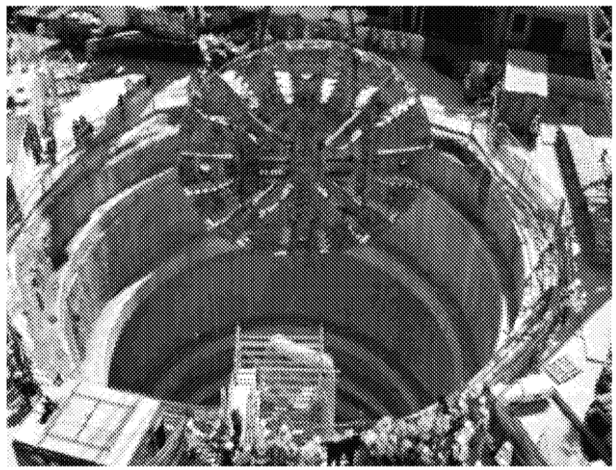
May 10, 2012

RIDEAU TRANSIT GROUP



OTTAWA LIGHT RAIL TRANSIT PROJECT:

TUNNEY'S PASTURE TO BLAIR STATION

DESIGN PRESENTATION #7

Vehicles & Train Control, Operational Performance Requirements

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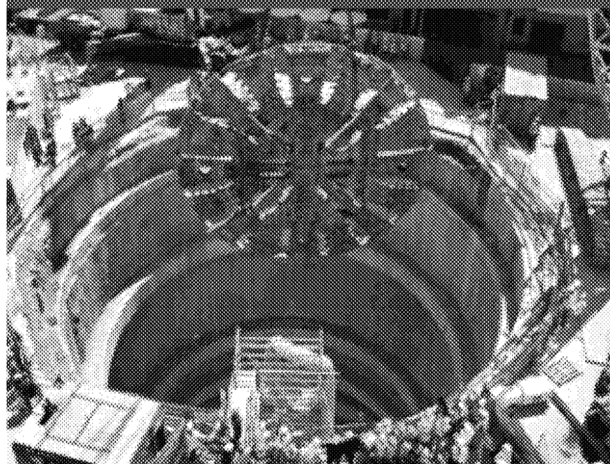
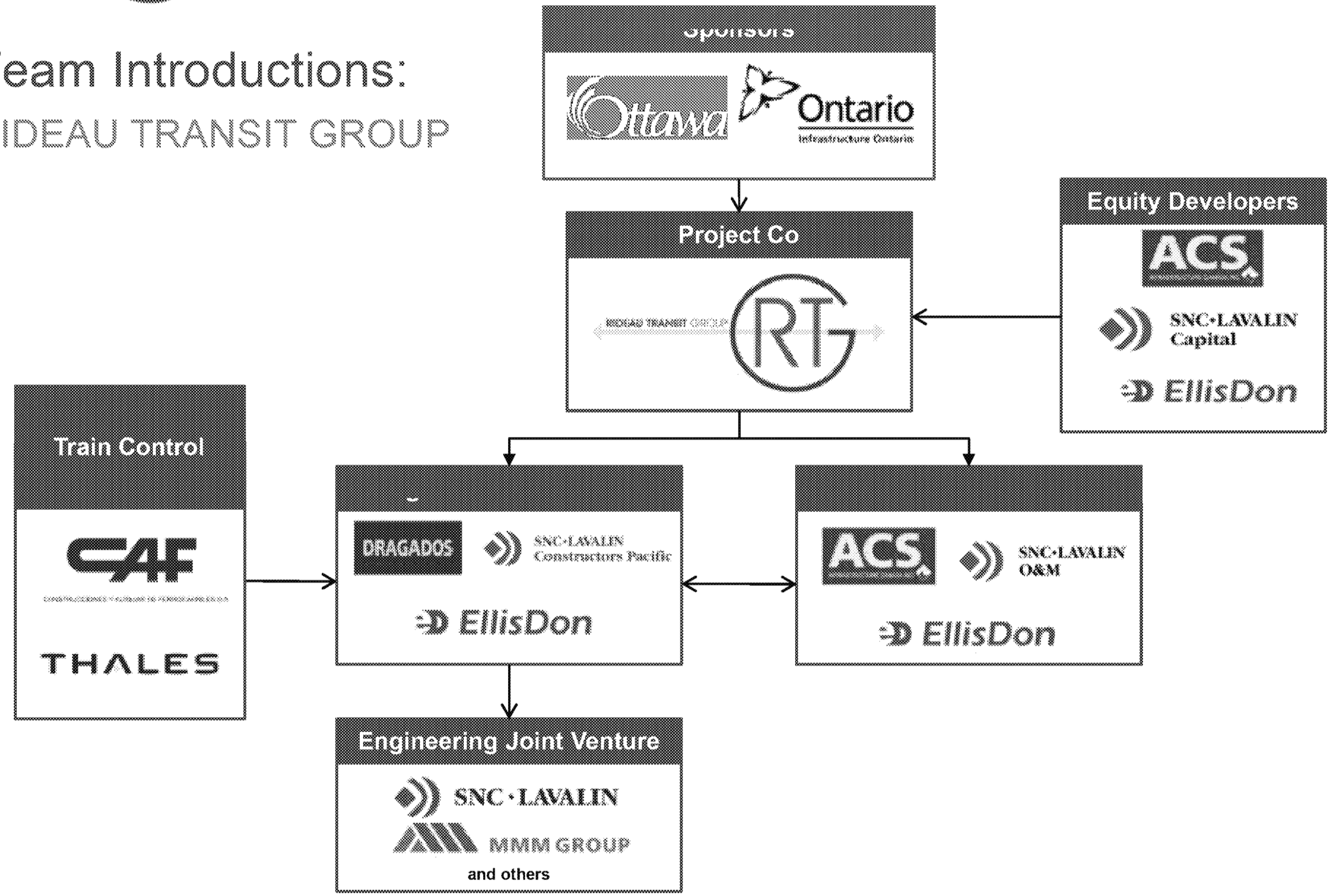


1 TEAM MEMBER INTRODUCTIONS & AGENDA

Team Introduction & Agenda

Team Introductions:

RIDEAU TRANSIT GROUP



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Team Introduction & Agenda

Team Introductions: RIDEAU TRANSIT GROUP – BID PHASE

Concessionaire

Riccardo Cosentino
Vicente Marana

DBJV

Roger Woodhead, Bid Director
Daniel Botero, Deputy Bid Director
Marta Navarro, Vehicles and Systems Specialist
Sandy Webster, Communications Director
Igan Erostarve, Vehicles
Julian Barrutia, Vehicles
Olatz Bastida, Vehicles
Alain Estevez, Vehicles
Mario Péloquin, Train Control
David Dimmer, Train Control
George Istrate, Train Control

EJV Consultants

Chris McCarthy, Design Manager
Tom Middlebrook, Deputy Design Manager
John Selke, Train Control Lead

Maintenance & Operations

Ana Gallego, Maintenance Lead

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Team Introduction & Agenda

Dr. Roger Woodhead, P.Eng.

DBJV Bid Director

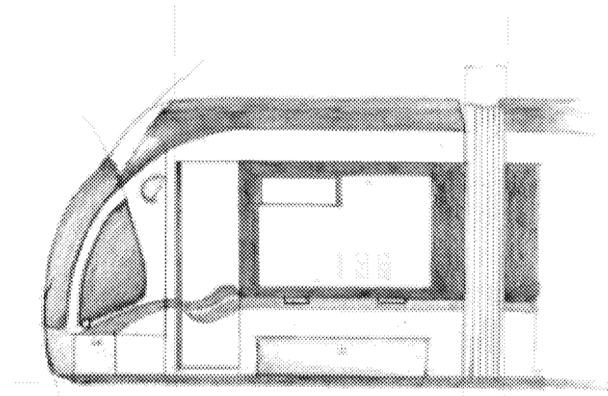
- Over 35 years experience in design and construction
- PhD from University Calgary
- Management role on two of Canada's largest recent LRT projects
  - SkyTrain Millennium Line ($1.2b)
  - Canada Line ($2b)
- Involved in rapid transit for past 16 years
- Accolades/awards
  - CSCE National Lecture Tour -1997-8
  - Construction Award ACI 2005
  - Canada Line won Schreyer and Lieutenant Governor's Awards

Team Introduction & Agenda

RTG Vehicle Supplier

- Proud to introduce our vehicle supplier CAF
- World-class designer and builder of passenger rail vehicles
- Expertise and ingenuity reflected in the calibre and thoughtfulness of light rail design
- Strong sense of aesthetics and sensitivity to brand
- Highly responsive to customer's design criteria
- First 100% LFLRV in North America (Cincinnati)

CAF



Team Introduction & Agenda

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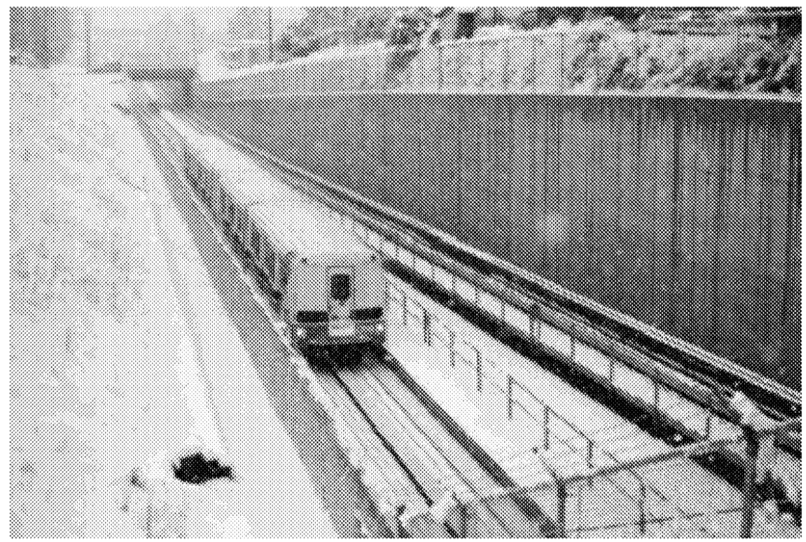
Team Introduction & Agenda

RTG Train Control Supplier

- Proud to introduce our Train Control supplier Thales
- Largest number of installed CBTC systems of any company in the world
- Longest time – 26 years in Vancouver and Toronto (SRT)
- Coldest reference in cold climate CBTC system (Edmonton)
- Thales equipment for CBTC is already qualified to operate in Ottawa's climate
- Expertise to integrate into various rolling stock manufacturers is part of Thales' culture
- A Canadian company, based in Ontario

THALES



Team Introduction & Agenda

Agenda

1. Introduction
2. Systems Integration
3. Vehicles

    Discussion

4. System Branding and Identity
5. Non-Revenue Vehicles – *narrative documents only*
6. Train Control

    Discussion

7. LRT Systems – *narrative documents only*
8. Operational Performance
9. Safety Management & Certification
10. Response to DPM #3 Feedback

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Team Introduction & Agenda

Agenda

10. Questions
11. Issues Moving Forward

    Discussion

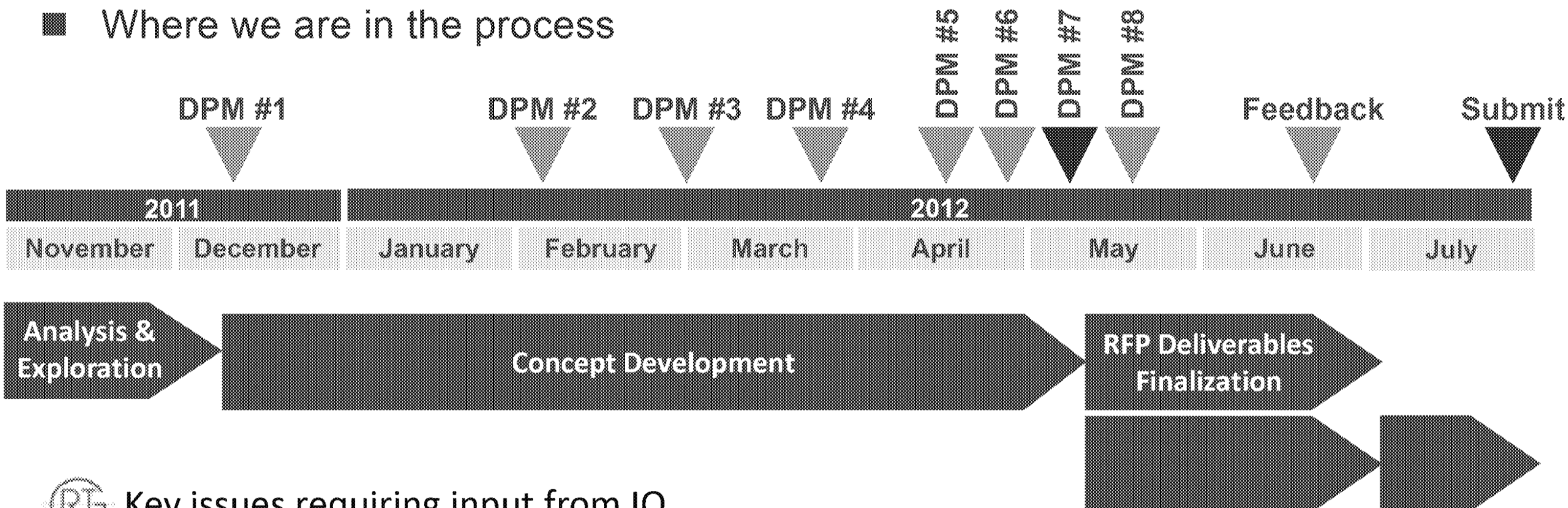
12. Summary & Closing Comments

Team Introduction & Agenda

Delivering a Winning Bid

Key Objectives Today:

- Compliance of Vehicle & Train Control and Operational Performance Requirements
- Current focus – Achieving Affordability; Issues affecting compliance
- Seeking feedback / information on critical issues
- Where we are in the process



Key issues requiring input from IO

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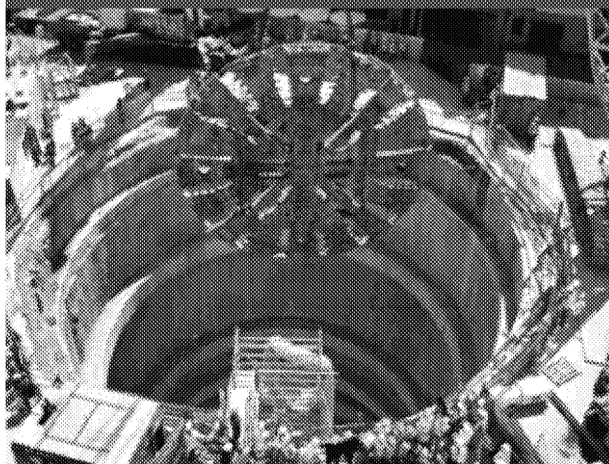
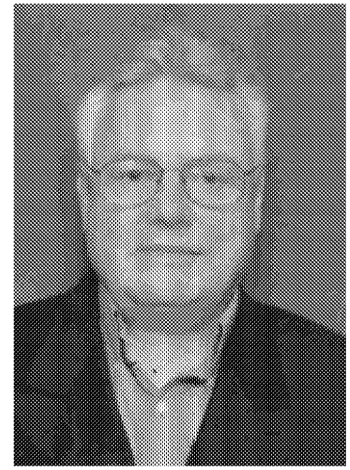
RTG



2 SYSTEMS INTEGRATION

Systems Integration



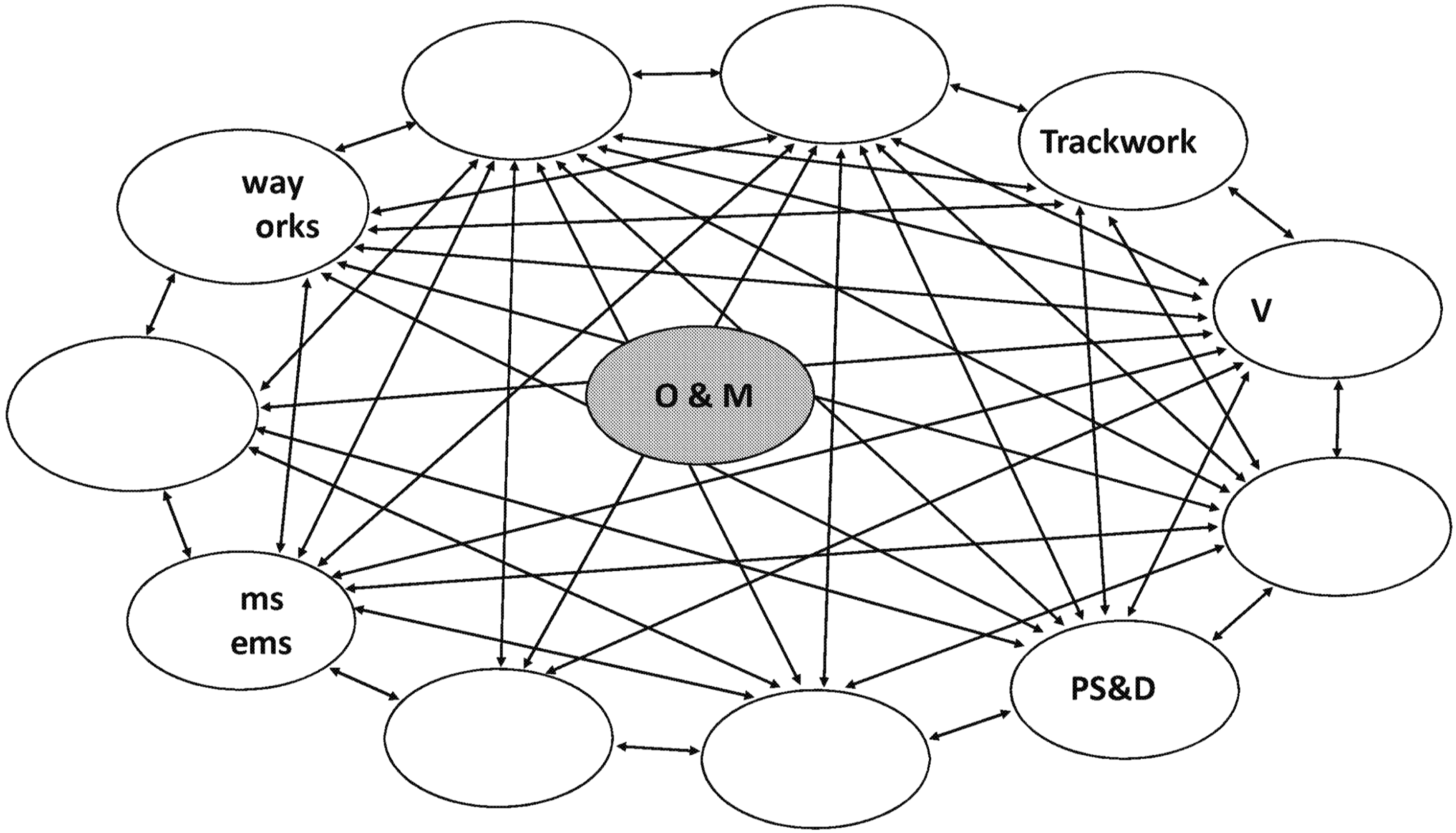
John Selke, P.Eng.

Train Control & Systems Integration Lead

- 30 years experience in System Engineering of CBTC Transit Systems including T&C Manager on Canada Line
- During commissioning of Train Control system for the initial phases of Vancouver SkyTrain:
  - Pioneered the development of the system engineering processes for CBTC systems
  - Worked closely with the operator to develop operational strategies (operational requirements analysis)
  - Achieved every major milestone opening date
- Lead the team which leveraged the SkyTrain success to other projects including the San Francisco Municipal Railway (MUNI) and the Docklands Light Railway in London, UK

Systems Integration

Technical Challenges



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Systems Integration

Key Issues

- Thorough Requirements Analysis
- **Able to choose proven suppliers and subsystems**
- Comprehensive test & verification planning
- **Emphasize off-site acceptance testing**
- **Maximize simulators and test tracks**
- Propose to involve the operator in commissioning as early as possible
- We will mobilize our maintenance staff early

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Systems Integration

Proven Suppliers and Subsystems

- RTG not a manufacturer
- Good working relationship with suppliers
- Excellent response to our RFPs
- Neither supplier makes the other's product
- The best System Integration team for OLRT

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CAF

CONSTRUCCIONES Y AUXILIAR DE FERROCARRILES S.A.

THALES

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Systems Integration

Successful Transit Systems

- Vancouver SkyTrain (Canada)
- Calgary (Canada)
- Edmonton (Canada)
- Kuala Lumpur Monorail (Malaysia)
- Canada Line (Vancouver, Canada)
- DockLands Light Rail (London, UK)
- Jubilee Line (London, UK)
- San Francisco Municipal Railway (Muni) (USA)
- Barcelona Line 1 and Line 9 (Spain)
- Seville Metro Line 1 (Spain)
- Arganda Metro, Madrid (Spain)
- Figueras-Perpignan High Speed Train (Spain, France)
- Tenerife Light Train (Spain)

Systems Integration

Test Tracks & Simulators

- Emphasize off-site acceptance testing
- Maximize simulators and test tracks
- Reduce risk by testing interfaces early
- Minimize mainline track access for systems testing

Systems Integration

Test Tracks & Simulators

- Impact of Canadian Content policy
- Opportunity for local test track
- Provide automatic yard and implement early
- Early testing of all systems including vehicles and CBTC
- Two seasons of winter testing
- Provide on-site CBTC simulator for testing and Central Operator training

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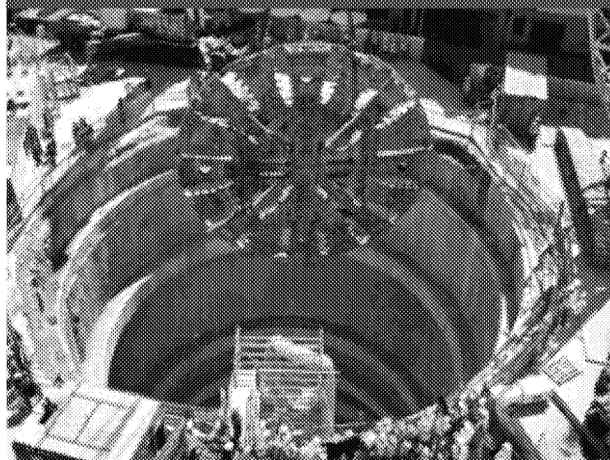

3 VEHICLES

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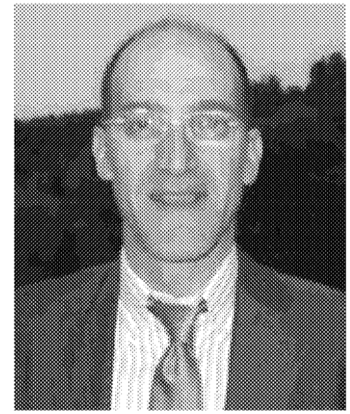
Rail Vehicles



Julian Barrutia, Ind. Mech. Eng.

Area Director International Division, CAF

- 12 years experience in leading international proposals, negotiations and contracts, for the supply and maintenance of Rolling Stock.
- PPP and Turn Key project experience.
- Main focus in LRT, Mass Transit and Main Line projects.
- Contracts awarded in excess of $1.3b in countries like Italy, New Zealand and Algeria.

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Rail Vehicles

Olatz Bastida, Ind. Mech. Eng.

New Products Project Manager, CAF

- 6 years of experience in the preparation of technical proposals for the supply and maintenance of Rolling Stock for international procurements.
- PPP and Turn Key project experience.
- Contracts awarded in countries like the US, UK and Turkey.

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Rail Vehicles

Igan Erostarbe, Ind. Eng.
Master in Management
Engineer in CAFUSA

- 3 years of experience in the preparation of technical proposals for the supply and maintenance of Rolling Stock for North American procurements
- Contracts awarded in the US
- Working for HVAC and Blowmolding Machinery Sectors previously

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Strategy to Meet Canadian Content Policy

CAF Understanding of Canadian Content Policy

- CAF understands and will comply with the RFP request with regards to the observance of the Canadian Content Policy for Transit Vehicles:

  The overall Canadian content of the transit vehicles proposed must meet the minimum of 25% threshold, calculated as a percentage of the total final costs to the manufacturer, less applicable taxes.

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Strategy to Meet Canadian Content Policy

CAF Understanding of Canadian Content Policy

CAF Experience with Local Content

- Local content is a usual request in many supply contracts for rolling stock for all the markets, and CAF has supplied, over the years, projects in different countries with adapted solutions to the local content requirements (such as USA and Brazil):
  - Light Rail Vehicles in Sacramento, Pittsburgh, Houston, Cincinnati, Amtrak LDSL coaches, and Washington DC metro. All of them compliant with Buy America Act
  - PPP5000 project (36 EMUS of 8 cars each) in Sao Paulo (Brazil) with 60% of local content

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Strategy to Meet Canadian Content Policy

CAF Understanding of Canadian Content Policy

CAF Experiences with Local Content

- CAF is currently participating in tenders that require important local content in countries like Australia (50% local content), Turkey (30% local content) and India
- Note that the local content requested in OLRT project is less demanding than the practices and rules of Buy America Act in the United States. CAF is very familiar with the methodology of detailed calculation by component and compliance audits
- CAF will take the advantage of experienced suppliers network of rolling stock equipment and components for passenger transport found in Canada
- The experience of CAF in the United States and around the world demonstrates that our company has the skills and organizational capacity and financial resources to ensure that the City of Ottawa's Canadian content requirement will be met

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Strategy to Meet Canadian Content Policy

CAF Understanding of Canadian Content Policy

CAF Experiences with Local Content

- CAF commits that on further stages of the Procurement process a Certification that the proposed Vehicles meet the requirements of the Canadian Content Policy, will be supplied
- CAF has no objection to granting consent to disclosure for the purpose of being able to verify and audit the process for compliance of Canadian content required for this project
- Meeting local content will never affect performance, quality and cost of the operating vehicles. In fact, this should improve the level of the product by promoting the local economic benefits without compromising the quality of the new rolling stock

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Strategy to Meet Canadian Content Policy

CAF Previous Experience with Canadian Content

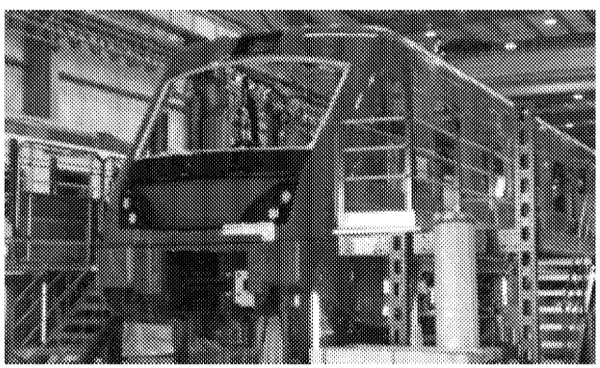
- CAF responded in 2010 to the International Public Notice issued by the Société de Transport de Montréal (STM), for the supply of 765 rubber tired subway cars
- The compliance with a minimum 60% of Canadian Content was requested
- After a thorough and deep analysis of CAF's response, STM's Board of Directors confirmed CAF's compliance with all the requirements contained in the International Public Notice, and in particular
  - CAF's capacity and engagement to respect the requirements regarding the Canadian content
  - CAF's experience
  - CAF's financial and technical capacity to perform the project
  - CAF's manufacturing and organizing capacity to respond to the requested delivery schedule

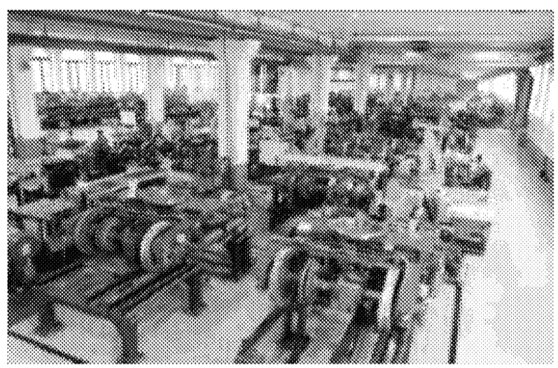
Strategy to Meet Canadian Content Policy

Main Elements of the Action Plan for OLRT

Labour

- The final assembly of the LRVs will be carried out in the production facility that CAF proposes to establish in the Ottawa area. The Canadian content of the final assembly carried out in this factory will be 100%.
- LRV final assembly activities begin with the reception of the painted car shell and truck frames. Main activities are:
  - Final assembly of Car Shells
  - Final assembly of Trucks
  - Coupling between Truck and Car
  - Routine tests and Static testing at factory





Strategy to Meet Canadian Content Policy

Main Elements of the Action Plan for OLRT

Components & Onboard Systems

- The components and on board systems represent a significant part of the vehicle total content. CAF has discussed with several world quality suppliers in order to validate our action plan and confirm that our hypothesis about the Canadian content are reasonable
  - Door systems and HVAC system
    - Possible Suppliers: Vapor (Montreal), Door Spec (Montreal) or Faiveley (Châteauguay, Québec)
  - Communication and Passenger Information systems
    - Possible Suppliers : Axion (La Pocatière, Québec) or Interalia (Calgary)
  - Traction Motors
    - Possible Suppliers: IEC Holden (Montreal), Sherwood Electromotion (Ontario)

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Strategy to Meet Canadian Content Policy

Main Elements of the Action Plan for OLRT

Freight & Warranty Support

- We have considered in our action plan that the freight required and the warranty support that will be ensured during the first years of operation of the vehicles will be carried out with a 100% Canadian content

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Strategy to Meet Canadian Content Policy

Main Elements of the Action Plan for OLRT

Conclusion

- Taking into account all the explained, our approach give us a range between 26% and 33% of Canadian content:

Eligible Cost Concepts	Canadian Content % Range of Total Vehicle Cost
Labour	12% - 14%
Sub-components and Components	8% - 10%
Freight	4% - 5%
Warranty	2% - 3%
Others (1)	0% - 1%
Total	26% - 33%

(1) "Others": Project Management, Engineering, Manuals, Special Tools, Test Equipment and Others

Vehicle Performance Requirements

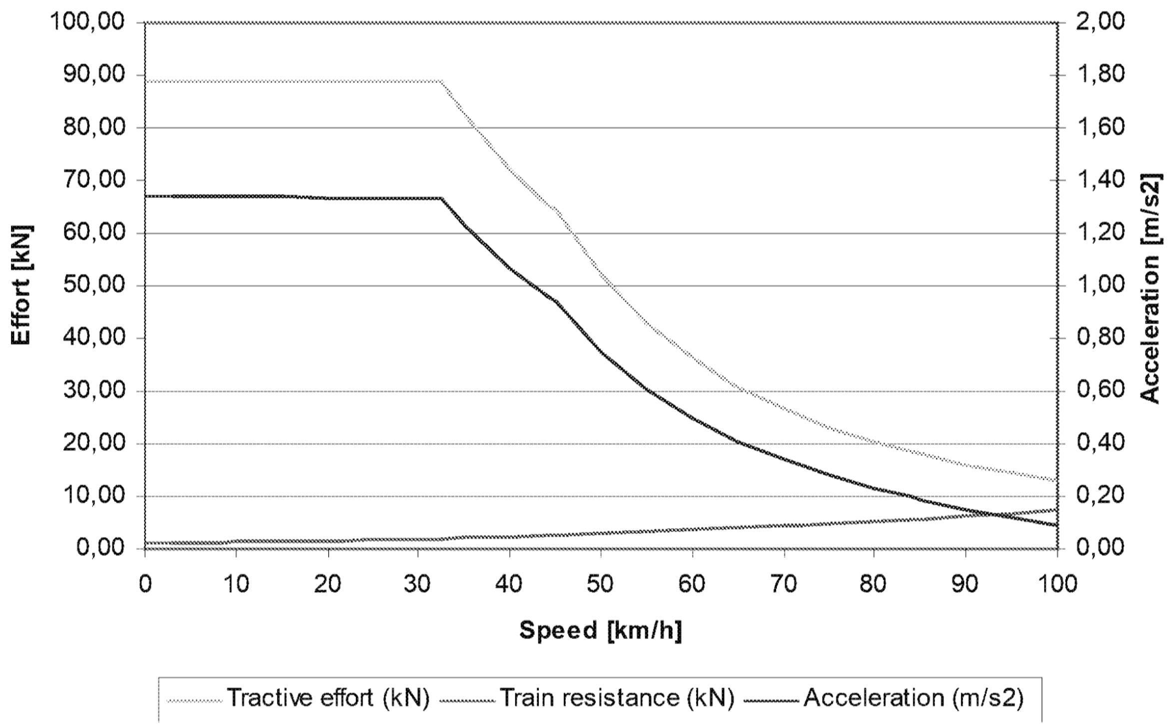
Vehicle Performance Requirements

- Based on the previous projects, CAF has experience with this type of performance level:
  - Pittsburgh
  - Houston
  - Sacramento
- The Performance requirements of the City of Ottawa will be achieved applying the specific solutions for extreme winter conditions, both for vehicle and infrastructure
- The requirements in the specification will be an input for the project and will be demonstrated during project phase and testing

Vehicle Performance Requirements

Powering Performances (AW2)

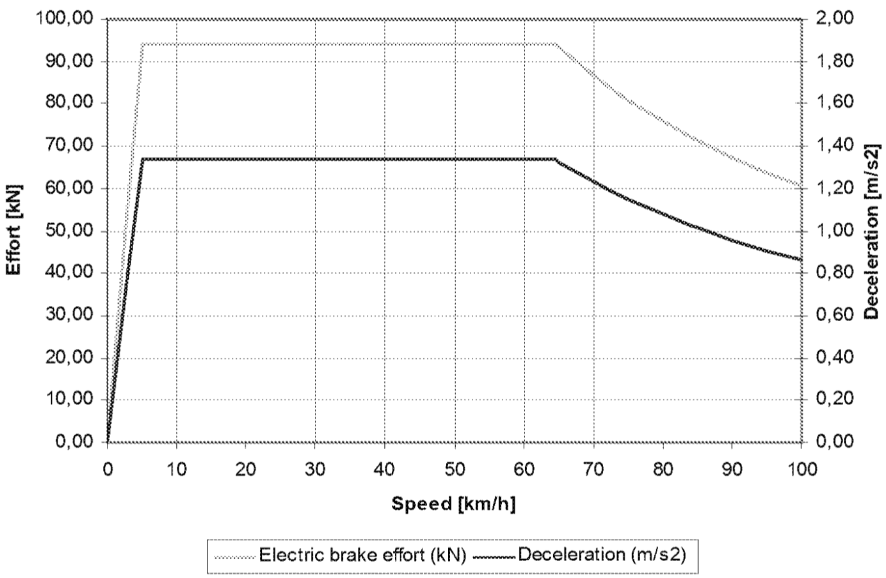
- Maximum speed: 100km/h
- 1,34 m/s2 starting acceleration (up to 32,5 km/h)

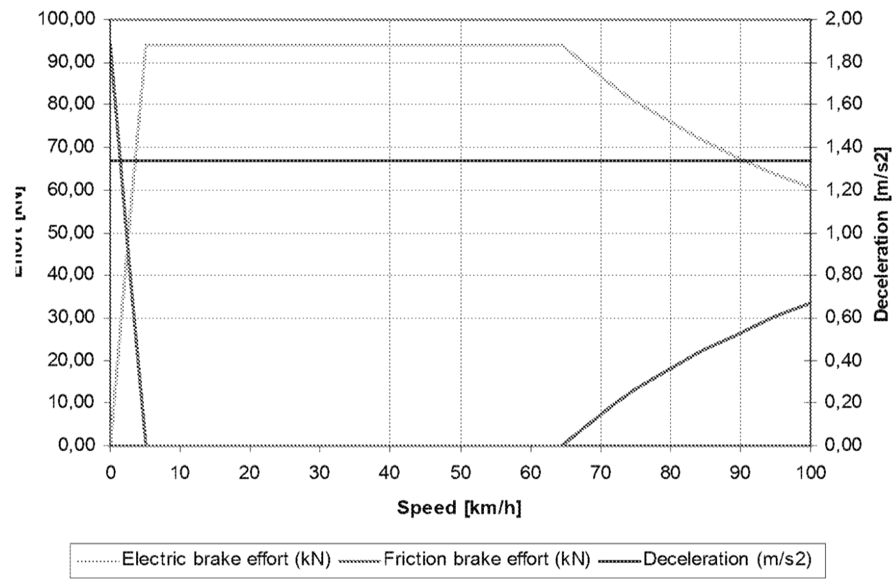


Vehicle Performance Requirements

Service Braking performances (AW3)

- Electric brake: 1,34 m/s2 constant from 64 km/h to 5 km/h
- Blended brake: 1,34 m/s2 from 80 km/h to 0 km/h
  2 m/s2 from 88 km/h to 0 km/h with track brakes
- Friction brake: 1,34 m/s2 from 80 km/h to 0 km/h





Vehicle Performance Requirements

Emergency Braking performances (AW3)

- Friction brake: 1,78 m/s2 from 80 km/h to 0 km/h
- Friction + track brake: 2.5m/s2 – 0.005m/s2 per km/h, starting above 48 km/h

  2.5m/s2 starting from less than 48 km/h

Parking brake (AW3)

- Will hold the Vehicle on a 6% grade, indefinitely

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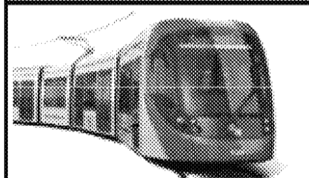
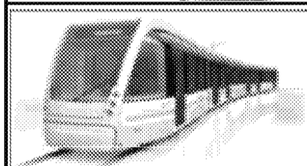
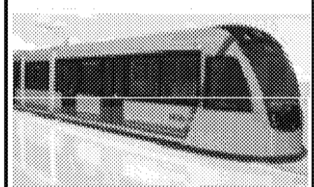
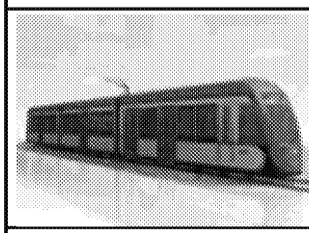
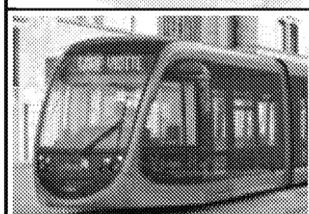
Service History of Proposed Vehicle

PICTURE	PROJECT	COUNTRY	Nº UNITS	Nº CARS	UNIT CONFIGURATION		YEARS IN SERVICE
	BIRMINGHAM LRV 70% low floor	U.K.	19	95	M-S-T-S-M	Bidirectional	Expected 2013
	DEBRECEN LRV 100% low floor	HUNGARY	18	90	M-S-T-S-M	Bidirectional	Expected 2013
	HOUSTON LRV 70% low floor	USA	39	117	M-T-M	Bidirectional	Expected 2013
	STOCKHOLM LRV 70% low floor	SWEDEN	15	45	M-M-M	Bidirectional	Expected 2013
	BESANÇON LRV 100% low floor	FRANCE	19	57	M-S-M	Bidirectional	Expected 2013

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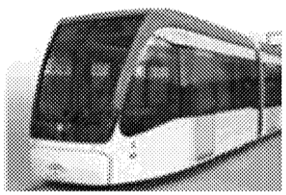
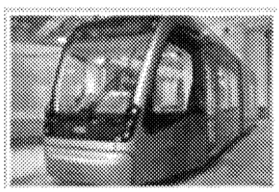
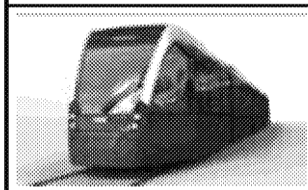
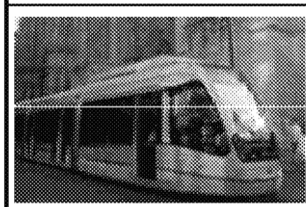
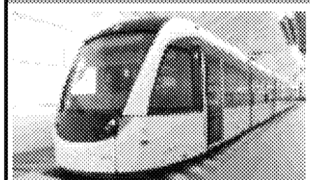
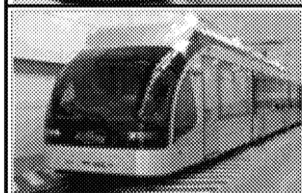
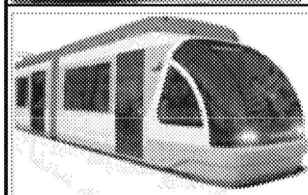
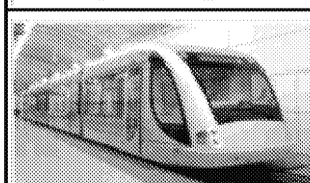
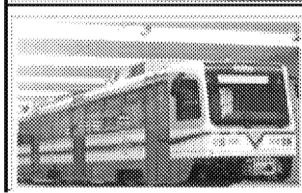
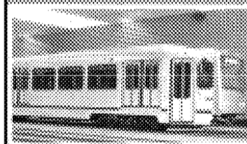
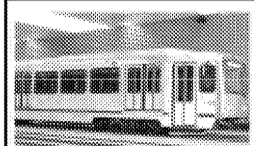
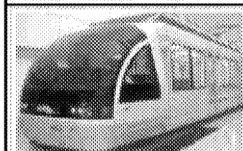
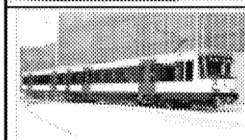
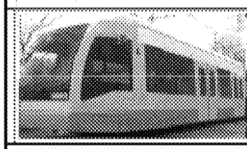
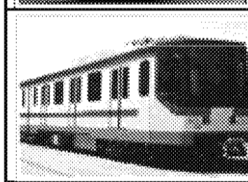
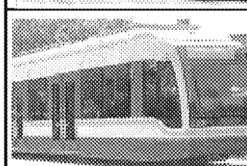
Service History of Proposed Vehicle

PICTURE	PROJECT	COUNTRY	Nº UNITS	Nº CARS	UNIT CONFIGURATION		YEARS IN SERVICE
	NANTES LRV 100% low floor	FRANCE	8	40	M-S-T-S-M	Bidirectional	Expected 2012
	GRANADA LRV 100% low floor	SPAIN	13	65	M-S-T-S-M	Bidirectional	2011 (1 year in service)
	ZARAGOZA LRV 100% low floor	SPAIN	21	105	M-S-T-S-M	Bidirectional	2011 (1 year in service)
	BELGRADE LRV 100% low floor	SERBIA	30	150	M-S-T-S-M	Unidirectional	2011 (1 year in service)
	METRO CENTRO SEVILLE LRV - Extension	SPAIN	4	20	M-S-T-S-M	Bidirectional	2011 (1 year since service)

Service History of Proposed Vehicle

PICTURE	PROJECT	COUNTRY	Nº UNITS	Nº CARS	UNIT CONFIGURATION		YEARS IN SERVICE
	EDINBURGH LRV 100% low floor	UK	27	189	M-S-T-S-M-S-M	Bidirectional	Expected 2014 (Vehicles were delivered on 2011 but Infrastructure is not finished)
	ANTALYA LIGHT METRO 100% low floor	TURKEY	14	70	M-S-T-S-M	Bidirectional	2009 (3 years in service)
	VITORIA LRV 100% low floor	SPAIN	11	55	M-S-T-S-M	Bidirectional	2008 (4 years in service)
	SEVILLE LIGHT METRO 100% low floor	SPAIN	17	85	M-S-T-S-M	Bidirectional	2008 (4 years in service)
	SACRAMENTO LRV S/200	USA	40	80	M-M	Bidirectional	2005 (6 years in service)

Service History of Proposed Vehicle

PICTURE	PROJECT	COUNTRY	Nº UNITS	Nº CARS	UNIT CONFIGURATION		YEARS IN SERVICE
	PITTSBURGH LRV (Refurrbisment)	USA	40	80	M-M	Bidirectional	2005 (6 years in service)
	LRV PITTSBURGH	USA	28	56	M-M	Bidirectional	2004 (7 years in service)
	BILBAO LRV 70% low floor	SPAIN	8	24	M-T-M	Bidirectional	2002 (10 years in service)
	AMSTERDAM LRV	NETHERLAND S	9	18	M-M	Bidirectional	1996 (16 years in service)
	LISBON LRV	PORTUGAL	6	12	M-T-M	Unidirectional	1995 (17 years in service)
	Metrorrey LRV MM93	MEXICO	22	22	M-M	Bidirectional	1994 (18 years in service)
	VALENCIA LRV Extension I 70% low floor	SPAIN	12	36	M-T-M	Unidirectional	1993 (19 years in service)

RIDEAU TRANSIT GROUP

Service History of Proposed Vehicle

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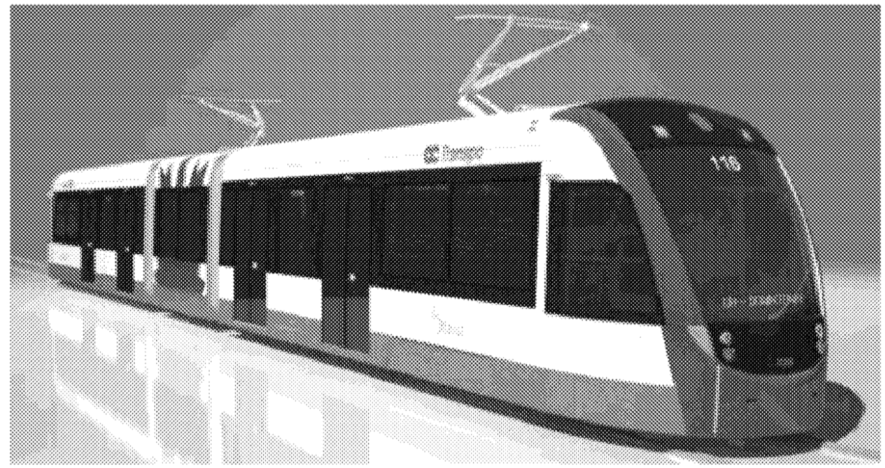
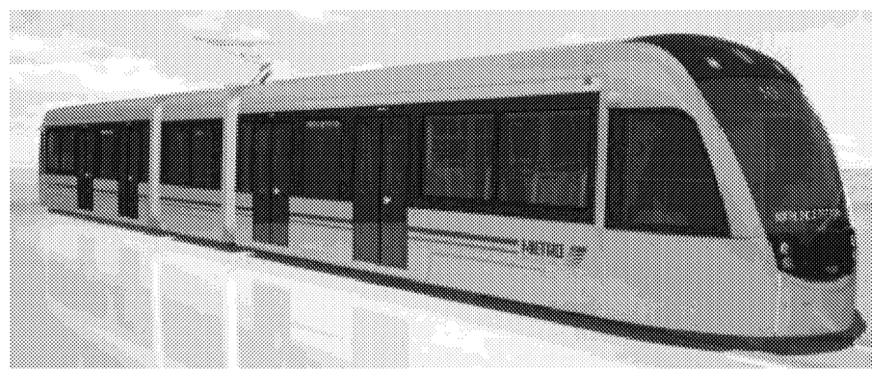
Differences Between OLRT LV and Houston LRV

- Traction Voltage
  - 1,500 Vdc vs. 750 Vdc
- Winterization requirements
  - All measures CAF has developed from similar weather conditions projects (eg. Stockholm)
- Radio, CBTC, CCTV, etc. as required by OLRT



Houston RAMS Values

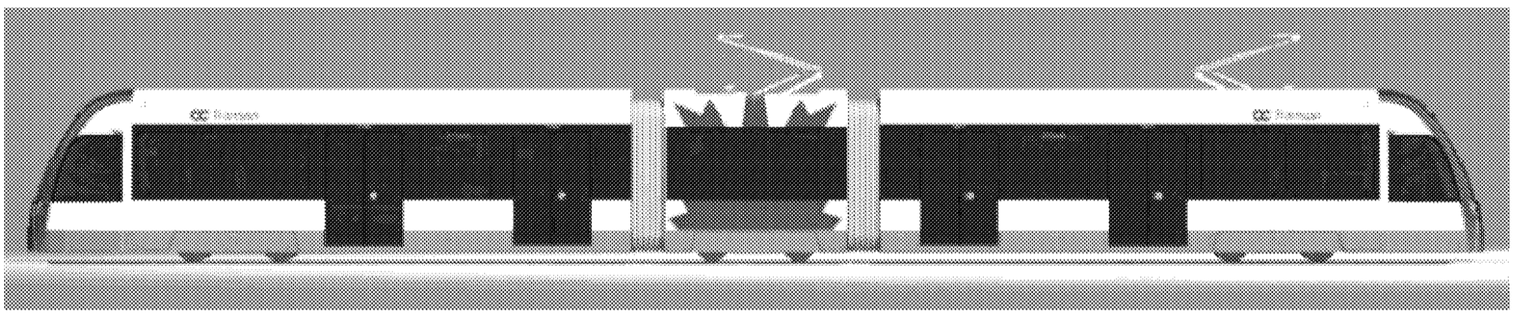
- MDBDT = 24,140 km
- Average speed of 40 km/h and an annual mileage of 88,500 kms have to be considered.



Vehicle General Description & Arrangement

Vehicle General Description & Arrangement

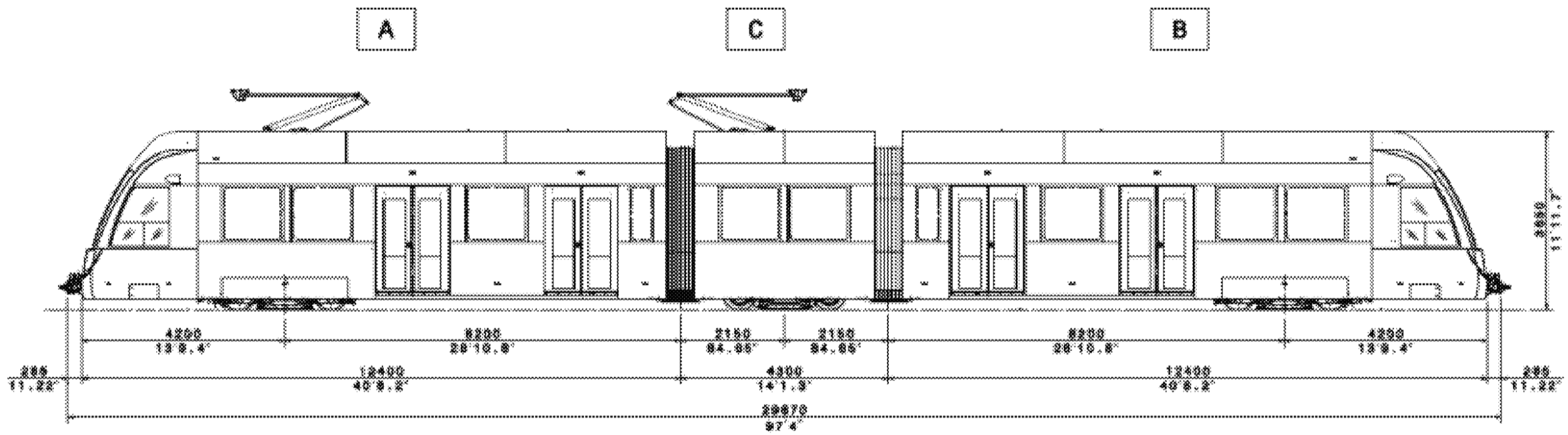
- Electrically propelled unit consisting of 3 carbodies joined with 2 articulation sections to form a single operating unit
  - 2 Powered Trucks
  - 1 Center Trailer Truck



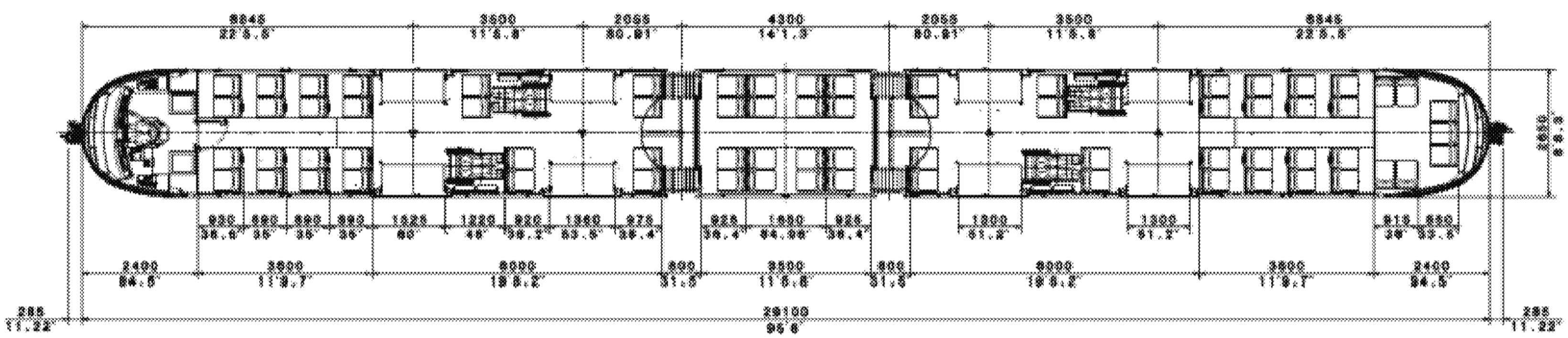
- 70% Low Floor Vehicle
- HSLA Steel Carbody

Vehicle General Description & Arrangement

Vehicle General Description & Arrangement

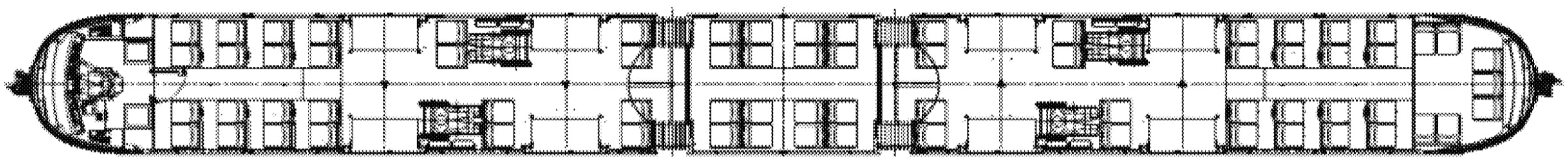


L = 30.000 mm, W = 2.650 mm, H = 3.600 mm



Vehicle General Description & Arrangement

Layout



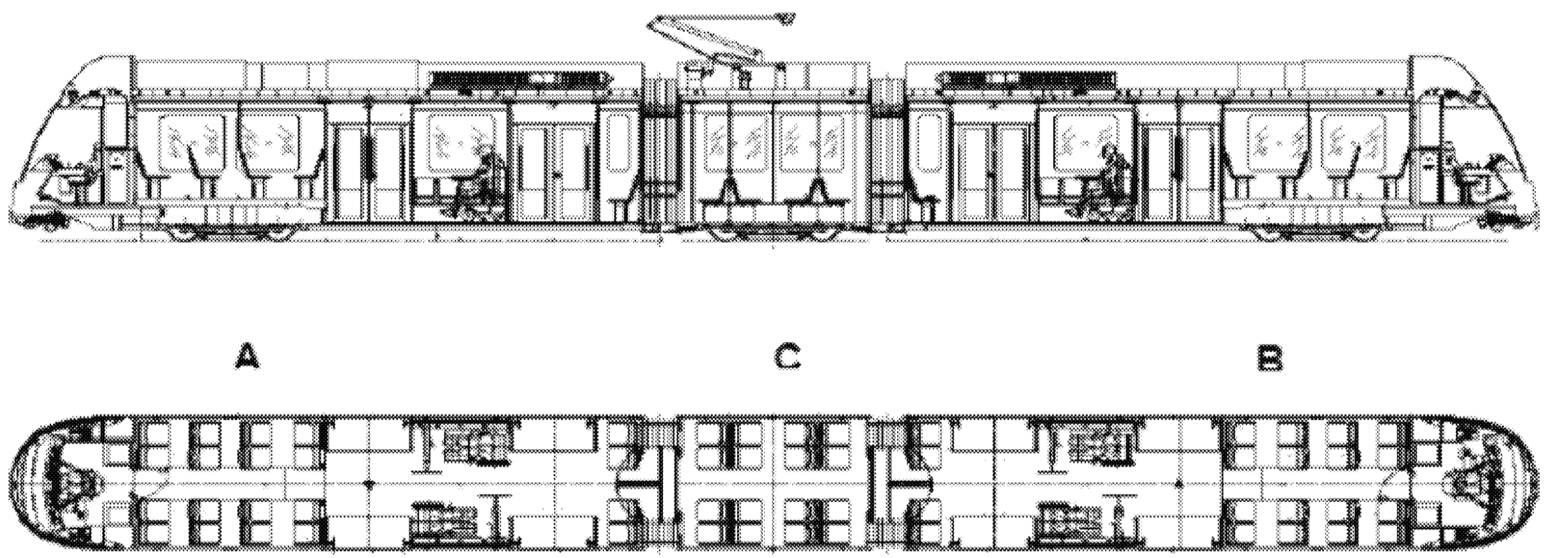
- Capacity
  - 71 Seated Passengers
- Wheelchair Area
  - 4 Passengers
  - AODA/ADA Compliant
- Priority Seating
  - AODA/ADA Compliant
- Bike and Strollers

PASSENGER CAPACITY		
SEATED		71
FLIP-UP SEATS		8
AREA (m^2) FLIP-UP SEATS DOWN		30.05
STANDEES	**3.3p/m^2**	100
	4p/m^2	120
	6p/m^2	180
	8p/m^2	240
TOTAL (SEATED + STANDEES)	**3.3p/m^2**	179
	4p/m^2	207
	6p/m^2	267
	8p/m^2	327

Vehicle Accessibility (AODA / ADA)

Compliance with AODA-ADA Requirements

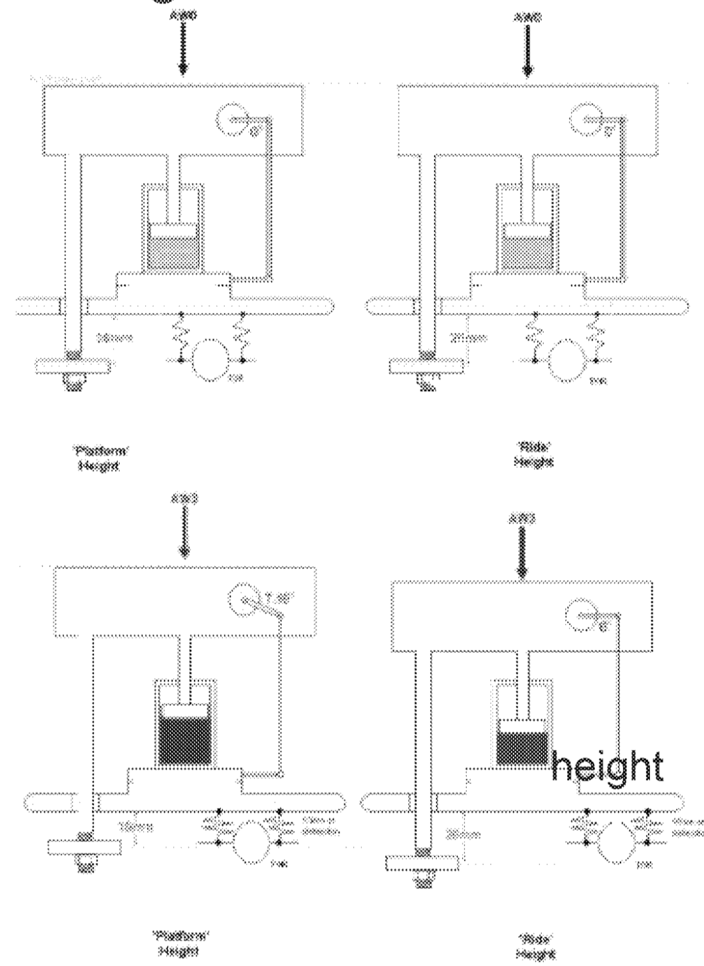
- Low Floor Access
- Wheel Chair Locations



Vehicle Accessibility (AODA / ADA)

Hydraulic Leveling System for Level Boarding

- Compact vehicle height adjustment system utilizing the same fluid medium as the brake system
- ADA-Compliant Level Boarding
- The secondary suspension will be constituted by
  - Spring Coils
  - Dampers
- Hydraulic Levelling System for vehicle adjustment
- Height compensation only at stations

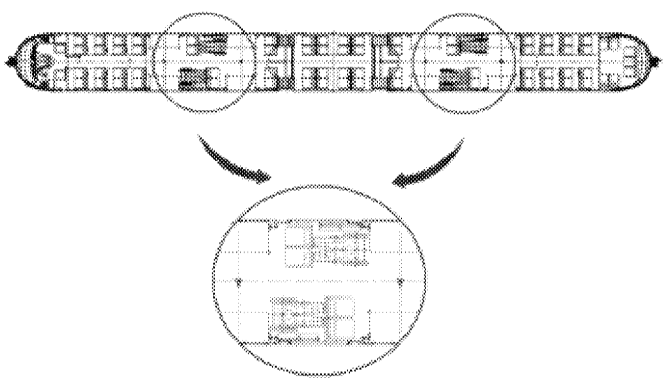


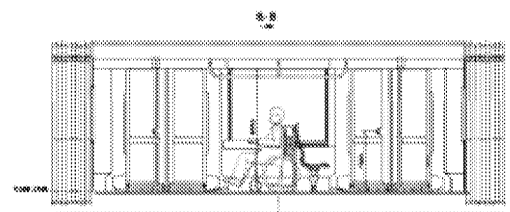
Leveling Control - AW0 & AW3 Load Weighs

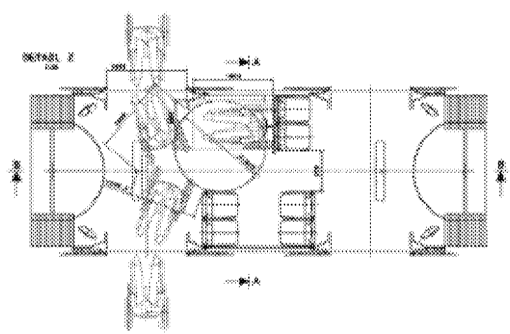
Vehicle Accessibility (AODA / ADA)

Mobility Impaired Accommodation

- There will be two wheelchair areas in each A and B vehicle sections (4 in total)
- Each area will comply with the minimum dimension required (1220 mm by 760 mm)
- Additionally, there will be 2 flip-up seats per wheelchair space







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Vehicle Accessibility (AODA / ADA)

Stanchions, Handrails & Windscreen

- Stanchions and grab rails will be ADA-compliant
  - On both sides of all doorways (total four per vestibule)
  - Alternate transverse seats as required
  - Overhead, horizontal grab rails extending longitudinally (flip-up area)
  - Four assist handles, at each corner of the articulation section
  - 2 windscreens per door to protect passengers from exterior draughts

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Vehicle Accessibility (AODA / ADA)

Additional Features

- Final arrangement of the Wheelchair area subject to OLRT approval
- Information Displays
  - Located in each main body section
  - Permit passengers seated in a wheelchair, to have a view of at least one of the signs
- Pushbuttons
  - Interior pushbuttons will be provided in each wheelchair space and adjacent to each priority seating area

Train Systems & Safety Critical Items

Safety Critical Items

- RAMS area defines for all projects the SCIL (Safety Critical Item List) and distributes it to the different departments
- Function: Identification of hazards, assessment of the associated risks and, where appropriate, adopting the necessary mitigation measures
- Houston SCIL
  - Systems:
    - Friction Brake
    - Truck
    - Carbody + Carbody-Truck connection
    - Coupler
    - Doors
    - (...)
  - Affected Areas:
    - Design
    - Quality
    - Manufacturing
    - Maintenance

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Train Systems & Safety Critical Items

Safety Critical Items

- SCIL – Example: Brake

Failure mode	Hazard		Accident	Severity	MITIGATION MEASURES	
	Id.	Description			Id.	Affects
Acceleration higher than requested	HT-1.1	Excessive speed	1.- Derailment	I	SRR-PHA. 004	Design
The brake is not applied when it is requested	HT-1.1	Excessive speed	1.- Derailment	I	SRR-PHA. 004	Design
	HT-1.1	Excessive speed	1.- Derailment	I	SRR-PHA. 051	Design
	HT-1.1	Excessive speed	1.- Derailment	I	SRAC-SCIL. 001	Maintenance
	HT-1.1	Excessive speed	1.- Derailment	I	SRAC-SCIL. 002	Maintenance

- MITIGATION MEASURE

SAFETY CRITICAL ITEM LIST (SCIL) - DESIGN

Metro Houston LRV Procurement

Subsystem	Component	MITIGATION MEASURES	
		Id.	Description
Friction brake			
	General	SRR-PHA. 004	There must be one route separate to the master controller for the Driver to request emergency braking.
		SRR-PHA. 051	The hydraulic brake cylinders must be reverse logic, such that in the event of a loss of oil pressure the brake is applied.

Train Systems & Safety Critical Items

Carbody

- Material:
  - HSLA Steel
- Structural and Crashworthiness Design:
  - According to OTTAWA TS
  - FEA analysis with ABAQUS
  - Static Testing of the Carshell (Prototype)

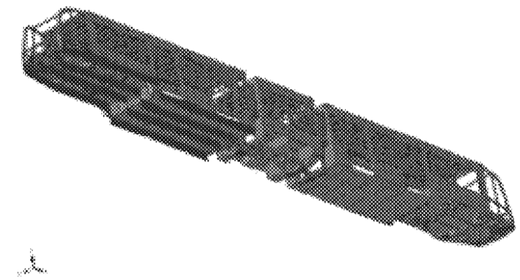


Figure A2- 1 Vertical load distributed on car A underframe

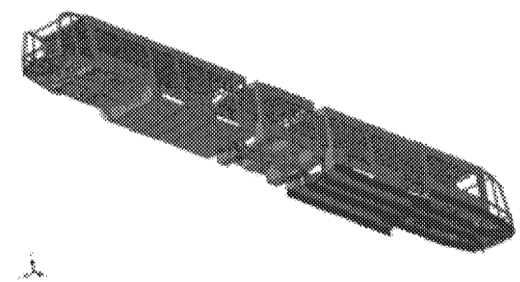
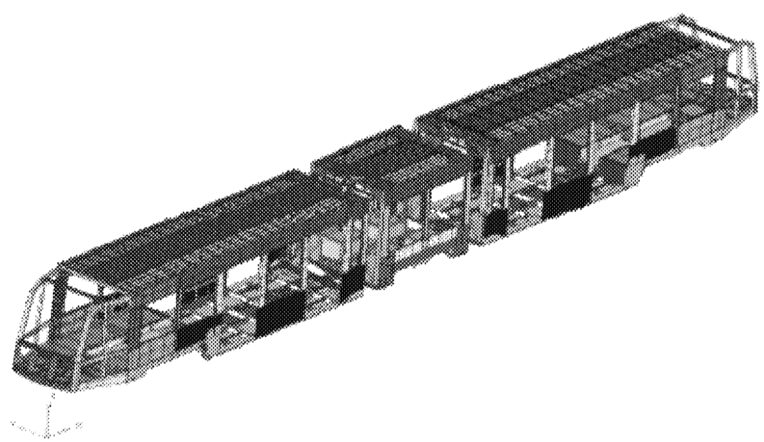
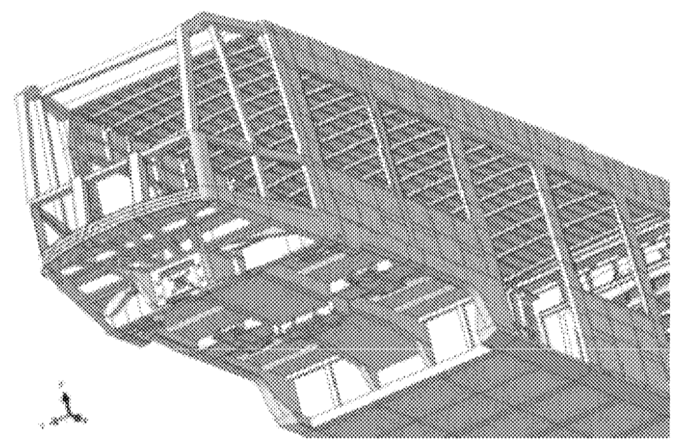


Figure A2- 3 Vertical load distributed on car B underframe

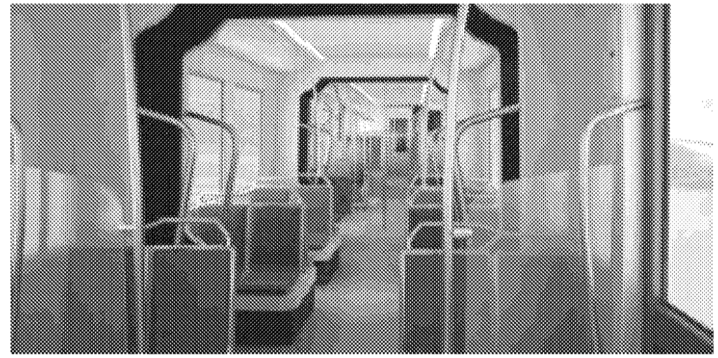




Train Systems & Safety Critical Items

Interior Finishing & Accessories

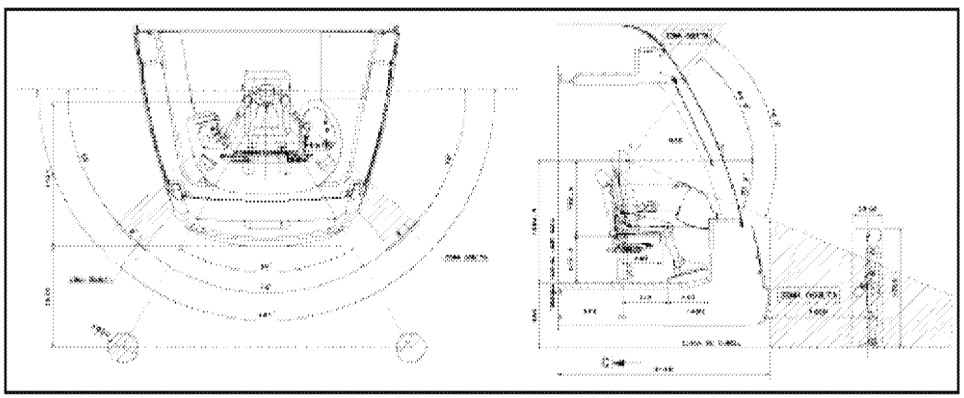
- Graffiti Resistant
- Smoke and Flammability
- Panels
  - FRP
  - Melamine-faced aluminum
- Seats
  - Contoured Stainless Steel Module
- Stanchions and Grab Rails

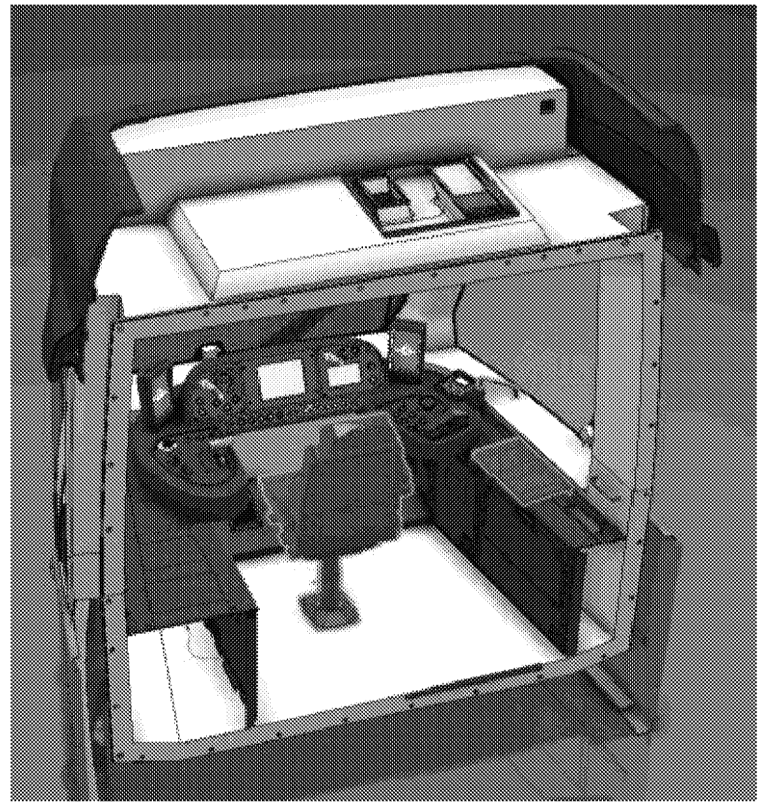


Train Systems & Safety Critical Items

Operator's Cab

- Compliant with TS requirements
- Final design to be approved at the mock up review
- Operator Visibility and Ergonomic Studies





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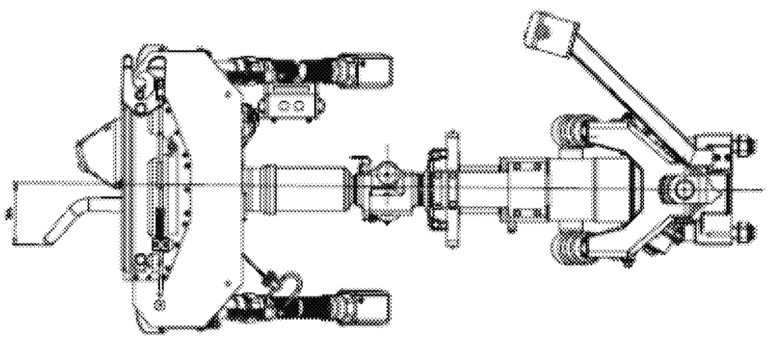
Train Systems & Safety Critical Items

Coupler & Draft Gear

- CAB-END: Manually Foldable
- NON CAB-END: Non-Foldable

- Automatic coupling:
  - Mechanically
  - Electrically



Train Systems & Safety Critical Items

Passenger Doors & Controls

- Electric Sliding Plug
- Double Leaf
  - Clear opening = 1.300 mm
  - Minimum Height = 1.980 mm
- 4 Doorways per Side
- 1 DCU and 1 Electric Operator per Doorway
- Obstruction Detection on each door
  - Motor current monitoring
  - Way/time monitoring
  - Sensitive edge

Train Systems & Safety Critical Items

HVAC

Passenger Compartment

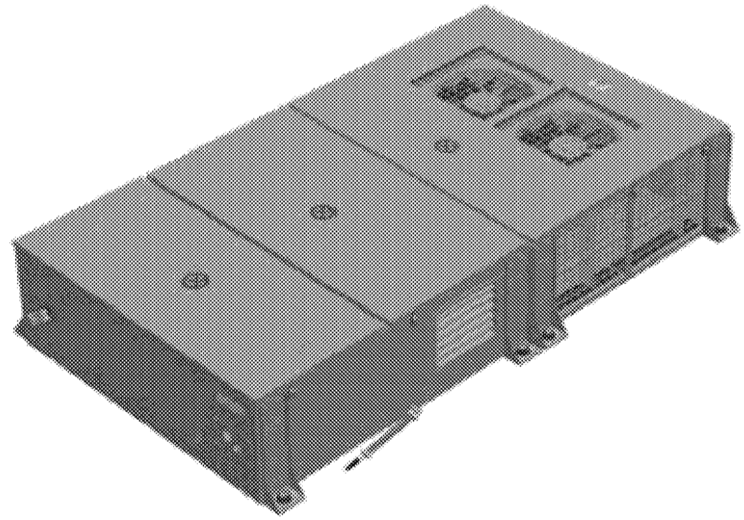
- 1 HVAC per half vehicle
- Floor heaters

Cab

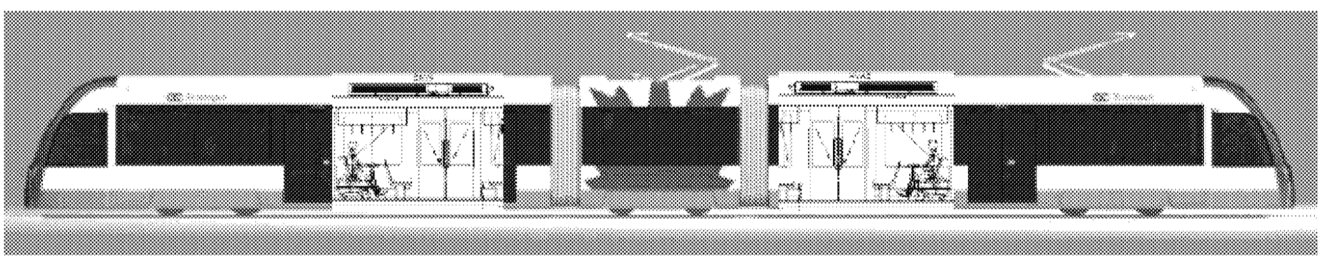
- 1 HVAC Duct
- 2 Heaters

Power

- Cab
  - 7 kW heating capacity
- Passenger
  - 40 kW cooling capacity
  - 56 kW heating capacity



- The vehicle will be fully tested in a climate chamber



Train Systems & Safety Critical Items

Lighting

Exterior Lights

- According to OTTAWA's TS

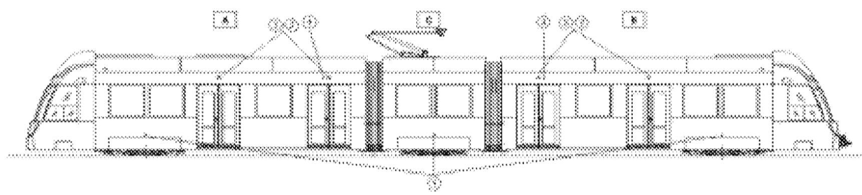


Figure 2. Exterior Light Distribution

ITEM	SUPPLY ITEM	A	C	B
01	Disc Brake Applied	2	2	2
02	Door Open	4	0	4
03	Door Out Of Service	4	0	4
04	Bridge Plate Out-of-Service	2	0	2
05	Headlight	2	0	2
06	Tail/Brake/Turn Lights	2	0	2
07	Railway Headlight	1	0	0
08	Marker Light	2	0	2

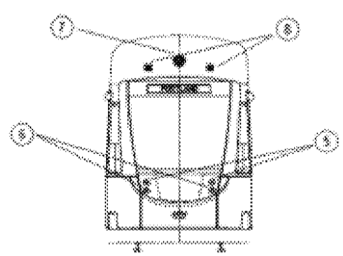
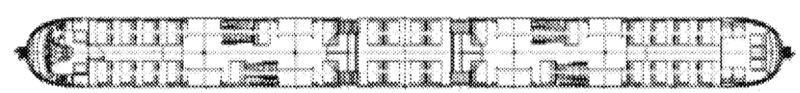
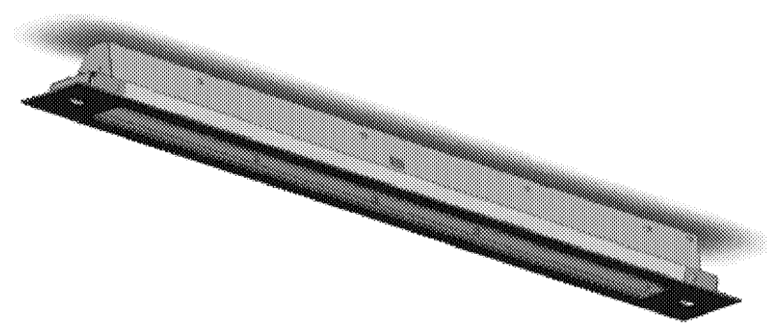


Figure 3. Front End Light Distribution

Interior Lights

- Two rows of LED fixtures mounted above the seats on each side of the aisles





Train Systems & Safety Critical Items

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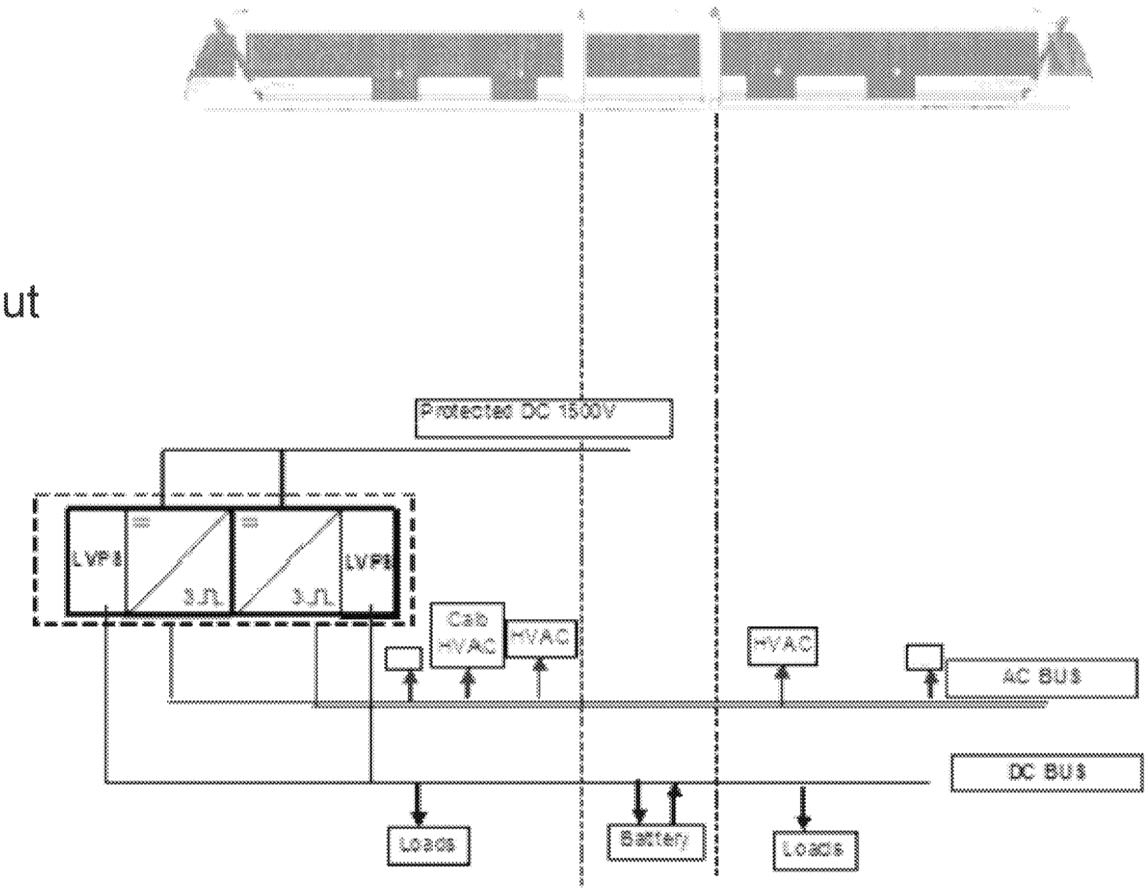
Auxiliary Electric

Main Technical Figures

- 75 kVA: Rated power at the AC three phase output
- 4.8 kVA: Rated power at the AC single phase output
- 10 kW: Rated power at the DC output
- 200 Ah: Battery



Auxiliary & Low Voltage Power Supply Diagram

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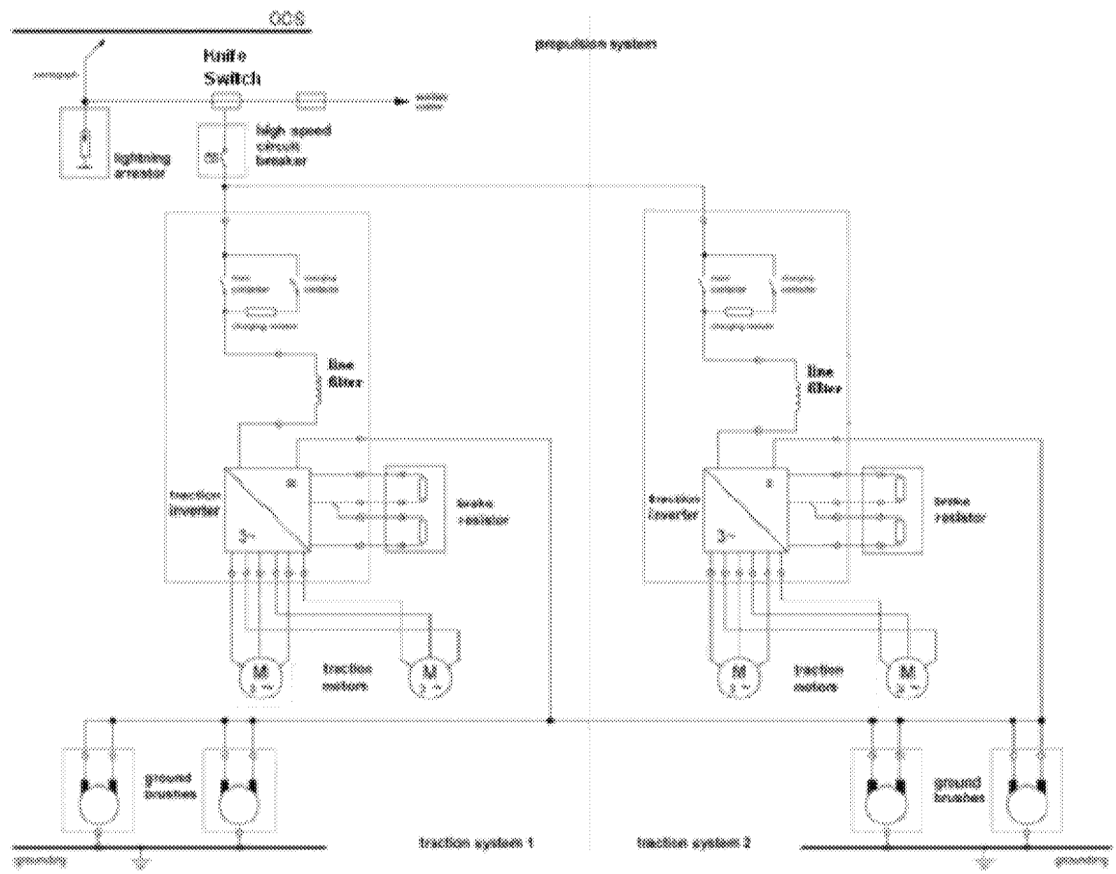
Train Systems & Safety Critical Items

Propulsion System & Control

System layout

- A traction inverter is installed on each car
- Each inverter feeds two traction motors
- Each Motor Truck has two traction motors
- Compliant with required performance

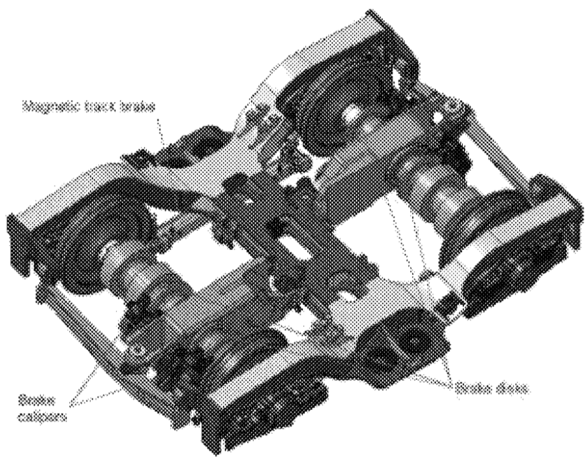


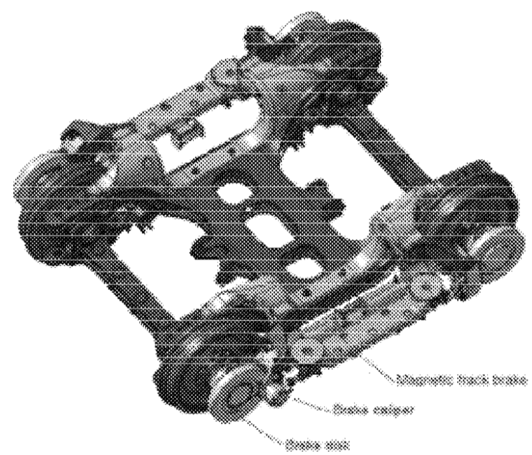
Train Systems & Safety Critical Items

Friction Brake & Pneumatic Systems

- Compliant with the performance requirements
- Friction brake layout
  - BCU per truck (independent control)
    - Motor Truck:
    - 2 Brake discs & 2 indirect calipers per axle
    - Track brake
    - Parking Brake

- Trailer Truck
- 2 Brake discs & 2 direct calipers per axle
- Track brake





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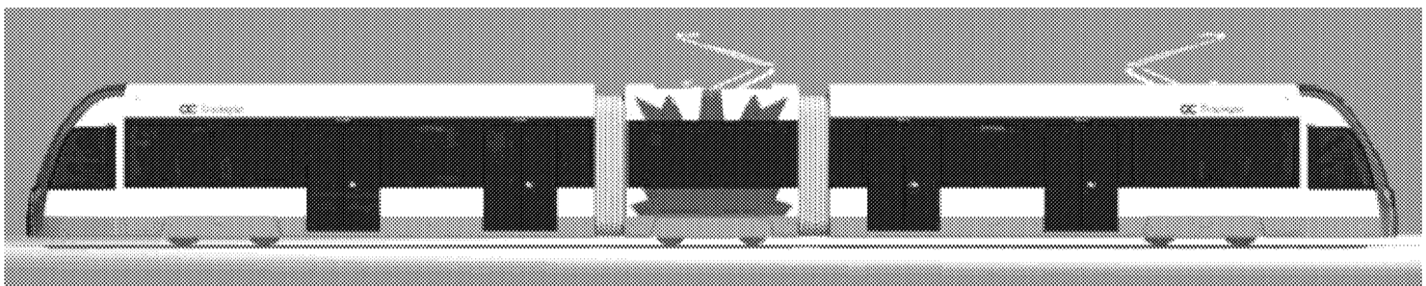
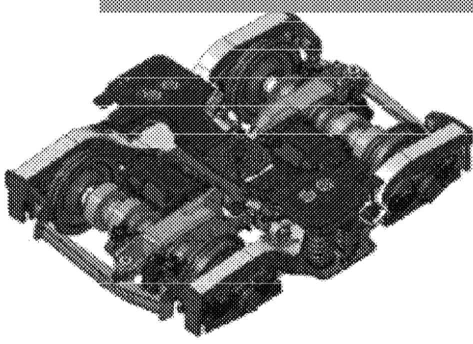
Train Systems & Safety Critical Items

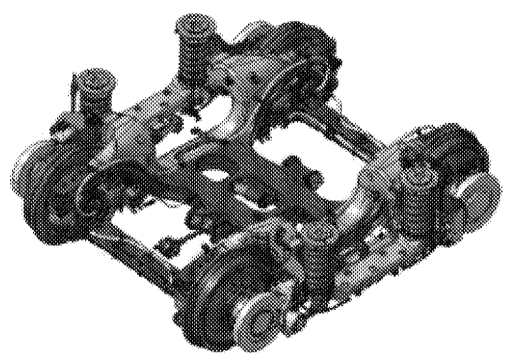
Trucks & Suspension

- Proposed truck: Service proven
- Based on Houston design:
  - Motor Trucks: based on CAF's 70% and High Floor vehicle trucks
  - Trailer Trucks: based on CAF's 100% LF vehicle trucks

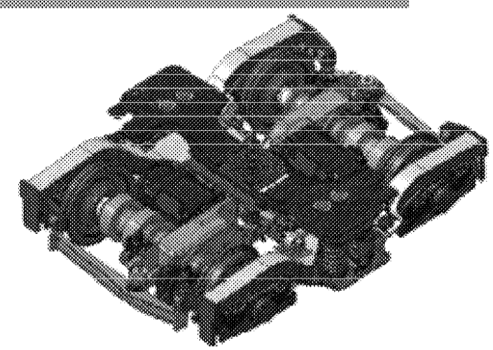




MOTOR TRUCK



TRAILER TRUCK

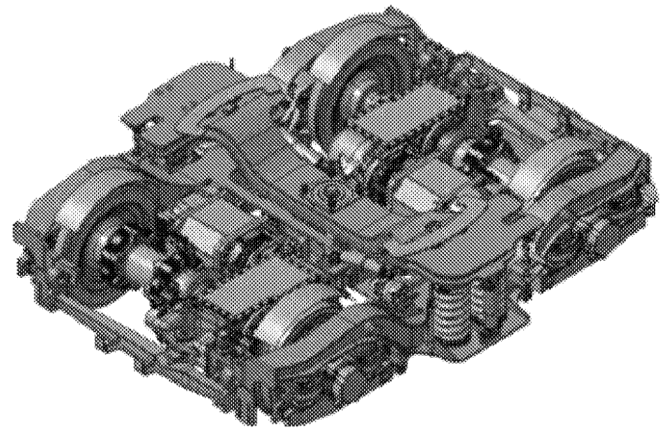


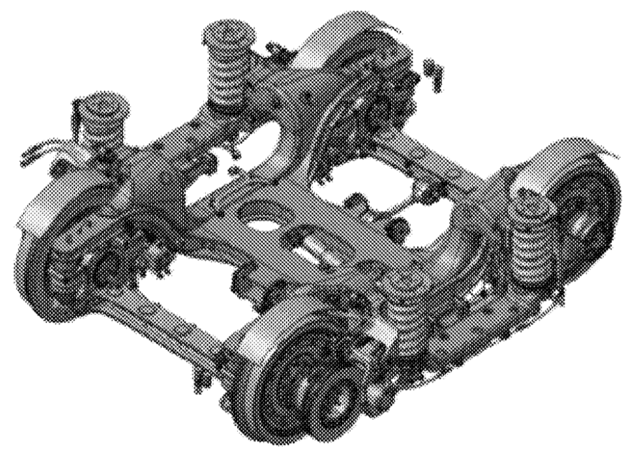
MOTOR TRUCK

Train Systems & Safety Critical Items

Characteristics

- Trucks and their components compliant with current OTTAWA's TS Requirements
- Main features
  - Axle wheelbase:
    - 1,900 mm (Motor Truck)
    - 1,850 mm (Trailer Truck)
  - Track gauge: 1,435 mm
  - Wheel diameter (new/worn): 660 mm / 580 mm
  - Primary suspension: Elastomeric spring
  - Secondary suspension: Coils, dampers
  - Motor arrangement: Parallel drive
  - Hydraulic levelling system
  - Brake discs assembly: Axle mounted
  - Stub axle: free wheels on trailer truck

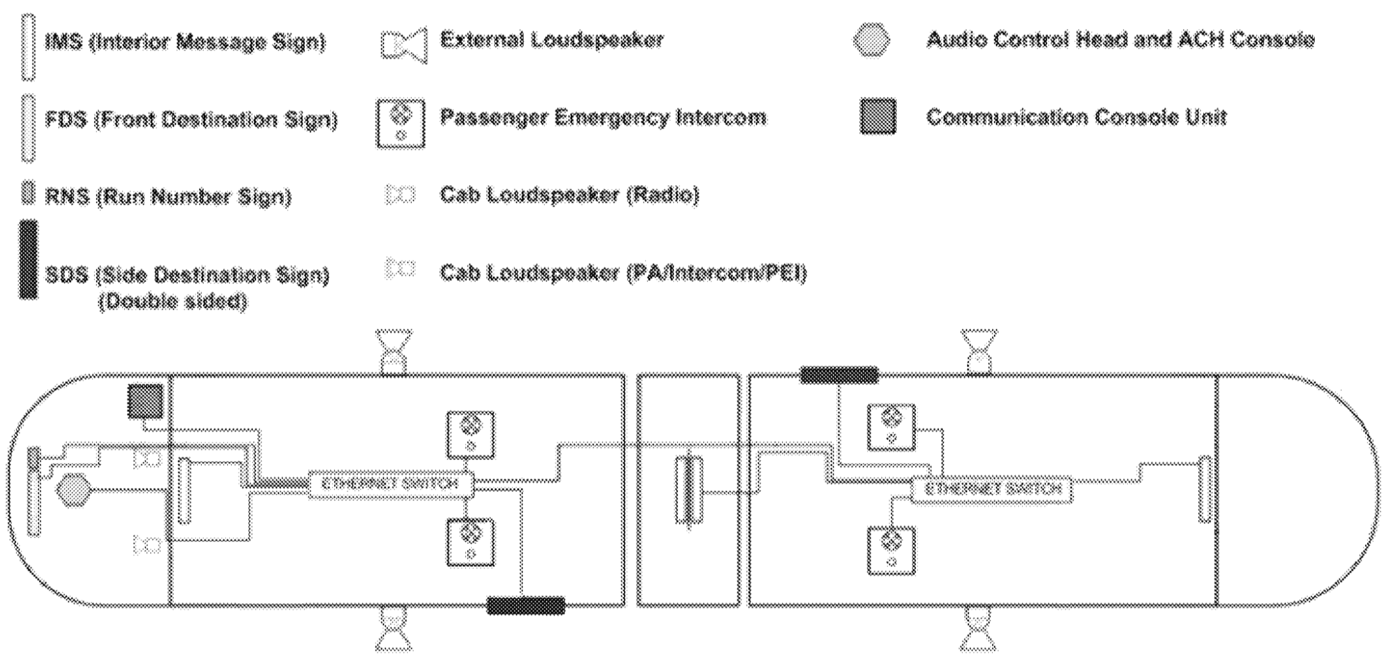




Train Systems & Safety Critical Items

Communications & Signs

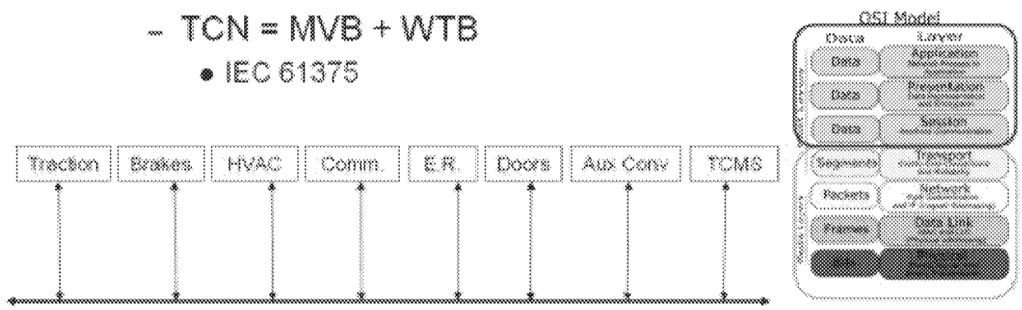
- Subsystems
  - Public Address System
  - Passenger Inter Communications System
  - Automatic Announcement and Display System
  - Video Surveillance System



Train Systems & Safety Critical Items

Data Communication Network

- Two data communication networks for complementary functions
  - Train Communication Network TCN
    - Based on standards IEC 61375 / IEEE 1473-T
    - MVB and WTB networks
    - Mainly used for Train Control and Monitoring Operational Data



  - Ethernet IEEE 802.3
    - Multimedia applications: Audio and Video information
    - Maintenance tasks: downloading log files, configuration of equipment, software versions updates

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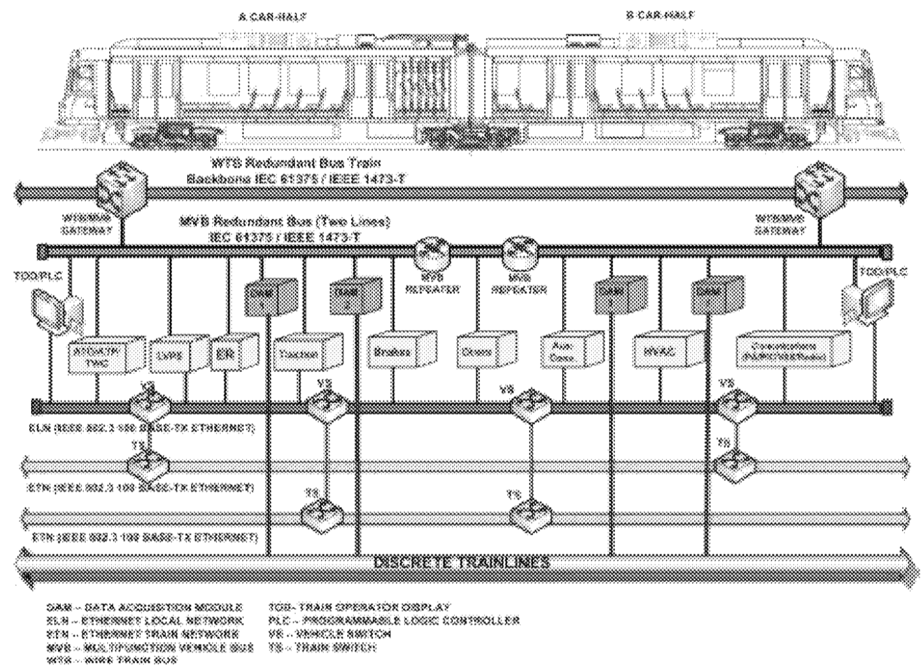
Train Systems & Safety Critical Items

Monitoring & Diagnostics System

- Management of communication between train's systems
- Interface with the train through input / output channels and execution of train logic
- Supervision, monitoring and recording of the train's performance
- Chronological register of event with environmental variables to facilitate maintenance of train systems
- Control of auxiliary systems



CAF's Philosophy Train's Networks

Vehicle Type, Arrangements & Performance Levels

Vehicle Performance in Winter Conditions

- CAF has the following projects in similar climatic conditions:
  - Pittsburgh LRV
  - Finland Sm4 EMU's
  - Turkey High Speed Train (TCDD)
  - Belgrade LRV (Design Stage)
  - Stockholm LRV (+40ºC to -40ºC)(Design Stage)
  - Cincinnati 100% Low Floor LRV (+42ºC to -32ºC) (Design Stage)

- The experiences and lessons learned from these projects will be brought to ensure:
  - Vehicle design and manufacturing based on demonstrated experience
  - Service proven components

Vehicle Type, Arrangements & Performance Levels

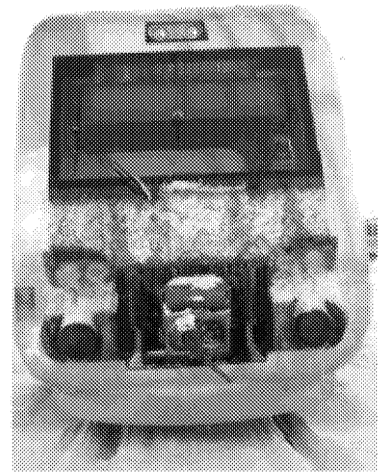
Winterization

Vehicle Type, Arrangements & Performance Levels

Winterization

Carbody

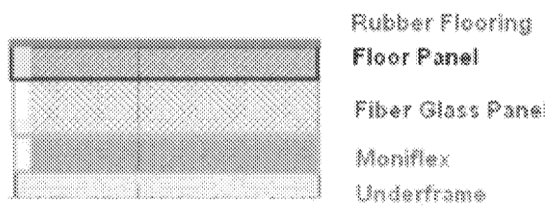
- Measures to mitigate:
  - Snow Accumulation and Icing
  - Cold Bridges
  - Ice Blocks and Stone-shooting
- Surface Treatment & Paint

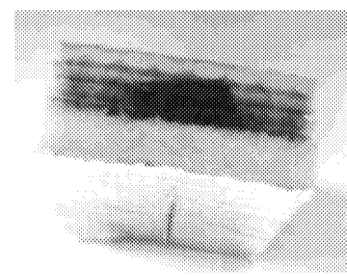


Insulation

Ceiling, Floor and Sides design based on the Stockholm Solution (-40ºC, +40ºC)

- Moniflex
- Fiberglass insulation
- Aluminium Face (Vapour barrier)





- The moisture content is finally drained to the exterior using the holes drilled in the frame.

Vehicle Type, Arrangements & Performance Levels

Winterization

Thermal Bridges

- Interior Fixings with non-metallic parts
- Double Glazing windows

Thermal Expansion

- Flexible joints and gaps will be taken into account in the design

Air Intakes and Circulation

- Air intakes, grilles and filters in high positions
- Air ducts, insulated

Vehicle Type, Arrangements & Performance Levels

Winterization

Heated Equipment

- Thresholds (provided)
- Windshield (provided)
- Sanding Equipment (provided)
- Cab Seat (provided)
- Windshield wipers (optional)
- Pantograph (optional)
- Radiant Vestibule Floor (optional, more oriented to long distance vehicles)

Additional Equipment

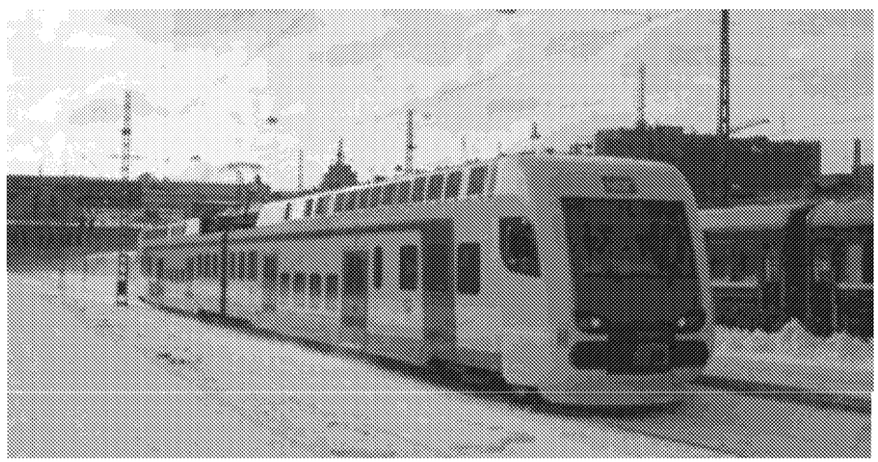
- Snow Plough
- Ice Scraper

Vehicle Type, Arrangements & Performance Levels

Winterization

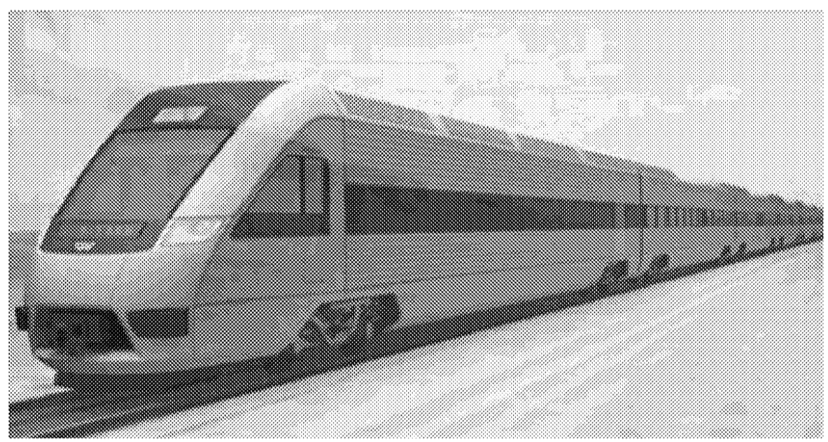
Reference Documents

- EN 50125-1 Railway applications – Environmental conditions for equipment
- prEN 16251 Railway application – Environmental conditions – Design and test of rolling stock under severe conditions
- NUP T1 Winter Durability of Rolling Stock
- NUP T1:2 Preventing snow or ice from accumulating on and penetrating into the vehicles, method for de-icing
- NUP T2 Electronic equipment used on rolling stock
- Transrail GrönaTåget



Vehicle Performance in Extreme Heat Conditions

- CAF has the following projects in harsh summer climatic conditions:
  - Seville LRV
  - Saudi Arabia Coach cars + Locomotive
  - Alger Metro
  - Algeria DMUs
  - (…)



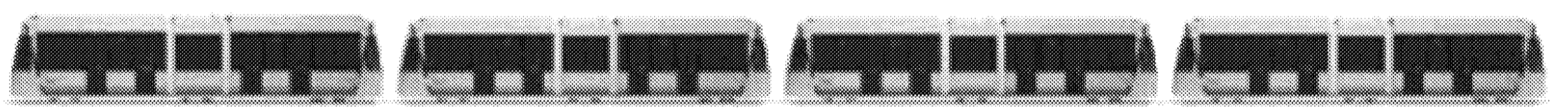
Consist Arrangements

Experience with Consist Arrangements

- CAF has extensive worldwide experience with a variety of vehicle configurations for several different platforms
  - i.e. Trieste, Italy, 3 EMUs of 5 vehicles each with a possibility to add 1 more in the future (approximately 270m)

- CAF does not foresee any particular problems running in multiple consist. CAF will design the vehicle structure and the coupler taking into account this condition

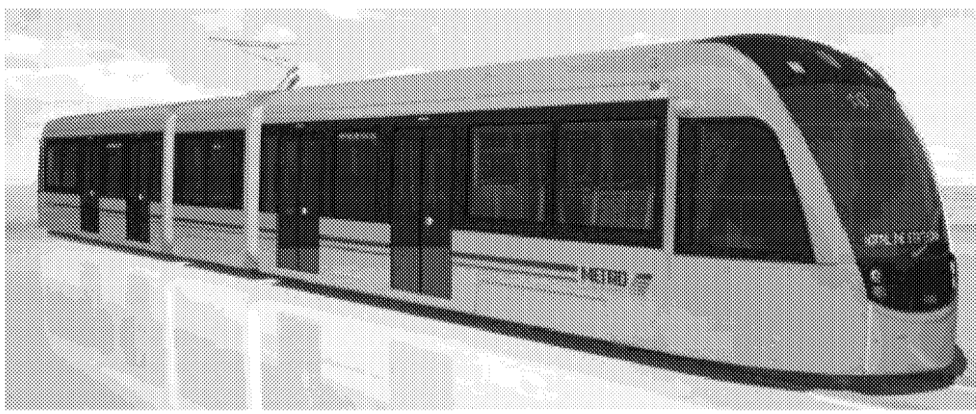
- CAF trains are fully compatible with the local OLRT infrastructure.
  - For train configuration up to 4 vehicles, 120m.



Testing

List of Tests of Equivalent Vehicles

- CAF will comply with the requirements in the TS
- Reference Vehicle: Houston LRV (Currently in design stage)
- All testing to be conducted before the end of 2013
- Houston Test results may be used to reduce the scope of OLRT testing
- List of Houston Testing Provided in the Narrative



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Testing

Standard CAF Test Program

- Type Testing
  - Mandatory for all newly developed equipment
  - Verification of the operation in accordance with the approved design data
  - Performed on the first unit produced
  - When used previously in a similar application, the existing type test results may be submitted for approval
- Serial Testing and Inspection
  - Serial inspection ensures that the standard approved by type testing is maintained
  - A functional routine test is also carried out to demonstrate that the function of the test item is operationally assured

Testing

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Test Plan

- Test plans, procedures, and reports will meet the requirements of the TS
  - Subject to review and approval by the City
- Design qualification, factory acceptance, and on-site acceptance testing on all items
- The City or its representatives, will be invited to the tests

CAF

PLAN DE PRUEBAS Y ENSAYOS
TEST PLAN
PROYECTO / PROJECT : **PITTSBURGH (R)**

EDICION / ISSUE: 05
Clave(s) Obra: 2680

	Elemento u Operación a Controlar / Part or Operation to be Controlled			Tipo de Control / Control Type							Registros / Records	
Item / *Item*	Código / *Code*	Denominación / *Designation*	Suministrador (lugar) / *Supplier (location)*	Tipo / *Type*	Fal / *Fal*	Serie / *Routine*	Especificación de Control / *Control Specification*	Responsable / *Responsible*	Frecuencia / *Frequency*	Presencia Cliente / *Customer Presence*	Documento / *Document*	Entrega Cliente / *Delivery to Customer*
200.		**PRUEBAS FINALES** / ***FINAL TESTS***										
210.		**Bogie** / ***Truck***										
210.1.		Verificación del eje montado / *Wheelset verification*	C.A.F. (Div.II+Emira)			I	M8190105 / M8290105	F.C	100%	A	M8190105 / M8290105	Sí / Yes
210.2.		Pruebas neumáticas / *Pneumatic tests*	C.A.F. (Div.IV+Emira)			I	M8190112 / M8290112	F.C	100%	A	M8190112 / M8290112	Sí / Yes
210.3.		Verificación final de pintura / *Final painting verification*	C.A.F. (Div.IV+Emira)			I	M8190111 / M8290111	F.C	100%	A	M8190111 / M8290111	Sí / Yes
210.4.		Verificación de la resistencia eléctrica / *Electric resistance verification*	C.A.F. (Div.IV+Emira)			I	M8190107 / M8290107	F.C	100%	A	M8190107 / M8290107	Sí / Yes

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Industrial Design Representation of Proposed Vehicle

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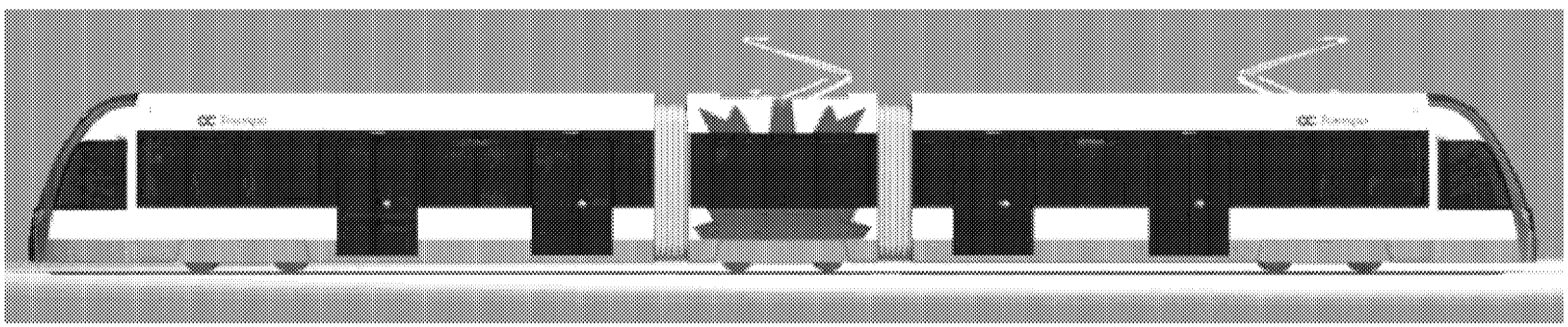
Industrial Design Representation of Proposed Vehicle



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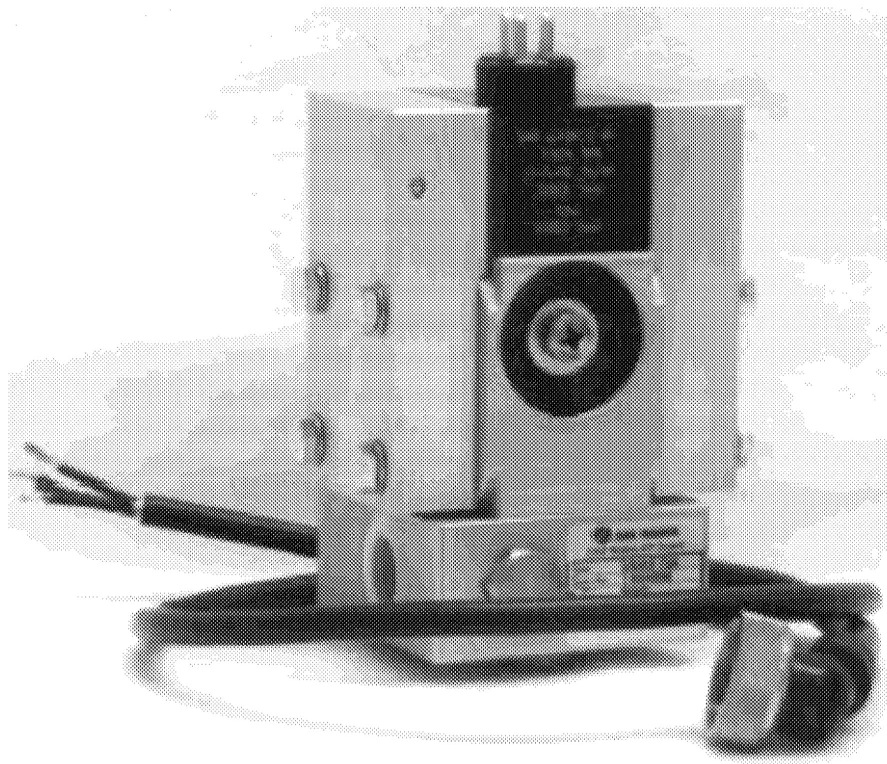
Industrial Design Representation of Proposed Vehicle

Spin / Slide Control System

Spin / Slide Braking System Interface

- Wheel Spin/Slide Control system (SSC) prevents wheels from spinning during accelerating and sliding during braking

- Two control methods:
  - Spin/Slide Control with Reference Speed
  - Spin/Slide Control without Reference Speed



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Spin / Slide Control System

Spin / Slide Correction System

Coordination between Dynamic and Friction Brake

- Performed by the propulsion (dynamic brake) and brake control units (Friction brake)
- Both systems coordinated to avoid simultaneous corrections
- During the blended brake dynamic slide correction is applied first. Only when the correction is not possible, the dynamic brake is removed and only friction brake will be applied (with its slide correction system)
- During the friction brake application, friction brake slide correction system will be active

Sanding

- Activated Manually by means of the cab driver desk pushbutton
- Activated Automatically when:
  - Propulsion system detects spin or slide above a predefined level of severity
  - Friction brake system detects slide above a predefined level of severity

Low Adhesion

- The propulsion system optimizes the torque according to the available adhesion
  - The efficiency of the wheel spin system will provide more than the 90% of the acceleration rate allowed by the available rail adhesion

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Vehicle Delivery to the Site

Transport

- Once factory testing is finished, each Vehicle is Transported from CAF's Final Assembly facilities in Canada to End Customer Facilities

Testing at Customer's Facility (Track Test & Commissioning)

- Track Test & Commissioning of the vehicles commences when each vehicle is at Final Customer's facility with all equipment installed, and is developed according to CAF internal procedures and to Inspection and test Plan of the project. All results are recorded and duly documented
- Cold weather testing will be made a priority
- CAF will supply necessary human resources for carry out the testing and commissioning, and eventually responsible of different equipment and Technical Office Staff from CAF will be present during Track Test Period
- On this Stage Project Co. will provide dedicated drivers for on track testing of vehicles on Final Customer Railway Network. The drivers training will be done by qualified CAF staff on the first vehicle before commissioning of the first vehicle

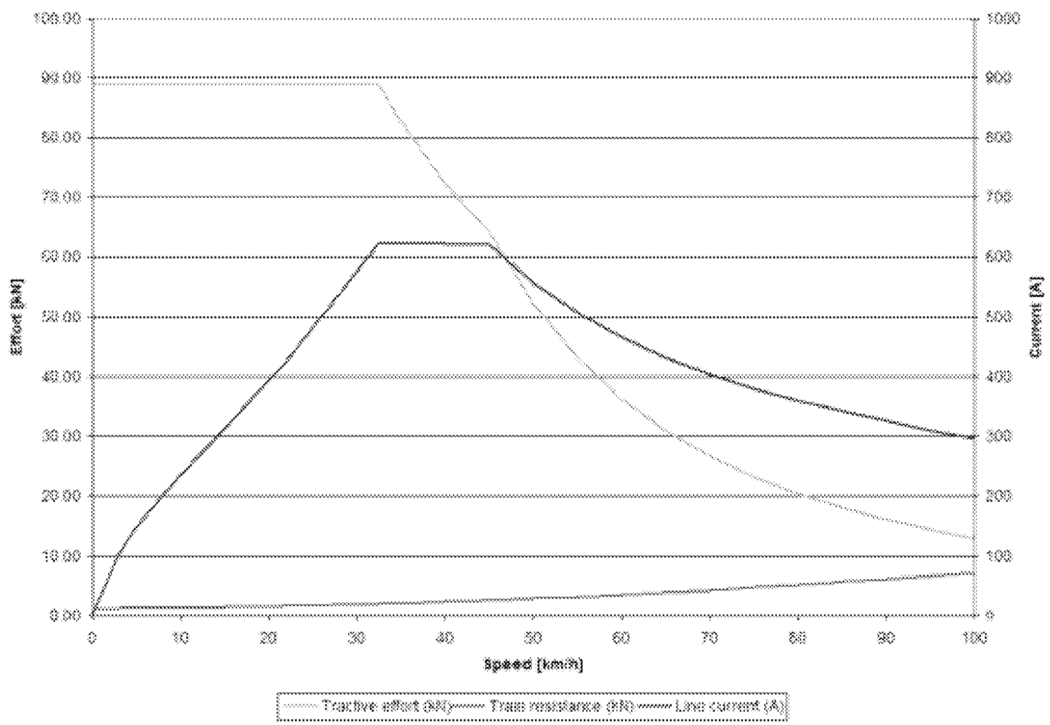
Vehicle Delivery to the Site

Delivery

- The delivery of the vehicle occurs once each vehicle passed the track tests, the commissioning and acceptance milestone. It is then that the vehicle will be handed over to the consortium (Project Co) at the final customer's facility

Key System Interfaces between Vehicle & Wayside Subsystems Site

Current Draw per Vehicle



Regeneration

- Maximize the regenerated braking energy
- The regeneration level will depend on the receptivity of the line

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Key System Interfaces between Vehicle & Wayside Subsystems Site

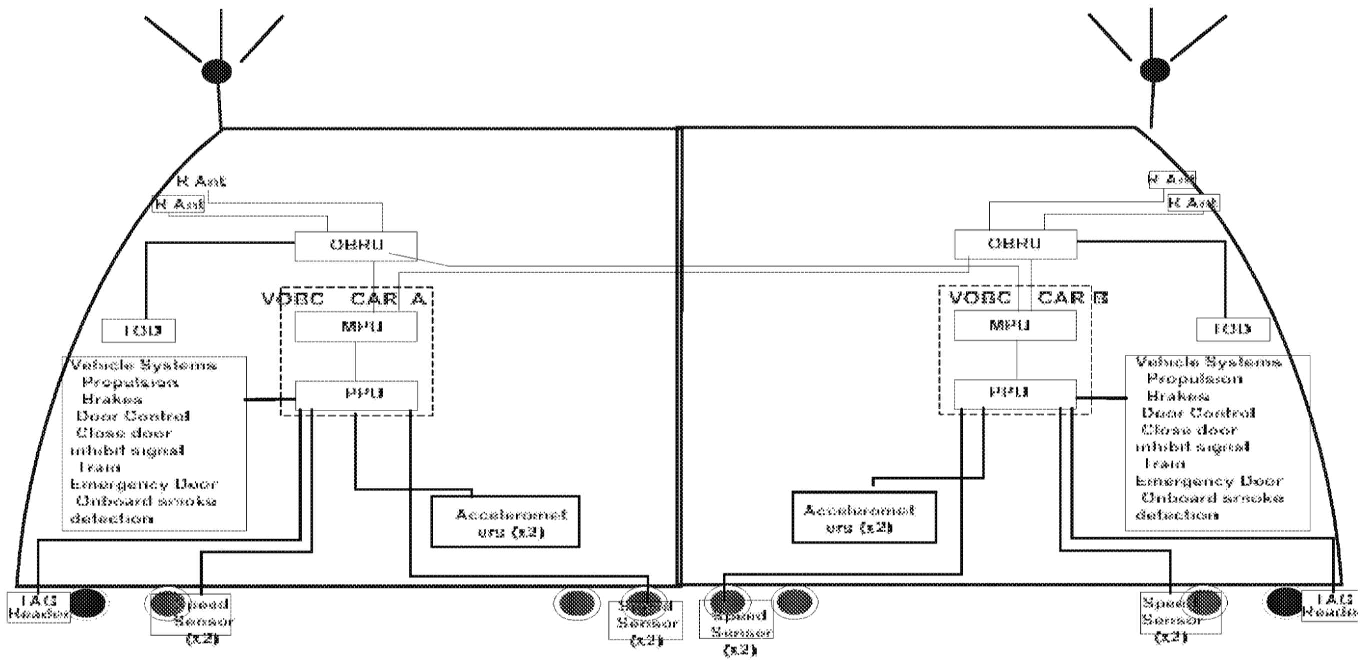
Interface with the CBTC System

- CAF has already installed CBTC systems in several trains with successful results:
  - Chile Metro
  - Istanbul Metro
  - Algiers Metro
  - Malaga Metro (100% LFLRV)
  - Madrid Metro series 9000 and 2000A
  - Caracas Metro
  - Sao Paulo Metro
  - CPTM Sao Paulo
- Train Control from different suppliers:
  - Thales
  - Ansaldo
  - Alstom
  - Siemens
  - Invensys

Key System Interfaces between Vehicle & Wayside Subsystems Site

Train Control

- The CBTC system supplied by Thales and integrated by CAF:



Key System Interfaces between Vehicle & Wayside Subsystems Site

Interface with Train Voice Radio

- CAF will install and integrate radio (provided by others) and integrate the interface between the radio and other subsystems (e.g. PA/PIDS)
- CAF will work with the Radio System Supplier to define the interface and functionality

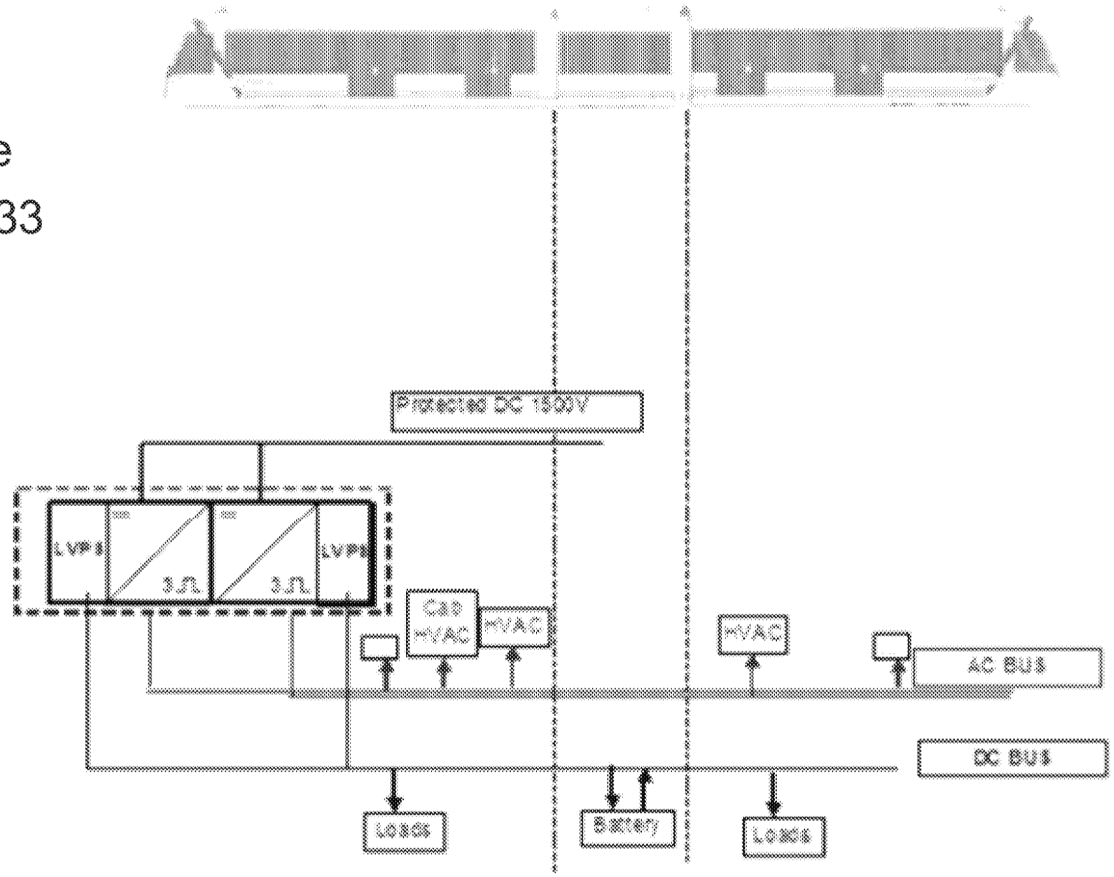
Additional Interfaces

- CCTV:
  - As required, CCTV images shall be transmitted from the station area to the vehicle.
- APC:
  - The data collected by the APC will be provided to the Performance Monitoring System at TSCC in real time.
- Physical interfaces (e.g. wheel/rail, dynamic envelope) will be managed through the Project Co's interface management process

Supply Voltage

Supply Voltage

- The LRV to operate under the catenary nominal voltage of 1500 Vdc as per IEEE 1833



Benefits

- Infrastructure Benefits
- Lower currents
- High Voltage Wiring lighter
- Lower filter inductances, consequently higher performance

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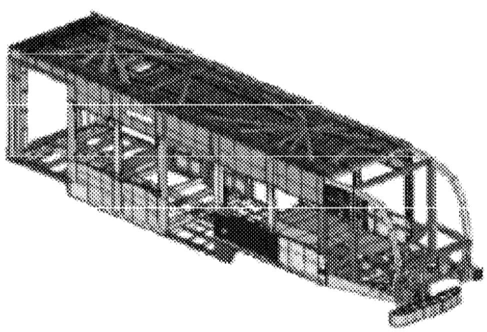
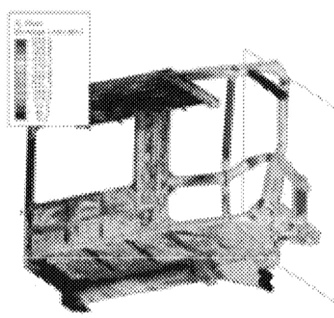
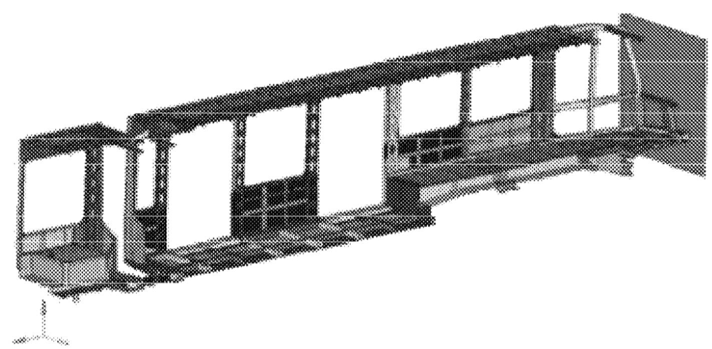
Carbody Strength & Supporting Test Results

Carbody Structural Strength

- CAF's design and testing approach can be summed up as follows:
  - Carbody design based on the existing LRV of Houston (2g, approx. 900kN)
  - CAF will design, analyze, and test the LRV to the structural provisions specified ASME-RT1 or equivalent.
  - FEA analysis with ABAQUS
  - Static Testing of the Carshell (Prototype)



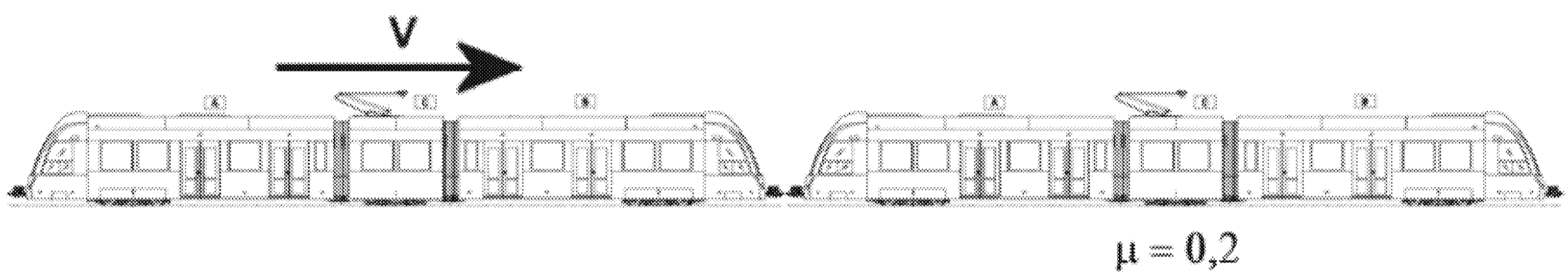




Crashworthiness & Modelling Results

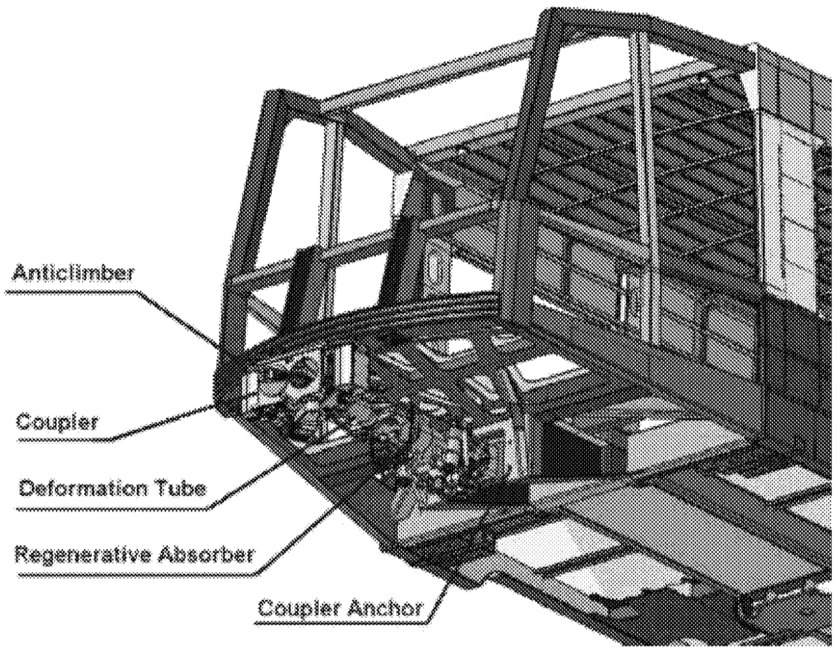
Crashworthiness

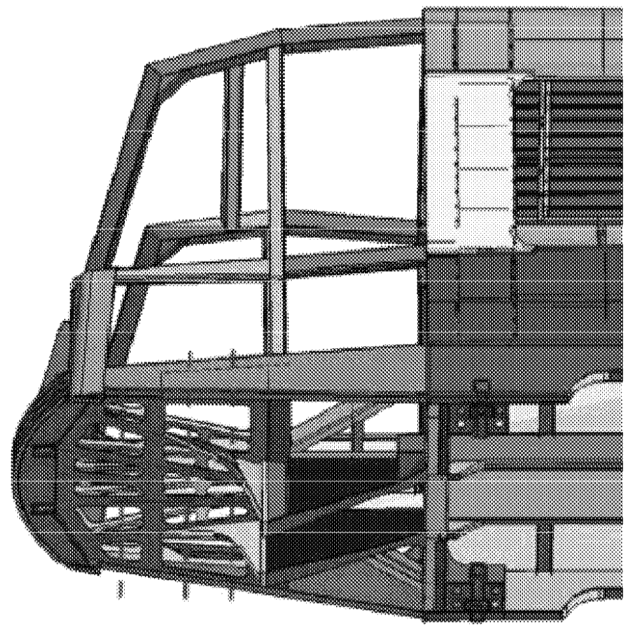
- As required CAF will design, analyze, and test the LRV to the structural provisions specified in ASME-RT1 or equivalent
- The considered collision scenario for the crashworthiness is a collision with an equivalent vehicle at 32km/h
- A dynamic rigid body model will be used to determine deformations, velocities, accelerations and forces generated during the crash
- Calculations will be validated by testing components of the structure



Crashworthiness & Modelling Results

Crashworthiness





Elements Involved in Crash Scenarios and Collapse Lines at Carbody Front End

Crashworthiness & Modelling Results

Crash Test Video

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Vehicle Weight & Axle Loads

Vehicle Weights

Description	Weight*
AW0 = LRV empty weight (Tare) + dry sand	47,000 kg
AW1 = Fully seated Passenger load and one Driver + AW0	51,970 kg
AW2 = Standees at 4 Passengers/m2 of suitable standing space + AW1	60,370 kg
AW3 = Standees at 6 Passengers/m2 of suitable standing space + AW1	64,570 kg
AW4 = Standees at 8 Passengers/m2 of suitable standing space + AW1 (Structural design load, not expected for Revenue Service)	68,770 kg

Axle Load AW4

- Motor Truck A-B, per axle: 11,612 kg *
- Center Truck, per axle: : 11,161 kg *

Maximum Weight Supported

- Estimate Maximum Weight supported by the Motor Truck will be 23,224 kg *

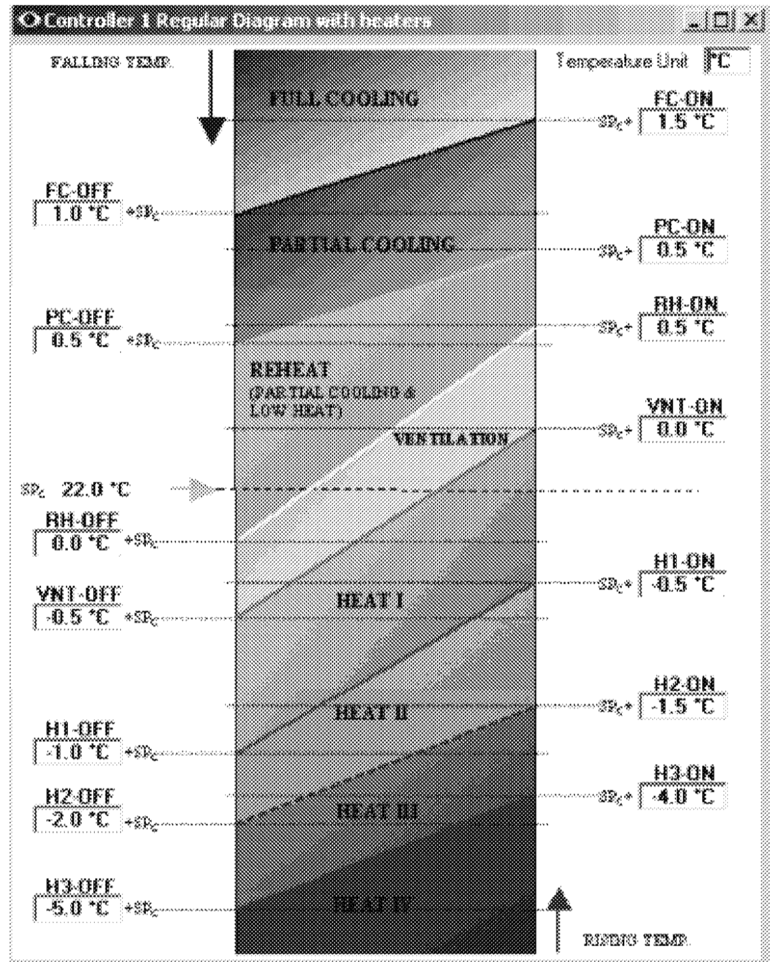
* Estimate values for OLRT Vehicle

Heating / Cooling to Meeting Climatic Requirements

HVAC Preliminary Estimation Calculations

- Preliminary estimation calculations based on the following conditions:
  - Outside temperature
  - Inside temperature
  - Outside RH
  - Inside RH
  - Solar radiation
  - Transmission losses
  - Ventilation losses

- From this information:
  - Thermal load to calculate unit power for air-conditioning / heating in the most adverse conditions



Train Systems & Safety Critical Items

HVAC

Passenger Compartment

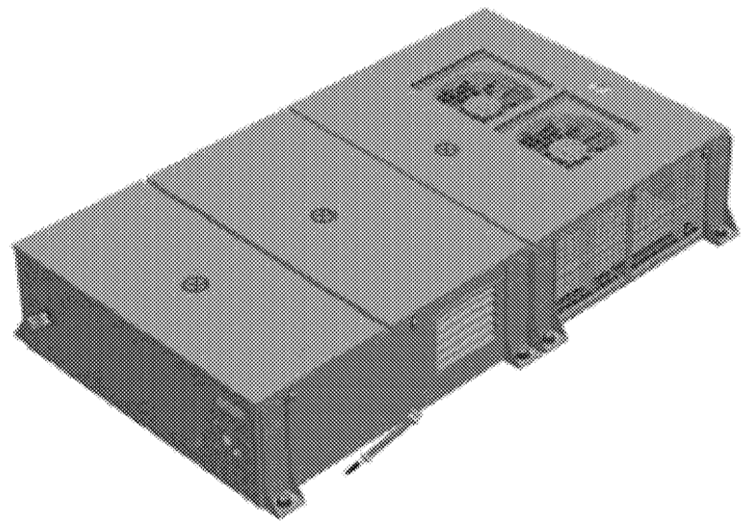
- 1 HVAC per half vehicle
- Floor heaters

Cab

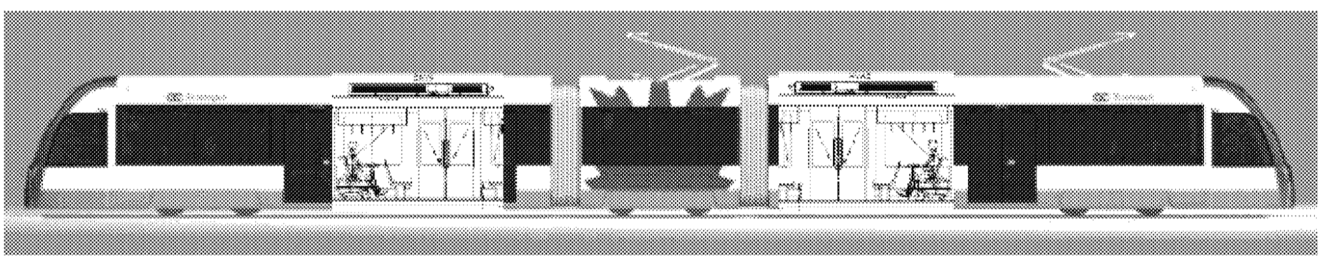
- 1 HVAC Duct
- 2 Heaters

Power

- Cab
  - 7 kW heating capacity
- Passenger
  - 40 kW cooling capacity
  - 56 kW heating capacity



- The vehicle will be fully tested in a climate chamber



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Pushing / Towing

Pushing / Towing: Compliant with OLRT TS-3.12 Requirements

Ability to Push or Pull Another Full Train Consist

- At AW3, maximum ambient temperature, maximum allowed variation in truck wheel diameters (…) the propulsion system shall exceed the manufacturer's limits for a 30 year life

- At AW0, maximum ambient temperature, maximum allowed variation in truck wheel diameters (…) propulsion system shall exceed the manufacturer's limits for a 30 year life

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Fire Safety

Fire Safety: Compliant with OLRT TS Requirements

- Compliance in previous CAF North American projects
  - Sacramento
  - Pittsburgh
  - WMATA

Example Project: Houston

- NFPA 130, Chapter 8 (for materials) and Chapter 8.6 (for electrical equipment)
- ASTM 1354 (for Heat Release Rate)
- BSS-7239 (for material toxicity)
- Applicable to the scope of supply of all CAF suppliers

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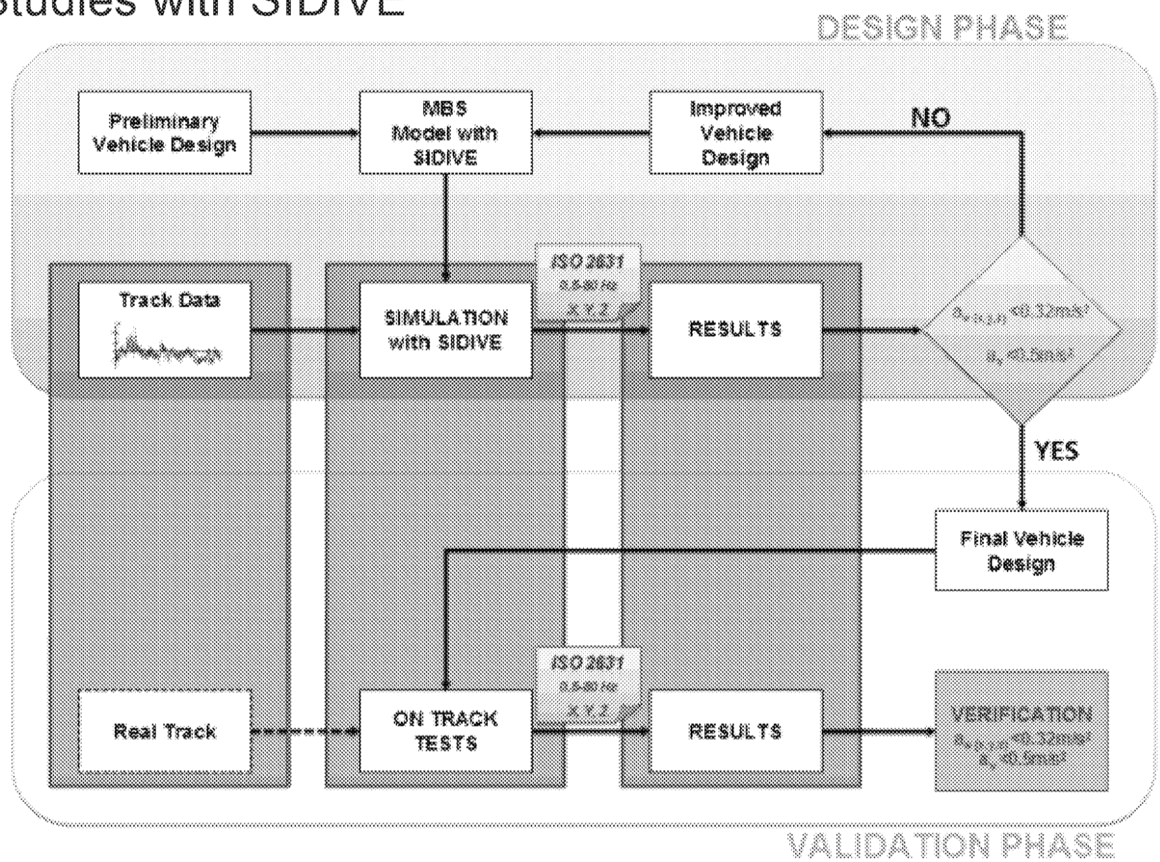
Ride Quality

Ride Quality: Compliant with OLRT TS and ISO2631 Standard

- Dynamic Studies with SIDIVE



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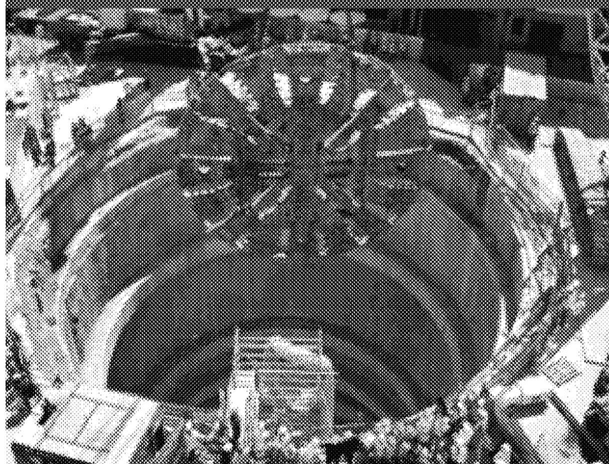
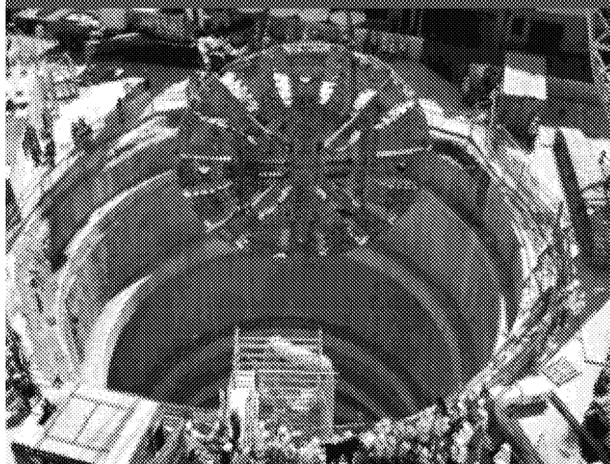


DISCUSSION



4 SYSTEM BRANDING AND IDENTITY

Sandy Webster

Sandy Webster

Communication Director

- Sandy has over 16 years of experience in strategic transportation communication and consultation, media relations, issues management, incident communication, proposal writing and evaluations, and other public and private sector communications.
- Sandy previously worked for the BC Provincial Government with traffic safety programs, and worked for the City of Richmond (BC) on the Canada Line Rapid Transit Project.
- Since joining SNC-Lavalin in 2005, Sandy worked on the Canada Line Project, Calgary West LRT Project, Edmonton North LRT Project, and the Hurontario-Main LRT Project in Ontario's GTHA.
- Sandy has a Masters Degree in Communications from Royal Roads University and is the Communications Director for SNC-Lavalin's Transportation Division

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System Branding: Where We Begin

A Partnership Approach to Benefit the Public

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System Branding and Identity

Strong Collaboration With The City To Put The Public First

- Trusting partnerships and a best practice approach
- We consider vehicle branding within the greater context of the system brand - a customer centric brand must start with the public in mind
- The LRT system and vehicles deliver many of the features most important to customer satisfaction and ridership loyalty

The Power Of Launch

- Launch of new service is the definitive opportunity to define the positioning and brand promise of the system

Vehicles Are Iconic

- Passenger vehicles are the dynamic linking element and ultimately become the face of the system
- Unique potential to capture and communicate the brand promise with each passing view or travel experience

These principles inform our system branding strategy

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Branding Strategy

System Branding – A Complete Design Approach

- Branding goes beyond vehicles – our team provides a 'complete design approach' to support the City in thoughtfully integrating the LRT
- Strategic Visioning and Branding guides and aligns with other design and implementation disciplines
- Lessons learned from LRT projects enhances our excellence in system design and function, including vehicle branding

Lessons Learned – The Benefits

- A strong partnership commitment, blueprint structure and process is key
- We expect and will manage competing interests in the political realm
- Our branding support will align with the City's vision to create a world-class identity for the system (association with images, text, language, logos, colours, fixtures, textures and more)
- We understand how all the parts fit together in a complete system. From big ideas to logo placement to way-finding signage to tourism route maps to tweets about service – we recognize the OLRT identity is precedent setting

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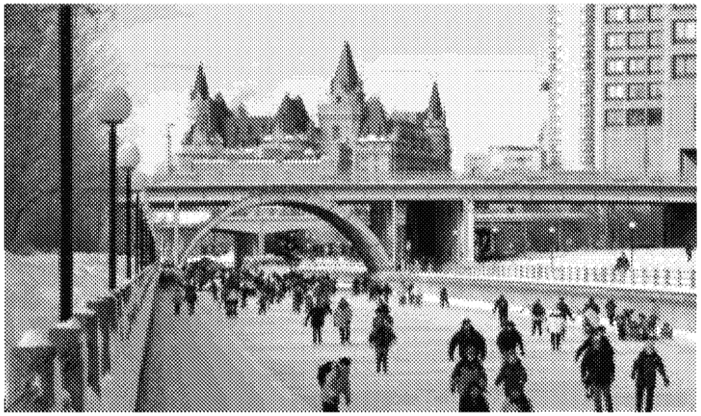
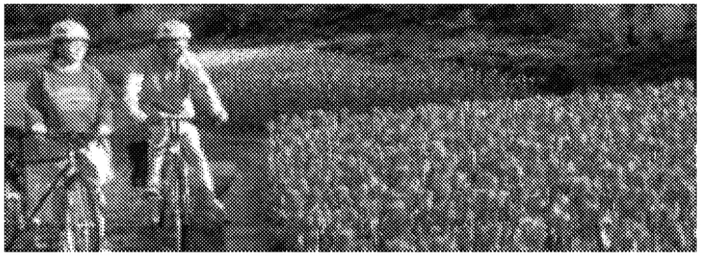
Our Capital Pride

The Essence of Ottawa

- The system and vehicle brand must fully integrate with the City's Vision and Project Goals to reflect:
  - A World-Class Liveable City
  - Leadership in Public Transit and Mobility
  - Leadership in Sustainability and TOD
  - Technologically Progressive
- Developing the brand should be undertaken in partnership, not in isolation, and must be holistic
  - Current and Future LRT Systems in Ottawa
  - Comprehensive Communication and Consultation
  - Stations, Vehicle and Urban Design
  - Long-term Operations and Maintenance





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Brand Strategy Elements

Building a Compelling, Positive and Recognizable Brand

- **A long term vision** - an explicit definition of what the OLRT brand is to represent in the eyes of its target audience
- **A better product** - product quality is an ideal branding variable. Working within the budget envelope, we work smarter to deliver a better product across vehicles, stations and stops, urban design, operations & maintenance
- **An analytical edge** – we will work with the City to research, consult and obtain a clear understanding of customers and customer needs
- **Consistency** - consistency is absolutely critical to long-term brand image. This includes consistency over time, consistency over system elements and consistency with BRT and other transit services where appropriate
- **Creativity** - brand building requires creative thinking, planning and execution through every element of the system
- **Positioning** – brand positioning creates a specific place in the market for the brand and service offerings. It reaches a certain type of customer and delivers benefits that meet the needs of key target groups and users

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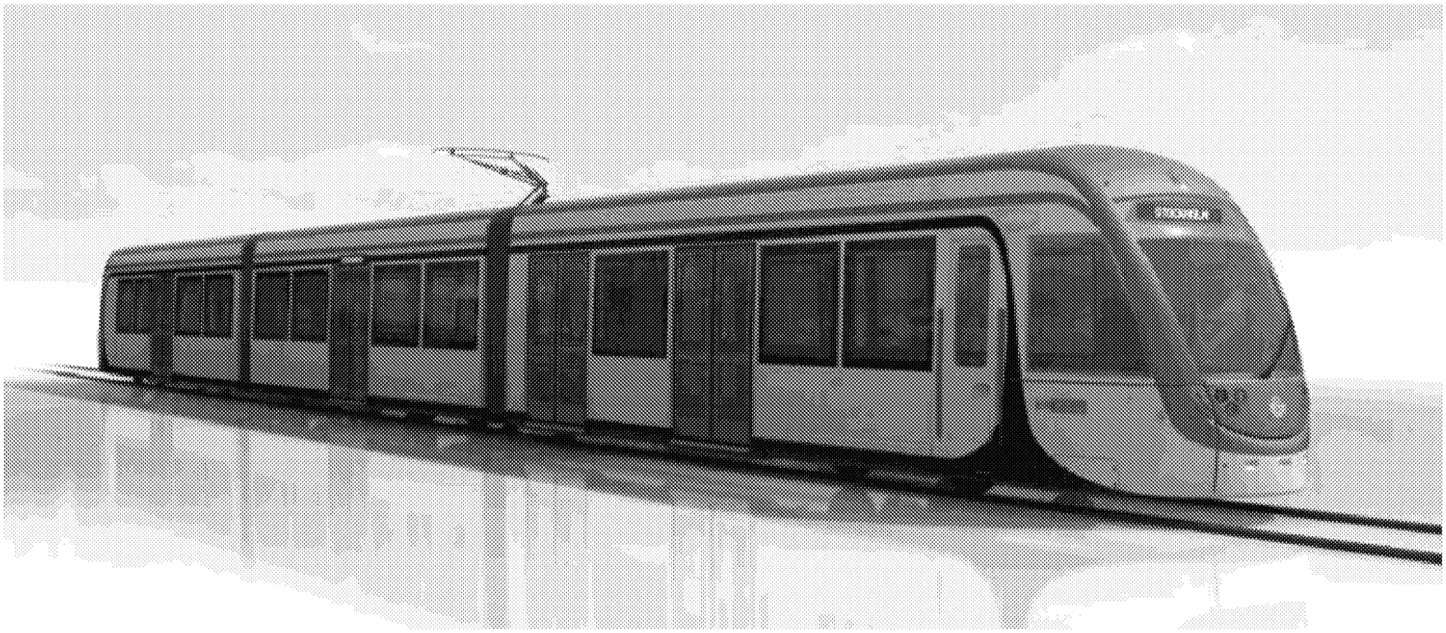
Fusion of Art and Vehicles: Stockholm

Partners in Aesthetics & Branding Identity



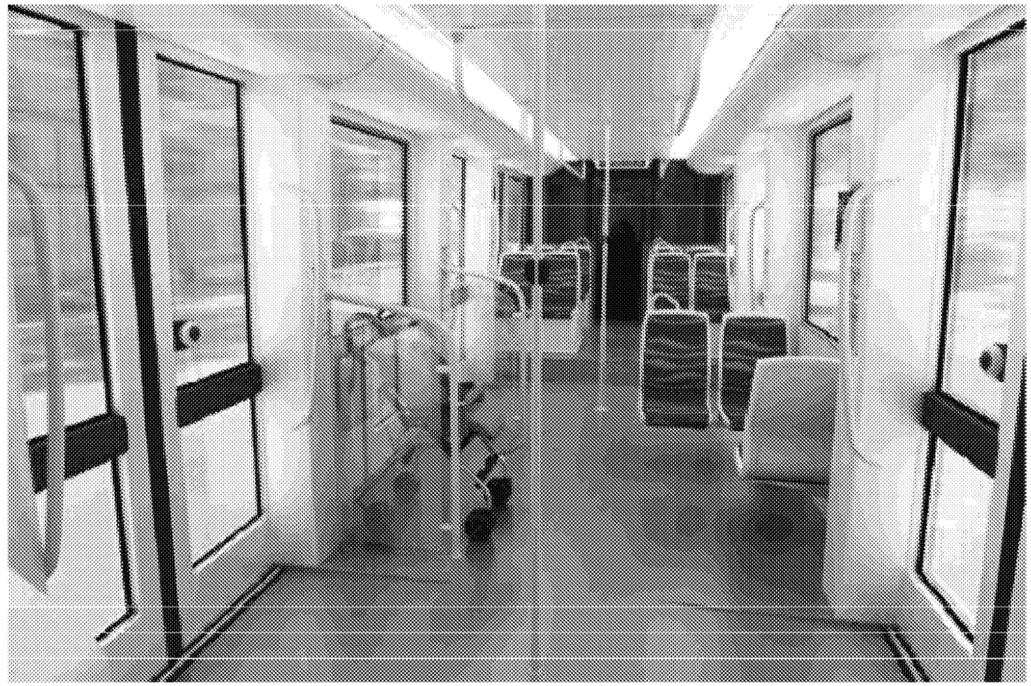
Stockholm City LRV

- Integration of the City blue colour on and in the vehicle
- Front end design chosen by the City
- Destination signs and City logo location
- Designed to suit cold climates

Partners in Aesthetics & Branding Identity

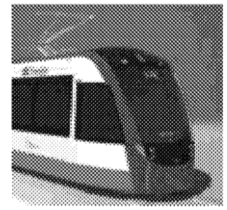
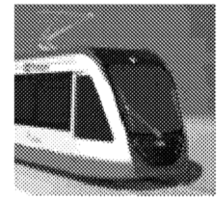
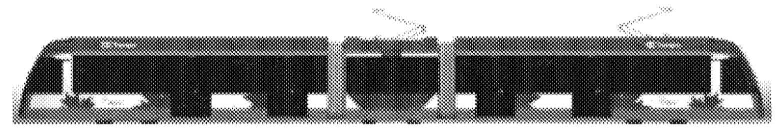
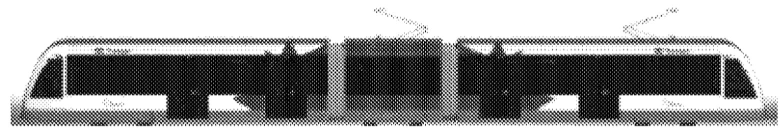
Interior Design

- Colors according to the City of Stockholm
- Seats, layout and contour including the ADA location
- Handrails, stanchions and windscreens
- Passenger information system and advertisement board locations

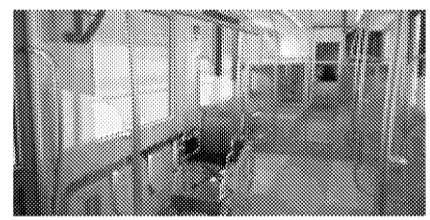
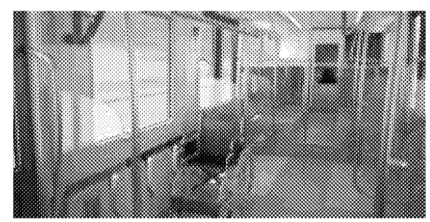


Partners in Aesthetics & Branding Identity

Tailored to Your Needs

- **EXTERIOR**
  - Color Schemes
  - Front Ends
  - Lighting
  - Rearview mirrors
  - Location of Destination Signs
  - Location of City Logo and Brand
- **INTERIOR**
  - LAYOUT (longitudinal/transversal seats)
  - Color schemes, seats (color/contour), walls, etc.
  - Handrails, stanchions and windscreens
  - ADA and bicycle/trolley locations
  - Passenger information system and on-board advertisement locations

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Big Brand Ideas

Trains and Planes: Big Thinking and Customer Focused

Fun Brand Ideas

Hop. Skip. Jump. Bolt. Dash. Stampede. (Boulder, CO)

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Iconic Brands: London

Enduring & Evolving

Where We Start

The Vehicle Branding Scheme Cannot Be Developed In Isolation

- Overarching consideration = Relationship between the brand and the public
- We consider all system elements are part of the brand
- Vehicle Branding is a crucial element in the mix - *vehicles are iconic*

Integrated Design And A Comprehensive Strategy

- Sum is greater than the parts
- The combination of vehicles, stations and stops, urban design, operations & maintenance

Brand Blueprint Approach - Envisioning and Storytelling

- Collaborative approach - city and key stakeholders actively involved
- Multi-disciplinary team (e.g. graphic designers, architects, planners, engineers, branding specialists, stakeholders)
- Blueprint unifies the variables, focuses on the customer, ensures consistency
- Four stage process

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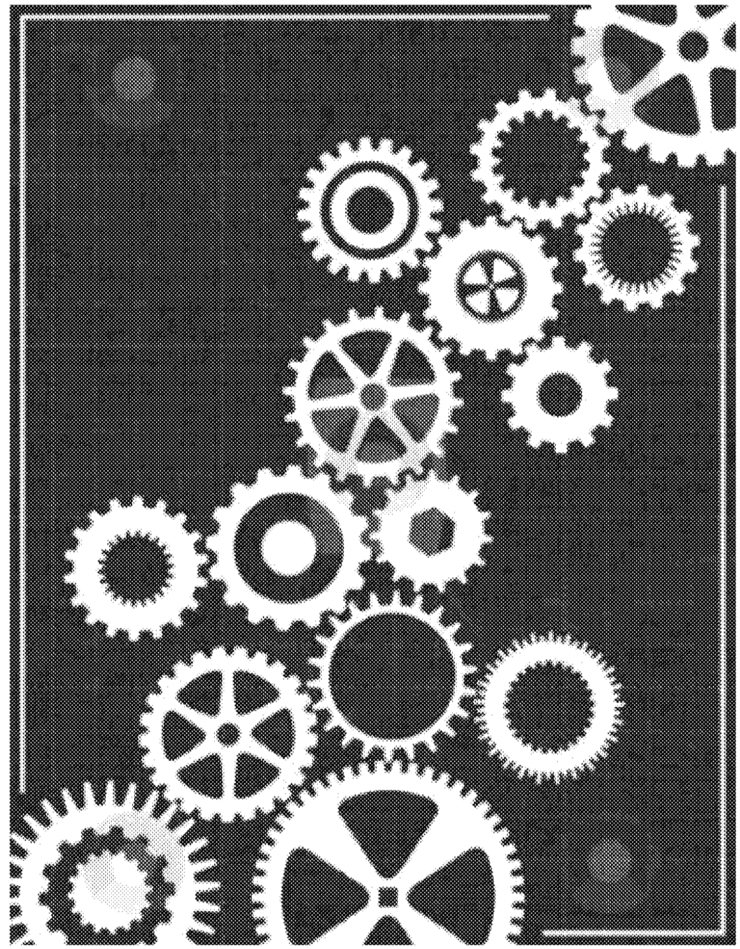
What is a Brand Blueprint?

A Brand Blueprint brings together the key components of brand strategy, from concept through to final design, and ensures brand consistency over time and extension to new applications and platforms.

It is developed through a series of activities including research, workshop sessions, idea development, testing and implementation.



Brand Blueprint: Strategic Engagement

The process brings together representatives, at key junctions, to advance branding ideas and concepts from a vision to reality.

Strategic inclusion early on with internal and external stakeholders is a key element to success (examples include):

- The Green Jacket
- Participatory Agencies
- Business Is Open Campaign
- Advertising and Partnering

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Brand Blueprint - Four Stage Process

Discovery

- Review and analysis of: existing market research, stakeholder interviews, background reports, guidelines, best practices scan, key issues and other considerations

Analysis and Needs-based Positioning

- Envisioning & Storytelling - a process to understand the needs and profiles of key customer segments; envisioning their end to end experience with the brand
- Brand Promise & Positioning Statement - development of brand promise; capture of brand essence, brand values, brand tone and images

Creation of Ideas and Testing – Vehicle Schemes

- Design Alternatives - Initial exploration of application to vehicle branding schemes (ideation); testing (market research) of selected final branding schemes

Design Implementation Across all Brand Touch Points

- Guided by the Brand Blueprint, all teams support brand consistency (e.g. livery, vehicle interiors, station and public realm elements, signage, collateral, web, digital and print communications, recruitment and training)

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Brand Strategy Workplan - Preliminary

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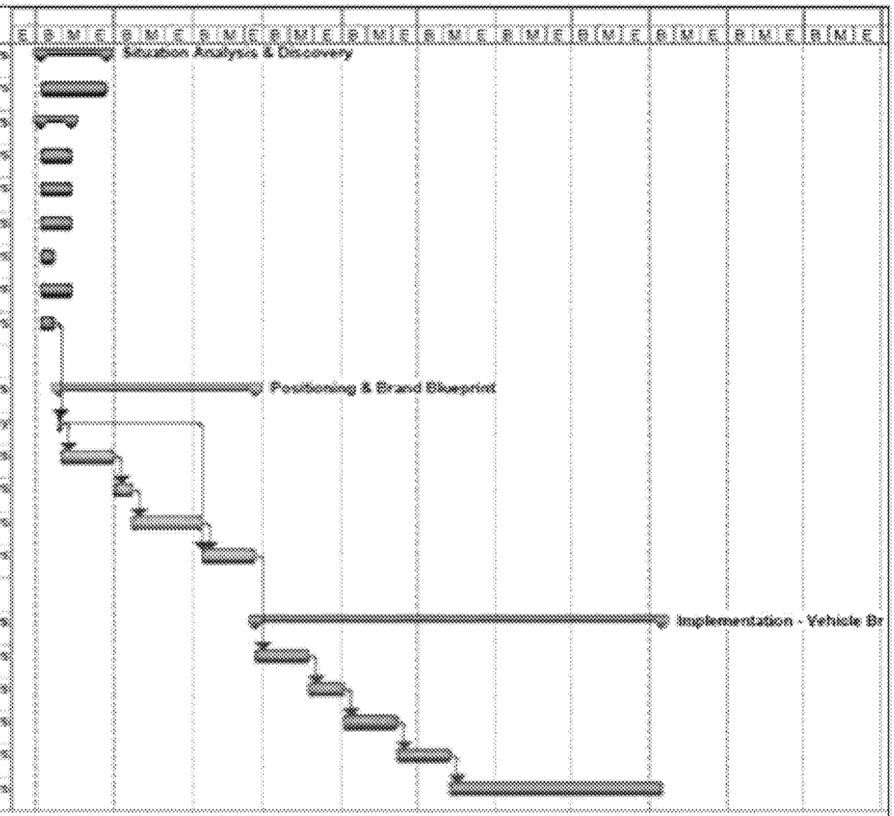
ID	Task Name	Duration
1	**Situation Analysis & Discovery**	**20 days**
2	Situation Analysis	20 days
3	**Research Review**	**10 days**
4	Customers	10 days
5	Internal Interviews	10 days
6	Design Guideline documents	10 days
7	Key Target Markets & Customer Segments	5 days
8	Best Practices Scan	10 days
9	Issues & Opportunities	5 days
10		
11	**Positioning & Brand Blueprint**	**56 days**
12	Positioning Workshop	1 day
13	Design Development	15 days
14	Design Testing	5 days
15	Brand Guidelines	20 days
16	Brand Blueprint	15 days
17		
18	**Implementation - Vehicle Branding**	**115 days**
19	Vehicle specifications	15 days
20	Design Drawings	10 days
21	Technical Drawings	15 days
22	Computer Simulation	15 days
23	Build mockup	60 days



Brand Strategy Workplan v1
Date: Sun 5/6/12

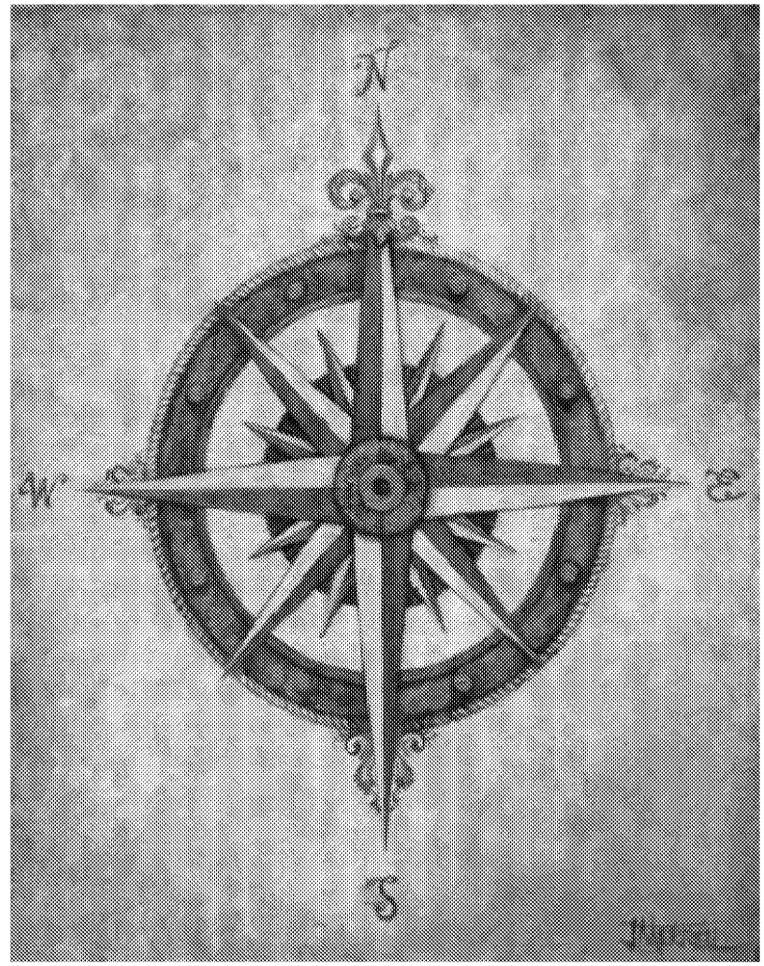
Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Page 1

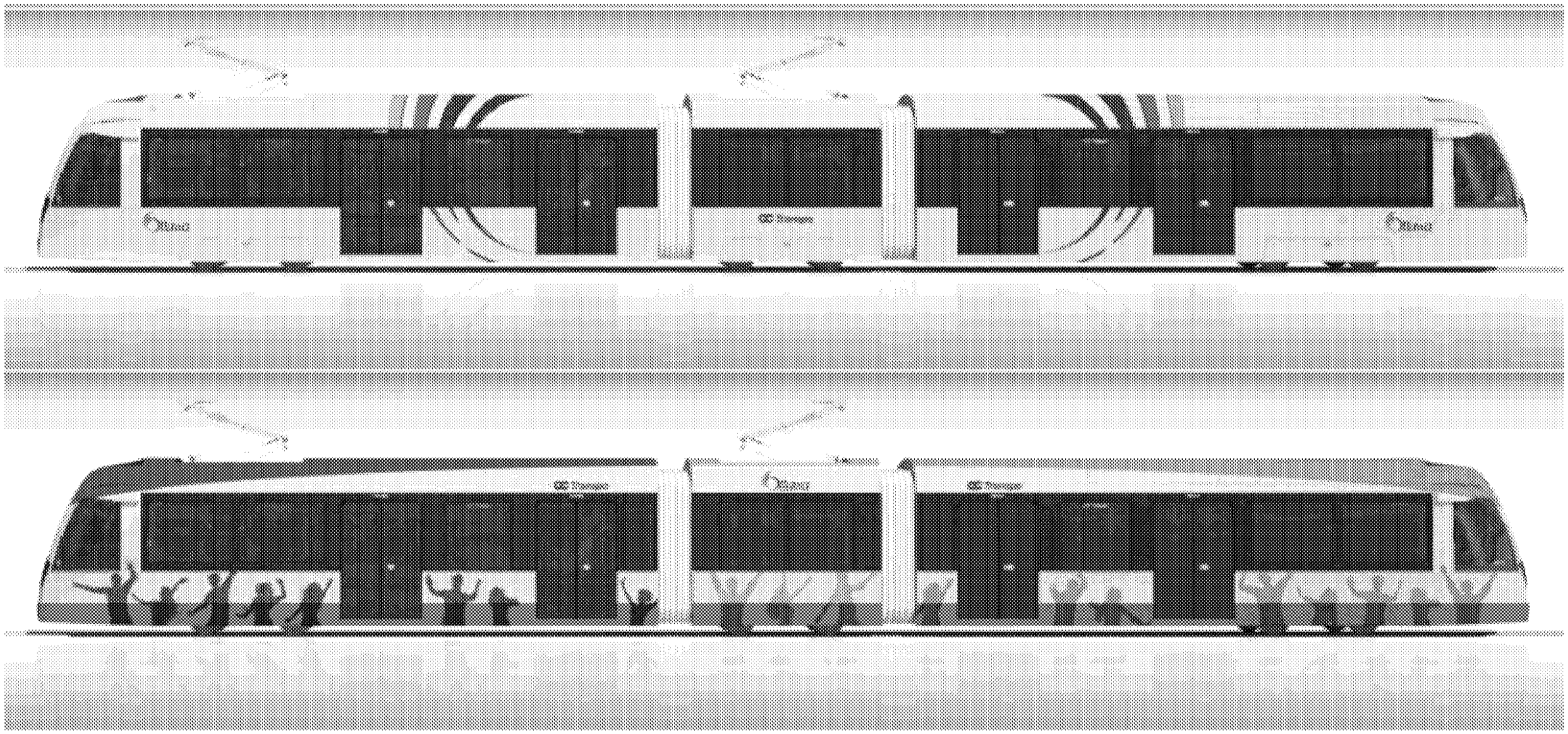
Moving Forward: Potential Positioning

Brand positioning will take the design in different directions. Potential directions could be:

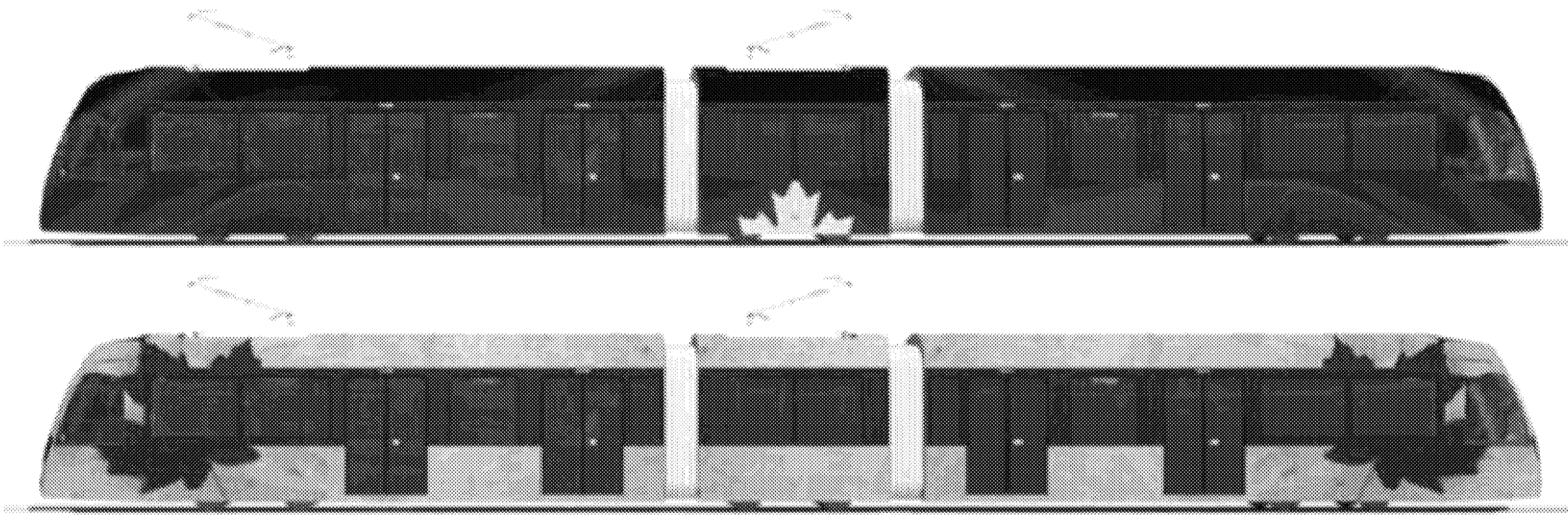
- A celebration of Canada, its talent and its ingenuity
- The Art of Mobility
- Connections to the living landscape
- Capital Pride
- Public friendly, active and engaged
- Smart Mobility for the 21st century and beyond



Potential Schemes



Potential Schemes



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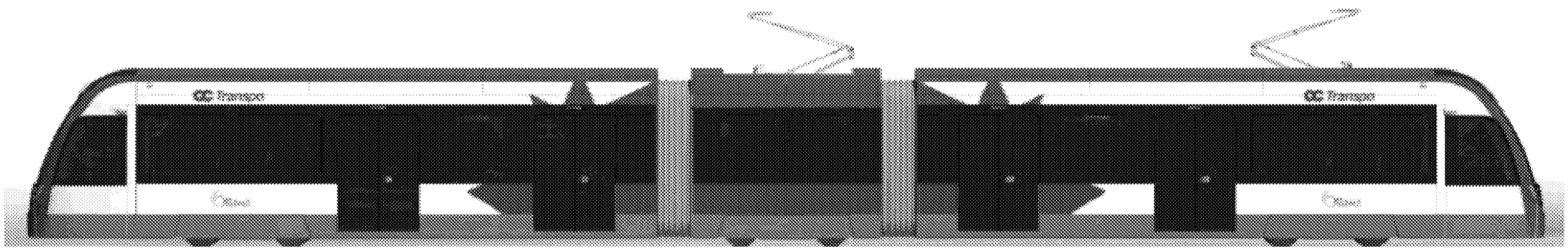
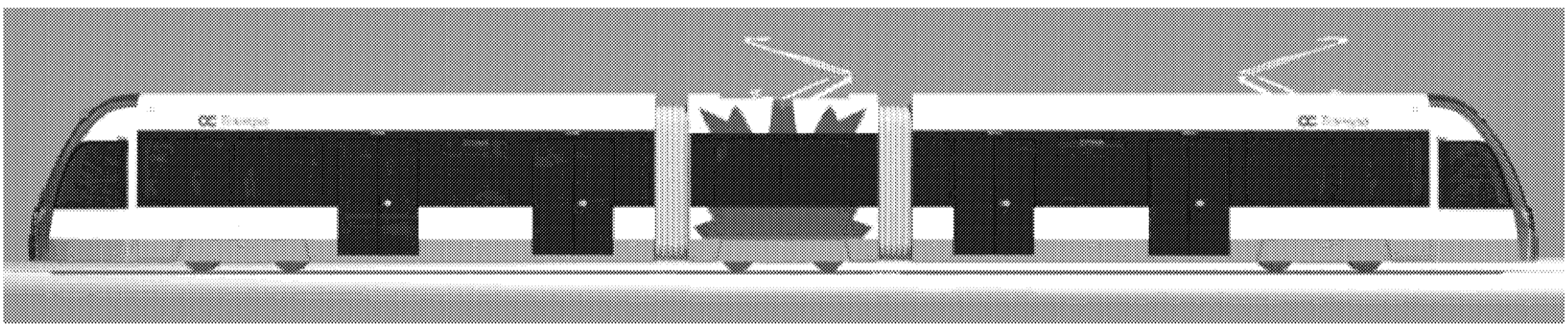
Potential Schemes





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Potential Schemes

Potential Schemes

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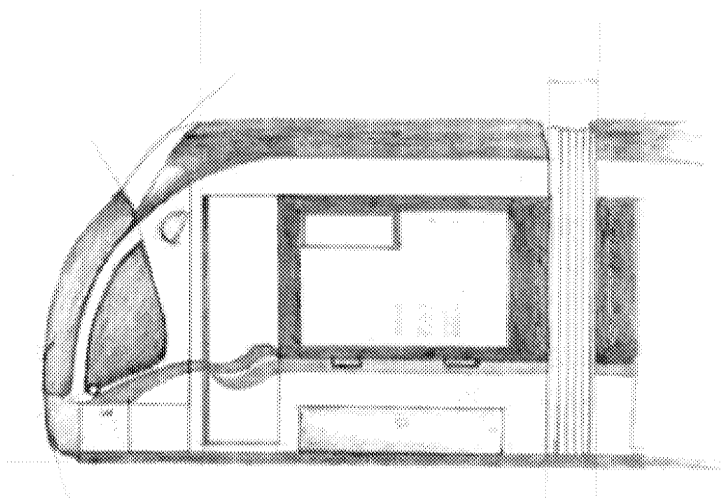
Potential Schemes

A Creative Partnership

- The Focus: creating a world-class LRT system-wide brand
- The Process: flexible yet structured to deliver success
- The People: inclusion, creativity and accountability as a united team
- The Results: a legacy LRT system and iconic vehicle that the City and the public profoundly connect with



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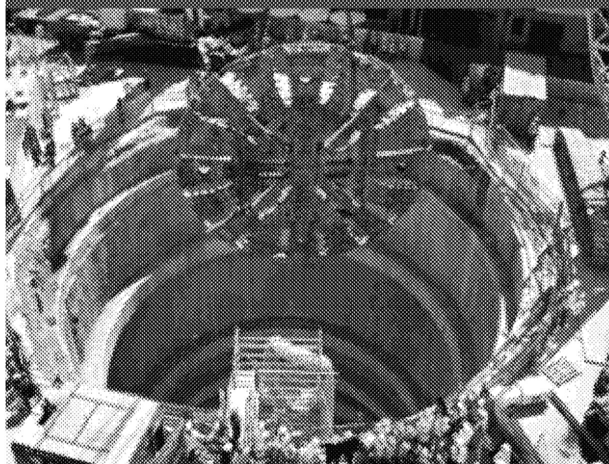

5 NON-REVENUE VEHICLES

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Vehicles

Ana Gallego, MSc.
Electromechanical Engineer, PMP

Maintenance Lead

- Over 15 years experience in design, construction and maintenance
- Involved in rapid transit for past 10 years
- Systems Project Manager: Jerez de la Frontera Tramway (Spain)
- Project for the construction tender of Metro North in Dublin
- Project Manager: Training courses for staff of the Croatian Infrastructure Manager
- Project Manager: Consultancy services on the analysis of the safety regulations for Israel Railways

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Non-Revenue Vehicles

RTG Non-Revenue Equipment List

(RB = Rail Bound, HR = High Rail)

Description	Type	Qty	Primary User	Anticipated Specifications
Train Shunter	RB	1	Shunt and position trains in the MSF where no overhead power is available	Rechargeable battery powered electric
Utility Maintenance Vehicle	RB	1	Crew transport, material handling, track and OCS maintenance, train rescue.	Requires towing capacity, deck, crane, crew compartment, bucket, hydraulic circuits, and train couplers on both ends.
Trailers	RB	3	To be towed behind Utility Maintenance Vehicle. One for general material handling, one for cable handling, and one for tunnel wash equipment.	10 tonne useful load, air brakes, 7.0 m x 2.5 m decks.
Large Hi-Rail Trucks	HR	2	One for Welding and heavier track maintenance One for OCS inspection and work	Ford F-750 or equivalent. One with complete welding set-up, one with double buckets for OCS work.
Smaller Hi-Rail Trucks	HR	2	One for Guideway inspection and light repair One for Signal system inspection and light repair	Ford F-350 4x4 crew cabs or equivalent
Ballast Regulator	RB	1	Regulating ballast in summer, snow clearing in winter	Industry standard ballast regulator with snow fighting attachments
Rail Grinder	RB	1	Rail grinding to address corrugation and rail profile	Minimum 8 stone, programmable rail profiling, sealed pressurized cab, dust collection.
Multifunction road/rail Loader/Excavator	HR	1	Multi-function material handling, excavating, loading, rail handling, snow fighting, vegetation control.	360° road rail excavator with attachments
Spot Tamper	RB	1	Spot surfacing of slab to ballast sections, switches, low spots	Spot utility 16 tool tamping machine

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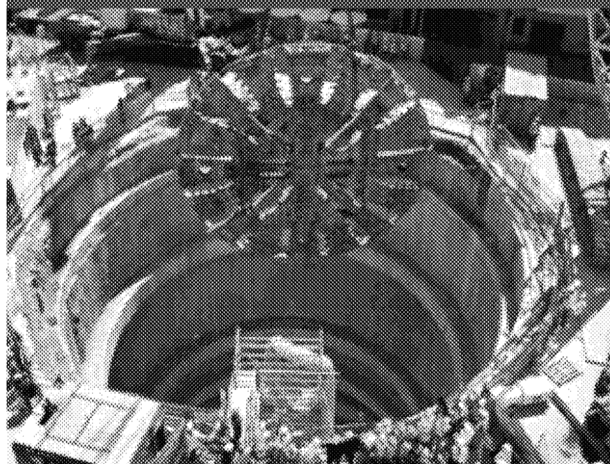

6

TRAIN CONTROL

RIDEAU TRANSIT GROUP RTG

Train Control – Thales Canada

Thales Video

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Train Control

Mario Péloquin, MBA

Vice-President, Thales

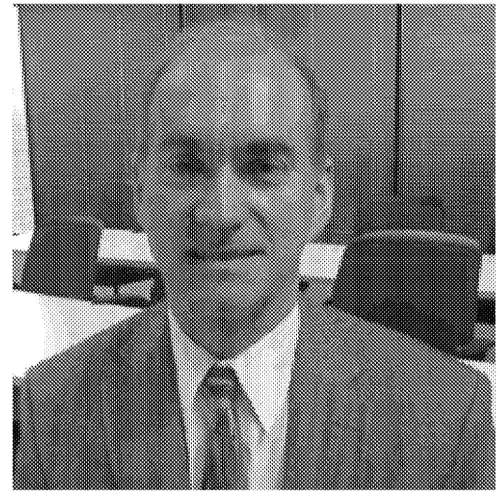
- 28 years experience in Rail Transportation and Transit;
- Experience in main line railway, transit, regulatory, rail accident investigations;
- Started operations of O-Train and oversaw for 3 years;
- Expert in operations and interfaces between different parts of system (rolling stock, infrastructure and operations)

Train Control

David Dimmer, B.A.Sc

Product Manager

- 25 years experience in CBTC system design and development;
- Led onboard software development for CBTC systems
  - Docklands Light Railway
  - San Francisco MUNI
  - Ankara Metro
- System design lead during development of Thales' radio based CBTC solution
- Thales representative in the MODURBAN research project developing standardized CBTC solutions
- Canadian representative on IEC WG 40 developing world standard for train control.



Train Control – Thales Canada

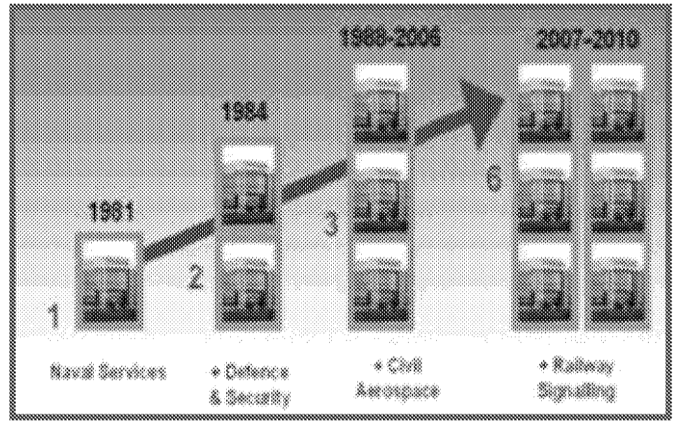
Thales Canada

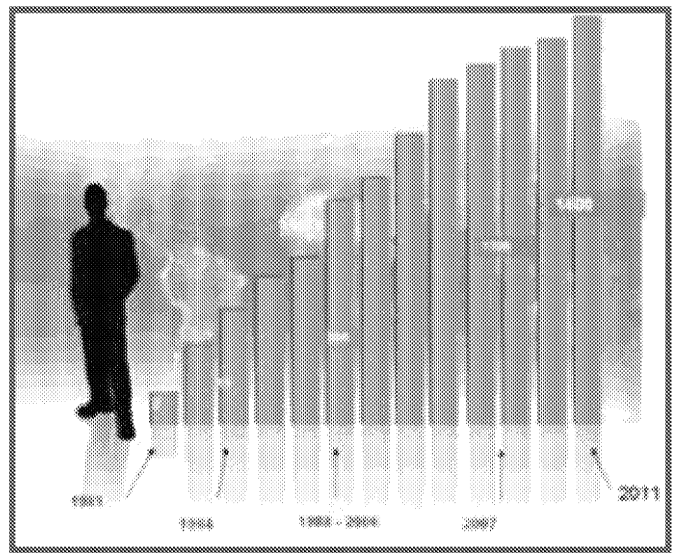
- In Numbers
  - 30 years in Canada
  - Employing 1,300 people in 6 sites
  - 3 world-wide centres of excellence

- Business and Regional Jets

- Optronics

- Urban Rail Signalling





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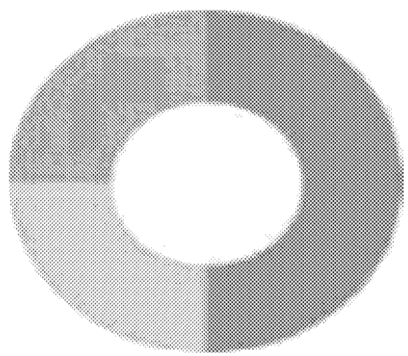
Train Control – Thales Canada

A Company with 1,300 Employees and $500 million (CAD) in Revenues

We help our customers to:

- Provide reliable and secure solutions
- Monitor and control
- Protect and defend

In three major sectors



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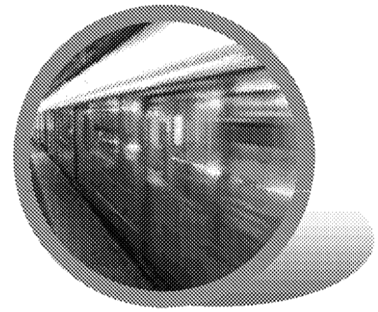
Train Control – Thales Canada

Transportation Solutions

Toronto and Vancouver, employing 800+ people

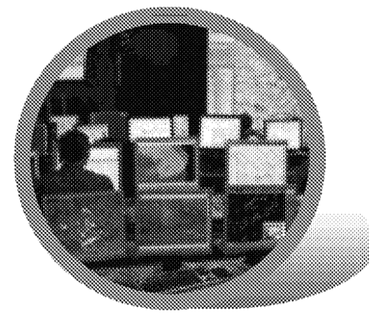
- World centre of excellence for CBTC
  - 90% of employees in Toronto



Defence & Security

Ottawa, Montreal & Quebec City, employing 300+ people:

- Systems Integration
- Mission Systems and Sensors
- Communications
- C4ISR Systems
- Optronics



Aerospace

Montreal, employing 120+ people:

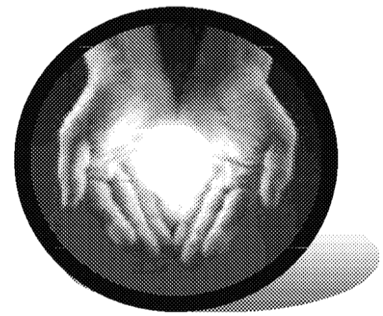
For Regional & Business Aircraft Customers

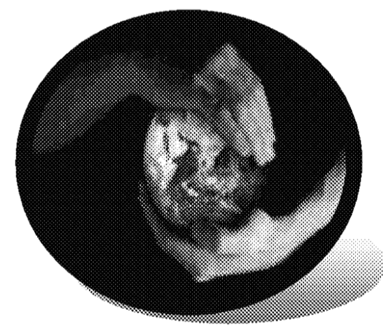
- Cockpit rapid design & validation tool
- Avionics Systems
- Flight Controls

Train Control – Thales Canada

Significant yearly R&D investment

- Convergence of SelTrac CBTC solutions
- Completion of On-going Activities linked to Revenue Projects
- Obsolescence Management
- New Innovations
- Green activities to reduce carbon footprint





Train Control – Thales Canada

Special partnership with, associations, local universities

- Canadian Forces appreciation Night with the Ottawa Senators
- Key Sponsor of Army Run
- True Patriot Love Foundation
- Highway of Heroes'
- Friends of the War Museum
- Wreaths across Canada
- University of Toronto
- United Way Campaign with in 2011 $89,000 CAD donated (1/2 being matched by the company)
- Each year, TRSSI's BD sponsors various high school teams competing to prove their robotics prowess at the First Robotics Competitions
- TRIEC (Toronto Regional Immigrant Employment Council) Award

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Train Control – Thales Canada CBTC

Thales implemented the world's first CBTC systems

- Toronto Scarborough RT 1985
- Vancouver Skytrain 1986

First re-signalling with CBTC

- Docklands Light Railway 1995
- San Francisco MUNI 1998

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Train Control – SelTrac Project References

SelTrac Automatic Train Control Systems

Operating Mode	Project Type	Interlocking	Kilometers	Revenue Kilometer - years	Project
S	N	I	6	173	Toronto SRT
U	N	I	29	680	Vancouver - Expo Line
U	N	I	5	118	Detroit DPM
U	N	I	2	40	Tampa APM
D	R	I	38	256	London DLR
U	E	I	8	98	Newark APM
S	N	I	14	210	Ankara
D	R	I	11	154	San Francisco MUNI
U	N	I	4	56	Jacksonville ASE
U	E	I	46	406	Kuala Lumpur Kelana Jaya Line
U	E	I	20	210	Vancouver - Millenium Line
S	E	I	35	290	Hong Kong West Rail
U	N	I	13	117	JFK APM
U	N	I	6	51	Las Vegas Monorail
S	E	I	29	119	Wuhan LRT
S	N	I	11	80	Hong Kong Ma On Shan
S	E	I	67	278	Guangzhou - Line 3
S	O	E	6	33	Bundang Commuter
U	N	I	3	19	Hong Kong Disney Resort Line
S	E	E	36	142	Shanghai Metro Line 8
S	E	E	60	256	Shanghai Metro Line 9
S	P	E	33	166	Shanghai Metro Line 6
P	O	E	65	195	Toronto Speed Enforcement
U	N	I	4	11	Dulles APM
U	N	I	52	156	Dubai Metro Red Line
S	N	E	29	87	Beijing Line 4
U	N	I	18	54	Vancouver Canada Line
S	R	I	37	74	London Tube Lines - Jubilee
S	E	E	44	88	Shanghai Metro Line 7
S	E	E	68	90	Shanghai Metro Line 11
S	P	I	20	40	Mecca - Al Mashaer Al Mugaddassah Metro
S	P	E	22	44	Beijing Daxing Line
U	E	I	23	23	Dubai Metro Green Line
U	N	I	24	24	Korea Busan-Kimhae Line
U	E	I	31	19	Korea Sin Bundang Line
S	O	E	23	-	Paris RATP Line 13
D	N	I	22	-	Istanbul Kadikoy-Kartal
S	R	I	58	-	London Tube Lines - Northern
D	R	I	12	-	Edmonton North LRT
U	N	I	29	-	Korea Incheon Line 2
U	R	I	4	-	Hong Kong APM
S	R	I	63	-	London Tube Lines - Piccadilly
U	P	I	18	-	Sao Paulo Line 17
S	O	E	8	-	New York Culver
U	R	E	46	-	Singapore North-South Line
S	R	E	15	-	New York Flushing Line
U	R	E	57	-	Singapore East-West Line
			1,269	4,854	Revenue km-years as of end-of 2012

Operating Mode		
Manul Driving with Automatic Train Protection	ATP	1
Automatic Operation with Attendant in the Cab	STO	21
Automatic Operation with Attendant on-board	DTO	4
Automatic Operation without a Driver	UTO	21

Project Type	
New	17
Extended	12
Phased	4
Overlay	4
Resignal	10

Interlocking	
Integrated	33
External	14

Communications	
Loop	25
Radio	21

Extension(s)

Train Control – Thales Canada

A Canadian company, based in Ontario

- Ontario has the largest employee base in Canada
- CBTC expertise resides in Toronto
- Excellent integration and support expertise in Ottawa

- Because Thales Canada has 3 centres of excellence, it is one of the main companies within Thales. For this reason, there is an increased focus on delivery and operations excellence in Canada.

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Train Control – Rolling Stock Interface

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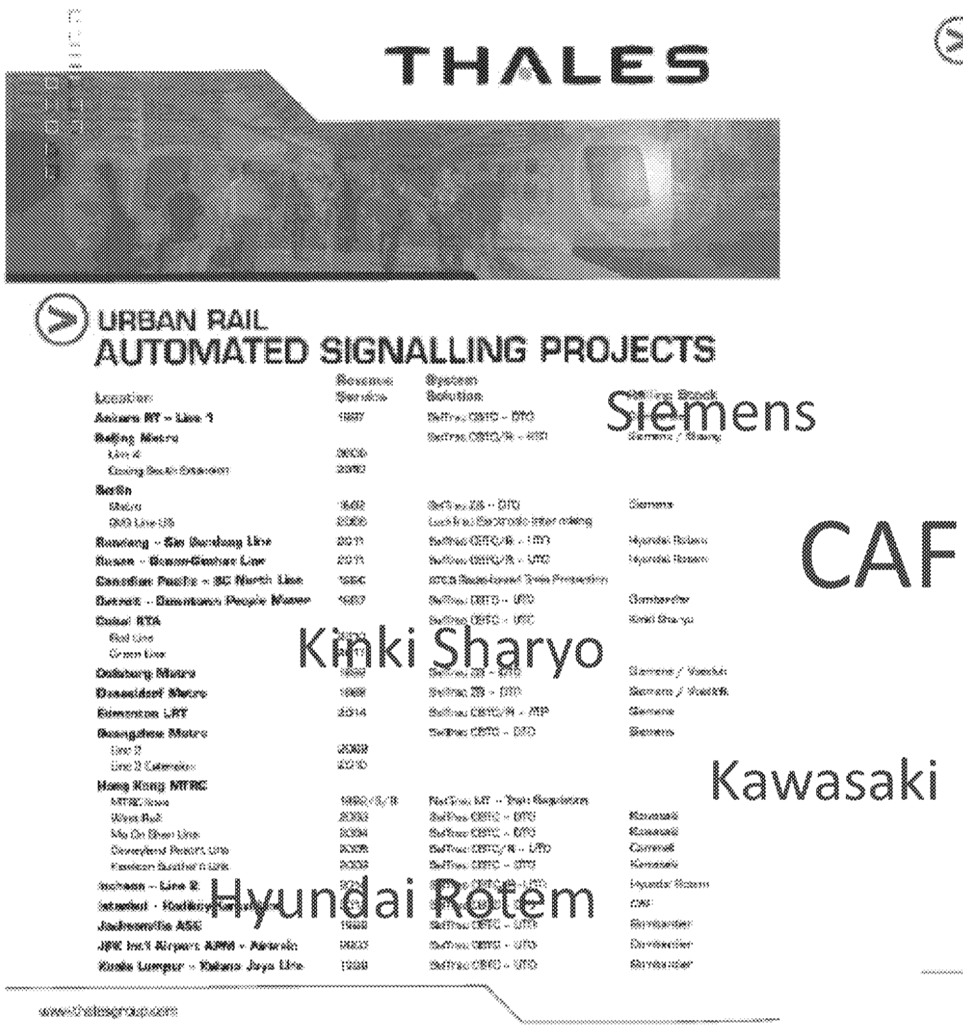

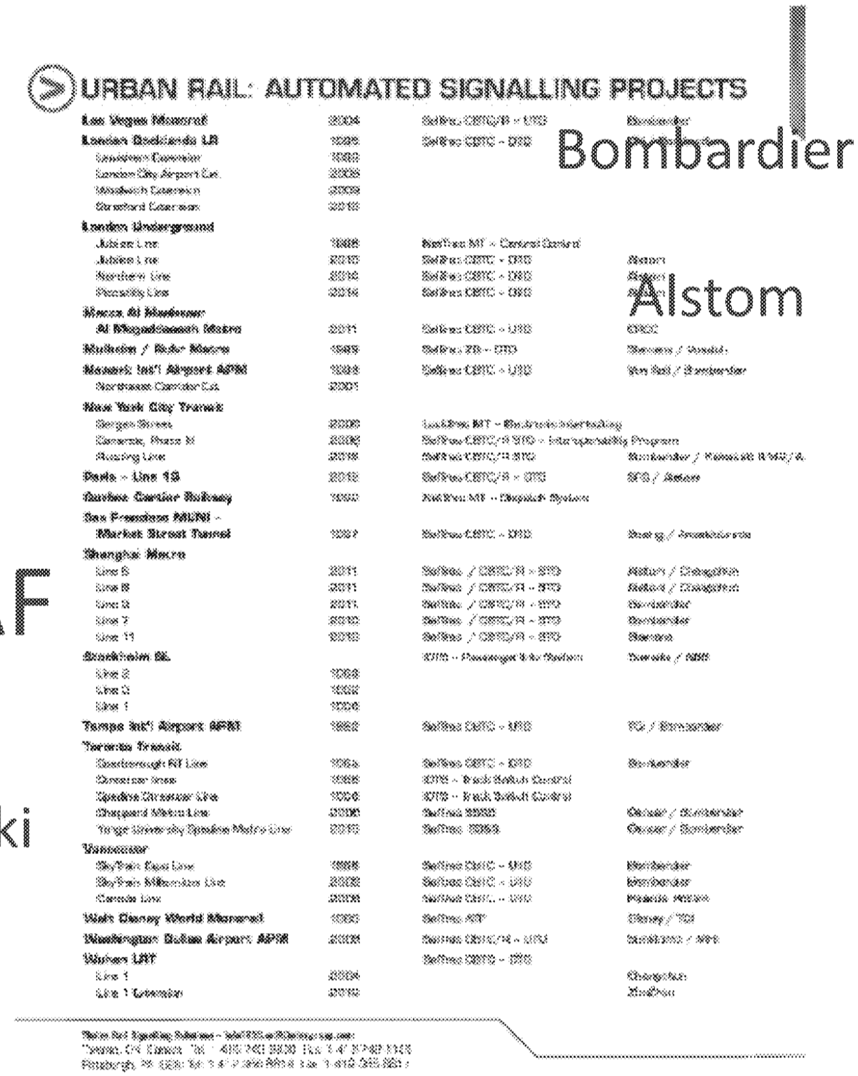

Train Control – Rolling Stock Interface

Integration of CBTC technology with vehicles

- Thales does not manufacture rolling stock
- Expertise to integrate into various rolling stock manufacturers is part of Thales' culture
- Due to this culture, best placed to be flexible and adapt to any rolling stock

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Train Control – Cold Climate

Ottawa Climate

- Ottawa, as one of the coldest City in the world, certainly poses challenges for railways and rail transit
- It has one of the largest variations in temperatures between summer and winter
- The requirement for meeting -38C is justified, this temperature occurs in Ottawa

Thales

- Not only has the largest number of installed CBTC systems of any company in the world, but it has the longest time reference – 26 years in Vancouver and Toronto (SRT). Also, it has the coldest reference in cold climate CBTC system (Edmonton)
- The Thales equipment for CBTC is already qualified to operate in Ottawa's climate

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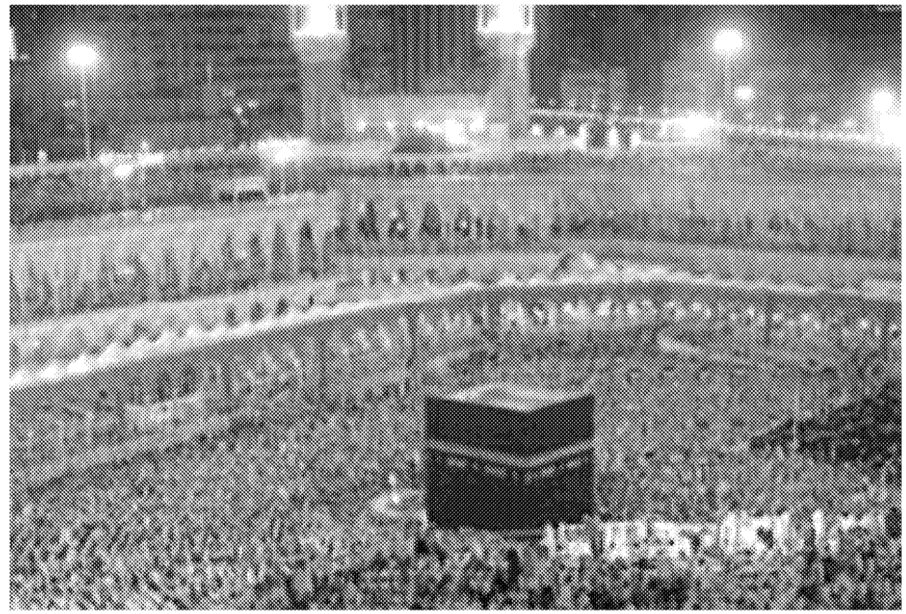
Train Control

Delivery in tight timelines: Makkah, Saudi Arabia

Customer challenges

- Improve transit in and around Mecca to facilitate the mobility of 2 million people who participate in the annual Hajj pilgrimage to Mecca
- Build a driverless 20km Metro Line



Thales answer

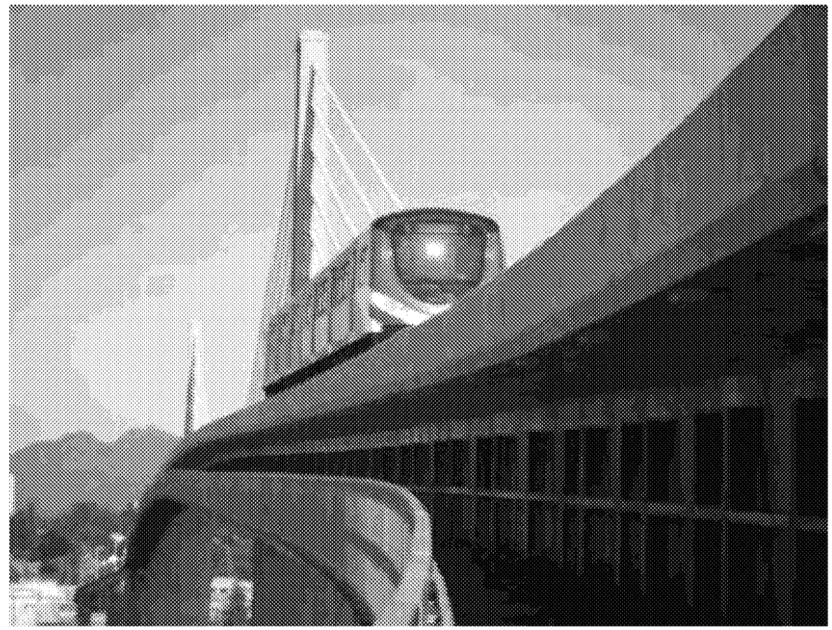
- Turnkey Thales solution including signalling (SelTrac CBTC solution), communications, operation control centre, CCTV, SCADA, automatic address and information system

Key dates:

- Awarded in June 2009
- Revenue service 1st stage Nov 2010

Train Control

Delivery in tight timelines: Vancouver Canada Line



Customer challenges

- The first airport rail - link in Canada
- Extend the mass transit in Vancouver while providing enhanced service
- Ready to deliver for 2010 Winter Olympics

Thales answer

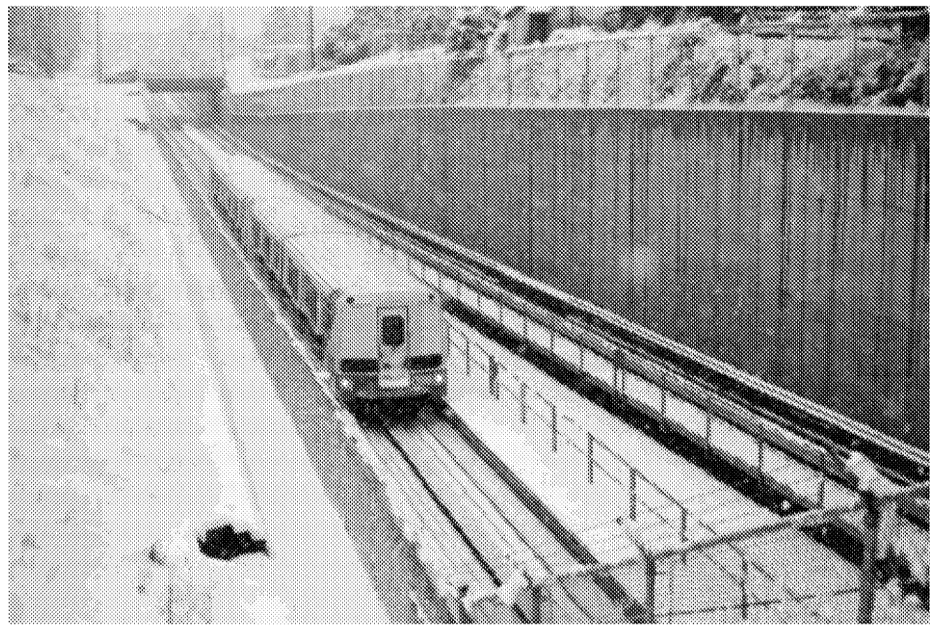
- Flexible regarding the new “big picture” view (with some same partners as OLRT)
- Early integration of the vehicle in the factory
- service commencement on August 11, 2009 (110 days early than the schedule requirement)

Train Control

Train Control System Interaction

With Revenue Vehicles

- Automatic Train Protection
- Automatic Train Operation
- Automatic Train Supervision



Train Control - SelTrac System Architecture

[redacted]

Train Control – Ottawa LRT Architecture

Ottawa LRT Signalling System Architecture

[redacted]

Train Control – Onboard Architecture

[redacted]

Train Control – VOBC

Vehicle On-Board Controller (VOBC)

- Vital checked-redundant (2oo2 CPU configuration)
- Includes CPU, Peripheral Interface Communication & Control (PICC), Interface Relay Control (IRC) and Power Supply Units (PSU)
- Incorporates all ATP and train operation functions
- Receives Limit of Movement Authority data from ZC
- Processes data from Transponder reader
- Supervises actual velocity against permitted velocity
  - Calculates velocity, distance, acceleration and detects and compensates for slip/slide
  - If exceeded signals an audible alarm
  - If no action taken, EBs train; logs event
- Interfaces to train brakes
- Monitors Train Integrity Status
- Incorporates guideway configuration files (speed zones, tag positions, gradients, etc.)

Train Control - Transponders

[redacted]

Train Control – Transponder Interrogator

[redacted]

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Train Control – Speed Sensors

[redacted]

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Train Control - Accelerometers

[redacted]

Train Control – Train Operator Display

Train Operator Display (TOD)

- Mounted in each cab at each end of a vehicle

- The VOBC will provide data to the TOD that will include but not be limited to
  - Displays speed
  - distance to go
  - train door status
  - LMA indication
  - Destination status
  - Door status
  - Train ID
  - Train length
  - system health status
  - Alarms
  - Etc.

Train Control – Zone Controller

[redacted]

Train Control – Central ATS

Central Control

- Fully functional ATC with driver operated train operations performed by the on-board, wayside and ATS systems.

- ATS automatically regulates train schedule, requests train routing, manages movement conflicts and junctions

- ATS Equipment at Central Control connected to Local Area network (LAN)
  - Dual Redundant System Servers
  - Data Logger PCs
  - System Administrative Workstation PCs
    - Provides Human Machine Interface (HMI)
    - Receives and Displays Status Information and Alarms data from ZCs, VOBCs
    - Provides System Status and train location data
  - Network Monitoring PC provides the status of the DCS Components
  - Diagnostic server

Train Control – Local ATS

Local Control

Local Workstations located at each Interlocking Station provide

- Capability to monitor/control the system from remote locations
- Capability to assume control of the local territory in the event of communication loss between the Central and the Local Zone controller

ATS Equipment at Local Control connected to Local Area network (LAN)

- Data Recorder
- System Administrative Workstation PCs running multiple clients (Workstation and Local SRS)
  - Provides Human Machine Interface (HMI)
  - Receives and Displays Status Information and Alarms data from ZCs, VOBCs..
  - Provides System Status and train location data

Train Control - Data Communication System

Data Communications System

[redacted]

Train Control - DCS Network Architecture

DCS Network Architecture

[redacted]

Train Control - Redundant Radio Coverage

[redacted]

Train Control - Interference Mitigation

Methods

[redacted]

EFFECTIVE INTERFERENCE MITIGATION

RIDEAU TRANSIT GROUP

Train Control – Interference Mitigation

ComTrac 802.11 Frequency Hopping Spread Spectrum (FHSS)

DISREGARD	**CONTEND**	**AVOID**	**Strongest Protection**

802.11 Direct Sequence Spread Spectrum (DSSS), or WiFi 802.11b, g

DISREGARD	**CONTEND**	**Fixed channel frequency**	

Proprietary DSSS

DISREGARD	**Non-standard access**	**Fixed channel frequency**	**Weakest protection**

Train Control – DCS Network Security

- Protection: Nothing on the trusted side can talk to anything inside the untrusted network
- Data integrity: 802.11 retransmission protocol
- Source authentication: IPSec
- Source authentication: IKE dynamic key management
- Data privacy: IPSec encryption

[redacted]

Train Control DCS Security Cenelec 50159-2

DCS SECURITY - THREATS AND DEFENSES

Design based on prEN 50159-2 CENELEC - Requirements for Safety Related Communication Open Transmission Systems

[redacted]

Train Control - Success of the DCS

Las Vegas Monorail
- DCS in revenue service, open-air elevated guideway

Hong Kong Disney Resort Line
- DCS in revenue service, outdoor and tunnel guideway

Shanghai
- DCS in revenue service on Lines 6, 7, 8, 9, and 11

Beijing
- DCS in revenue service on Line 4, and Daxing Line

Washington, D.C.
- DCS in revenue service on Dulles Airport People Mover

Korea
- DCS in revenue service on Sin Bundang and Busan-Gimae lines

Train Control – ATS Functions

Automatic Train Supervision – Major Functions

- Train Regulation:
  - Schedule
  - Headway
  - Energy Conservation
- Automatic Train Routing
- Trip Assignment
- Turnback Handling and Deadlock prevention
- TSCC Operator Interface
- Firewalled Interface to other systems (SCADA, City Systems)
- Local control of Interlocking for failure management

Train Control – ATP Functions

Automatic Train Protection – Major Functions:

- Train position determination
- Train speed measurement
- Train tracking
- Safe train separation, including rollback management
- Interlocking Management (route locking, approach locking, etc.)
- Enforcement of safe train speed, including zero speed
- Train door supervision
- Train door enable
- Train mode supervision
- Train integrity supervision

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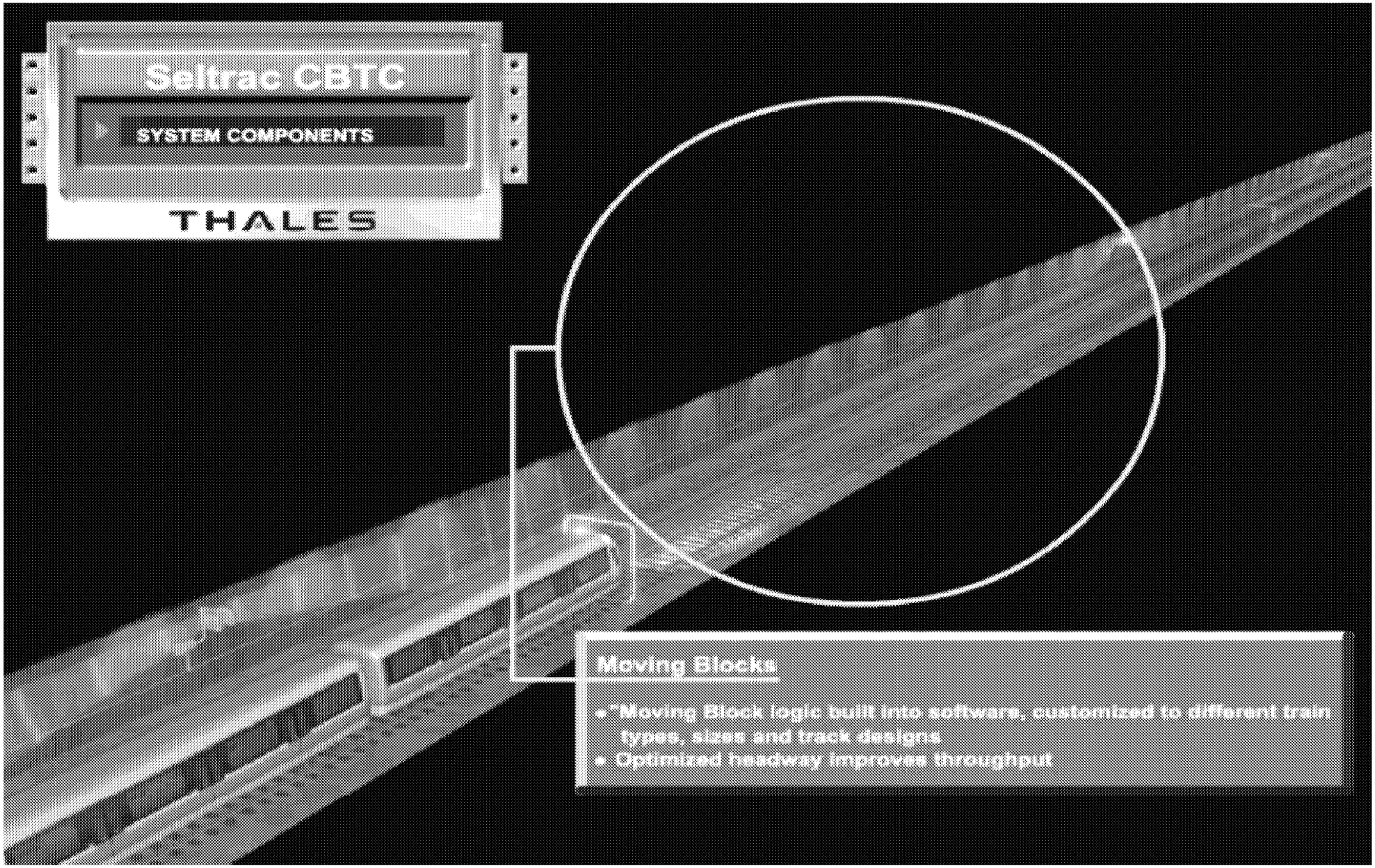
Train Control – ATO Functions

Automatic Train Operation– Major Functions:

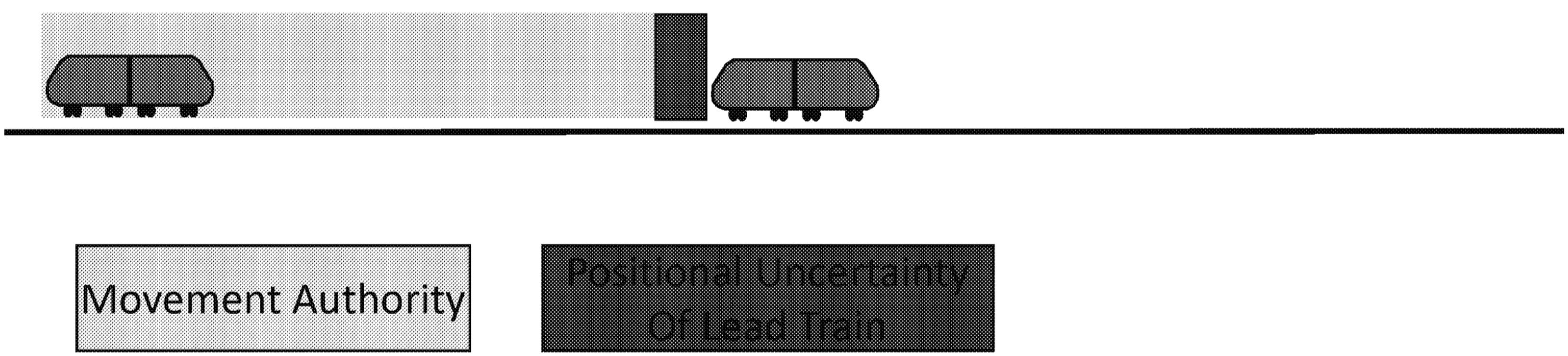
- Control train speed in accordance with scheduled profile
- Operate train within passenger ride quality limits
- Automatic door opening and closing with override
- Deadman switch supervision

Train Control



Train Control – Movement Authority

- ZC generates a movement authority for each train in its territory
- Movement authority is created using Moving Block Principles
- Movement authority communicated to train based on location of first obstruction



Train Control – Safe Braking Model

VOBC dynamically determines safety distance, based on

- Current speed and positional uncertainty of the train
- Rolling stock propulsion and braking parameters
- Guideway grade between train location and Limit of Movement Authority (LMA)

[redacted]

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Train Control – Non-revenue Vehicles

Train Control System Interaction

With Non-Revenue Vehicles

- Non-Revenue Vehicles will be tracked by block occupancy using track circuits
- Protected using Manual Route Reservations

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Train Control – Interaction with Drivers

Train Control System Interaction

With Drivers

- In ATO mode the Driver may take control of the train by moving the lever out of the coast position without moving the mode select switch
- When the Driver puts the lever back into the coast position the VOBC will take control of the train
  - VOBC supports mode change on the fly from ATO-> ATPM and ATPM-> ATO
- In ATO mode the Driver must keep his hand on the deadman switch
  - The VOBC will send an alarm to the ATS when the deadman switch is released
  - The Train will service brake to a stop when the deadman switch is released.
- The yard is a fully automated yard
  - The driver will embark / disembark in the maintenance building
  - The train will operate in unattended train operation mode.

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Train Control – Interaction with Central Operators

Train Control System Interaction

With Staff at TSCC, YCC and BCC

- Under normal conditions, system runs with minimum input from the ATS operator at the TSCC or BCC
- Manually override of automatic train regulations
- Manually associate a non-communicating train with occupancy
- Initiate Manual Route Reservations for non-controlled trains
- Manually reset emergency brakes on individual trains
- Lift temporary speed restrictions on areas of track where there is a false broken rail alarm

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Train Control – Cold Weather

Extreme Weather Conditions

- ATS Operator can select 1 of 3 wet rail conditions, that will directly affect the propulsion and braking.
  - No reduction / Normal
  - Reduced Rate Type 1
  - Reduced Rate Type 2

- The calculated guaranteed emergency brake rate (GEBR) is compliant to IEEE standard 1474.1 which specified the maximum allowable tail wind.

Train Control – Failure Scenarios

Failure Scenarios

VOBC loses communication with Zone Controller (ZC) (requires multiple failures to disable communications)

- VOBC automatically service brakes the train to a stop
  - If communication is restored before the train stops, then train will accelerate to target speed, operation will continue in the current mode. No operator action required
- Driver (in ATO or ATPM mode) can switch to Manual Release Mode driving.
- ATS operator uses a Manual Route Reservation (MRR) to route the non-communicating train
- When communication is restored, driver will be informed on the Train Operator Display (TOD) – can switch to ATPM or ATO mode
- If communication failure of the train persists, system puts safety envelop around NCT train and uses track circuits to track the train

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Train Control – Failure Scenarios

Failure Scenarios

VOBC loses position (ZC and radio network working well, VOBC has a momentary loss of position)

- VOBC brakes the train to a stop
- VOBC stops communicating with the ZC.
- ATS operator uses a Manual Route Reservation (MRR) to route and protect the non-communicating train
- Driver must switch to Manual Release mode to move the train and cross over two transponders to re-establish position
- Once position is restored the VOBC will re-establish communication with the ZC.
- Driver will be informed on the TOD – can switch to ATPM or ATO mode

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Train Control – Failure Scenarios

Failure Scenarios

Redundant Zone Controller failure (VOBC and radio network working well)

- VOBCs in the zone of the failed ZC will detect a loss of communication.
  - Can transition to Manual Release mode
- Adjacent ZCs will detect failure
  - Movement authorities for trains travelling toward the border will be limited to the border
  - Once a train reaches the border, trains in ATO will brake but can be switched to Manual Release mode for train driver operation in degraded mode
  - Once the train crosses the area controlled by the ZC under failure, and reaches the area controlled by a ZC operating well, that information will appear in the TOD who can then switch to ATO again

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Train Control – Failure Scenarios

Failure Scenarios

ATS failure

- Central ATS provides Hot Standby Configuration
  - Switchover in less than 10 seconds

- Local ATS provides control for a zone
  - Issues route requests to ZC

Train Control – Local Operation

Local Operation of the Interlocking

- Local ATS workstation will be located near an interlocking
  - Route Setting
- Local control panel with switch control will be located near the interlocking
  - Manual control of switches
  - Manual control of signals
  - Track and switch indications

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Train Control - Reliability

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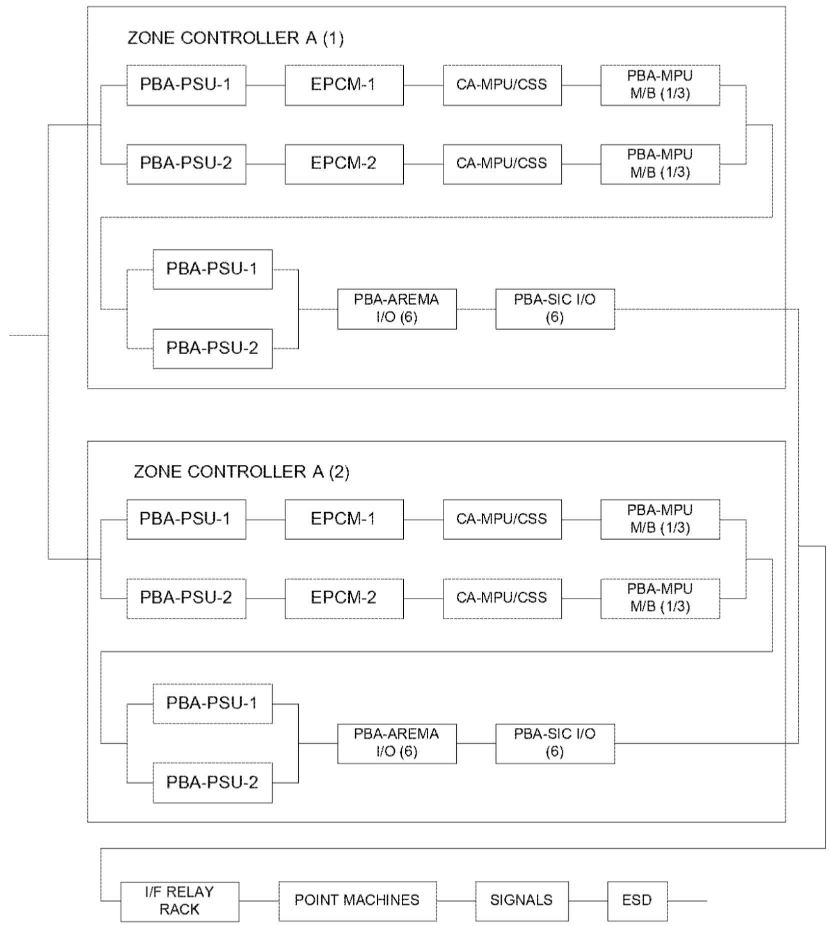
Thales predicted availability is 99.992%

Typical Zone Controller Reliability Block Diagram



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Train Control – Broken Rail

System Reaction to Broken Rail

- The ZC will report the broken rail status to the ATS
- The ATS will highlight the area with broken rail, and send an alarm to the Operator
- A warning will be presented on the Train Operator Display that a speed restriction is in place
- Operations may allow the first train to sweep the failed track circuit section, and subsequent trains will be allowed to operate normally through the section based on ATS operators disabling the alarm

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Train Control – Lessons Learned

Lessons Learned

- Confirm customer understanding and expectation of Contract Milestones
  - Avoids miss understandings and expectations of the contract milestones
- Make Integrated Lab available to the project early
- Complete simulator design early in project
- Need a decision maker within the customer
- Setup interface meetings as soon as possible, as early as the proposal phase
- Ensure all stakeholders have compete consolidated program schedule incorporating everyone's activates
- Value of early integration tests of train control with rolling stock

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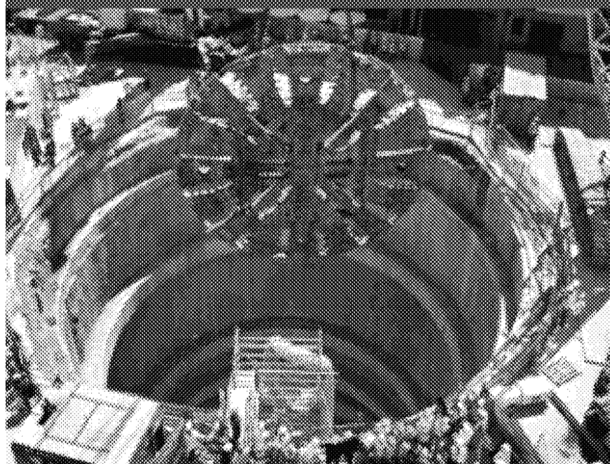


DISCUSSION

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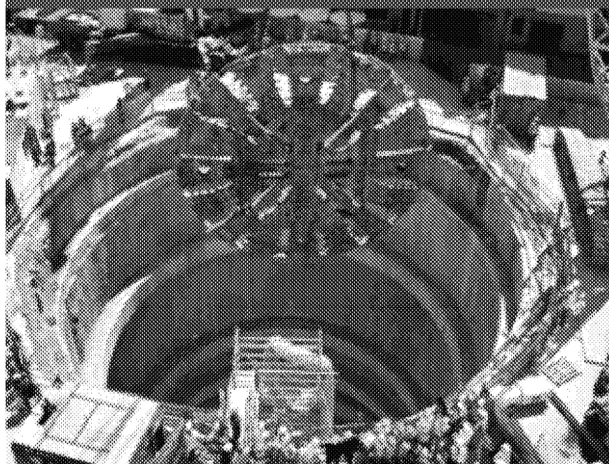

7 LRT SYSTEMS

LRT Systems

LRT Systems

DMP #3 Results / DPM #7 Submission

- RTG presented the following LRT Systems elements at DPM #3:
  - Traction power
  - Overhead catenary system
  - Communication systems
  - Corrosion control
  - EMI / EMC
- RTG received “Y” compliance feedback for all non-revenue items at DPM #3 except for the following issue that received a “U” response:
  - Unobservable Issue: **Proposed substation locations**
  - Additional information was requested detailing the substation locations
    - The substations will be located in general accordance with the Reference Design
- LRT Systems, including the additional information on substation locations, are presented in our narratives only

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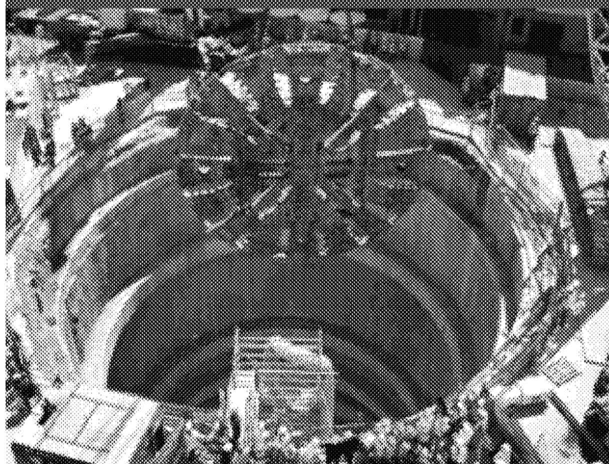

5 redux

NON-REVENUE VEHICLES

Vehicles

Ana Gallego, MSc.
Electromechanical Engineer, PMP

Maintenance Lead

- Over 15 years experience in design, construction and maintenance
- Involved in rapid transit for past 10 years
- Systems Project Manager: Jerez de la Frontera Tramway (Spain)
- Project for the construction tender of Metro North in Dublin
- Project Manager: Training courses for staff of the Croatian Infrastructure Manager
- Project Manager: Consultancy services on the analysis of the safety regulations for Israel Railways

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Non-Revenue Vehicles

RTG Non-Revenue Equipment List

(RB = Rail Bound, HR = High Rail)

Description	Type	Qty	Primary User	Anticipated Specifications
Train Shunter	RB	1	Shunt and position trains in the MSF where no overhead power is available	Rechargeable battery powered electric
Utility Maintenance Vehicle	RB	1	Crew transport, material handling, track and OCS maintenance, train rescue.	Requires towing capacity, deck, crane, crew compartment, bucket, hydraulic circuits, and train couplers on both ends.
Trailers	RB	3	To be towed behind Utility Maintenance Vehicle. One for general material handling, one for cable handling, and one for tunnel wash equipment.	10 tonne useful load, air brakes, 7.0 m x 2.5 m decks.
Large Hi-Rail Trucks	HR	2	One for Welding and heavier track maintenance One for OCS inspection and work	Ford F-750 or equivalent. One with complete welding set-up, one with double buckets for OCS work.
Smaller Hi-Rail Trucks	HR	2	One for Guideway inspection and light repair One for Signal system inspection and light repair	Ford F-350 4x4 crew cabs or equivalent
Ballast Regulator	RB	1	Regulating ballast in summer, snow clearing in winter	Industry standard ballast regulator with snow fighting attachments
Rail Grinder	RB	1	Rail grinding to address corrugation and rail profile	Minimum 8 stone, programmable rail profiling, sealed pressurized cab, dust collection.
Multifunction road/rail Loader/Excavator	HR	1	Multi-function material handling, excavating, loading, rail handling, snow fighting, vegetation control.	360° road rail excavator with attachments
Spot Tamper	RB	1	Spot surfacing of slab to ballast sections, switches, low spots	Spot utility 16 tool tamping machine

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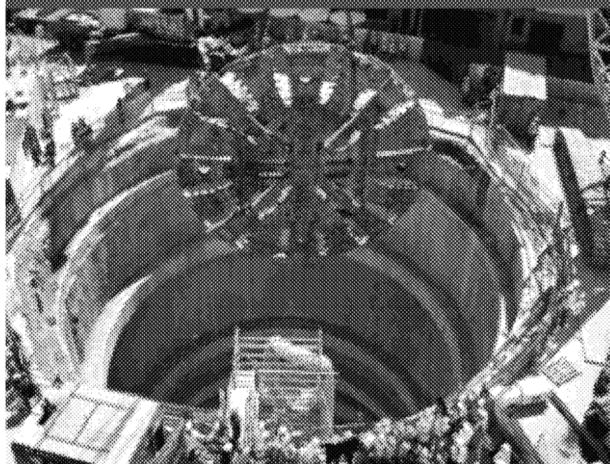

8 OPERATIONAL PERFORMANCE

Operational Performance

Topics Discussed in DPM #3:

- Operational Performance Requirements for Scenarios 1 and 2
- Approach to expanding the system
- Terminal operation

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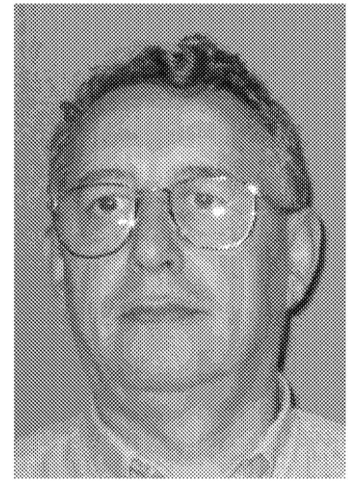
Operational Performance



George Istrate

Operational Performance Simulations, Thales

- More than 20 years experience in CBTC Design and Operational Analysis
- Thales Canada – Systems Operations Manager
- Development of CBTC Systems Operations Plans
- Signalling Design: Track Block Design, Interlocking Logic Design
- Safe Train Separation
- Performance Analysis and Optimization
- CBTC System Databases
- CBTC Projects: MUNI, Hong Kong West Rail and MOS, DLR, RATP L13, Beijing Line 4 and DXL, Shanghai Lines 6, 7, 8, 9, 11, NYCT Flushing Line.

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Operational Performance

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Assumptions used in Performance Simulations

- CBTC controlled trains in ATO or ATPM modes
- Trains 120 m long
- Train acceleration:
  - 1.34m/s2 at speeds up to 30km/h
  - gradually reducing to 0.24m/s2 for 80km/h
- Normal train deceleration:
  - 0.8m/s2 grade compensated as controlled by CBTC
- Emergency braking:
  - Minimum guaranteed rate of 0.92m/s2 (on level track)
- Switch in reverse speeds:
  - 30km/h for switches #8
  - 40km/h for switches #12

Operational Performance

Demand & Capacity Requirements

Design Headway

- Calculated Design Headway from TUN station to BLR station
  - 75.6 sec for Scenario 1
    - 195 sec required
  - 81.6 sec for Scenario 2
    - 126 sec required

Design Headway from TUN2 to BLR2 Eastbound					
Station Name	ABBR	Scenario 1		Scenario 2	
		Default Dwell	Headway	Default Dwell	Headway
		[s]	H_w [s]	[s]	H_w [s]
Tunney's Pasture Station East Bound	TUN2	68	-	70	-
Bayview Station East Bound	BAY2	20	61	33	74
Lebreton Station East Bound	LEB2	20	55.6	20	55.6
Downtown West Station East Bound	DTW2	26	66.6	31	71.6
Downtown East Station East Bound	DTE2	31	75.6	37	81.6
Rideau Station East Bound	RID2	29	70.2	27	68.2
Campus Station East Bound	CAM2	22	60.6	23	61.6
Lees Station East Bound	LES2	20	75	20	75
Hurdman Station East Bound	HUR2	22	61.4	26	65.4
TrainStation East Bound	TRA2	20	64.6	20	64.6
St. Laurent Station East Bound	STL2	20	58.6	20	58.6
Cyrville Station East Bound	CYR2	20	61.8	20	61.8
Blair Station East Bound	BLR2	52	-	59	-

Operational Performance

Design Headway

- Calculated Design Headway from BLR station to TUN station
  - 74 sec for Scenario 1
    - 195 sec required
  - 76.2 sec for Scenario 2
    - 126 sec required

Design Headway from BLR1 to TUN1 Westbound					
Station Name	ABBR	Scenario 1		Scenario 2	
		Default Dwell	Headway	Default Dwell	Headway
		[s]	H_w [s]	[s]	H_w [s]
Blair Station West Bound	BLR1	68	-	70	-
Cyrville Station West Bound	CYR1	20	58.4	33	58.4
St. Laurent Station West Bound	STL1	20	72.4	20	72.4
Train Station West Bound	TRA1	26	55.4	31	55.4
Hurdman Station West Bound	HUR1	31	65	37	69
Lees Station West Bound	LES1	29	67.4	27	67.4
Campus Station West Bound	CAM1	22	64	23	64
Rideau Station West Bound	RID1	20	66.2	20	70.2
Downtown East Station West Bound	DTE1	22	74	26	76
Downtown West Station West Bound	DTW1	20	71.2	20	76.2
Lebreton Station West Bound	LEB1	20	60.6	20	60.6
Bayview Station West Bound	BAY1	20	57.6	20	57.6
Blair Station West Bound	BLR1	52	-	59	-

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Operational Performance

Dwell times

- Dwell times reviewed CTP, Tom Parkinson (APTA), and from experience (Canada Line)
- Simulations performed with two sets of dwells – CTP and from experience

OLRT Dwell Calculations - Scenario 1 Year 2021 (Peak)

Direction	Station	Dwell - CTP	Dwell - TCRP	Dwell - Exper.
East	Tunney's Pasture	162.6	162.6	68
East	Bayview	19	17	18
East	LeBreton	19	17	18
East	Downtown West	34	25	26
East	Downtown East	42	30	31
East	Rideau Centre	39	23	29
East	Campus	28	22	22
East	Lees	18	16	18
East	Hurdman	28	20	22
East	Train Station	16	16	18
East	St. Laurent	22	17	18
East	Cyrville	17	16	18
West	Blair	162.6	162.6	52
West	Cyrville	17	15	18
West	St. Laurent	23	16	18
West	Train Station	16	15	18
West	Hurdman	38	17	29
West	Lees	19	16	18
West	Campus	27	21	21
West	Rideau Centre	38	24	29
West	Downtown East	46	32	34
West	Downtown West	37	26	28
West	LeBreton	18	17	18
West	Bayview	19	17	18

OLRT Dwell Calculations - Scenario 2 Year 2031 (Peak)

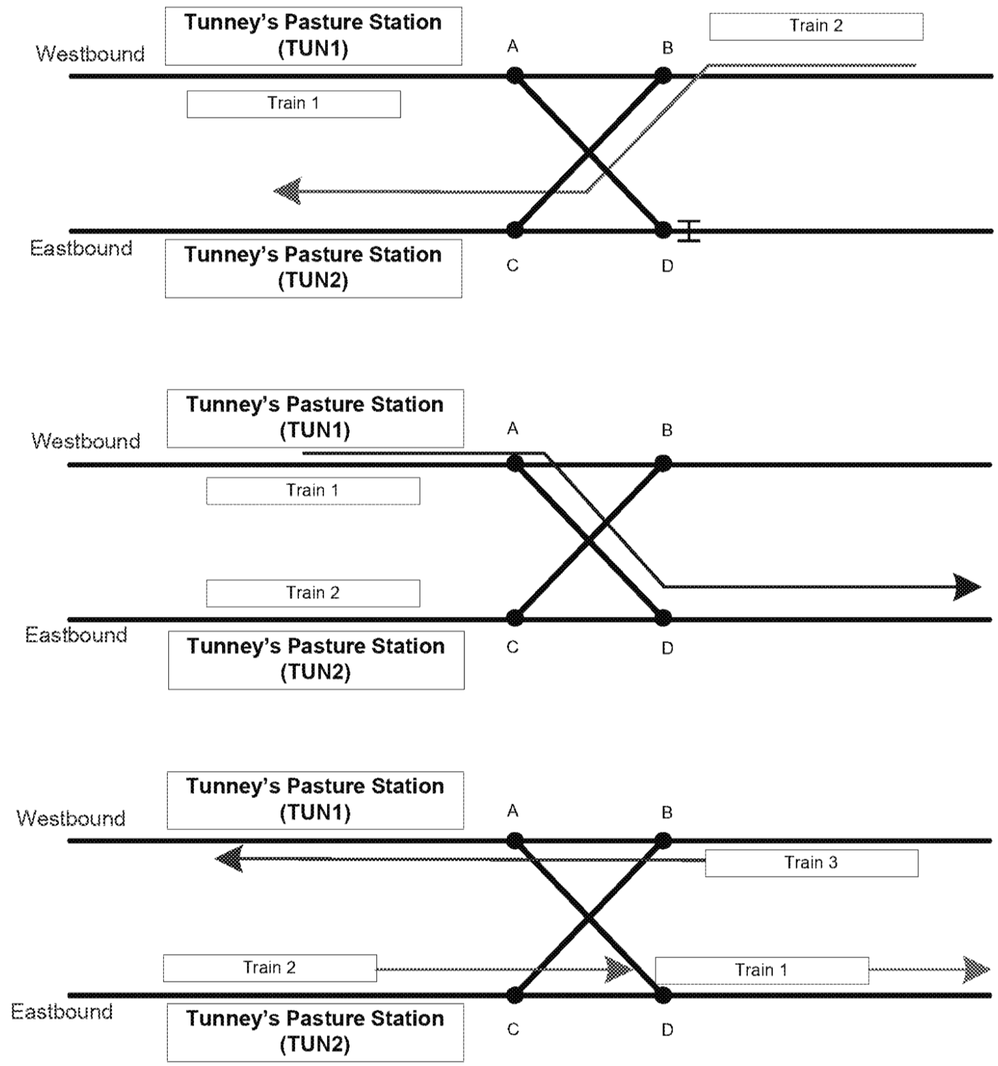
Direction	Station	Dwell - CTP	Dwell - TCRP	Dwell - Exper.
East	Tunney's Pasture	147	147	70
East	Bayview	37	28	33
East	LeBreton	20	18	18
East	Downtown West	35	27	31
East	Downtown East	42	32	37
East	Rideau Centre	30	25	27
East	Campus	26	22	23
East	Lees	18	17	18
East	Train Station / Hurdman	[illegible]	[illegible]	[illegible]
East	St. Laurent	22	19	19
East	Cyrville	17	16	18
West	Blair	147	147	59
West	Cyrville	16	16	18
West	St. Laurent	23	20	20
West	Train Station	15	15	18
West	Hurdman	37	29	33
West	Lees	18	17	18
West	Campus	24	21	21
West	Rideau Centre	37	29	33
West	Downtown East	40	31	36
West	Downtown West	37	29	33
West	LeBreton	18	17	18
West	Bayview	19	17	18

Operational Performance

Terminal Times

- Double Platform Turnback Design Headway at Tunney's Pasture Station
  - 84 sec in ATO mode
  - 87 sec in ATPM mode

- Possible use of Integrated Platform Passenger Information System



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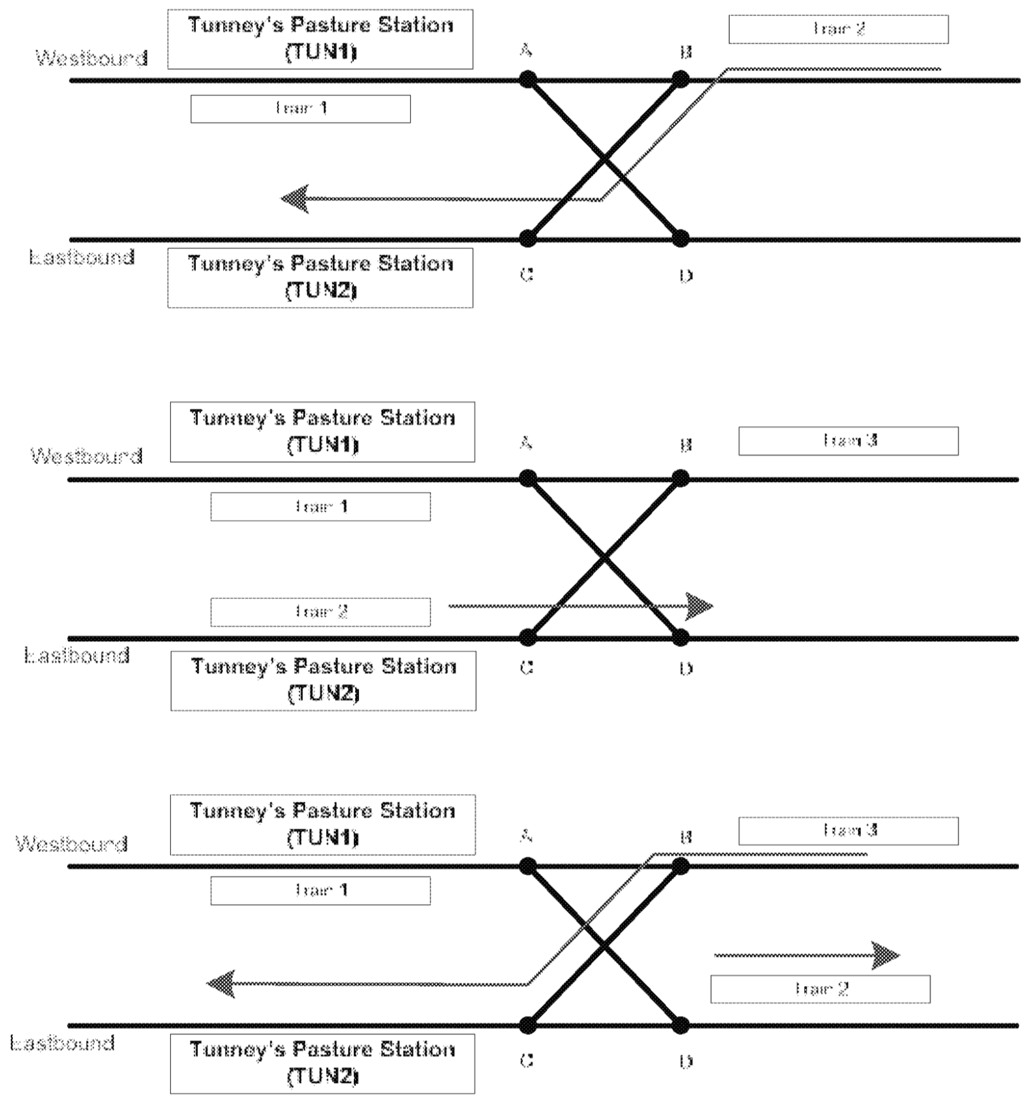
Operational Performance

Terminal Times

- Single Platform Turnback Design Headway at Tunney's Pasture Station
  - 144 sec in ATO mode
  - 150 sec in ATPM mode
- This turnback scenario can be used when a disabled train occupies one of the Tunney's Pasture Platforms

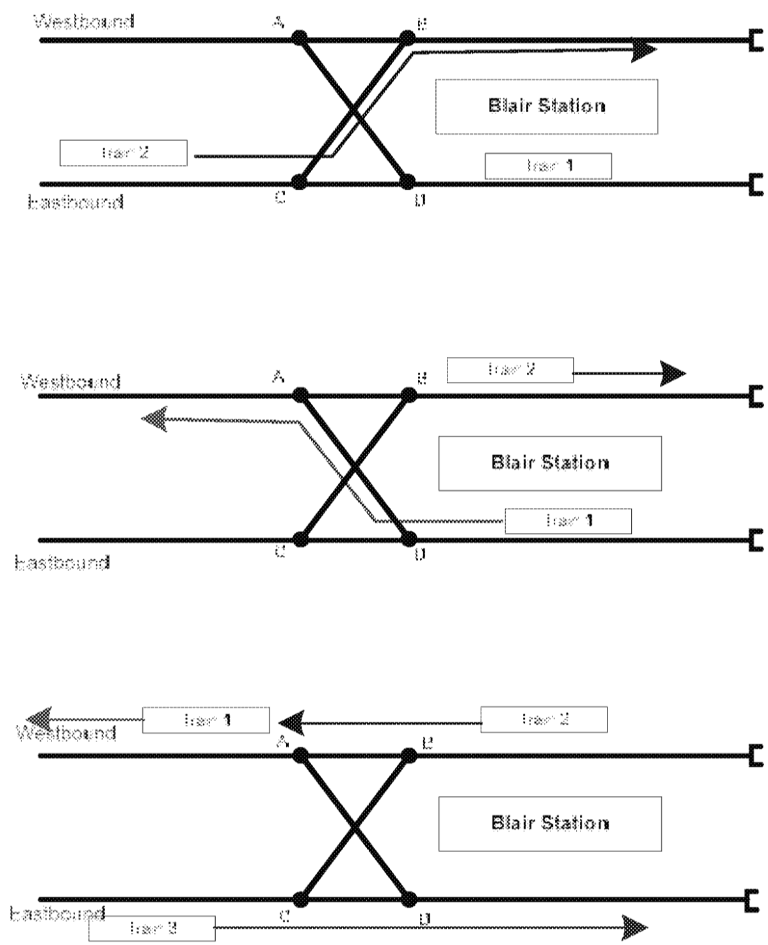


Operational Performance

Terminal Times

- Double Platform Turnback at Blair Station
  - 89 sec in ATO mode
  - 92 sec in ATPM mode

- Review use of faster switches or faster turn-out speed limit



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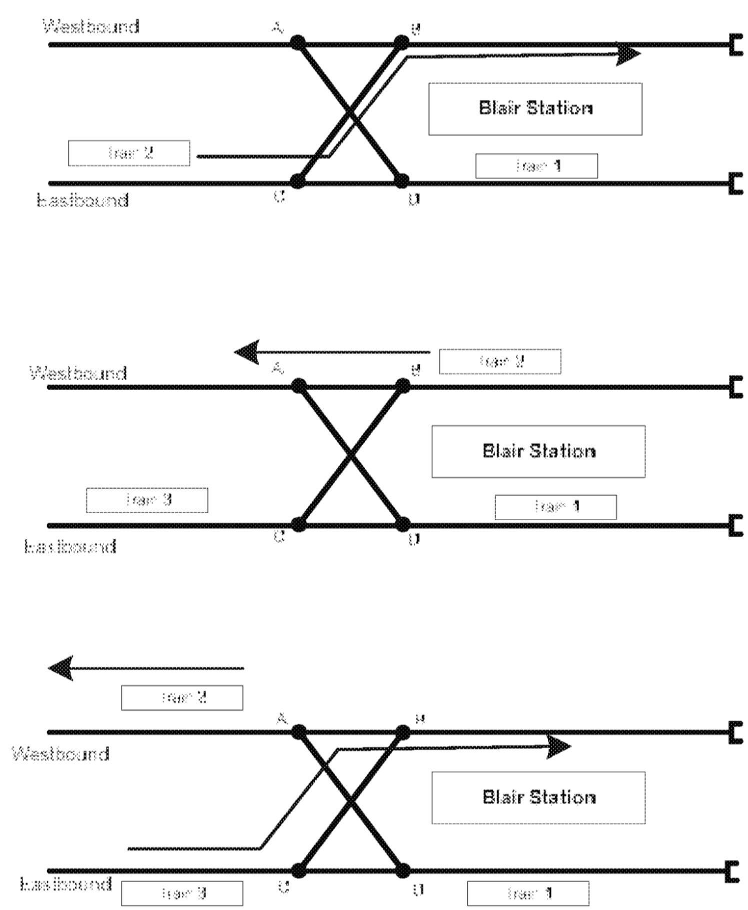
Operational Performance

Terminal Times

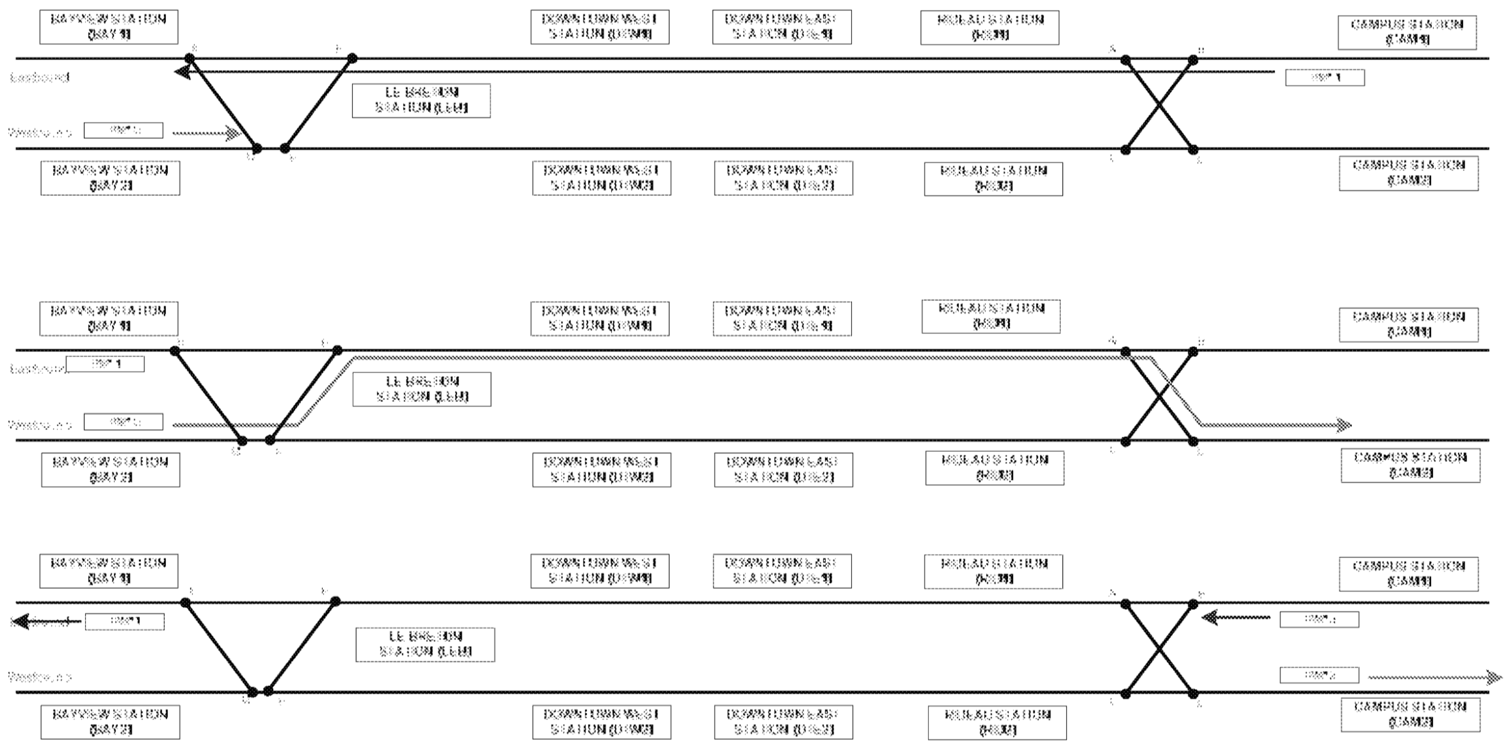
- Single Platform Turnback at Blair Station
  - 141 sec in ATO mode
  - 146 sec in ATPM mode
- This turnback scenario can be used when a disabled train occupies one of the Tunney's Pasture Platforms



Operational Performance

Single Track Outage

- Failure between Bayview and Campus Stations for operation Scenario 1
  - Worst case track outage headway is 898.2sec (14.97 minutes)
- Platooning trains in ATO or ATPM mode offers an opportunity to increase capacity in Single Track Outage



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Operational Performance

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Compliance with Operational Performance Criteria & Through Reliable System Performance Simulations

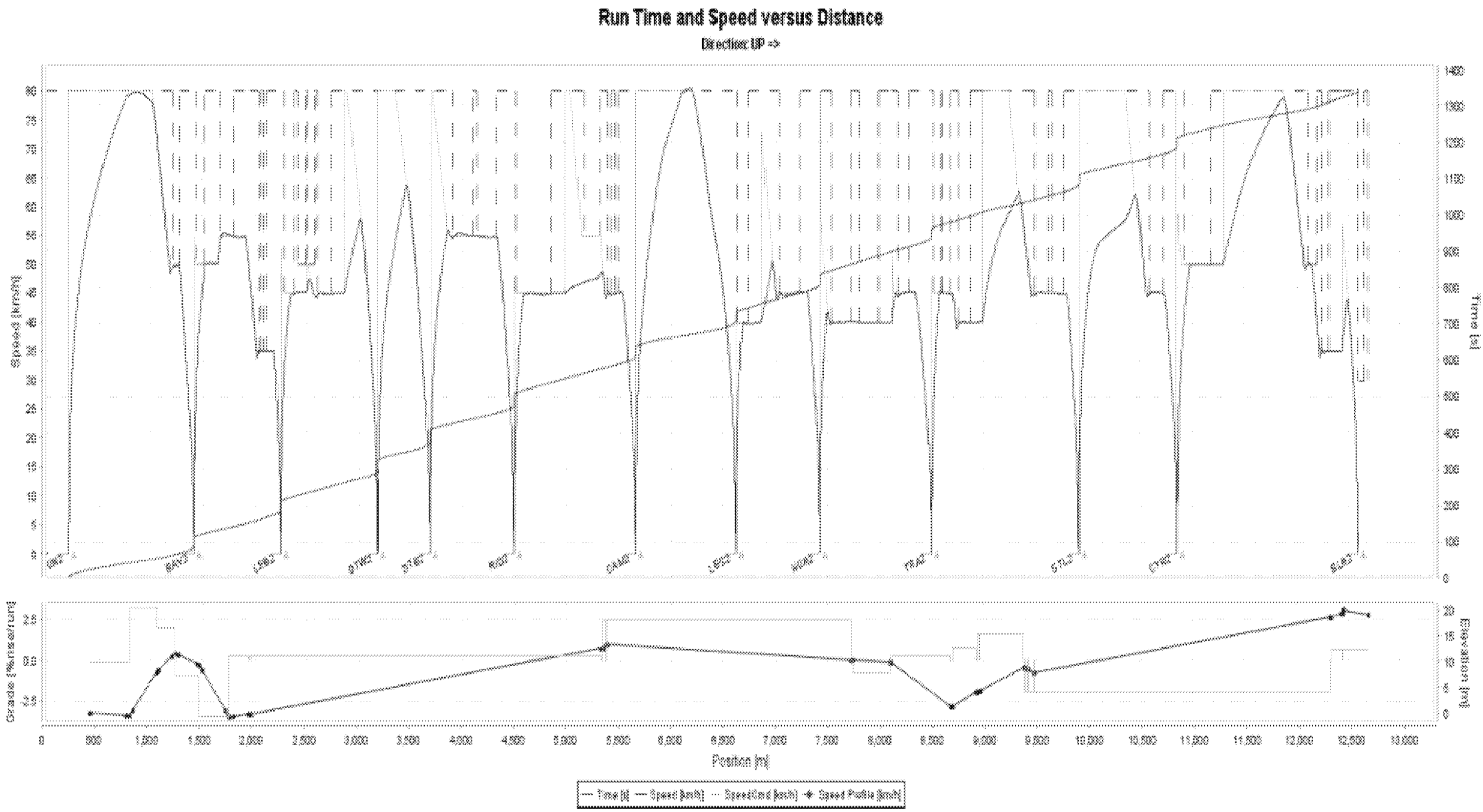
Eastbound Normal Run in ATO Mode

- Scenario 1
  - 1344 sec (22.4 min)
- Scenario 2
  - 1370 sec (22.8 min)
- Required 23 min

Travel Times for Eastbound Normal Run in ATO Mode					
Station	Station	Scenario 1		Scenario 2	
From	To	Dwell Time [s]	TravelTime [s]	Dwell Time [s]	TravelTime [s]
-	TUN2	-		-	
TUN2	BAY2	20	89	33	89
BAY2	LEB2	20	79.2	20	79.2
LEB2	DTW2	26	86.6	31	86.6
DTW2	DTE2	31	51.8	37	51.8
DTE2	RID2	29	71.4	27	71.4
RID2	CAM2	22	107.8	23	107.8
CAM2	LES2	20	73.2	20	73.2
LES2	HUR2	22	81.4	26	81.4
HUR2	TRA2	20	110.4	20	110.4
TRA2	STL2	20	124.2	20	124.2
STL2	CYR2	20	83	20	83
CYR2	BLR2	-	135.8		134.4
Total Travel Time		1344 s		1370 s	

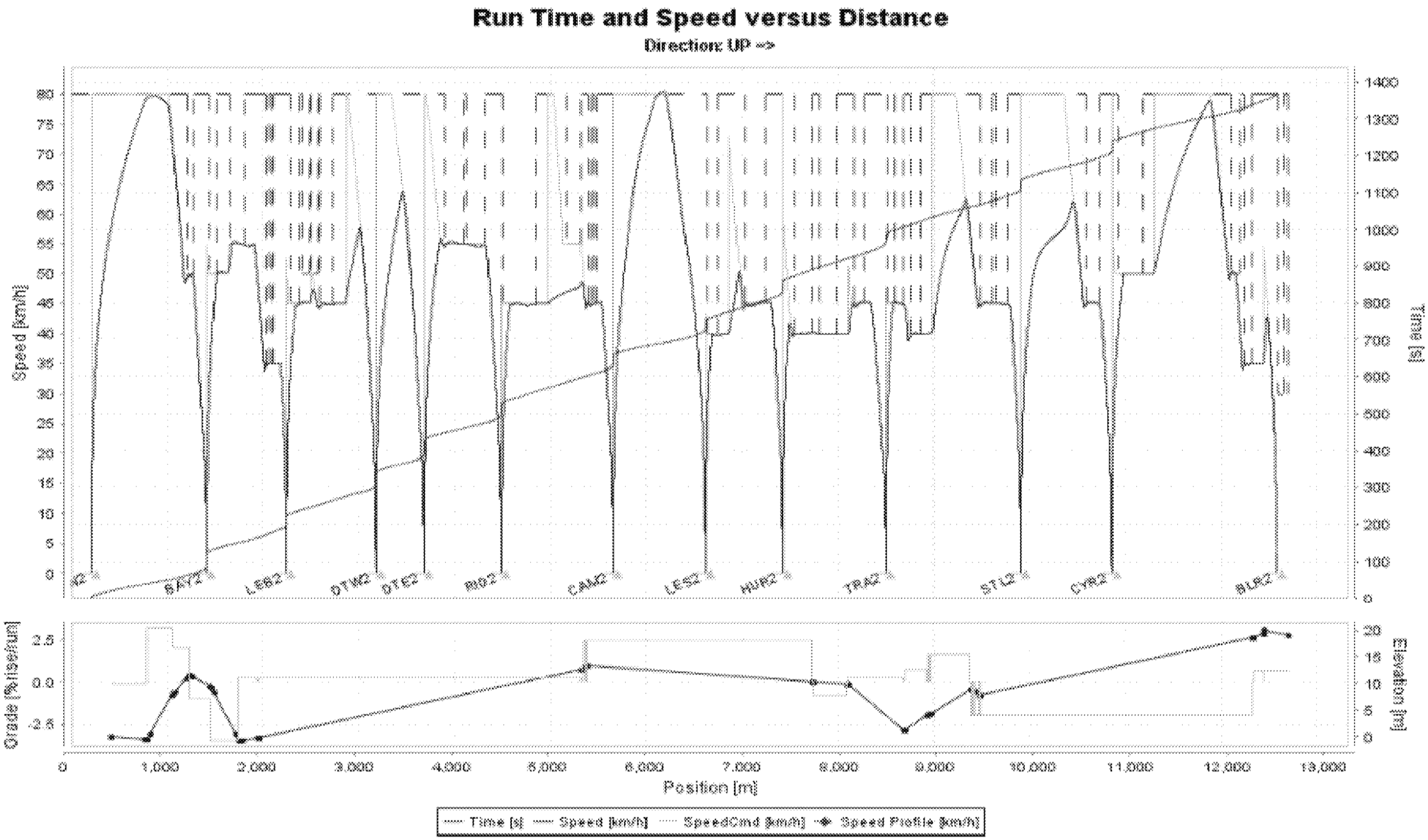
Operational Performance

Runtime and Speed versus Distance Plot (TUN2 to BLR2) for Scenario 1



Operational Performance

Runtime and Speed versus Distance Plot (TUN2 to BLR2) for Scenario 2



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Operational Performance

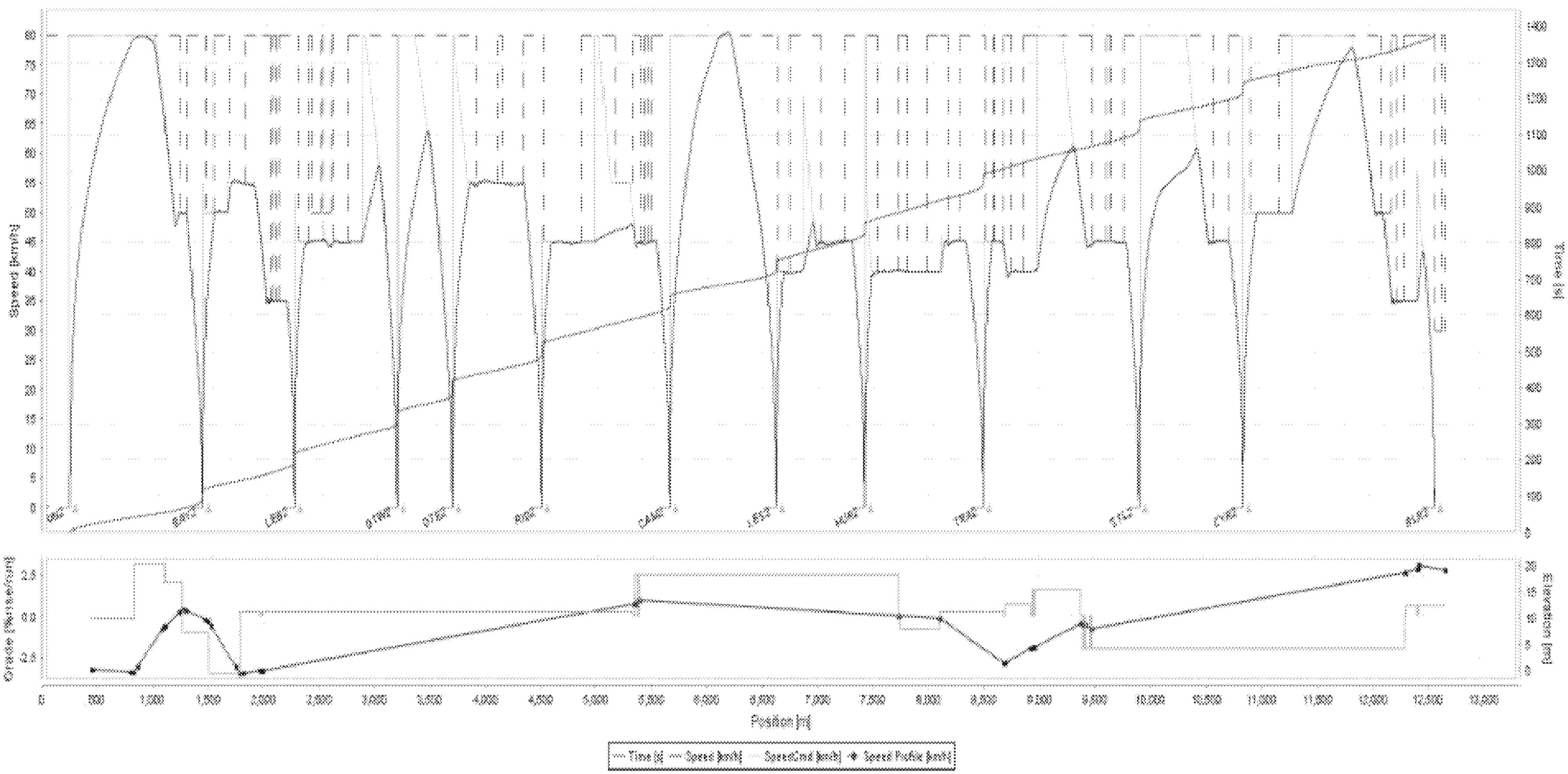
Eastbound Normal Run in ATPM Mode

- Scenario 1
  - 1378 sec (22.97 min)
- Scenario 2
  - 1404 sec (23.4 min)
- Required 24 min

Travel Times for Eastbound Normal Run in ATPM Mode					
Station	Station	Scenario 1		Scenario 2	
From	To	Dwell Time [s]	TravelTime [s]	Dwell Time [s]	TravelTime [s]
-	TUN2	-		-	
TUN2	BAY2	20	92.2	33	92.2
BAY2	LEB2	20	82.4	20	82.4
LEB2	DTW2	26	89	31	89
DTW2	DTE2	31	54.6	37	54.6
DTE2	RID2	29	74	27	74
RID2	CAM2	22	110.4	23	110.4
CAM2	LES2	20	75.8	20	75.8
LES2	HUR2	22	84.2	26	84.2
HUR2	TRA2	20	112.2	20	112.2
TRA2	STL2	20	127.6	20	127.6
STL2	CYR2	20	86	20	86
CYR2	BLR2	-	139.6		138.2
Total Travel Time		**1378 s**		**1404 s**	

Operational Performance

Runtime and Speed versus Distance Plot for Scenario 1 in ATPM Mode



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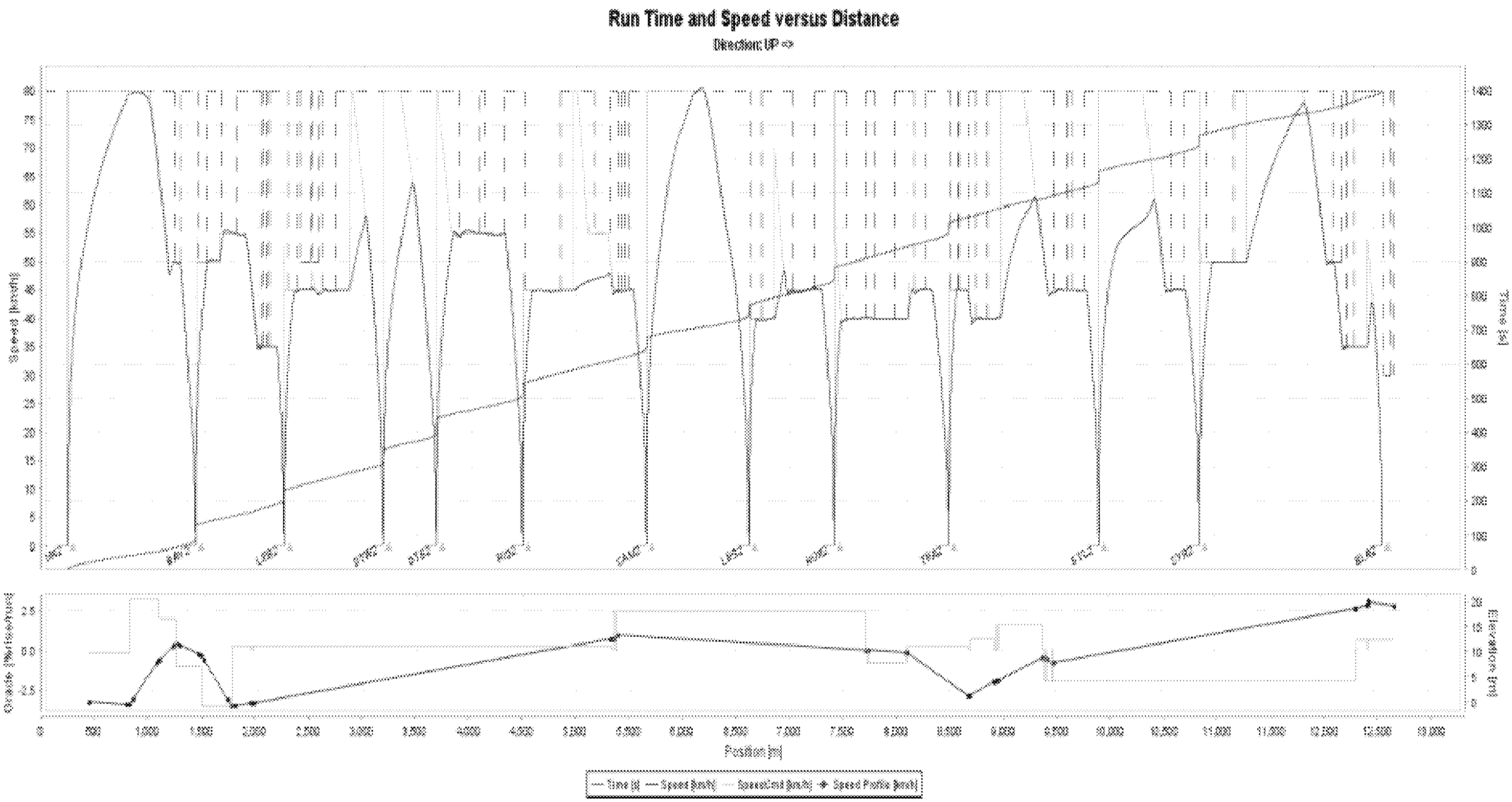
Operational Performance

Runtime and Speed versus Distance Plot for Scenario 2 in ATPM Mode



RIDEAU TRANSIT GROUP

Operational Performance

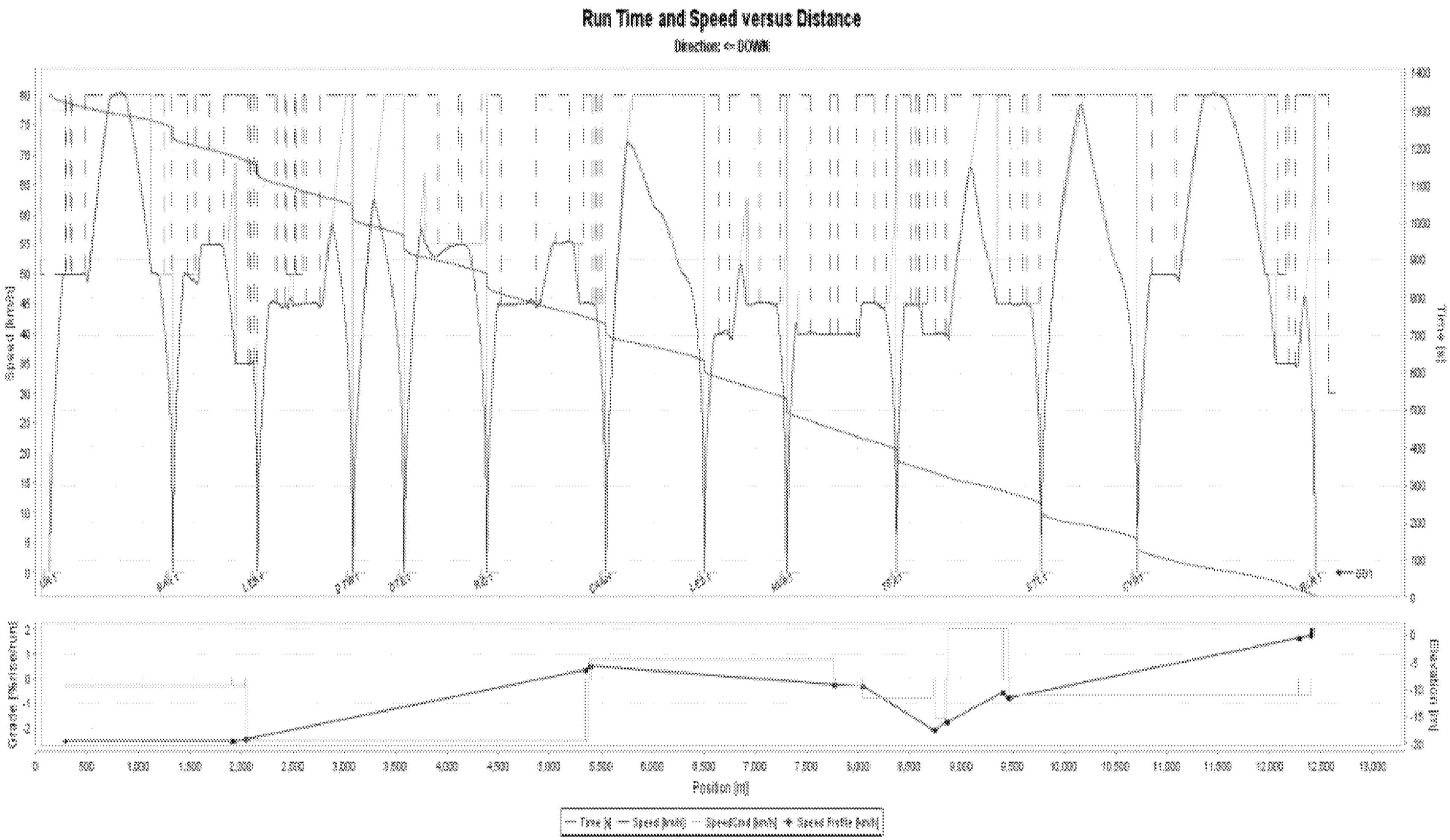
Westbound Normal Run in ATO Mode

- Scenario 1
  - 1344 sec (22.4 min)
- Scenario 2
  - 1357 sec (22.6 min)
- Required 23 min

Travel Times for Westbound Normal Run in ATO Mode					
Station	Station	Scenario 1		Scenario 2	
From	To	Dwell Time [s]	TravelTime [s]	Dwell Time[s]	TravelTime [s]
-	BLR1	-		-	
BLR1	CYR1	20	133.6	20	133.2
CYR1	STL1	20	75	20	75
STL1	TRA1	20	122.2	20	122.2
TRA1	HUR1	29	107.6	33	107.6
HUR1	LES1	20	81	20	81
LES1	CAM1	21	77	21	77
CAM1	RID1	29	103.6	33	103.6
RID1	DTE1	34	71	36	71
DTE1	DTW1	28	51.6	33	51.6
DTW1	LEB1	20	87.6	20	87.6
LEB1	BAY1	20	79.8	20	79.8
BAY1	TUN1	-	92.2	-	91
Total Travel Time		**1344 s**		**1357 s**	

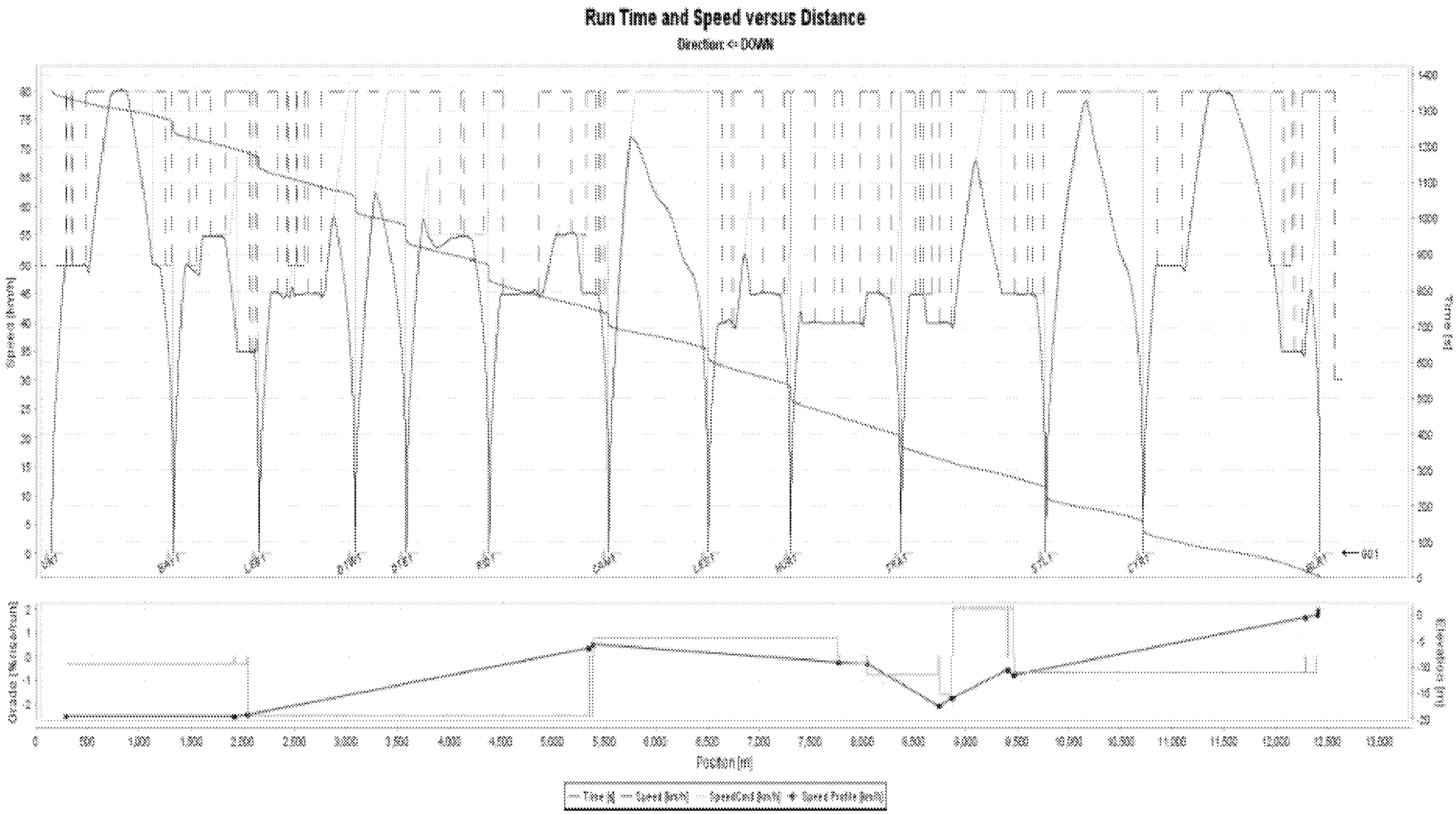
Operational Performance

Runtime and Speed versus Distance Plot (TUN1 to BLR1) for Scenario 1



Operational Performance

Runtime and Speed versus Distance Plot (TUN1 to BLR1) for Scenario 2



Operational Performance

Westbound Normal Run in ATPM Mode

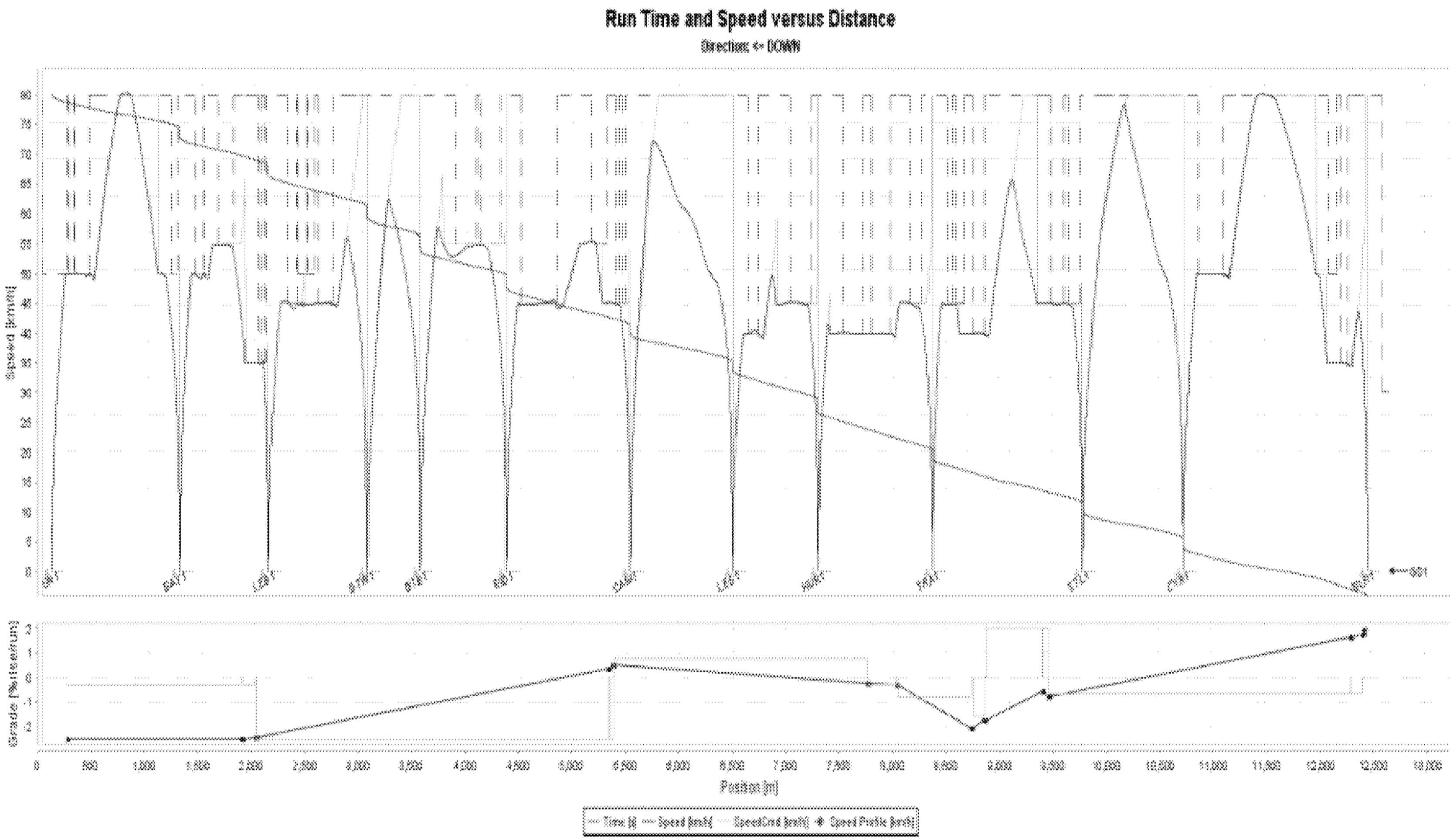
- Scenario 1
  - 1378 sec (22.97 min)
- Scenario 2
  - 1392 sec (23.2 min)
- Required 24 min

Travel Times for Westbound Normal Run in ATPM Mode

Station	Station	Scenario 1		Scenario 2	
From	To	Dwell Time [s]	TravelTime [s]	Dwell Time[s]	TravelTime [s]
-	BLR1	-		-	
BLR1	CYR1	20	137.4	20	137
CYR1	STL1	20	77.6	20	77.6
STL1	TRA1	20	125.6	20	125.6
TRA1	HUR1	29	110.2	33	110.2
HUR1	LES1	20	83.8	20	83.8
LES1	CAM1	21	79.6	21	79.6
CAM1	RID1	29	106.4	33	106.4
RID1	DTE1	34	73.4	36	73.4
DTE1	DTW1	28	54.4	33	54.4
DTW1	LEB1	20	90.4	20	90.4
LEB1	BAY1	20	82.6	20	82.6
BAY1	TUN1	-	95.6	-	94.6
Total Travel Time		**1378 s**		**1392 s**	

Operational Performance

Runtime and Speed versus Distance Plot for Scenario 1 in ATPM Mode



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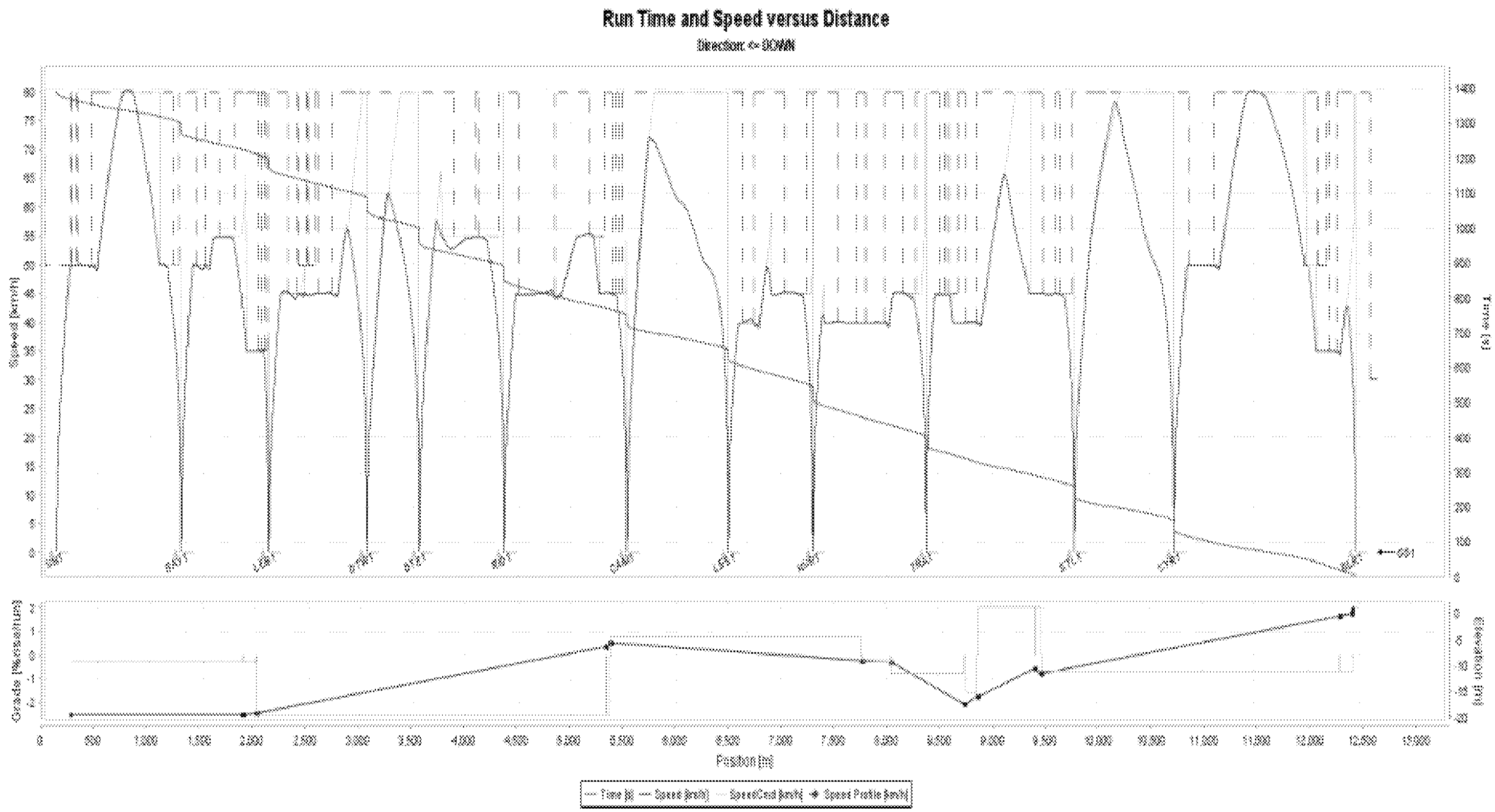
Operational Performance

Runtime and Speed versus Distance Plot for Scenario 2 in ATPM Mode



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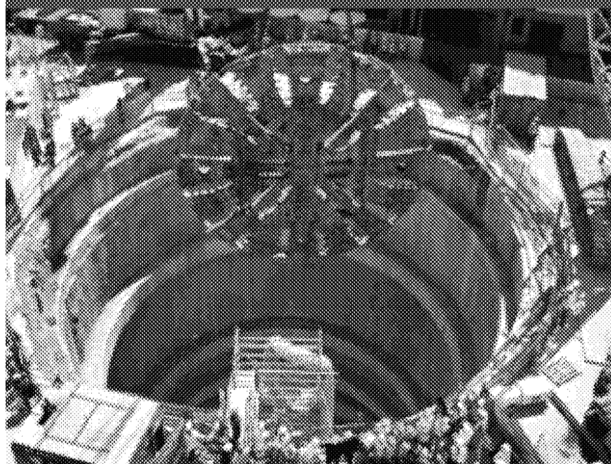

9 SAFETY MANAGEMENT & CERTIFICATION

Safety Management & Certification

System-Wide Safety Management

DMP #3 Results / DPM #7 Submission

- RFP section 22.0 (b) (iv) A. states: "A narrative shall describe the process of developing the System-wide safety management and how this is used to generate the System Safety Case."
- System-wide safety management was addressed by both narrative (17 pages) and presentation (10 slides) during DPM#3 under System Wide Safety & Certification. Feedback indicated acceptance.
- The Safety Case was addressed by the following single sentence of narrative in DPM#3: "The Safety Case willl be based on the composite of all of the documents identified in the System Safety Certification Plan above, and will provide links to the disposition of all hazards, and to the status of the Safety Certificates." Otherwise, the material from DPM #3 is not repeated for DPM#7.
- However, further information is included below specific to the System Safety Case, to expand on the single sentence quoted above, and provided in the narrative.

Safety Management & Certification

System Safety Case

Guidelines

- These following guidelines will be applied to the OLRT project:
  - Generic Safety Case guidelines as provided in CENELEC 50126, Railway Applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS).
  - Additional specific Safety Case guidelines as provided in CENELEC 50129, Railway Applications – Communication, signalling and processing systems – Safety related electronic systems for signalling.
- More details of the specific documentation requirements based on these two standards are described in the accompanying narrative.

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Safety Management & Certification

Overall Safety Certificate

SNC·LAVALIN

CANADA LINE
SYSTEM SAFETY CERTIFICATE
No. 0001

Canada Line
PROJECT OFFICE

Completion of this certificate indicates that the Canada Line complies with all applicable safety criteria in accordance with the System Safety Certification Plan for the Canada Line, and is therefore safe to be placed in service for public use in accordance with the Safety Management System.

This certificate and referenced documentation were also prepared as evidence of compliance with the requirements of Clause 4.13, *Engineering Work* of the draft document received from BCSA on June 10, 2008 *Certification, Design, Construction, Operation and Maintenance Guidelines for British Columbia Commuter Railways*.

Date of Certificate: This certificate is effective as of July 28, 2009 in advance of service commencement which is scheduled for August 1, 2009.

RESTRICTIONS STATUS & CLOSURE REQUIREMENTS: During times when a single stay cable is being replaced on the North Arm Bridge, operation shall be restricted to one train (three cars maximum) on the bridge at a time. Restriction to be lifted when cable replacement is complete. Special Instructions, Operating Notes and Operating Restrictions are documented in Operations Bulletin 118. Inspections are to be performed per Operations Bulletin 109 until magnetic valves are installed on all vehicles.

The attached System Safety Certificates spreadsheet identifies each of the safety certificates for the Canada Line, and the status of signatures. The signatures on each indicate acceptance by one or more Professional Engineers registered in BC for that element of the Canada Line.

Also attached is the Hazard Log as required by the System Safety Certification Plan. The signatures on the Hazard Log indicate that all hazards have been administered in accordance with the System Safety Certification Plan.

There are four other Hazard Logs for the Canada Line project. Rotem provided a Hazard Log for the Vehicles. Thales provided a Hazard Log for the ATC system. WRSL (Westinghouse) provided a Hazard Log for the Communications Systems. SNC-Lavalin prepared an Interface Hazard Log covering the interfaces between the Vehicles, ATC and Communications Systems. All hazards in all Hazard Logs have been administered in accordance with the System Safety Certification Plan.

The original signed certificates and supporting system safety documentation are located in a 3-ring binder with the title 'System Safety Certificates'. These are located in the Canada Line Project Records file. A preliminary copy of this binder was provided to BCSA on June 1, 2009, that date being 60 days prior to the scheduled service commencement, but with some of the certificates in draft and unsigned. The complete binder is being issued to BCSA as of the date of this certificate, including all signed certificates, the System Safety Certification Plan, the Preliminary Hazard Analysis, the System Safety Analysis for the Tunnel Ventilation System, and the Hazard Log.

Recommended: B. McDonnell P. Eng. (Systems Assurance Manager – Canada Line)	Approved: R. Woodhead P.Eng. (Technical Director – Canada Line)

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Safety Management & Certification

Operating Permit

SNC·LAVALIN

SNC-LAVALIN Inc.
[illegible] West Georgia Street
Vancouver, British Columbia
Canada [illegible]

Telephone: [illegible]
Facsimile: [illegible]

July 29th, 2009

British Columbia Safety Authority
505 6th Street, Suite 200
New Westminster, B.C. V3L 0E1

Our Ref.: 016876-SNC/BCSA-0010

Attention: Eric Samuelson
Provincial Railway Safety Manager

Dear Mr. Samuelson,

Subject: Operating Permit for Canada Line

In accordance with clause 4.13 of the draft Certification, Design, Construction, Operation and Maintenance Guidelines for British Columbia Commuter Railways we are pleased to enclose our System Safety Certificates for the Canada Line. In addition to the fifty Certificates, the documentation includes the Hazard Log for the Project.

We also confirm that:

a) all engineering work has been done in accordance with sound engineering principles

b) the individual certificates have been certified by engineers responsible for that field of expertise

c) the overall safety of the works has been certified by the senior engineer responsible for technical management of the design, construction and evaluation of the Canada Line in Certificate No. 0001

d) engineers who have vouched for the safety of any part of the works are registered and in good standing with APEGBC.

We trust you will find the enclosed documents satisfy BCSA's requirements. If you have any questions please contact the undersigned.

Yours sincerely,

SNC-Lavalin Inc.

Roger Woodhead, Ph.D., P.Eng
Technical Director

RW/jt

cc. Jean Marc Arbaud, InTransit BC
Robert Newland, SNC-Lavalin Inc.
Brian McDonnell, McDonnell Consulting Inc.

[illegible]

RIDEAU TRANSIT GROUP RTG

Safety Management & Certification

Operating Permit

BRITISH COLUMBIA
The Best Place on Earth

OPERATING PERMIT #2009 – 15

Permit Holder: **InTransit BC Limited Partnership**

Railway: **Canada Line** (as further described and defined in this Permit)

Authority for Permit

This Permit is issued pursuant to Section 11 of Part 2 of the *Railway Safety Act* S.B.C. 2004, c.8.

Terms and Conditions

Having regard to the Permit Holder's application dated August 4, 2008, together with all information and documentation submitted by and on behalf of the Permit Holder and all relevant considerations, including the approvals confirmed by letters dated April 9, 2009 and June 18, 2009 (a copy of each letter is attached as Appendix "3" to this Permit) and the applications that have been made to the Minister by letters dated July 11, 2009 for approval of certain amendments to standards, this Permit is, subject to the terms and conditions set out herein and subject to all applicable laws, including the *Railway Safety Act*, issued to the Permit Holder in respect of the commuter railway known as the Canada Line to operate from Waterfront Station in Vancouver, to the Vancouver International Airport on Sea Island and into the City of Richmond on Lulu Island (herein the "Railway").

1. This Permit must not be used by any other railway company and must not be used by the Permit Holder or any other railway company in respect of any other railway.
2. The Permit Holder will comply with all applicable laws including, the applicable provisions of the *Railway Safety Act* (Canada), as adopted and modified by the Railway Safety Adopted Provisions Regulation (B.C. Reg 210/2004), as amended, the provisions, regulations, rules, codes, procedures and standards adopted pursuant to and the regulations made under Section 8 of the *Railway Safety Act*, all applicable orders, including orders that may be issued by the Minister, and any lawful order respecting a threat to the safety of rail operations that may be issued by a railway safety inspector in relation to the Permit Holder or the Railway or any part thereof.
3. The Permit Holder will bring into compliance, remedy and complete to the satisfaction of the British Columbia Safety Authority (herein, the BC Safety Authority") each of the items listed in Appendix "1" to this Permit, on or before the specified date corresponding to each item, as set out in the "Date to Be Completed" Column of Appendix "1".
4. In reference to the applications that have been made to the Minister by letters dated July 11, 2009 for approval of certain amendments to standards, and in particular, the Request for Code Amendment/Exemption RFAE Number F020 made by the Permit Holder by cover letter dated July 11, 2009 and in further reference to the considerations of the BC Safety Authority as set out in its letter dated July 2, 2009, all of which I understand remain under consideration in connection with those applications for approval, it is a further term and condition of this Permit that the Permit Holder will as an interim measure, pending review, consideration, completion, and decisions, as the case may be, in regard to such applications for approval, implement and at all times maintain the measures proposed by the Permit Holder in the section entitled "Mitigation Measures During Operations Prior to Approval" in the Permit Holder's July 11, 2009 RFAE Number F020 Request letter.
   A copy of each of the Permit Holder's RFAE Number F020 letter dated July 11, 2009 and of the BC Safety Authority's letter dated July 2, 2009 are attached as Appendix "2" to this Permit.
5. A reference in this Permit to a statute means a statute of the Province of British Columbia unless expressly stated otherwise and includes every amendment to it, every regulation made under it and any enactment passed in substitution therefore or in replacement thereof, unless expressly provided otherwise in this Permit.
6. Any reference to this Permit means this instrument and any and all appendices and schedules attached to it and all documents referenced herein or in any of the appendices and schedules.

See Attached Appendices "1", "2" and "3" to this Permit.

Ministry of Transportation and Infrastructure
Registrar of Railway Safety
Mailing Address: [illegible]
Telephone: [illegible]
Fax: [illegible]
Location: [illegible]

RIDEAU TRANSIT GROUP RTG

System-Wide Safety & Certification

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Sample Safety Certificates for the Canada Line

Canada Line System Safety Certificate No. 0204

SNC·LAVALIN | CANADA LINE SYSTEM SAFETY CERTIFICATE No. 0204 | Canada Line PROJECT OFFICE

Completion of this certificate indicates that appropriate evidence has been provided that the Certifiable Element described below complies with all applicable safety criteria, and is hereby certified in accordance with the System Safety Certification Plan.

CERTIFIABLE ELEMENT NUMBER & NAME:	DATE OF CERTIFICATE
0204 ATC Systems Assurance	Date: July 29, 2009

RESTRICTIONS STATUS & CLOSURE REQUIREMENTS: None

BACKGROUND

1. The Automatic Train Control (ATC) system for the Canada Line was designed and assembled by Thales Rail Signalling Solutions Inc. (formerly Alcatel Canada Inc.) Company under subcontract 016876-P4300.
2. In accordance with the Canada Line System Safety Certification Plan, System Safety documentation guidelines for the ATC (as well as Vehicles and Communications Systems) were provided in a Design Brief, System Safety Guidelines for Canada Line Contractors.

EVIDENCE

The following system safety documents were provided by Thales, and reviewed and accepted by SNC-Lavalin. These meet the requirements of Background item 2 above.

1. Canada Line ATC System ATC System Safety Program Plan, rev 03, 3CU 00351 0003 DUZZA,
2. Canada Line ATC System ATC Preliminary Hazard List and Analysis, rev 02, 3CU 00351 0061 DUZZA,
3. Canada Line ATC System VOBC Interface Relay Unit Safety Analysis, rev 02, 3CU 00351 0086 DUZZA,
4. Canada Line ATC System Safe Braking Model, rev 03, 3CU 00351 0072 DUZZA,
5. Canada Line ATC System ATC System O&SHA, rev 02, 3CU 00351 0118 DUZZA,
6. Canada Line ATC System ATC System Hazard Analysis, rev 02, 3CU 00351 0087 DUZZA,
7. Canada Line ATC System ATC System Fault Tree, rev 02, 3CU 00351 0099 DUZZA,
8. Canada Line ATC System ATC System FMECA, rev 02, 3CU 00351 0092 DUZZA,
9. Canada Line ATC System ATC EMC Control Plan, rev 02, 3CU 00351 0004 UEZZA,
10. Canada Line ATC System ATC System Preliminary EMC Control Report, rev 03, 3CU 00351 0071 QZZZA,

.... continued on Page 2

Page 2

System Safety Certificate No. 0204, ATC Systems Assurance

11. Canada Line ATC System VOBC Subsystem Safety Analysis, Rev 02, 3CU 00351 0076 DUZZA,
12. Canada Line ATC System STC Relay Rack Safety Analysis, Rev 01, 3CU 00351 0134 DUZZA,
13. Canada Line ATC System ATC VCC Subsystem Safety Analysis, Rev 02, 3CU 00351 0102 DUZZA,
14. Canada Line ATC System ATC System Data Communications Safety Analysis, Rev 01, 3CU 00351 0151 DUZZA,
15. Canada Line ATC System ATC System Station Controller Subsystem Safety Analysis, Rev 02, 3CU 00351 0089 DUZZA,
16. Canada Line ATC System Hazard Log, rev 01, 3CU 00351 0088 DUZZA, and
17. Safety Certification Letter # 0686.

The following documents were produced by Thales, and reviewed and accepted by SNC-Lavalin and Rotem:

18. Canada Line ATC System Vehicle Interface Control Document, rev 04, 3CU 00351 0014 PBZZA, and
19. ATC System On-Board/Vehicle PHA/IHA rev. 03, 3CU 00351 0028 DUZZA.

The following documents were produced and accepted by SNC-Lavalin:

20. ATC-Vehicle Hazard Logs; i.e. Design Briefs 016876-3030-48EB-SW-001 and 016876-3030-46EB-SW-002

Confirmed: B. McDonnell (Systems Assurance Manager)	Approved: M. Palmer (ATC Project Manager)
Approved: K. Tagg (Systems Manager)	Approved: R. Woodhead (Technical Director)

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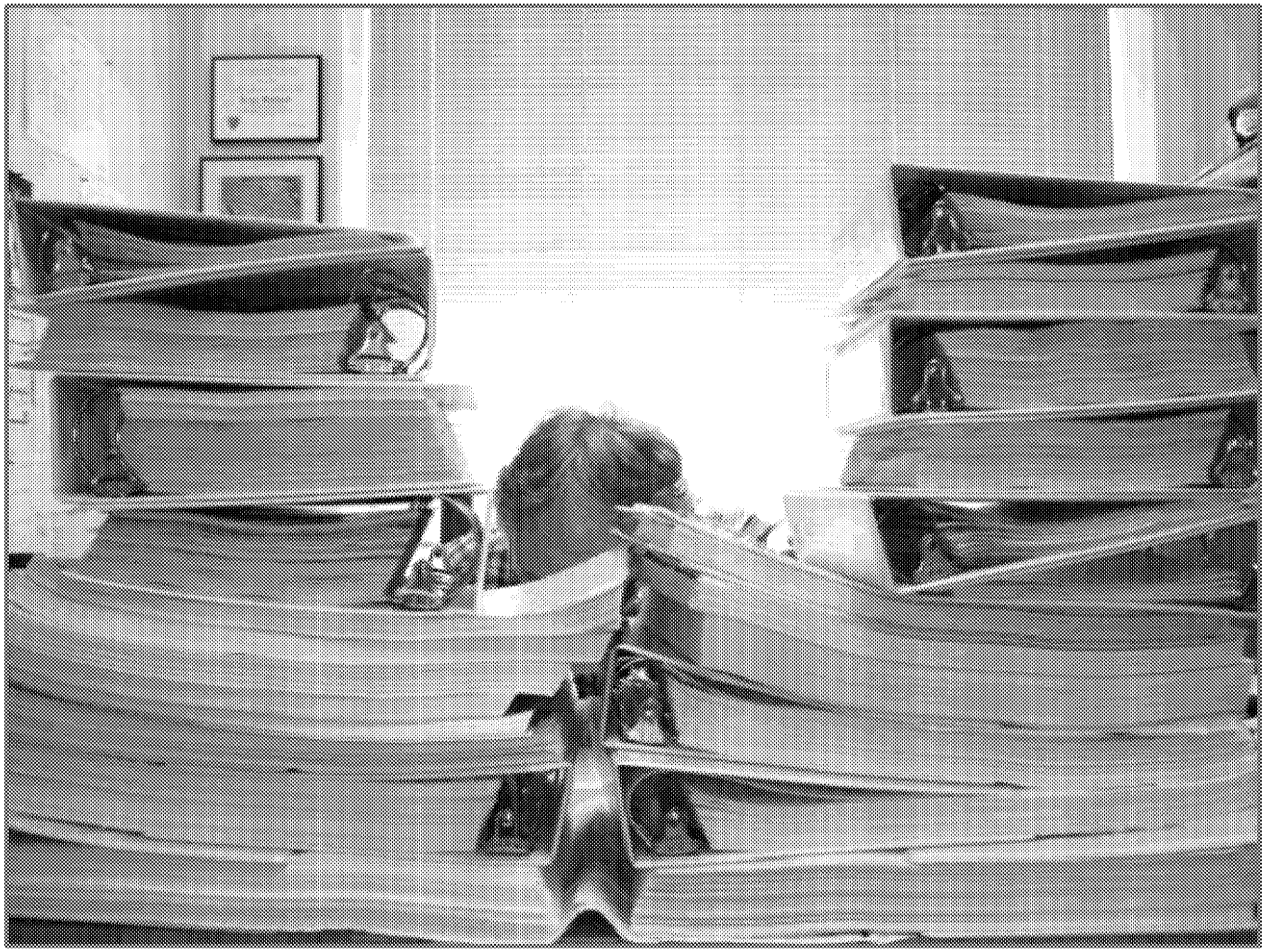
Safety Management & Certification

The job isn't finished until…



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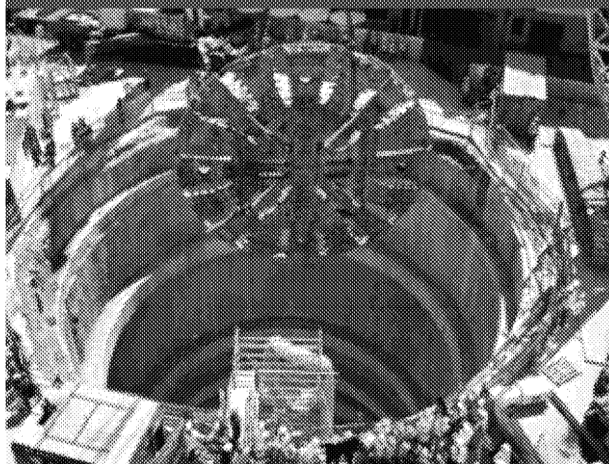

10 RESPONSE TO DPM #3 FEEDBACK

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Response to DPM #3 Feedback

Response to IO Feedback on RTG DPM #3

Approach to Addressing Comments

- Feedback on Non-Compliance and Unobservable Issues
  - RTG has taken the Sponsors verbal and written feedback along with the non-compliance and unobservable issues comments provided at DPM #3 and have incorporated them into the Quality Assurance checklists
  - Checklists will be used in the preparation of the RFP submission narratives and drawings
  - Comments and Issues that RTG agree with have or will be incorporated into the RFP submission narratives and/or text and are indicated with ☑
  - Comments and Issues that require further clarification from the Sponsors are indicated with ☒

Response to DPM #3 Feedback

Systems Assurance

Verification & Validation Strategy (Comment #3: U)

Addressed ☑

- Information is required to detail how performance failures are managed during the testing phase

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Response to DPM #3 Feedback

Light Rail Vehicles

Branding Strategy (Comment #13: U)	Addressed
■ Additional information required to provide the scope of branding possibilities and aspects of vehicle design which could serve this purpose	☑
Vehicle Type & Manufacturer (Comments #14a, b & c: U)	
■ Additional information required to detail vehicle type and manufacturer chosen for OLRT, its performance characteristics, and its environmental conditions	☑

RIDEAU TRANSIT GROUP

Response to DPM #3 Feedback

Light Rail Vehicles

	Addressed
Service History (Comment #15: U)	
■ Additional information required to detail vehicle type and manufacturer chosen for OLRT, including the number of vehicles supplied, and the names of authorities working with vehicle	☑
Conceptual Drawings (Comment #16: U)	
■ Additional information required to detail vehicle type and manufacturer chosen for OLRT	☑
Vehicle Testing & Commissioning (Comment #17: U)	☑
■ Additional information required on specific test schedule for the vehicle type and manufacturer chosen for the OLRT	

Response to DPM #3 Feedback

Light Rail Vehicles

Modeling & Simulation Results (Comments #18: U) — Addressed

- Additional information required to detail vehicle type and manufacturer chosen for OLRT ☑

Design Approach to Vehicle Accessibility (Comment #19: N)

- PSOS requires vehicle to include a load levelling system. Information as presented during DPM did not elaborate on the approach to meet ADA/AODA maximum of 75 mm gap and +/- 16mm floor height with respect to platform. Also of note, the statement in Written Narrative the "load levelling is not used on LRV's" is inconsistent with other systems currently in use. Additional information is required to support AODA and ADA compliance ☑

Response to DPM #3 Feedback

Light Rail Vehicles

Train System & Safety Critical Items (Comments #20: U)	Addressed
■ Additional information required to detail train system and safety critical items on the chosen vehicle for the OLRT	☑
Spin / Slide Control System (Comment #21: U)	☑
■ Additional information required to detail spin-slide system and functionality for the chosen vehicle for the OLRT	
Vehicle Delivery & Partial Assembly (Comment #22: U)	☑
■ Additional information required to detail delivery method for the chosen vehicle for the OLRT	
Key System Interfaces (Comment #23: U)	
■ Additional information required to detail train system interfaces on the chosen vehicle for the OLRT	☑

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Response to DPM #3 Feedback

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Train Control

	Addressed
Modelling & Results of Expected System Performance (Comments #24: U)	
■ Additional information required to detail and demonstrate that the minimum headway requirements are achievable for the chosen OLRT system design.	☑
■ Supporting information required to describe the approach to the diagnostic requirements and fault monitoring arrangements of the system.	☑
Train Control System, Software, Hardware & Validation Data (Comment #25: U)	☑
■ Additional information required to detail train control system and manufacturer chosen vehicle for the OLRT	
Interaction of the Train Control System, Normal & Abnormal Modes wrt all Modes of Operation (Comment #26: U)	☑
■ Additional information required to detail system safety	

RIDEAU TRANSIT GROUP RTG

Response to DPM #3 Feedback

Train Control

Proposed Substation Locations (Comment #36: U)

- Additional information is required to detail substation locations for the OLRT

Addressed

☑

The substations will be located in general accordance with the Reference Design

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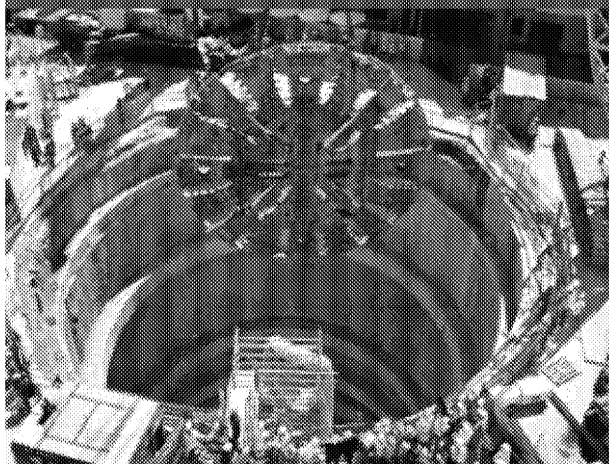

11 KEY QUESTIONS

RIDEAU TRANSIT GROUP

Questions

Five Key Questions

Question #1

- The specification requires Broken Rail Detection but does not specifically require track circuits to perform this function. It could be argued that a manual track inspection regime could meet this requirement. Can the Sponsors please clarify whether they require track circuits to provide Broken Rail Detection or can an inspection regime be a compliant option?

Question #2

- Schedule 15-2 Part 4 of the Project Agreement, Article 3 Section 3.5 (c) states *"Brake discs shall be provided on all axles."* In CBTC Systems it is useful to have at least one Train Control tachometer mounted on an un-braked axle to increase the reliability of train position detection. If RTG meets all deceleration requirements with one un-braked axle can this reliability improvement be considered?

Questions

Five Key Questions

Question #3

- Schedule 15-2 Part 4 of the Project Agreement, Article 3 Section 3.27 (c) (xii) refers to the NVR system requirements. Part B of the above reference document states that the NVR shall have sufficient capacity to store 30 days of video data, while Part D states that the NVR shall *"prevent the video data from being overwritten for 60 days"*. If RTG's design ensures that train video data is downloaded daily and archived on wayside servers, does the NVR still need the capability to store data on-board, and if so, please clarify the duration of storage capacity, 30 days or 60 days?

Question #4

- In Addendum 12, Schedule 15-2 Part 4 of the Project Agreement, Article 3 Section 3.18 (d) an additional requirement was added stating that manual force requirements shall not exceed the limits for 5th percentile females as detailed in MIL-STD-1472. To what operation is this additional requirement intended to apply?

Questions

Five Key Questions

Question #5

- Schedule 15-2 Part 4 of the Project Agreement, Article 3 Section 3.17 (h) refers to the requirements for Carshell Qualification Testing for the Carbody. It states that the first carshell shall be evaluated and certified to comply with collision crashworthiness of ASME RT-1 or equivalent. Schedule 15-2 Part 4 to Project Agreement Section 1.1 (a) discusses standards equivalence and variances. Can the Sponsors clarify whether the requirements regarding locomotives are applicable to the OLRT since it is a closed system?

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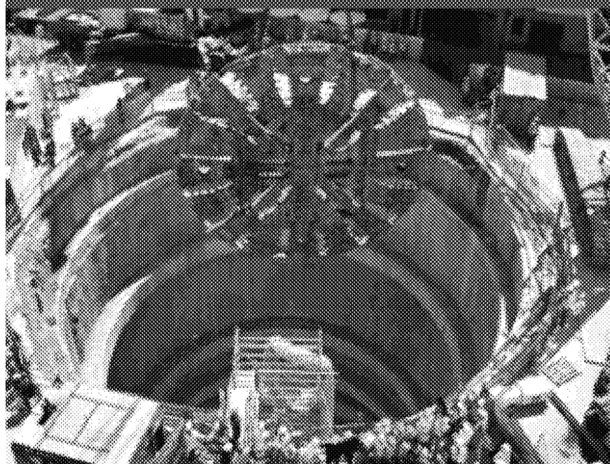

12 KEY ISSUES MOVING FORWARD

Key Issues Moving Forward

Key Issues Moving Forward

Issue #1

- Affordability Cap

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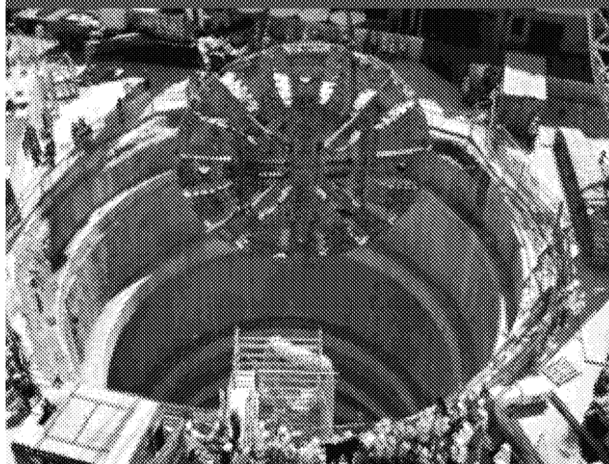

DISCUSSION

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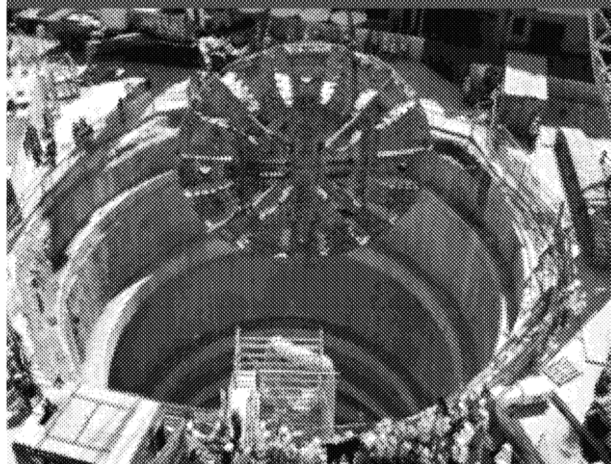

13

SUMMARY & CLOSING COMMENTS

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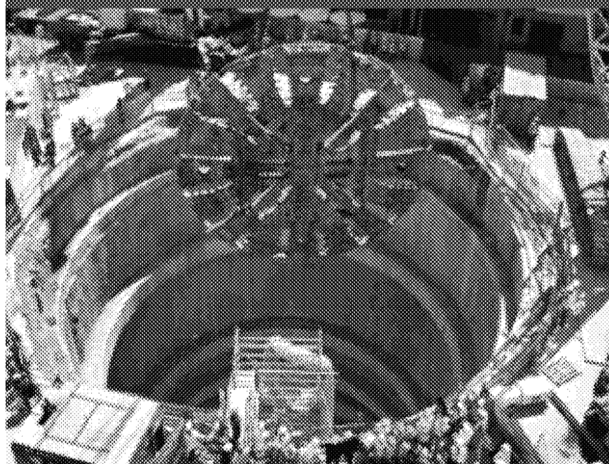

THANK YOU