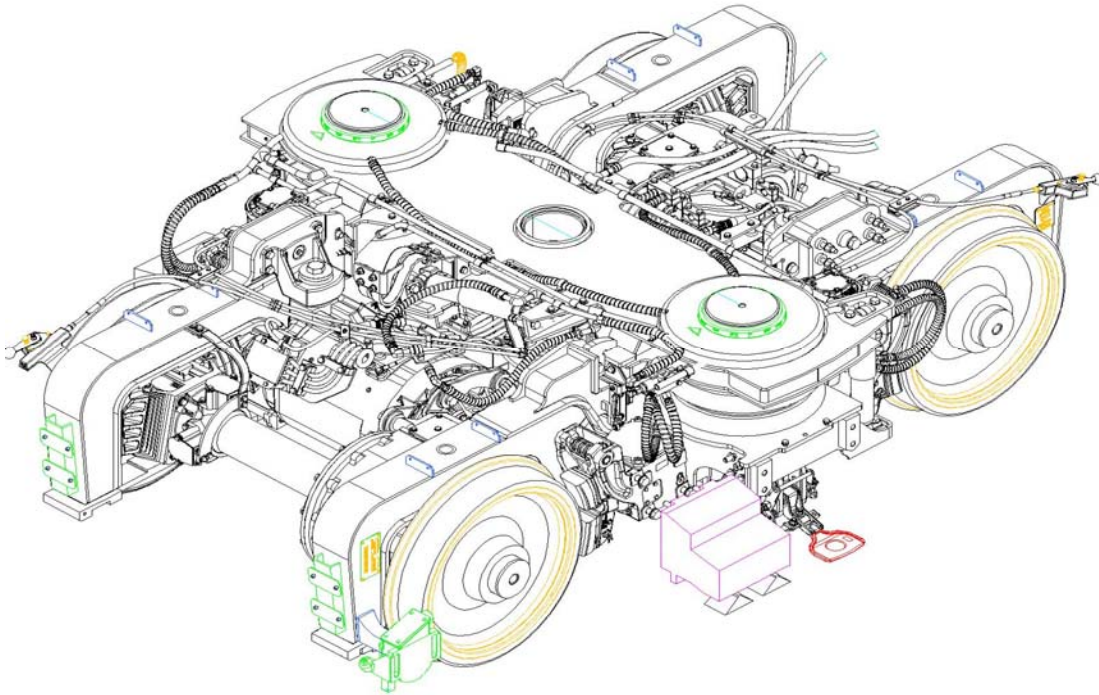
The proposed fabricated truck frame will be manufactured at the Bombardier Sahagún, Mexico facility where more than 1000 trucks have been manufactured. The truck will be mechanically assembled at the Bombardier Plattsburgh, New York plant for the Pilot Cars, and in the Bombardier Massachusetts Final Assembly Facility for the series Vehicles, as requested by the MBTA. Based on preliminary analysis, the expected truck assembly weight will be approximately 13,200 lbs.

The proposed fabricated truck frame and truck bolster will be made of ASTM A-572 Grade 50 steel with specific corrosion index of at least 4 times the one of the carbon steel. Some local castings (such as the wheel arch, the tread brake unit anchor, etc.) made of ASTM A-352 Gr.LCC could also be used.

The strength of the truck frame, truck bolster, and other truck structural components will be verified by performing finite element (FE) stress analysis using state-of-the-art commercial software, in full conformance with the Technical Specification requirements. This commercial software includes the

Altair 'Hyperworks' suite for FE pre- and post-processing operations (that is mesh preparation and results visualization, respectively) in combination with the Nastran and Altair 'Radioss' solvers.

The structural performance of these parts will be validated by performing static and fatigue testing of complete prototype under controlled conditions in a specialized laboratory environment.



Truck 3D Model

The same service proven chevron primary suspension, supplied by Bombardier on the previous Boston Red Line # 3 project, is proposed. This will allow Bombardier to meet the requested wheel unloading performances. The vertical upward (+1.375") and downward (-2.000") primary suspension travel up to the stops, from the AWO nominal position, will also remain the same.

Similar air bags will also be used at secondary suspension. The vertical upward (+2.00") and downward (-1.25") secondary suspension travel up to the stops will remain the same. A three leveling valve system will be supplied. The air bags are installed on the truck frame and the truck bolster is resting on the air bags.

The air bags are absorbing the vertical, lateral and longitudinal displacements. Truck to carbody rotation takes place in between the carbody and the truck bolster while 2 vertical dampers and one lateral damper will provide the appropriate damping. Progressive lateral bumpers will be used and will keep the carbody within the clearance diagram. The secondary suspension free gap up to contact with the lateral bumper will be 0.375" and 1.375" with the solid stop as on the previous Boston Red Line # 3 project. A carbody center pin is engaged in a vertical wear sleeve. The vertical load is taken by the side-bearings.

Above each air bag, a complete integrated wheel wear compensating device will be provided. Wheel wear will be compensated per 0.25" increment up to 1 inch. When the carbody is raised up to a contact in between the carbody lifting hook and the truck bolster, the wheel wear compensating device can be rotated up to the next increment to compensate 0.25" of wheel wear. Therefore, no shims are required.

The wheels will be manufactured according to AAR M-107 Class B. A class E (6x11) bearing meeting the specified L10 life will be used. A grade F axle, double normalized and tempered, will have a minimum fatigue life of 40 years. The gear unit will be press fitted over the axle.

A current collector similar to the one used on the MBTA Blue line metro Vehicles will be used. It will be mounted on the central portion of the truck frame.

On No.1 end truck, an air operated sleet scraper will be provided on both sides of the truck. It will be mounted on the side of the tread brake unit (ref. above figure for truck 3D model).

Two trip switches will be provided on the No.1 truck of each car, with one on each side of the truck. The Addendum 1 of the Technical Specification requires mounting of the trip switches slightly to the front of the lead axle (ref. above figure for truck 3D model). This is a different configuration compared to the existing car where the trip cocks are mounted a few inches behind the wheel in the longitudinal direction. We suggest that this required modification be discussed during design reviews because it could affect the cab signal distances.

On the No.1 end truck, 2 tread brake units with parking brakes and 2 tread brake units without parking brake will be side mounted on the truck frame. On the No.2 end truck, 4 tread brake units without parking brake will be side mounted on the truck frame. A parking brake release mechanism will be provided. The release can be operated from inside the car or from the truck.

The motor will be attached to the gear unit via elastomeric bushings. The motor and the gear box will be attached to the truck frame with vertical suspension posts.

The SIMPACK software package will be used to perform all vehicle dynamics calculations such as ride quality, wheel unloading, safety against derailment, wheel-rail forces, stability, and clearance simulations. Upon contract award, Bombardier will perform track geometry measurement to measure the track conditions of the Orange and Red Lines.

e) Weight Requirements

Describe how the absolute weight requirements are met and how the weight is managed during the design phase and during manufacturing. Describe how the Weight Management Plan is coordinated with the various subcontractors.

Weight control is an integral part of Bombardier's design philosophy. A Weight Control Program is established to monitor and control the total weight of each Vehicle as it progresses from the initial Proposal through design development and manufacturing up to the final delivery.

As early as the Proposal stage, initial estimates are already made, based on the MBTA specification requirements, knowledge of existing designs, and engineering data.

During this bid preparation phase, Bombardier specifies weight allocation to each major system suppliers through a Bombardier Technical Requirements Description (TRD) process document. Through this process, the suppliers are required to provide their own system weight estimates as part of their proposal, that need to match the received allocation. As information is received from potential suppliers and more detailed weight breakdowns of the subsystems are performed, the estimates are revised and updated, to define and identify the weight budget.

Bombardier is completely aware of the importance of maintaining the weight of the Vehicle within the contractual limits, as we know that the weight limitations of the MBTA system are clearly absolute and cannot be compromised. Following the standard practices and based on the weight budget estimated during the bid preparation phase, clear budget weights are allocated for each Vehicle systems early in the design stage of the Project. Each system weight is rigorously monitored during the design and manufacturing stages to identify any potential deviation and ensure alignment with the weight targets. Bombardier reviews the supplier design (which is subject to approval by Bombardier) to ensure that the best design practices are used to meet the technical requirements and achieving the weight targets. First production units are weighed for comparison with the calculated weight requirements. As part of the weight control process, at a Vehicle level, the lateral and longitudinal balance of the Vehicle is also analyzed to eliminate any potential problems early in the Project phase. As the design of the Vehicle progresses, the weight of the Vehicle is monitored and design adjustments could be made to ensure that the target weight is met while still achieving the specified performance requirements. Bombardier has also experience in weight reduction program through previous projects and has developed a worldwide expertise with its Weight Performance Center of Competency.

Bombardier follows an internal procedure that provides objectives, responsibilities and document processing activities related to weight management. The compilation of weights calculations serves to convey information regarding the weight of the Vehicles. The weight compilation will be updated by the Lead Engineer Team responsible for the weight management at the Bombardier Design Center. During the design and manufacturing phase, a total Vehicle weight compilation estimate is issued periodically to the customer from contract award through to final delivery of the Vehicles. Each completed Vehicle will be weighed and the results recorded in the Vehicle History Book.

f) Vehicle Safety

Describe how Safety of the vehicles is ensured, and what methods are applied to verify and certify the safety of all subsystems and the vehicle as a whole.

Bombardier's approach to safety is structured, and integrated in all the activities and processes undertaken from design to end of warranty and beyond. Bombardier's priority is to ensure that its high performing trains, in revenue service all around the globe, are designed and manufactured with the highest levels of reliability, availability, maintainability and safety (RAMS), to transport millions of commuters safely every day. In order to achieve this goal, Bombardier integrates the RAMS procedures and analysis from project onset to ensure that safety is designed-in and built-in for each system/subsystem and for the complete vehicle.

To ensure compliance with the system safety requirements of the MBTA Contract Specification T2.06, Bombardier led by its Safety Engineer will use the following approach:

- Top-down approach for identification and tracking beginning at the system level hazards down to the subsystems hazards from identification to resolution. Close interaction (through group meetings, phone calls, one on ones) between Design Engineers and Safety Engineers early in the design phase to ensure that appropriate safety concepts are built-in to the different subsystem designs by bringing design engineers to focus on minimizing the number and severity of hazards which might reside in their system
- Constant follow-up by the Project dedicated Safety Engineer and the Design Engineer of every Supplier in such a way that all safety requirements are fulfilled and, most importantly, Bombardier's approach is shared with the Suppliers throughout every step of the program
- Safety Reviews will take place with the MBTA throughout all phases of the Project to validate that the system and subsystem designs properly integrate with the overall safety requirements
- Follow-up of the manufacturing, by the Safety Engineers, of the first units of subsystems and of the first Vehicles to ensure mitigation efficiency
- Thorough testing and verification by the Project Engineering team, ensuring that all safety measures are considered, such as braking distance, dead man release and zero speed interlock for doors
- Rigorous documentation and traceability throughout the Project phases with adequate and regular distribution of information internally and to the MBTA
- Close monitoring and control of the System Safety Program

System Safety Program Plan (SSPP)

Consistent with the requirements set forth in the MBTA Orange and Red Line Vehicles Specification T2.06.01.C.1.a, the System Safety Program Plan explains how all the hazards related to the Vehicle will be identified, categorized, mitigated, tracked, and closed. The SSPP is covering the work and scope of supply of Bombardier and is structured and tailored in accordance with MIL-STD-882E. More specifically, this plan has the following purposes:

- Establish the process for identification, assessment, documentation, management, and verification of safety hazards in order to eliminate or reduce these hazards to an acceptable and controlled level, as requested by the Specification T2.06.01.D.1.
- Identify the structure of the safety management organization and related responsibilities. Establish the process, tasks and criteria for management of safety issues through specifications, design, fabrication, testing and verification.
- Ensure proper integration of the subsystems safety documentation into the complete Vehicle safety documentation.
- Identify the System Safety Program key milestones
- Ensure that the implementation of the plan will result in the required level of safety for the Vehicles as well as for each subsystem. The SSPP will be maintained and updated, as necessary, throughout the phases of engineering, manufacturing, supply, testing and commissioning until the completion of the Project.

Bombardier is responsible for the development and the coordination of the implementation of the overall SSPP as well as for the integration of all safety documentation and verification. Each Supplier is further responsible, under Bombardier's coordination, for the complete implementation of the SSPP for the scope of supply for which they have prime responsibility.

Safety Certification Plan (SCP)

The Safety Certification Plan (SCP) details the activities related to the safety certification process that will be performed for the MBTA Orange and Red Lines Project. This process is implemented to confirm the safety readiness of the Vehicles for public use.

The SCP is based on the requirements of DOT-FTA-MA-90-5006-02-01, "Handbook for Transit Safety and Security Certification". The safety certification relies on the system assurance activities described in the System Safety Program Plan (SSPP).

The SCP will address the Vehicle and systems conditions under Bombardier's scope of Contract that could result in unintentional harm (fatalities, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment). The Plan describes the organization, activities, methodology, and documentation by which Bombardier will ensure that all the Project certification requirements and objectives are met throughout all phases of the Project.

These activities consist of:

- Identification of certifiable elements
- Development of safety design criteria
- Development of complete design criteria conformance checklists
- Development of construction specification conformance checklists
- Identification of additional safety test requirements, if needed
- Testing and validation activities in support of the certification program
- Management of "open" items in the certification program
- Conducting final determination of Project readiness and issuing certification documentation (certificates)

✓ Safety Program Main Activities

The Safety Program will guide the design and manufacturing process in the following way:

- At the beginning of the program, Bombardier will prepare detailed Technical Requirement Documents (TRDs) defining the technical required scope for its Suppliers for the MBTA Orange and Red Line Vehicles and ensure such Suppliers commit to the TRDs
- Bombardier will issue for approval a Preliminary Hazard List (PHL), listing possible subsystem hazards resulting from failures or normal operation

- Starting from this list, safety analyses (such as industry standard PHA, FMECA, FTA, SSHA, and SVM analysis) will be initiated by Bombardier and/or Suppliers as design work starts, and will be maintained and updated with the design evolution. These documents will serve as a basis to assess that the equipment meets the requirements, or alternatively to define the design modifications required to meet the safety requirements
- At design reviews, the MBTA Orange and Red Line Vehicles and subsystems safety features and data will be provided to the MBTA to ensure design compliance with the Contract Specifications. Bombardier's Hazard Management Database (HMD) will be used to identify, document and follow-up the closure of each identified Vehicle-level or subsystem-level hazard

In order to optimize the efficiency in hazard management, Bombardier has developed the HMD (Hazard Management Database) application (including an interface with Suppliers) in order to keep an accurate traceability on hazards management with Suppliers and Bombardier system engineering.

All the processes and tasks mentioned above are in place to ensure safety when using the Vehicles, for passengers, employees and the public.

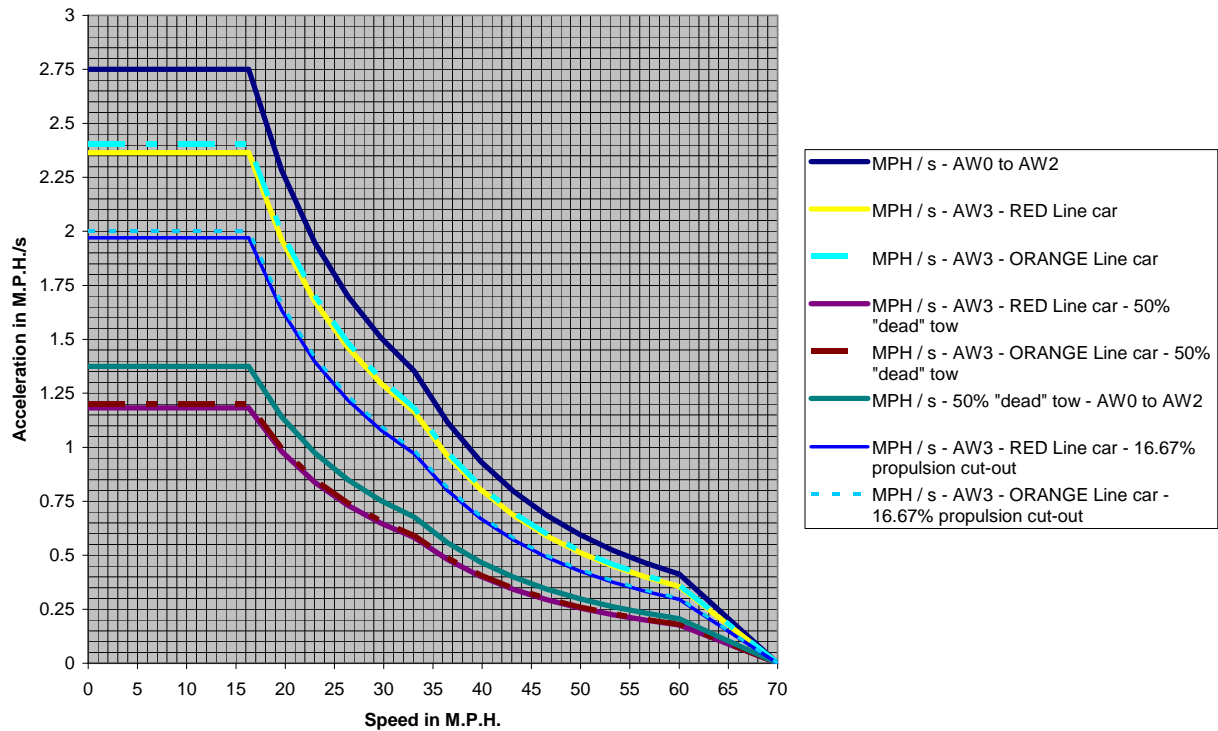
g) Performance Simulation and Summary Duty Cycle

Using the provided track charts, provide a performance simulation and summary duty cycle analysis.

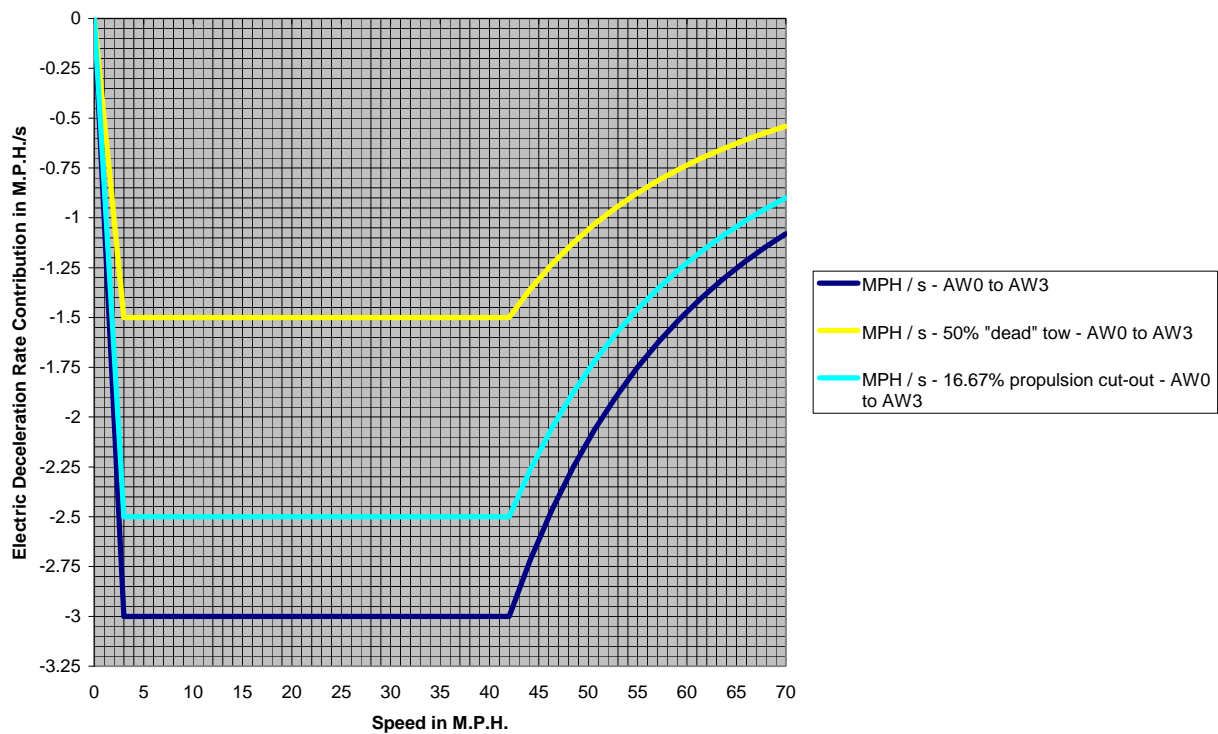
Propulsion (Acceleration and Electric Braking) Train Performance Simulations

The following propulsion system performance curves are intended to demonstrate Bombardier's thorough understanding and full compliance with the MBTA Orange and Red Line propulsion performance requirements. The simulations were executed taking into account the weight limit as provided by the MBTA in Specification section T2.01.08. The performance calculations are plotted below using the provided track charts in conjunction with the requirements of the MBTA Specification section T2.02. It is to be noted that temperature simulations were also performed in order to demonstrate the equipment capacity. The propulsion equipment is compliant to the most demanding condition which is continuous duty at AW3 in degraded mode (with propulsion cut out on 16% of the trucks in the train).

Acceleration / Deceleration versus Speed (level tangent) for Orange and Red Lines:

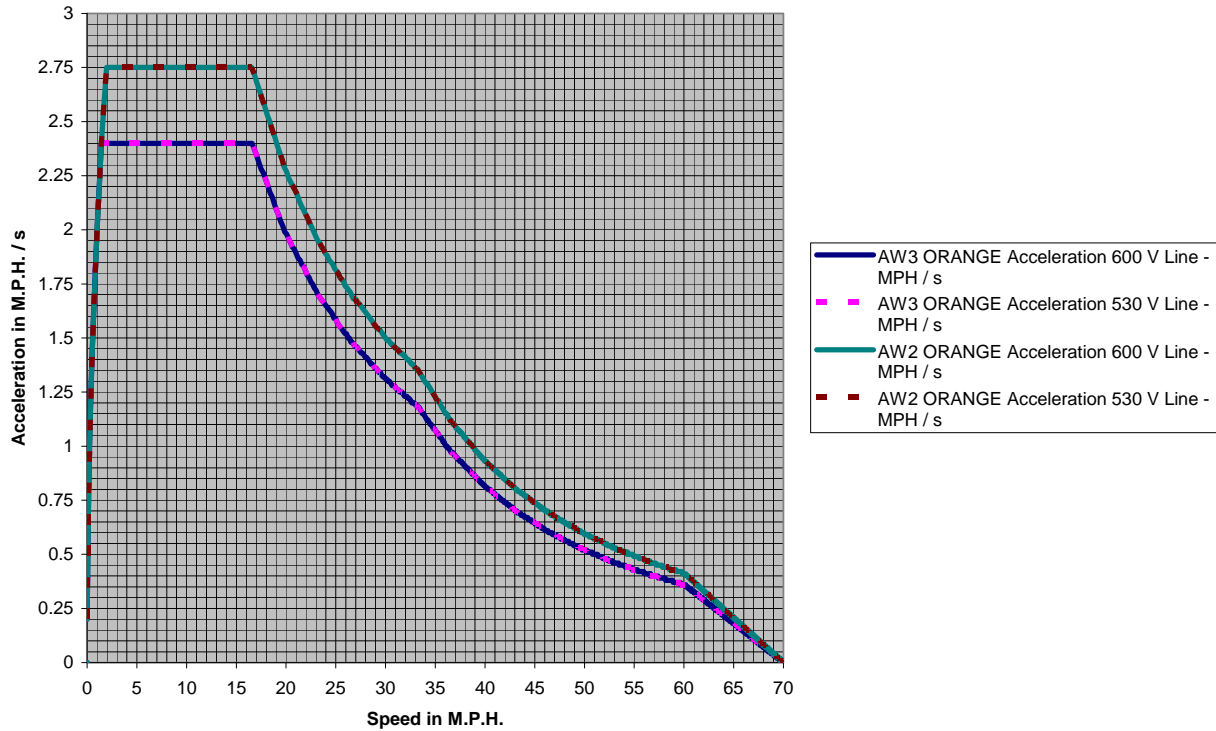


Acceleration versus Speed (level tangent)

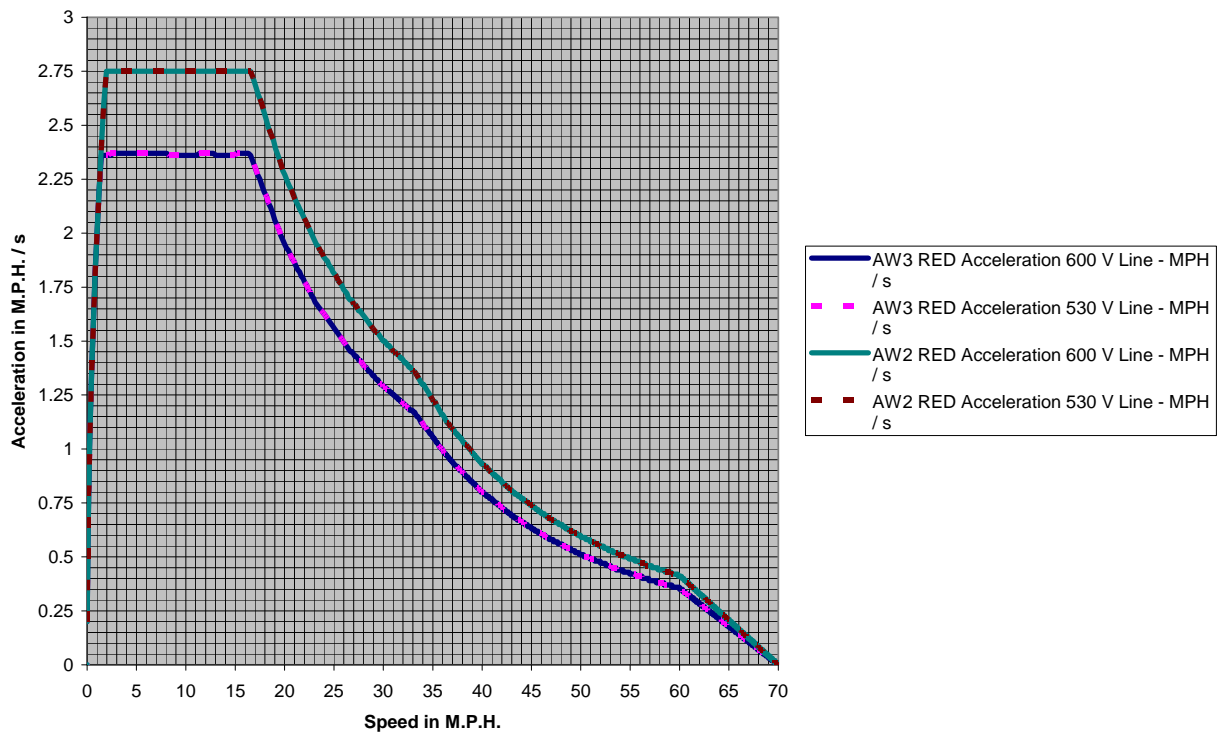


Electric Deceleration versus speed (level tangent)

Acceleration versus Speed (level tangent) with Different Line Voltages:

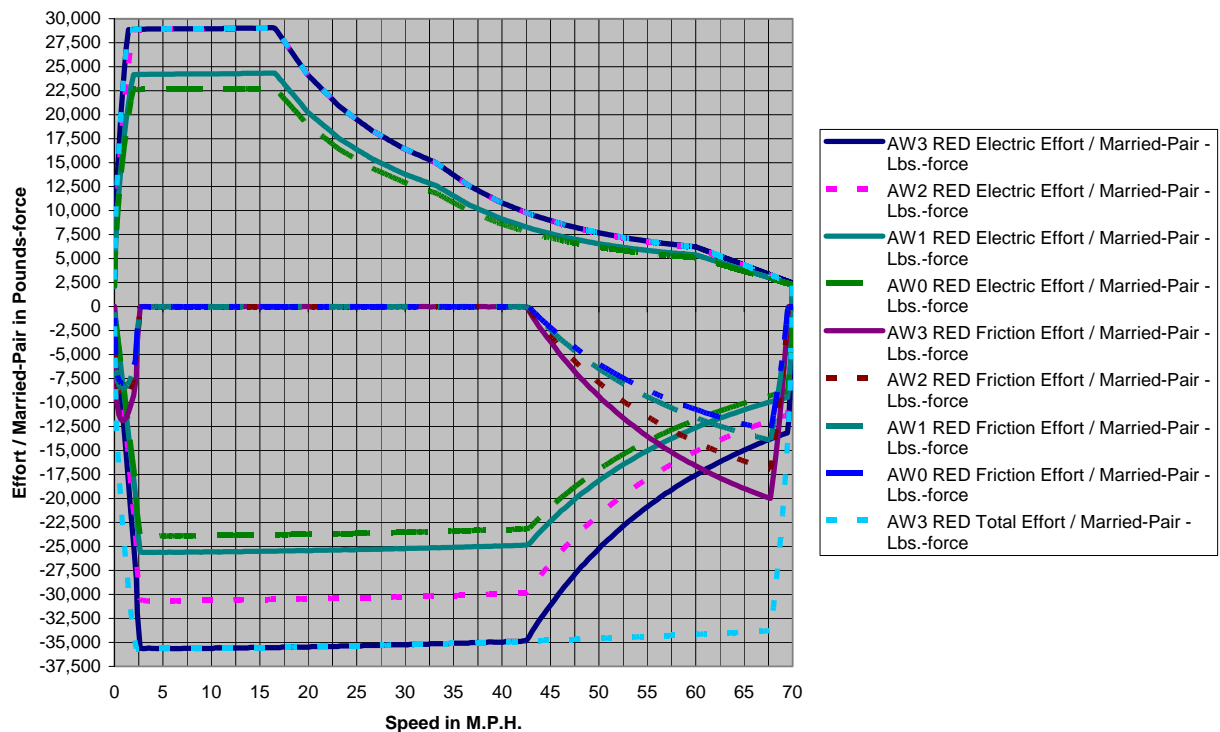
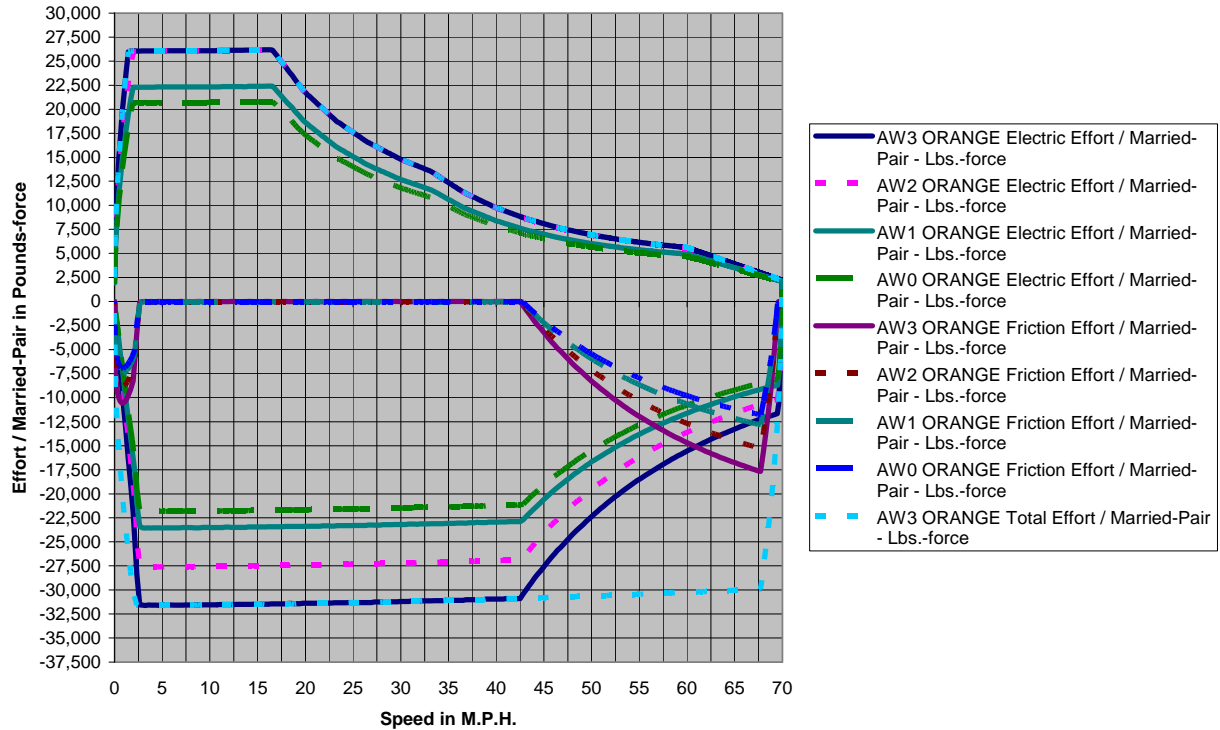


Orange Line

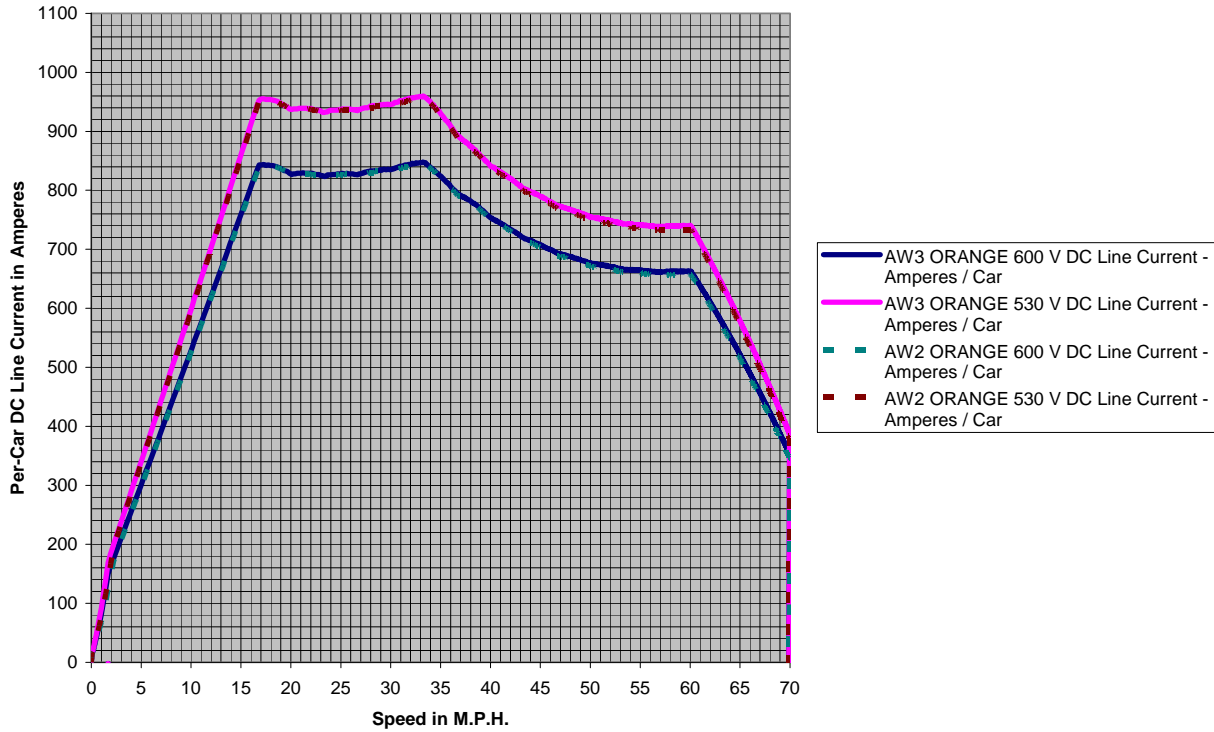


Red Line

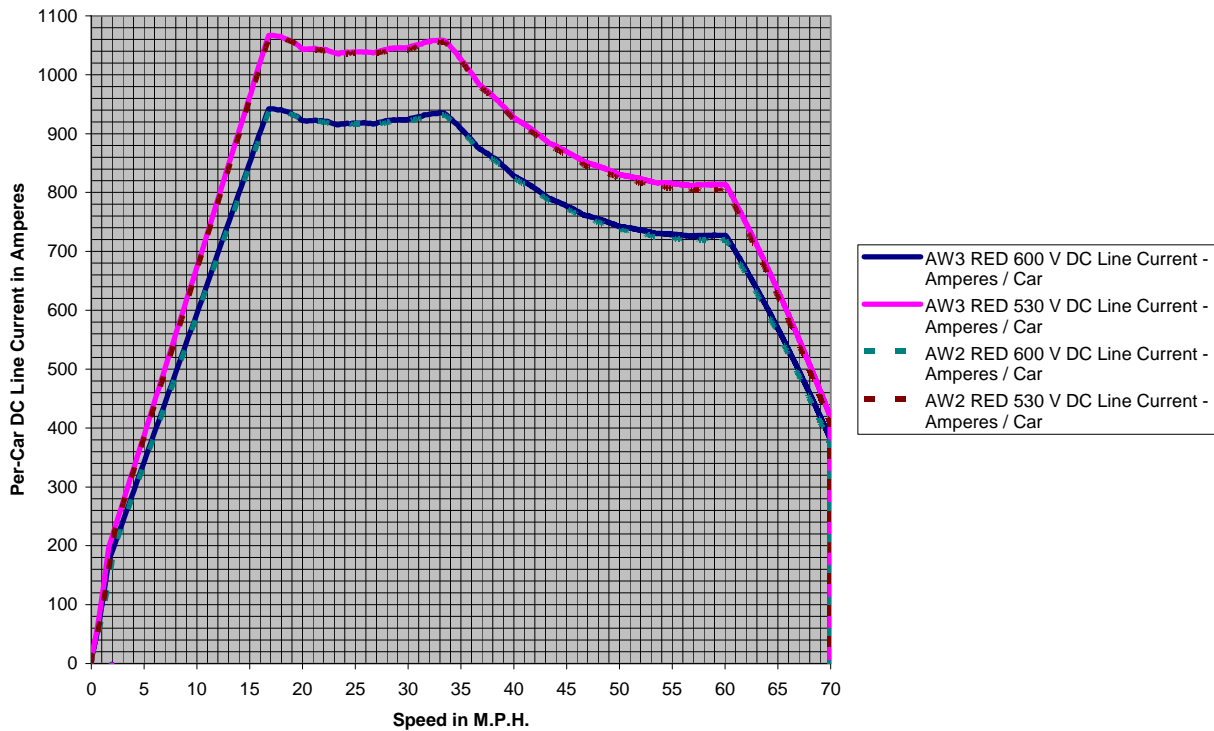
Effort versus Speed:



DC Line Current versus Speed (level tangent) at Different Line Voltages:



Orange Line



Red Line

Dynamic Train Performance Simulations with Summary Duty Cycle:

			Distance	Time to travel includes dwell or layover	Traction motor average RMS current	Traction motor average shaft speed	Average train speed	Traction motor peak RMS current	Traction motor peak shaft speed	Peak train speed	Energy consumed/car/mile NO regen	Energy consumed/car/mile 100% regen	RMS line current NO regen	RMS line current 100% regen
			feet	seconds	AC Amp	RPM	MPH	AC Amp	RPM	MPH	kWh /car/mile	kWh /car/mile	DC-Amp	DC-Amp
RED LINE	Braintree to Alewife	Normal Operation Continuous at AW3	96382	2867	209	1697	22.9	493	3701	50.0	5.342	2.657	355	482
		6-Car Train 16% truck at AW3	96382	2899	221	1678	22.7	494	3701	50.0	6.151	3.264	390	518
		Towing a "Fully-"Dead" AWO Train	96382	3062	201	1589	21.5	353	3701	50.0	6.238	3.324	358	450
	Alewife to Braintree	Normal Operation Continuous at AW3	96382	2912	207	1671	22.6	494	3701	50.0	5.141	2.596	345	459
		6-Car Train 16% truck at AW3	96382	2944	217	1653	22.3	494	3701	50.0	5.864	3.166	376	490
		Towing a "Fully-"Dead" AWO Train	96382	3103	201	1568	21.2	353	3701	50.0	6.000	3.198	347	428
	Ashmont to Alewife	Normal Operation Continuous at AW3	61913	2387	212	1309	17.7	494	3698	50.0	5.754	2.533	327	446
		6-Car Train 16% truck at AW3	61913	2410	224	1297	17.5	494	3696	49.9	6.590	3.164	356	477
		Towing a "Fully-"Dead" AWO Train	61913	2542	203	1229	16.6	353	3452	46.6	6.494	2.984	321	405
	Alewife to Ashmont	Normal Operation Continuous at AW3	61913	2468	210	1267	17.1	494	3694	49.9	5.827	2.860	322	423
		6-Car Train 16% truck at AW3	61913	2493	221	1254	16.9	494	3610	48.8	6.670	3.509	351	452
		Towing a "Fully-"Dead" AWO Train	61913	2622	205	1192	16.1	353	3317	44.8	6.754	3.434	320	391
ORANGE LINE	Forest Hills to Oak Grove	Normal Operation Continuous at AW3	55353	2090	211	1337	18.1	441	4070	55.0	6.431	2.937	347	474
		6-Car Train 16% truck at AW3	55353	2128	219	1313	17.7	441	4069	55.0	7.312	3.769	373	493
		Towing a "Fully-"Dead" AWO Train	55353	2314	204	1207	16.3	328	3802	51.4	7.470	3.538	339	427
	Oak Grove to Forest Hills	Normal Operation Continuous at AW3	55353	2121	215	1318	17.8	441	4070	55.0	6.584	2.770	355	483
		6-Car Train 16% truck at AW3	55353	2161	225	1293	17.5	441	4070	55.0	7.524	3.595	382	507
		Towing a "Fully-"Dead" AWO Train	55353	2357	206	1185	16.0	328	4068	55.0	7.206	3.210	329	416

Friction Brake Thermal Capacity:

The friction brake system foundation equipment for the new Orange and Red Line Vehicles will be similar to the equipment currently in use on Red Line #3 fleet. Therefore, the capacity in friction braking will be similar to this existing system, with adaptation to the new car weights. The friction and electrical brake systems will have sufficient capacity to meet the revised scenario specified in section T2.02.07.F (ref.: Add. No.8).

However, based on preliminary thermal calculation information received from the friction brake suppliers, it remains a challenge to keep the shoe and wheel tread/bulk temperatures within the acceptable thermal limits according to the revised requirement of section T2.02.07.E (ref.: Add. No.8), "to allow cars to run one end to end trip in normal service operation..."

During the Project design phase, Bombardier and the selected friction brake Supplier will work with the Authority to refine the duty cycle analysis to consider and align on “normal service operation”.

h) Vehicle Design Approach

Describe how the design of the two different vehicles is approached while ensuring the use of same subsystems and components to the maximum extent possible.

Bombardier is highly committed to making the required efforts to reach the maximum commonality of systems and parts between both the Orange and Red Line Vehicles, and wants to assure the MBTA that, starting with the bid preparation phase, we have undertaken an exhaustive analysis process to review, define and optimize the usage of identical components and systems for the two different Vehicles. In addition, Bombardier fully understands that this commonality approach is a great opportunity to help simplify the MBTA operations and maintenance activities, enhance cost effective solutions, and ease the design process of both Vehicles. This should imply common design reviews for identical systems, when and where applicable. To do so, it is expected that the MBTA and their consultants will have an Engineering team to jointly review and approve the common designs of both Orange and Red line Vehicles.

As the Project starts, Bombardier will conduct a thorough requirement management and architectural/conceptual design review, to quickly identify all the opportunities to maximize the commonality of parts and systems between both lines. The Lead Engineer of the Project Office will be responsible to oversee the design process of the engineering teams with the goal to create an adaptable MBTA platform. Design Center cells assigned to major systems (HVAC, Doors, Trucks, etc.) will concurrently work on the solutions that will meet the performance requirements for both Vehicle designs considering the performances constraints of the larger and heavier vehicle (Red Line) while also considering the physical constraints of the smaller vehicle (Orange Line), while meeting the MBTA's expectations for maintainability and equipment access.

In the cases where we intend to use identical systems for both Orange and Red Line vehicles, software adaptations may be used to manage the performance or functional differences (if applicable).

Although we expect to apply similar concepts for both Vehicle types, carbody and interior designs will require more engineering efforts due to the technical specification requirement differences for Vehicle dimensions and floor layout, thus leading to two similar, but separate solutions. Bombardier's intent is to ensure, during the entire design process, that the mechanical, functional (including trainlines and controls) and operational (including maintainability) integration parameters for the common systems and parts will be identical for both the Orange and Red Line Vehicle types.

As part of this RFP, following a preliminary analysis, Bombardier considers that the following elements could be identical for both Vehicles (ref. proposal section 1.c for additional system details):

- Interior components such as, but not limited to: seat shells, windscreens, stanchions parts, Operator seat, Passenger flip-up seats, etc.
- Truck components: wheels and axle, truck frame, truck bolster, current collector, sleet scraper

- Propulsion equipment: traction motors, gearbox, truck disconnect, traction inverter, high voltage box, brake resistors, line inductors, ground brushes
- Auxiliary power: auxiliary power Inverter, LVPS, battery, battery box, main breakers
- Friction brake equipment: tread brake units, air compressor
- Coupler (including electrical heads) and drawbar
- Side doors components: door operators, door panels, door controls
- HVAC unit and controller
- Communication system and passenger information components
- Video surveillance system components
- Event recorder
- ATP/ASR system components
- Vehicle monitoring system components
- Train network components
- LED interior lighting fixtures
- Exterior lighting fixtures
- Cab console and controls

The above is a list of high level items. The Project design phase will be structured with the goal that the Vehicle design commonality between the two lines be maximized down to the lowest line replaceable units (LRU's).

In addition to the identical systems or components mentioned above, the commonality approach will provide other benefits such as:

- Usage of similar harnesses and connectors
- Potential inventory reduction (quantity of parts and floor space)
- Same training, maintenance procedures, troubleshooting aids, bench test units for all identical system thus providing more flexibility with maintenance crew
- Same operation using same control and operator display interface

We believe that it will be in the interest of the MBTA to know that the standardization is already integrated in Bombardier's design philosophy.

Bombardier developed many platforms as well as for vehicle level as for system and major component level. Bombardier designed metros and Light Rail Vehicles platforms that were used in Europe and were adapted for North American market (such as Toronto Metrolinx and Legacy LRVs, Stockholm & Hamburg metros, etc.). Bombardier also developed standardized solutions for major systems (such as HVAC, side doors, propulsion, etc.) in partnership with key suppliers with the mindset of maximizing the re-use while creating flexible and adaptable solutions.

i) Electromagnetic Compatibility

Describe how EMC will be achieved and interferences with the train control system avoided.

Over the years, Bombardier has developed a standard EMC control plan which is adapted to the specificities of each project. The EMC Control Plan explicitly defines the roles and responsibilities of the Authority, Bombardier management, engineering teams and all sub-systems suppliers with regards to achieving EMC. Bombardier's AC traction technology and power electronics knowledge and experience have evolved through multiple service proven designs currently running in similar operating environments in North America. Based on Bombardier's gained expertise, all aspects of the EMC program for the Orange and Red Line Vehicles procurement will be analyzed and evaluated in order that all interferences be properly managed.

The EMC Control Plan provided early in the Project, covers the general EMC between systems onboard the Vehicle and the wayside in general. The EMC Control Plan addresses all items specified within the APTA documents SS E 010-98 '*Standard for the Development of an Electromagnetic Compatibility Plan*'.

The EMC Control Plan includes:

- EMC Management and Planning
- Technical Program Description
- EMC Compliance Test Program
- EMC Verification and Validation Process
- EMC Concept and System Requirement Allocation

In the course of the EMC Control Plan, the activities listed below are considered to address all EMC issues including Radiated Emissions, Conductive Emissions, Inductive Emissions and Cab Signaling Interference (CSI).

- Regular EMC Program Progress Report
- EMC Risks Matrix
- Signaling EMC Assessment
- EMC Safety Analysis
- Engineering Test Procedures and Reports
- Qualification Test Procedures and Reports
- Power Equipment EMC Control Plans
- Power Equipment EMC Design Reports
- Power Equipment EMC Test Procedures and Reports

For the train control system interferences specifically, Bombardier will closely examine the mutual location and geometry of the susceptible and emitting equipment (for example traction motors junction box versus ATC antennas) in order to minimize risks of interference problems appearing at integration testing.

Due to the criticality of the compatibility between power converters and onboard/wayside signaling equipment, a dedicated analysis will be done and documented through a "*Signaling EMC Assessment*". The application of the EMC activities described above is coordinated for all systems through dedicated EMC Coordinator, EMC Specialists, Power Electronics Systems Engineers and Suppliers.

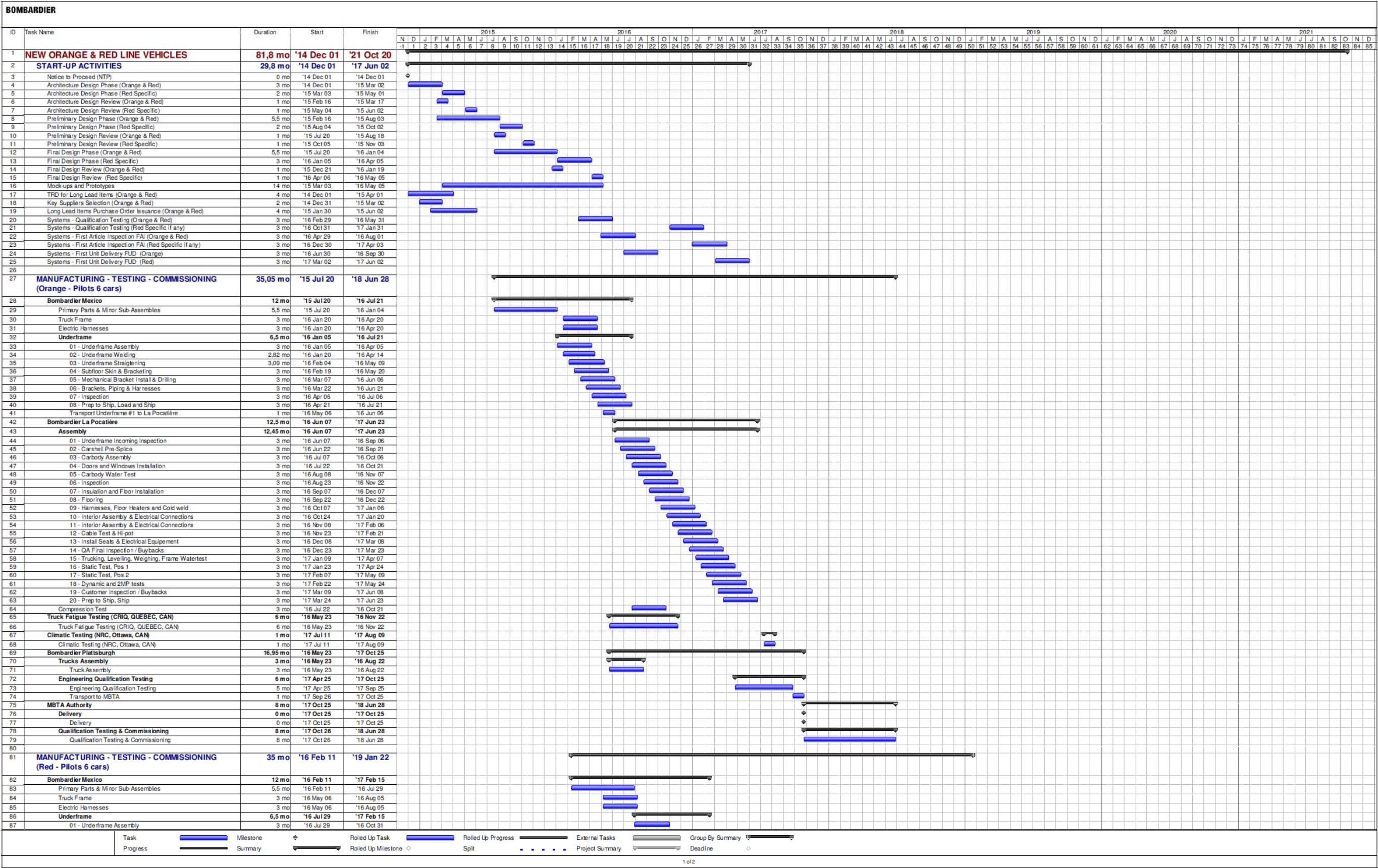
j) Design, Manufacture, Testing and Delivery Detailed Schedule

Submit a detailed schedule for the design, manufacture, testing and delivery of each car in the form of a milestone type bar chart. Each chart shall indicate anticipated dates for starting and completing all major aspects of the program including, but not limited to, First Article Inspection and completion of major hardware components; the delivery to the MBTA of the Pilot Cars and subsequent delivery of the balance of the Cars on order. Quantity to be delivered shall be clearly noted.

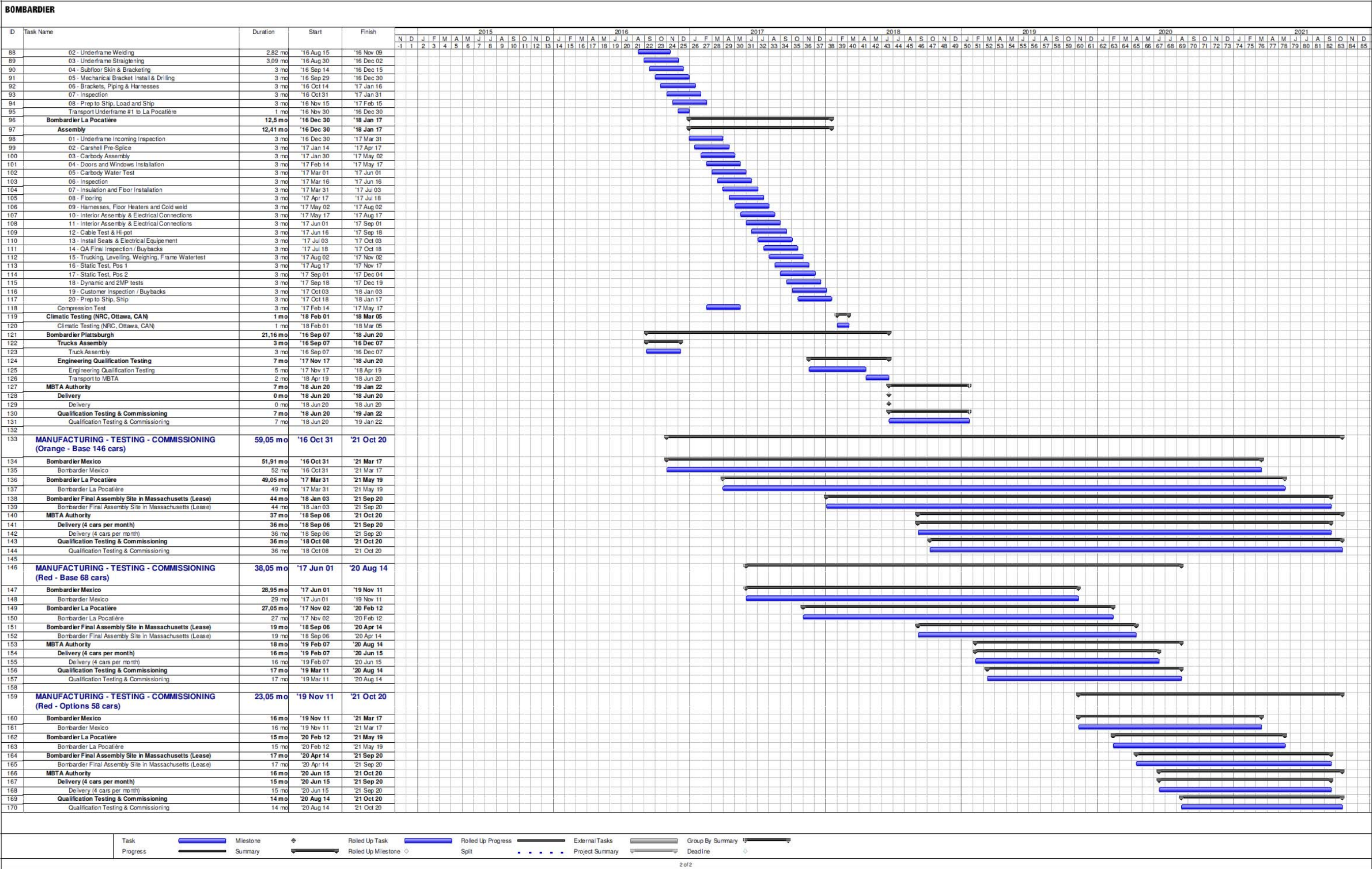
Please find hereafter Bombardier's detailed schedule for the MBTA New Orange and Red Line Vehicles Project.

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1) Technical Approach



1) Technical Approach



The Option 1 Price indicated in our Price Forms is based on the fact that Option 1 for the 58 Red line Vehicles is exercised no later than 12 months before the scheduled delivery of the last Base Red line Vehicle, to ensure production continuity and best value for the Authority.

k) Design Review Process

Present the Design Review Process, including the presentation of the contents of Conceptual, Preliminary and Final design reviews. The Offeror shall present the proposed process for progressing through these as well as the approach to addressing questions and concerns of the MBTA.

First, we would like to mention that Bombardier, over the years, has developed a robust design review process, used across all Bombardier projects and tailored to customer specific requirements in order to ensure high efficiency design process and customer satisfaction.

The objective of this section is to explain the philosophy, the methodology and the frequency of technical design review meetings held between the Authority and Bombardier. The purpose of the design review process is to verify that the MBTA's requirements have been clearly understood, allocated, and reviewed by all stakeholders. Subsystem Suppliers will participate in the design review meetings.

Design Review Activities

In these reviews, the project team members, stakeholders and technical experts evaluate the evolution of the design:

- Performance and compliance with requirements (customer, contractual and internal requirements)
- Manufacturability, maintainability, safety, simplicity, robustness, reliability, human factors, aesthetics, quality assurance, testability
- Operating logic, technical choices, risks, costs
- Definition and validation of interfaces
- Integration of systems and sub-systems in the product (including software aspects)

The design review process also has secondary quality objectives, such as:

- Validating that the design is acceptable for internal customers
- Ensuring that the current design takes into consideration lessons learned and best practices
- Mitigating risks in new designs with assessment tools

In short, design reviews are facilitated through a gate process. Each gate assessment confirms that the design is compliant, that it can be further detailed and that it is either ready to move forward to the next gate or ready to be produced.

Activities with the MBTA

The following sections will describe the contents of each MBTA design review meetings. For all activities mentioned, documented minutes of meetings will be created and action items will be included in the minutes. Those action items will have an assignee as well as a closure date and will be followed using Bombardier's Contractual Tracking System (CTS).

Conceptual Design Review:

As indicated in Part T21.04.B of the Technical Specification, there will be a detailed specification review conducted with the MBTA to address any outstanding questions that Bombardier may have regarding the Technical Specification. The goal is that all Project participants fully agree on the meaning of the requirements contained within the specification.

In addition to Bombardier's presence, all key subsystem Suppliers will participate in this review.

- Bombardier will present the high level driving concepts to be used to meet the performance, compatibility, reliability, maintainability and commonality of components and systems (between Orange and Red Lines Vehicles) requirements.

Bombardier will provide an explanation of the approach planned in response to each Specification requirement.

Pursuant to the Conceptual Design Review, scheduled Preliminary Design Review and Final Design Review will be held with Bombardier and the Suppliers, to cover all the aspects of the design that as a minimum are described in the Contract Specification Part T21.06.D.

Contents of the Preliminary Design Review (PDR)

Upon reaching agreement with regards to the design concepts, Bombardier will prepare conceptual design drawings that will be submitted for review and comment to the MBTA. Upon receipt of the conceptual design drawings, Bombardier will request that the MBTA respond with status as quickly as possible in accordance with Contract Specification Part T21.07.01.B.2. Subsequent to the receipt of status for conceptual design drawings, a Preliminary Design Review Meeting (PDR) will be scheduled as outlined in the approved Management Plan.

In addition to the elements listed for review in the table of the Contract Specification Section 21.06.D, the PDR will:

- Confirm the orientations set at the conceptual level
- Validate with the MBTA the way in which these orientations are to be practically applied to the product
- Define the procedures as well as the operating logic that underlines them
- Outline the details of the equipment and its final installation

The design is examined in such a way as to demonstrate clearly how it will meet the specification requirements. It is essential to justify the results, the calculations, as well as the hypothesis and testing that will validate compliance. In case of problems or exceptions, alternatives are examined and a mutually agreed decision is made between Contractor and the Authority which may involve an

update of the design, and/or a request for waiver of the specification requirements. Along with Bombardier, all key subsystem suppliers will participate in this review as part of the Join Design Definition Process (JDDP) developed by Bombardier.

Interim Design Review

Interim Design Review (IDR) meetings may be scheduled as deemed necessary for specific systems to ensure a successful transition between the conceptual designs to final designs. The IDR or Working Session would serve as a forum to discuss design problems and solutions.

Contents of Final Design Review

The Final Design Review (FDR) will take place when the design is essentially completed. All PDR open action items (unless otherwise agreed) must be resolved prior to scheduling and commencing the FDR activity. In addition to the elements listed for review in the table of the Contract Specification Part T21.06.D, the FDR is to provide the opportunity to review, revise, and agree on the details of the final design prior to release of the designs for manufacture. Any open engineering items and related program management issues must be discussed and resolved during the FDR to consider the FDR closed.

All key subsystem suppliers will participate to this review as well. No major issues should be presented to the MBTA during this meeting since all items should have been addressed as PDR or IPDR items prior to the FDR. The design is considered frozen after the FDR in order to start the production; however any open item during the qualification process will be addressed and integrated into the design.

Use of the Prototype Center

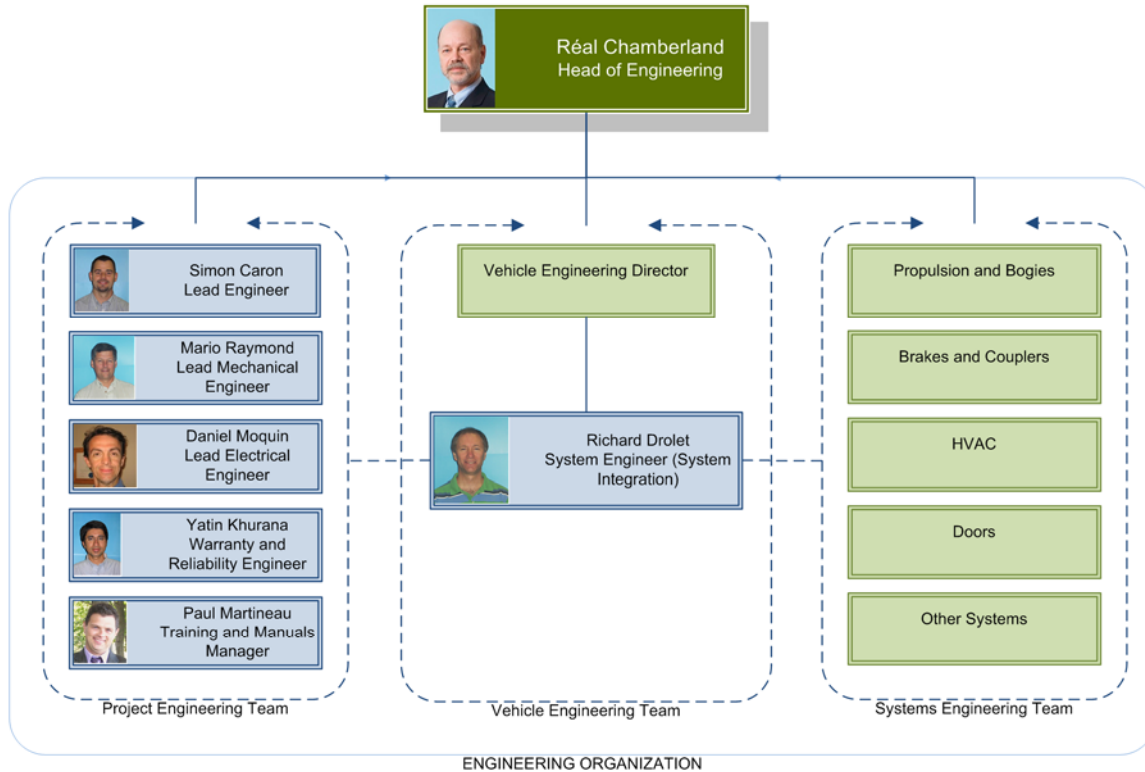
During the Project design phase, Bombardier also plans to perform prototyping activities at our Bombardier Prototype Center located next to our Design Center in Montreal, Canada. The prototyping activities will allow the MBTA to visualize selected equipment as early as the preliminary design phase. It will enable Bombardier's Engineers to work together with the Authority to validate design concepts and eliminate uncertainties related to design before start of production. Concurrent with prototyping, Bombardier's Industrialization team will work as a liaison between the Methods and Engineering groups to ensure that the Vehicles are designed for manufacturing to ease the manufacturing process and enhance Vehicle and systems maintainability.

I) System Integrator Engineer

Identify the engineer proposed as the System Integrator, as required by T21.02.D, and present the Systems Integration Plan referenced require in T21.02.D.

The System Integrator Engineer has a central role for managing the design interfaces for systems with respect to the Project requirements defined by the Project Lead Engineers. The block diagram below is an extract of Bombardier's Engineering organization chart and shows the role of the System Integrator Engineer which for Vehicle functions makes the link between Project Engineering and

Systems Engineering. The System Integrator Engineer is part of the Vehicle Engineering group which is responsible for the implementation of the Vehicle architectures, Vehicle functional integration, requirements management, electrical cabling and wiring, and Vehicle qualification testing.



Legend:

Name Title	MBTA Project Engineering Team
Name Title	Engineering Support Team

The System Integrator is dedicated to the Project on a full-time basis from the onset and remains dedicated to integration of Vehicle and subsystem functions all along the design phases. The System Integrator position is usually fulfilled by Bombardier senior rail transportation Project Engineer. For the MBTA Orange and Red Lines Project, Bombardier is very pleased to appoint one of our most experienced System Integrator: Richard Drolet. More detail on Mr. Drolet's past experience can be found in Section 1a) Organization Chart.

The System Integrator will have the responsibility for the Vehicle/Unit/Train system integration and will review, coordinate and approve the following activities:

- The overall Vehicle functional requirements
- The subsystems functional architecture and requirements
- The interfaces of the train-set with the operating environment
- The functionality of the interfaces in between subsystems

- The communications protocols between subsystems
- The monitoring and diagnostic system information management approaches

System integration is accomplished through delivery of several documents which are used to define and manage the system functions and components that necessitate mechanical, electrical or pneumatic interfaces either at the Vehicle or train level. Specification requirements analyses are performed and are documented by issuing Technical Requirement Documents (TRD) defining Suppliers' scope of supply and Bombardier Report and Analysis (BRA) documents. In the first months of the Project, the System Engineers will define the physical configuration of the systems to be installed in the Vehicle and, more specifically, they will identify all components and their location in the Vehicle. Later in the Project, interfaces between systems are defined and detailed in the Interface Control Documents (ICD), based on the requirements identified in the BRA documents. System Functional Description (SFD) documents are also produced for each subsystem and include a description of the system interfaces.

Systems integration testing is under the responsibility of the Vehicle Engineering group. As part of its responsibilities, each System Engineer is responsible to ensure that the system functional, performance and interface requirements are met. The Vehicle Engineering team develops a comprehensive Test Program Plan (TPP) referring to tests including a validation or testing of the performance criteria. The plan addresses vendor component/system tests, car/unit testing and site acceptance testing. The integration effort is considered completed once the design requirements of the MBTA Technical Specifications are incorporated into the systems and properly integrated to the Vehicle as validated by the testing program.

m) Conceptual Designs

Provide one (1) print each of the following conceptual designs for each car type (Orange, Red, Cab Car, Non-Cab Car):

Please find in Appendix A of this section the following drawings:

Drawing Number	Description
C514-119-01	Powered Truck
C514-399-01	Red Line Cab Car Carbody Structural Diagram
C514-399-02	Red Line Non-Cab Car Carbody Structural Diagram
C514-399-11	Orange Line Cab Car Carbody Structural Diagram
C514-399-12	Orange Line Non-Cab Car Carbody Structural Diagram
C514-499-01	Red Line Undercar Equipment Layout
C514-499-11	Orange Line Undercar Equipment Layout
C514-739-01	Red Line Cab Layout
C514-739-11	Orange Line Cab Layout

Drawing Number	Description
C514-852-01	Orange and Red Line Floor Plans (Seating)
C514-971-01	Red Line Cab Car General Arrangement
C514-971-02	Red Line Non-Cab Car General Arrangement
C514-971-11	Orange Line Cab Car General Arrangement
C514-971-12	Orange Line Non-Cab Car General Arrangement

n) Mobilization Plan and Approach

Describe the mobilization plan and approach for conducting the dynamic vehicle – level qualification testing required in Section T20 of the Technical Provisions. Provide a preliminary indication of test sequencing for the two fleets. Describe the methods by which on-going test results will be cycled through the design process to ensure that design modifications are implemented prior to the delivery of Pilot Cars. Describe how such design modifications are implemented into the ongoing manufacturing and assembly process of the production cars.

Mobilization Plan and Approach for Conducting the Dynamic Vehicle-Level Qualification Testing

Upon NTP, Bombardier will implement the Mobilization Plan for the Project. Bombardier's Engineering group will be in charge of the Vehicle Qualification Test Program. The initial Engineering testing and qualification testing will be conducted on the Pilot Cars at our Plattsburgh, NY facility and will be supported by the Field Engineering test personnel.

The next phase will be to perform the On-Site Qualification testing on the Pilot Cars. During this phase, the Engineering team will be supported by the Field Support team, who will subsequently be in charge of all Vehicles' commissioning, inspection and warranty activities in Boston.

The Field Support team will initially establish mobile offices at the Wellington Maintenance Facility for the Orange Line Vehicle support and an additional mobile office at the Cabot Maintenance Facility for the Red Line Vehicle support. Bombardier will maintain two full time teams of on-site representatives for technical and warranty support, as well as all necessary materials and test equipment to identify and resolve all deficiencies identified and to maintain the warranty program.

The two Field Support teams will share a common Site Manager, a Lead Engineer moving between both sites, an HSE (Health, Safety and Environment) Representative, and will be supported full time by Field and Repair Technicians.

The activities of the Field Support team will include testing, commissioning, and troubleshooting on the delivered Vehicles. Throughout the commissioning period, the Field Engineer will be assigned to manage the resolution of all technical issues which may arise in a vehicle program.

The Field Engineer will also be the liaison with Bombardier's Reliability Engineering department during the course of the Reliability Demonstration program and with System Design Engineering and Suppliers as appropriate to ensure a timely and successful delivery of the program.

Preliminary Indication of Test Sequencing

Engineering and Qualification Testing on Pilot Cars – The engineering and qualification testing (Specification TS 20.05 to 20.19) on the Orange Line Pilot Cars and the Red Line Pilot Cars will take place at Bombardier's Plattsburgh Manufacturing facility for a period of 4 months each respectively and consecutively. The test track at this facility is 2,800 feet long, has a nominal power supply of 650 VDC and permits a maximum speed of 31 mph. The performance and functionalities of the onboard systems including propulsion and friction brake systems will be verified prior to shipment to the MBTA, thus allowing for a seamless qualification period when the shipped Vehicles are tested on MBTA property.

On-Site Qualification Testing of Pilot Cars – The on-site qualification testing (Specification TS 20.23) at the MBTA sites will be as follows: 8 months for the Orange Pilot Cars and 6 months for the Red Pilot Cars, including their respective commissioning activities. Bombardier System Design Engineers will provide support to Plattsburgh and MBTA sites during qualification testing and commissioning of the Pilot Cars.

Dynamic Vehicle testing, either for qualification or commissioning will be performed on the Authority's property. Some dynamic testing could be performed on test tracks located at the Maintenance facilities. The costs required for MBTA crews to operate the Pilot Cars for the On-Site Qualification testing is included in our Proposal and is based on RFP section C6.07.A.2 specified rate.

On-Site Commissioning of all Vehicles – Testing to be performed on incoming Vehicles as per Bombardier's Commissioning Test Procedure will include:

- Receiving Inspection to verify that no damage has occurred during shipment and to ensure that the Vehicles are properly adjusted and in suitable condition for subsequent MBTA testing
- Functional Testing during on-site commissioning will be performed in accordance to the approved Master Test Plan to demonstrate the complete functionality of selected components or equipment
- Parking brake, service brake and emergency brake tests, propulsion system test, ATP/ASR tests
- 500-mile Operational Test

The 500-mile Operational test will be performed on the MBTA mainline at each respective facility for a minimum testing period of 3 consecutive hours of actual train operation, during the night, as indicated by the MBTA. Bombardier will manage the instrumentation and data collecting activities and will utilize the MBTA Crew to operate the tested cars, as required.

The cost of all work performed by the Authority personnel related to commissioning testing of the Vehicles which will be supported by the Contractor in accordance with the Contract will be the cost for the hours the trains are being effectively operated for testing by Bombardier and the MBTA.

Bombardier will perform the necessary Production tests at the MBTA site in order to ensure the intent of full vehicle functionality verification.

Vehicles delivered to the MBTA cannot be used for revenue service prior Conditional Acceptance. We understand the Vehicles can only be used in revenue service, once each Vehicle is conditionally accepted by the Authority, as per RFP Section C6.07.

Methods for Test Results Cycled Through the Design Process

All test procedures will identify a sequence of steps with associated pass/fail criteria and the test results will be gathered in the form of a Test Report which will identify any areas of non-conformity or a failed test. These results will be provided to the design team which will follow the method described below:

- Review failed result or test non-conformity
- Determine non-conformity cause (s)
- Evaluate the root cause and cause for escape of the non-conformity
- Determine and implement the corrective action
- Ensure corrective action is logged and records maintained (retest, test plan and results)
- Verify that corrective action has continued to be implemented and remains effective

Patterns of non-conformance, either of design or non-quality, will be investigated by the Field Engineer and will be reported to the Engineering team, the Supplier and/or the Manufacturing facility to ensure the issue is communicated and understood, so that corrective actions are taken by the responsible party. The Engineering Change Management process described in the section below will be followed from the start of the first Pilot Car production. The implementation of the modifications is recorded in a Configuration Management tool to keep track of the revision of all equipment of the Vehicles. The Authority and Bombardier shall agree on the modifications that must be implemented on the Pilot Cars before delivery.

Implementation of Design Modifications into the Ongoing Manufacturing and Assembly Process of Production Vehicles

Engineering Change Management – Bombardier's Engineering Change Management Process oversees the product configuration changes.

This process covers:

- Designs owned and not owned by Bombardier (ex.: components within Supplier equipment),
- Components not covered in Bombardier's manufacturing system (ex.: Supplier or Bombardier software products)
- Products delivered to the MBTA, but not installed on the Vehicle (ex.: Portable Test Equipment, Bench Test Equipment, Simulators, etc.)

Anyone involved in the Project can raise an issue. This issue is then evaluated by the Technical Issue (TI) coordinator. The TI coordinator's role is to evaluate and validate the description of the technical issue and assign the issue to the Engineering function.

The Engineering team is responsible for the first four steps of the technical issue resolution process which are:

- Engineering Manager will assign a Responsible Engineer to resolve the issue
- Responsible Engineer will investigate the technical issue
- Solution of the technical issue will be documented in the form of an Engineering Change Order (ECO)
- Drawings are updated and the change is properly inputted into the configuration management tool

The Project Management team is responsible for rolling out the Issue Management Tool database which will track the status of all technical issues raised throughout the duration of the Contract.

Change Implementation – Engineering is also responsible to determine which cars are affected by the change; either retrofit or cut-in basis. When the Engineering Change Order (ECO) is issued as a full project change with retrofit, it will trigger our Methods team to write a Modification Notice (MOD) and enter it into the MOD Tracking System by car application.

The Methods Technician will then consult the Supply Management representative for a material delivery date. Once the material is available, the Material Management team will issue a Mod package to Production for the modifications that need to be implemented on the cars in the production line. The MOD package will include parts, instructions, bill of materials and drawings to perform the actual work on the vehicle.

The Field Support team is responsible to coordinate all the modifications that need to be implemented on the cars already shipped to the customer sites. If applicable, a MOD package will also be sent to the PI team. Bombardier PI will open a work order to track the hours to do the MOD on the vehicles. When the work is completed, it is inspected and the MOD Tracking System is updated to show that a particular car has received the MOD and the work order will be closed out.

Bombardier will use MBTA personnel on a case by case basis and as required to support larger field modifications.

o) T2.03 Reliability Requirements

Describe how the Reliability requirements of T2.03 will be met and what methods the Offeror will undertake to ensure all major subsystem suppliers achieve this requirement.

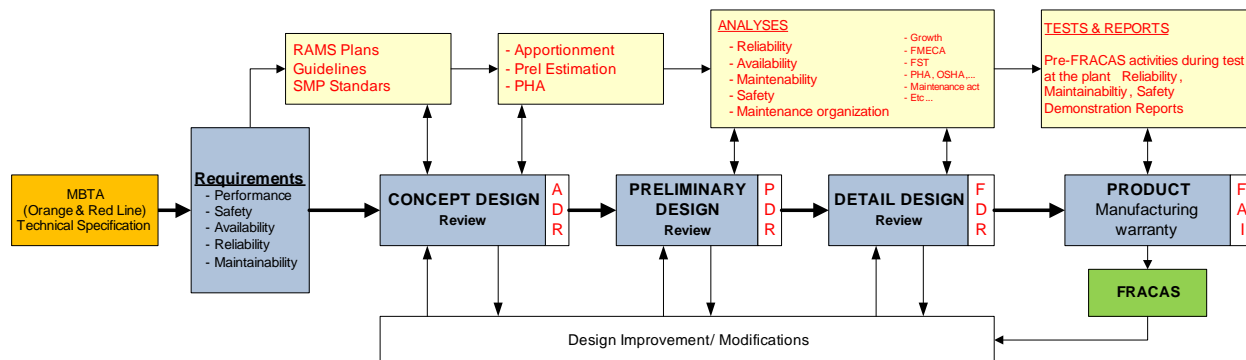
Over our many years of designing and manufacturing transit vehicles, Bombardier has gained solid experience in both the design and performance of the vehicles it has delivered to a large number of customers. For example, our vehicles offer a high level of reliability performance as executed in the following recently completed projects: NYCT R142, LIRR M-7, Toronto Rocket and Kuala Lumpur

ART. These results are due to our implementation of continuously improving processes which define the best identification of reliability issues. This approach provides the opportunity to surpass our different customer requirements while taking into consideration the environmental constraints and types of vehicles.

Bombardier's Reliability Program is built around two major pillars, as follows:

- **Prediction:** the first phase, during the design, is based on engineering design integration, through reliability modeling. The main goal is to define the design concept, based on the Reliability Prediction Analysis (using international standards), and the field data analysis (using past experience on similar projects).
- **Demonstration:** the second phase is based on the Reliability Test Program (detailed below). The main goal is to assess the reliability compliance to the Authority specifications through a Reliability Demonstration Program. The aim is to ensure that the observed Vehicle performances (including the Vehicle systems) are compliant to the predictions and conform to the Authority requirements.

Sequenced from design phase to end of warranty, the figure below depicts how the different phases of the Bombardier Reliability Program (defined above) are deployed along the design and manufacturing process:



Bombardier's RAMS Process & Approach

Reliability Modeling

The reliability modeling approach for the MBTA Orange and Red Line Vehicles program (referring to Section T2.03) will be conducted for each specified system, using the Parts Stress Method in the MIL-HDBK-217F Notice 2 "Military Handbook Reliability Prediction of Electronic Equipment" for electrical and electronic components, and the IITRI/RAC Document NPRD-95C for non-electronic parts.

In addition, field data contained in Bombardier's database will be used to get extra reliability data on specific system constituents. These data are collected from the Bombardier comprehensive rolling stock experience and supplier base. Most of the data originates from commercial operation of Bombardier fleets which have cumulated several millions of car-miles each. The Reliability Prediction Analysis will be based on those actual reliability performances achieved by similar equipment operating in similar environments.

In the context where reliability data would not be available, and in conformance to Section T2.03.05 B, Bombardier will propose (upon the MBTA validation) other international standards such as the ones published by IEC, BELCORE, and Telcore. Throughout the whole program, the reliability modeling (prediction approach) will be managed at two levels, as follows:

- **Systems and subsystems:** at this level, the reliability analyses will be initiated by each party (Suppliers) having prime responsibility for a given system or subsystem, as soon as the design work starts, and will be maintained and updated along with design evolution. The results of this reliability analysis will be used as a reference to assess the equipment's reliability compared to the reliability target figures in Section T2.03, or alternatively to improve the systems designs. The reliability analyses will also include the Service Failure criteria defining the different scenarios for out of service situations, to predict the component failures (MDBCF) and service failures (MDBF). The reliability analyses will closely follow design development and, therefore, will reflect the current state of the design and the latest configuration ensuring quick feedback to the Engineers. As design progresses, the reliability predictions of the Vehicle systems/subsystems will be updated in a reliability prediction summary table to reflect the latest configuration for each major system. This Reliability Analysis Summary Table will be submitted to the MBTA on a regular basis following the Preliminary Reliability Analysis submittal at first design review.
- **Systems integration in the Vehicle:** at this level, the reliability analyses will be initiated and conducted by Bombardier, having the prime integration responsibility, as soon as the design work begins, and will be maintained and updated along with design evolution. The results will be used as a reference to assess predicted reliability compared to the reliability target figures, or alternatively to improve the design. The reliability analysis at the Vehicle level will closely follow design development and therefore, will reflect the current state of the design at the latest configuration. As the design progresses, the reliability predictions will be updated in a Reliability Prediction Summary Table to reflect the latest configuration. Those reliability prediction results will be integrated into the Reliability Analysis Summary Table as described in the previous paragraph.

Prior to Proposal submission, Bombardier already conducted preliminary prediction analyses and field data comparisons in order to evaluate ability to achieve the reliability requirements stated in Section T2.03. These preliminary analyses show that Bombardier will comply with the requested reliability final target requirements on the whole car and overall systems. However, for the trucks and vehicle monitoring system, Bombardier's MDBCF targets are based on similar systems field data derived from large vehicle fleets, as detailed below, taking into account the average speed of MBTA Red and Orange line fleets:

<i>Truck:</i>	<i>150,000 miles</i>
<i>Vehicle Monitoring System:</i>	<i>225,000 miles</i>

The target for these systems is considered quite challenging when compared to other Industry requirements for similar Vehicles, as detailed in section 3b) of our Proposal. Bombardier would like the opportunity to better understand the evolution of these requirements to ensure that we have adequately interpreted the proper breakdown for these specific systems.

The reliability targets (whole car and systems) will be revised, if needed, in the event that any option(s) V to X are exercised.

In conformance with the requirements of Section T2.09, and to illustrate the theoretical compliance corresponding to this approach, Bombardier will present the deliverables (CDRL 007, "Reliability Program Plan", CDRL 02-06, "Reliability Prediction Report") to the MBTA, explaining Bombardier's approach for reliability prediction analysis. The Authority will be invited to participate at each stage of this reliability validation during each Design Review.

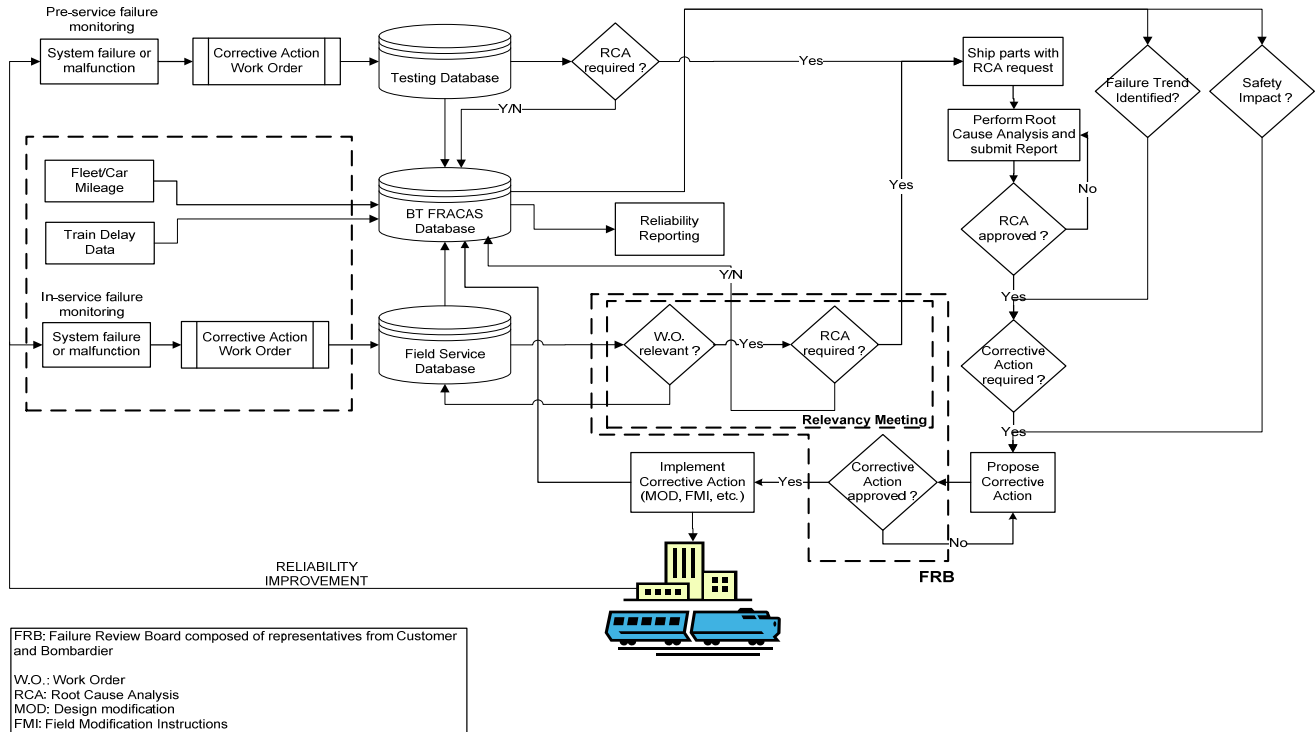
Reliability Test Program Testing Activities

In line with the requirements of the MBTA Orange and Red Line Technical Specification, Bombardier will undertake a Vehicle Reliability Testing Program, starting at the launch of the testing of the first married pair of the Pilot Car, and finishing at the end of warranty of the last Vehicle in revenue service. The objective of this program is to allow: (1) weeding-out of infant mortality problems; (2) increasing efficiency in a good reliability growth compliant with the industry standards as per NF F01-305, which means that Bombardier will achieve the 12 month and 24 month component reliability targets over a longer period of time than required by the Specification; and (3) improvement of the system's reliability in relation to the intrinsic requirements such as the Fleet Defect, the MBDF as well as the MDBCF. Thus, Bombardier will monitor in-service Vehicle performance during the "Reliability Test period" (as specified above) and will include an effective Failure Reporting, Analysis and Corrective Action System (FRACAS) to ensure that failures affecting the Vehicle and its major subsystems are properly tracked and documented, and that the identified problems are raised and resolved efficiently in accordance with the Technical Specification.

This program will consist of the following activities:

- Measuring train performance through the MDBF, MDBCF and the Fleet Defect criteria
- Setting up the process of Data collection and failure Root Cause Analysis (RCA)
- FRACAS (Failure Reporting Analysis and Corrective Action System)
- Establishment of a FRB (Failure Review Board)
- Procedures to implement design changes during the program
- Individual monitoring of each requirement

The figure hereafter presents the Vehicle Reliability test process as it will be deployed for the MBTA's Orange and Red Line Vehicles Project.



Bombardier FRACAS

Through this process, particular attention will be directed to each failure. All failures will be documented in the Bombardier's FRACAS database and then be consolidated in groups of investigation items and Technical Issues (TI) to set focus on the resolution of a problem or a larger trend. Each investigation item (and all related failures) is under the responsibility of the Design Engineer or Supplier who is in charge to identify the root cause and to define the necessary corrective action. Bombardier RAMS (Reliability, Availability, Maintainability, Safety) Engineers will be responsible of the coordination of all actions aiming to resolve the reliability issues.

Consistent with Section T2.03.08.E, and to illustrate demonstration compliance corresponding to this approach, Bombardier will present the deliverables (CDRL 02-10, "Reliability Demonstration Plan", CDRL 02-09, "Pilot Car Reliability Test", CDRL 02-11, "6 Month Reliability Target", CDRL 02-12, "12 Month Reliability Target", CDRL 02-13, "Completion of the Reliability Demonstration Plan"), in sufficient details through its Reliability Demonstration Program. At the conclusion of the Demonstration Period, Bombardier will provide to the MBTA a final report that will include the achieved MDBCF, MDBF, Reliability Growth and test records.

Failure Reporting, Analysis and Corrective Action System (FRACAS)

Bombardier will implement a FRACAS program to manage system failures affecting Vehicle reliability, in order to eliminate the causes of unreliability from the Vehicle design, and thus ensure that the reliability requirements will be met. With the beginning of revenue service, the Bombardier FRACAS database will be used to issue periodically FRACAS Reports which will indicate the progress of the Reliability Improvement Program.

Accumulation of data in the FRACAS database will be used to identify any potential failure patterns which may develop later during the Project. The process of tracking pre-service failures will continue until the beginning of the on-site Pilot Cars testing. The closed-loop nature of the process will enforce the close monitoring of corrected problems to ensure the adequacy of the implemented corrective action. The FRACAS program consists of two approaches: the In-House FRACAS and the In-Service FRACAS, explained below.

In-House FRACAS (Pre-service) – This process will be initiated as soon as systems enter into the testing phase. Failure monitoring and tracking will start with testing at the Bombardier Design and Prototype Centers and continue with testing conducted at Bombardier's plants and at the testing site, until the start of the on-site Pilot Cars testing. When failures or malfunctions are observed at this stage, a Root Cause Analysis (RCA) is immediately requested for safety related failures or upon identification of a failure trend to ensure that problems related to manufacturing are addressed as early as possible during the production cycle. This also serves to identify potential design weaknesses or interface problems. When an RCA is requested, the FRACAS database is updated.

In-service FRACAS – In-service failure monitoring and tracking will start with the on-site Pilot Cars testing and end at the closure of the general fleet warranty period. It is similar in nature to the in-house FRACAS, except that failure data collection is performed and that the FRB is involved in the relevancy meetings.

Root Cause Analysis (RCA)

Defined as prime input in the resolution process of the investigation items and in support of FRACAS process, the RCA will allow us to determine the mechanism of failures in order to:

- Determine the root cause of the failures
- Analyze failed parts for documentation and prevent occurrence of additional failures
- Define and propose appropriate corrective actions as needed

The RCA will be performed jointly by Bombardier and its Suppliers and the results or conclusions of the investigations will be used by the Engineering team as input to their investigation process.

Failure Review Board (FRB)

To ensure the efficient classification of failure data collected and the appropriate corrective actions undertaken, this group comprises representatives from both the MBTA and Bombardier who will actively participate in the FRACAS process. The FRB will be responsible for holding regular meetings to review the progress of the FRACAS Program.

Two types of meetings will be held:

Relevancy Meetings – Delegates from the FRB, preferably one representative from the MBTA and one representative from Bombardier will meet on a regular basis to review work orders. The intent is to classify failures between relevant and non-relevant failures, according to the agreed upon criteria.

Corrective Action Review Meetings – During those meetings, current investigations and Technical Issues are being reviewed with the Engineering team and the Authority to assess their progression and resolution.

Suppliers' Responsibilities

The Bombardier RAMS team is organized to supervise Suppliers' activities. By attending Design Reviews, the Bombardier RAMS Engineers will fully understand the system functionalities and the direct implication of components loss or failure. By analyzing circuit elements and layouts, the RAMS group will evaluate the design and identify the weak points and areas that need improvement, if any. By reviewing the Suppliers' reliability documentation received on a regular basis during the design phase, the RAMS group ensures that the proper methodology is being used, clear and healthy assumptions are taken, and that the predictions meet the expected in-service performance of the system. Bombardier Systems Engineers will support the RAMS group to ensure that the reliability modeling and analyses take into account the actual design implementation.

The Bombardier RAMS group has user friendly templates that can be used by the Suppliers, in which they will report their reliability progress. These templates (depending on type of analysis) identify portions of the system and their relative contribution to the system's reliability. This information indicates the areas of improvement and allows for a better follow-up on the Suppliers' corrective actions. In addition, the template also provides information on design modifications that have contributed to increase the system's reliability.

The RAMS group has the necessary authority to enforce design changes/modifications when these are necessary to ensure that the system's reliability will meet or exceed the requirements. Being in a separate department from the design engineering, it ensures independency of vision and access to high management when necessary.

Thus the review process with the Suppliers is defined in the following way:

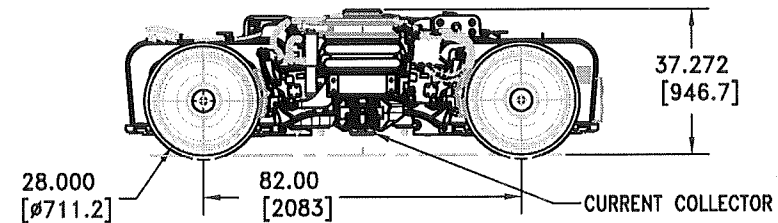
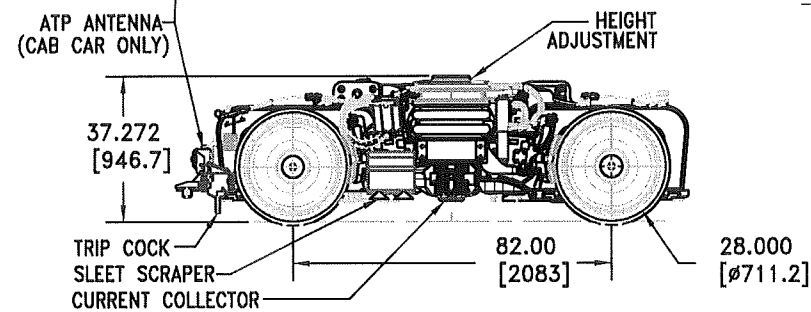
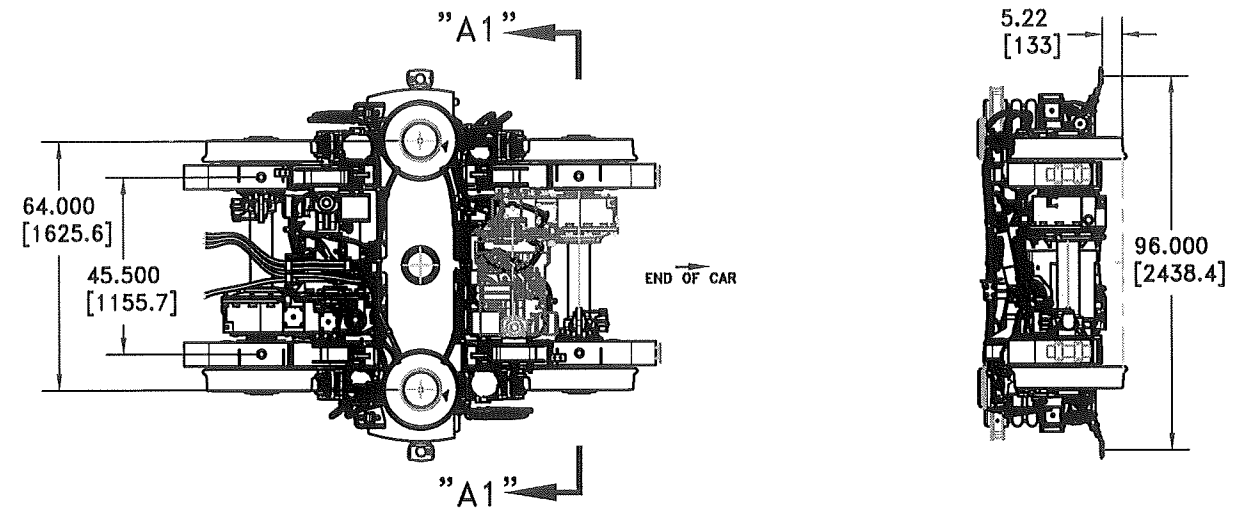
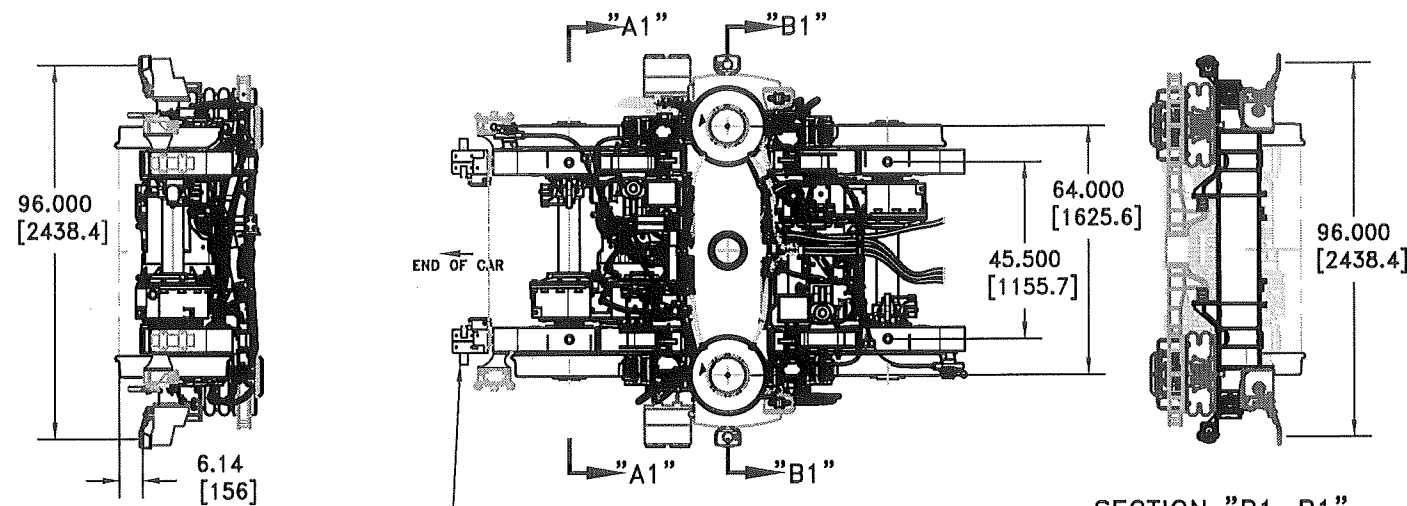
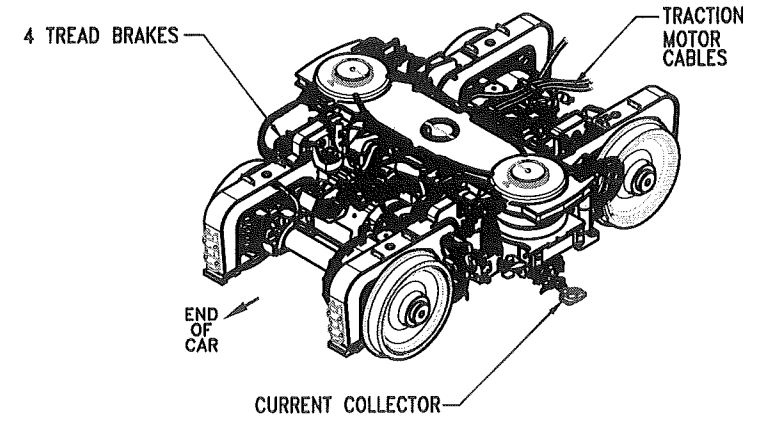
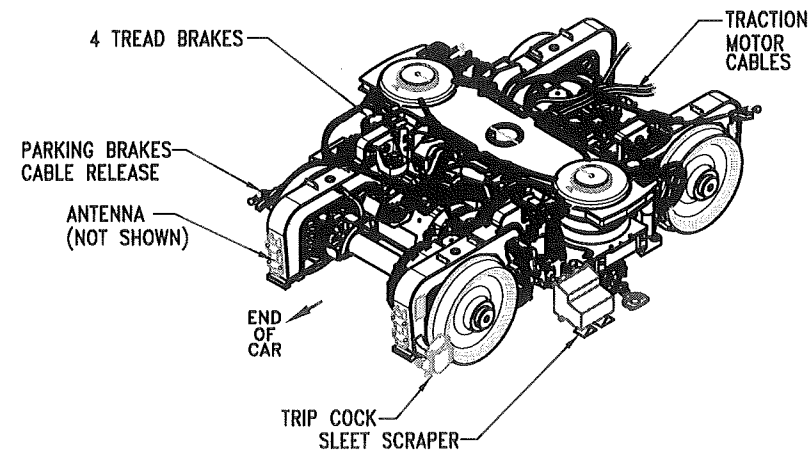
- Bombardier will prepare detailed Technical Requirement Descriptions (TRDs) defining the scope for Suppliers of the MBTA Orange and Red Line Vehicles program. These TRDs will include specific subsystem reliability requirements allocated from the overall MBTA Orange and Red Line Vehicles reliability requirements
- Reliability analyses will be initiated when design work starts, and will be maintained and updated with the design evolution. They will be used as a basis to assess the performance of each Supplier (in terms of systems/subsystem reliability performance) and the potential of each Supplier to meet or exceed the reliability requirements, or alternatively to define the necessary design modifications to meet the requirements
- At design reviews, vehicle and system reliability features and data will be reviewed with the MBTA and the Suppliers to ensure design compliance with the reliability requirements stated in Section T2.03
- Through an effective Failure Reporting, Analysis and Corrective Action System (FRACAS) (as defined above), the reliability performance of each Supplier/system will be tracked throughout the warranty period to detect problem areas and to define adequate corrective actions

Therefore, through the well-established and proven reliability process described above, Bombardier will make sure to provide reliable and safe vehicles to the MBTA, with full support of its Suppliers.

Summary

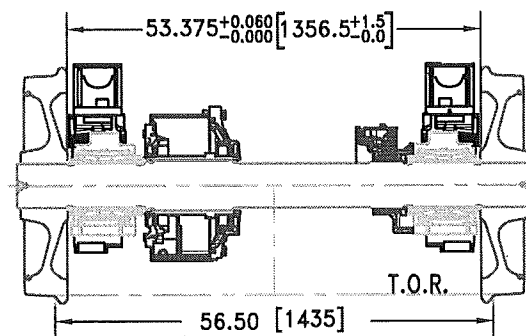
Bombardier fully understands the criticality of reliability for these Orange and Red Line Vehicles. As described above, we have a very robust process for establishing and monitoring reliability performance. We would like the opportunity to better understand the evolution of certain requirements within Section T2.03, to ensure that we have adequately interpreted the needs and requirements of the Authority.

Bombardier's Conceptual Designs



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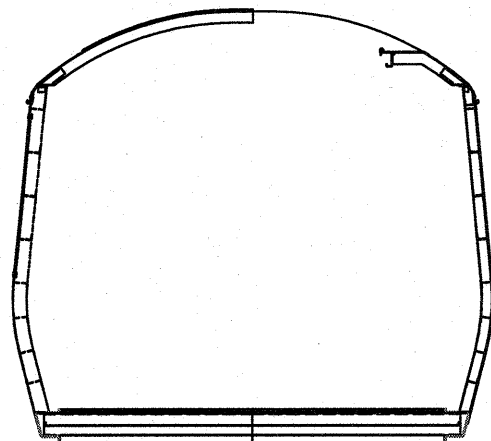
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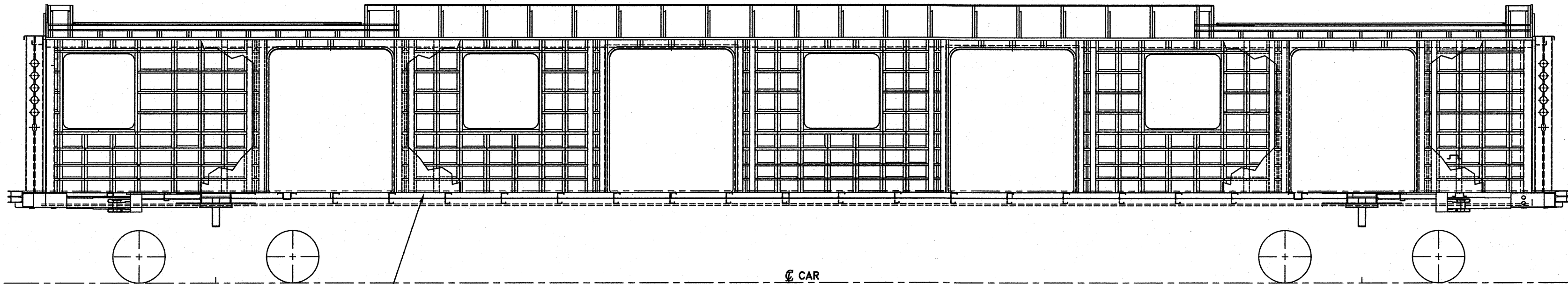
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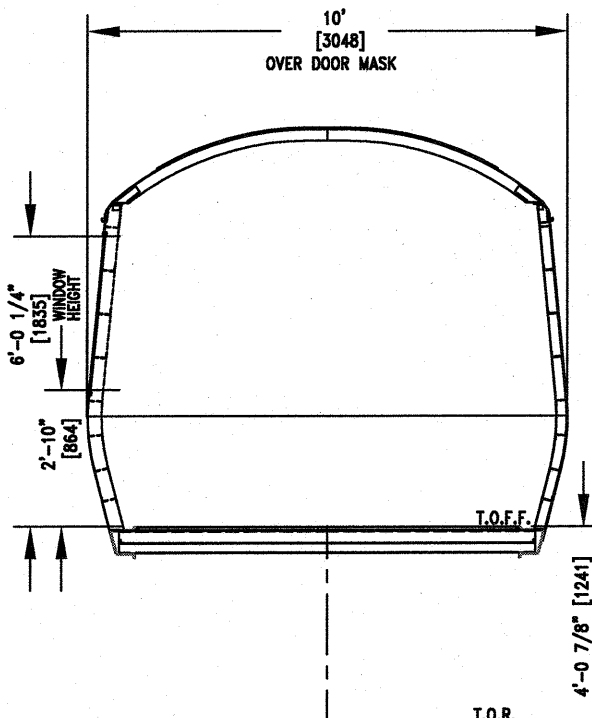
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Approved M. DUFOUR		Init. <i>MD</i>	Date 2014/04/11	Drawing number C514-119-01-1	
				Sheet 1 of 1	Revision 1



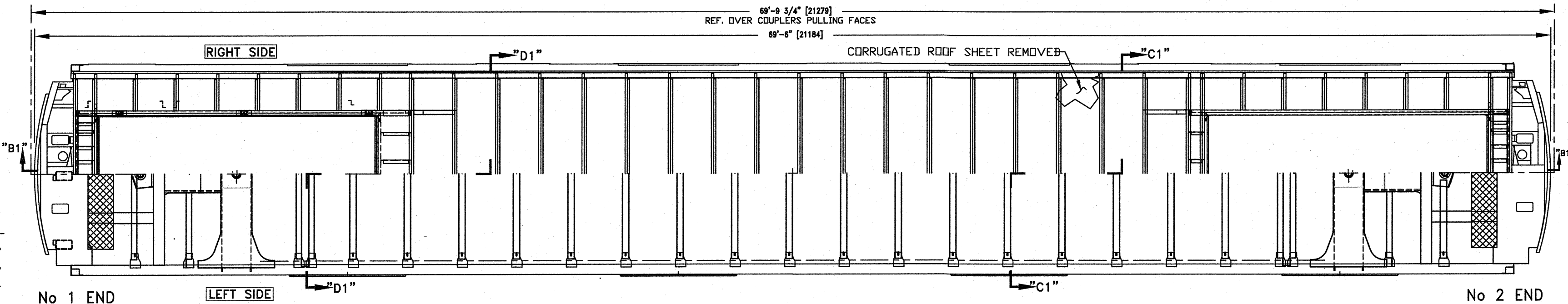
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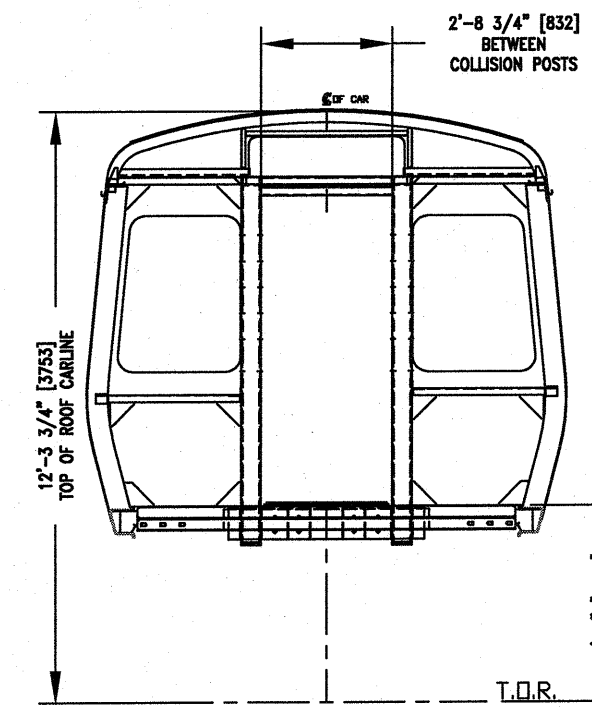
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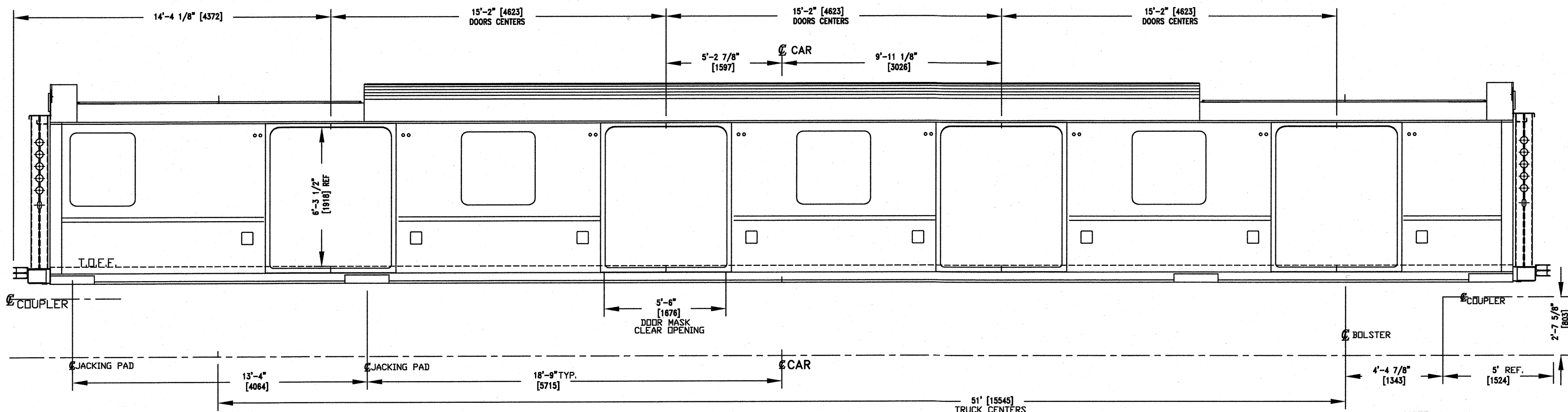
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LEFT SIDE ELEVATION
RIGHT SIDE TYPICAL



END VIEW NO.1 END
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NOTE: CAMBER AWO: 3/4" MAX
AW3: 0" MIN

PRELIMINARY
DATE : 2014/04/18

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P. FRENETTE				
E. LAMOREUX				

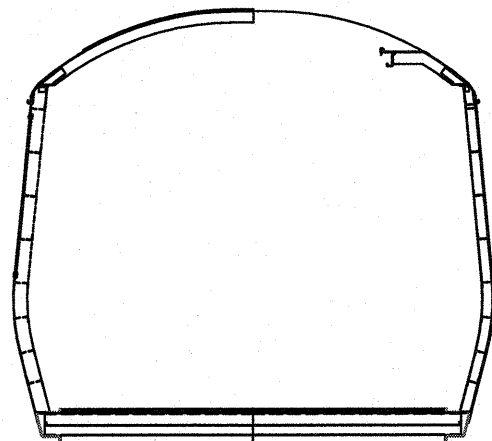
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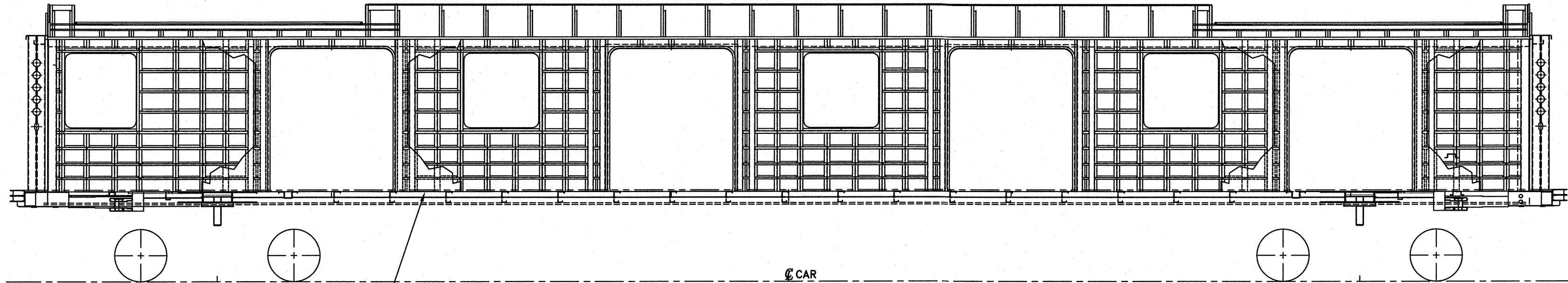
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APPROVED	DATE	SIZE	DRAWING NUMBER
E. LAMOREUX	2014/04/18	C	C514-399-01-1

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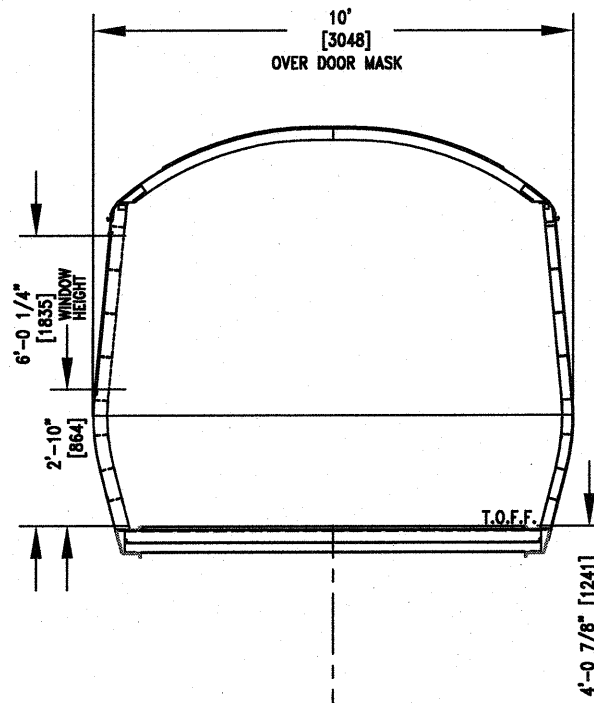
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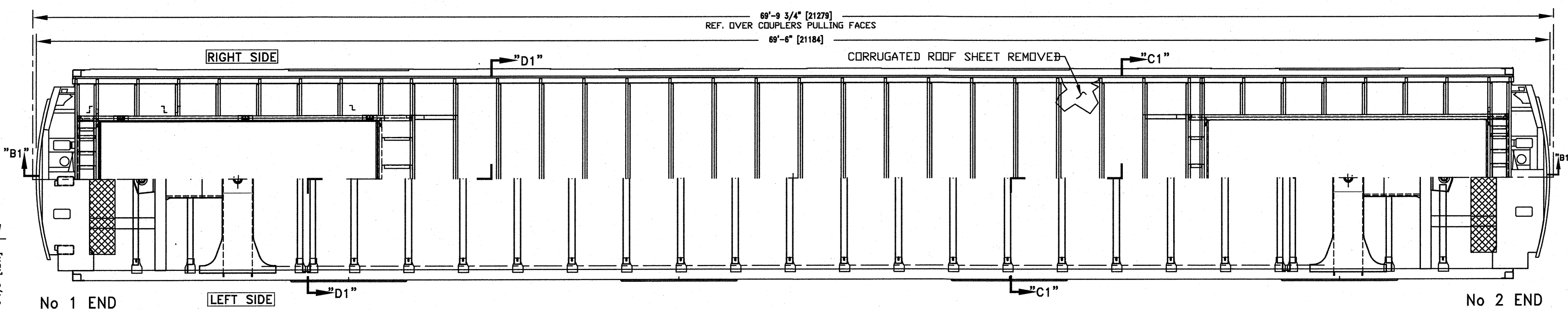
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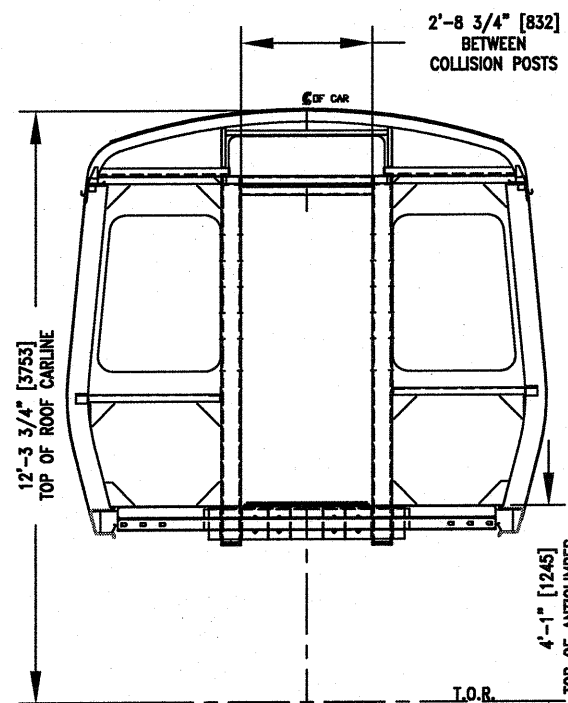
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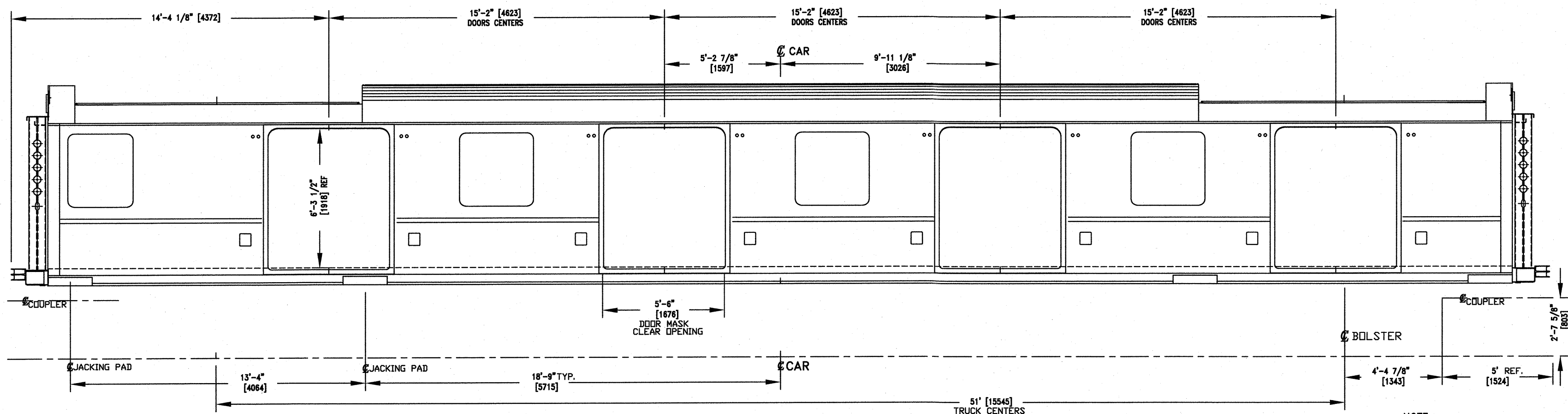
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LEFT SIDE ELEVATION
RIGHT SIDE TYPICAL



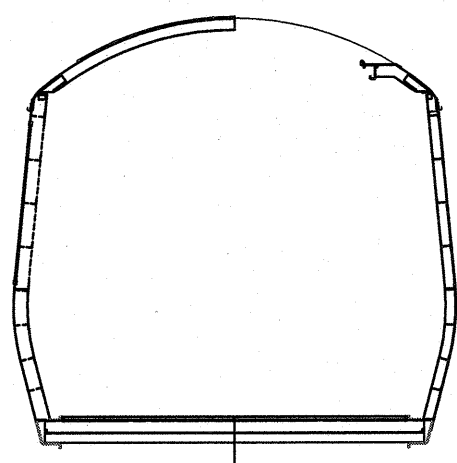
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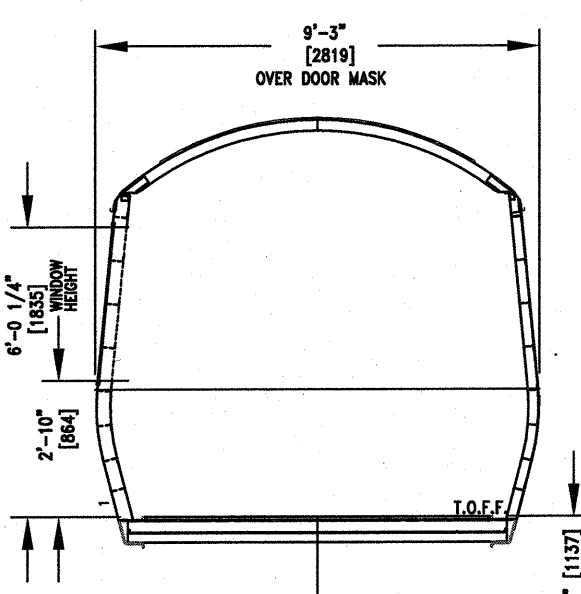
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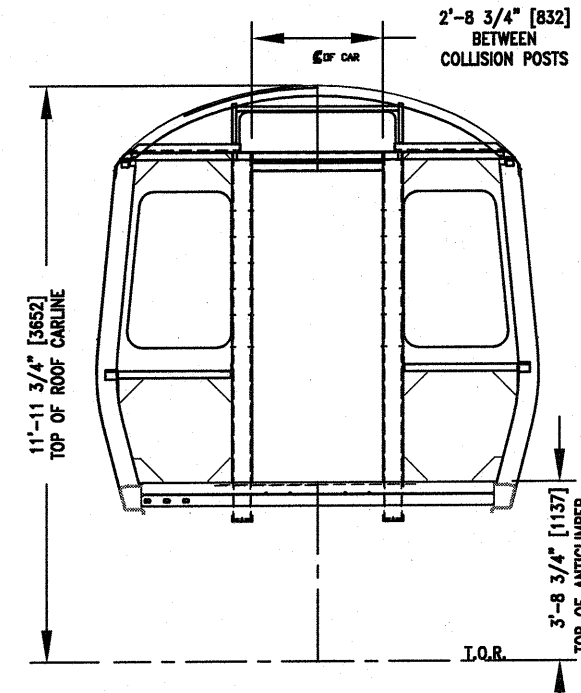
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Designer	P. FRENETTE	2014/04/18	<p>BOMBARDIER</p> <p>© 2014, Bombardier Inc. or its subsidiaries. All rights reserved.</p> <p>MBTA RED LINE; NON-CAB CAR CARBODY STRUCTURAL DIAGRAM</p>		
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Approved	E. LAMOREUX	2014/04/18			
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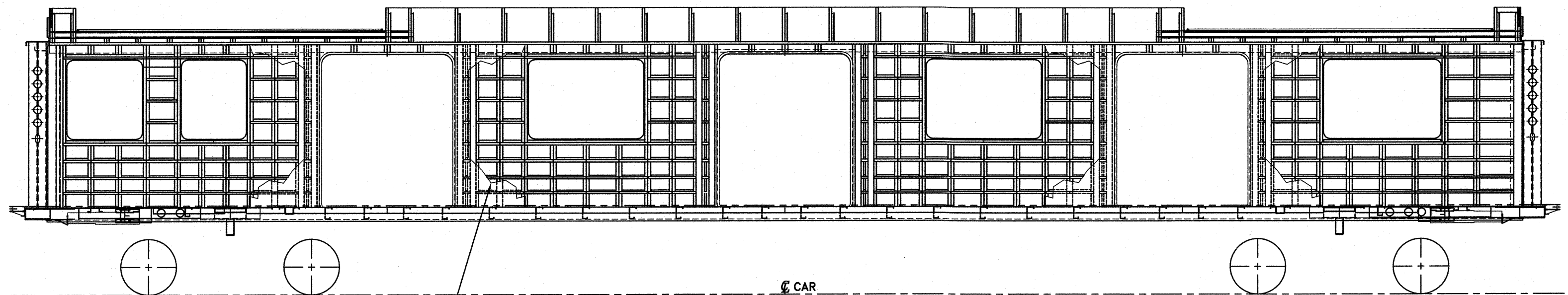
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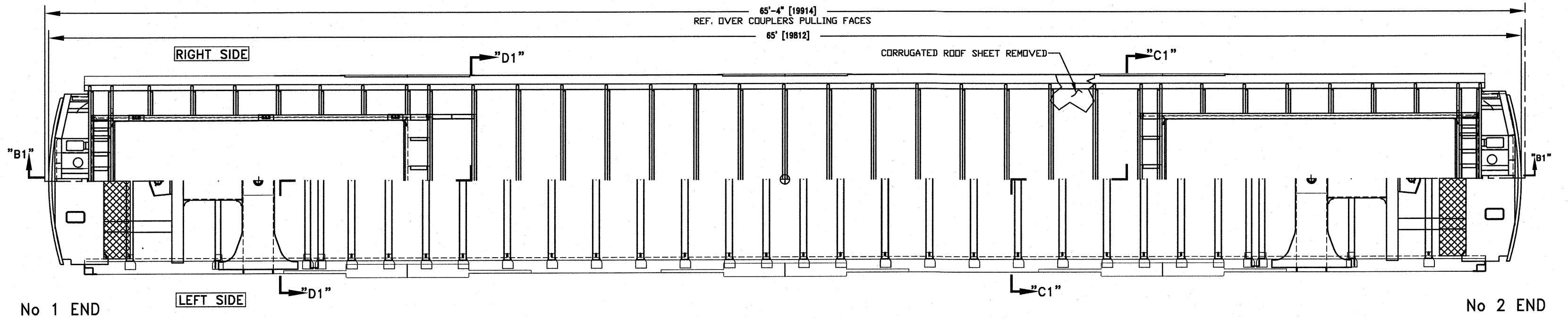
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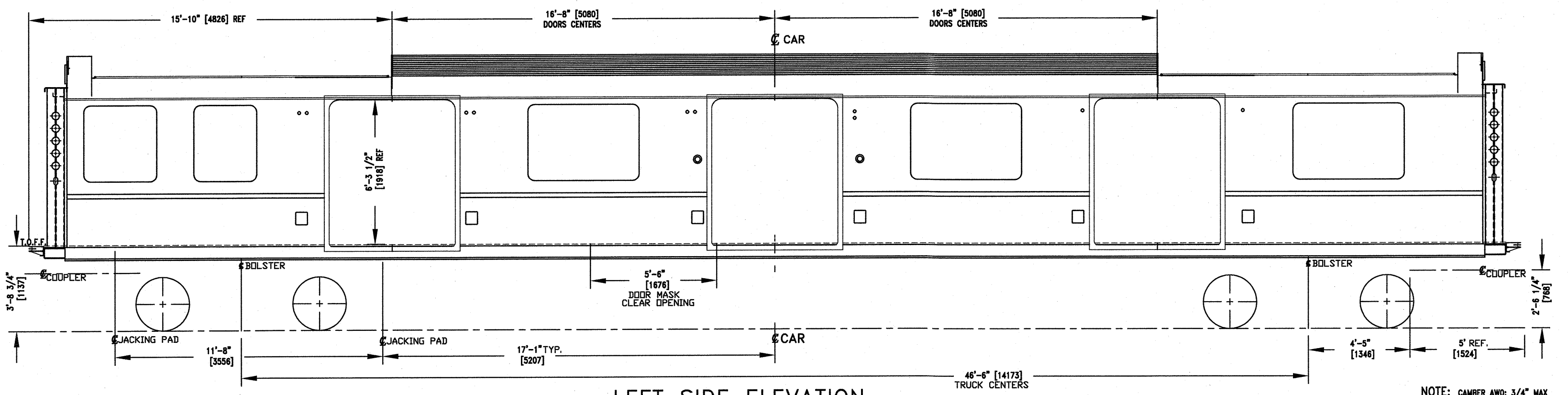


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No 2 END



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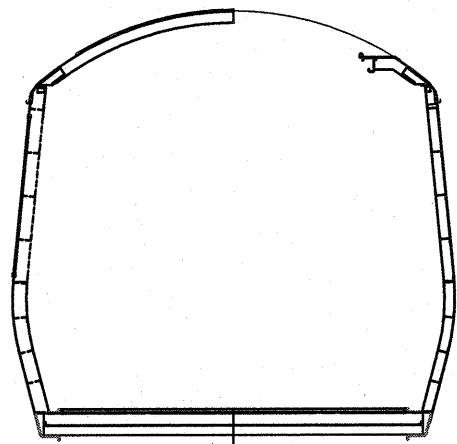
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NOTE: CAMBER AWO: 3/4" MAX
AWO: 0" MIN

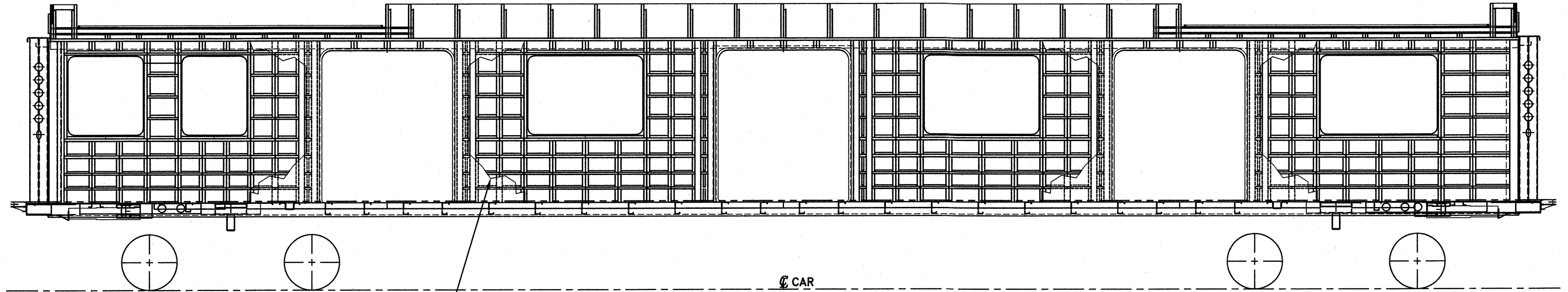
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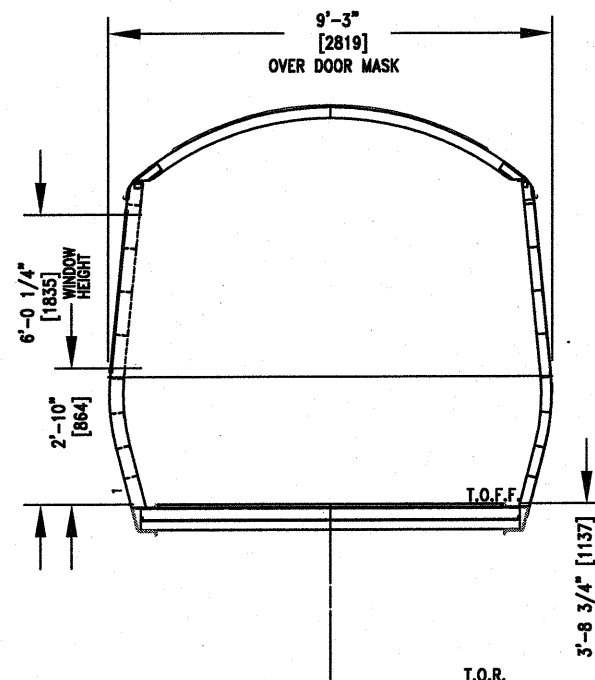
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MBTA ORANGE LINE: CAB CAR CARBODY STRUCTURAL DIAGRAM					Revision 1



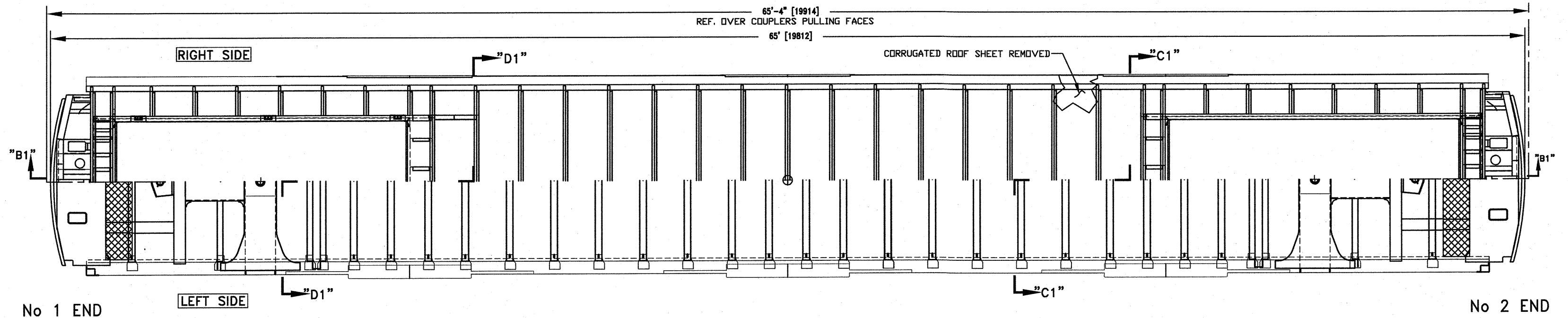
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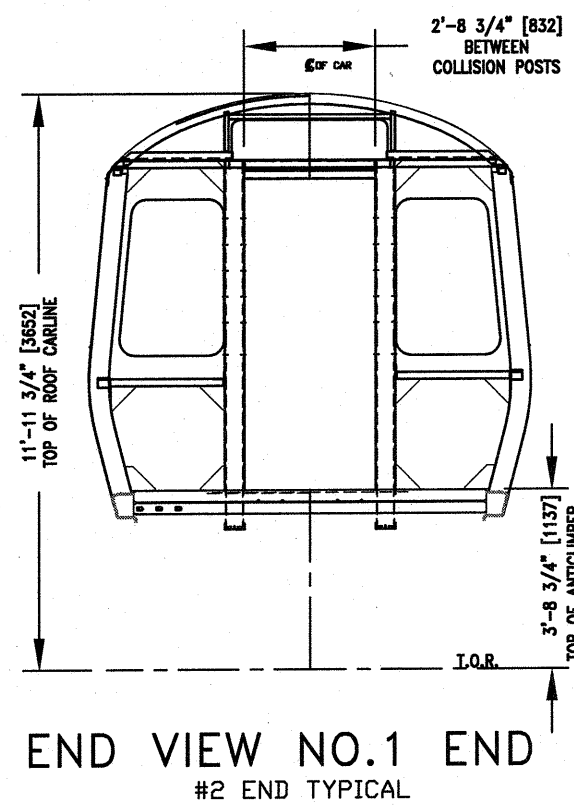
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RIGHT SIDE WALL STRUCTURE
SHOWN FROM INSIDE OF CAR



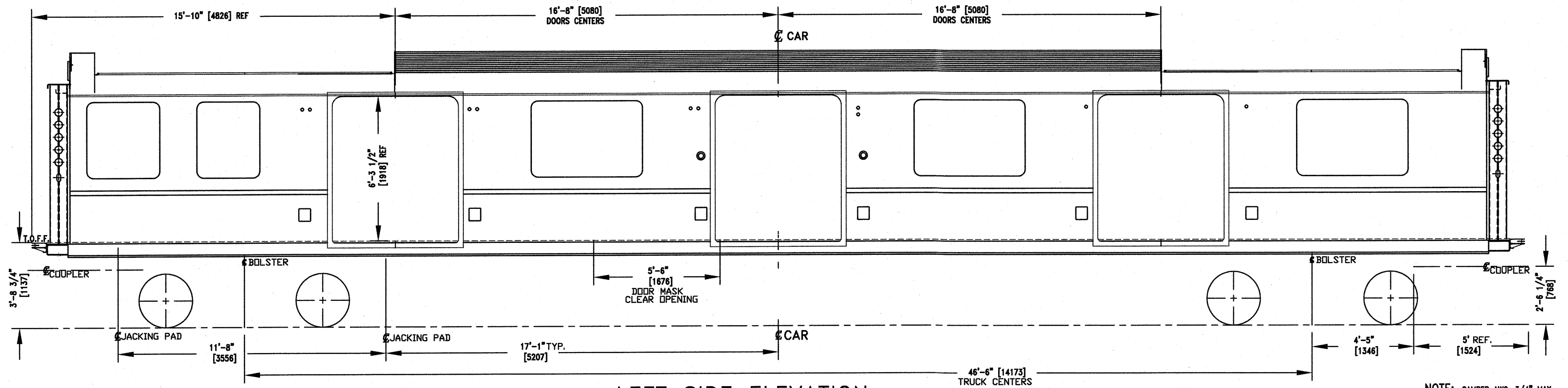
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LEFT SIDE ELEVATION
RIGHT SIDE TYPICAL



END VIEW NO.1 END
#2 END TYPICAL



NOTE: CAMBER AWO: 3/4" MAX
AWS: 0" MIN

PRELIMINARY
DATE : 2014/04/18

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DESIGNER	APPROVED	DESCRIPTION	DATE	REV.
P. FRENETTE				
P. FRENETTE				
E. LAMOREUX				

INCH	MILLIMETRE
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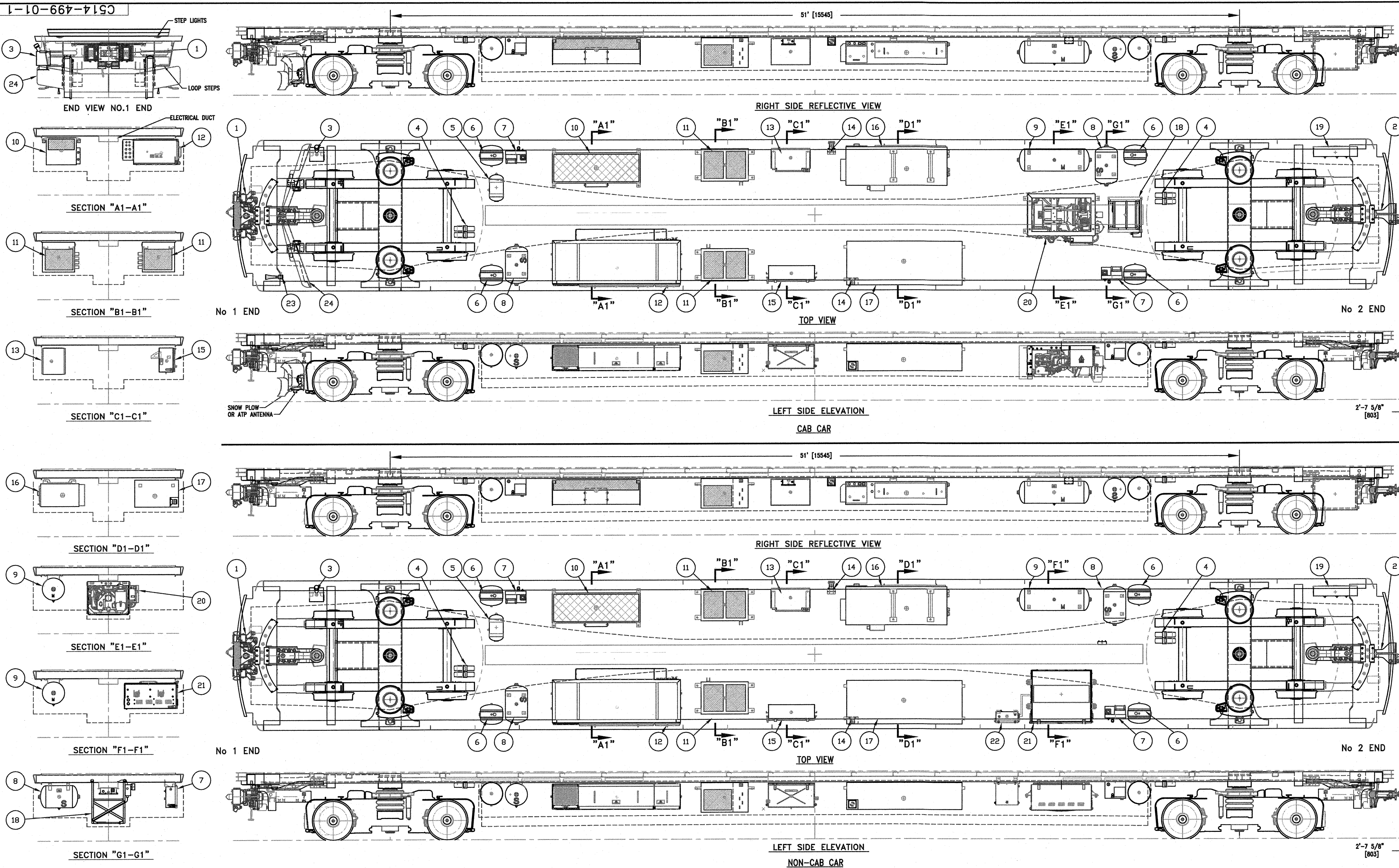
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MBTA ORANGE LINE; NON-CAB CAR
CARBODY STRUCTURAL DIAGRAM

C514-399-12-1

1 of 1



NO	DESCRIPTION
1	AUTOMATIC COUPLER
2	SEMI-PERMANENT COUPLER
3	WASHER FLUID TANK & PUMP
4	QUICK TRUCK DISCONNECT
5	PARKING BRAKE RESERVOIR
6	SECONDARY SUSPENSION RESERVOIRS
7	BRAKE VALVE MANIFOLD UNIT
8	SUPPLY RESERVOIR
9	MAIN RESERVOIR
10	BRAKE RESISTOR
11	LINE FILTER INDUCTOR
12	DUAL INVERTER
13	HIGH SPEED CIRCUIT BREAKER

NO	DESCRIPTION
14	SHOP POWER RECEPTACLE
15	600 VDC HIGH VOLTAGE DIST.BOX
16	API/ LVPS
17	HIGH VOLTAGE BOX
18	ASI RFID TAG READER
19	JUNCTION BOX #2
20	AIR COMPRESSOR
21	BATTERY BOX
22	BATTERY CIRCUIT BREAKER BOX
23	PNEUMATIC HORN
24	SNOW PLOW

PRELIMINARY
DATE : 2014/04/11

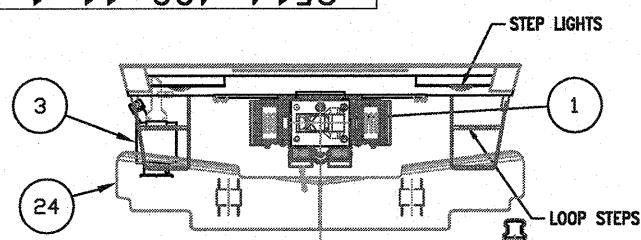
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Drawn	P. FRENETTE	Init.	2014/04/11	Size	C
Approved	P.Y.NOEL	Init.	2014/04/11	Sheet	1 of 1
				Revision	
				1	

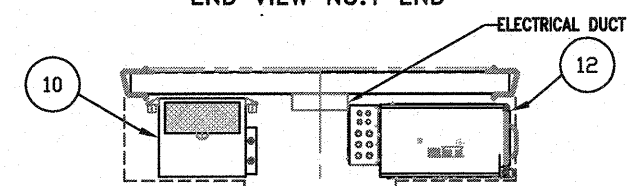
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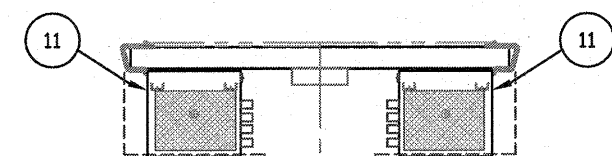
MBTA RED LINE
UNDERCAR EQUIPMENT ARRGT.
C514-499-01-1



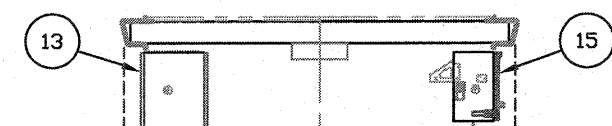
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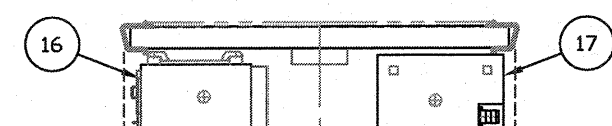
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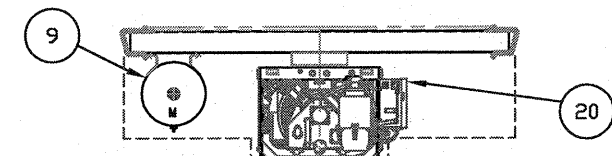
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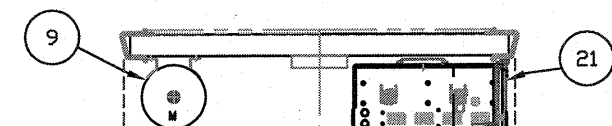
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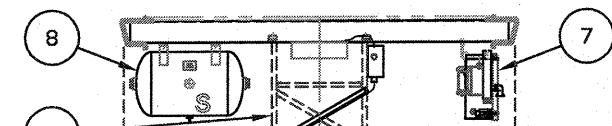
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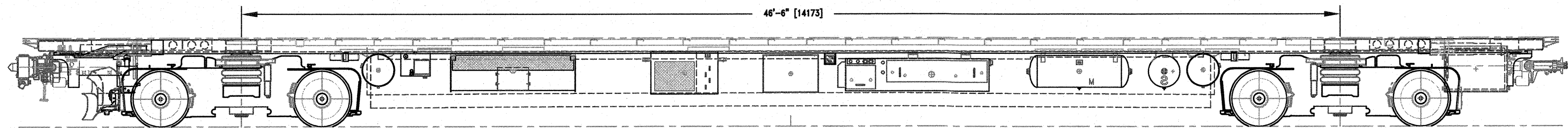
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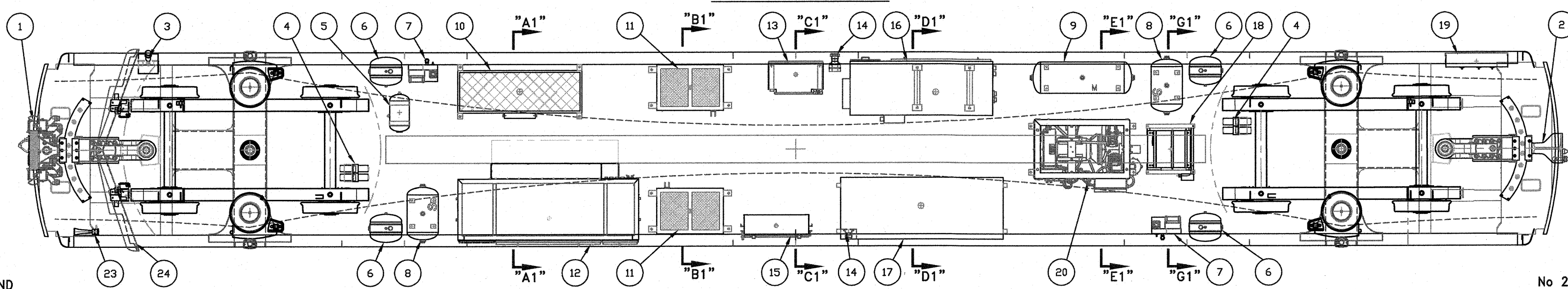
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No 1 END

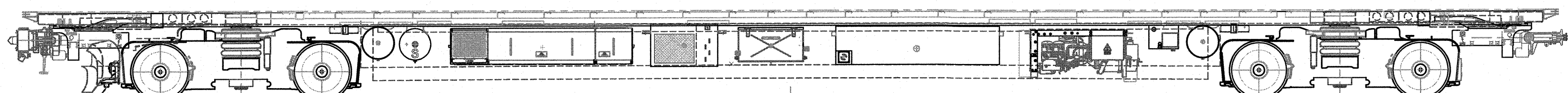


RIGHT SIDE REFLECTIVE VIEW



TOP VIEW

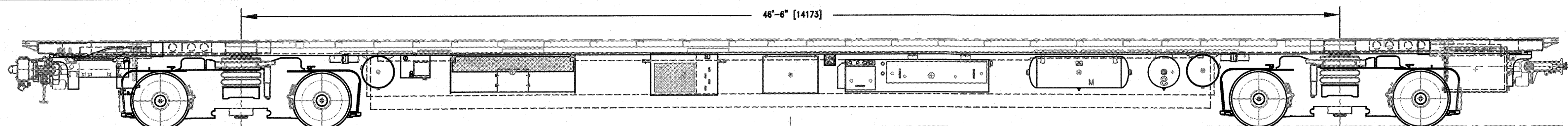
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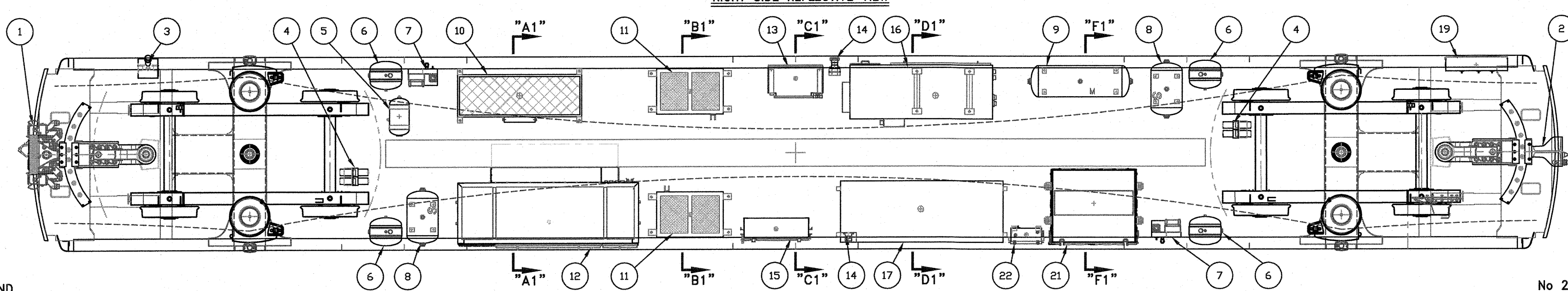
LEFT SIDE ELEVATION

CAB CAR

2'-6 1/4" [768]

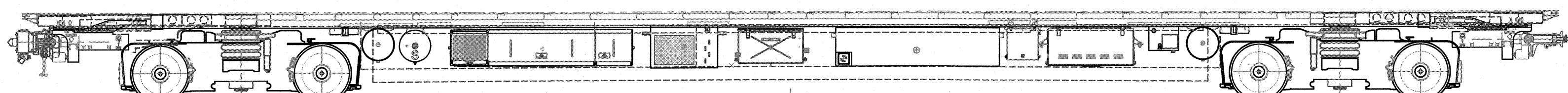


RIGHT SIDE REFLECTIVE VIEW



TOP VIEW

No 2 END



LEFT SIDE ELEVATION

NON-CAB CAR

2'-6 1/4" [768]

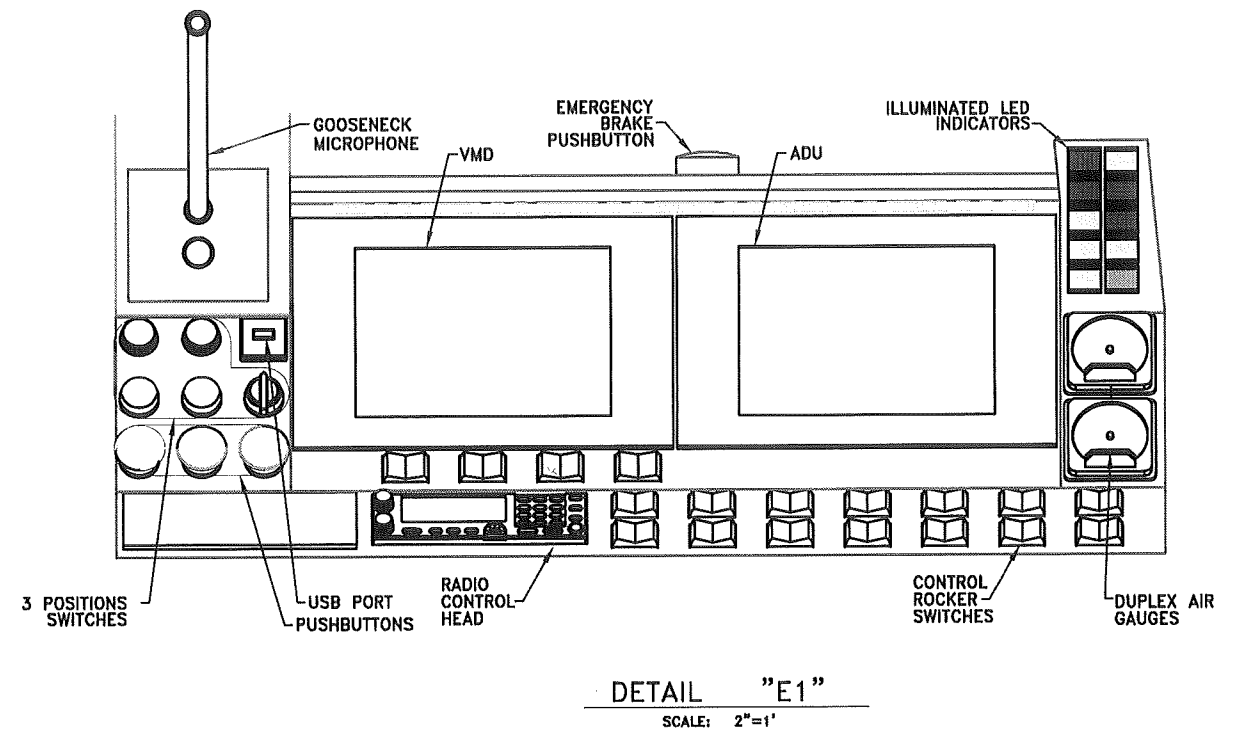
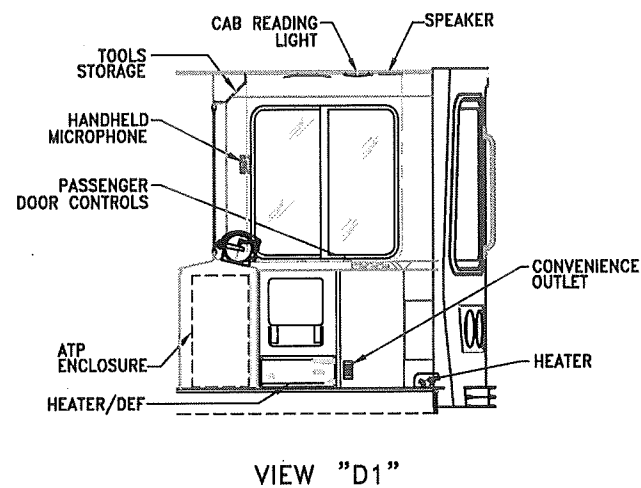
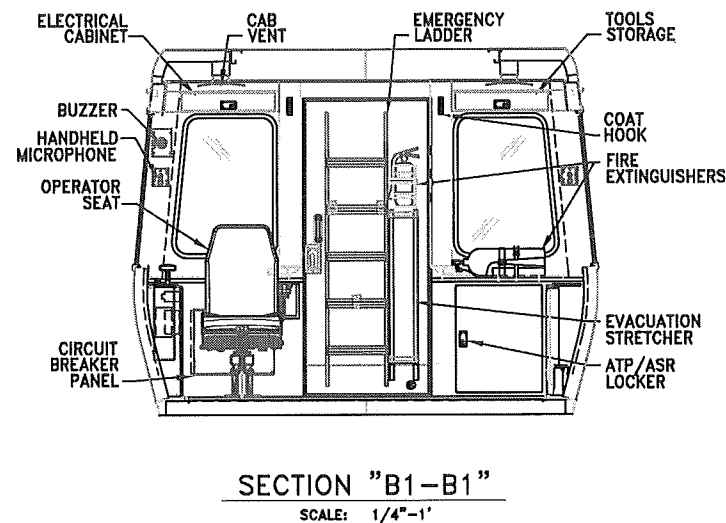
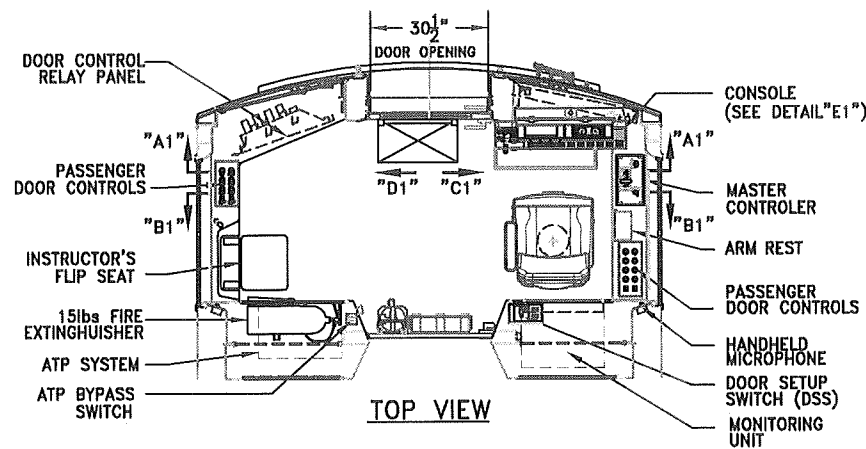
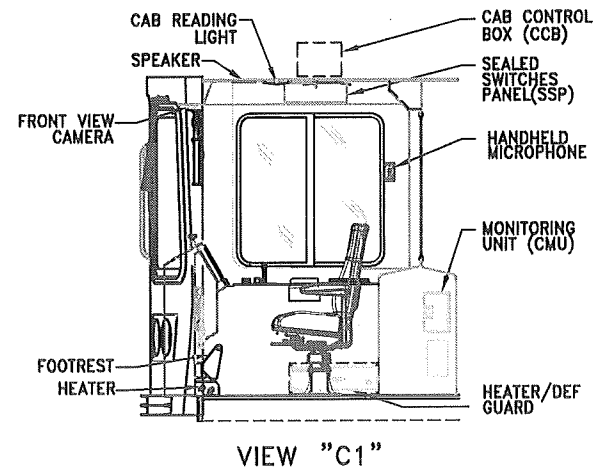
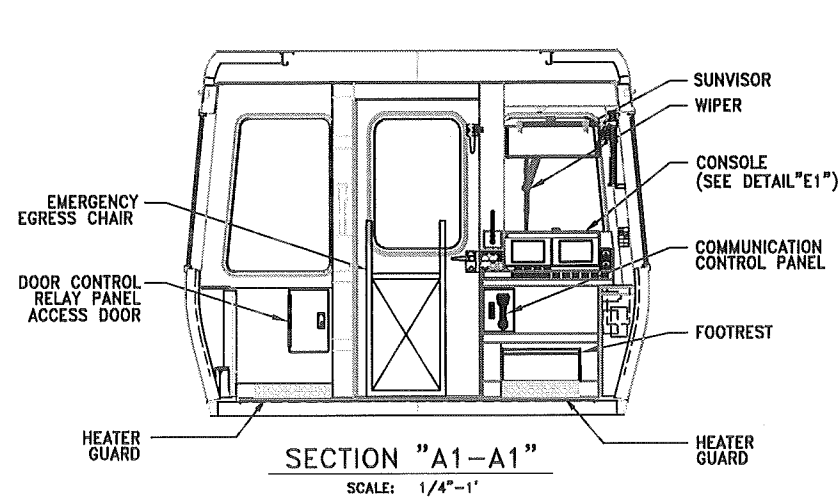
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2	SEMI-PERMANENT COUPLER
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4	QUICK TRUCK DISCONNECT
5	PARKING BRAKE RESERVOIR
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8	SUPPLY RESERVOIR
9	MAIN RESERVOIR
10	BRAKE RESISTOR
11	LINE FILTER INDUCTOR
12	DUAL INVERTER
13	HIGH SPEED CIRCUIT BREAKER

NO	DESCRIPTION
14	SHOP POWER RECEPTACLE
15	600 VDC HIGH VOLTAGE DIST.BOX
16	API/ LVPS
17	HIGH VOLTAGE BOX
18	ASI RFID TAG READER
19	JUNCTION BOX #2
20	AIR COMPRESSOR
21	BATTERY BOX
22	BATTERY CIRCUIT BREAKER BOX
23	PNEUMATIC HORN
24	SNOW PLOW

PRELIMINARY
DATE : 2014/04/11

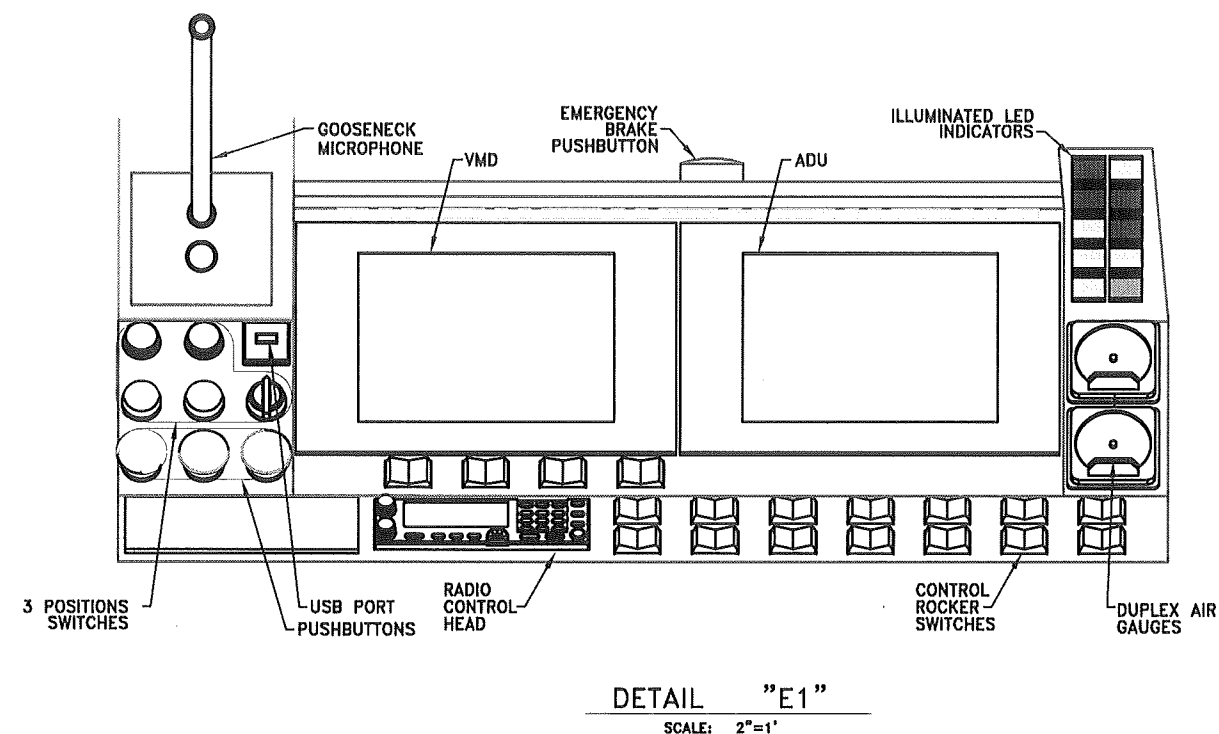
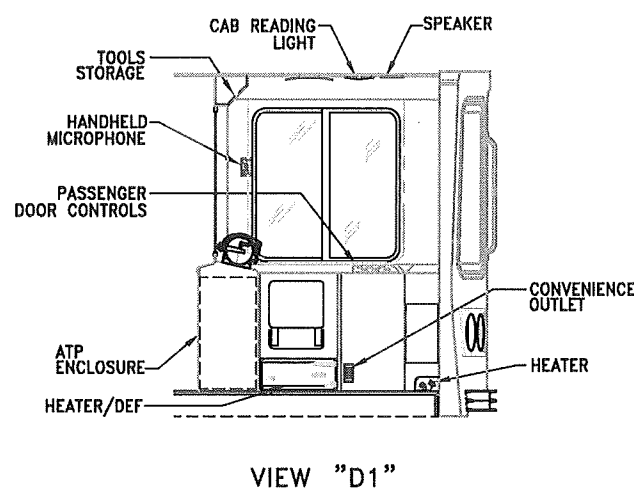
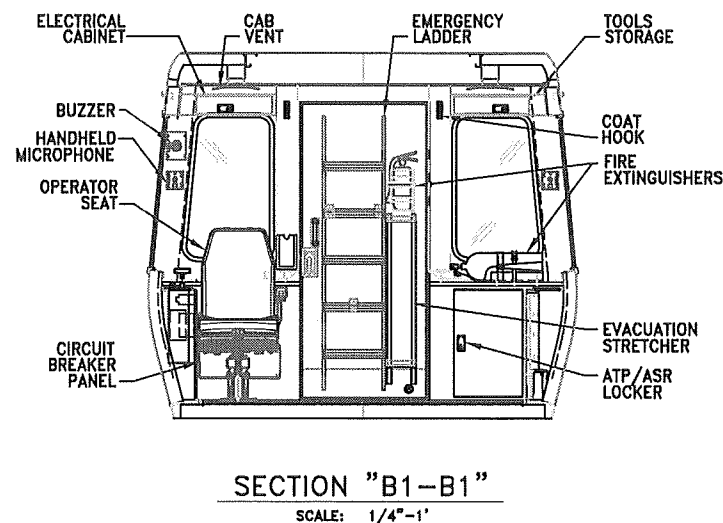
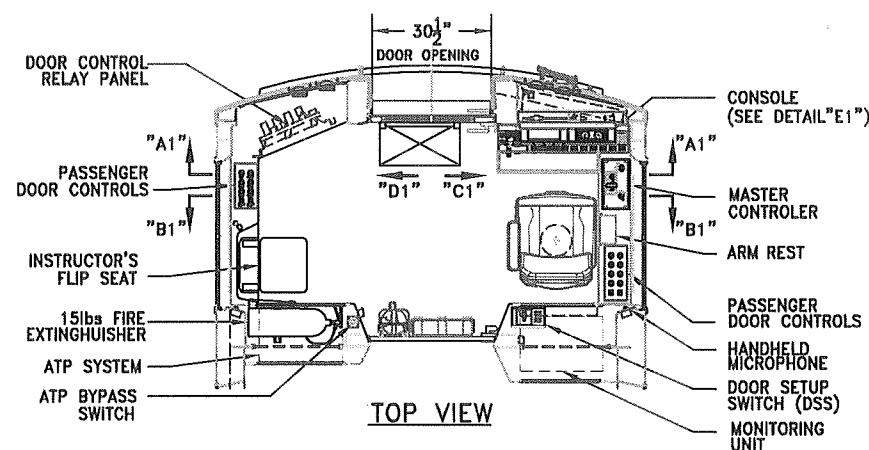
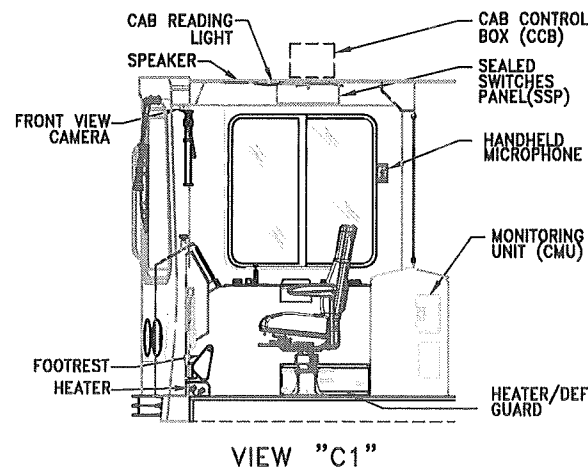
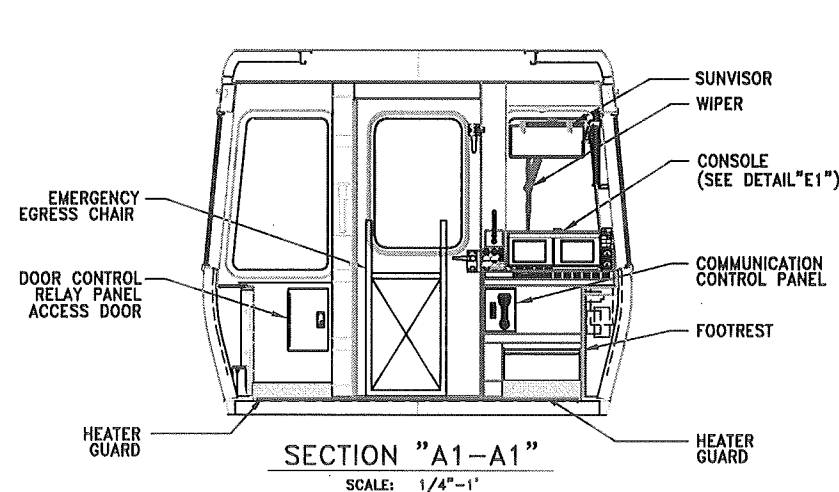
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Drawn	P. FRENETTE	2014/04/11	Size	C	
Approved	P.Y.NDEL	2014/04/11	Sheet	1 of 1	1
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MBTA ORANGE LINE UNDERCAR EQUIPMENT ARRGT.					
C514-499-11-1					



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DATE : 2014/04/17
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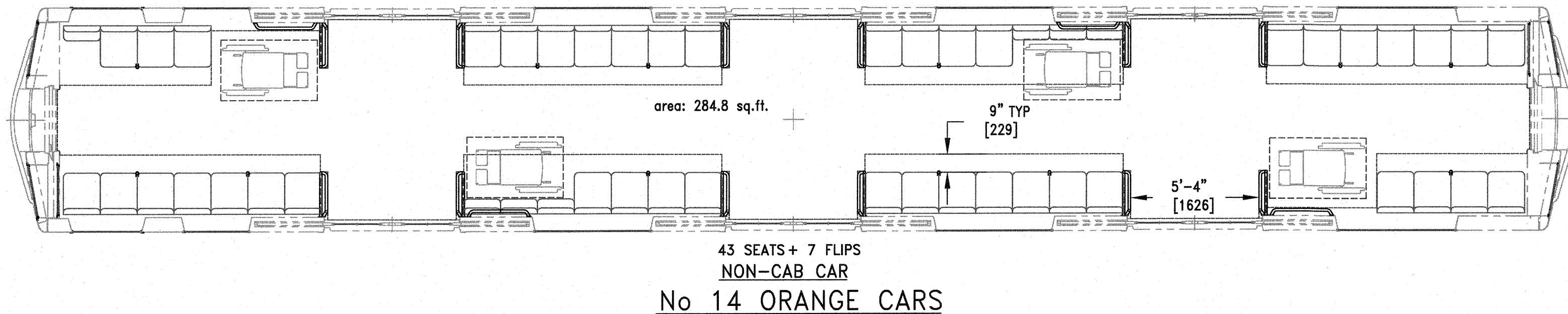
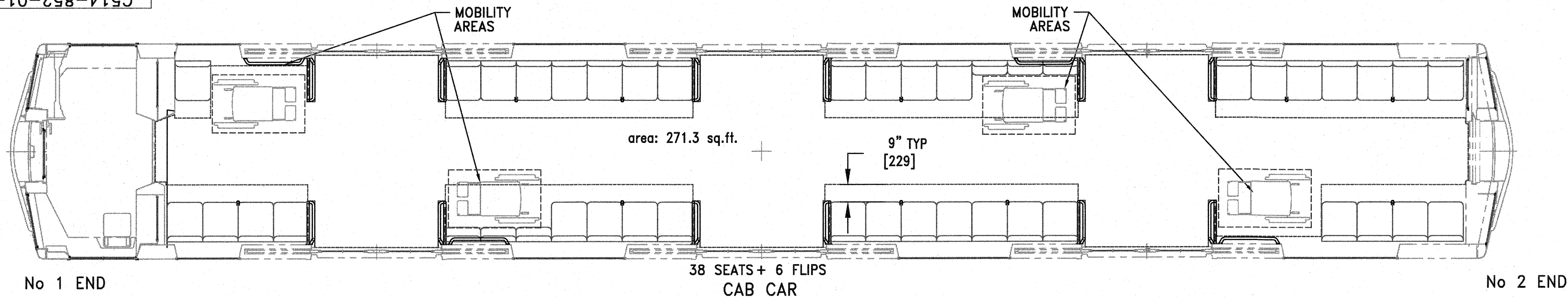
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Designer		P. FRENETTE	Int.	Date	Scale	Title	
Drawn		P. FRENETTE	2014/04/17	2014/04/17	1/4"=1'	MBTA RED LINE CAB AND CONSOLE LAYOUT	
Approved		G.GAGNE	2014/04/17	2014/04/17	Size B	Drawing number	C514-739-01-1
						Sheet 1 of 1	Revision 1



PRELIMINARY
DATE : 2014/04/17

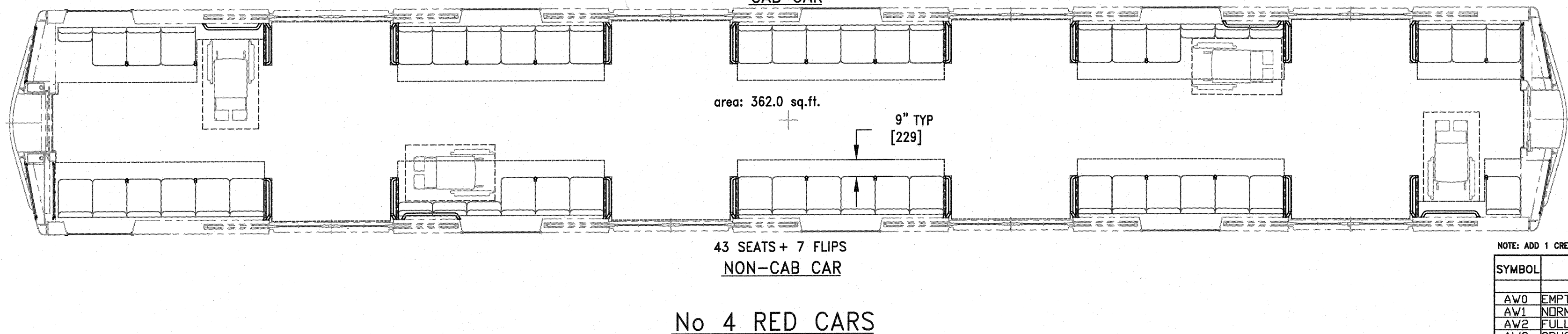
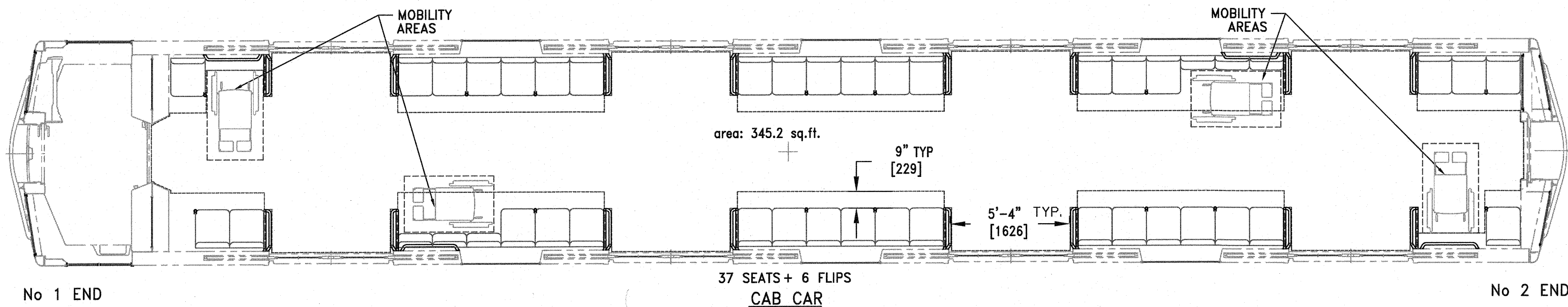
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Design	P. FRETTE	2014/04/17	MBTA ORANGE LINE CAB AND CONSOLE LAYOUT	1 of 1	1
Drawn	P. FRETTE	2014/04/17			
Approved	G.GAGNE	2014/04/17			



SYMBOL	DEFINITION		PASS. LOADING CAPACITY	
			CAB	N-CAB
AW0	EMPTY			
AW1	NORMAL	SEATED+ CREW	45	50
AW2	FULL	SEATED + 3sq.ft./p	135	145
AW3	CRUSH	SEATED + 1.5sq.ft./p.	225	240

NOTE: ADD 1 CREW MEMBER PER A CAR FOR TOTAL CAPACITY.



SYMBOL	DEFINITION		PASS. LOADING CAPACITY	
			CAB	N-CAB
AW0	EMPTY			
AW1	NORMAL	SEATED+ CREW	44	50
AW2	FULL	SEATED + 3sq.ft./p	159	170
AW3	CRUSH	SEATED + 1.5sq.ft./p.	270	289

NOTE: ADD 1 CREW MEMBER PER A CAR FOR TOTAL CAPACITY.

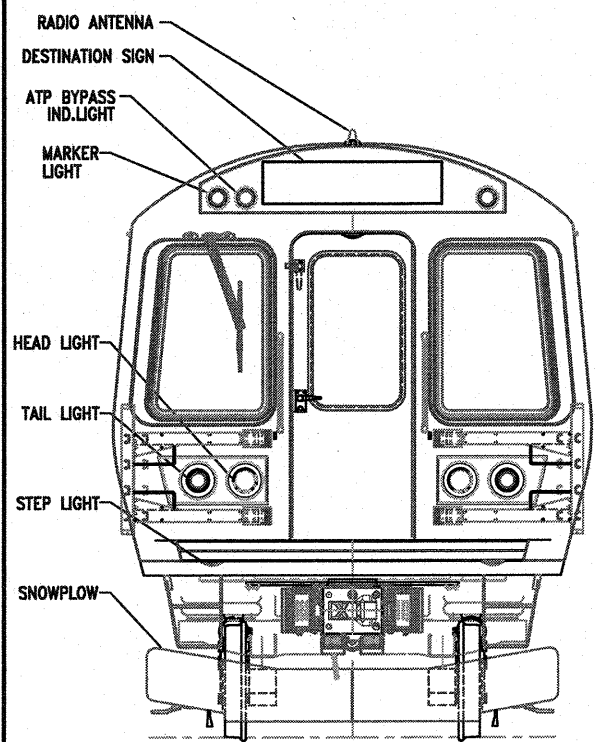
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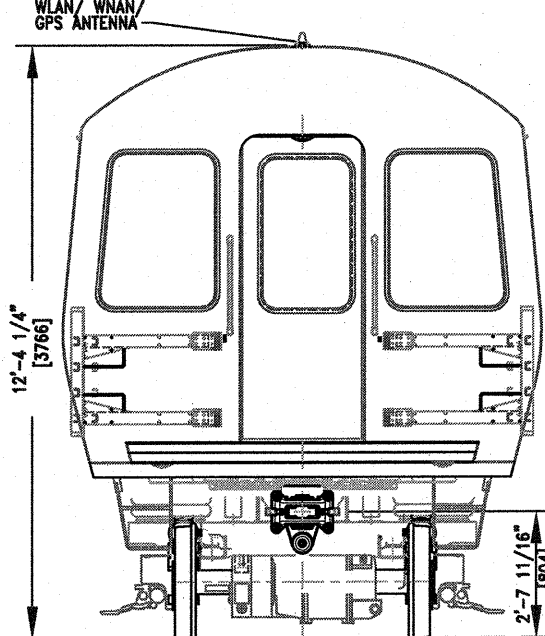
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DRAWN	P. FRENETTE	DATE	2014/04/17	TITLE	MBTA ORANGE AND RED LINES FLOOR PLANS
APPROVED	S. POULIN	DATE	2014/04/17	DRAWING NUMBER	C514-852-01-1
					SHEET 1 OF 1

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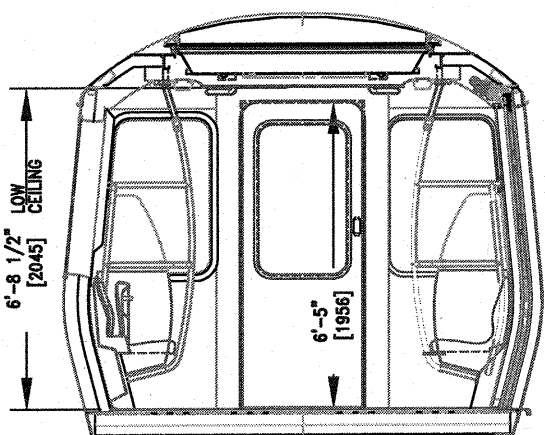
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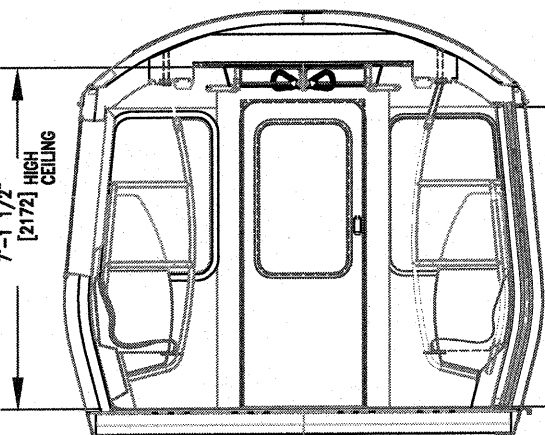
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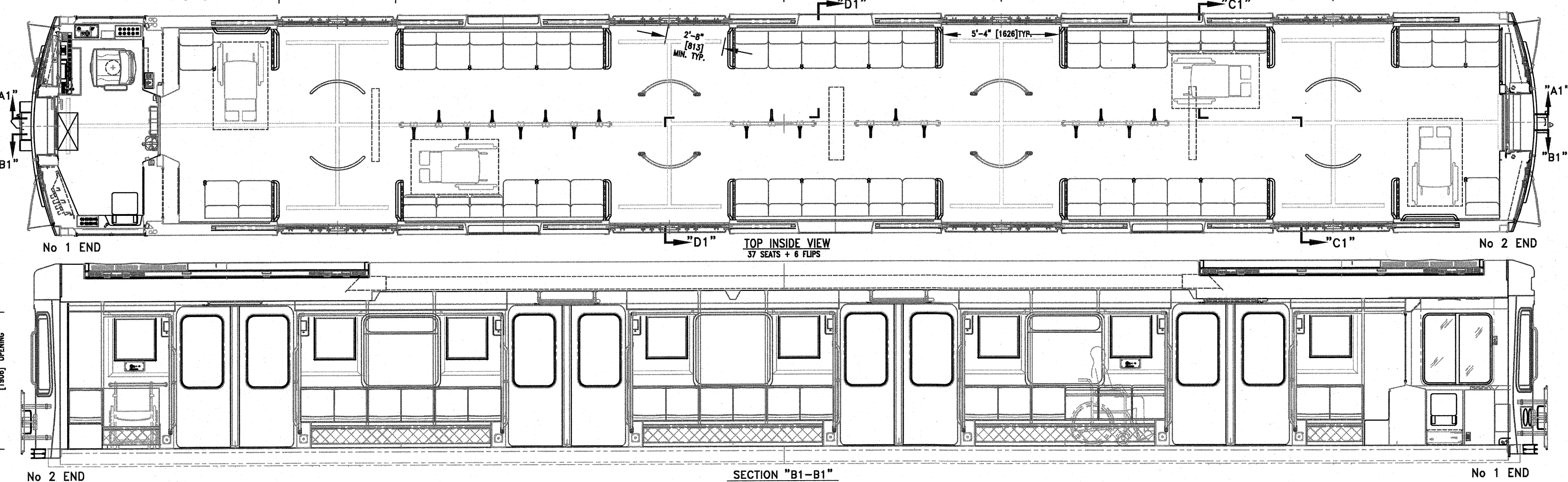
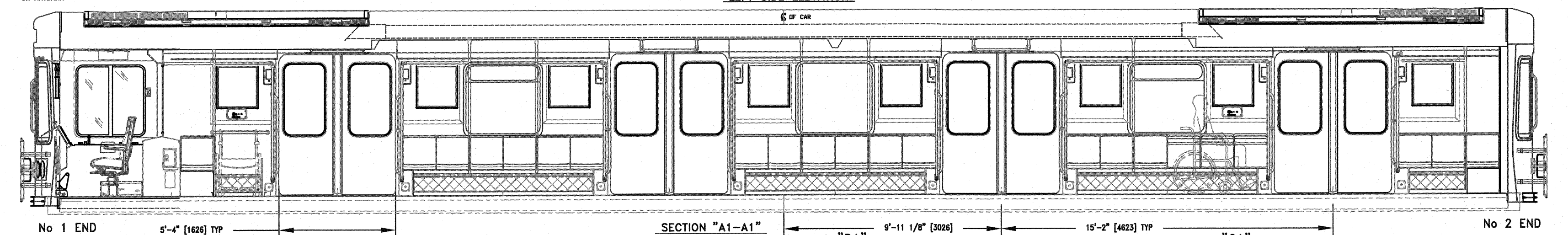
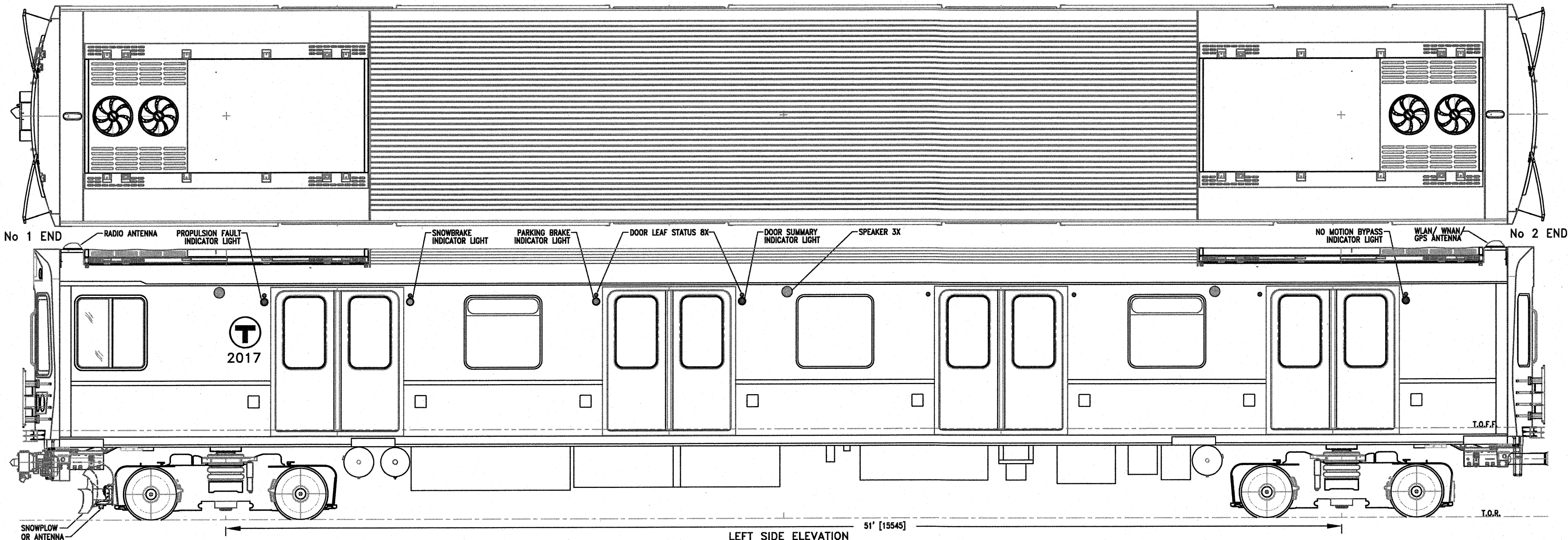
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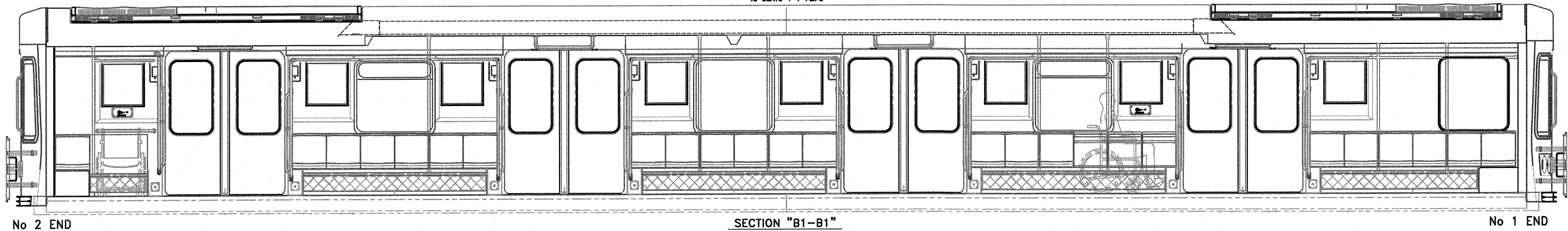
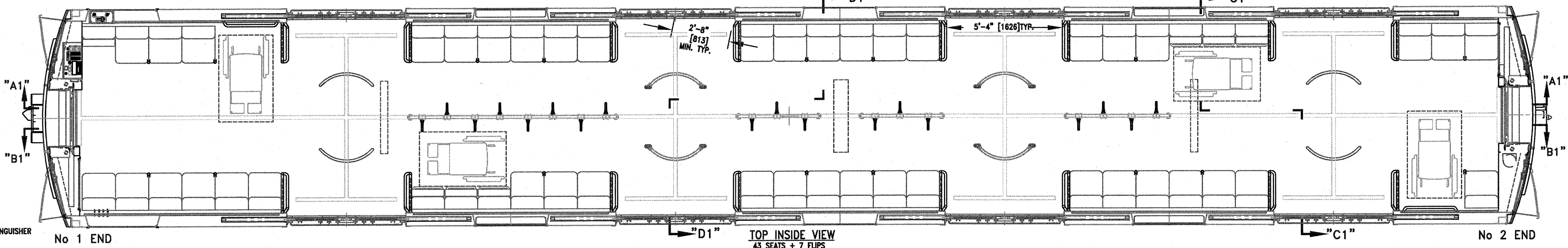
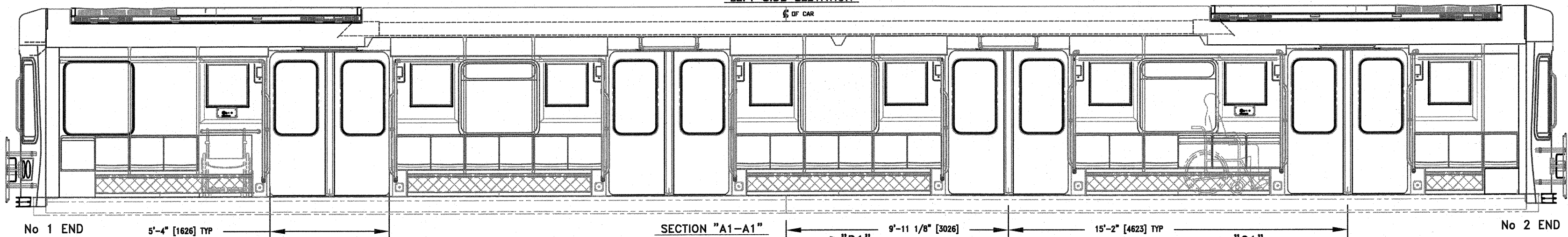
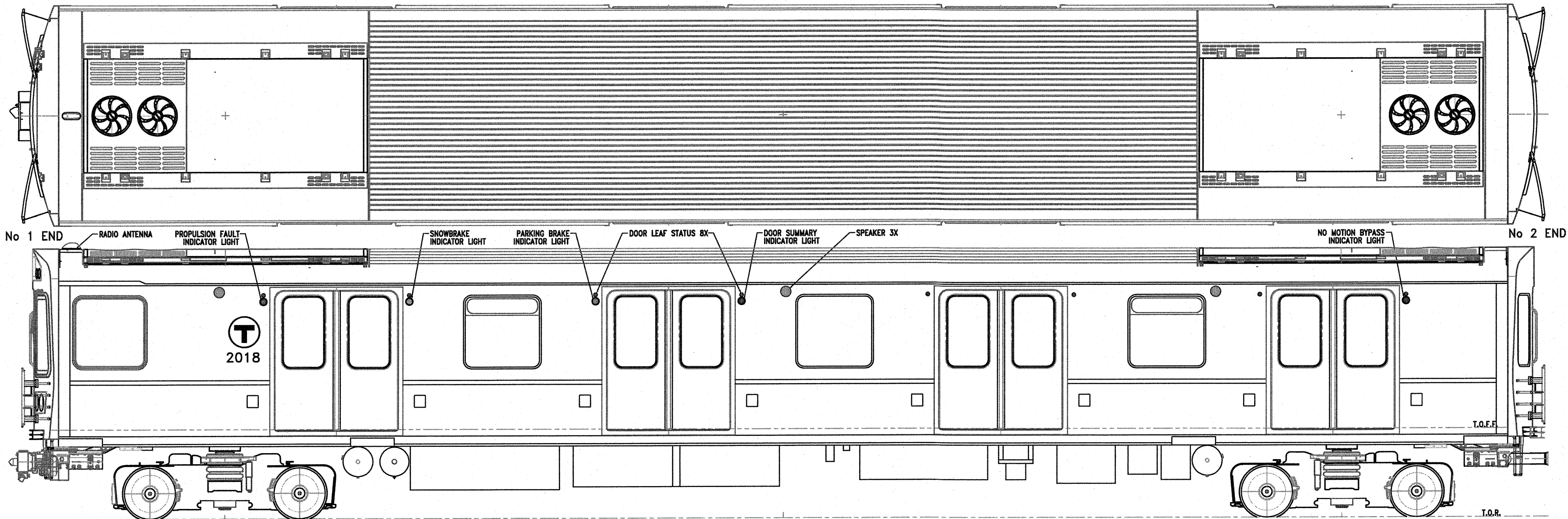
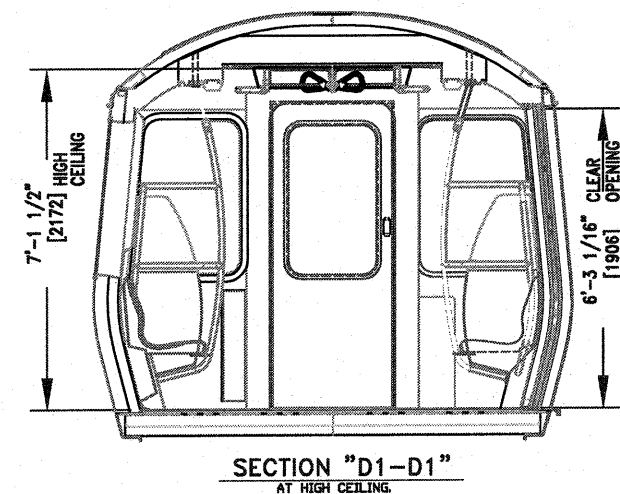
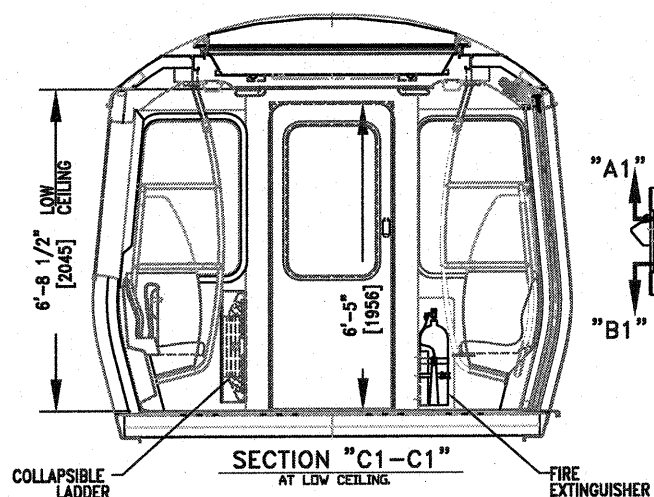
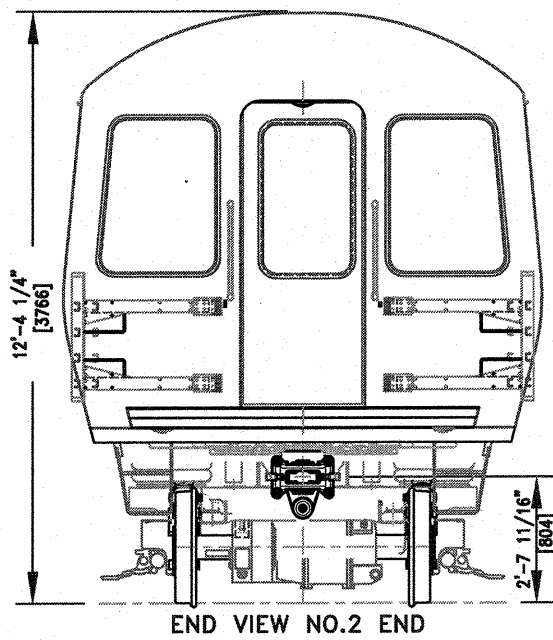
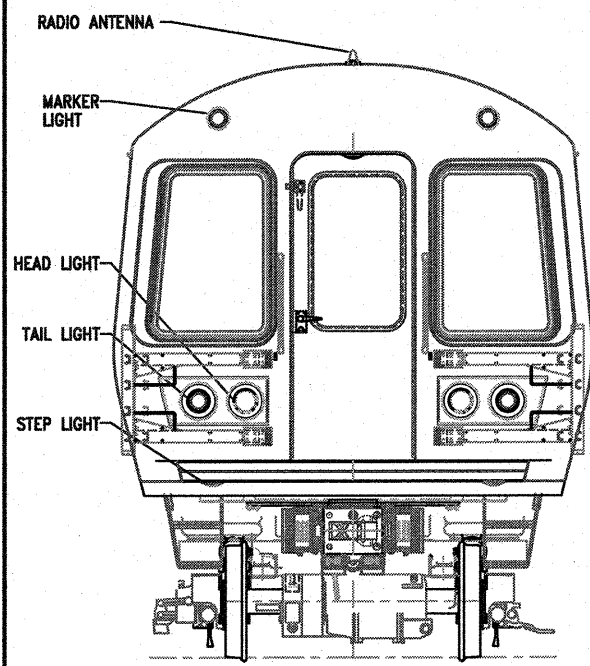


SECTION "D1-D1"
AT HIGH CEILING



PRELIMINARY
DATE : 2014/04/17
CONFIDENTIAL

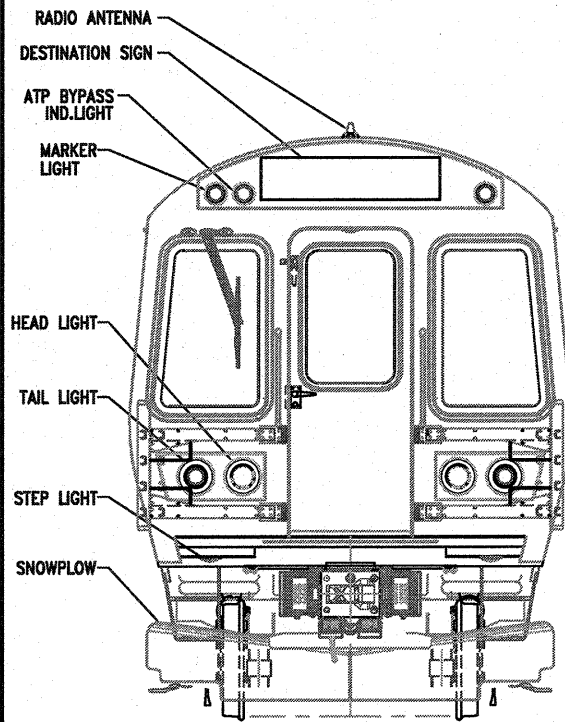
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Drawn	P. FRETTE	Int.	2014/04/17	Size	C
Approved	S. POULIN	Int.	2014/04/17	Sheet	1 of 1
BOMBARDIER					
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MBTA RED LINE CAB CAR GENERAL ARRANGEMENT C514-971-01-1					



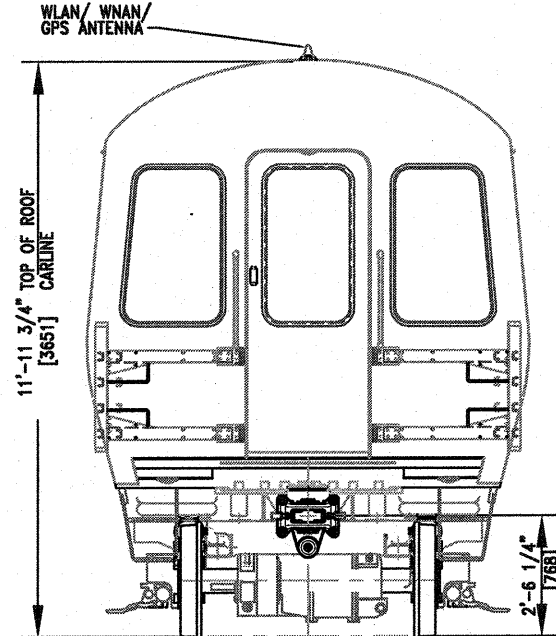
PRELIMINARY
DATE : 2014/04/17
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Approved	S. POULIN	Int.	2014/04/17	Sheet	1 of 1
				Revision	
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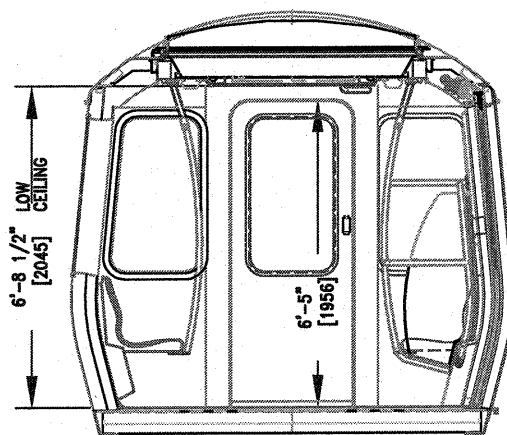
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MBTA RED LINE
NON-CAB CAR GENERAL ARRGT.
C514-971-02-1



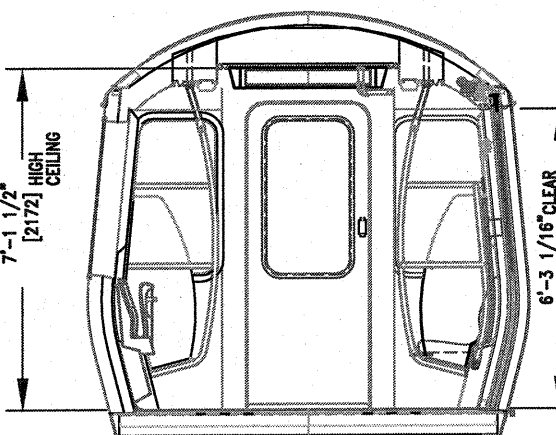
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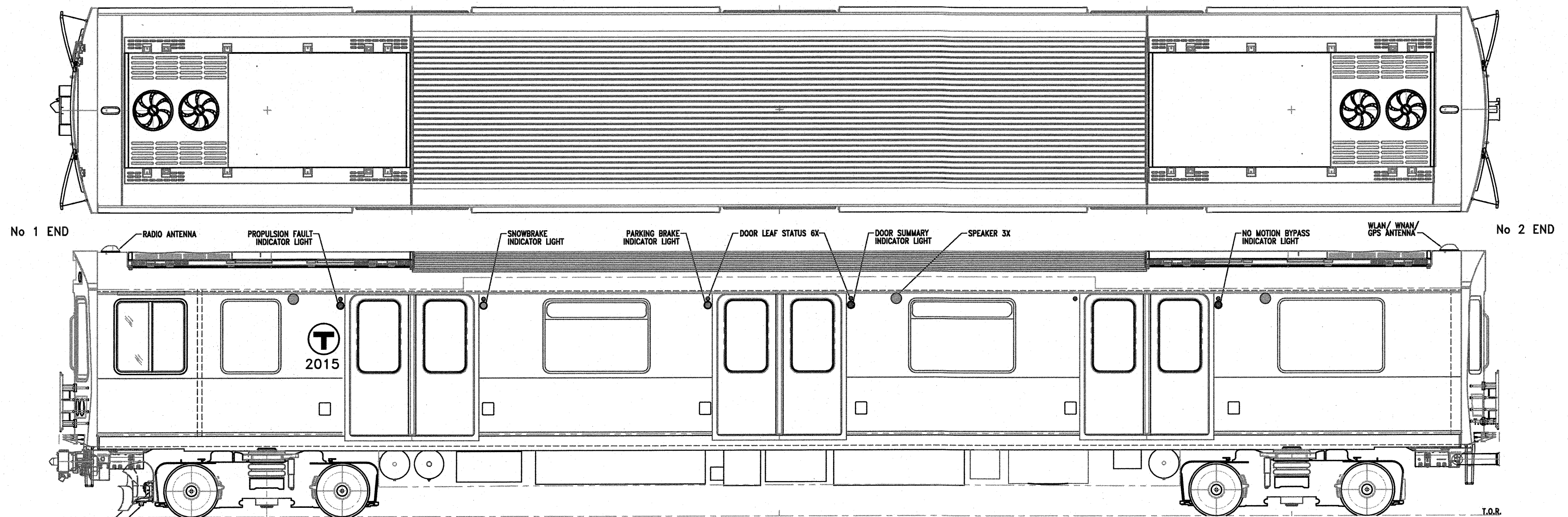
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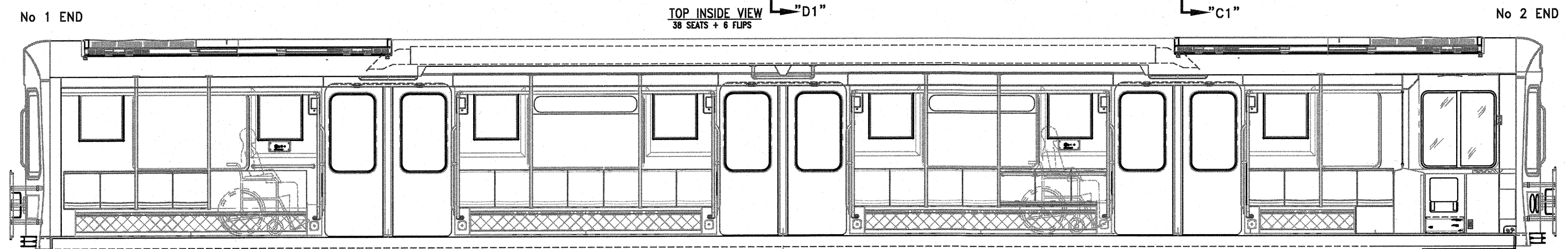
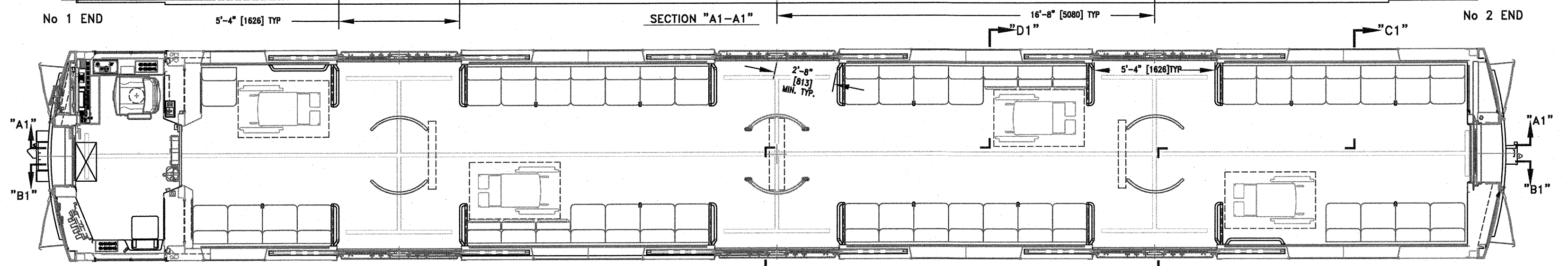
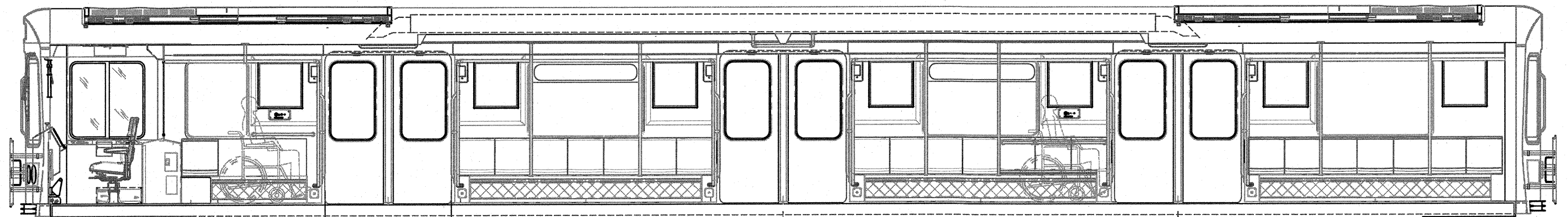
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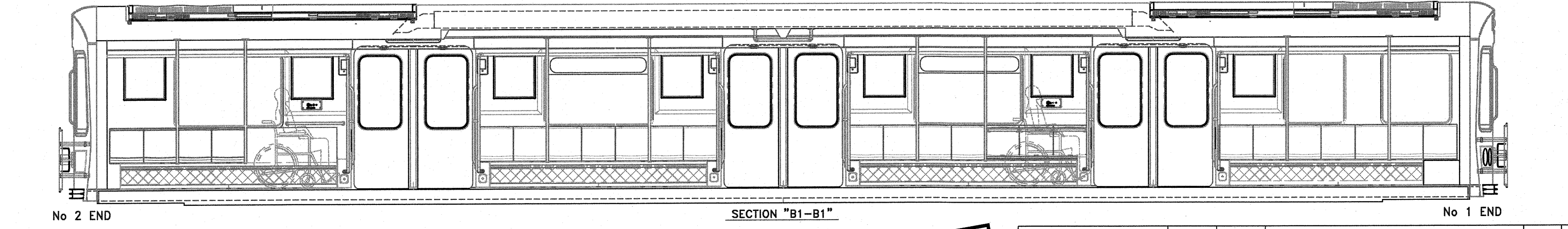
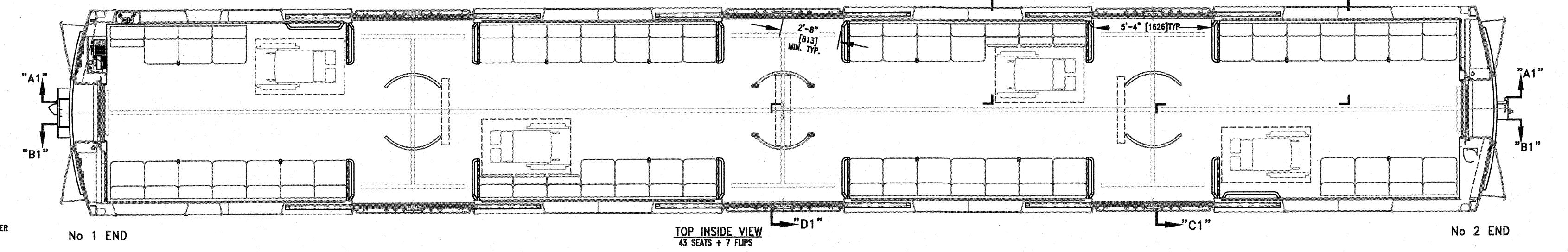
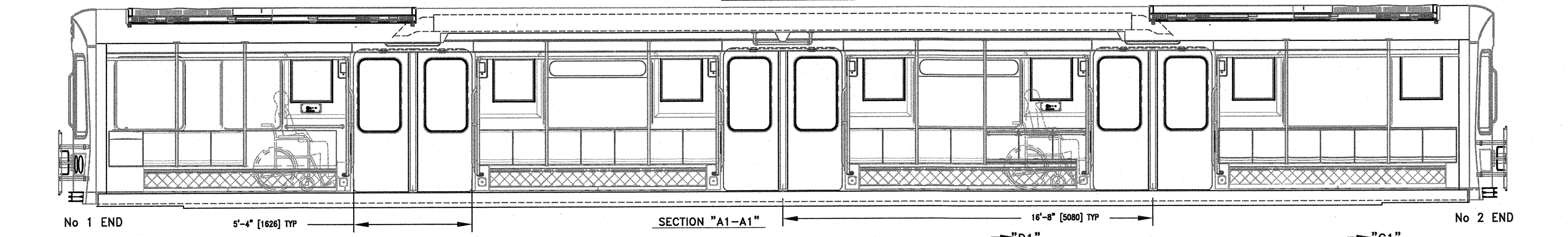
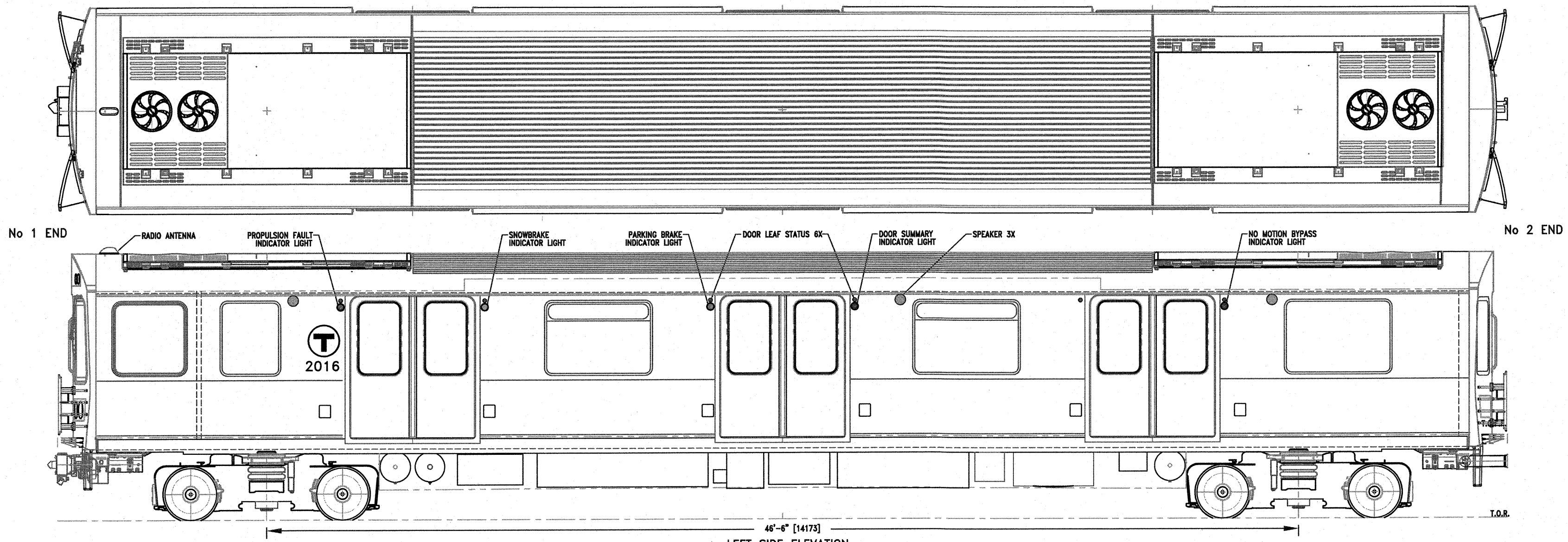
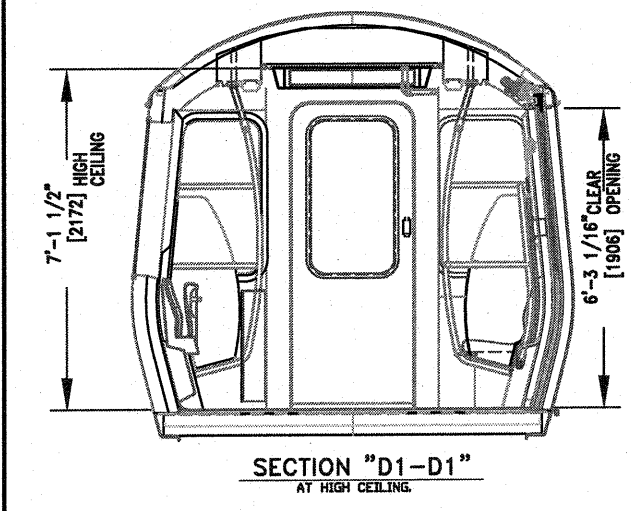
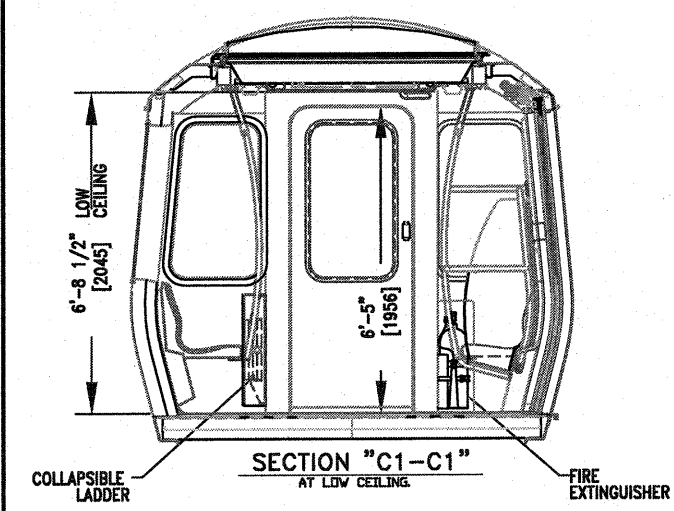
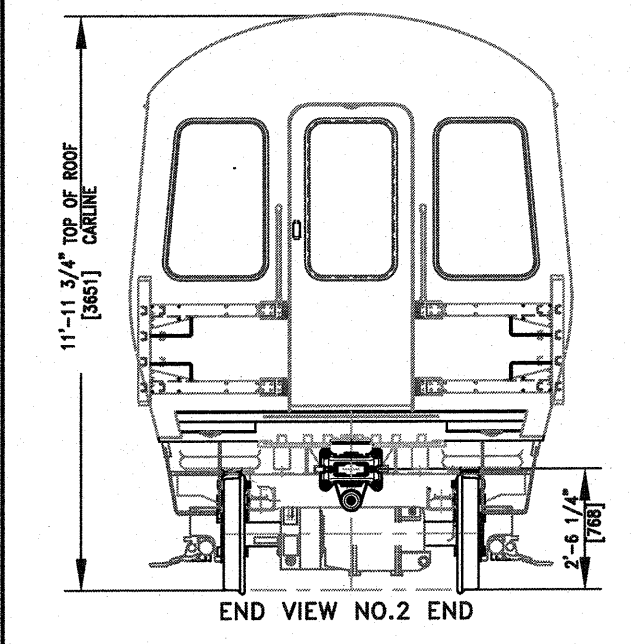
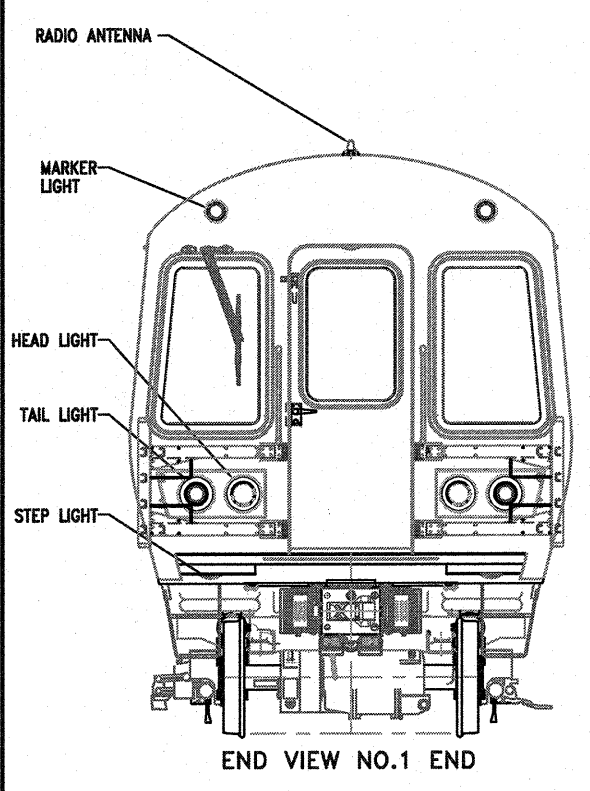
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PRELIMINARY
DATE : 2014/04/16

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<p>MBTA ORANGE LINE CAB CAR GENERAL ARRANGEMENT</p>				<p>Drawing number C514-971-11-1</p>	



PRELIMINARY
DATE : 2014/04/17

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MBTA ORANGE LINE NON-CAB CAR GENERAL ARRGT.				
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MANUFACTURING PLAN

2. MANUFACTURING PLAN

a) Manufacturing Capacity and Logistics

The Manufacturing plan should address [...]

Overall Approach to Manufacturing and Assembly of Car Body Components

Considerations include, but are not limited to, the overall approach to manufacturing and assembly of car body components.

Bombardier has a well-established footprint in North America and throughout the world, with sites offering different specialties and serving different product lines and markets. These sites work in concert with one another and our team works diligently to balance the logistics of transferring elements of the production process from one site to the other while maximizing the benefits of each site's special technical expertise and cost benefits.

Our manufacturing plan for the new MBTA Orange and Red Line Vehicles involves 3 of Bombardier's existing manufacturing main sites: Plattsburgh, New York (United States), La Pocatière (Canada), and Sahagún (Mexico). The Plattsburgh manufacturing site in New York State will be used for particular mandates during the Pilot phase only encompassing Truck Assembly and Testing. The Production (Non-Pilot) Vehicles activities will take place at the Final Assembly site in the Commonwealth of Massachusetts.



Below is a general overview of the Manufacturing Plan that Bombardier will deploy for this Project. Not only does this plan take into account all of the Authority's requirements, it also uses experienced, skilled, available, and dedicated personnel in order to deliver a quality product on time and within budget. Bombardier will rely on its own staff, without the use of subcontractors, to perform these key activities:

Activities	Pilot Cars	Production (Non-Pilot) Vehicles
Truck Frames	Sahagún, MX	Sahagún, MX
Truck Assembly	Plattsburgh, US	Massachusetts, US
Harnesses & Cabinets	Huehuetoca, MX	Huehuetoca, MX
Carbody	La Pocatière, CA	La Pocatière, CA
Final Assembly	La Pocatière, CA	Massachusetts, US
Testing	Plattsburgh, US	Massachusetts, US

In addition, the MBTA will benefit from the activities performed during the Project design phase at our Bombardier Prototype Center located next to our Design Center in Montréal, Canada. The prototyping activities will allow the Authority to visualize selected equipment as early as the preliminary design phase. It will also enable Bombardier's Engineers to work with the Authority to validate design concepts and eliminate uncertainties related to design before start of production. Concurrent with prototyping, Bombardier's Industrialization team will work as a liaison between the Methods and Engineering groups to ensure that the Vehicles are designed for manufacturing in order to ease the manufacturing process and enhance Vehicle and systems maintainability.

In the next sections, we further explain the Bombardier manufacturing locations describing a short history, the capabilities and equipment, the available capacities, and more details on the respective work scope for this Contract.

La Pocatière Plant, Québec, Canada (Total Area 550,413 sq. ft.)

In 1971, the La Pocatière site of Bombardier Transportation Canada Inc. became the first facility to manufacture railcars under the Bombardier name. With major contracts such as the Montréal Metro, the NYCT R62A rapid transit cars, the Acela Express high speed train and the LIRR M-7 EMUs, the La Pocatière site has, over the years, acquired a rich legacy of manufacturing. To date, more than 5,800 trains and metro cars have been built at this facility. It is one of Bombardier's Centers of Expertise for stainless steel car body manufacturing and has an established laser welding capability (see hereafter).



La Pocatière Plant - Aerial View

✓ *Competencies*

- Designated as a Center of Expertise for stainless steel car body manufacturing
- Manufacturing Excellence in Welding processes (including Laser Welding)

✓ *Certifications*

- ISO 9001:2008 (Quality)
- ISO 14001:2004 (Environmental Management)
- OHSAS 18001-2005 (Health & Safety)
- CWB (Canadian Welding Bureau)

✓ *Main Products and Contracts over the Last Years*

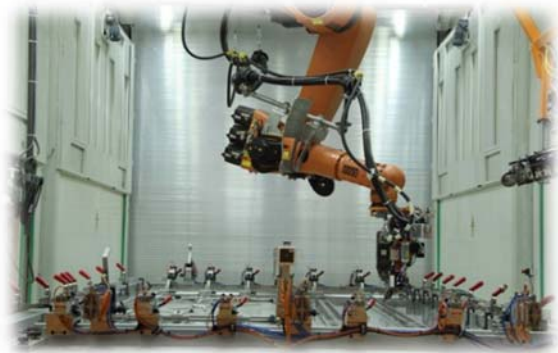
- R142 rapid transit cars for NYCT (New York, USA)
- M7 Electric Multiple Unit commuter rail cars for LIRR/MNR (New York, USA)
- Acela high-speed train sets for Amtrak (USA)
- Electric high-horsepower locomotives for Amtrak and MARC (USA)
- Multi-Level commuter rail cars for NJ TRANSIT (New Jersey, USA)
- Subway cars for Chicago Transit Authority (Illinois, USA)
- Major shell's components of Subway cars for Toronto Transit Commission (Canada)
- Multi-Level commuter rail cars for Agence Métropolitaine de Transport (AMT) in Montréal (Canada)
- Subway cars for Société de Transport de Montréal (STM), in Montréal (Canada)

✓ *Equipment*

Fabrication Equipment	Miscellaneous
<ul style="list-style-type: none"> • CNC equipment (laser cutting, punch, machining centers, lathes, pipe benders, break presses) • Plasma & Oxygen cutting 	<ul style="list-style-type: none"> • Passivation, sandblast, paint • Automatic spray wash & surface treatment • Water test • Straightening
Welding Equipment	
<ul style="list-style-type: none"> • Automatic Laser Welding Cell • Automatic Spot welding (sidewalls) • Automatic Spot welding (roof) • Fixed spot welding • Stud welding 	<ul style="list-style-type: none"> • MIG, TIG, GMAW • Pulse welding • Seam welding • Condenser welding • X-ray
Testing Facility	
<ul style="list-style-type: none"> • 20,000 square foot static testing building with indoor tracks • Oval test track of 5,248 feet of standard gauge track and a catenary power source (nominal 600 VDC and 25,000 VDC) 	

✓ *Laser Welding*

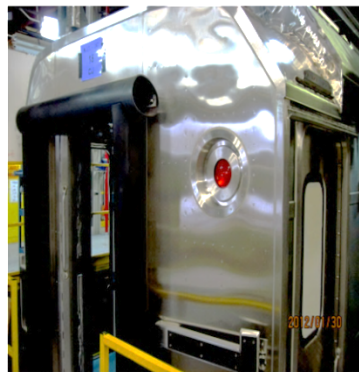
Bombardier is the only railcar builder to have an established and service proven laser welding capability in North America. The laser welding process, which improves the exterior appearance of the vehicles when compared to traditional spot welding techniques, has been used successfully in design and fabrication since 2010. Both design and operation practices are well established and implemented. Bombardier will use laser welding on the new MBTA Orange and Red Line Vehicles in order to meet MBTA's preferred welding solution and provide state of the art products.



Laser Welding Cell

During the last 7 years, Bombardier has developed and implemented autogenous laser beam welding for stainless steel side walls, roofs, carlines, and sub floor sheeting in its La Pocatière plant. Today, with more than 10,000 major subassemblies laser welded, real improvements such as parts count, weight reduction, tooling cost, footprint reduction, design simplification, and production time reduction have been reached. Bombardier, with its world-class laser welding developments, continues to innovate and to lead the rail transportation industry by reducing weight and improving aesthetics.

Aesthetic Improvement



Spot welded NJT car end



Laser welded NJT car end

✓ *Project Work Scope*

For the new MBTA Orange and Red Lines Project, the La Pocatière's manufacturing team will produce:

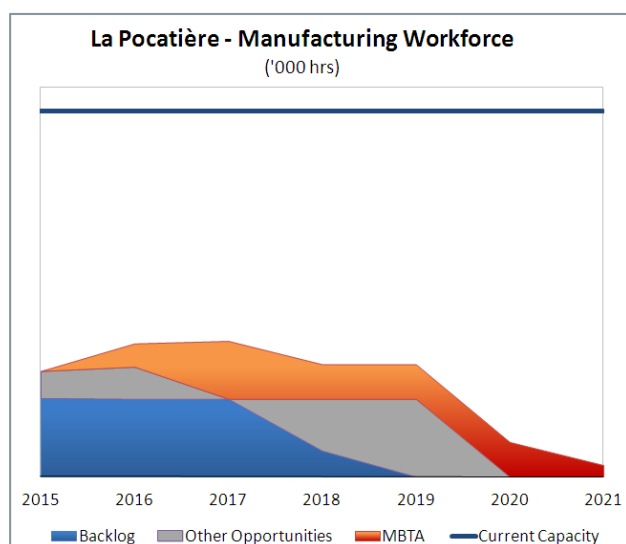
- Side walls, Roofs, End walls
- Carbody Splice & Water Test
- Post-Splice Activities (insulation, harnesses & conduits, flooring, interior structure, etc.)
- Final Assembly Activities for Pilots (propulsion, energy source for auxiliaries and controls, heating, air conditioning, communication, final water test, etc.)
- Inspection and Stationary in-plant testing

La Pocatière's experienced technicians will also be supporting the start-up of the activities for Final Assembly in Massachusetts and ensure skills and know-how transfer.

✓ *Plant Capacity*

The graph below shows the manufacturing loading for La Pocatière corresponding to the committed work for other Authorities, future market opportunities, and the load for the new MBTA Orange and Red Line Vehicles. The data in this chart covers production, assembly, plant testing, and tooling. The 2016 manufacturing hours for the MBTA Project are in line with early tooling activities as well as Pilot car production.

As shown, the La Pocatière plant will have sufficient available capacity for the new MBTA Orange and Red Line Project, even considering schedule slippages on other projects. Experienced personnel as well as equipments will therefore be fully available and dedicated to build the Vehicles to be delivered as per Contract, and within the requested timeframe.



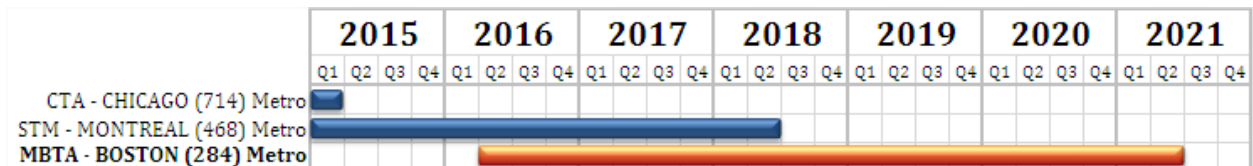
FUNCTION	EMPLOYEES
Plant Engineering	6
Administration	21
Manufacturing	322
Methods	42
Engineering	36
Customer Service	25
Program Management	38
Quality Assurance	23
Procurement	66
TOTAL	579

✓ *Staffing*

With an average of over 21 years of service, the La Pocatière site staff members are the most experienced at Bombardier in North America. They are very skilled and proficient employees, surrounded by a pool of workers experienced in rolling stock manufacture and assembly. This workforce is stable and consistent. A significant number of experienced individuals who worked on the MBTA Red Line Project produced by Bombardier in the 1990's remain in La Pocatière and are available. The current status of the human resource distribution in La Pocatière is also shown above.

✓ Ongoing Projects

The next figure shows the commitment of ongoing projects in La Pocatière and the timing of the MBTA Orange and Red Lines Project. We can see the acronym of the Authority (i.e. CTA), the city (i.e. Chicago), the quantity of vehicles to deliver (i.e. 714) and the vehicle type (i.e. Metro).



La Pocatière - Plant Loading

Please note that the CTA Project will be completed before the start of the MBTA Project, clearly confirming the availability of all resources mentioned above. Only the STM Project will continue in parallel. The STM Project will be at the series' production mid-point, thus stabilized and not impacting any needed support for the MBTA Project.

We therefore confirm that the Bombardier La Pocatière site has the necessary capacity, personnel and other resources to execute this Project within the requested timeframe.

Plattsburgh Plant

(Total Area 219,000 sq. ft.)

The Plattsburgh manufacturing site of Bombardier Mass Transit Corporation has been in operation since 1995. It is the Bombardier Center of Excellence with truck assembly, final assembly as well as both static and dynamic testing as its core competencies. The plant is located in Plattsburgh, New York, less than 250 miles North West of Boston.

At its inception, Bombardier built the Plattsburgh plant in order to perform the final assembly, interior finishing, and testing for the Single level push pull Metro North Railroad contract.

In 1998, an expansion of approximately 58,000 sq. ft. in the main building was completed, and a new testing installation with rails was added. The plant now totals over 133,000 sq. ft. To serve the growing US market, the Plattsburgh site was again expanded in 2013 to reach the present size of 219,000 sq. ft.



Plattsburgh - Aerial View

✓ Competencies

- Center of Expertise for truck assembly, final assembly, and testing

✓ *Certifications*

- ISO 9001:2008 (Quality)
- ISO 14001:2004 (Environmental Management)
- OHSAS 18001 (Health & Safety)

✓ *Main Products and Contracts over the Last Years*

- Single-level commuter coaches for MTA/Metro-North Railroad and the Southeastern Pennsylvania Transportation Authority (USA)
- Monorail Vehicles for the Jacksonville Transportation Authority (Florida, USA)
- Electric locomotives for Amtrak and the Maryland Transit Administration (USA)
- Power cars for high-speed trainsets for Amtrak (USA)
- Bombardier *BiLevel™* commuter coaches for the Central Puget Sound Regional Transit Authority (Seattle), Trinity Railway Express (Dallas-Fort Worth), Caltrain, the Utah Transit Authority (Salt Lake City), the Metropolitan Council (Minneapolis-St. Paul) and Sunrail (Florida).
- R142 rapid transit cars for MTA/New York City Transit (New York, USA)
- 70% low-floor light rail vehicles for the Metropolitan Council (Minneapolis-St. Paul, USA)
- M7 electric multiple unit commuter cars for MTA/Long Island Rail Road and MTA/Metro-North Railroad (New York, USA)
- Multi-Level commuter vehicles for NJ TRANSIT (New Jersey, USA)
- Rapid transit cars for the Chicago Transit Authority (Chicago, USA)

✓ *Equipment*

Fabrication Equipment	Miscellaneous
<ul style="list-style-type: none"> • Manual Millings, Lathes, Band saws, Drills for tooling purposes. 	<ul style="list-style-type: none"> • Paint booth • Water test room • Bridge cranes (130T+) • Truck load press • Line moving system • Calibration lab
Welding Equipment	
<ul style="list-style-type: none"> • Automatic spot welding machine for sidewalls and roof structures • Automatic spot welding machine for carbody splice • Fixed spot weld machine for small sub-assemblies 	<ul style="list-style-type: none"> • Stud welding machines • Metal Inert Gas (MIG) & Tungsten Inert Gas (TIG) welding machines • Pulse welding machines • Automatic seam welding machine for wall and roof joining of panels • Weld inspection lab

Testing Facility

- Building of 27,000 sq. ft.
- The test track is 2,550 feet of running rail which is protected at each end by 100-foot long sand traps.
- Testing can be safely performed with trains running in both directions. The normal operational speed is limited to 30 mph but can be up to 40 mph depending on the performance of the Vehicles.

✓ Project Work Scope

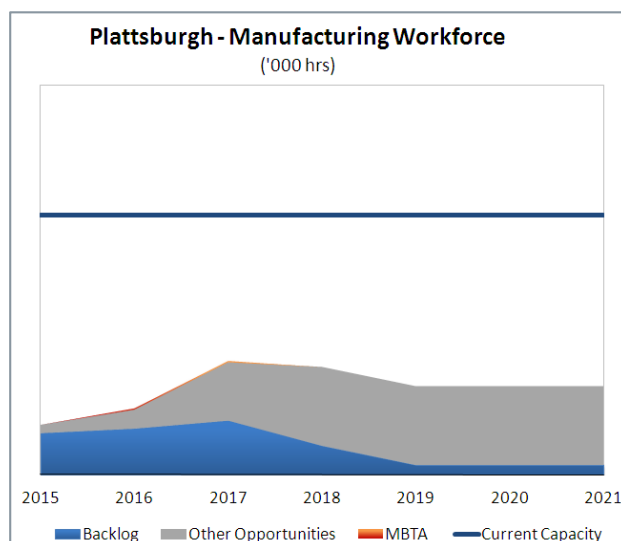
For the new MBTA Orange and Red Lines Project, the Plattsburgh's manufacturing team will perform:

- Truck Assembly (Pilot Vehicles only)
- Dynamic Testing and Engineering Qualification Testing (Pilot Vehicles only)
- Plattsburgh's experienced technicians will be supporting the start-up of the activities of Truck Assembly in Massachusetts.

✓ Plant Capacity

The graph hereafter shows the manufacturing loading for Plattsburgh corresponding to the committed work for other Authorities, future market opportunities, and the load for the new MBTA Orange and Red Lines Vehicles.

The data in this chart covers production, assembly, plant testing, and tooling. Given that the Plattsburgh site workload for this Project is limited to the Final Assembly and Testing of Pilot Vehicles, we are well positioned to achieve our manufacturing commitments to the MBTA, even if other projects were to encounter delays.



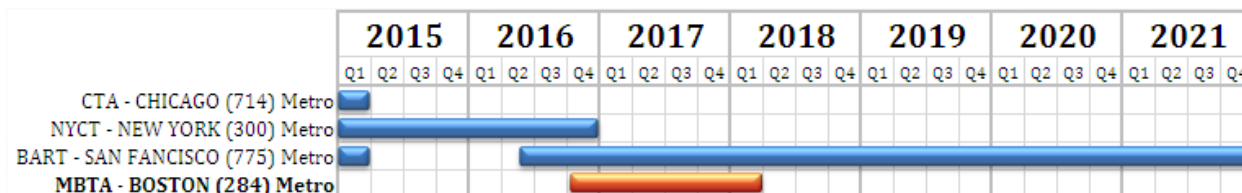
FUNCTION	EMPLOYEES
Plant Engineering	6
Administration	7
Manufacturing	235
Methods	18
Engineering	4
Customer Service	42
Program Management	2
Quality Assurance	27
Procurement	22
TOTAL	363

✓ Staffing

The Plattsburgh site has the most experienced personnel in North America in terms of qualification testing and truck assembly, which is why these activities are performed at this site. The current status of the human resource distribution in Plattsburgh is also shown above.

✓ Ongoing Projects

The next figure shows the commitment of ongoing projects in Plattsburgh and the timing of the MBTA Orange and Red Lines Project.



Plattsburgh - Plant Loading

We observe that at the time of the new MBTA Orange and Red Lines Project, only the BART Project will be ongoing since the NYCT Project will be phasing out. The Plattsburgh core team will therefore be available for MBTA's activities.

We therefore confirm that the Bombardier Plattsburgh site has the necessary capacity, personnel, and other resources to execute this Project within the requested timeframe.

Sahagún Plant

(Manufacturing Area 869,724 sq. ft.)

Constructora Nacional de Carros de Ferrocarril (Concarril), was founded by the Mexican government in 1952. Its facilities in Sahagún, Hidalgo, are the only operations in Mexico dedicated to manufacturing freight and passenger rail vehicles. Bombardier acquired Concarril and the Sahagún site in 1992.

In 1997, the Sahagún site of Bombardier Transportation Mexico, S.A. de CV expanded its focus to support Bombardier's business activities in the North American market. This plant started building diesel electric locomotives for the General Motors Electromotive Division, and freight cars through its joint venture, Gunderson Concarril.



Sahagún - Aerial View

In 2000, Sahagún was designated by Bombardier as a Light Rail Center of Expertise for the Americas, and in 2001 started the design and manufacture of 70% low floor Light Rail Vehicles for the city of Minneapolis. In 2002, the *Sistema de Transporte Colectivo* in Mexico City awarded Bombardier a contract to design, build, test, and commission 405 rubber-tire metro cars. Since then,

many other projects, New Jersey, Montréal, Toronto, Vancouver, New York, and Chicago among others, have been produced with the involvement of our Sahagún site.

✓ *Competencies*

- Light Rail Center of Expertise
- Primary Parts and Welded subassemblies (underframes)
- Truck frame manufacturing
- Harnesses and Electric Cabinets (in Huehuetoca)

✓ *Certifications*

- ISO 9001:2008 (Quality)
- ISO 14001:2004 (Environmental Management)
- OHSAS 18001 (Health & Safety)
- Certified American Welding Society
- Certified American Association of Railroads
- Certified Clean Industry

✓ *Main Products and Contracts over the Last Years*

Throughout its history, the plant has supplied more than 70% of the total passenger rail vehicles in Mexico:

- 65% of metro's fleet of Mexico City
- 100% of the fleet of Electric Transport in Mexico City (STEDF, Mexico)
- 74% of the fleet of Urban Transit System, Metrorrey (Monterrey, Mexico)
- 100% of the fleet of the Urban Electric Train System, SITEUR (Guadalajara, Mexico)

Bombardier's plant in Mexico has expanded its reach throughout North America by participating in projects for Progress Rail Locomotives, commuter rail for New Jersey Transit (USA), trams, and light rail for Toronto, Canada (Toronto Transit Commission and Metrolinx), metro cars for Montréal, Toronto, Chicago, New York City Transit (NYCT) and Bay Area Rapid Transit (BART) in San Francisco, California, among others.

✓ *Equipment*

Fabrication Equipment	Miscellaneous
<ul style="list-style-type: none"> ● CNC Cutting machines (laser, plasma, oxygen) ● CNC Punching machines ● CNC Machining Centers & Lathes ● CNC Pipe bending ● Shears ● CNC break presses 	<ul style="list-style-type: none"> ● Sand blast room ● Paint booth ● Water test room ● Straightening room ● Automatic spray wash and surface treatment equipment ● Heat treatment oven
Welding Equipment	Electric Harness (Huehuetoca)

- Fixed spot welding equipment for sub-assemblies 100 KVA
- Stud welding machines
- Metal Inert Gas (MIG) & Tungsten Inert Gas (TIG) welding machines
- Pulse welding machines
- X-ray room for inspection
- Welding training center

- Overhead projection equipment
- Adaptive cutting tables
- Automatic feeders & markers

Testing Facility

- Testing facility of 24,757 sq. ft.
- Equipped with a test track with third rail and Linear Inductor Motor capability.
- The test tracks can be used to perform dynamic testing on metros (1,600 ft) and locomotives (3,900 ft).

✓ *Project Work Scope*

For the new MBTA Orange and Red Lines Project, Sahagún's and Huehuetoca's manufacturing team will produce:

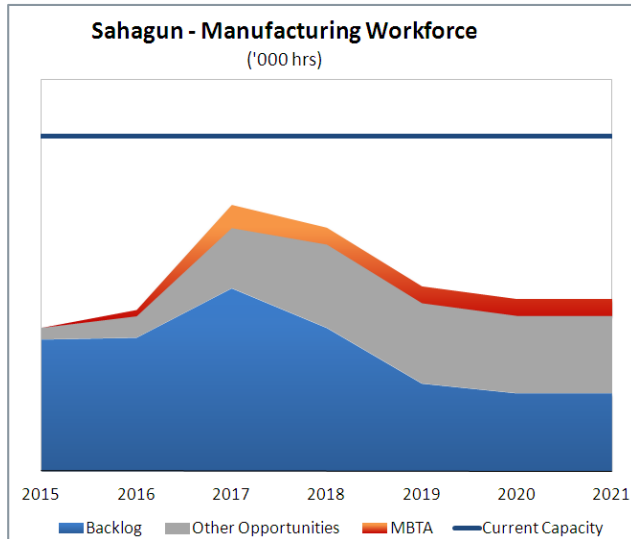
- Primary Parts and Minor Sub-assemblies
- Truck Fames
- Harnesses and Electric Lockers (Huehuetoca)
- Underframe Structure and Pre-Assembly

✓ *Plant Capacity*

The graph hereafter shows the manufacturing loading for Sahagún and Huehuetoca combined corresponding to the committed work for other Authorities, future market opportunities, and the load for the new MBTA Orange and Red Lines Vehicles.

The data in this chart covers production, assembly, plant testing, and tooling.

Given the available capacity of this site, we are well positioned to achieve the commitments, even if other projects were to encounter schedule delays.



FUNCTION	EMPLOYEES
Plant Engineering	20
Manufacturing	1,307
Methods	94
Customer Service	10
Program Management	5
Quality Assurance	97
Procurement	7
TOTAL	1,540

✓ Staffing

The Sahagún site hosts the largest number of representatives of the functions above.

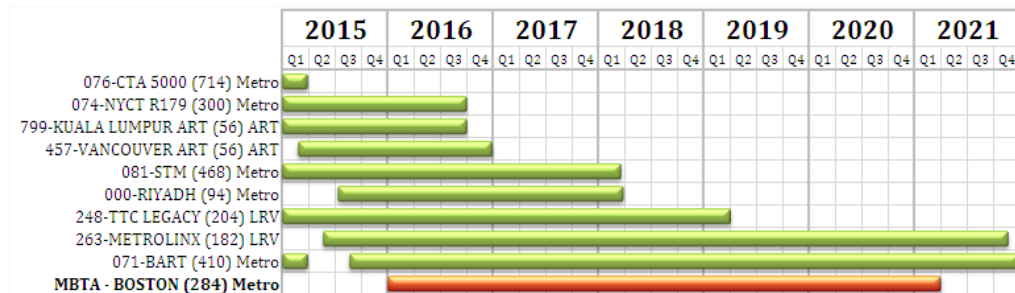
✓ Manufacturing, Quality Assurance, and Methods

As trained and skilled workers, staff members use modern equipment ensuring a high production capacity and consistent quality for their scope of work.

The current status of the employee distribution in Sahagún is also shown above.

✓ Ongoing Projects

The next figure shows the commitment of ongoing projects in Mexico and the timing of the MBTA Orange and Red Line Project.



Sahagún Plant Loading

Although several projects are manufactured in parallel, it should be noted that the load will be at 60% of the installed capacity, as illustrated above. In addition, 3 projects end in 2016, freeing up experienced resources when needed for the Production (Non-Pilot) Vehicles manufacturing of the new MBTA Orange and Red Line Vehicles. We therefore confirm that the Bombardier Sahagún and Huehuetoca sites have the necessary capacity, personnel, and other resources to execute this Project within the requested timeframe.

Testing and Commissioning

Bombardier's Field Support Department, along with our test Engineers and system Engineers, will participate in the testing and commissioning on site. We will have 2 sites led by one Site Manager to handle the delivery of the Vehicles. Office trailers and parts containers will be located in the Wellington Maintenance Facility and the Cabot Maintenance Facility. This will allow for close, direct, and immediate communication between the MBTA and our dedicated staff on site.

Bombardier will hire local workers to fill staffing needs at both sites, supplemented by current Bombardier employees. Several technicians will be sent to the plant for further training on these new Vehicles and will be brought up to speed on the different procedures Bombardier uses when delivering Vehicles to customers. We will use the "train the trainer" approach: technicians will be sent to the Bombardier manufacturing site(s) and will coach and train other technicians as the number of Vehicles on site increases.

Immediately after each Vehicle is received at the MBTA facilities, it will be inspected for any possible road damage that could occur during transport from the Final Assembly site. Once this inspection is complete, the static portion of the commissioning testing will begin.

Static testing will assure the MBTA that all Vehicle functions are operating correctly and were not damaged during Vehicle shipment to the final delivery point. In addition, all of the necessary Production Testing listed in T20.22 will be completed. Once the dynamic commissioning tests required by T20.23 are accomplished and confirm that the Vehicle meets certification standards, the 500 mile operational test will then be performed.

For more detail on this phase and associated activities, please see Section 1.n) Mobilization Plan and Approach of our Proposal.

Plant Capacity

The available plant capacity at the various locations.

This topic is covered in Section 2.a) Manufacturing Capacity and Logistics above for each Bombardier's manufacturing site.

Certified Personnel

Certified personnel and other resources to perform the work, including the local on-site staff.

This topic is covered in Section 2.a) Manufacturing Capacity and Logistics above for each manufacturing site.

Methods of Transportation

The methods of transportation between the various work locations as well as to the Authority.

This topic is covered in Section 2.i) Expected Conveyance and Route below.

Plans or Local Coordination with, and Support to, the Authority

Bombardier's Field Support team will be on site prior to the first Vehicle being delivered to either site. At both the Wellington Maintenance Facility and the Cabot Maintenance Facility, Bombardier will have a double wide office trailer to house our staff. Our Field Support Manager is a dedicated on site Manager who will be responsible for both sites. At each site we will have a Field Support Supervisor who will be in charge of the daily activities. Both sites will also have commissioning technicians and warranty technicians; the exact number of technicians will be contingent on the number of Vehicles and the work load requirements.

The Site Manager will be in constant contact with the plant and the engineering department to ensure the timely resolution of any engineering issues arising after the pilot program and commissioning period.

The Field Support team also includes a staff member dedicated to the safety of our employees. Our safety supervisor will keep our employees up to date on OSHA and Bombardier rules and regulations, while ensuring that our employees attend any safety training program hosted by the MBTA.

As Bombardier staff stays fully committed until the end of the warranty period to provide high quality Customer support and make sure all Vehicles remain safe and reliable in revenue service, we have gained solid experience in efficiently handling warranty work and repairs in partnership with our Customers and Suppliers. We understand that the MBTA would like its staff to perform warranty repairs in certain circumstances whenever possible, on the Vehicles at Bombardier's cost (100\$ per hour). In order for Bombardier to ensure all Vehicles are properly repaired to the benefit of the MBTA and remain safe and reliable in revenue service, unless otherwise agreed to by the MBTA and Bombardier, we offer our warranty on Vehicles following a repair by the MBTA staff and agree to reimburse the MBTA accordingly, if the following conditions are satisfied:

- (i) MBTA staff is sufficient in terms of workforce at the time of repair, fully available, properly skilled, trained, and experienced in accordance with US industry standards for carrying work of similar scope, type and nature, in order to properly and efficiently perform the repair work
- (ii) Performance of the warranty work is in accordance with Bombardier's maintenance manuals and under Bombardier's oversight and direction to ensure that the MBTA staff performs the repairs according to Bombardier's standards
- (iii) only the number of hours upon which the MBTA and Bombardier have previously agreed for the warranty work to be performed will become payable by Bombardier
- (iv) the MBTA may not outsource warranty work to a third party
- (v) for all major components such as propulsion, motors and gears, or for safety components such as event recorders, ATP/ASR, vital relays , Bombardier (or its responsible Supplier) will exclusively perform the repair work, as such repairs require personnel with specific skills and certifications and could otherwise pose safety issues for the MBTA. The MBTA's technicians could be allowed to remove and replace certain major components upon mutual agreement with Bombardier

Bombardier's warranty on repairs performed by the MBTA and Bombardier's consequent payment obligation will become void in the event of improper maintenance by the MBTA staff or if the warranty work has not been performed by the MBTA staff in accordance with industry standards and Bombardier's manuals.

Final Assembly of all Production (Non-Pilot) Vehicles

The Manufacturing Plan must address all efforts the Offeror will undertake to comply with the obligation in Section C7.18 that Final Assembly of all Production (Non-Pilot) Vehicles delivered under the Contract take place in Massachusetts.

This topic is covered in Section 2.e) Final Assembly Site in Massachusetts below.

b) Final Assembly Requirements

If the Offeror's anticipated final assembly operations, processes and measures it will use in connection with the Production Vehicles delivered under the Contract differ from or do not include at a minimum all operations, processes and measures listed in the definition of Final Assembly in Section C7.18, describe how the Offeror's final assembly will differ from the final assembly requirements in Section C7.18 and explain why the Offeror believes that its final assembly satisfies the general requirement of final assembly of all production Vehicles in Massachusetts.

Bombardier will respect the requirements listed in Section C7.18 of the MBTA's RFP.

c) Prime Contractor and Location(s)

List the work to be performed by the prime contractor and the location(s) at which this work will be performed. If major carbody manufacture is to be performed by subcontractors, identify by name and work locations.

As Bombardier is the prime contractor, this topic is covered in Section 2.a) Manufacturing Capacity and Logistics above and Section 2.e) Final Assembly Site in Massachusetts below for each manufacturing site.

d) Massachusetts Final Assembly Contractor and Location

List the Massachusetts final assembly contractor and location. Include sample assembly procedures and controls and sample material control program. Describe the group responsible for preparation of workflow plans, schedules, procedures, quality control, material control, etc., at the final assembly location. Describe how and where retrofit work might be performed if Authority facilities are not available. If more than one contractor is being considered, provide information for each.

The information on the Final Assembly site can be found in Section 2.e) Final Assembly Site in Massachusetts below.

e) Final Assembly Site in Massachusetts

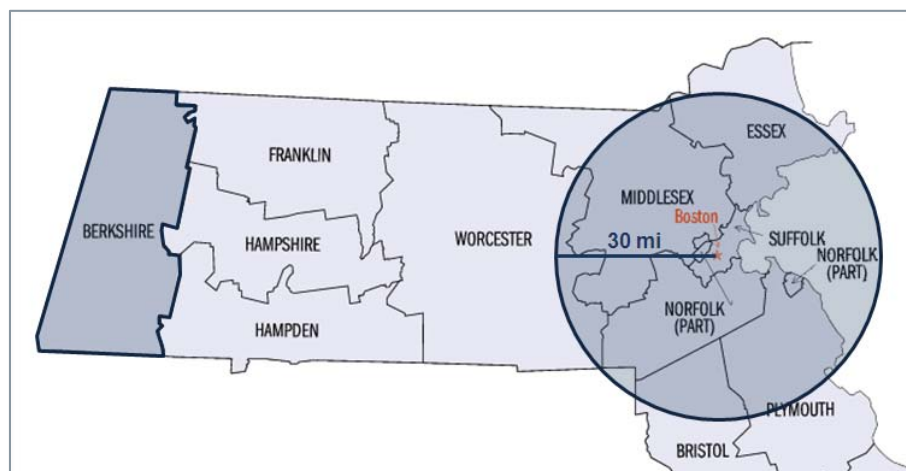
Identify whether the Offeror will utilize an existing or new assembly facility in Massachusetts, the Offeror's schedule for the conversion or creation of a new assembly facility in Massachusetts in order to meet the delivery deadlines in the contract, and measures the Offeror will take in accordance with this schedule, including but not limited to the hiring and training of skilled labor and the transfer or acquisition of equipment and technology in order to satisfy the manufacturing and assembly requirements.

List all efforts Offeror has undertaken in order to satisfy the requirements of this section, such as posting job opportunities in local papers, using employment recruitment firms or job placement organizations to fill newly created positions, forming partnerships to support the development of a skilled workforce capable of performing technically demanding tasks at the assembly facility, contacting unions and educational institutions in order to utilize local labor pools, advertising for or hiring designers and contractors for the assembly facility, beginning the permitting process for the assembly facility, and contacting suppliers for the purchase of tools and machinery for the assembly facility. The MBTA encourages Offerors to learn from the Workforce Initiative Now (WIN) model employed by Denver RTD, which aims to foster workforce development in targeted communities identified by key socio-economic factors, such as unemployment rate, low income job growth, and educational attainment, and to ensure that communities and groups historically underutilized in the vehicle manufacturing and transportation sectors have full and fair access to job opportunities generated by publicly funded projects, such as this MBTA Red and Orange Line Vehicle Procurement.

Foreword – To meet the requirements of Section C7.18 of the MBTA's RFP, Bombardier intends to lease an existing manufacturing space in the Commonwealth of Massachusetts and enhance it to the Bombardier's standards of World Class manufacturer in order to perform the final assembly activities. We have great experience in transferring work among our Bombardier factories as well as satellite locations. Our strong and experienced personnel has already successfully supported similar transfers of manufacturing on previous projects such as New York, Chicago, Toronto and Vancouver.

Location – During the bid period, a number of potential Final Assembly sites were scouted and evaluated allowing us to determine the sites best suited to perform Final Assembly activities as described in Section C7.18 of the MBTA's RFP.

Considering such activities in Massachusetts will not begin until early 2018 (mid 2017 for site implementation activities), Bombardier continues to search for the optimal location. There are suitable sites located within a 30 mile radius of Boston's metropolitan area and the western side of the Commonwealth (Berkshire Area). We remain in contact with different agencies and several groups of economic development to assess all location opportunities.



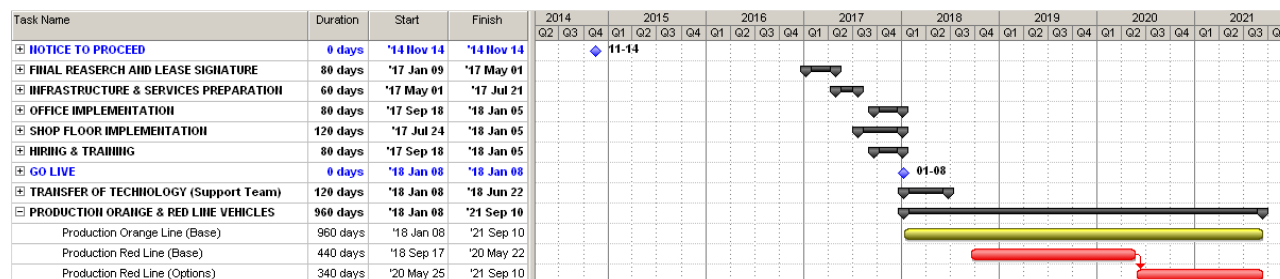
Final Assembly Site in Massachusetts - Potential Locations

Facility Characteristics – Below is a table showing the main characteristics of the desired Final Assembly site:

Item	Characteristic
Term of the lease	5 years (2017 to 2021)
Floor Space - Shop	~ 32,000 ft ²
Floor Space – Offices & Common	~ 4,000 ft ²
Ceiling Height	24'+ under structure
Drive-in Doors W*H	14' x 18' (min 2x)
Dock Doors W*H	8' x 10' (min 1x)
Concrete Floor - Shop	10" – 30 MPa
Power Source	500 KVA

Implementation Schedule – In order to be ready in time for the start of the Orange Line Base Vehicles' production, some preparation activities must begin several months in advance. Hereafter is the schedule showing the main activities needed to implement the Final Assembly site in Massachusetts:

2) Manufacturing Plan



Final Assembly Site in Massachusetts - Implementation Scheduling

In our scheduling, the activities of Final Assembly in Massachusetts for the Orange Line Vehicles (Base) start in January 2018, which corresponds to the *GO LIVE*. The schedule leaves sufficient time to complete the required activities without any risk on the Project and to build as well as deliver the Vehicles under the Contract and within the requested time.

Processes – As we intend to establish a World Class execution site in Massachusetts, all processes of Bombardier's ISO quality system will fully apply to the MBTA Project and will be implemented at the new site by Bombardier's knowledgeable and experienced staff. Here is an overview of the main processes related to the activities of our new site in Massachusetts:

- Project Integration Management Process
 - Initial Assembly Program
 - Master Production Schedule
 - First Product Realization (Pilots in La Pocatière)
 - Assembly Workstations
 - Material Delivery Strategies
- Manufacturing Strategies Development Process
 - Tooling Strategies
 - Make or Buy Agreement
 - Work Split Description
 - List and Content of Assembly Line Workstations
 - Plant Layout
 - Logistics Strategy
- Manufacturing Methods
 - Manufacturing & Routine Tests Workflow
 - Manufacturing Instructions and Process Sheet Preparation
 - Assembly Books Preparation
 - Progress Monitoring
 - Work Preparation for Logistics
- Tooling Design & Fabrication
 - Tooling Design and Fabrication/Procurement process
 - Plant Layout Implementation
 - Tooling Used for Manufacturing Assembly Methods

- Other
 - Planning
 - Inventory Control
 - Quality

Bombardier will apply all the necessary, well established, and controlled processes in order to implement a seamless production site that will deliver the MBTA Orange and Red Lines Vehicles on time and at the expected quality level.

Equipment

Production Equipment	Miscellaneous
<ul style="list-style-type: none"> • Water Test gantry, trenches & recirculation system • Hydraulic & Electric floor jacks • Load & unload ramp • Hydraulic lift tables • Pit for trucking • Rubber tired dummy trucks 	<ul style="list-style-type: none"> • Test fences • Power supplies, low voltage • Power supply, high voltage DC • Car weight system • Electric & piping repair tools • Truck press • Truck assembly equipment
Welding Equipment	Electric Harness
<ul style="list-style-type: none"> • MIG welding 	<ul style="list-style-type: none"> • None
Testing Facility	
<ul style="list-style-type: none"> • Static Testing stations • No Dynamic Testing capabilities. The Dynamic Testing will be done at the Authority's facilities. 	

Project Work Scope – Except for the Pilot Vehicles that will be completed in La Pocatière and tested in Plattsburgh, the activities listed below will be performed at the new Final Assembly site in Massachusetts for the MBTA Orange and Red Line Vehicles Project:

1. Installation and interconnection of:
 - Propulsion control equipment
 - Propulsion cooling equipment
 - Brake equipment
 - Energy source for auxiliaries and controls
 - Heating and air conditioning
 - Communication equipment
 - Motors
 - Wheels and axles
 - Suspensions and frames
2. Inspection and verification of all installation and interconnection work
3. In-plant testing of the stationary product to verify all functions

The activities listed above are in line with Section C7.18 of the MBTA's RFP and therefore comply with the MBTA requirements. Bombardier's approach to completing these Final Assembly tasks utilizes a method that balances key criteria for a successful project.

We are well versed in design and manufacturing and have optimized the requirements of the Final Assembly to ensure the on time delivery of a Vehicle with high technical performance, superior quality, and minimal induced risk. Bombardier has carefully evaluated all requirements for this important Project in order to assure the MBTA that the suggested approach provides the most optimized service proven methods and experiences that will result in the *Most Advantageous* and *Best Value* product for the Authority.

Retrofit Work – While we have solid processes in place coupled with highly skilled workers on duty throughout all phases of the Project,, in the event that any retrofit work should be required on Vehicles already delivered to the MBTA, Bombardier will be able to perform modifications on site using a portion of track allocated to this type of work. In the event that the Authority’s facilities would not be available or do not prove sufficient for reasonable causes, several options are possible to us depending on the scope of work to be completed:

1. Use the Final Assembly site in Massachusetts
2. Use the Plattsburgh’s site
3. Use the site of La Pocatière

In all cases, potential retrofit and/or modification work will exclusively be performed by Bombardier and/or its Suppliers according to our normal practice, unless another agreement has been reached with the MBTA.

Staffing – To perform the Final Assembly tasks as described in the previous section, and given the combined production rate of 8 cars per month, here are the details of the intended team at the Massachusetts’ Final Assembly site (in the table below, only employees related to manufacturing activities are listed; please find the complete list of Bombardier’s employees in Massachusetts in Section 2.f) of our Proposal).

FUNCTION	EMPLOYEES
Plant Engineering	1
Administration	2
Manufacturing	21
Methods	2
Program Management	1
Quality Assurance	1
Procurement	1
TOTAL	29

The above team members would be in place full time to work on the Production (Non-Pilot) Vehicles’ manufacturing starting in 2018. These team members will assume the newly created “direct” job positions as noted above and will be assigned to our Final Assembly facility located in the Commonwealth of Massachusetts. Additional job creation and retention information can be found in section 2.f) Economic Development in Massachusetts of our Proposal.

Bombardier has met with a number of organizations within the Commonwealth to discuss and assess potential facilities for Final Assembly, potential Suppliers/Sub suppliers and also local workforce capacities/capabilities. We have also discussed utilizing partnerships with local employment recruiting agencies, Veterans groups and local educational institutions to identify, define, develop, and secure a capable workforce for the specific tasks associated with the work scope to be performed in the Commonwealth of Massachusetts.

Bombardier is well versed in performing all necessary tasks of establishing local facilities and securing a capable/competent local workforce for these type projects. We have completed similar tasks for railcar manufacturing as well as services projects in the United States with entities in New Jersey, New York, Maryland, Florida, Illinois, and California. We have also completed such tasks in the Canadian cities of Montréal, Toronto, Vancouver, and Ottawa. As the majority of these work activities in Massachusetts will only begin early 2018, we are not yet in a position to finalize the facilities and/or employment positions for this Project. Therefore, the process of acquiring permits, forming contracts for tools and equipment or advertising for specific job opportunities will follow the established Project Schedule. We know the requirements, understand the tasks and have envisioned the plan to execute these activities in the proper time frame for superior performance. Bombardier has solid and proven internal processes to establish a new set up and workforce, using the following recruitment initiatives:

- All positions will be posted on the Bombardier career website and also linked to the DirectEmployers.com website, promoting diversity and targeting designated affirmative action groups and veterans
- Online media Marketing campaign will be set via our Jobs2Web technology
- Social Media - Promotion of positions via the Bombardier page on LinkedIn or to specific affinity groups
- Activation of the employee referral program
- Print campaigns - local newspaper or trade journals
- Campus Recruiting - local community colleges, trade schools or universities (depending on the skill set required)
- Leverage Industry, Trade and Professional Associations

Bombardier has also reviewed information related to the Workforce Initiative Now (WIN) model and we describe in section 2.f) Economic Development in Massachusetts our efforts related to this important approach. Bombardier has a well-established Workforce Planning and Development program embedded into our Global Human Resources Department that is tailored to address the needs of local areas and communities as noted above. In addition, Bombardier also used a Center of Economic Development from a National University to provide a report detailing the positive economic impacts when providing Railcar Manufacturing and Services. Moreover, Section 5) M/WBE Participation of our Proposal shows our continuous effort to promote W/MBE for this Project, based upon a number of initiatives on past and current projects to foster employment for Disadvantage Business Enterprises and Small Business Entities both at State and National levels.

f) Economic Development in Massachusetts

Describe what effect, if any, the manufacturing, assembly and delivery of Vehicles, Spare Parts, and other Materials will have on job creation and retention in Massachusetts and how it will foster economic development in Massachusetts. List specifically the expected number of new jobs that will be created, and the Offeror's plans for hiring, training and retention of qualified workers, including the actions the Offeror plans to take to promote the development of a qualified and diverse workforce.

In tabular format, identify by job classification (e.g. electricians, mechanics, welders, engineers, testers, quality assurance staff, administrators, building maintenance, etc.) each position Offeror expects to directly employ in Massachusetts, when each position will be created and filled in reference to the production schedule, the duration of each position, in reference to the production schedule, and the hours of work required for the position in full-time equivalents calculated as the total number of hours of work required by the position per week divided by forty (40).

Through the course of our solid and in-depth growth over the years, Bombardier has maintained and created thousands of jobs throughout the world and specifically in North America and in the U.S. We have also established and grown our strong presence in a number of U.S States for railcar manufacturing and railcar service. We have experience and know-how that allow us to understand what it really takes to make this type of investment. We are keenly aware of the importance of spending tax dollars wisely and to assist in promoting U.S. and regional job opportunities through the supply of mass transit products and services. Bombardier is already "registered" with the Secretary of the Commonwealth of Massachusetts to do business in the Commonwealth of Massachusetts. Therefore, we are ready and remain fully committed to establish a solid long term plan that fosters economic development in the Commonwealth of Massachusetts, and can reinforce that as follows:

We will continue to commit and expand our North American resources in a manner designed to serve the priority needs of the MBTA. **This means continuing to invest with a presence of a Final Assembly facility and a local Project office in the Commonwealth of Massachusetts.**

We will utilize the manufacturing expertise of our La Pocatière plant established in 1971 to perform the requested laser welding for carshell manufacturing. This will be coupled with the use of our Plattsburgh, New York plant, established in 1995 to serve the qualification testing needs of the MBTA Pilot Vehicle program. This MBTA program will benefit from the knowledge acquired during the execution of other projects through the transfer of technology accomplished on the Chicago Transit Authority 5000-Series project and the NYCT R179 Project. These transfers of technology programs have effectively transferred the technology and capability of our La Pocatière plant to our Plattsburgh complex making it the first New York State facility capable of all phases of the manufacturing cycle, from carshell manufacturing to Vehicle Final Assembly and Testing. The Plattsburgh plant, test track, and supporting facilities have truly matured into a center of rail transit excellence and expertise. This well-established and proven operation has already seen the output of more than 3,000 rail vehicles, with peak production reaching rates of 40 vehicles per month. The facility includes a separate test track that will be used to power the MBTA Orange and Red Line Pilot Vehicles and perform testing prior to delivery to the MBTA. **All of this acquired knowledge described above will be used to complete a similar extension of capabilities into the Final Assembly facility in the Commonwealth of Massachusetts.**

We will also engage ourselves in a solid W/MBE program, looking at alternatives to maximize the use of these important entities into the scope of our supply and services. In addition to the outreach activities already performed during the bid phase, Bombardier will plan an outreach session to increase W/MBE participation while making reasonable commercial efforts to develop potential suppliers and sub-suppliers that could obtain long term certification for this specific program and could establish a base for continued application on future procurements for the entire rail transportation industry.

Bombardier is focused and committed to fully understand the positive impacts of the above actions as well as those related to other activities taking place during project execution in the Commonwealth of Massachusetts (i.e. training, commissioning, field service, etc.). In order to support our focus and commitment, Bombardier recently partnered with the Center of Economic Development at a nationally known University to prepare a report that details the positive economic impacts when providing railcar manufacturing and services. This report analyzed the impacts of a very similar railcar project to that of the MBTA Orange and Red Line Vehicles Project and estimated the number of jobs nationally and regionally that will be created or maintained over the course of a railcar vehicle project. Details from this report were extrapolated and applied to the MBTA Orange and Red Lines Project scope. An overview of these details is summarized below.

The report was generated using estimates of in-house project work hours and in-house and contract expenditures, supplied by Bombardier on a confidential basis, and 2011 IMPLAN Pro 3.0 data and input-output modeling software. Input-output models describe the way industries are connected to one another. They are based on the fact that each industry's non-labor product inputs are the output of other industries. IMPLAN is a standard software package that economic development analysts often use to estimate or project the national or regional impacts of economic activities.

A new economic activity, such as Bombardier's proposed rail car design and manufacturing, can lead to the creation or retention of jobs in a geographic area only by bringing economic activity into that area that would not otherwise exist in the area. The employment impacts of this new economic activity are of three types, commonly called "direct," "indirect," and "induced."

- The direct employment impact of Bombardier's proposed rail car manufacturing project is the number of jobs created or retained by Bombardier to perform the work on the Project.
- The indirect employment impact is the number of jobs created or retained by suppliers to Bombardier, and throughout its supply chain, to provide goods and services that Bombardier uses to perform the work on the Project.
- The induced employment impact is the number of jobs created when the workers hired or retained by Bombardier and the companies in its supply chain spend their incomes on goods and services.

The total employment impact of the proposed Project is the sum of the Project's direct, indirect, and induced employment impacts.

In this report, "employment impact" refers to the number of full-time equivalent jobs in a geographic area that are attributable to Bombardier's proposed design and manufacturing Project.

These may be new jobs created as a result of the Project or existing jobs that are retained because of the Project. The estimation methods used for this report do not make it possible to distinguish between the creation of new jobs and the retention of existing jobs.

In this report, it could be concluded that for every ONE railcar designed, produced, and delivered by a U.S. railcar manufacturer, an average of ONE full-time equivalent US job per year is created and or maintained.

This equates into an average of 226 full-time equivalent US jobs for the Base order and would add another average of 58 full-time equivalent US jobs for the Red Line option order. Overall, based on this report, the number of full-time equivalent US jobs could reach close to 300 for the total executed projects.

A preliminary assessment of the work activity to be completed with the Massachusetts Final Assembly Facility coupled with other Massachusetts State work activities on the Project (Local Project Office, Commissioning, Acceptance Testing, Field Service, Training, Warranty, etc.), estimates that approximately 52 direct full-time equivalent jobs per year will be created or retained in the Commonwealth of Massachusetts. This is a preliminary figure as Bombardier continues to seek out further hiring opportunities for extra scope of work, such as Extended Warranty, Technical Support Spares Supply Agreement as well as Spare Parts and Inventory Management. Bombardier would like the opportunity to further define these unsolicited after-market activities with the MBTA in order to better assess the Authority's specific needs and proceed in an efficient manner in this regard. Using the above extrapolation and a similar study conducted recently on the Manufacturing Economic Impact in another US State, the total positive economic impact that could be generated from this activity may reach close to an average of approximately 140 full-time equivalent jobs per year in the Commonwealth of Massachusetts, over the life of the Project. These jobs encompass the combination of direct, indirect and induced as defined above.

In addition, the MBTA and Bombardier know the challenge of keeping up with the latest technology and best practices evolving in our industry and in transit operations. Should Bombardier be awarded the MBTA Orange and Red Line Vehicle Contract, we will work with local universities and career centers in the Commonwealth to discuss a "Training / Hiring Program" and an "Apprenticeship Program" in the proximity of our Final Assembly facility and the MBTA Vehicle acceptance facilities. The mission of this Training/Hiring Program would be to provide either in house or offsite core training for rail systems personnel in facets of manufacturing and testing and could expand to include operations, maintenance and systems management. We would reach out to the MBTA to identify a core curriculum of skills, subjects and technical needs to ensure our program is aligned as much as possible with those needs. The result of these efforts could generate a positive economic impact in the form of both "indirect" and "induced" job opportunities.

Bombardier also has an impressive record of helping suppliers to establish and/or expand operations in the localities where we have a presence and we will continue these efforts on the MBTA Orange and Red Line Project. Reinforcing our efforts through our global Bombardier Supply Management system and our proven ability to effectively manage our supply chain will serve for the long-term benefit of the MBTA. The result of these efforts could generate a positive economic impact in the form of both "indirect" and "induced" job opportunities.

In summary, when combining the Final Assembly activities and other work activities in the Commonwealth of Massachusetts with the Transfer of Production, a solid W/MBE plan, potential training/hiring program and the effects of a possible supplier presence initiative, the overall economic (job) development impact for the Commonwealth of Massachusetts will be positively impacted.

Please note that detailed in the attached “Bombardier Workforce in Massachusetts” table, is the number of intended “Direct” jobs associated with this Project for a limited specified duration of the Project. These “Direct” jobs must be allocated together with the “Indirect” and “Induced” jobs to attain the level of 140 full-time equivalent US jobs per year possibly created and or maintained.

Bombardier Workforce in Massachusetts					
Position Description	Employees ¹	Start	Duration	Other Information	DEPT
Plant Engineering	1	Q2-2017	57 Months	Final Assembly Facility	MFG
Administration	2	Q4-2017	51 Months	Final Assembly Facility	MFG
Manufacturing	21	Q1-2018	48 Months	Final Assembly Facility	MFG
Methods	2	Q4-2017	51 Months	Final Assembly Facility	MFG
Engineering	1	Q4-2017	51 Months	Final Assembly Facility	MFG
Plant Management	1	Q1-2017	60 Months	Final Assembly Facility	MFG
Quality	3	Q3-2017	54 Months	Final Assembly Facility	MFG
Procurement	1	Q3-2017	54 Months	Final Assembly Facility	MFG
Project Management	1	Q2-2015	18 Months	Local Project Office	PM
Lead Project Engineer	1	Q2-2015	18 Months	Local Project Office	ENG
Test Engineer	1	Q4-2017	14 Months	Qualification Testing	ENG
Test Technicians	5	Q4-2017	14 Months	Qualification Testing	ENG
Electrical Engineer ²	1	Q2-2015	18 Months	Shared offices	ENG
Mechanical Engineer ²	1	Q2-2015	18 Months	Shared offices	ENG
Systems Engineer	1	Q2-2015	24 Months	Project Execution	ENG
Field Engineering	1	Q4-2017	31 Months	Commissioning/Acceptance	ENG
Field Technician	6	Q4-2017	45.5 months	Commissioning/Acceptance	FS
Warranty Technician	8	Q4-2017	40 months	Warranty	FS
Site Manager	1	Q4-2017	73 months	Field Support	FS
Maximo Clerk	1	Q4-2017	67 months	Field Support	FS
Site Material Mgmt	2	Q4-2017	68 months	Field Support	FS
Site Engineer	1	Q4-2017	72 months	Field Support	FS
Site Safety Supervisor	0.5	Q4-2017	34 months	Field Support	FS
Site Supervisors	2	Q4-2017	68 months	Field Support	FS

1 Full Time Equivalents working 40 hours a week

2 Positions will share time between Design Office and Local Project Office

Some of the above positions may complete the noted durations in non - consecutive months

Bombardier Workforce in Massachusetts					
Position Description	Employees ¹	Start	Duration	Other Information	DEPT
Warranty Quality	0.5	Q4-2017	54 months	Field Support	FS

In addition to all the above job creation and retention data, Economic Development is often quantified by the overall dollar value that can be associated with all those jobs. A separate study has been completed by an Economic Development Specialist from the Commonwealth of Massachusetts that encompasses communities and groups historically underutilized in the vehicle manufacturing and transportation sectors, within the Commonwealth of Massachusetts.

The results of that study have determined the following Economic Development data in terms of dollar value per 50 employees, using the following % breakdown of activities:

75% production
 5% supervision
 5% quality assurance
 10% process (engineering)
 5% administrative

- Base wage/salary impact: \$ 1,820,000 / per 50 employees, annually
- Labor-wage impact: \$ 2,200,000 / per 50 employees, annually
- Total value added impact: \$2,525,000 / per 50 employees, annually
 - The base wage/salary represents the dollars paid to the 50 employees, tax affected.
 - The labor-wage figure is based on the local secondary impact of the disposable income/spending habits of the employees being paid
 - The total value added calculation factors in the impact of the disposable income being spent, with a portion then being re-spent locally by the local companies receiving the disposable income

As Bombardier's above tabulated intended Workforce in Massachusetts exceeds this 50 employee calculation baseline, it can be anticipated that the economic impacts described in this recent study is achievable and could likely be exceeded for Bombardier's approach.

In summary, a significant amount of economic development will be generated in the Commonwealth of Massachusetts through direct job creation/retention as direct, indirect and induced job creation/retention together with other spending initiatives. Bombardier is committed to continuing its partnership with a National University as we proceed through this procurement process. This study, focusing solely on Massachusetts job creation/retention specific to this critical and important Rail Vehicle Project, will validate the above data and allow us to establish an economic development plan. Study results will be available within the next 2 to 3 months and Bombardier would welcome the opportunity to share with the MBTA the details associated with such research.

g) Other Work for Entities

List all other work for entities other than the MBTA at the separate locations indicated in (c) and (d) during the period of the Contract detailing the customer, the quantity and type of vehicle, and delivery dates for same. Describe plant capacity and indicate the capacity available for work under this contract while satisfying other commitments. This includes the final assembly contractor. Provide a statement, supported by further details, that the contractor has the capacity, personnel and other resources to build the Vehicles required to be delivered under the Contract within the time proposed.

This topic is covered in Section 2.a) Manufacturing Capacity and Logistics above for each manufacturing site.

h) Locations and Capacities of Proposed Suppliers for Major Subsystems

List locations and capacities of proposed suppliers for major subsystems listed in Tab I.1 Technical Approach. Include information showing North American manufacturing experience and capacity for this project.

In the following pages, are listed the locations and capacities of proposed Suppliers for major subsystems, including capacity for this Project. The information showing North American manufacturing experience is included in Section 1c) Heavy Rail Transit Vehicles Stainless Steel Carbodies Experience of this Proposal.

Propulsion Vehicle Monitoring System

Bombardier Transportation Propulsion & Controls (BTPC)

Rail transit vehicle propulsion systems and associated test equipment and services have been designed, applied, manufactured, and delivered by the Bombardier (BTPC) Pittsburgh, Pennsylvania site to customers all over the world for over 40 years.

Details of the Bombardier Pittsburgh site include the following:

- Customers consist of authorities operating a variety of rail transit systems including metro/subways, light rail transit, and automated people mover transportation systems
- The Pittsburgh site is 108,000 square feet, of which 67,000 square feet is manufacturing space
- The Pittsburgh site employs over 200 employees covering numerous disciplines including program management, engineering, quality, manufacturing, and product introduction

Certificates and Certifications earned and maintained include the following:

- Certified ISO 9001:2008
- Certified OHSAS 18001:1999
- Certified ISO 14001:2004
- CMMI Level2

The propulsion system equipment proposed for supply on the MBTA Orange and Red Line Vehicles by Bombardier will be manufactured and assembled in Pittsburgh, PA. USA. Approved and experienced external vendors are also used to supply and manufacture components including traction motors (to Bombardier BTPC design), gear units (to Bombardier BTPC design), electronic assemblies (to Bombardier BTPC design), and brake resistors, line reactors, and high speed circuit breakers procured to Bombardier BTPC specifications.

This same Bombardier BTPC Pittsburgh site manufactured the propulsion system equipment for previous MBTA rail vehicle fleets such as the MBTA Red Line 1 and 2 (Series 1500, 1600, 1700) (DC switched resistance propulsion), MBTA #7 LRVs (DC chopper propulsion), and MBTA #8 LFCs (AC IGBT propulsion).

The Pittsburgh plant is fully equipped to handle the manufacturing for the MBTA Orange and Red Lines propulsion system Project. Please find below a list of the existing plant equipment required and available for the execution of the MBTA Orange and Red Lines propulsion Contract.

Manufacturing Equipment	
<ul style="list-style-type: none"> • Qualified Assembly Personnel • Sub Assembly Work Cells • Roller Assembly Lines for Continuous Production • Assembly Hand tools • Torque Tools 	<ul style="list-style-type: none"> • Assembly Fixtures • Material Delivery Carts • Riveting Machine for Knife Switches • IGBT Silkscreen machine • Weldment Rotating Machine • High Voltage Assembly Pallet
Testing	
<ul style="list-style-type: none"> • Routine Test Area • Inverter Testing Equipment • Inverter Testing Software • Ultrasonic Testing Equipment 	<ul style="list-style-type: none"> • High Voltage Testing Equipment • High Voltage Testing Software • Power Lab Testing Equipment

Trucks and Major Truck Components

Bombardier

Please refer to Section 2.a) Manufacturing Capacity and Logistics.

Auxiliary Power and Low Voltage DC Power

Transtech Corp. USA

Transtech state of the art manufacturing facility in Ball Ground, GA USA is strategically configured to ensure a smooth, clean, and productive production line. Transtech develops production schedules together with their customers as time and space allows. Their solid backlog ensures on-going quality leadership and growth that enhances the operations team experience.

There are no ongoing or foreseeable projects that would impose any constraints on Transtech's workforce, facilities or financial commitments. In fact, Transtech has a very flexible workforce.

Their workforce industry experience averages 15-20 years in the Auxiliary, LVPS, Inverter and Battery Charger industries. The US Management Team alone has well over 130 combined years specifically in the power conversion industry and the rail markets.

Currently the estimated workforce is utilized at approximately 40% of capacity. Transtechnik also has the capabilities of adding a shift should a specific project require extra workforce.

Transtechnik has achieved a solid reputation as a competent partner for the railway industry for high-class, reliable, and low maintenance operating power electronics. Since 1968, Transtechnik has supplied auxiliary power systems worldwide for all power classes, reduced dimensions, and low weight. Operating under a broad range of environmental conditions, Transtechnik has delivered more than 20,000 static power converters for more than 360 projects in more than 80 cities around the globe. Additionally, they are an acknowledged partner in the aviation and military industries. Their clients can expect high operational availability, time-saving diagnostic systems, innovative data bus connections, and high efficiency products.

The series production of the auxiliary power and low voltage DC power for this Project will be manufactured in Transtechnik Ball Ground, Georgia, USA to meet the US content RFP requirements.

To ensure the maximum possible reliability, Transtechnik products' engineering designs and manufacturing processes are certified according to ISO 9001 – 2000 quality standards.

HVAC

Mitsubishi Electric Power Products, Inc. (MEPPI)

Mitsubishi Electric Power Products (MEPPI) also known as Melco (Mitsubishi Electric Company) has a newly built plant located in Warrendale, PA, that will be used for the MBTA Orange and Red Lines Project. The plant has a dimension of 51,000 ft² including 7,300ft² of office space.

The plant, that is certified ISO -9001 and ISO -14001 has the following characteristics:

- 2 main assembly lines
- 1 testing chamber
- 7 bridge cranes – task specific
- 2 dock doors, 1 drive door
- 30 ft. ceiling height

Currently, a total of 28 technicians are dedicated to the manufacturing of HVAC units and has a capacity of 40 units per month. Only one assembly line is used for current manufacturing. As required, the second assembly line will be used. In addition, if required, one or two working shifts could be added to meet HVAC manufacturing demand.

Carbody

Bombardier

Please refer to Section 2.a) Manufacturing Capacity and Logistics.

**Couplers / Draft Gear
Air brake Equipment and Controls**

Wabtec Passenger Transit

Alone, Wabtec's Spartanburg, SC facility, at 130 Ridgeview Center Drive, Duncan, SC, 29334, is currently configured to produce approximately 60 car sets per month/per shift for all equipment.

At this level, this facility is operating predominantly at full "1st shift operations" in assembly.

When additional production capacity becomes essential, Wabtec can rapidly activate up to 2 additional shifts of production.

Wabtec's overall production volume during the expected period of the MBTA Orange and Red Line Vehicles delivery is currently foreseen between 50 and 60% of its total OEM capacity for all contracts.

Therefore, based on forecasted volumes, Wabtec does not foresee a capacity constraint and has reserved, with additional shifts, significant additional capacity for component manufacture.

Based on the projected starting date of shipments and quantities required on a monthly basis Wabtec Passenger Transit does not anticipate issues to meeting the delivery date requirements for our scope of equipment being supplied.

Wheel Sets

UTCRA (UTC)

Current Operations – UTCRA currently operates out of a 120,000 square foot facility on 17 acres in Morton, Pennsylvania, just outside of Philadelphia. This facility will be used for the MBTA Orange and Red Lines Project.

UTCRA's facility is outfitted with 2 mounting presses, 2 dismount presses, 3 boring mills, 3 axle lathes, 2 spin test centers for gear units and 2 load testing centers for truck assemblies. This allows UTCRA to avoid any bottlenecks and make changes to the schedule with ease.

UTCRA regularly carries out load/capacity comparisons based on the schedule. This is done through weekly meetings conducted by the Production Manager with UTC's division managers (e.g. Truck Division Manager, Wheel Assembly Division Manager, etc.).

UTCRA also conducts weekly upper management meetings involving the Production Manager, Director of Operations, Director of Programs and chaired by the Vice President.

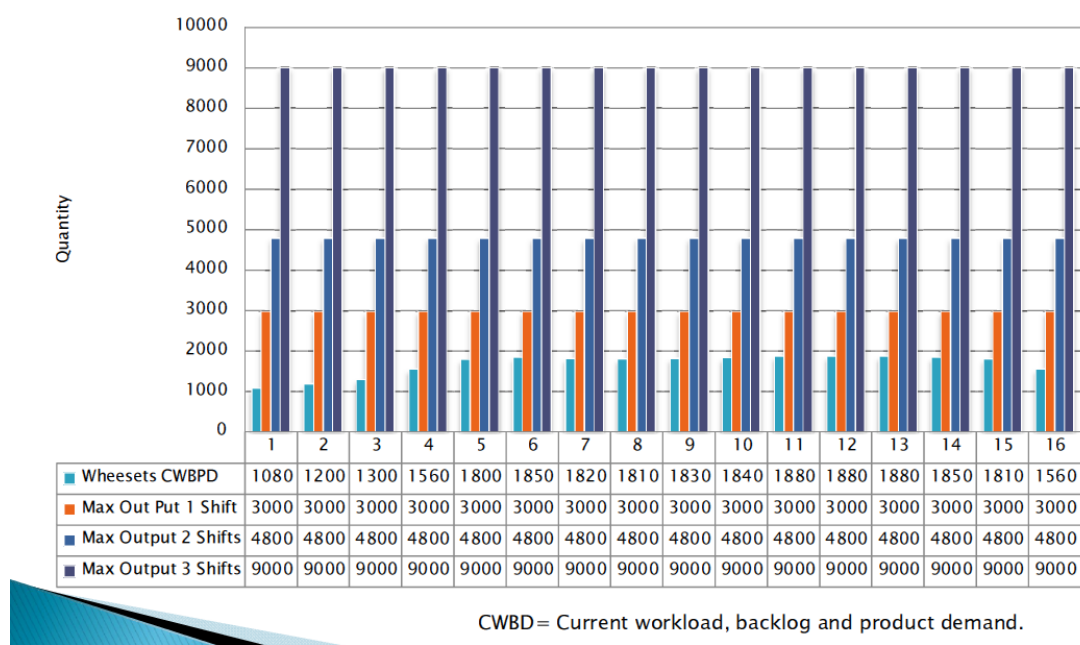
UTCRA currently operates one shift and operates at 22% capacity, leaving a significant portion of potential for increases in production output.

Expansion – Through UTCRA's current capital enhancement initiative, UTCRA is improving its operations.

- UTCRAS is improving its wheel and axle machining operation by purchasing and installing new state of the art equipment and installing some machines currently held in storage to increase productivity and increase its capacity.
- UTCRAS is improving its truck assembly operation by converting the adjacent building to the current truck assembly production facility into a second line.
- UTCRAS is relocating its welding and fabrication operation to its own dedicated building to give UTC the ability to complete large scale fabrications.
- UTCRAS is erecting a new 10,000 sq ft storage facility to facilitate the addition of a second line for the truck division, the installation of the new wheel and axle machines, and the move of the welding operation.

The table hereafter illustrates UTCRAS production capacities over the next 3 years.

Wheelset Projections 2014–2017 (Quarterly)



Cab Signal Equipment

Ansaldo STS USA Inc. (US&S)

The MicroCab-based system proposed for the MBTA will be manufactured at ASTS USA's Manufacturing & Service Center in Batesburg, SC. This includes the ATP/ASR equipment and Bench Test Equipment (BTE). No other manufacturing sites will be utilized.

Ansaldo STS USA's Batesburg plant is utilized for fabrication, assembly, factory testing, packaging and shipment of finished products. This 180,000 sq. ft. plant consists of 2 main structures. The company owns the entire plant, which was originally constructed in 1965 and expanded on several

occasions in the 1980s. All MicroCab-based equipment has been fabricated in Batesburg since the product's introduction in 1994. This includes systems for both domestic and international projects. The plant has ample production and staffing capacity to manufacture the proposed MicroCab ATP/ASR equipment, even with current and anticipated contracts in progress.

To further ensure timely and quality manufacturing capacity, ASTS USA has recently subcontracted key production operations to several subcontractors stationed within the Batesburg facility. Potential manufacturing subcontractors for the MBTA MicroCab equipment include:

- a) Axiom/OMP: Equipment enclosures, electronic assemblies, mechanical assemblies
- b) Elesien: Printed Circuit Boards (PCBs)

As such, these companies can bring their external manufacturing assets to bear if needed to support the Batesburg operations. Manufacturing planning with these subcontractors will be finalized during the MBTA Project planning phase and will be communicated to and coordinated with Bombardier.

Door Systems

Nanjing Kangni Mechanical & Electrical Co. Ltd. (Kangni)

Nanjing Kangni Mechanical & Electrical Co., Ltd. (Kangni) has a R&D comprehensive building and a manufacturing plant totaling more than 5,000,000 square feet, located in Nanjing, China.

More than 700 employees are working within the premises of the R&D building and the manufacturing plant. Among them, 306 employees are working directly on the assembly line. The number of employees can be adjusted very quickly to adjust to manufacturing demand.

In addition to the above, the following workforce will be assigned to the MBTA Project in China:

- One full time Project Manager
- One full time Project Assistant
- One full time Mechanical Engineer
- One full time Electrical Engineer
- One full time QA Engineer
- One part time RAMS Engineer
- One part time Manufacturing Engineer
- One part time Procurement Engineer
- One part time Logistic Specialist

Kangni will have a team at Bombardier's locations comprised of a full time Project Engineer and 6 other specialized Engineers (working full time or part time) to jointly develop a solution. This team will be reassigned to the MBTA premises upon delivery of the Vehicles to the MBTA.

Seats

Freedman Seating Co.

Freedman Seating is a 100+ year old manufacturer of transportation seating products. Located in Chicago, IL, manufacturing and assembly of the seats will take place in its 375,000+ sq. ft manufacturing facility. As far as capacity is concerned, Freedman Seating will deliver seats as needed per the production schedule.

Network Equipment and Integrator Vehicle Monitoring System

Bombardier

Vehicle Monitoring System – The complete Vehicle Monitoring System (VMS) is provided by Bombardier's *MITRAC* standard product line. These products are manufactured by the Bombardier BTPC and its sub-contractors. Bombardier BTPC is responsible for the manufacturing, support and the base standard software of all VMS components throughout all Bombardier projects. The *MITRAC* product is composed of hardware components and software standard components such as TDS (Train Diagnostics System). The *MITRAC* product is used in more than 100 projects over the world. Bombardier BTPC has delivered and is delivering *MITRAC* products (onboard and wayside) to more than 10 projects in North America including the CTA 5000 series metro cars in Chicago.

The Train Control and Management System (TCMS) software team located at Bombardier's Montréal, Québec, Canada site will be responsible for the VMS application software for the MBTA Project. This application software is built on top of the software delivered by Bombardier BTPC and is tailored to meet the MBTA requirements. The onboard part of the VMS will be under the responsibility of the TCMS team which comprises more than 60 Engineers. The wayside portion will be under the responsibility of the Bombardier BTPC team in Europe. Both the onboard and the wayside teams are backed by over 1000 Engineers throughout Bombardier that are related to the TCMS *MITRAC* products.

Network Equipment and Integrator – All network equipment is provided by Bombardier's *MITRAC* standard product line. These products are manufactured by Bombardier BTPC. Bombardier BTPC is responsible for the manufacturing, support and the base standard software of all network equipment throughout all Bombardier projects.

All network integration and configuration are done by the TCMS team in Bombardier's laboratory located in Montréal, Québec, Canada. The integration laboratory comprises a complete Vehicle software and validation test bench using a combination of simulators and real onboard hardware. These benches are also used to validate the complete network interfaces integration. The integration laboratory has the capacity (location space and infrastructure) to accommodate all MBTA Orange and Red Lines test benches.

Communications Equipment including LED and LCD
Signage
Option V: Operator Display Screens
Option VIII: LCD Monitors
Option IX: Active Route Maps

Singapore Technologies Electronics
(Shanghai) Co., Ltd. (STE)

Location and Capacity:

Singapore Technologies Electronics (Shanghai) Co., Ltd.
No.6 building No.1151 Lianxi Road,
Pudong New Area Shanghai, China

Systems for more than 600 cars

North American Experience and Capacity:

System	Project in America	Project Qty	Project Status
Communications Equipment including LED and LCD Signage	BART Project	Base: 410 cars Option: 365 +250 cars	FAI: May, 2013

Singapore Technologies Electronics (Shanghai) is currently working on the following projects and project milestones are included:

Project Name	FAI	Last delivery
Wuxi Line 2	In April, 2013	At the end of January, 2014
Malaysia Ampang Extension Line	Already passed	In 2015
Nanjing Line 6	Already passed	In 2014
Singapore NEL/CCL Supplementary Procurement	In June 2013	In September 2015
BART Project	In January, 2014	In 2019
Malaysia ETS Project	In February, 2014	In 2015
Malaysia KV MRT SBK Project	In February, 2014	In April 2016
Nanchang Line 1	In January, 2014	In 2015

For delivery of the MBTA Orange and Red Lines Project:

- Assuming NTP is late 2014; required first Pilot Cars delivery is scheduled for NTP+35 months, therefore from 2017 at the earliest.
- As of today, STE's plant will be in production for only one North American project between 2017 and 2019.

STE Shanghai is able to produce annually equipment for 600 cars at present. Currently, STE's North American order is for 775 cars spread from 2017 to 2019. Since 226 cars need to be produced for the MBTA Project STE would have to deliver approximately 270 cars per year for the next few years which can easily be met by STE Shanghai's current capacity.

Based on the above analysis, there is no design and manufacturing constraints for STE Shanghai to successfully complete the MBTA Orange and Red Lines Project.

Lighting

TDG Transit Design Group

Location:

TDG Transit Design Group Inc.
9-3770A Laird Road
Mississauga, Ontario L5L 0A7 CANADA

TDG Transit Design Group International
4450 Witmer Indus. Estates Drive, Unit #4
Niagara Falls, New York 14305 USA

Capacity – TDG's capacity plan has factored the MBTA Orange and Red Lines Project into its calculation - TDG calculations show this Project would require between 13% and 19% of TDG's capacity (if successful) covering the years of 2016 thru 2020.

Capacity Plan Summary and Action Plan – Capacity analysis was done for all potential TDG products and services contracts from 2013 to 2023. Since all projects were considered, even those with a low probability of realization, this analysis is conservative and may overestimate the load on TDG resources.

The resource utilization graphs to show a project load that builds with time until reaching a peak during 2015 / 2016. Load then reduces gradually to 2023. This trend may change as new projects begin during the next few years.

The following are the key results of the capacity analysis:

- Resources have been planned for assembly, packaging & shipping, as well as for retrofit, if needed, starting in 2014 for other projects.
- Additional resources will be required and hired in 2015 for the following work areas:
 - Quality Control
 - Cable Assembly
 - New Car / Locomotive Assembly
 - Engineering & Design
- A second Painting vendor will be required and hired by 2015.

Option X: Automatic Passenger Counting System

Dilax Systems Inc.

DILAX manufacturing plants are located in Berlin, Germany.

Components	Manufacturing Plant	Location	Plant Capacity
PCU	DILAX Intelcom GmbH	Berlin, Germany	160 per month
Sensors	First Sensor AG	Berlin, Germany	1,500 per month
Sensors	Zollner	Berlin, Germany	500 per month

Note: Both Sensor manufacturing plants can increase their output to 6,000 units per month if required by demand.

Based on the above provided numbers, DILAX can easily satisfy the delivery schedule indicated in Section C6 – Delivery and Acceptance Materials document.

Option XI: Training Simulator

Corys T.E.S.S.

Corys Thunder, Inc. (CTI) is the fully owned North American subsidiary of CORYS T.E.S.S. CTI is the largest provider of simulators and simulator services for the nuclear power and rail industries in North America. Over 60% of the nuclear plant simulators in the U.S. are powered by CORYS products, and CORYS has provided over 100 rail simulators to the North American freight and passenger rail industry. Worldwide, CORYS has provided over 700 train simulators.

CTI is located at 1351 Tradeport Dr., Jacksonville, FL 32218.

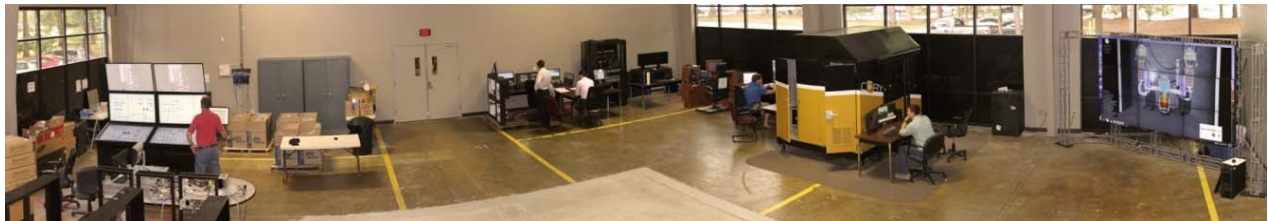
CTI's state-of-the-art 25,000 sq. facilities house a 40-strong and experienced team of industry professionals. Software development, simulator fabrication, assembly, integration, and testing are all conducted at CTI offices using hardware and software design and development techniques perfected over decades of service to the Power and Transportation industries.



CTI offices in Jacksonville, FL



Development facilities of CTI



Hardware integration area of CTI

Our simulation solutions as mentioned above include major transportation authorities and railroad companies in North America:

1. Metro North Railroad (New York City): refurbishment of 4 driving simulators (in progress)
2. Bay Area Rapid Ttransit (San Francisco): 1 Full Cab and 10 Desktop Simulators (in progress)
3. Chicago Transit Authority (Chicago): 1 Full-motion Simulator and 8 Compact Simulators
4. Toronto Transit Commission (Toronto): 2 Interconnected Static Replica Simulators w/ passenger saloon
5. Metra (Chicago): 5 Half-cab Simulators for Different Rolling Stock: F40, MP36, Cab Car, Nippon Emu, Highline

6. Long Island Rail Road (New York City): 1 Full-motion Simulator
7. Port Authority Trans-Hudson (New York City): refurbishment of a Full-motion Simulator
8. Amtrak: 1 Full-sized and 10 Networked Simulators for the Acela, P42, F59, AEM7
9. Metrolink (Los Angeles): 2 Desktop Simulators, 1 ½ Cab Simulator with PTC
10. Herzog (for North County Transit District – California): 1 Compact Simulator with PTC
11. Caltrain (California): 1 Compact Simulator with PTC
12. Kansas City Southern: 6 Networked Simulators
13. Canadian Pacific: 4 Networked Simulators
14. Burlington Northern and Santa Fe Rail Road: 44 Networked Simulators
15. Union Pacific Rail Road: 40 Networked Simulators
16. Rail Safety & Training Resources: 2 Simulators, servicing CN/IC and small RRs
17. ACME Worldwide (contractor through which CTI provided simulators to the US Army):
3 Simulators

A large majority of CTI's contracts have been awarded in competitive tenders.

Bombardier also foresees potential suppliers as alternates in the eventuality that preferred major Suppliers named above would become unavailable. Please refer to Section B – Part B Technical Proposal and Statements and Certifications regarding Eligibility, Form page B-94.

i) Expected Conveyance and Route

Describe the expected conveyance and route by which the cars will be shipped from the manufacturing site to the Massachusetts final assembly site and to the MBTA Facilities in the greater Boston area. Indicate methods to be used to protect the cars while in transit and during interim storage, if applicable.

The Production (Non-Pilot) Vehicles car shells produced at our facility in La Pocatière, Québec, will be transported by truck to the Final Assembly site in Massachusetts. This mode of transportation is a proven procedure at Bombardier. Routes for each transport will be defined according to schedule and approved by the Ministry of Transportation in Canada and the Department of Transportation in the United States.

The Vehicles for the MBTA Orange and Red Lines will travel by road from the Final Assembly site to the MBTA sites. Routes will be defined according to schedule and approved by the Department of Transportation. The Vehicles will be secured on the transportation trailer with blocking and bracing devices that will be specifically developed and fabricated to avoid movement on all axes (x,y,z) during transport.

Bombardier will ensure Vehicle protection to avoid road hazards that could cause exterior damage and affect the integrity of the Vehicle during transport.

j) Local Area Office

Indicate the local area office in accordance with Section C4.07. Indicate expected staffing at this location for manufacturer and subcontractor representatives during period from 60 days after Notice-to-Proceed to end of warranty period. Describe decision making authority of such local staff.

Bombardier will open a Local Business Office (Local Office) as per Section C4.07 which will evolve during the various Project phases. The Local Office will be functional 2 months after NTP.

Design Phase

Bombardier will staff the Local Office with the following employees during the Design Phase of the Project:

- Project Director
- Project Administrator
- Lead Engineer - Project Office
- Lead Mechanical Engineer (shared between Local Office and Engineering Office)
- Lead Electrical Engineer (shared between Local Office and Engineering Office)
- Administrative Assistant

The mandate of the Local Office during this phase will be to prepare and present to the MBTA the design orientations for the Vehicle Architecture, Conceptual Design, Preliminary Design, and Final Design. The Local Office will be equipped with necessary tools, namely proper conference capabilities and bandwidth to view 3D models and to perform the design reviews with the MBTA, consultants and Suppliers.

Suppliers and Bombardier System Engineers will have available/dedicated office spaces in the Local Office to ensure a proper working environment.

The Project Manager will have authority to make decisions on the Project orientation, approve Supplier designs, and lead all required technical discussions and design orientations with the MBTA.

The Lead Engineer - Project Office will have the authority over Design Engineers and will be supported by Engineering Experts. The Electrical and Mechanical Engineers will report directly to the Lead Engineer - Project Office.

Deliverables and milestones will be reviewed with the MBTA within 2 months after NTP in order to ensure proper alignment and complete customer satisfaction. A schedule of meetings with the MBTA at the Local Office covering all planned design reviews and other Project meetings will be defined at the beginning of the Project and submitted to the MBTA for its approval.

Pilot Vehicles Phase

Bombardier plans to staff the Local Office with the following employees during Pilot Vehicles Phase:

- Project Director (shared with Pilot Vehicles manufacturing plant)
- Project Administrator
- Lead Engineer – Project Office (shared with Pilot Vehicles manufacturing plant)
- Lead Mechanical Engineer (shared with Pilot Vehicles manufacturing plant)
- Lead Electrical Engineer (shared with Pilot Vehicles manufacturing plant)
- Administrative Assistant

The mandate of the Local Office staff during this phase will be to present all documentation required by the MBTA such as design CDRLs, design review packages and other CDRLs that are necessary during the Pilot Vehicles phase. As the work load migrates to the Final Assembly plant, the key staff will effectively move to the Final Assembly plant.

Base Vehicles Manufacturing Phase

Bombardier plans to staff the Local Office with the following employees during this phase:

- Deputy Project Manager / Project Administrator
- Field Service Manager
- Field Service Technicians
- Lead Mechanical Engineer (shared with Base Vehicles manufacturing plant)
- Lead Electrical Engineer (shared with Base Vehicles manufacturing plant)
- Administrative Assistant

The mandate of the Local Office staff during this phase will be to address all open items raised during the previous phases and ensure proper alignment between the MBTA and Bombardier.

The Deputy Project Manager / Project Administrator will manage daily activities of the Project Office and will be in direct contact with people of all Functions such as Procurement, Engineering Services, Quality, Manufacturing, and Logistics.

The local Electrical and Mechanical Engineers will have the authority to make decisions as defined by the Lead Engineer - Project Office in order to fully support the MBTA Project. They will have access to our extensive pool of engineering resources in order to gather and analyze information and data when making design decisions in complex situations requiring Engineering Expert's inputs. The Electrical and Mechanical Engineers will report directly to the Lead Engineer - Project Office.

Warranty Phase

Bombardier will staff the Local Office with the following employees during this Warranty Phase:

- Field Support Manager (also acts as the Warranty Coordinator)
- Field Support Technicians
- Supplier and Parts Management Manager
- Administrative Assistant

The mandate of the Local Office staff during this phase will be to manage Product Introduction of the Vehicles on MBTA sites including, but not limited to commissioning of the Vehicles, management of spare parts and consignment parts, implementation of modifications (if required), and overall Warranty support to the MBTA.

The Field Support personnel will have full authority to manage the activities mentioned above including purchase of necessary material, management of on-site personnel and coordination with the MBTA to plan and schedule all activities and conduct all necessary follow-ups related to these tasks.

As necessary, Bombardier will provide additional staff at the local office as well as the Final Assembly facility in order to address the required needs of the Project Management and overall Project Execution responsibilities. The Project Director will indeed be based at Bombardier's Headquarters in Montréal, Québec, and will remain fully committed to the MBTA Project until the beginning of warranty phase. It is to be noted that Bombardier headquarters, Engineering Center of Expertise and Prototype Center located in Montréal, Québec, are a mere 5 hour drive from the Boston area and in the same time zone, enabling Bombardier staff to be available on short notice to fully support the MBTA Orange and Red Line Vehicle Project as required.



PAST PERFORMANCE

Tab 1.3

3. PAST PERFORMANCE

a) Heavy Rail Transit Car Contracts Reliability Information

List (in a matrix format) reliability information for all heavy rail transit car contracts, of similar size, scope, and operation environment as described in Technical Specification Section 2 for the past ten (10) years shall include all contracts that were active at any time during the past ten (10) years, inclusive of warranty stage as well as any executed contracts during this period.

For each entry, the Offeror shall:

- include customer, type, quantity, major vendors, and a brief description of the vehicle (dimension, weight, capacities, features, etc.)*
- describe whether the vehicles delivered were of an existing design or an entirely new design: and indicate the extent of the Offeror's design responsibility (i.e., total vehicle including carbody and all systems, carbody only, systems only etc.)*
- include the contractual reliability requirements (MDBF, MTBF, definition of failures, warranty period(s), etc.)*
- provide a description of the data collection process, the method of reliability calculation and sample of the raw defect history data*
- include actual reliability achieved at the end of the warranty period*
- include actual reliability currently being realized, if data is available*
- identify each project for which the actual vehicle level reliability has met or exceeded the requirements of T2.03.03*
- submit a formal letter of concurrence from the listed customers for each listed project*
- provide current customer contact information for verification*
- state the total length of every contract (closed and current) since 1995. Provide the date of Notice to Proceed and if closed, date of closeout.*

Bombardier has an unparalleled record of serving the MBTA with metro rolling stock since the late 1970's. Initially with the Orange and Blue Line fleets (Hawker Siddeley – Can Car Rail), then the Red Line # 2 fleet (UTDC) in mid 1980's followed by the Red Line # 3 fleet (Bombardier) in mid-1990's. This is supplemented by a number of Single Level Commuter COMET Cars (Pullman) during the 1980's. Our products illustrate decades of reliable, safe equipment customized to the T's special infrastructure and operating environments, a record of achievement in partnership with the MBTA that is unmatched.

Having been associated in some fashion in all these fleet procurements, Bombardier can re-use its successful experience, design concepts and increased knowledge about the environment of the MBTA to address the requirements for the Orange and Red Line Vehicle Program and is thus

uniquely positioned to provide a proven solution with high reliability and an overall reduced risk for the MBTA. Please find hereafter the project information matrix of all heavy rail transit car contracts reliability information.

Our customers' Letter of Concurrence

In Appendix A following this section, Bombardier is proud to submit the current customers' Letter of Concurrence for the following projects:

- Toronto Transit Commission (Rocket project)
- MTA Long Island Rail Road (M7 project)
- MTA Metro North Railroad (M7 project)

b) Service Proven Reliability of each Proposed Major Subcontractor

List (in a matrix format) the service proven reliability of each proposed major subcontractor for all comparable programs and service environments as described in Technical Specification Section 2 over the past ten (10) years. Past ten (10) years shall include all contracts that were active at any time during the past ten (10) years, inclusive of warranty stage as well as any executed contracts during this period. Major systems and/or subsystems shall, at a minimum, include those identified in T2.03.03. Cited reliability data shall be for major system and/or subsystems which are fundamentally identical to that being proposed for this contract. Should the proposed system and/or subsystem be newly developed for this program, the Offeror shall provide reliability data for the most recent, technological predecessor to that which is being proposed. The proposed major system and/or subsystems and their suppliers shall be those that the Offeror shall use, should they be successful.

For each entry, the Offeror shall include:

- *reliability data provided shall be limited to those previous programs where a fundamentally identical system and/or subsystem has met or exceeded the reliability goals requirements of T2.03.03*
- *include the contractual reliability requirements (MDBF, MTBF, definition of failures, warranty period(s), etc.)*
- *a description of the data collection process, the method of reliability calculation and sample of the raw defect history data*
- *actual reliability achieved at the end of the warranty period*
- *actual reliability currently being realized, if data is available*
- *a formal letter of concurrence form the listed customers for each listed project*
- *a current customer contact information for verification*

Please find hereafter the list of service proven reliability of each proposed Major Supplier.

c) Passenger Transportation Rail Car Project Information

List (in a matrix format) project information for all passenger transportation rail car (including light rail, streetcar/tram, commuter/suburban, metro/heavy rail, intercity and high speed) contract issued to the

Offeror for the past ten (10) years. Past ten (10) years shall include all contracts that were active at any time during the past ten (10) years, inclusive of warranty stage as well as any executed contracts during this period. For each entry the Offeror shall include:









- The contractual delivery schedule (including pilot car, first production car, last production car, manuals, spare parts, special tools)*
- The actual delivery schedule (including for pilot car, first production car, last production car, manuals, spare parts, special tools)*
- Reasons for delays (technical, commercial, force majeure, other)*
- Penalties and/or liquidated damages*
- A current customer contact information for verification.*

Please find hereafter the project information matrix for all passenger transportation rail car contracts issued for the past 10 years.

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a) Heavy Rail Transit Car Contracts Reliability Information

Please find below the matrix for all heavy rail transit car contracts of similar size and operation environment, i.e. similar underground / above ground operation, weather conditions, speed, mileage / year. The contracts are listed from left to right by similarity of conditions.

Heavy Rail Transit Car Contracts ¹								
Customer	Massachusetts Bay Transportation Authority (MBTA)	MTA – New York City Transit (NYCT)	MTA – New York City Transit (NYCT)	Toronto Transit Commission (TTC)	Chicago Transit Authority (CTA)	Long Island Rail Road Metro-North Commuter Railroad (MTA – LIRR & MNCR)	Société de Transport de Montréal (STM)	San Francisco Bay Area Rapid Transit District (BART)
Product Picture								
Project Name	Red Line Rapid Transit / 01800	R142 Metro Heavy Rail Transit Car	R179 - Heavy Rail Transit Car	Toronto Rocket	5000 Series Rapid Transit	M-7 EMU Passenger Car	Metro / Rapid Transit / MPM-10	BART “Fleet of the Future”
Contact Name	Mr. Christopher Carven Project Coordinator Vehicle and Systems Procurement 10 Park Plaza, Room 2810 Boston, MA 02116 USA	Mr. Robert S. Garner P.E., R142 Project Manager 130 Livingston St., Room 2048-E Brooklyn, NY 11201 USA 1-718-694-4489	Mrs. Marian Murray Assistant Chief Procurement Officer 2 Broadway, New York, NY, 10004 USA 1-646-252-6040	Mr. K.T. Kwok Senior Project Engineer Rail & Cars Shops Department 1835 Young Street Toronto, ON, M4S 1X8 Canada 416-393-3608	Mr. Robert Kielba Acting Chief Rail Equipment Engineer Skokie Shops, 3701 Oakton Skokie IL 60076 USA 1-847-982-5164	Mrs. Helena Williams, President 90-27 Sutphin Blvd. Jamaica, NY, 11435 USA 1-718-558-8252	Mrs. Francesca Torasso Head of Division, Rolling Stock 800 de la Gauchetière Ouest Montreal QC, H5A 1J6 Canada 1-514-280-5358	Mr. Richard Wieczorek Procurement Manager P.O. Box 12688, Oakland CA, 94604-2688 USA 1-510-464-6380
Quantity (# of Vehicles)	86	1,030	300	420 (+60 Vehicles ordered March 2014)	714	1,172	468	775
Length of contract ²	80 months	99 months	Ongoing	Ongoing	Ongoing	112 months	Ongoing	Ongoing
NTP Date	December 1990	April 1997	June 2012	December 2006	July 2006	May 1999	November 2010	June 2012
Date of closeout ³ (if closed)	July 1997	July 2005	Ongoing	Ongoing	Ongoing	October 2008	Ongoing	Ongoing
Major Vendors	GE, Knorr, SMC, Krupp, Luminator, US & S	Alstom Onix, Knorr, Wabtec	King, Saft, Victall, Wabtec	Curtis, Knorr, Liebherr, Saft	Merak, Saft America, Vapor, Wabtec	Melco, Knorr, Sepsa, Merak, US & S	Alstom, Faiveley, Knorr, Ansaldo	King, Knorr, Saft, Wabtec
Brief Description								
Dimensions	Length: 21,184 mm Width: 3,048 mm	Length: 15,650 mm Width: 2,620 mm	Length: 18,350 mm Width: 3,048 mm	Length: 23,190 mm (A car) 22,860 mm (B & C car) Width: 3,124 mm	Length: 14,630 mm Width: 2,838 mm	Length: 25,908 mm Width: 3,200 mm	Length: 17,387 mm Width: 2,234 mm 7,387 mm	Length: 21,300 mm Width: 3,200 mm
Weight	77,160 lbs	72,752 lbs	83,776 lbs	75,398 lbs	57,320 lbs	128,309 lbs	68,343 lbs	63,934 lbs
Capacities	Seated: 50 passengers	A Car – 176 passengers B Car – 188 passengers	A Car – 40 passengers (cab) B Car – 44 passengers (non-cab)	A Car – 229 passengers (6 pass/m ²)	123 passengers (4.7 pass/m ²)	Seated: A car – 110 passengers	Seated: 24 passengers (cab)	305 passengers (6 passengers/m ²)

1- For the past ten (10) years
2- Length is calculated from NTP to end of Warranty Date
3- End of warranty period

Heavy Rail Transit Car Contracts ¹								
Customer	Massachusetts Bay Transportation Authority (MBTA)	MTA – New York City Transit (NYCT)	MTA – New York City Transit (NYCT)	Toronto Transit Commission (TTC)	Chicago Transit Authority (CTA)	Long Island Rail Road Metro-North Commuter Railroad (MTA – LIRR & MNCR)	Société de Transport de Montréal (STM)	San Francisco Bay Area Rapid Transit District (BART)
Product Picture								
Project Name	Red Line Rapid Transit / 01800	R142 Metro Heavy Rail Transit Car	R179 - Heavy Rail Transit Car	Toronto Rocket	5000 Series Rapid Transit	M-7 EMU Passenger Car	Metro / Rapid Transit / MPM-10	BART “Fleet of the Future”
				B & C Car – 250 passengers (6 pass/m²)		B car – 101 passengers	32 passengers (non-cab)	
Features	<ul style="list-style-type: none">AC Traction motorsOperated in married pairsAutomated stop announcement systemFull width cabs	<ul style="list-style-type: none">Trainline MultiplexingDynamic braking with regenerationAutomatic climate controlOn-board intercom systemFirst cars to feature automated recorded announcements	<ul style="list-style-type: none">Semi-permanently coupled multi-car unitsMITRAC propulsion and train control equipmentFull IP NetworkIndependent Single Door Panel ControlWLAN with Wayside	<ul style="list-style-type: none">Six-car fixed configurationFull-open gangways to allow passengers to move freely from one car to anotherFull IP Train Control and Management SystemEnd detrainment rampLED Active Route MapState-of-the-art train simulatorCCTV camerasAnti-microbial TreatmentMultimedia DisplaysWayside ORBIFLO tool	<ul style="list-style-type: none">Married Pair ConfigurationFull IP Train Control and Management SystemActive Suspension SystemAC motorsControl Center live audio and visual announcements to passengersLongitudinal SeatingLive video systemWayside ORBIFLO tool	<ul style="list-style-type: none">Married Pair ConfigurationAsynchronous AC MotorsEnergy efficient Dynamic BrakingGPS enabled automatic station identification with audio and visual announcementsFull width cabs	<ul style="list-style-type: none">Nine-car trainsetsFull-open gangways to allow passengers to move freely from one car to anotherHybrid Stainless Steel and AluminumFull-width gangwaysPneumatic suspension systemPassenger information system with High definition screensLED lighting	<ul style="list-style-type: none">MITRAC propulsion and train control equipmentIncreased quantity of doorsEnergy efficient lightingAutomated announcements public address systemOnboard security camerasConfigurable length with cab and non-cab carsLED lighting
Actual Design	<input type="checkbox"/> Existing <input checked="" type="checkbox"/> New	<input type="checkbox"/> Existing <input checked="" type="checkbox"/> New	<input checked="" type="checkbox"/> Existing <input type="checkbox"/> New	<input type="checkbox"/> Existing <input checked="" type="checkbox"/> New	<input checked="" type="checkbox"/> Existing <input type="checkbox"/> New	<input type="checkbox"/> Existing <input checked="" type="checkbox"/> New	<input type="checkbox"/> Existing <input checked="" type="checkbox"/> New	<input type="checkbox"/> Existing <input checked="" type="checkbox"/> New
Design Responsibility	Total Vehicle	Total Vehicle	Total Vehicle	Total Vehicle	Total Vehicle	Total Vehicle	Carbody, interior, train integration, operator cab	Total Vehicle
Reliability								
Contractual reliability requirement		MDBF (equivalent to MDBSF)= 100,000 miles MDBCF= N/A	MDBF (equivalent to MDBSF)=150,000 miles MDBCF= for 6 systems (refer to Section 3b)	MDBTD= 480,000 miles	No contractual requirement	MDBCF = 20,000 miles MDBSF = 60,000 miles MDBF = 100,000 miles	MDBF (MDBCF) = 9,300 miles	CR-MTBF= 500 hours (D Car) 700 hours (E Car) CS-MTBF= 6000 hours (D Car) 12,000 hours (E Car)
Description Of:								
Data collection process	N/A	See question 1.o)	Not yet in revenue service	See question 1.o)	N/A	See question 1.o)	N/A	N/A
Method of reliability calculation	N/A	Mean Distance Between Failure (MDBF): The MDBF of an item is the ratio of total	Mean Distance Between Failure (MDBF): The MDBF of a car class is the ratio of the	The Mean Distance Between Train Delays (MDBTD) shall be the ratio of the accumulated	N/A	The Mean Distance Between Component Failures (MDBCF) - A measure of the reliability of	N/A	N/A

Heavy Rail Transit Car Contracts ¹								
Customer	Massachusetts Bay Transportation Authority (MBTA)	MTA – New York City Transit (NYCT)	MTA – New York City Transit (NYCT)	Toronto Transit Commission (TTC)	Chicago Transit Authority (CTA)	Long Island Rail Road Metro-North Commuter Railroad (MTA – LIRR & MNCR)	Société de Transport de Montréal (STM)	San Francisco Bay Area Rapid Transit District (BART)
Product Picture								
Project Name	Red Line Rapid Transit / 01800	R142 Metro Heavy Rail Transit Car	R179 - Heavy Rail Transit Car	Toronto Rocket	5000 Series Rapid Transit	M-7 EMU Passenger Car	Metro / Rapid Transit / MPM-10	BART “Fleet of the Future”
		operating distance accumulated by the total population of identical items to the total number of relevant critical failures which result in a train delay . The Mean Distance Between Component Failures (MDBCF): The MDBCF of an item is the ratio of the total operating distance, <i>d</i> , accumulated by the total population of identical items to the total number of relevant failures, <i>F</i> , occurring within the population of identical items during the time <i>t</i> . It is expressed by the following equation: MDBCF = <i>d</i> / <i>F</i>	total operating distance accumulated by the total population of the cars in the class to the total number of relevant critical failures which result in a train delay . Mean Distance Between Component Failure (MDBCF): The MDBCF of an item is the ratio of the total operating distance, <i>d</i> , accumulated by the total population of identical items to the total number of relevant failures, <i>F</i> , occurring within the population of identical items during the time <i>t</i> . It is expressed by the following equation: MDBCF = <i>d</i> / <i>F</i>	mileage of each car in the fleet during a given period over the total number of Train Delays Failures during the same period. The MDBTD shall be demonstrated during the Reliability Demonstration using moving windows covering 12 consecutive months (12-month moving windows).		an Item expressed as the mean operating mileage traveled between all Relevant Component Failures (Measure in miles) The Mean Distance Between Service Failures (MDBSF) - A measure of reliability of an Item expressed as the mean operating mileage traveled between all Relevant Service Failures (Measured in miles). The Mean Distance Between Failures (MDBF) - A measure of reliability of a Car expressed as the mean operating distance mileage traveled between all Relevant Train Delay Failures.		
Actual reliability achieved (end of warranty period)	MDBCF =9,300 miles	MDBF = 409,324 miles MDBCF =11,419 miles	N/A	MDBTD = 153,137 miles (demonstration in process)	N/A	MDBCF = 24,961 car-miles MDBSF = 552,418 car-miles MDBF = 1,697,146 car-miles	Not yet in service	Not yet in service
Actual reliability (currently being realized)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Met or exceed the level of reliability requested in T2.03.03	Exceeded <input type="checkbox"/> Met <input checked="" type="checkbox"/> Not met <input type="checkbox"/> N/A <input type="checkbox"/>	Exceeded <input checked="" type="checkbox"/> for MDBF Met <input checked="" type="checkbox"/> for MDBCF ⁴ Not met <input type="checkbox"/> N/A <input type="checkbox"/>	Exceeded <input type="checkbox"/> Met <input type="checkbox"/> Not met <input type="checkbox"/> N/A <input checked="" type="checkbox"/>	Exceeded <input type="checkbox"/> Met <input checked="" type="checkbox"/> Not met <input type="checkbox"/> N/A <input type="checkbox"/>	Exceeded <input type="checkbox"/> Met <input type="checkbox"/> Not met <input type="checkbox"/> N/A <input checked="" type="checkbox"/>	Exceeded <input checked="" type="checkbox"/> Met <input type="checkbox"/> Not met <input type="checkbox"/> N/A <input type="checkbox"/>	Exceeded <input type="checkbox"/> Met <input type="checkbox"/> Not met <input type="checkbox"/> N/A <input checked="" type="checkbox"/>	Exceeded <input type="checkbox"/> Met <input type="checkbox"/> Not met <input type="checkbox"/> N/A <input checked="" type="checkbox"/>
Formal letter of concurrence (see attachment)	N/A	Requested	N/A	See Appendix A	N/A	See Appendix A	N/A	N/A

4- Please find below the complete heavy rail order list of Bombardier since 1995:

3) Past Performance

NTP Year	Account Name: Account Name	Base / Option	Market Sub Segment	Total # of Cars/Units	NTP Date	Contractual First Delivery	Contractual Last Delivery
1995	STC - Sistema de Transporte Colectivo	Base	Metro	78	12.1995	09.1997	05.1999
1997	NYCT - New York City Transit Authority	Base	Metro	680	04.1997	01.2001	12.2003
1998	TTC - Toronto Transit Commission	Option	Metro	156	06.1998	09.1999	09.2001
2001	NYCT - New York City Transit Authority	Option	Metro	350	01.2001	05.2001	01.2003
2002	STC - Sistema de Transporte Colectivo	Base	Metro	252	10.2002	09.2004	07.2006
2006	CTA - Chicago Transit Authority	Base	Metro	406	06.2006	01.2009	11.2013
	TTC - Toronto Transit Commission	Base	Metro	234	12.2006	08.2010	08.2011
2010	STM - Société de Transport de Montréal	Base	Metro	468	11.2010	03.2014	09.2018
	TTC - Toronto Transit Commission	Option	Metro	60	05.2010	12.2012	03.2015
	TTC - Toronto Transit Commission	Option	Metro	126	05.2010	12.2012	03.2015
2011	CTA - Chicago Transit Authority	Option	Metro	28	07.2011	02.2014	02.2017
	CTA - Chicago Transit Authority	Option	Metro	56	07.2011	02.2014	02.2017
	CTA - Chicago Transit Authority	Option	Metro	216	07.2011	02.2014	02.2017
2012	BART - Bay Area Rapid Transit	Base	Metro	260	06.2012	05.2015	06.2021
	BART - Bay Area Rapid Transit	Option	Metro	150	06.2012	05.2015	06.2021
	NYCT - New York City Transit Authority	Base	Metro	300	07.2012	12.2014	01.2017
	TransLink - South Coast British Columbia Transportation Authority	Base	Metro	28	11.2012	08.2014	03.2016
2013	CTA - Chicago Transit Authority	Option	Metro	8	02.2013	12.2016	02.2017
2014	BART - Bay Area Rapid Transit«	Option	Metro	100	01.2014	05.2019	06.2021
	BART - Bay Area Rapid Transit«	Option	Metro	115	01.2014	05.2019	06.2021
	BART - Bay Area Rapid Transit«	Option	Metro	150	01.2014	05.2019	06.2021

b) Service Proven Reliability of each Proposed Major Subcontractor

In lieu of letters, the agency point of contact and associated information is being provided. Bombardier also foresees additional potential suppliers as alternates for certain Major Equipment as listed in Form B-94 included herein. Please refer to Section B – Part B Technical Proposal and Statements and Certifications regarding Eligibility, Form page B-94.

Propulsion / Vehicle Monitoring System				Bombardier (BTPC)			
In order to better correlate the “past performance” data with the BTPC proposal for MBTA Orange and Red propulsion, the recent propulsion system applications in Kuala Lumpur, Vancouver, Toronto, and Taipei, which utilize IGBT-based propulsion inverters from the Bombardier <i>MITRAC</i> TC-1410 (single inverter) and TC-1420 (dual inverter) families, have been selected, since the TC-1420 unit forms the basis for the MBTA Orange and Red Line Vehicles’ propulsion system proposal. As such, the “past performance” data required by the MBTA RFP is provided for these Bombardier <i>MITRAC</i> TC-1410 and TC-1420 applications, as follows:							
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence ***	Contact information
Vancouver Project Dual Inverter IGBT-based AC Propulsion System; Automated Rail Transit (ART) System (Linear Induction Motors) NTP 2006	Vancouver	MTBF: 2,000 hours Warranty period: 24 months	Data is collected from field site and Vehicle builder reports. MTBF = Mean Time Between Failures - components. MIL-STD 217F Notice 2/ MIL-STD 785	5,041 hours (as of January 2012)	Not available	Requested	Mr. Mike Belyea Vehicle Project Administrator 604-927-4452 Mike.belyea@gov.bc.ca
Kuala Lumpur Project Single Inverter GBT-based AC Propulsion System; Automated Rail Transit (ART) System (Linear Induction Motors) NTP 2007	Kuala Lumpur	MTBF: 5,000 hours Warranty period: 24 months	Same as Vancouver Project	5,524 hours (as of May 2013)	11,712 hours (as of November 2013)	Requested	Mr. Khairani Mohamed Chief Executive Officer +603 7625 6622 Khairani@prasarana.com.my
Toronto Rocket Dual Inverter IGBT-based AC Propulsion System; Heavy Rail Vehicles (HRV) NTP 2006	Toronto Transit Commission	MDBF: 6,115,506 km Definition of failures: Train delay of more than 5 minutes. Warranty period: 24 months general equipment 5 years for motors and gears.	Data is collected from field site and Vehicle builder reports. MDBF = Mean Distance Between Train Delay (5 min delay in service) MIL-STD 217F Notice 2/ MIL-STD 785 Only reliability failure at this point is a zero velocity relay outside of the propulsion system but supplied by BTPC. Each failure requires waiting for a technician.	Still in warranty	2,094,819 km (as of February 2014)	Requested	Mr. Kam T. Kwok Senior Project Engineer Rail & Cars Shops Department 416-393-3608 kam.kwok@ttc.ca
Taipei TRTC C301 Single Inverter IGBT-based AC Propulsion System; Heavy Rail (HRV)/Commuter Trains NTP 2010	Taipei	MTBF: 30,600 hours Definition of failures: Component failures Warranty period: 24 months	Data is collected from field site. MTBF = Mean Time Between Failures - components. MIL-STD 217F Notice 2/ MIL-STD 785	Still in warranty	34,850 hours	Requested	Mr. Chui Y. C. Director – Rolling Stock Division 886-2-2893-0105 Ext. 8660 e00093@mail.trtc.com.tw

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Trucks and Major Truck Components				Bombardier (prime)			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Toronto Rocket NTP 2006 480 Vehicles Average Speed = 20 mph Interchangeable trucks between motorized and unmotorized with Parallel drive train	Toronto Transit Commission	MDBTD: N/A Definition of failures: An improper condition of Items which requires a corrective maintenance action to restore the affected Item back to its normal operating condition. Warranty period: 2 years Other: Train Delay >= 5min.	Data collection: FRACAS Method of reliability calculation: MDBTD= “ <i>Accumulated Distance for all Vehicles of the fleet (in car – km) during last 12 months</i> ” divided by “ <i>Number of Train Delay failures during same 12 months</i> ” Sample of the raw defect history data: Operator reported truck over rotation past crossover entering Eglinton STN. NO EVENT of over rotation displayed at the ECD. All trucks confirmed to be on track with visual inspection, train managed to reset EB on its own, offloaded at Eglinton STN. LM reported after confirmation on TIMS to have no other alarms besides truck over rotation on Car 5622. Back in service at Finch S/LM rode to Davisville OK. Fault reoccurred N/B ST.George. Train offloaded and proceeded private to Wilson yard. Further inspection required for repeated false alarm and train going into emergency.	N/A, Warranty period not completed.	MDBTD: 6,417,836km (component failures, delay >=5min.)	Requested	Mr. K.T. Kwok Senior Project Engineer Rail & Cars Shops Department 416-393-3608 kam.kwok@ttc.ca
CTA Rapid Transit 5000 series NTP 2006 714 Vehicles Flexible frame Truck with High wheel Unloading	Chicago Transit Authority	MDBF: N/A Definition of failures: Component failures Warranty period: 2 years Other: No reliability demonstration required	Data collection: FRACAS MDBF= “ <i>Accumulated Distance for all Vehicles of the fleet (in car – miles) during last 12 months</i> ” divided by “ <i>Number of failures during same 12 months</i> ” Sample of the raw defect history data: Broken ground bus bar on axle 1 replaced ground buss bar on axel 2	N/A, Warranty period not completed.	MDBF: 258,127 miles	Requested	Mr. Robert Kielba Acting Chief Rail Equipment Engineer Skokie Shops, 3701 Oakton Skokie IL 60076 USA 1-847-982-5164
043 NYCT R142 1030 Vehicles 1997-2003 Average Speed = 20 mph Motorized truck with bolster	NYCT	MDBCF: 80,000 miles Definition of failures: An improper condition which requires unscheduled equipment maintenance or replacement to restore affected equipment to its normal operating condition Warranty period: RDT (Reliability Demonstration Test) Other: Tested from Nov. 2000 to Oct. 2005	Data collection: FRACAS Method of reliability calculation: MDBCF: 12 months Accumulated mileage (in car-miles)/12 months Number or relevant failures	MDBCF: Achieved 83,320 miles	Not available	Requested	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Auxiliary Power and Low Voltage DC Power

Transtechnik Corp. USA

Note for the Authority:

Any reliability figures issued by Transtechnik are dependable and are based on the information known as of the time such calculation is made. Reliability calculations are calculated by the company RAMS Expert. As no one project is 100% identical to another, these calculations are specifically made per project. Once Transtechnik delivers the product to the customer, results of any reliability studies are not reported back to Transtechnik Corp USA and therefore are unable to be tracked or accounted for unless the customer brings forward an issue needing Transtechnik's intervention.

The Transtechnik RAMS Approach includes the capability to competently demonstrate its ability to implement the project specific RAMS required features.

As the expected reliability performance is generally considered part the selection criteria, Transtechnik can provide the expected reliability performance of the proposed system to confirm that the proposed system configuration meets the project reliability requirements, using either theoretical and/or experimental data.

Generally, a formal RAMS Program Plan outline is requested in customer specific documentation. From that outline, Transtechnik creates the required CDRL RAMS documentation. This package of information varies from project to project and is very comprehensive in nature. A list and a submission schedule of RAMS deliverables are included in the RAMS documentation, based on review of the customer TRD.

Thereafter, Transtechnik will submit a RAMS Program Plan as an outline to what can be provided.

As an example, part of this plan could contain some of the following items/CDRL's:

- Reliability Predictions Analysis
 - Maintainability Analysis
 - Mean Time To Repair (MTTR) estimate
 - Failures Modes Effects and Criticality Analysis (FMECA)
 - Operating and Support Hazard Analysis (O&SHA)
- Reliability Summary
 - **MDBCF** estimate
 - Preliminary Hazard Analysis (PHA)
 - Fault Tree Analysis (FTA)
 - Safety Verification Matrix (SV Matrix)

Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
MARTA APS (2006) Supply of APS (Auxiliary Power Supply)	MARTA	MDBF: 653,802 miles MTBF: 25,146 hours Warranty period: 24 months	Description of data collection and method of reliability calculation: IEC61709 / SN29500 failure rates	Not available	Not available	Requested	Mr. Joseph Erves Director, Rail Car Maintenance 404-848-3245 jierves@itsmarta.com
Septa Silverliner (2003) Supply of APS (Auxiliary Power Supply)	SEPTA	MDBF: 438,872 miles MTBF: 17,555 hours Warranty period: 36 months from delivery	Description of data collection and method of reliability calculation: IEC61709 / SN29500 failure rates	Not available	Not available	Requested	Mr. Sachit Kakar Manager of Engineering 215-580-8057 skakkar@septa.org
VRE Virginia Rail Express (2001) Supply of APS (Auxiliary Power Supply)	Virginia VRE (provided to Nippon Sharyo)	MDBF: 576,028 miles MTBF: 16,942 hours Warranty period: 24 months	Description of data collection and method of reliability calculation: IEC61709 / SN29500 failure rates	Not available	Not available	Requested	Mr. Detrius Williams Procurement Specialist 703-684-1001
053 New Jersey Transit Authority (2003) Supply of APS (Auxiliary Power Supply) Fleet Annual Distance : 5,466,628,784,000 miles	New Jersey Transit	MDBF: 200,000 miles (including Batteries and Battery Charger)	Data collection: FRACAS	MDBF: 700,000 miles	Not Available		Mr. David W. Carter, Senior Director Equipment Design and Engineering One Penn Plaza East Newark, NJ 07105-2246
080 AMT (2007) Supply of APS (Auxiliary Power Supply) Fleet Annual Distance : 1,812,147 miles	Agence Métropolitaine de transport	MDBF: None	Data collection: FRACAS	MDBF: 150,000 miles	Not Available		Mr. Stéphane Lapierre Vice-President Operations 700, rue De La Gauchetière Ouest, 26th Floor, Montreal, Quebec, Canada H3B 5M2 (514) 287-2464 x4311

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.


Cab Equipment and Controls				Bombardier			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Toronto Rocket NTP 2006 480 Vehicles Average Speed = 20 mph	Toronto Transit Commission	MDBTD: N/A Definition of failures: An improper condition of Items which requires a corrective maintenance action to restore the affected Item back to its normal operating condition. Warranty period: 2 years Other: Train Delay >= 5min. Demonstration from Nov 2011 and not finalized	Data collection: FRACAS Method of reliability calculation: MDBTD= “ <i>Accumulated Distance for all Vehicles of the fleet (in car – km) during last 12 months</i> ” divided by “ <i>Number of Train Delay failures during same 12 months</i> ” Sample of the raw defect history data: Dead person/ Safety device not working. Handle does not reposition to 90 degree when let go slowly.	N/A, Warranty period not completed.	MDBTD: 2,568,522 km (component failures, delay >=5min.)	Requested	Mr. K.T. Kwok Senior Project Engineer Rail & Cars Shops Department 1835 Young Street Toronto, Ontario, M4S 1X8 Canada 416-393-3608
CTA Rapid Transit 5000 series NTP 2006 714 Vehicles	Chicago Transit Authority	MDBF: N/A Definition of failures: Component failures Warranty period: 2 years Other; No reliability demonstration required	Data collection: FRACAS MDBF= “ <i>Accumulated Distance for all Vehicles of the fleet (in car – miles) during last 12 months</i> ” divided by “ <i>Number of failures during same 12 months</i> ” Sample of the raw defect history data: Horn Inop. CTA inspection found horn`s defective on married pair. Found horn amp not supplying power to foot switch. Horn amp will need to be replaced.	N/A, Warranty period not completed.	MDBF: 124, 100 miles	Requested	Mr. Robert Kielba Acting Chief Rail Equipment Engineer Skokie Shops, 3701 Oakton Skokie IL 60076 USA 1-847-982-5164
043 NYCT R142 1040 Vehicles 1997-2003 Average Speed = 20 mph	NYCT	MDBCF: 250,000 miles Definition of failures: An improper condition which requires unscheduled equipment maintenance or replacement to restore affected equipment to its normal operating condition Warranty period: RDT (Reliability Demonstration Test) Other: Tested from Nov. 2000 to Oct. 2005	Data collection: FRACAS Method of reliability calculation: MDBCF: 12 months Accumulated mileage (in car-miles)/12 months Number or relevant failures	MDBCF: Achieved 401,560 miles	Not available	Requested	Mr. Robert S. Garner P.E., R142 Project Manager 130 Livingston St., Room 2048-E Brooklyn, NY 11201 USA 1-718-694-4489
045 LIRR M7 1172 Vehicles 2002-2007 Average Speed = 35 mph	LIRR	MDBF: N/A Definition of failures: A Relevant Failure of an item is an independent failure plus any dependent failure caused thereby which results in loss of function of that item Warranty period: RDT (Reliability Demonstration Test) Other: Tested from Aug. 2002 to Sept. 2008	Data collection: FRACAS MDBF= cumulated mileage for all Vehicles (in car -miles) / cumulated number of relevant component failures	MDBF= 282,370 miles	Not available	Requested	Mr. Patrick A. Nowakowski, President 90-27 Sutphin Blvd. Jamaica, NY, 11435 USA 1-718-558-8252

*** *Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.*

Trainlines & Networks				Bombardier			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Toronto Rocket NTP 2006 480 Vehicles Average Speed = 20 mph	Toronto Transit Commission	MDBTD: N/A Definition of failures: An improper condition of Items which requires a corrective maintenance action to restore the affected Item back to its normal operating condition. Warranty period: 2 years Other: Train Delay >= 5min.	Data collection: FRACAS Method of reliability calculation: MDBTD = “Accumulated Distance for all Vehicles of the fleet (in car – km) during last 12 months” divided by “Number of Train Delay failures during same 12 months” Sample of the raw defect history data: TVCU-O NOT sending IEEE files to YMSS.	N/A, Warranty period not completed.	MDBTD: 6,421,304 km (component failures, delay >=5min.)	Requested	Mr. K.T. Kwok Senior Project Engineer Rail & Cars Shops Department 1835 Young Street Toronto, Ontario, M4S 1X8 Canada 416-393-3608
CTA Rapid Transit 5000 series NTP 2006 714 Vehicles	Chicago Transit Authority	MDBF: N/A Definition of failures: Component failures Warranty period: 2 years Other; No reliability demonstration required	Data collection: FRACAS MDBF = “Accumulated Distance for all Vehicles of the fleet (in car – miles) during last 12 months” divided by “Number of failures during same 12 months”. Sample of the raw defect history data: MCG is offline tried to ping the unit failed to ping Tried to cycle the network breakers no help need a MCG. We found that somehow the network cables were swapped	N/A, Warranty period not completed.	MDBF: 168,344 miles	Requested	Mr. Robert Kielba Acting Chief Rail Equipment Engineer Skokie Shops, 3701 Oakton Skokie IL 60076 USA 1-847-982-5164

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

HVAC			Mitsubishi Electric power Products, Inc. (Melco)				
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Contact information	
MNR M-8 (USA) Commuter 405 Vehicles 2008-2014	NYCT (provided to KRC)	MDBCF 200,000 Miles Definition of failures: An improper condition of Items which requires maintenance or replacement to restore affected Items to their normal operating condition Warranty period: 3 years from delivery of HVAC	Description of data collection process: Information from Car Builder Method of reliability calculation: Mean Distance Between Component Failure (MDBCF)	N/A (Warranty ongoing)	MDBCF 470,825 miles (as of Jan 2014)	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460	
NJT Multi-Level (USA) Multi-Level Vehicles 195 Vehicles 2008-2014	New Jersey Transit	MBDF 320,000 Miles Definition of failures: The inability of a component, system, or subsystem to function or perform in accordance with the Specification and requiring a corrective action to restore the specified function or performance. Warranty period: 3 years from delivery of HVAC	Description of data collection process: Information from Car Builder Method of reliability calculation: Mean Distance Between Failures (MBDF)	MBDF 415,901 Miles (Base Cars) (Option Cars are under warranty)	Not available	Mr. Jose Rivera Sr. Director, ROS 1-973-491-7583 One Penn Plaza East Newark New Jersey 07105	
NYCT R188 (USA) Subway 126 cars 2011-2013	NYCT	MDBCF 100,000 Miles Definition of failures: An improper condition of Items which requires maintenance or replacement to restore affected Items to their normal operating condition Warranty period: 3 years from delivery of HVAC	Description of data collection process: Information from Car Builder Method of reliability calculation: Mean Distance Between Component Failure (MDBCF)	N/A (Warranty ongoing)	Not available	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460	

				Wabtec Passenger Transit			
Air Brake Equipment and Controls				Chart Reliability of Proposed Major Subcontractor Wabtec Passenger Transit RT5 Friction Brake and Pneumatic Systems - Predicted Reliability Figures			
Proposed Major Subcontractor	Project Name	No. of Cars	Customer	Contractual Reliability Requirements for Friction Brakes Systems	Predicted Reliability Requirements for RT5 Friction Brake and Pneumatic Systems (<i>WPT collects Current and Warranty reliability data without distinction</i>)	Data Collection / Raw Data ¹	Customer Concurrence Letter*** /Contact Information
Wabtec Passenger Transit	NYCT R142	1,030	NYCT	MDBCF = 60,000 miles MDBF = 1,260,000 miles	MDBCF = 113,160 miles MDBF = 1,267,455 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	NYCT R142A / R142S	600	NYCT	MDBCF = 60,000 miles MDBF = 719,424 miles	MDBCF = 94,740 miles MDBF = 1,204,815 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	NYCT R143 ²	212	NYCT	MDBSCF = 71,940 miles MDBF = 719,424 miles	MDBSCF = 103,020 miles MDBF = 1,197,767 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	NYCT R160	1,002	NYCT	MDBSCF = 60,000 miles MDBF = N/A	MDBSCF = 110,852 miles MDBF = 1,260,504 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	MBTA #5 Blue Line	94	MBTA	MDBF = 60,000 miles	MDBF = 94,925 miles	Details provided below	Mr. S. Adkins Chief Mechanical Officer sadkins@mbta.com 617-293-4635
Wabtec Passenger Transit	PATH PA5	350	PATH	MDBF = 60,000 miles	MDBF = 497,084 miles (A-Car) MDBF = 2,692,515 miles (C-Car)	Details provided below	Mr. D. Dreisbach Program Manager 973 350-2854
Couplers / Draft Gear				Chart Reliability of Proposed Major Subcontractor Wabtec Passenger Transit Coupler System - Predicted Reliability Figures			
Proposed Major Subcontractor	Project Name	No. of Cars	Customer	Contractual Reliability Requirements for Friction Brakes Systems	Predicted Reliability Requirements for RT5 Friction Brake and Pneumatic Systems (<i>WPT collects Current and Warranty reliability data without distinction</i>)	Data Collection / Raw Data ¹	Customer Concurrence Letter*** /Contact Information
Wabtec Passenger Transit	NYCT R142	1030	NYCT	MDBCF = 3,000,000 miles MDBF = 6,000,000 miles	MDBCF = 3,048,780 miles MDBF = 38,461,545 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	NYCT R142A / R142S	600	NYCT	MDBCF = N/A MDBF = N/A	MDBCF = 3,048,780 miles MDBF = 38,461,545 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	NYCT R143 ²	212	NYCT	MDBCF = N/A MDBF = N/A	MDBCF = 3,048,780 miles MDBF = 38,461,545 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	NYCT R160	1002	NYCT	MDBSCF = N/A MDBF = N/A	MDBSCF = 3,048,780 miles MDBF = 38,461,545 miles	Details provided below	Mr. M. Wetherell Chief Mechanical Officer 718-694-4460
Wabtec Passenger Transit	MBTA #5 Blue Line	94	MBTA	Not Specified	Not Available	Details provided below	Mr. S. Adkins Chief Mechanical Officer sadkins@mbta.com 617-293-4635
Wabtec Passenger Transit	PATH PA5	350	PATH	MDBF = N/A	MDBF = 1,727,116 miles (A-Car) MDBF = 1,149,425 miles (C-Car)	Details provided below	Mr. D. Dreisbach Program Manager 973 350-2854

1- WPT Predicted Reliability values are calculated based on the contract requirements and relevant industry standards, such as APTA, ARP, and MIL Standards. This information can be found in the associated WPT Reliability Engineering document, which WPT can provide upon request.

2- NYCT R143 reliability information and documents for the Coupler equipment are the same as NYCT R142A / R142

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Cab Signal Equipment
ATP/ASR System

Ansaldo STS USA Inc. (US&S)

Note for the Authority:

1. Since the formal introduction of the MicroCab product in 1994, Ansaldo STS USA, Inc. has received no reports of an unsafe failure of a MicroCab subsystem or component. For reference, this encompasses over 450 cab sets delivered to 39 different North American and international rail mass transit customers.
2. Information provided in the table below only for systems which are “fundamentally identical to that being proposed for this contract” as required by the Specification. (The redundant ATC hardware alone makes this system unique)
3. WMATA 7K and MPM-10 are systems that are still in the design phase. For this reason Ansaldo does not include most of the information requested including the actual reliability information since none exists.
4. MR-73 same architecture as MPM-10, however, Ansaldo does not maintain the level of actual reliability data that we are being asked to provide. Furthermore, Ansaldo can only release the reliability information once the STM customer has agreed, and it is not common for customers to retain or disclose such information.

Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
MPM-10 Vehicle Cab Signaling, (2011-2018) ATP/ATO Cab Signal System	STM - Montreal	MDBF: 4,570,360km/car MTBF: 15,900h/car Warranty period: N/A	Description of data collection process: FRCAP Method of reliability calculation: MIL-217 Sample of the raw defect history data: N/A – Not in service	N/A – Not in service	Not available	Requested	Mr. Etienne Malouin Administrator of Contracts 1-514-281-5020 etienne.malouin@dessau.com
WMATA 7000 Series Vehicle Cab Signal System (2010-2017) ATP/ATO/ATS/TWC Cab Signal System	WMATA	MDBF: 344,272 miles/car MTBF: 22,952 H Warranty period: N/A	Description of data collection process: FRCAP Method of reliability calculation: MIL-217 Sample of the raw defect history data: N/A – Not in service	N/A – Not in service	Not available	Requested	Mr. David Kubicek Deputy General Manager – Operations 202-962-2585 dkubicek@wmata.com
MR-73 Vehicle Cab Signaling, (2005-2016) ATP/ATO Cab Signal System	STM – Montreal	MDBF: 3,586,550km/car MTBF: 12,456 H	Description of data collection process: FRCAP Method of reliability calculation: MIL-217 Sample of the raw defect history data: N/A – Not in service	N/A – Not in service	Not available	Requested	Mr. Etienne Malouin Administrator of Contracts 1-514-281-5020 etienne.malouin@dessau.com

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Door Systems				Nanjing Kangni Mechanical & Electrical Co. Ltd. (Kangni)			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Shanghai Line 9 (2007) 3,264 sets of doors	Shanghai (provided to Bombardier)	FPMK=1.154 (all definite failures) Definition of failures: a. Immobilizing Failure: A defect/failure/loss of functionality that requires the Train to stop immediately and cannot continue with no “evident” or built-in mitigation possible b. Terminating Failure: A defect/failure/loss of functionality that requires the train to terminate passenger operation at the earliest opportunity taking into consideration the “evident” or built-in mitigation. c. Operation impacting Failure: A defect/failure/loss of functionality that impacts operation but allows the train to continue passenger operation until end of journey/day. d. Operation prohibiting Failure: A known defect/failure/loss of functionality that prohibits the Train to enter operation. e. Tolerant Failure: A known defect/failure/loss of functionality that does not prevent the Train from entering Operation, but must be repaired at the next planned workshop visit (when convenient). f. Transparent Failure: A defect/failure/loss of functionality that cannot be noticed or is passenger operation transparent. Warranty period: 24 months	Description of data collection process: FRACAS Method of reliability calculation: Point estimate Sample of the raw defect history data: All door system	MTBF =52,650 H (Intrinsic Reliability) MTBF =100,217 H (service reliability)	MTBF =82,317 H (Intrinsic Reliability, at the end of 2012) MTBF =496,761 H (service reliability)	Requested	Mr. Wang Min Procurement Manager 008613904311751 wang.min@cbrc.com.cn
Shanghai Line 7 (2008) 2,048 sets of doors	Shanghai (provided to Bombardier)	same as Shanghai Line 9	same as Shanghai Line 9	MTBF =62,517 H (Intrinsic Reliability) MTBF =237,310 H (service Reliability)	MTBF =130,386 H (Intrinsic Reliability, at the end of 2012) MTBF =460,341 H (service reliability)	Requested	Mr. Wang Min Procurement Manager 008613904311751 wang.min@cbrc.com.cn
Beijing Metro Line 9 (2009) 1,248 sets of doors	Beijing (provided to CNR)	No specific requirement Warranty period: 24 months	same as Shanghai Line 9	MTBF =95,680 H (Intrinsic Reliability) MTBF =873,083 H (service reliability)	MTBF =118,634 H (Intrinsic Reliability) MTBF =1,082,532 H (service reliability)	Requested	Mr. Wang Guidong Engineering Manager 008618686671130 wangguidong@cccar.com.cn

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Door Systems				Nanjing Kangni Mechanical & Electrical Co. Ltd. (Kangni)			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Shanghai Line 12 (2010) 2,624 sets of doors	Shanghai (provided to Bombardier)	FPMK: .05 FaF FC 1 FPMK: 70 Fail FC 2+3 Total FPMK: 70.05 Failure definition: 1_Stopping and delay Failure: delay > 5 min. (train stopping time or service operation delayed); failing to start and to continue in revenue service (train is off line); passenger evacuation; distress, i.e. needs another train to draw the failed train back to the depot 2_Delay and Minor Failure: delay < 5 min. and no influence of operation service 3_Minor Failure (Inherent to FC2): no delay and no influence of operation service Warranty period: 24 months	same as Shanghai Line 9	Not at end of warranty	MTBF =102,001 H (Intrinsic Reliability) MTBF =510,005 H (service reliability)	Requested	Mr. Wang Min Procurement Manager 008613904311751 wang.min@cbrc.com.cn
Chengdu Metro Line 2 (2010) 1,196 sets of doors	Chengdu (provided to CSR)	MTBF =3000h (Intrinsic Reliability, per car,8 door per car) Warranty period: 24 months	same as Shanghai Line 9	Not at end of warranty	MTBF =99,405 H (Intrinsic Reliability) MTBF =795,243 H (service reliability)	Requested	Ms.Li Shujun Engineering Superior 008613583258308 sf-lishujun@cqsf.com
Chongqing Metro Line 6 Exp (2011) 528 sets of doors	Chongqing (provided to CNR)	MTBF =178,571h (service reliability) Warranty period: 24 months	same as Shanghai Line 9	Not at end of warranty	MTBF =77,648 H (Intrinsic Reliability) MTBF =257,210 H (Service reliability)	Requested	Mr. Wang Guidong Engineering Manager 008618686671130 wangguidong@cccar.com.cn
Chongqing Metro Line 2 Exp (2011) 312 sets of doors	Chongqing (provided to CNR)	No specific requirement Warranty period: 24 months	same as Shanghai Line 9	Not at end of warranty	MTBF =88,969 H (Intrinsic Reliability) MTBF =177,938 H (service reliability)	Requested	Mr. Wang Guidong Engineering Manager 008618686671130 wangguidong@cccar.com.cn

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Network Equipment and Integrator				Bombardier (TCMS)			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Toronto Rocket NTP 2006 480 Vehicles Average Speed = 20 mph	Toronto Transit Commission	MDBTD: N/A Definition of failures: An improper condition of Items which requires a corrective maintenance action to restore the affected Item back to its normal operating condition. Warranty period: 2 years Other: Train Delay >= 5min.	Data collection: FRACAS Method of reliability calculation: MDBTD = “Accumulated Distance for all Vehicles of the fleet (in car – km) during last 12 months” divided by “Number of Train Delay failures during same 12 months” Sample of the raw defect history data: reported for c breaker tripped, and brakes holding, also ac inverter cut out, and bodylight out. Isolated brakes manually and ran train out of service to carhouse. Hold for Bombardier eng network issue.	N/A, Warranty period not completed.	MDBTD: 6,421,304 km (component failures, delay >=5min.)	Requested	Mr. K.T. Kwok Senior Project Engineer Rail & Cars Shops Department 1835 Young Street Toronto, Ontario, M4S 1X8 Canada 416-393-3608
CTA Rapid Transit 5000 series NTP 2006 714 Vehicles	Chicago Transit Authority	MDBF: N/A Definition of failures: Component failures Warranty period: 2 years Other: No reliability demonstration required	Data collection: FRACAS MDBF = “Accumulated Distance for all Vehicles of the fleet (in car – miles) during last 12 months” divided by “Number of failures during same 12 months” Sample of the raw defect history data: TOTs stuck in "OS Idle"/frozen	N/A, Warranty period not completed.	MDBF: 83,446 miles	Requested	Mr. Robert Kielba Acting Chief Rail Equipment Engineer Skokie Shops, 3701 Oakton Skokie IL 60076 USA 1-847-982-5164

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Communications Equipment including LED and LCD Signage				Singapore Technologies Electronics (Shanghai) Co., Ltd. (STE)			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Guangzhou Metro Line 3 North Extended	Guangzhou (provided to CSR)	MDBF: 60,000 miles MTBF: 5,000 hrs Definition of failures: Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service Engineer find the failure and report to STE. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Several contents of LED displays are blank	MTBF: 5,717 hrs	Not available	Requested	Mr. Shan Jianli 0731-28441525 shanjianli@csrzec.com
Shenzhen Metro Line 1 Extension NTP 2011	Shenzhen Metro Group (provided to CSR)	MDBF: 160,000 miles MTBF: 8,000 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service Engineer find the failure and report to STE. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: One amplifier in the Vehicle fails	MTBF: 8,354 hrs	Not available	Requested	Mr. Shan Jianli 0731-28441525 shanjianli@csrzec.com
Kunming Metro Line 1 NTP 2011	Kunming (provided to CSR)	MDBF: 175,000 miles MTBF: 7,000 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service Engineer find the failure and report to STE. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Several contents of LCD displays are blank	MTBF: 7,669 hrs	Not available	Requested	Mr. Shan Jianli 0731-28441525 shanjianli@csrzec.com
Hong Kong MTRC Metro Line	MTR Corporation (provided to CCC)	MDBF: 132, 000km MTBF: 6, 600 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service Engineer find the failure and report to STE. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Several contents of LED displays are blank.	MTBF: 7,653 hrs	Not available	Requested	Mr. Jin Yu 0431-87832593 jinyu@cccarr.com.cn
Low-speed Magnetic Suspension Project	CSR	MDBF: 48,000km MTBF: 4,800 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service engineer finds the failure and reports to STES. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: One amplifier in the Vehicle fails.	MTBF: 4,925 hrs	Not available	Requested	Mr. Shan Jianli 0731-28441525 shanjianli@csrzec.com

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Communications Equipment including LED and LCD Signage				Singapore Technologies Electronics (Shanghai) Co., Ltd. (STE)			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Shenzhen Metro Line 2 NTP 2001	Shenzhen Metro Group (provided to CSR)	MDBF: 132,000km MTBF: 5,000 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service engineer finds the failure and reports to STES. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Several contents of LED displays are blank.	MTBF: 5,641 hrs	Not available	Requested	Mr. Jin Yu 0431-87832593 jinyu@cccar.com.cn
Nanjing Metro Line 2 NTP 2011	Nanjing Metro (provided to CSR)	MDBF: 175,000km MTBF: 7,000 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service engineer finds the failure and reports to STES. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Some amplifiers in the Vehicle fail.	MTBF: 7,167 hrs	Not available	Requested	Mr. Wang Jun 025-85848976 wangjun@csr pz.com
Ningbo Metro Line 1 NTP 2011	Ningbo Rail Transit (provided to CSR)	MDBF: 96,000km MTBF: 4,800 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service engineer finds the failure and reports to STES. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Some content of LCD displays are blank.	MTBF: 4,887 hrs	Not available	Requested	Mr. Shan Jianli 0731-28441525 shanjianli@csrz elc.com
Saudi Arabia Mecca Metro Line NTP 2009	Saudi Arabia (provided to CSR)	MDBF: 101,850km MTBF: 4,850 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Two years	According to the field feedback, service engineer finds the failure and reports to STES. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Some content of LCD displays are blanked. One amplifier in the Vehicle fails.	MTBF: 5,789 hrs	Not available	Requested	Mr. Jin Yu 0431-87832593 jinyu@cccar.com.cn
Brazil RIO EMU June 2009 30 EMU	Rio de Janeiro (provided to CSR)	MDBF: 117,300km MTBF: 5,100 hrs Failures for sub system or component are minor but would require maintenance to be carried out. Warranty period: Three years	According to the field feedback, service Engineer find the failure and report to STE. Reliability calculation: 1. NPRD-95 2. MIL-HDBK-217F Raw defect ex: Some content of LED displays are blanked.	MTBF: 5,045 hrs	Not available	Requested	Mr. Jin Yu 0431-87832593 jinyu@cccar.com.cn

*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Lighting				TDG Transit Design Group			
Project Details	Customer	Contractual Reliability Requirement	Data collection process / Method of reliability calculation / Sample of raw defect history data	Actual Reliability achieved at end of warranty	Actual reliability currently being realized (if available)	Formal letter of concurrence***	Contact information
Metrolinx / Go Transit <i>BiLevel</i> ™ (2014) Supply of the Interior Lighting System	GO Transit (provided to Bombardier)	MDBCF ≥ 2,000,000 car miles MTBF ≥ 58,824 hours (based on average speed of 34 MPH) Definition of failures: Single component failure Warranty period: Two years, equipment replacement Other: Failure analysis within 30 days Reliability demonstration program	Data collection process: TDG records data when a field failure is reported to TDG. Method of reliability calculation: Use failure data of product with similar circuitry to determine MTBF . Apply MTBF value to specific system with specific instances of the core circuitry. Sample of raw defect history data: No failures on similar circuitry to date	No data, warranty period not reached.	Not available.	Approval letter for Reliability Prediction Analysis attached. (See Appendix B)	Mr. Greg Percy, President +416-202-5544 greg.percy@gotransit.com
King Abdullah Financial District Monorail Project (2012) Supply of the Interior and Exterior Lighting System	Rayadah Investment Co. (provided to Bombardier)	MDBF ≥ 4,000,000 km (based on average speed of 20 KPH) MTBF ≥ 200,000 car hours Definition of failures: Failure which reduces light intensity below minimum. Warranty period: Two years, equipment replacement Other: MTTR ≤ 0.5 hours Failure analysis as required.	Same as Metrolinx Project	No failures to date MTBF calculated at 7,884,000 hours to date.	No failures to date.	Requested	Mr. Waleed Al-Eisa Engineer + 966 11 2059911 RICinfo@alraidah.com.sa
ART MK III Platform (2011) Supply of the Interior and Exterior Lighting System	Vancouver (provided to Bombardier)	MDBF ≥ 8,000,000 km (based on average speed of 40 KPH) MTBF ≥ 200,000 car hours Definition of failures: Failure which reduces light intensity below minimum. Warranty period: Two years, equipment replacement Other: MTTR ≤ 0.5 hours Failure analysis as required.	Same as Metrolinx Project	No failures to date. MTBF calculated at 3,431,000 hours to date.	No failures to date.	Requested	Mr. Ian Jarvis TransLink CEO +778-375-7500


*** Bombardier requested Customer Concurrence letters from its Suppliers, but not available at this time.

Whole Car	Bombardier
Please refer to Carbuilder reliability performance in Section 3.a) of Bombardier’s Proposal.	

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c) Passenger Transportation Rail Car Project Information

Passenger Transportation Rail Cars







Customer	Massachusetts Bay Transportation Authority (MBTA)	MTA – New York City Transit (NYCT)	MTA – New York City Transit (NYCT)	Toronto Transit Commission (TTC)	Chicago Transit Authority (CTA)	MTA – Long Island Rail Road Metro-North Commuter Railroad (LIRR & MNCR)
Product Picture						
Project Name	Red Line Rapid Transit / 01800	R142 Metro Heavy Rail Transit Car	R179 - Heavy Rail Transit Car	Toronto Rocket	5000 Series Rapid Transit	M-7 EMU Passenger Car
Contact Name	Mr. Christopher Carven Project Coordinator Vehicle and Systems Procurement 10 Park Plaza, Room 2810 Boston, Massachusetts 02116	Mr. Robert S. Garner P.E., R142 Project Manager 130 Livingston St., Room 2048-E Brooklyn, NY 11201 USA 1-718-694-4489	Mrs. Marian Murray Assistant Chief Procurement Officer 2 Broadway, New York, NY, 10004 USA 1-646-252-6040	Mr. K.T. Kwok Senior Project Engineer Rail & Cars Shops Department 1835 Young Street Toronto, Ontario, M4S 1X8 Canada 416-393-3608	Mr. Robert Kielba Acting Chief Rail Equipment Engineer Skokie Shops, 3701 Oakton Skokie IL 60076 USA 1-847-982-5164	Mrs. Helena Williams, President 90-27 Sutphin Blvd. Jamaica, NY, 11435 USA 1-718-558-8252
Quantity	86	1,030	300	420 (+60 Vehicles ordered March 2014)	714	1,172
Current Status	Finished	Finished	Ongoing	Ongoing	Ongoing	Finished
Total Contract Length ¹	80 months	99 months	N/A	N/A	N/A	112 months
NTP Date	December 1990	April 1997	June 2012	December 2006	July 2006	May 1999
Delivery Schedule						
As per Contract Pilot cars First Delivery	N/A	N/A	Q3 2014	N/A	January 2009	N/A
As per Contract Pilot Cars Last Delivery	N/A	N/A	Q3 2014	N/A	September 2009	N/A
As per Contract First Delivery	December 1992	December 1999	January 2015	August 2010	N/A	May 2002
As per Contract Last Delivery	August 1994	December 2003	January 2017	March 2015	February 2017	February 2007
Actual Dates						
Pilot Cars First Delivery	N/A	N/A	TBC	N/A	September 2009	N/A
Pilot Cars Last Delivery	N/A	N/A	TBC	N/A	November 2009	N/A
Production Cars First Delivery	January 1993	December 1999	TBC	October 2010	June 2011	October 2002
Production Cars Last Delivery	December 1994	December 2003	TBC	TBC	TBC	April 2007
Other Deliverables	N/A	N/A	TBC	TBC	TBC	N/A
Penalty and/or Liquidated Damages	No	No	No	No	No	No

1- Length is calculated from NTP to end of Warranty Date

Passenger Transportation Rail Cars

Customer	Société de Transport de Montréal (STM)	San Francisco Bay Area Rapid Transit District (BART)	Agence Métropolitaine de Transport (AMT)	GoTransit Toronto	New Jersey Tansit Authority (NJT)	Transit Administration Maryland MTA (MARC)
Product Picture						
Project Name	Metro / Rapid Transit / MPM-10	BART “Fleet of the Future”	Commuter – Multi-Level	Commuter - <i>BiLevel</i> ™	Commuter – Multi-Level	Commuter – Multi-Level
Contact Name	Mrs. Francesca Torasso Head of Division, Rolling Stock 800 de la Gauchetière Ouest Montreal QC, H5A 1J6 Canada 1-514-280-5358	Mr. Richard Wiczorek Procurement Manager P.O. Box 12688, Oakland CA, 94604-2688 USA 1-510-464-6380	Mr. Stéphane Lapierre Vice-President Operations 700, rue De La Gauchetière Ouest, 26th Floor, Montreal, Quebec, Canada H3B 5M2 (514) 287-2464 x4311	Mr. Walter Speare, Senior Project Leader, Rail Equipment Engineering 335 Judson Street, Toronto, ON, Canada M8Z 1B2 (416) 354-7727	Mr. David W. Carter, Senior Director Equipment Design and Engineering One Penn Plaza East Newark, NJ 07105-2246 (973) 491-7738	Mr. Erich Kolig, Chief, Mechanical Officer 1-410-454-7297 ekolig@mta.maryland.gov
Quantity	468	775	160	662	429	54
Current Status	Ongoing	Ongoing	Ongoing	Ongoing	Finished	Ongoing
Total Contract Length¹	N/A	N/A	N/A	N/A	59 months	N/A
NTP Date	November 2010	June 2012	December 2007	First GO Transit <i>BiLevel</i> ™ contract signed November 1975; latest signed March 2013	March 2003	November 2011
Delivery Schedule						
As per Contract	Spring 2014	Q2 2015	N/A	N/A	N/A	N/A
Pilot cars First Delivery						
As per Contract	Spring 2014	Q2 2015	N/A	N/A	N/A	N/A
Pilot Cars Last Delivery						
As per Contract	March 2014	May 2015	September 2009	1976	March 2006	N/A (contractual req. for last Vehicle only)
First Delivery						
As per Contract	September 2018	June 2021	July 2011	May 2017	March 2010	September 2014
Last Delivery						
Actual Dates						
Pilot Cars	Spring 2014	TBC	N/A	N/A	N/A	N/A
First Delivery						
Pilot Cars	Spring 2014	TBC	N/A	N/A	N/A	N/A
Last Delivery						
Production Cars	March 2014	TBC	August 2009	1976	November 2006	March 2014
First Delivery						
Production Cars	TBC	TBC	June 2011	TBC	January 2010	TBC
Last Delivery						
Other Deliverables	TBC	TBC	N/A	TBC	N/A	TBC
Penalty and/or Liquidated Damages	No	No	No	No	No	No

Passenger Transportation Rail Cars

Customer	Central Puget Sound Regional Transit Authority - ST	North East Corridor - Amtrak	TTC - Toronto Transit Commission	Metrolinx - Greater Toronto Transportation Authority	Region of Waterloo	Metro Transit Minneapolis
Product Picture						
Project Name	Commuter - <i>BiLevel</i> ™	ACELA High Speed Train set	<i>FLEXITY</i> Outlook, Tram 100% low-floor	<i>FLEXITY</i> Outlook freedom, Tram 100% low-floor	<i>FLEXITY</i> Outlook Freedom, Tram 100% low-floor	Hiawatha Light Rail Line
Contact Name	Mr. John Carpenter Contracts Manager Central Puget Sound RTA 401 S. Jackson St. Seattle, WA 98104 Tel: (206) 389-5149	Mr. John Prader, Contracting Officer's Representative 30th and Market Street Philadelphia, PA 19104 1-215-349-1680	Mr. Stephen Lam, Chief Engineer 416-393-3168 stephen.lam@ttc.ca	Mr. John Jensen, VP - Rapid Transit 416-228-9221 john.jensen@metrolinx.com	Mr. Darshpreet Singh Bhatti, Manager 519-575-4500 dbhatti@regionofwaterloo.ca	Mr. Ed Toomey, Director of Rail Vehicle Maintenance 1-612-341-5605 ked.toomey@metc.state.mn.us
Quantity	67	174	204	182	15	27
Current Status	Ongoing	Finished	Ongoing	Ongoing	Ongoing	Finished
Total Contract Length ¹	N/A	108 months	N/A	N/A	N/A	99 months
NTP Date	First contract signed June 1998; latest signed July 2013	May 1996	June 2009	June 2010	August 2013	January 2001
Delivery Schedule						
As per Contract Pilot cars First Delivery	N/A	N/A	N/A	N/A	N/A	N/A
As per Contract Pilot Cars Last Delivery	N/A	N/A	N/A	N/A	N/A	N/A
As per Contract First Delivery	October 1999	November 1999	October 2013	March 2015	July 2016	April 2003
As per Contract Last Delivery	August 2016	July 12000	August 2019	February 2022	February 2022	March 2007
Actual Dates						
Pilot Cars First Delivery	N/A	N/A	N/A	N/A	N/A	N/A
Pilot Cars Last Delivery	N/A	N/A	N/A	N/A	N/A	N/A
Production Cars First Delivery	October 1999	October 2000	October 2013	TBC	TBC	November 2003
Production Cars Last Delivery	TBC	April 2002	TBC	TBC	TBC	March 2007
Other Deliverables	TBC	N/A	TBC	TBC	TBC	N/A
Penalty and/or Liquidated Damages	No	No	No	No	No	No

3) Past Performance

Please find below the complete list of all our contracts for the past 10 Years in North America.

NTP Year	Account Name: Account Name	Base / Option	Market Sub Segment	Total # of Cars/Units	NTP Date	First Delivery	Last Delivery
2000	CDOT - Connecticut Department of Transportation	Base	Commuter	10	09.2000	05.2002	08.2002
	GO Transit	Base	Commuter	16	05.2000		09.2002
2001	CALTRAIN - California Transport	Base	Commuter	17	11.2001	09.2002	10.2003
	GO Transit	Option	Commuter	4	01.2001	02.2002	09.2002
	LIRR - Long Island Rail Road	Option	Commuter	100	01.2001		02.2007
	Metro Transit Minneapolis	Base	Light Rail Vehicles	18	01.2001	04.2003	04.2004
	Metro Transit Minneapolis	Option	Light Rail Vehicles	1	10.2001	04.2003	05.2004
	NCTD - North County Transit District	Option	Commuter	6	11.2001	02.2003	04.2003
	NYCT - New York City Transit Authority	Option	Metro	350	01.2001	06.2001	01.2003
	ST - Sound Transit	Option	Commuter	17	11.2000	10.2001	01.2002
2002	ACE SJRRC- Altamont Commuter Express, San Joaquin Regional Rail Commission	Option	Commuter	4	02.2002	11.2002	06.2003
	DART - TRE -Trinity Rail Express	Base	Commuter	3	02.2002	01.2003	09.2003
	GO Transit	Base	Commuter	2	02.2002		
	GO Transit	Option	Commuter	20	12.2002		
	LIRR - Long Island Rail Road	Option	Commuter	352	05.2002	05.2002	02.2006
	Metro Transit Minneapolis	Option	Light Rail Vehicles	3	06.2002	04.2003	05.2004
	MNR - Metro North Railroad	Option	Commuter	180	08.2002	01.2004	03.2004
	STC - Sistema de Transporte Colectivo	Base	Metro	252	10.2002	09.2004	07.2006
2003	AMT - Agence Métropolitaine de Transport	Base	Commuter	22	10.2003	07.2004	12.2004
	NJT - New Jersey Transit	Base	Commuter	103	03.2003	03.2006	03.2010
	GO Transit	Option	Commuter	4	08.2003		
	Metro Transit Minneapolis	Option	Light Rail Vehicles	2	06.2003	12.2003	05.2004
2004	GO Transit	Base	Commuter	10	02.2004	10.2005	01.2006
	GO Transit	Option	Commuter	10	11.2004	10.2005	01.2006
	MNR - Metro North Railroad	Option	Commuter	120	04.2004		03.2008
	NMDOT - New Mexico Department of Transportation	Base	Commuter	10	10.2004	01.2005	
2005	GO Transit	Base	Commuter	10	03.2005	02.2006	04.2006
	GO Transit	Base	Commuter	20	12.2005	02.2006	04.2007
	LIRR - Long Island Rail Road	Option	Commuter	158	07.2005	05.2002	02.2006
	Metro Transit Minneapolis	Option	Light Rail Vehicles	3	01.2005	03.2006	03.2007
	Metrorrey - Metro of Monterrey	Base	Light Rail Vehicles	14	08.2005	06.2007	07.2007
	MNR - Metro North Railroad	Option	Commuter	36	07.2005	05.2002	02.2006
	NJT - New Jersey Transit	Option	Commuter	131	09.2005	06.2007	08.2008
	UTA - Utah Transit Authority	Base	Commuter	12	08.2005	06.2006	10.2006
2006	CTA - Chicago Transit Authority	Base	Metro	406	06.2006	01.2009	11.2013
	DART - TRE -Trinity Rail Express	Option	Commuter	4	10.2006		
	NMDOT - New Mexico Department of Transportation	Option	Commuter	12	09.2006		
	STE - Servicio de Transportes Electricos	Base	Light Rail Vehicles	4	09.2006	02.2008	07.2014

NTP Year	Account Name: Account Name	Base / Option	Market Sub Segment	Total # of Cars/Units	NTP Date	First Delivery	Last Delivery
	TransLink - South Coast British Columbia Transportation Authority	Base	Automatic Rapid Transit	34	11.2006	05.2008	06.2009
	TTC - Toronto Transit Commission	Base	Metro	234	12.2006	08.2010	08.2011
	UTA - Utah Transit Authority	Option	Commuter	8	08.2006		
2007	ACE SJRRC- Altamont Commuter Express, San Joaquin Regional Rail Commission	Base	Commuter	4	07.2007	01.2008	07.2018
	AMT - Agence Métropolitaine de Transport	Base	Commuter	30	12.2007	12.2009	07.2011
	AMT - Agence Métropolitaine de Transport	Option	Commuter	130	12.2007	12.2009	07.2011
	CALTRAIN - California Transport	Base	Commuter	8	10.2007	08.2008	09.2008
	GO Transit	Base	Commuter	20	03.2007	01.2008	12.2009
	GO Transit	Base	Commuter	35	12.2007	01.2008	03.2009
2008	DART - TRE -Trinity Rail Express	Option	Commuter	4	12.2008		
	Metro Transit Minneapolis	Base	Commuter	18	03.2008	03.2009	03.2010
	NJT - New Jersey Transit	Option	Commuter	20	12.2008		03.2010
	NJT - New Jersey Transit	Option	Commuter	30	12.2008		03.2010
	NJT - New Jersey Transit	Option	Commuter	45	03.2008		03.2010
	TransLink - South Coast British Columbia Transportation Authority	Option	Automatic Rapid Transit	14	04.2008	08.2015	10.2016
2009	UTA - Utah Transit Authority	Base	Commuter	18	07.2008		
	GO Transit	Base	Commuter	25	03.2009	06.2009	07.2010
	TransLink - South Coast British Columbia Transportation Authority	Base	Commuter	7	07.2009	07.2010	09.2010
	TTC - Toronto Transit Commission	Base	Light Rail Vehicles	204	06.2009	10.2013	08.2019
2010	GO Transit	Base	Commuter	20	03.2010	08.2010	12.2011
	Metrolinx - Greater Toronto Transportation Authority	Option	Light Rail Vehicles	182	06.2010	03.2015	02.2022
	NJT - New Jersey Transit	Base	Commuter	100	09.2010	01.2012	03.2013
	STM - Société de Transport de Montréal	Base	Metro	468	11.2010	03.2014	09.2018
	TTC - Toronto Transit Commission	Option	Metro	60	05.2010	12.2012	03.2015
	TTC - Toronto Transit Commission	Option	Metro	126	05.2010	12.2012	03.2015
2011	CTA - Chicago Transit Authority	Option	Metro	28	07.2011	02.2014	02.2017
	CTA - Chicago Transit Authority	Option	Metro	56	07.2011	02.2014	02.2017
	CTA - Chicago Transit Authority	Option	Metro	216	07.2011	02.2014	02.2017
	FDOT - Florida Department of Transportation	Base	Commuter	14	07.2011	07.2013	05.2014
	GO Transit	Base	Commuter	50	03.2011	11.2011	11.2012
	GO Transit	Option	Commuter	25	12.2011	05.2012	11.2012
	MTA - Maryland Transit Administration	Option	Commuter	25	11.2011	02.2013	09.2014
	MTA - Maryland Transit Administration	Option	Commuter	29	11.2011	02.2013	09.2014
2012	ACE SJRRC- Altamont Commuter Express, San Joaquin Regional Rail Commission	Option	Commuter	2	10.2012	04.2014	04.2014
	BART - Bay Area Rapid Transit	Base	Metro	260	06.2012	05.2015	06.2021
	BART - Bay Area Rapid Transit	Option	Metro	150	06.2012	05.2015	06.2021
	FDOT - Florida Department of Transportation	Option	Commuter	6	08.2012	07.2013	05.2014
	GO Transit	Base	Commuter	60	03.2012	12.2014	10.2015

NTP Year	Account Name: Account Name	Base / Option	Market Sub Segment	Total # of Cars/Units	NTP Date	First Delivery	Last Delivery
	NYCT - New York City Transit Authority	Base	Metro	300	06.2012	01.2015	01.2017
	STE - Servicio de Transportes Electricos	Base	Light Rail Vehicles	4	11.2012	05.2013	06.2014
	TransLink - South Coast British Columbia Transportation Authority	Base	Metro	28	11.2012	08.2014	03.2016
2013	CTA - Chicago Transit Authority	Option	Metro	8	02.2013	12.2016	02.2017
	GO Transit	Base	Commuter	28	04.2013	08.2015	10.2016
	GO Transit	Option	Commuter	65	12.2013	12.2015	05.2017
	Region of Waterloo	Base	Light Rail Vehicles	16	08.2013	07.2016	02.2022
	ST - Sound Transit	Option	Commuter	9	07.2013	05.2016	02.2022
2014	BART - Bay Area Rapid Transit	Option	Metro	100	01.2014	05.2019	06.2021
	BART - Bay Area Rapid Transit	Option	Metro	115	01.2014	05.2019	06.2021
	BART - Bay Area Rapid Transit	Option	Metro	150	01.2014	05.2019	06.2021

Appendix A
Customers' Letter of Concurrence

3) Past Performance

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Mr. Thomas F. Faber
Business Development & Sales Executive
Bombardier Transit Corporation
101 Gibraltar Road, Suite 112
Horsham, PA 19044 United States

Subject: Letter of Concurrence for Rail Transportation Project Reliability

Dear Madam, Sir

We hereby confirm that Toronto Transit Commission (name of Transit Agency) has worked with Bombardier Transit Corporation on a past or is working on the current rail transportation project(s) detailed below. This letter also confirms our assessment as to the performance of Bombardier Transit Corporation on the project reliability requirements.

Project Designation (s): Toronto Rocket Project

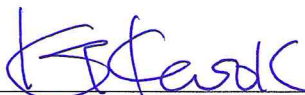
Project Reliability Evaluation (Please check one)

☒ **Good**

☐ **Acceptable**

☐ **Unacceptable**

Narrative Evaluation Comments (optional): Nil.



Transit Agency Representative Signature
(Please see below)

Tuesday, April 01, 2014

Date

Please Print Full Name and Title

Phone number

Mr. K.T. Kwok
Manager – Subway Vehicle Engineering
Rail & Cars Shops Department
Toronto Transit Commission
1835 Yonge Street
Toronto, Ontario, M4S 1X8 Canada
416-393-3608

Mr. Thomas F. Faber
Business Development & Sales Executive
Bombardier Transit Corporation
101 Gibraltar Road, Suite 112
Horsham, PA 19044 United States

Subject: Letter of Concurrence for Rail Transportation Project Reliability

Dear Madam, Sir

We hereby confirm that LONG ISLAND RAIL ROAD (name of Transit Agency) has worked with Bombardier Transit Corporation on a past or is working on the current rail transportation project(s) detailed below. This letter also confirms our assessment as to the performance of Bombardier Transit Corporation on the project reliability requirements.

Project Designation (s): M-7 EMU Passenger Car

Project Reliability Evaluation (Please check one)



Good



Acceptable



Unacceptable

Narrative Evaluation Comments (optional):

CARS MET OR EXCEEDED SPECIFIED
REQUIREMENTS.

J. W. Allen

Transit Agency Representative Signature

4/29/14

Date

JAMES W. ALLEN Director NEW

Please Print Full Name and Title

Rolling Stock

718-725-2625

Phone number

Mr James Allen, Director – New Rolling Stock
MTA – Long Island Rail Road
144-41 94th ave
Jamaica, NY, 11435 USA
1-718-725-2625

Mr. Thomas F. Faber
Business Development & Sales Executive
Bombardier Transit Corporation
101 Gibraltar Road, Suite 112
Horsham, PA 19044 United States

Subject: Letter of Concurrence for Rail Transportation Project Reliability

Dear Madam, Sir

We hereby confirm that Metro-North Railroad (*name of Transit Agency*) has worked with Bombardier Transit Corporation on a past or is working on the current rail transportation project(s) detailed below. This letter also confirms our assessment as to the performance of Bombardier Transit Corporation on the project reliability requirements.

Project Designation (s): M-7 EMU Passenger Car

Project Reliability Evaluation (*Please check one*)

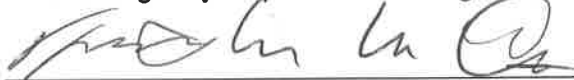
XX ☒ Good

☐ Acceptable

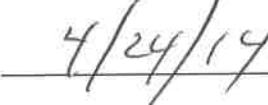
☐ Unacceptable

Narrative Evaluation Comments (optional):

Transit Agency Representative Signature



Date



Timothy M. McCarthy
Sr. Director Capital Programs
MTA – Metro North Railroad
420 Lexington Ave 11th Floor
New York, NY 10017

Phone Number
212 499-4428

Go Transit Interior Lighting 272-TRD-0402 Document Return

Appendix B

3) Past Performance

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BOMBARDIER

TRANSPORTATION

Bombardier Transportation Canada Inc.
1001 Montreal Street, P.O. Box 67
Thunder Bay, Ontario, Canada P7C 4V6
www.bombardier.com

TEL 807-475-2810

FAX 807-475-1830

Date: July 09, 2013

O/R: 272-BO-TDG-0024

Y/R: 272-TDG-BO-0026

272-TDG-BO-0031

Via Email: dallen@whitespire.ca

Mr. David Allen

TDG Transit Design Group Inc.

9-3770A Laird Road

Mississauga, Ontario

Canada

**Subject: Go Transit CABs (272)
Interior Lighting 272-TRD-0402
Document Return**

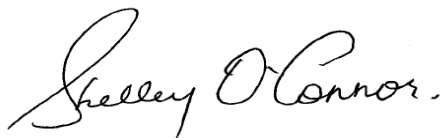
Dear David,

Bombardier Transportation Canada Inc. has completed their review of the document as submitted on your referenced letter and provided the following disposition.

CDRL	Drawing / Document #	Rev	Description	Status
D013B	TDG-RPP-272L	B	RAMS Program Plan	No comment/Attached
D014E	TDG-RPA-272L	B	Reliability Prediction Analysis	No comment/Attached
D016E	TDG-BLESS-272L	1	Maintainability Analysis	No comment/Attached
D060D	TDG-EMCP-272L	B	EMC Control Plan	No comment/Attached

If you have any questions or concerns, please don't hesitate to contact the undersigned.

Sincerely,



Shelley O'Connor
Senior Buyer
BTNA-Thunder Bay
Email: Shelley.o_connor@ca.transport.bombardier.com
Attachments: RAMSPP_Lighting.xlsm
TDG-RPP-272L Rev B - BT stamp.pdf
RPA Interior Lighting.xlsx
TDG-RPA-272L Rev B - BT stamp.pdf
BLESS Interior Lighting.xls
TDG-BLESS-272L rev 1.xls
TDG-EMCP-272L rev B - BT Stamp.pdf
Status : Closed

QUALITY ASSURANCE

4. QUALITY ASSURANCE PLAN

a) Quality Assurance Manual and Project Quality Plan Requirements

The Offeror is to provide an outline of the Quality Assurance Manual and Project Quality Plan requirements stipulated in T 19.03 of the Technical Provisions within Part B of its proposal. The outline should include details of approach, organization, sample procedures, sample documentation, and feedback mechanisms for all phases of the program (design, manufacture, final assembly, test/commissioning, warranty).

Bombardier has extensive experience in building and delivering high quality trains given our systematic and well-established quality assurance processes. We are confident that our approach will easily allow us to meet the Quality System Requirements stipulated in T19.03. Similar requirements are currently met on multiple ongoing projects, namely NYCT R179, BART New Rapid Transit Cars, Société de Transport de Montréal MPM-10 metro Cars amongst others.

As an integrator, Bombardier is responsible for meeting the quality expected by the customer and its daily commuters, while reaching the performance requirements for the whole range of products and services used in our customer's Vehicles. We accomplish this by focusing on strict adherence to the project requirements, implementing preventive actions, and maintaining constant communication with the customer.

Quality Assurance (QA) is obtained not only by implementing a Quality Program, but also by making quality a part of every Bombardier employee's daily activities. Bombardier's Quality Assurance Group also has the mandate to implement, maintain, and enforce ISO 9001:2008 requirements and processes.

Bombardier's Quality System allows proper planning, control, and monitoring of all critical/important activities that take place during the execution of a project. For the past 10 years, this approach has been used successfully on projects such as:

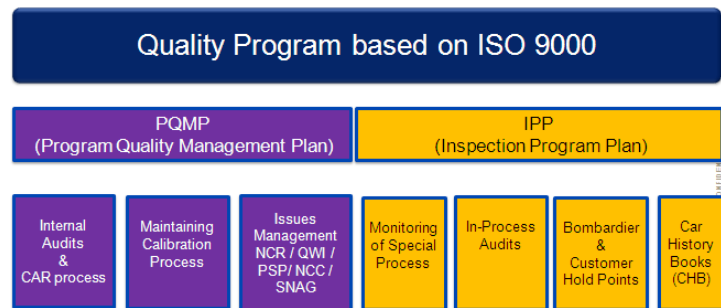
- **New Jersey Transit:** Multi-Level Commuter Cars
- **Agence Métropolitaine de Transport, Montréal:** Multi-Level Commuter Cars
- **NYCT R179:** Subway Cars
- **BART:** Rapid Transit Cars
- **Toronto Transit Commission:** Rocket Subway Cars and *BiLevel™* Commuter Cars

Bombardier's systematic approach on every project is based on thorough planning of the activities in a manner that ensures performance, documentation, control, verification, and validation of these activities. The following sections describe the plans and processes used by Bombardier to achieve high quality standards expected by the MBTA.

Project Quality Management Plan (PQMP)

The Project Quality Management Plan (PQMP) summarizes the quality activities and applicable management systems that relate to the customer's project. All quality requirements identified in the customer's specification are included within the plan.

The PQMP ensures the use of consistent and efficient methods in the application of QA processes and procedures in order to meet the customer's contractual requirements.



QA/QC at Bombardier

Applicable to all Bombardier plants involved in this Project throughout the different phases – design, supply management, manufacturing, inspection, testing, delivery, commissioning and field support – the PQMP is supported by a set of documents developed by each Bombardier manufacturing site, as well as by the major Suppliers. These documents provide Bombardier employees with the necessary tools and insight to be proactive in preventing non-conformities, project delays, and in avoiding cost overruns.

In addition, as part of each project's documentation, the Master Detailed Project Schedule – managed by Project Management – lists the activities required to fulfill the customer's requirements and to meet milestones. All major quality assurance activities are linked to the Master Detailed Project Schedule.

Other Key Quality Documents

The PQMP is complemented by a number of other key documents including:

- Supplier Quality Plan (SQP)
- Software Program Plan (SQAP)
- Inspection Program Plan (IPP)
- Configuration Management Program Plan (CMP)

✓ Supplier Quality Plan (SQP)

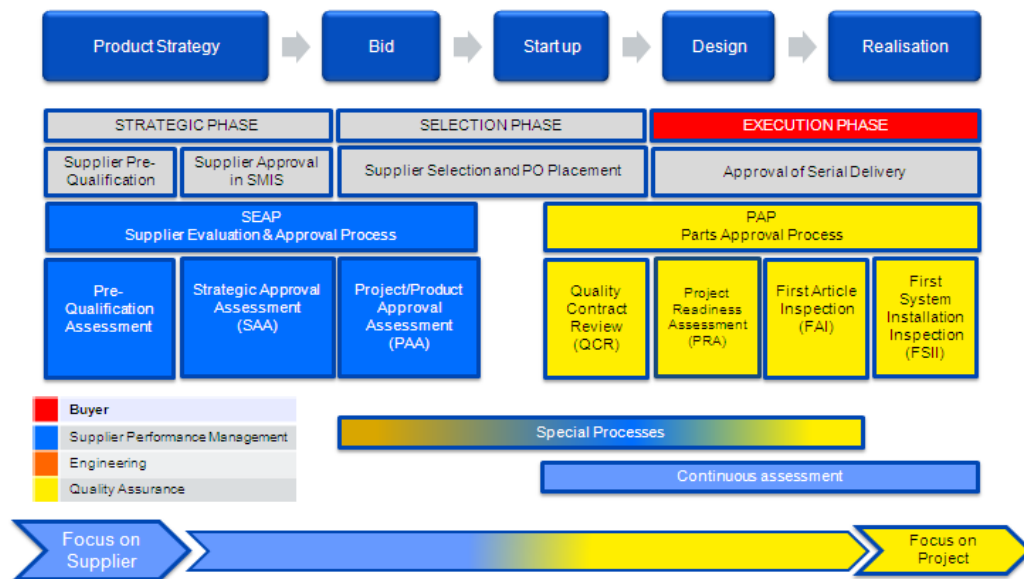
Bombardier ensures that its Suppliers meet the Quality System requirements through a tight selection process referred to as the System Evaluation and Approval Process (SEAP), a thorough description of Bombardier's requirements. The SEAP in addition to the customer requirements in the Technical Requirement Description (TRD) is followed by a clear description of the Supplier Quality Plan (SQP), and a continuous monitoring of the Suppliers adherence to

the plan. In addition, our Project Readiness Assessment (PRA) process is used to audit and assess supplier progress during project execution. The TRD is an integral part of the terms and conditions of the contracts signed with our suppliers. This TRD binds them to meet all of the customer's Technical Specification and Bombardier's specific requirements for the MBTA Orange and Red Line Project.

The Supplier Quality Plan highlights the quality related activities to be performed on our Suppliers' products to ensure product conformity. This document identifies the quality program levels required from suppliers as well as the methods used to qualify them (surveys, quality audits, process audits, etc.). It defines the type of inspections (e.g., First Article Inspection (FAI) or pre-shipment inspection) that will be performed, including their frequency. Finally, it identifies the quality related activities in which the customer intends to participate.

The following activities define and control the quality of the supplied systems and subassemblies:

- Subcontractor Qualification
- PQMP, explained above
- Conformity of Suppliers' scope (FAI and source surveillance activities)
- Configuration Management



Source Quality Activities

✓ Inspection Program Plan (IPP)

The Inspection Program Plan is used in the manufacturing quality assurance process to identify, during the manufacturing cycle, the inspection activities performed by Bombardier and the customer. This document highlights the type of inspections (receiving, in-process, final) that will be performed. It defines for each inspection the method used (procedure), the acceptance standards (reports), and the inspection frequency. This plan is supplemented by detailed inspection procedures that will be carried out at each manufacturing site.

✓ *Configuration Management (CMP)*

The Configuration Management Plan (CMP) identifies and describes the overall procedures for configuration management of the Vehicles throughout its lifecycle. Scope begins at Notice to Proceed (NTP) and ends at completion of general warranty. The plan addresses the configuration management of the design, manufacturing, testing and commissioning of the system and its associated documentation. The CMP outlines the methodologies through which Bombardier will establish and document any changes to the baseline designs.

Configuration Management activities affect Configuration Items (CIs) such as:

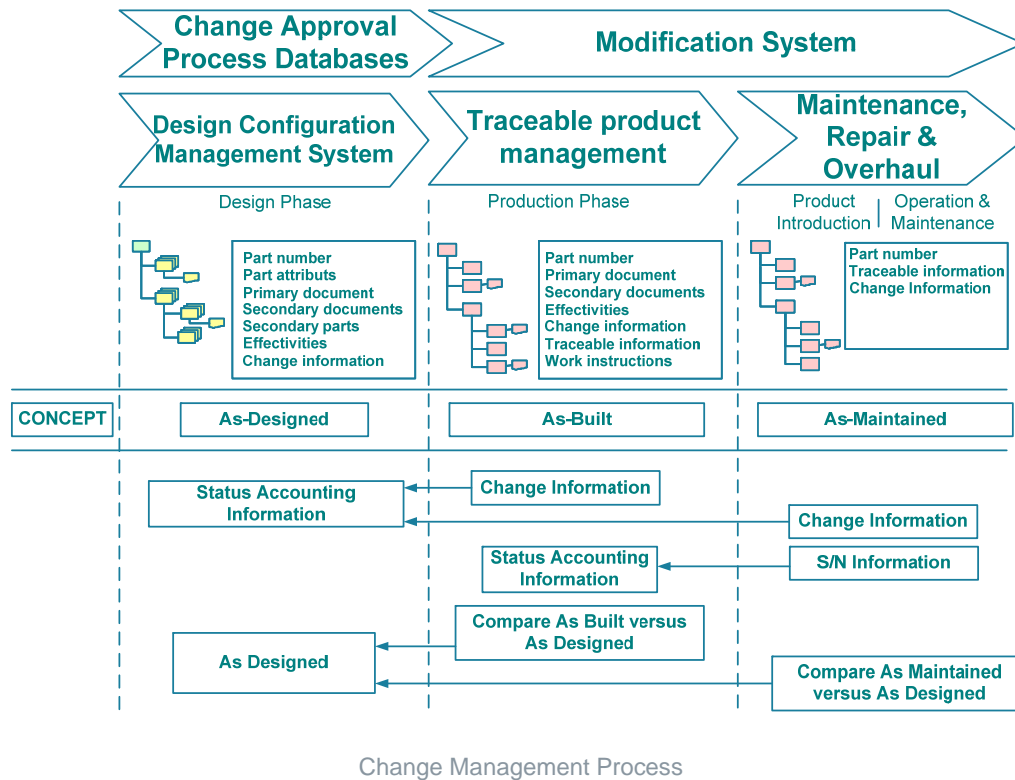
- Hardware products (e.g., serialized parts)
- Software products
- Items identified with modification levels
- Drawings
- Documents

Bombardier also imposes a configuration management process on systems provided by Suppliers. The Suppliers are required to submit for review and approval a CMP that covers the design, production, and supply of their system. Bombardier will monitor Suppliers to ensure:

- Continued compatibility of the Supplier-provided equipment for the technical system
- Compliance to approve supplier CMPs as well as software CMPs
- Updating of all data dependent on Supplier-provided equipment, for example, overhaul and maintenance manuals
- Readiness (including documentation) for activity such as FAI and qualification testing
- Compatibility of the supplier processes such as change management process, software documentation review process, etc. with Bombardier processes and with Technical Specification requirements
- Protection against unauthorized installation of product released for installation and/or unauthorized changes to product already installed on a Vehicle

Project audits will be performed at different phases during the Project to ensure conformance to Project plan, as well as configuration audits to establish product baseline.

The Configuration Management process throughout the life of the project can be summarized by the diagram hereafter.



✓ Control of Non-Conforming Products

All assigned Project employees of Bombardier are responsible for identifying non-conforming products and preventing their use until their final disposition. The Quality Assurance Group is responsible for the control and management of all non-conforming products.

When non-conforming products are detected during the manufacturing cycle, Quality Assurance issues a Non-conforming Material Report, and non-conforming parts are segregated until final disposition is proposed and accepted by all parties involved.

During Vehicle walk-through inspections (in-process or final), non-conformities are marked with a colored dot for Vehicles under inspection and logged on the Vehicle inspection sheet. Such non-conformities, identified as snags, are resolved with the customer's site representative prior to the release of the Vehicle for shipment to the customer site.

The pattern of snag occurrence is reviewed by Quality Assurance on a monthly basis, and corrective actions are put in place for repetitive snags. Resolution (closure) of non-conformities raised in a specific Vehicle requires the implementation of the necessary corrective and/or preventive actions on the Vehicle.

See attached in Appendix A a sample of the Nonconformity Management in the Realization Phase (VCM) (AME-40-10-25-010020) procedure.

✓ *Disposition of Non-Conforming Products*

The disposition of non-conforming products may be one of the following:

- Use as-is
- Rework
- Repair
- Scrap

Rework is an activity where the major physical condition or structure of the product is not altered (e.g., a hole is too small and has to be enlarged to conform to drawing). Alternatively, a repair is an activity where the physical characteristics of the product may have been affected (e.g., a hole is too large thus it needs to be welded and the hole drilled to the right size).

All Non-conforming Material Reports that propose “*use as-is*” or “*repair*,” will be justified and approved by the Design Engineer prior to disposition and final acceptance, and presented to the MBTA if required.

✓ *Feedback Mechanisms*

During the design phase, Design Failure Mode and Effects Analyses (DFMEA) are performed by Bombardier’s Engineering Department to ensure design integrity as a whole at critical junctions in the design phase. These DFMEA’s are aligned with the project schedule and serve the purpose of anticipating and resolving any potential issues. Following this activity, a mock-up could be built and assembled at the Bombardier Prototype Center to validate the entire design and to ensure the customer’s satisfaction.

To ensure proper feedback during manufacturing phase, the Bombardier Q6 process has been put in place at every site.



QA/QC at Bombardier Manufacturing Sites Q6 Initiative

The feed-back loop between the QA team at the plant, supply management and supplier quality assurance (SQA) is monitored by monthly meetings in which the Supplier's performance is reviewed.

Supplier Quality Assurance is also performing the following activities at the Bombardier Manufacturing Site:

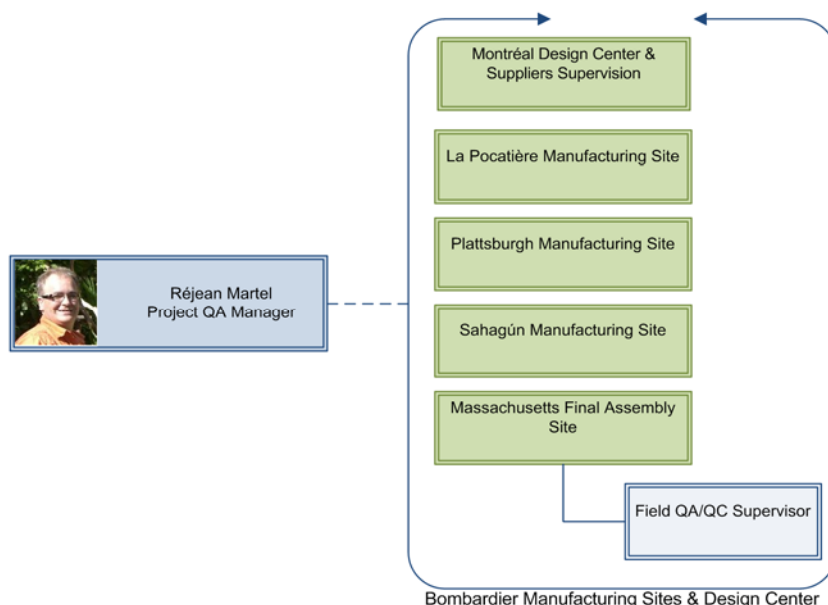
- Attend NCR meeting (Material Review Board)
- Attend the QWI meeting (Quality Workmanship Issues: for repetitive and major issues with supplier and sister division)
- Participate in First System Installation Inspection (FSII)
- Follow-up on supplier's action plan with the QA personal
- Collect feedback from supervisors and employees on the production lines

b) Subcontractor Quality Compliance, FAIs and Quality Control / Quality Assurance Role

The Offeror shall describe their approach to subcontractor quality compliance, first article inspections and quality control/quality assurance role at the final assembly site.

QA/QC Manager Authority & Team

The Bombardier Project QA Manager has overall responsibility for ensuring that all project deliverables meet the applicable quality contractual requirements. This person is responsible for managing the QA activities and processes related to the project. The Project QA Manager identified in the chart below, is the dedicated and empowered Bombardier representative responsible for communicating and addressing project-related quality issues with the customer's project organization.



The QA Site Directors have complete authority and responsibility for the Quality in their respective plants. Should it ever become necessary, the QA Site Director also has the authority to stop the production line.

Quality Assurance Role

On each project, a Quality Assurance Manager is assigned. As a direct report to the Quality Assurance Manager, a Quality Assurance Project Engineer is dedicated to the project and works solely on this project. As the project evolves and Quality Assurance activities ramp up, Quality Assurance Engineers are assigned to the project and report functionally to the Quality Assurance Project Engineer. These Quality Assurance Engineers are responsible for the Pre-FAI, FAI, Process Audits, and Pre-Shipment Inspection processes and FSII.

Plant quality control is assigned to the project when the project enters the realization phase. Bombardier also assigns the appropriate number of quality control personnel to cover the inspection and hold point activities. Also, the inspection program plan defines the type of inspection that must be performed from receiving to final inspection.

✓ *First Article Inspection and Source Surveillance Activities*

The First Article Inspection of products produced by Bombardier is performed on all major equipment, carshells, and complete car assemblies. This inspection confirms that products are of expected quality and according to the Authority's standards, that processes have been controlled, and that specified requirements have been met. The customer is given a 30 days' notice of the First Article Inspection activity. First Article Inspections are performed by a Quality Assurance member and, as necessary, performed jointly with Engineering and/or Technical Services (Methods) and/or Supply Management. The FAI units are retained for the duration of the manufacturing phase at the supplier facility and are used on the last production car. This ensures that the supplier always has a golden unit as a reference. This golden unit is updated to reflect the latest configuration if the product has changed.

Two types of source surveillance activities are performed at supplier facilities. These are process audits and pre-shipment inspections. Process audits (also called process mapping) are used to ensure that the production process is followed as per work instructions and that the production process is comprehensive and complete enough to ensure that the product will meet the intended requirements. The topics covered during a process audit include, but are not limited to, material acceptance, limited-life items, sub-assembly and assembly fabrication, identification, testing, inspection, packaging, and shipping. Pre-shipment inspections are used to ensure that the final work products about to be shipped by Suppliers meet the quality and workmanship requirements for the Project. Pre-shipment inspections are performed on major or critical equipment from the start of manufacturing until the product and production process meet the expected quality level. Quality indicators are monitored on a monthly basis to evaluate the level of source surveillance that is needed for each Supplier.

✓ *Inspection*

As the Bombardier Final Assembly site will be set up in Massachusetts to perform the requested Final Assembly activities on the Orange and Red Lines series Vehicles, Quality Assurance processes and concepts will be rolled out during the site implementation phase, to comply with Bombardier QA standards and certifications that are already in place in all Bombardier manufacturing sites worldwide. Newly hired employees will receive appropriate training by QA experts to meet Bombardier's high quality standards and best practices.

The material received at the Bombardier manufacturing and final assembly sites must be validated against the inspection parameters required by the SAP® system and sampling plan. All information must be entered into an electronic system including serialization. The approval of the product in the electronic system will indicate that the Inspection parameters were met.

During production and Final Assembly, Quality Assurance performs analysis of the monitoring and measurement results. This analysis allows, among other things, the ability to adjust the frequencies of self-verification, inspection and process audits. Furthermore, it allows the establishment of the parameters for self-verification and inspection, and contributes to the continual improvement of the manufacturing process.

See attached in Appendix B a sample of the Establish and Validate Quality Requirements (AME-20-15-15-012044) procedure as well as in Appendix C a sample of the Receiving Inspection (AME-20-30-40-010081) procedure.

✓ *Routine Inspections and Testing*

Functional testing of the Vehicles is performed by specialized test technicians, and will be detailed in the MBTA Test Program Plan. Each test activity is covered by a detailed test procedure that also indicates the performance requirements to be met. Records of all tests are included in the Car History Book. The Quality Assurance Group performs process audits to ensure that all tests are completed satisfactorily and that the equipment used is calibrated.

Inspection and test status is well identified either with a "quality indicator" placed on the part or on the associated document(s). All products found to be nonconforming are identified by means of a "suspension" quality indicator and segregated in order to prevent unauthorized use. The indicator remains on the product until such a time that the final disposition has been carried out and that the products are accepted by the Quality Assurance Group.

✓ *In-Plant Customer Final Inspection*

The activities related to the in-plant final inspection of the Vehicles before shipment from the Final Assembly plant to the MBTA site are as follows:

- For each Vehicle, Bombardier issues a Certificate of Compliance
- For each Vehicle, the customer issues a Release for Shipment

The remaining open items (if any) related to the shipped Vehicle will be listed and signed by Bombardier and the customer, and included in the Car History Book.

✓ *On-Site Quality Assurance Activities*

Post-delivery inspections will be performed in the commissioning phase to identify the possible transportation damages, if any, as well as safety verification on the Vehicle. An additional inspection is performed after the Vehicle commissioning cycle is complete. Both of these inspections will be carried out by Bombardier and the MBTA representatives. The objective of these inspections is to make sure that the Vehicle performance is not altered and that the Vehicle is ready for revenue service.

During the warranty period, inspections and audits of the modifications executed by Bombardier or our Suppliers will be performed according to our procedures. The Vehicle history book will be updated to reflect the change made in the Vehicle. Bombardier Quality Assurance will also audit the serialization process to ensure that the tracking of these modifications is up-to-date and complete.

In conclusion, Bombardier's processes are thorough and well-established ensuring a proactive approach to Quality Assurance. As a result, we will design and produce quality vehicles to fully meet the Authority's expectations.

Appendix A
Nonconformity Management in the Realization Phase (VCM)
(AME-40-10-25-010020)

4) Quality Assurance Plan

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Title:				
<h1>PROCEDURE</h1> <h2>Nonconformity Management in the Realization Phase (VCM)</h2>				
Purpose: To allow the proper management and resolution of nonconformities during the realization phase and allow the various departments to come to a final decision by mutual agreement on the disposition of a nonconforming product.				
Scope: This procedure applies to all BTNA production centers which reference it in their quality plans.				
Responsible unit:	Process owner:	Document type:	Confidentiality status:	Document state:
AME	Quality	Procedure	Internal	Released
Prepared:	Sylvain Tetreault Ing.Jr. Continuous Improvement Agent _____ Author	e-approved	2013-10-04	
Verified:	Michel Cloutier SAP Business Expert, Quality _____ Sponsor	e-approved	2013-01-11	
Approved:	Marc Macot Divisional BTIP Coordinator _____ BTIP	e-approved	2013-01-11	
Released:	Christine Brasseur VP Performance Management & Design Center _____ Process owner	e-approved	2013-01-14	
		Signature	Date	
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		AME-40-10-25-		010020
		Effective date:	Revision:	Original Language:
		Released	02.02	EN
Translated by:		Translation approved by:		Translation languages:
Name / Function		Name / Function		

Doc ID-number: 010068 rev02

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Revision log

Revision	Date (yyyy-mm-dd)	Description of changes
00	2012-07-20	First issue, transfer from AQ 406 into an AME following SAP implementation
01	2012-09-24	New name. Mapping updated to show the part process as much as the transactional process with all functions tasks/responsibility. Link roles to VCM training material for more detailed instructions. Executive summary and SIPOC revised accordingly. Reference document updated.
02	2013-01-14	Update of Visio mapping to match current process
02.01	2013-09-13	Aligned with Q6 (AME-012059), updated reference doc, clarification of MRB for Car/Major Sub and addition of MRB task in case of Car/Major Sub. Wording improvements.
02.02	2013-11-11	Part of sentence removed in Executive Summary to reduce interpretation.

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	7.2 Use of Suspended Products	11
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8	Archiving of Business Process Documentation	11

1 Executive summary

The purpose of this procedure is to:

- Prevent usage of non-conforming parts until repaired, reworked, scrapped, returned to vendor or approved by the relevant authority (QA and/or Customer).
- Inspect part, assembly or car and define discrepancy with specifications, drawings or standards.
- Take the appropriate decision (disposition) and action: Root Cause Analysis, Purge, Create Instructions for Repair/Rework, RTV or Scrap, Setup Incoming Inspection.
- Complete task in SAP-VCM and gather relevant data for traceability, further analysis and archiving.

2 Reference documents

Number	Parent Document
AME-40-10-00-000557	BTNA Quality Assurance Handbook



This document



Number	Reference Document
AQ 406.01	Nonconforming Material Report (NCR)
AME-20-30-40-010081	Receiving inspection
AME-20-30-40-012043	Quality Control Labels
VCM NCR Tool	VCM NCR Tool for purchase parts (Transactional instructions for SAP)
AQ407	Identification and correction of snags on car assembly line
AME-40-10-20-004875	Corrective and Preventive Action Management
AME-20-30-35-012038	Manage Return Material from Production and Customer
AME-20-25-00-012020	Manage Good Receipt
AME-20-40-20-012021	Manage Shipping
AME-20-15-15-001395	Manage Chargebacks
AME-40-10-20-008060	BTNA NCC Capture Process (Supplement to GRP-0004536)
AQ551	Car History Books Management
GRP-40-10-20-007660	Defect Codes and Change Categories
AME-30-10-00-012059	Applying Q6 principles in BTNA production (Not yet released)
QU_05	QU05_NCC Coordinator BTNA_PRES_EN*.pptx QU05_QA_Inspector BTNA_PRES_EN*.pptx (Quality Controller SAP-VCM Training Packages)
QU_01	QU01_Quality Manager_PRES_EN*.pptx (Quality Manager SAP-VCM Training Package)
PL08	PL08_Create_Repair_order_EN*.pptx Planning_Create_repair_order*.vsd (MRP Controller NCR task SAP-VCM Training Package)
LO04	LO04 Shipping Technician_BTNA_PRES_EN*.pptx (Shipping Technician SAP-VCM Training Package)
LO02	LO02 Warehouse Supervisor BTNA_PRES_EN*.pptx (Warehouse Supervisor SAP-VCM Training Package)
ENL1	3-ENL1_EN*.pptx (BTNA Engineer NCR task SAP-VCM Training Package)

The current status of each business process document is documented on the coversheet of the available document in the respective database (e.g. in SDD BTNA Document Management and eBTM).

3 Involvement of functions

Activities for this document	Functions																							
	Business Units												Central and Support											
	Project Management	Finance	Engineering	Technical Services	Human Resources	Quality	Continuous Improvement	Health, Safety, and Environment	Procurement	Inventory	Planning	Product Introduction	Manufacturing Operations	Human Resources	Finance	Information Services	Contracts & Legal Affairs	Communication	Strategy	Business Development & Sales	Bids & Proposal	Development Office	Design Center	Quality Performance Management
Draft of the documentation																							R	R
Verification of the document			C			C			C	C	C		I										R	R
Approval of the document																							R	R
Release of the document																							R	R

R = Responsible

C= Consultation

I = Information

4 Definitions and Abbreviations

Term

Definition

Nonconforming Material Report (NCR)

Document used to suspend the use of nonconforming product. It is issued by Quality Assurance and is distributed to other business disciplines to support and document decisions concerning the disposition of the nonconforming material. In SAP-VCM, the electronic document is called Quality Notification (QN).

Quarantine

A quarantine area is a limited access area, which is used to store nonconforming product. When a product cannot be stored in a quarantine area, it must be clearly identified to prevent an unauthorized use in production.

Material Review Board (MRB)

The person or the team nominated (at least QA, Method & SM) to decide about part disposition. In case of discrepancy on a car or major assembly, it is a team (including QA, Prod, Meth, Eng & SM, as required) that go & see to disposition in a timely manner.

Defect Code

This field identifies the type of defect. The defect code is identified in the NCR by Quality Assurance at the time of issuance of the document, otherwise after the analysis of the nonconformities by the MRB. The list of code is found in GRP-40-10-20-007660

Cause Code

This field identifies the responsible of the nonconformity. The cause code is identified on the NCR by Quality Assurance after the analysis of the nonconformity by the MRB or after investigation. Only Quality Assurance has the authority to issue or to modify this code in the

NCR. Mandatory for NCC categorization.

Rework	Action on a nonconforming product to make it conform to the requirements for instance by carrying on a missing or incomplete operation.
Repair	Action on a nonconforming product to make it acceptable for the intended use . Unlike rework, repair can affect or change parts of the nonconforming product. May need customer and/or supplier approval.
Use as is	This decision indicates that the nonconforming product can be used. The signature of the engineering department is mandatory for a structural part or a part that derogates from specification. May need customer and/or supplier approval.
Return to supplier	This decision requires a shipping notice issued by Supply Management, which is attached to the NCR. Also need a PO
Scrap	Destruction or the disposal of a part. Quality Assurance must be able to testify that the product will not be used in production.

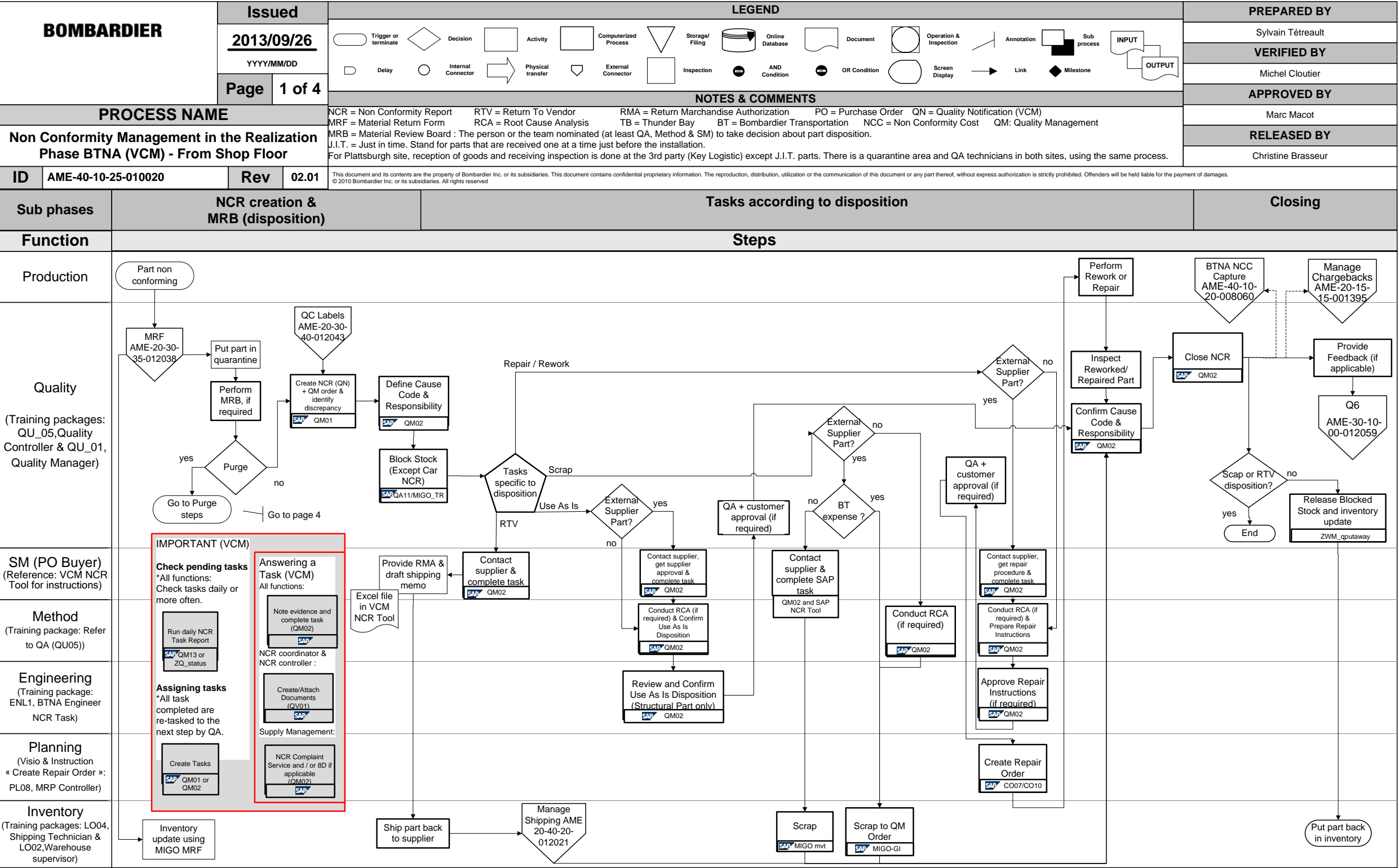
Definitions and abbreviations are defined in the Bombardier Transportation Lexicon in ExpressNet.

5 Process Characteristics (SIPOC)

Suppliers -Production & Receiving (Provide suspected parts or issue on car/assy) -Customer (spec) -Engineering (technical doc + drawing)	Process description -Detect and remove any defects from the line and prevent usage of defective products until reworked, repaired, scrapped, returned to vendor or approved by the relevant authority (QA and/or Customer).	Customers -Production & Inventory (good part) -Shipping (part to ship) -Quality (NCC for analysis & reporting) -Customer (Conforming car & history book)
Inputs -Suspected or defective part or car/major assembly. -Blank Material Return Form -Engineering Change Order / Method Change Order -The Technical descriptions (TD) or Technical Requirements Documents (TRD), drawings, standards & customer's technical specifications for inspection -NCR history for analysis -Quality Control Labels		Outputs -Good (or approved) part for production - Good (or approved) car or major assembly for customer -Request for incoming inspection option enabled in VCM (if required) -Nonconformity costs (Costs to chargeback if caused by supplier) -Quality Notification (QN) documented in VCM (with documents/evidences attached) -Car NCR signed by supplier (if required) -Engineering documents (for archive)
Recommended Indicators Critical to Cost : Number of open NCR (Total &/or per Functions/Task) Critical to Delay : Number of day open for NCR (Available in BI)		

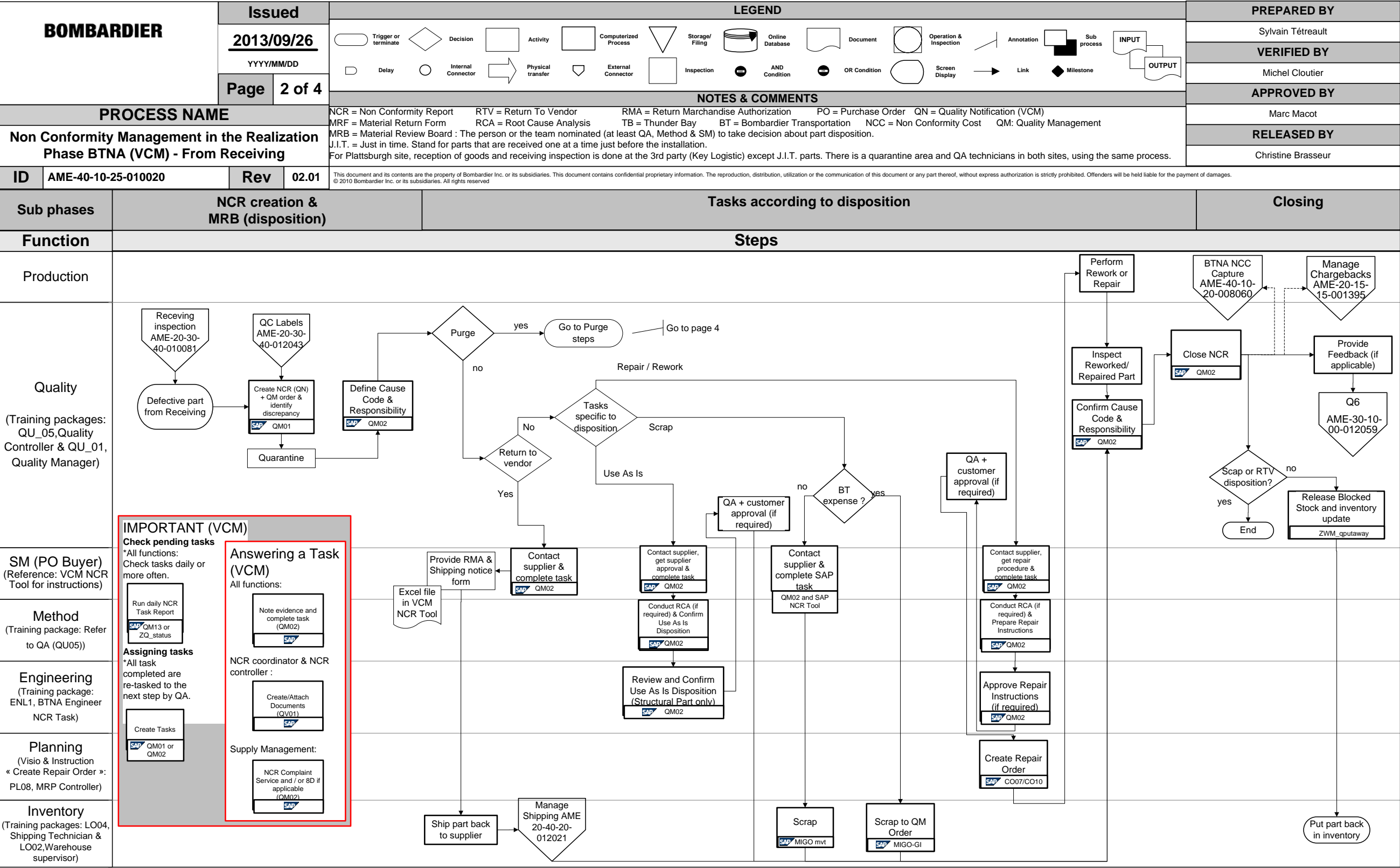
6 Process Mapping

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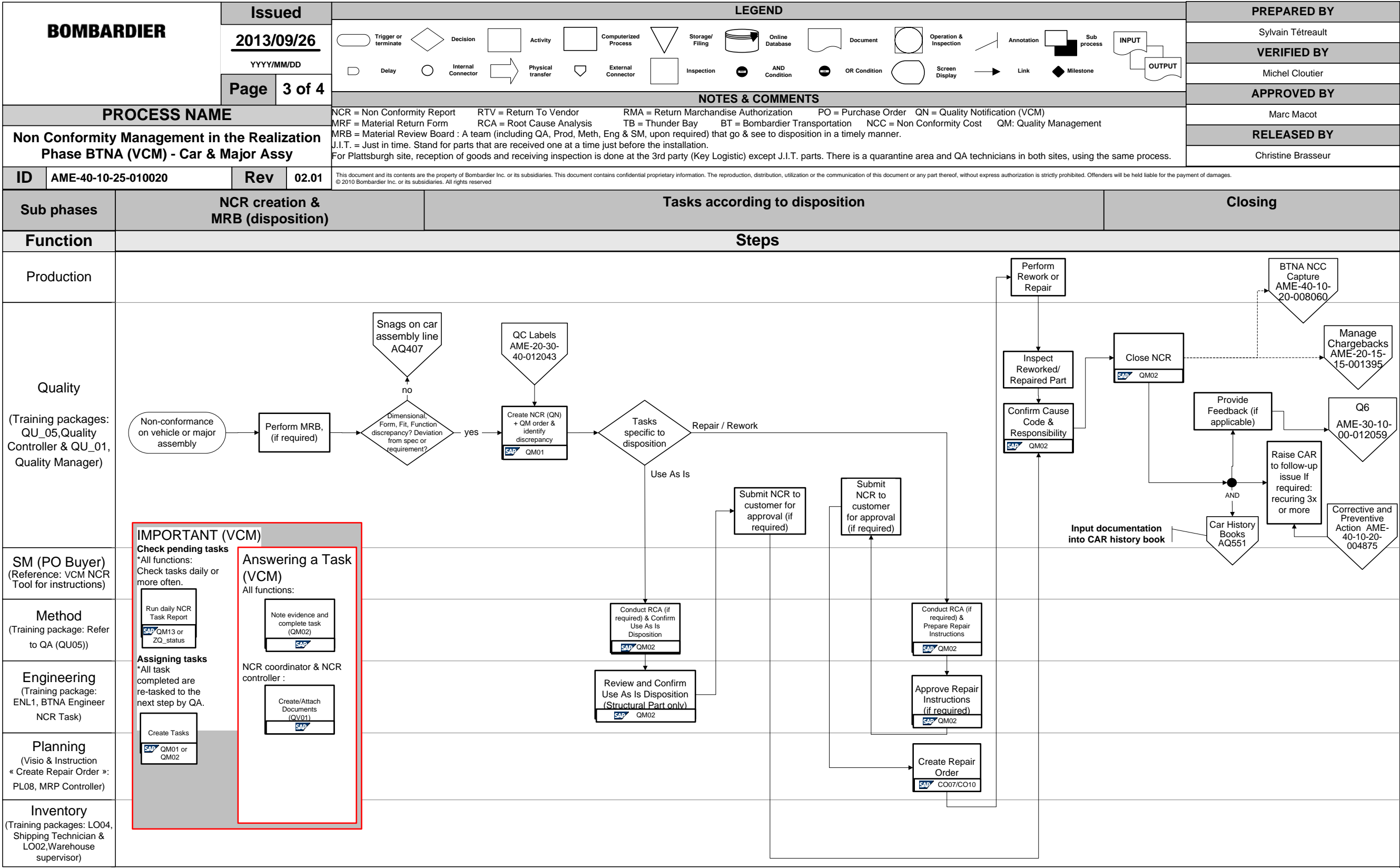
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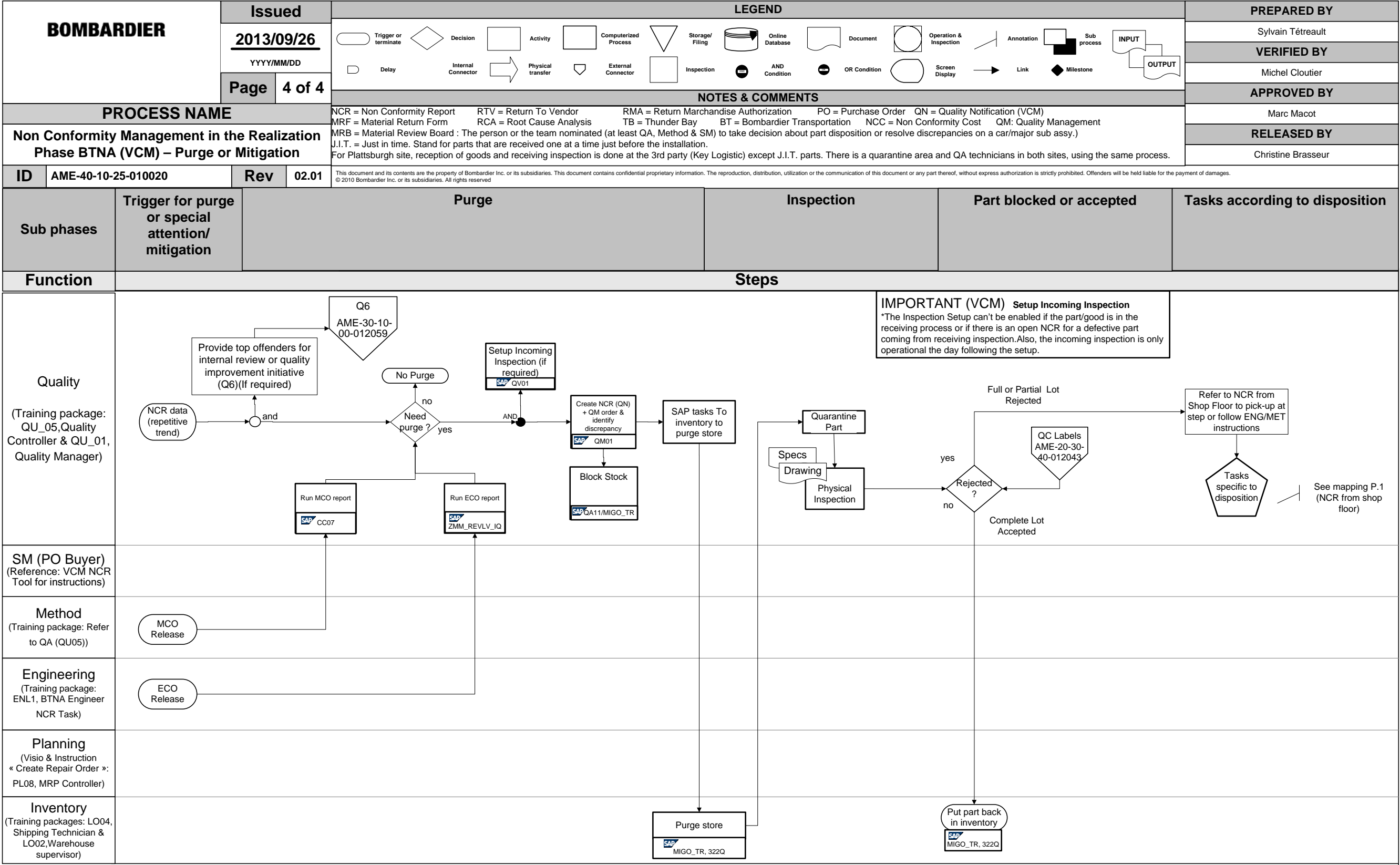


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7 Process Description (supplement to process mapping)

7.1 Part and defect on car/assy identification

As per AME-20-30-40-012043, Quality Control Labels, all product or lots of products stored in the quarantine area, and defect on car/assembly, must be identified with one of the following quality indicators:

- 012043.02 (AQ 500.04) Suspension;
- 012043.04 (AQ 500.08) Scrap;
- 012043.05 (AQ 500.10) Repair;
- 012043.06 (AQ 500.12) Rework;
- 012043.07 (AQ 500.14) Return to supplier.

The product is controlled by the Quality Assurance department and cannot be used for production purposes without authorization. A quality Indicator shall be affixed or removed only by an authorized Quality Assurance representative.

7.2 Use of Suspended Products

When a suspended product (serialized or not serialized) must be released for urgent production need, it must be identified by means of a quality indicator 012043.02(AQ 500.04) "Suspension" or 012043.21(AQ 500.40) "Positive Recall" on one of its visible sides at the time of production. It must be identified by means of an identification sheet (pick list GS62B-98) which must be attached as annex to the NCR to ensure its traceability. The identification sheet must be approved by the Quality Assurance Supervisor. The use of Positive Recall may require customer approval.

7.3 Paper NCR form

The NCR form AQ406.01 is the paper way to manage nonconformity when, exceptionally, SAP-VCM is unavailable or down at the time of the resolution. Afterward, the information on the paper form should be transferred in SAP-VCM in order to document the issue. All tasks should be done through SAP-VCM as soon as possible in order to make the inventory accurate and capture NCC.

8 Archiving of Business Process Documentation

Business process documents shall be maintained and archived in accordance with directive AME-40-10-05-007218 "Control of Business Process Documentation for BTNA" and in accordance with instruction AME-40-10-05-008053 "Records Transfer for Archiving to a Storage Site".

End of document

Appendix B
Establish and Validate Quality Requirements
(AME-20-15-15-012044)

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Title:				
<h1>Procedure</h1> <h2>Establish and Validate quality Requirements</h2>				
Purpose: Standardize the requirements setting of the purchased products. Define the method to be used for setting the appropriate requirements on purchased products.				
Scope: This procedure is applicable for all BTNA sites.				
Responsible unit:	Process owner:	Document type:	Confidentiality status:	Document state:
AME	Quality	Procedure	Internal	Released
Prepared:	Annick Harvey SAP Business Expert, Quality Author	e-Approved	2012-10-16	
Verified:	Michel Cloutier QA SAP VCM Sponsor	e-Approved	2012-10-19	
Approved:	Marc Macot Quality Improvement Specialist BTIP	e-Approved	2012-10-19	
Released:	Christine Brasseur VP procurement management and design center Process owner	e-Approved	2012-10-22	
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		AME-20-15-15-		012044
		Effective date:	Revision:	Original Language:
		2012-10-22	00	
Translated by:		Translation approved by:		Translation languages:
Name / Function		Name / Function		

Doc ID-number: 010068 rev01

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Revision log

Revision	Date (yyyy-mm-dd)	Description of changes
00	2012-10-22	First issue, transfer from AQ310 into an AME following SAP implementation

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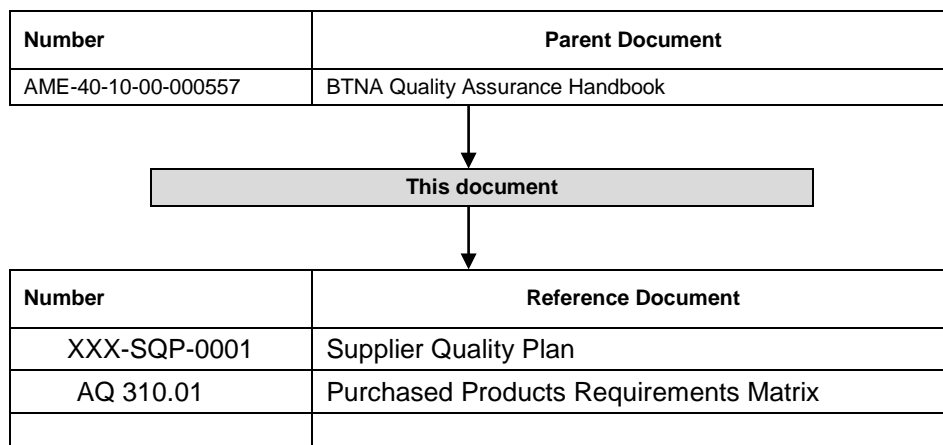
1 Executive summary

All Bombardier Transportation -North America activity centers using this procedure referenced in the Quality Assurance Handbook and/or Project Quality Plans.

The requirements setting apply to all purchased products registered in the Bombardier Manufacturing System (SMB).

All contracts assigned to Bombardier Transportation- North America

2 Reference documents



The current status of each business process document is documented on the coversheet of the available document in the respective database (e.g. in SDD BTNA Document Management and eBTM).

3 Involvement of functions

Activities for this document	Functions																			
	Business Units												Central and Support							
	Project Management	Finance	Engineering Project Office	Human Resources	Quality	Continuous Improvement	Health, Safety, and Environment	Manufacturing Engineering	Procurement	Logistics	Product Introduction	Manufacturing Operations	Plant Engineering	Human Resources	Business Development & Sales	Development Office	Design Center	Communications	Contracts & Legal Affairs	Finance
Draft of the documentation					R															
Verification of the document			C		R			C	C											
Approval of the document					R															R
Release of the document																				R

R = Responsible

C= Consultation

I = Information

4 Definitions and Abbreviations

<u>Term</u>	<u>Definition</u>
TD:	Technical descriptions
TRD:	Technical Requirements Documents

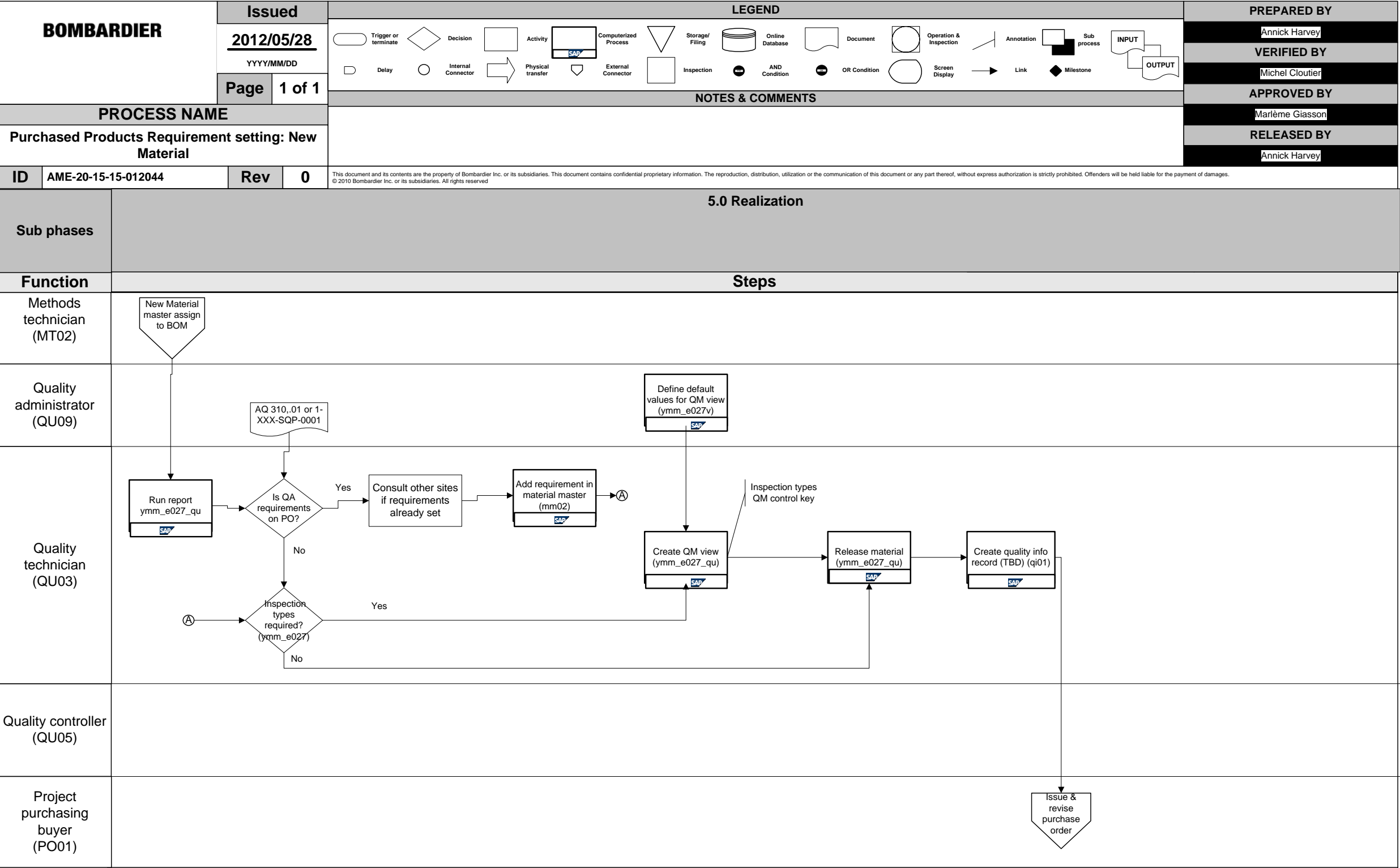
Definitions and abbreviations are defined in the Bombardier Transportation Lexicon in ExpressNet.

5 Process Characteristics (SIPOC)

Suppliers Customer Engineering Procurment	Process description Gather product specification in order to have a complete picture of purchased products	Customers Procurement Engineering
Inputs The Technical descriptions (TD) or Technical Requirements Documents (TRD); The technical drawings The standards The customer's technical specifications		Outputs AQ 310.01 Purchased Products Requirements Matrix
Indicators TBD		

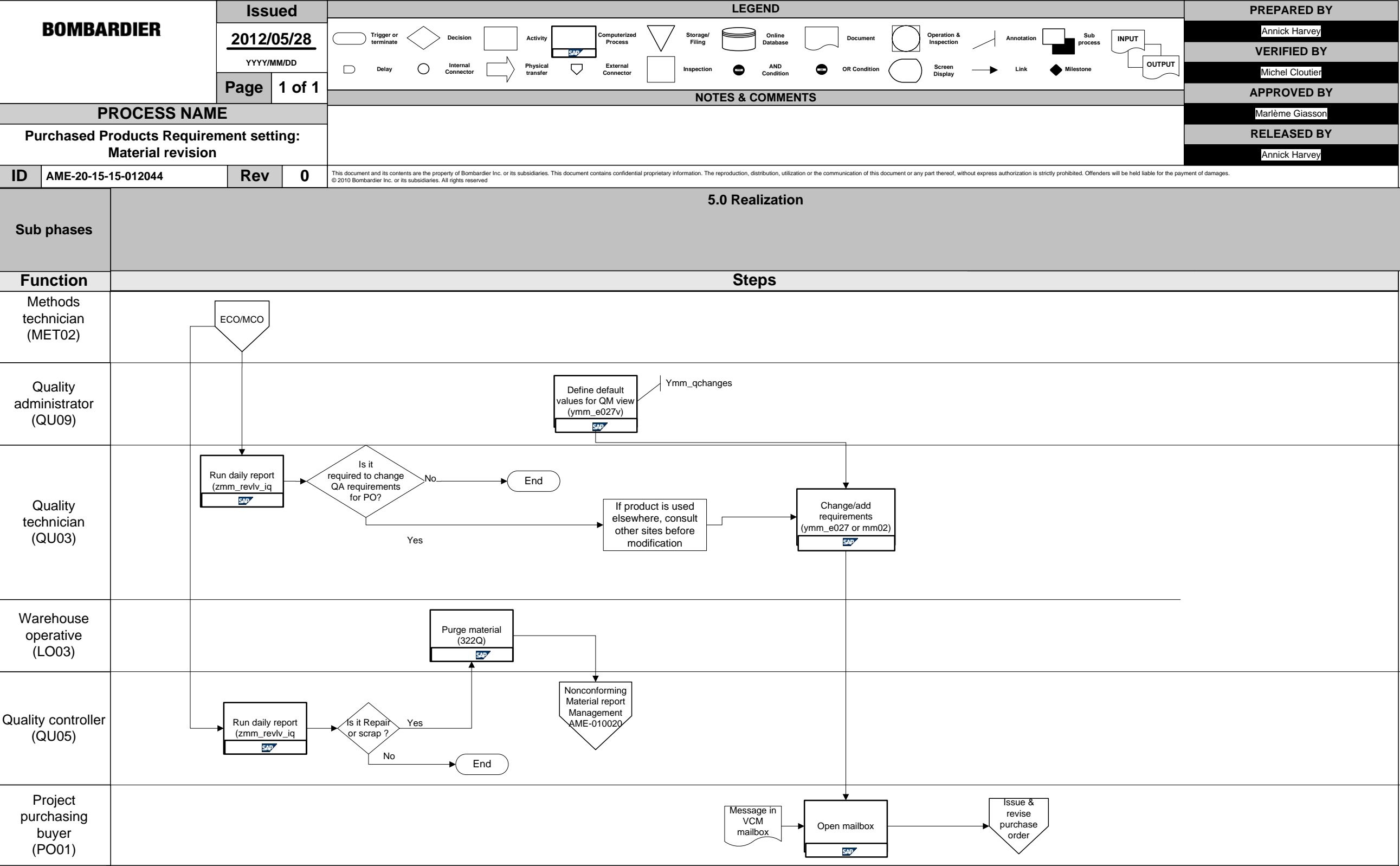
6 Process Mapping

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7 Process Description (supplement to process mapping)

7.1 Quality assurance

The Quality Assurance agent is responsible for setting the proper requirements for all purchased products registered in SAP.

7.2 Engineering department

The Engineering department is responsible for indicating in the product description whether a fire, smoke and toxicity (FST) standard and a report are required when issuing the technical specification.

8 Archiving of Business Process Documentation

Business process documents shall be maintained and archived in accordance with directive AME-40-10-05-007218 "Control of Business Process Documentation for BTNA" and in accordance with instruction AME-40-10-05-008053 "Records Transfer for Archiving to a Storage Site".

End of document

Appendix C
Receiving Inspection
(AME-20-30-40-010081)

4) Quality Assurance Plan

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Title:				
<h1>PROCEDURE</h1> <h2>Receiving Inspection</h2>				
Purpose: The purpose of this procedure is to ensure the use of uniform method for: <ul style="list-style-type: none"> - The QA receiving activities - The management of parts that do not require receiving inspection.(waive inspection) 				
Scope: Applies to all manufacturing sites of BTNA.				
Responsible unit:	Process owner:	Document type:	Confidentiality status:	Document state:
BTNA	Quality	Procedure	Internal	Released
Prepared:	Michel Cloutier Quality SAP Business Expert _____ Author	e-Approved	2012-11-07	
Verified:	Steve Paquet Quality Director _____ Sponsor	e-Approved	2012-11-12	
Approved:	Marc Macot Quality Improvement Specialist _____ BTIP	e-Approved	2012-11-12	
Released:	Christine Brasseur Vice President, Quality, Strategy, Performance Management and Design Centre _____ Process owner	e-Approved	2012-11-22	
		Signature	Date	
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		AME-20-30-40-		010081
		Effective date:	Revision:	Original Language:
		2012-11-22	02	EN
Translated by:		Translation approved by:		Translation languages:
Name / Function		Name / Function		

Doc ID-number: 010068 rev02

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Revision log

Revision	Date (yyyy-mm-dd)	Description of changes
00	2010-09-15	First issue, supersedes AQ 302 and AQ 311
01	2012-06-27	New process linked to SAP implementation and revision of quality indicator codes (sections 7.2 and 7.5) AQ 500 changed to AME 20-30-35-012043 rev 00
02	2012-11-22	Information added in the flowchart to define which training manual to use for each function

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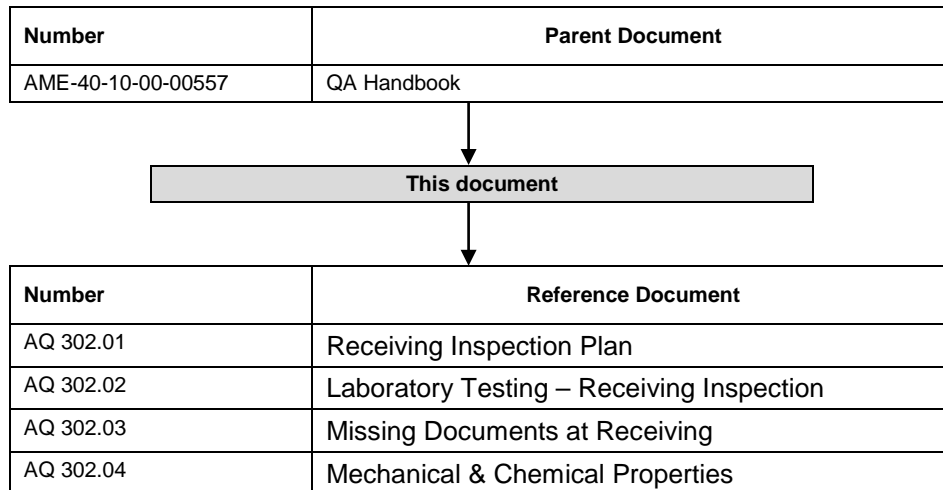
Section	Subject	Page
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1 Executive summary

Define the method to perform the receiving inspection of products. This process includes:

- Prepare the inspection plans;
- Perform the product inspection;
- Create and maintain the list of parts that do not require receiving inspection (waive inspection).

2 Reference documents



The current status of each business process document is documented on the coversheet of the available document in the respective database (e.g. in SDD BTNA Document Management and eBTM).

3 Involvement of functions

Activities for this document	Functions																									
	Business Units													Central and Support												
	Project Management	Finance	Engineering	Technical Services	Human Resources	Quality	Continuous Improvement	Health, Safety, and Environment	Procurement	Inventory	Planning	Product Introduction	Manufacturing Operations	Human Resources	Finance	Information Services	Contracts & Legal Affairs	Communication	Strategy	Business Development & Sales	Bids & Proposal	Development Office	Design Center	Quality	Performance Management	President Office
Draft of the documentation																									R	
Verification of the document						R																				
Approval of the document								I																	R	
Release of the document								I															R	R		

R = Responsible

C= Consultation

I = Information

4 Definitions and Abbreviations

Term

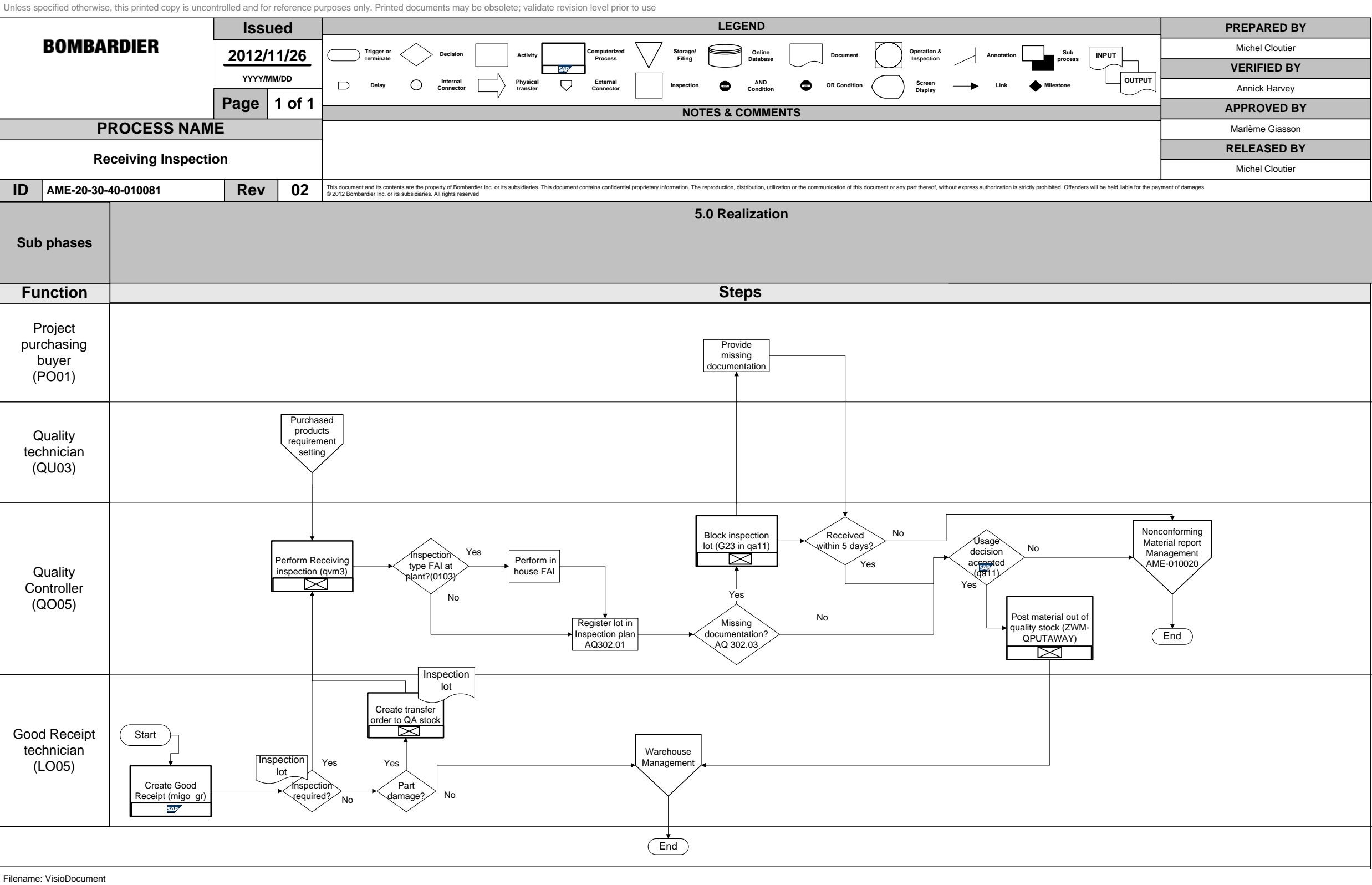
Definition

Definitions and abbreviations are defined in the Bombardier Transportation Lexicon in ExpressNet.

5 Process Characteristics (SIPOC)

<i>Suppliers</i> Supply Management Quality Assurance Customer	<i>Process description</i> Prepare the inspection plans Perform the product inspection Create and maintain the list of parts that do not require receiving inspection	<i>Customers</i> Production Quality Assurance
<i>Inputs</i> Product Quality Requirements Inspection Plan parameters		<i>Outputs</i> Product inspected Inspection Plan completed
<i>Indicators</i> N/A		

6 Process Mapping



7 Process Description (supplement to process mapping)

7.1 Inspection Plan preparation

The Inspection plan can be accomplished by using either an electronic system or AQ 302.01.

If AQ 302.01 is not used (non-waived item), the material must be validated against the inspection parameter(s) required by the SAP system (i.e. MM03.) and sampling plan AQ 101. All information must be entered into an electronic system (e.g. SAP) including serialization (if applicable in Solochain). The approval of the product in the electronic system will indicate the Inspection parameter(s) were met.

If AQ 302.01 is used, the following table represents the information required during receiving inspection.

Identification	Inspection Parameters	Inspection Results	Status
Issuance date	Customer samples	Inspection date	Quantity of accepted products
Bombardier Material number	Configuration control	Contract number	Quantity of suspended products
Description of the product	Serial number	Inspection lot number	Nonconforming Material Report number (NCR no.) (if applicable)
Drawing number(s)	Template number		QA technician's initials and stamp
Inspection level of sampling plan	Required documentation (test report, mill report, NDT report, mechanical and chemical properties of raw material, etc)	Lot size	Date
Name of person who prepared the inspection plan	All sub-contracted work that must be controlled (plating, anodization, machining, etc)	Quantity inspected	
Supervisor's approval signature (or his equivalent designated) after the inspection plan has been written		Drawing revision	
		Data gathered throughout the inspection	
		Release Notice (if applicable)	
		Configuration	

Section: Identification

The QA technician fills out the "Identification" section used to identify which product the inspection plan applies to.

Section Parameters:

The QA technician then fills out the "Inspection Parameters" section by writing down all the items to be inspected, visual and dimensional, as well as the acceptance criteria and other contractual requirements that will allow a decision on the acceptance or suspension of the product.

The data used to fill out this section is found in the operation system, Bombardier C&P Hardware Books, supplier product catalogues, drawings, contractual requirements, and any other associated materials. If the first page of control sheet AQ 302.01 does not allow enough space to write down all the required inspection parameters, the second page of this control sheet may be used. The inspection plan must be approved by the Supervisor or his equivalent designated by the Quality Assurance representative.

The withdrawal of an inspection parameter implies the revision of the inspection plan and its approval by the Supervisor or his equivalent designated by the Quality Assurance representative. However, upon the addition of an inspection parameter, none of these actions is required.

Sections: Inspection Results and Status

The QA technician fills out the control sheet by recording the information in the "Inspection Results" section.

If some inspection parameters of the control sheet are not applicable to a particular receiving, they must be noted as N/A (not applicable).

7.2 Identification of inspection status

The QA technician identifies the accepted products or lots of products with an "Accepted" (012043.01E) or "Accepted, parts none completed" (012043.09E or 012043.10E) Quality indicator on which he applies his initials, his stamp, and the date. It is not necessary to place an indicator on each piece as long as the lot received has status identified.

The QA technician identifies the suspended products or the lot of parts with a "Suspension" (012043.02E) Quality indicator on which he applies his initials, his stamp, the date, and the NCR number of the report that he filled-up. It is not necessary to place an indicator on each piece as long as the lot received has status identified.

In certain cases, when it is not possible to affix a quality indicator on the product, it is clearly necessary to identify the status of the product, the QA technician (initial and stamp) and date. It is possible to use a container or an indicator which is attached to the piece to write down the necessary information.

Each product piece does not require a quality indicator if the box or container holding the product has an indicator on it. The quality indicator of container is sufficient for all products within the container. If more than one container is used, it is not necessary to have an indicator on each container as long as the lot of material has status identification.

7.3 Waive inspection

The products in derogation of inspection are products for which inspection is waived and do not need to be inspected. They are automatically accepted at the Good Receipt transaction and they enter directly in stores or to the production line.

For a product to dispense from an inspection, at least one of the following conditions must be fulfilled:

- Last 5 lots of the product have been accepted without any rejection other than Bombardier responsibility;
- Items managed by a supplier (Vendor Managed Inventory or Kanban);
- Items shipped in just in time;
- Items originating from another site of Bombardier;
- Commercial off-the-shelf (COTS) items.

Voiding waive inspection applies when one of the following occurs:

- Changes of quality requirements in Material Master affecting the part;
- Revision of the inspection plan AQ 302.01 affecting the part;
- Results of nonconformities in previous inspections;
- NCR Supplier responsibility;
- Problem in production;
- Design change.

7.4 Inspection required

This list of parts should not be waived (if applicable):

- Serialized part,
- Part requiring certification of compliance, inspection report, etc... (If required by contract specification)

7.5 Use of suspended products

The Quality Assurance Supervisor or his equivalent designated by the Quality Assurance is responsible for approving the use of not serialized suspended products.

When a suspended product (serialized or not serialized) has to be released for urgent production purpose, it must be identified by means of a "Suspension" (012043.02E) quality indicator on one of its visible surface during production installation, it must be reported by means on an identification sheet (ex.: pick list GS62A) and attached to an NCR to ensure its traceability. It must be approved by the Quality Assurance Supervisor or his equivalent designated by Quality Assurance representative.

7.6 Products requiring laboratory tests

Two types of tests with different characters control sheets are necessary for lab testing:

Laboratory Testing – Receiving Inspection, AQ 302.02;

Mechanical and Chemical Properties, AQ 302.04.

When the received products require laboratory tests, the QA technician uses control sheet AQ 302.02 and sends it to the laboratory with the products to be tested.

When the received raw material requires laboratory tests, control sheet AQ 302.04 is prepared by the QA technician and sent to the laboratory for testing. Tests that need to be done are indicated on the Inspection Procedure. The QA technician brings a sufficient sample size of the material to be tested.

8 Archiving of Business Process Documentation

Business process documents shall be maintained and archived in accordance with directive AME-40-10-05-007218 "Control of Business Process Documentation for BTNA" and in accordance with instruction AME-40-10-05-008053 "Records Transfer for Archiving to a Storage Site".

End of document

M/WBE PARTICIPATION

Tab I.5

5. M/WBE PARTICIPATION

A. Completed M/WBE Utilization Form

The Offeror shall provide a completed M/WBE Utilization Form indicating the percentage of the Base Award Price and Total Proposal Price to be supplied by qualified M/WBEs under the Contract. For purposes of this requirement, the MBTA will only accept M/WBEs that are certified, at the time of proposal opening by the Massachusetts Supplier Diversity Office formerly known as the State Office of Minority and Women Business Assistance.

Please note that Bombardier's M/WBE Utilization Form (as RFP page B-86) is provided under Part B – Technical Proposal and Statements and Certifications Regarding Eligibility, Section Forms and Certifications.

B. M/WBE Participation Schedule

The Offeror shall provide an M/WBE Participation Schedule identifying those qualified M/WBEs with whom the Offeror intends to contract for the performance of the portions of the work under the Contract, the work to be performed by each qualified M/WBE, a proposed timetable for the performance or delivery of the Contract item, and other information as required by the M/WBE Participation Schedule form annexed to this Section. No work shall be included in the Schedule that the Offeror has reason to believe the listed M/WBE will subcontract, at any tier, to other than another M/WBE.

Please note that Bombardier's M/WBE Participation Schedule (as RFP page B-87) is provided under Part B – Technical Proposal and Statements and Certifications Regarding Eligibility, Section Forms and Certifications.

C. Completed M/WBE Letter of Intent and Affidavit

The Offeror shall provide a completed M/WBE Letter of Intent from each M/WBE listed in the M/WBE Participation Schedule using the form annexed to this Section, and a copy of the most recent certification letter or other documentation establishing the M/WBE certification of each M/WBE listed on the M/WBE Participation Schedule, and an M/WBE Affidavit executed by each M/WBE listed in the M/WBE Participation Schedule stating that there has not been any change in its status since the date of its last certification.

Please note that (i) the Letters of Intent, (ii) the most recent certification letters or other documentation establishing the M/WBE certification and the (iii) Affidavits (as per RFP page B-88 and B-89) of each M/WBE listed in the M/WBE Participation Schedule are provided under Part B – Technical Proposal and Statements and Certifications Regarding Eligibility, Section Forms and Certifications.

D. Ensure overall compliance with the MBTA's policy

The Offeror shall provide a narrative explaining how the Offeror intends to ensure overall compliance with the MBTA's policy of promoting equity and opportunity for M/WBEs and the good faith efforts it has made to obtain M/WBE participation. The Offeror shall include in the narrative the strategies it has and will use to obtain subcontractors and suppliers, including but not limited to documented communication with the Authority's Office of Diversity and Civil Rights, use of information concerning M/WBE subcontracting opportunities provided by the MBTA during the pre-proposal conference and/or through other means, the Offeror's solicitations to obtain M/WBE involvement in general circulation media, trade association publications, minority-focused media and other reasonable and available means within sufficient time to allow M/WBEs to respond to the solicitation, written notification to M/WBEs encouraging participation in the proposed Contract, and efforts made to identify specific portions of the work that might be performed by M/WBEs. At a minimum, the Offerors should provide the names, addresses, telephone numbers of M/WBEs that were contacted, a description of the information provided to targeted M/WBEs regarding RFP's work requirements, and efforts made to assist M/WBEs contacted in obtaining bonding or insurance required by the Offeror or by the Authority. Offerors are referred to 49 CFR Part 26 and OSD Construction reform Program, Attachment C (Municipal Contracts State-Assisted Building Projects), Section A, 4-10 for additional guidance concerning actions that are commonly considered good faith efforts to obtain M/WBE participation.

Creating opportunities for Minority and Women Business Enterprises is very important to Bombardier for all contracts. Bombardier strives to actively implement the M/WBE to foster their participation in the State of Massachusetts. As demonstrated in the M/WBE Utilization Form, Bombardier has already elected to work with at least 6 M/WBE firms for 9 different scopes of work. Bombardier will work diligently with such proposed Suppliers listed in Part B – Forms and Certifications tab *B-94 Manufacturer Subcontractors/ Suppliers* and other *Massachusetts Supplier Diversity Office* in a best faith effort to achieve maximum M/WBE content.

Bombardier recognizes the importance of being committed to achieving the maximum M/WBE content on the MBTA Orange and Red Lines Contract. Bombardier's approach on the MBTA Orange and Red Lines programs, as well as on past projects, is to provide maximum opportunity to the certified M/WBE firms both prior to and after Contract award. This allows Bombardier and the potential Supplier ample opportunity to identify value added supply and service solutions.

Bombardier has currently identified 2.44% of M/WBE content for this initial proposal submittal; we will continue strong efforts leading up to BAFO phase and into contract execution to improve this level of content.

Should Bombardier be afforded the opportunity to undertake the MBTA Orange and Red Line Contract, our program and purchasing team will work closely with the proposed Suppliers listed as well as with major suppliers to help identify how *Massachusetts Supplier Diversity Office* certified M/WBE's can add value and participate in the Project. As a result of these efforts, and even if our list is extensive, Bombardier's staff is very experienced at evaluating competent Suppliers and at identifying all applicable opportunities for MSDO certified M/WBE's. Bombardier will further be pleased to cooperate with the Authority to seek opportunities for M/WBE participation.

Bombardier welcomes opportunity to participate together with the MBTA Diversity Office to partner with Bombardier to support and assist us in identifying potential M/WBE firms that could fit with our identified scope of works.

Please find below a list of actions that Bombardier has undertaken/will take to optimize its MBE/WBE content:

- Bombardier attended the pre-bid meeting hosted by the MBTA and reviewed the attendees list to identify potential M/WBEs whom we contacted to obtain a quotation.
- Bombardier has sent a mailing to its entire selected supplier base to explain the importance of the M/WBE content for this Proposal.
- Bombardier has reviewed its internal processes and held workshops with the objective of unbundling work items of larger scope into smaller work packages to make the scope more accessible to a greater number of possible M/WBE suppliers. We successfully identified a number of these smaller work packages and were able to find additional M/WBEs to fulfill them.
- Bombardier has compiled a list of potential M/WBE firms from the Massachusetts Supplier Diversity Office directory and has circulated this information internally to our Procurement Department.
- We have assisted several DBE firms certified in other states in requesting their M/WBE certification with the Massachusetts Supplier Diversity Office.
- Bombardier held outreach session in New York, California and Texas to create synergies with new M/WBE suppliers in order to identify potential M/WBEs for this Orange and Red Line Vehicle Procurement. Judging by the very positive and eloquent comments, Bombardier was successful in creating an environment that was conducive to business and discovery which translated into additional MBE/WBE content for procurement.
- Bombardier has worked closely with 1 Berkshire Strategic Alliance to identify possible M/WBE firms specialized in other market niches, that could have the potential to enter the rolling stock market.
- During contract execution, throughout the design phase and the use of the facility in the Commonwealth of Massachusetts, Bombardier will continue to solicit M/WBE firms to participate in work scopes that will contribute to increase our M/WBE content level.
- Bombardier will work jointly with rolling stock Suppliers to develop a broader work base and to maximize the number of MBE/WBE Suppliers in Massachusetts.

- Once the contract awarded, Bombardier will be publishing a tailor-made invitation to bid in minority and women focused media to set attention on the opportunity to participate in the Contract. This invitation will detail all the work packages that are available for M/WBE to quote on.
- Bombardier will place advertisements in appropriate media and trade association publications announcing its interest in obtaining bids or proposals from MBE/WBEs.
- An activity log is included in Appendix A to demonstrate some of the efforts put forth by Bombardier to explore known and new M/WBEs for this Contract, and which include the coordinates of such M/WBEs.

E. Maintain continued efforts to preserve and enhance M/WBE participation

The Offeror shall provide a narrative explaining how during performance of the Contract it will maintain continued efforts to preserve and enhance M/WBE participation. Included within this narrative should be a description as to how the Offeror will interface with MBTA for outreach and assistance generally and with respect to the specific issues below. The narrative should describe how the Offeror will abide by the monitoring and reporting requirements in Section C7.16 of the Contract. Moreover, the narrative should describe dispute resolution procedures the Offeror will institute under its subcontracts with M/WBEs to encourage amicable resolution of disputes and continued performance by the M/WBEs. Finally, the narrative should describe procedures and guidelines for the termination of M/WBEs as well as for the identification and selection of substitutes.

Bombardier recognizes the importance of being committed to achieving the maximum M/WBE content on the MBTA Orange and Red Lines Contract. Bombardier's approach on the MBTA Orange and Red Line program, as well as on past projects, is to provide maximum opportunity to the certified M/WBE firms both prior to and after Contract award. This allows Bombardier and the potential Supplier ample opportunity to identify cost effective value added supply and service solutions.

Should Bombardier be afforded the opportunity to undertake the MBTA Orange and Red Lines Contract, our project and purchasing team will work closely with the MBTA Office of Diversity and Civil Rights to organize an outreach session to help identify certified M/WBE's that can add value and participate in the Project. Organizing outreach sessions are a integral part of our DBE and M/WBE Best Practices as demonstrated with our NYCT R179 and BART projects.

Bombardier takes pride in the way it has approached outreach sessions. We have been involved with these sessions for many years at different levels: local involvement to develop a DBE/MBE/WBE Supplier base in a given region, participation in Transportation Authorities and association organized outreach, organization of match-making sessions between our first tier Suppliers and DBE/MBE/WBE to create new working relationships, etc.

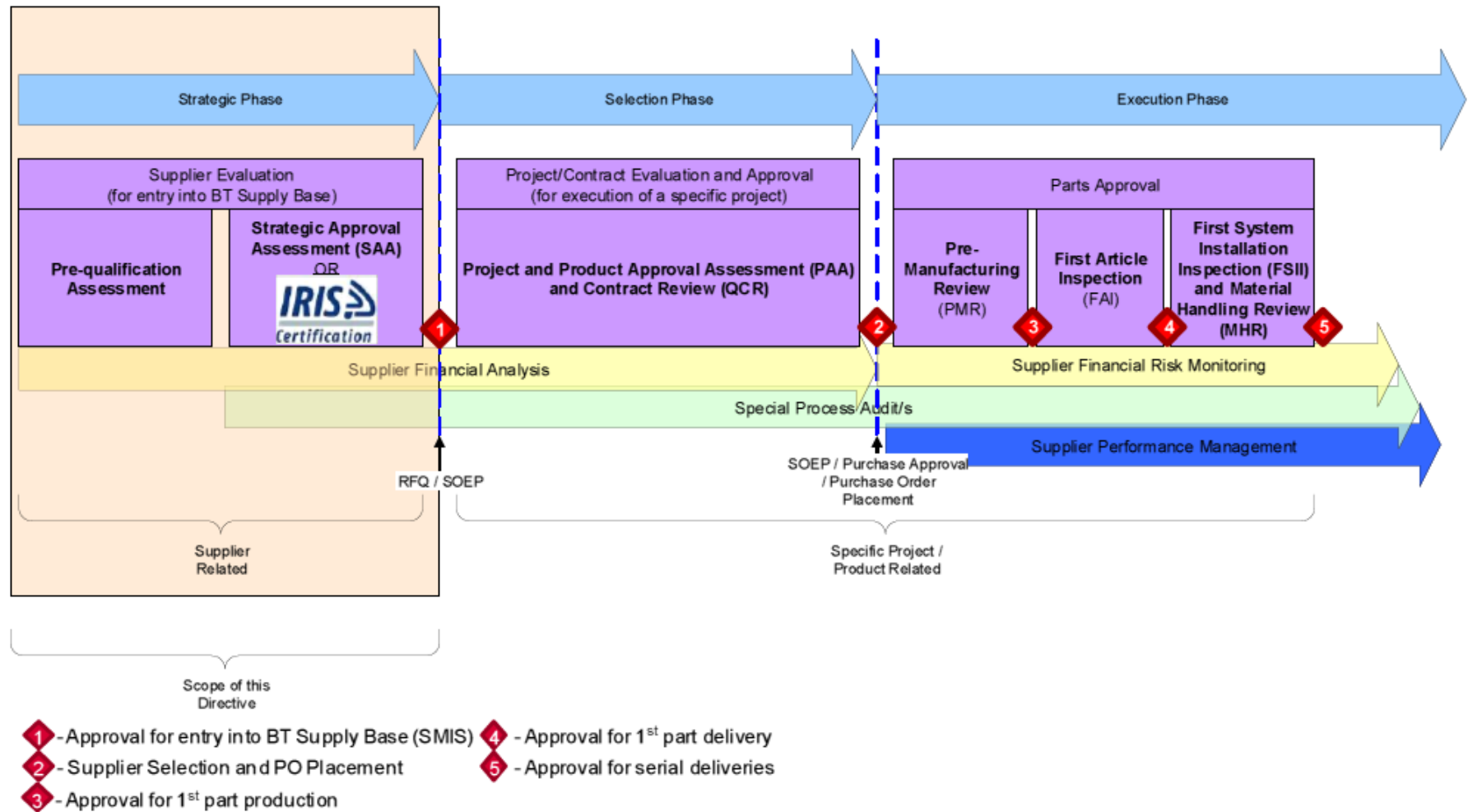
Bombardier is committed to organizing an M/WBE outreach session within 3 to 6 months of Contract signature in the State of Massachusetts to explore and develop the local M/WBE supplier base.

Bombardier will seek the help of Massachusetts Supplier Diversity Office (as required by the specification) identifying potential non-certified firms with the intention of assisting them with the process of certification.

The monitoring and reporting aspect of the Contract will be overviewed by a designated project procurement team person this person will be named once the Contract has been awarded to Bombardier. The selected person will be the single-point of contact for all communication pertaining to M/WBEs between Bombardier and the MBTA. This person will have the responsibility of producing the quarterly written reports and to search for ways of increasing our M/WBE content.

Because Bombardier prefers to be proactive, we have implemented the Strategic Approval Assessment (SAA) of the Suppliers Directive, a process which identifies and manages risk associated with initial Supplier Evaluation with the goal of providing a standard, rigorous methodology for the initial and periodic re-evaluation of a supplier's business management system. This assessment allows Bombardier to make an objective assessment of a Supplier's suitability for entry into the Bombardier Supply base through evaluation of their business management system.

Through this SAA Directive, Bombardier will conduct thorough analysis of all Suppliers' financials, risk assessment, quality standards, and performance data, including M/WBE Suppliers.



During the course of a project, the Supplier Performance Management (SPM) Procedure is applied. This procedure is a methodology used by the Supplier Performance Management (SPM) team to analyze, improve and report performances of Bombardier Supply base.

Each month the SPM team will highlight critical suppliers for which an in-depth Root Cause Analysis will be performed. The purpose of the Root Cause Analysis is to highlight recurrent issues and find solutions to address and eliminate these issues.

Key Performance Indicators (KPI) are generated for each supplier, focusing on:

- Non Conformity Reports (NCR)
- Receiving Discrepancy Reports (RDR)
- Special Transport Request (STR)
- On-Time Delivery (OTD)
- Back Order List

Once a Supplier has been put on the critical list, a Score Card will be generated to monitor the performance of the Supplier. If a Supplier Score Card is considered unacceptable for 2 consecutive months, SMP will initiate a Root Cause Analysis.

The result of the Root Cause Analysis will allow Bombardier and the Supplier to establish a Corrective Actions Plan to redress the situation.

The implementation of the above activities allows Bombardier to effectively monitor the supply chain and identify issues earlier, thus enabling a level of quality that meets our customer's standards and avoiding potential disputes with M/WBE Suppliers.

In the event that Bombardier would be forced to terminate for convenience a M/WBE listed in the M/WBE Participation Schedule and then perform the work of the terminated M/WBE Supplier with its own forces or an affiliate, it would not do so without MBTA's prior written consent. Bombardier shall make good faith efforts to find another M/WBE duly qualified to execute promptly the terminated scope of work and notify the MBTA in writing of its efforts to replace the original M/WBE.

The implementation of the above activities allows Bombardier to effectively monitor the supply chain and identify issues earlier, thus enabling a level of quality that meets our customer's standards.

M/WBE Main Activity Log

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MBTA Orange and Red Lines M/WBE Main Activity Log

Date	Type	From Bombardier	From External	To Bombardier	To External	Comment
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September 2013

9	E-mail		Beverley Johnson Bev Co & Associates	Thomas Faber		Introduction
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November 2013

11	E-mail	Alexandre Roy			Mass Mail	Mass Mail to invite M/WBE suppliers to quote
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December 2013

5	E-mail	Alexandre Roy			Mass Mail	Mass Mail to invite M/WBE suppliers to quote
5	E-mail	Dominique Légaré			Mass Mail	Mass Mail to invite M/WBE suppliers to quote
12	E-mail		Madeline Albani Adrian Name Plate	Alexandre Roy		Interest in submitting proposal
11	E-mail		Lindsay Robinson Solis Group	Bob Furniss		Introduction of Solis Group to Bombardier
11	E-mail	Alexandre Roy			Susan Pappas Diesel Electrical	Invitation to quote
11	E-mail	Alexandre Roy			Beverley Johnson Bev Co & Associates	Invitation to quote
11	E-mail		Beverley Johnson Bev Co & Associates	Alexandre Roy		Thank you for response and introduction of Lydia Rivera of LydRiv as a possible partner
11	E-mail		Lydia Rivera Lydriv	Alexandre Roy		Introduction of Lydriv to Bombardier

January 2014

7	E-mail		Susan Pappas Diesel Electrical	Alexandre Roy		Introduction of Diesel Electrical to Bombardier
8	E-mail		Madeline Albani Adrian Name Plate	Alexandre Roy		Response to Bombardier Invitation to quote

MBTA Orange and Red Lines M/WBE Main Activity Log

Date	Type	From Bombardier	From External	To Bombardier	To External	Comment
10	E-mail		Beverley Johnson Bev Co & Associates	Alexandre Roy		Response to Bombardier Invitation to quote
15	E-mail		Susan Pappas Diesel Electrical	Alexandre Roy		Possible visit in February 2014

February 2014

8	E-mail		JoAnn Mikulsky Mikulsky Rail	Alexandre Roy		Interest in bidding / never got back to us
11	E-mail	Dominique Légaré			Lindsay Robinson Solis Group	Are you M/WBE certified with MSDO?
12	E-mail		Lindsay Robinson Solis Group	Dominique Légaré		Certification is still pending
14	E-mail		Liora Stone Precision Engineering	Thomas Faber		Introduction of Precision Engineering to Bombardier
18	E-mail	Dominique Légaré			Liora Stone Precision Engineering	Are you M/WBE certified with MSDO?
18	E-mail		Liora Stone Precision Engineering	Dominique Légaré		Awaiting certification since Dec 2013
19	Telephone	Alexandre Roy			Nelson Rivas Matrix Railway	Discuss the possibility of quoting on the end door scope of work
19	Meeting	Dominique Légaré Philippe Giroux Sophie Moore				MWBE Planification
19	Telephone	Alexandre Roy			Sandi Elbert Contine Corp	Discuss the possibility of quoting on the end door scope of work
24	E-mail	Dominique Légaré			Sandi Elbert Contine Corp	Provide drawing to help supplier quote
27	E-mail	Dominique Légaré		Tracey Masamoto JTM Concepts		Invitation to quote
28	E-mail		Tracey Masamoto JTM Concepts	Dominique Légaré		Response to Bombardier invitation to quote
28	E-mail		Sandi Elbert Contine Corp	Dominique Légaré		Scope not possible from supplier

March 2014

MBTA Orange and Red Lines M/WBE Main Activity Log

Date	Type	From Bombardier	From External	To Bombardier	To External	Comment
3	E-mail		Tracey Masamoto JTM Concepts	Dominique Légaré		Questions
3	E-mail	Dominique Légaré			Tracey Masamoto JTM Concepts	Answer to questions
3	E-mail		Tracey Masamoto JTM Concepts	Dominique Légaré		Need for a conference call
3	E-mail	Dominique Légaré			Uttara Prasad Lin Industries	Does Lin Industries plan on getting certified with MSDO?
3	E-mail	Dominique Légaré			Nelson Rivas Matrix Railway	Invitation to quote
3	E-mail	Dominique Légaré			Nelson Rivas Matrix Railway	Provide drawing to help supplier quote
3	E-mail		Nelson Rivas Matrix Railway	Dominique Légaré		Scope not possible from supplier
4	E-mail		Tracey Masamoto JTM Concepts	Dominique Légaré		Need for a conference call
4	Telephone	Suzanne Dufresne			Tracey Masamoto JTM Concepts	Conference call
4	Telephone	Suzanne Dufresne			Tracey Masamoto JTM Concepts	Conference call to clarify spec requirements
5	E-mail		Tracey Masamoto JTM Concepts	Dominique Légaré		Additional questions
5	E-mail	Dominique Légaré			Tracey Masamoto JTM Concepts	Response to questions
6	E-mail		Doug Sand JTM Concepts	Dominique Légaré		More questions
6	E-mail	Dominique Légaré			Doug Sand JTM Concepts	Answers to questions
7	E-mail		Uttara Prasad Lin Industries	Dominique Légaré		Unsure when Lin Industries expect their M/WBE certification to be completed
10	E-mail	Dominique Légaré			Uttara Prasad Lin Industries	Thank you for keeping us informed
12	E-mail	Dominique Légaré			Tracey Masamoto JTM Concepts	When can we expect a quote?
12	E-mail		Tracey Masamoto JTM Concepts	Dominique Légaré		Reception of JTM's proposal

MBTA Orange and Red Lines M/WBE Main Activity Log

Date	Type	From Bombardier	From External	To Bombardier	To External	Comment
21	Meeting	Dominique Légaré Alexandre Roy Sophie Moore Philippe Giroux				Review M/WBE Strategy
24	Meeting	Dominique Légaré Alexandre Roy Sophie Moore Philippe Giroux				Continue reviewing M/WBE Strategy
25	E-mail	Dominique Légaré			Tracey Masamoto JTM Concepts	Explanation of price required
25	E-mail		Doug Sand JTM Concepts	Dominique Légaré		Price explanation
25	E-mail	Dominique Légaré			Mass Mail	Mass Mail to our first tier suppliers to stress how M/WBE Content is important
26	E-mail		Lindsay Robinson Solis Group	Dominique Légaré		Received their DBE certification

April 2014

3	E-mail	Sophie Moore			Madeline Albani Adrian Name Plate	Request for letter of interest and Affidavit
3	E-mail		Madeline Albani Adrian Name Plate	Sophie Moore		Confirmation that information will be provided before April 11th, 2014
3	E-mail	Sophie Moore			Tomoaki Morikawa BBA Project	Request for letter of interest and Affidavit
3	E-mail		Tomoaki Morikawa BBA Project	Sophie Moore		Letter of intent and Affidavit received
3	E-mail	Sophie Moore			Sandi Elbert Contine Corp	Request for letter of interest and Affidavit
3	E-mail		Sandi Elbert Contine Corp	Sophie Moore		Letter of intent and Affidavit received
3	Telephone	Jeannette Broekhuizen			Wendy Davis Davis Freight Management	Discuss the possibility of quoting on the end door scope of work
3	E-mail	Jeannette Broekhuizen			Wendy Davis Davis Freight Management	Request for letter of interest and Affidavit

MBTA Orange and Red Lines M/WBE Main Activity Log

Date	Type	From Bombardier	From External	To Bombardier	To External	Comment
3	E-mail	Sophie Moore			Cindy Roots / Craig Berger RTR Technologies	Request for letter of interest and Affidavit
8	E-mail		Madeline Albani Adrian Name Plate	Sophie Moore		Quotation received
9	E-mail		Wendy Davis Davis Freight Management	Jeannette Broekhuizen		Letter of intent and Affidavit received
10	E-mail	Sophie Moore			Uttara Prasad Lin Industries	Certification status request
10	E-mail		Uttara Prasad Lin Industries	Sophie Moore		Nothing yet received - Target is June 2014
15	Telephone	Sophie Moore			Cindy Roots RTR Technologies	Reminder that documentation is due
15	E-mail		Cindy Roots RTR Technologies	Sophie Moore		Reception of certification request acknowledgement
16	Telephone	Sophie Moore			Nedra D. White Director of Certification SOD	Request Confirmation that RTR Technologies is in the process of receiving their certification: CONFIRMED
16	Telephone	Sophie Moore			Nedra D. White Director of Certification SOD	Request Confirmation that 2 suppliers are in the process of receiving their certification: 1) RTR Technologies (Confirmed) 2) Tony Baird Electronics (Confirmed)

Contacts coordinates:

BOMBARDIER TRANSIT CORPORATION	101 Gibraltar Rd - Suite 112, Horsham, PA, 19044	Sophie Moore (450-441-8182)
ADRIAN NAME PLATES	PO Box 211, Essex, MA, 01929	Madeline Albani (978-768-7977)
BBA PROJECTS	8 Weschester Plaza, Elmsford, NY, 10523	Tomoaki Morikawa (914-345-8709)
BEV CO & ASSOCIATES / LYDRIV	11 Haller Street, Dorchester, MA, 02122	Lydia Rivera (617-851-1095)
CONTINE CORP	1820 Nagle Road, Erie, PA, 16510	Sandi Ebert (814-899-0006 x 102)

MBTA Orange and Red Lines M/WBE Main Activity Log

Date	Type	From Bombardier	From External	To Bombardier	To External	Comment
	DAVIS FREIGHT MANAGEMENT	13238 Broadway St, Alden, NY, 14004		Wendy Davis-Schlabach (716-902-4245)		
	DIESEL ELECTRICAL	139 N. Griffith Boulevard, Griffith, IN, 46319		Susan Pappas Gregory (219-922-1848)		
	JTM CONCEPTS	420 23rd Street, Rock Island, IL, 61201		Tracey Massamoto Marler (309-794-1007)		
	MIKULSKY RAIL	295 West 49th Street, Reading, PA, 19606		Jo Ann Mikulsky (610-370-1442)		
	LIN INDUSTRIES	6314 Ice House Rd, Hornell, NY, 14843		Uttara Prasad (631-249-2070)		
	MATRIX RAILWAY	69 Nancy St, W. Babylon, NY, 11704		Nelson Rivas (516-351-2861)		
	PRECISION ENGINEERING	29 Industria Drive, Uxbridge, MA, 01569-0546		Liora K Stone (508-278-5700)		
	RTR TECHNOLOGIES	48 Main St., Stockbridge, MA, 01262		Cindy Roots (413-298-0025)		
	SOLIS GROUP	145 Vista Ave. Suite 104, Pasadena, CA, 91107		Lindsay Robinson (626-685-6989 x 234)		

** Detailed information regarding each log entry is readily available upon request. **