OTTAWA LRT

VEHICLE AND TRAIN CONTROL

PREQUALIFICATION

MAIN SECTION

BDO0002215

ALSTOM

Table of contents

(ii) Executive Summary

We are confident in our ability to deliver an optimized system and services based on proven solutions that will meet or exceed the ORLT requirements.

We are proposing the service proven Citadis Dualis vehicle - a variant of the CITADIS LRT that has been sold to regional customers in France. The Dualis benefits from more than 15 years return of experience from the Citadis family product range. It complies totally with performance requirements for the ORLT project. Capable of running on multiple voltages such as 750V or 1500 V, the Citadis Dualis is adapted to a downtown circulator-type service as well as regional service on a segregated rail infrastructure. This vehicle meets European mainline standards for crash resistance. Equipped with high power compact motors, the train features a full low floor while being able to run at a speed of 100 km/h. The full low floor allows a great accessibility throughout the vehicle and reduces station infrastructures.

The specific environmental conditions encountered in Ottawa Specific have been carefully accounted for in our proposal. Based on our extensive experience in Northern Europe (regional trains, in Sweden, high speed trains in Finland and currently tramways in Russia) Alstom will adapt certain equipment in the Citadis Dualis in order to provide a safe, reliable vehicle meeting the required operational performances under Ottawa climatic conditions.

With a large experience of technology transfers in the world and in particular in North America, Alstom is confident in achieving the local content requirement of 25%. Procurement, assembly of trucks and traction drives, cabling and fitting of vehicles, testing, commissioning and warranty, will all be considered for localization in the frame of the OLRT project.

ALSTOM will seek to re-use the assets that will be invested locally for the OLRT project in the frame of other LRT developments in North America.

With regard to Train control, Alstom proposes its URBALIS solution for mass transit CBTC applications which is in service since 2003, the first application being the Singapore NEL. This solution has also been delivered to other transit systems in the world such as Santiago, Lausanne, Sao Paulo, Milano….
The URBALIS system is a radio-based CBTC based on a proven moving block principle. The solution is able to perform all ATC, Interlocking, TMS and maintenance functions required for automatic mass transit rail operation with Train Drivers or for Driverless operation.
The URBALIS principles enable to achieve the requested performances for Ottawa LRT in particular in terms of headway, RAMS and stopping accuracy. The URBALIS solution ensures the highest level of safety either with driver or driverless operation.
Also, its advanced and modular architecture enables it to achieve other important performance goals namely regarding expandability.

Last but not least, Maintenance has been considered at all stages of this proposal, with special emphasis on Life Cycle Cost, key criteria for the ORLT project. Alstom's extensive experience in Design Build Maintain projects will be used in the early stages of the project to ensure an effective design for maintenance. Indeed, maintenance and renovation is a core activity at Alstom, representing more than 20% of Alstom's transportation business. After 20 years in maintenance operations, working in close collaboration with rail operators of all types and in highly varied environments, Alstom provides the solutions that are best suited to the needs and requirements of customers in terms of availability levels and life cycle costs.
Since 1988, Alstom Train Life Services (TLS) activities have experienced significant growth. With 8,000 skilled and dedicated employees, we now maintain and renovate more than 7,000 railway vehicles produced by multiple manufacturers - including nearly 400 LRVs - at more than 40 industrial sites in 29 countries. A contributing factor in our success is our global expertise and knowledge in rolling stock maintenance, modernization, supply chain management, innovation, safety, quality and environmental standards.

ALSTOM

The Vehicle and Train Control prequalification package submitted by Alstom describes in detail how Alstom will make sure this strategic project will become a successful reference in North America.

(iii) Organization, Structure and Integration into Proponent's Team

A. Description of how the Vehicle and Train Control Key Individuals will function and integrate into the overall Proponent's team and organization.

Alstom is proposing to supply 2 lots under a subcontracting scheme: 1 for Vehicle and 1 for Train Control. Each lot has its own organization, which will be described below.

Please note that, should the 2 lots be awarded together, there will be only one contract governing the 2 lots then a Global Project Director will be assigned on the top of the two lot organizations in order to manage the whole scope.

The related maintenance will be performed under a separate contract. However, there will be Coordination between the Construction and the Maintenance at all stages of the Contract, from Design to Trial Run with coordinated Team mobilization, in order to ensure design to maintenance as well as proper maintenance activities launch. This is described in details Section vii – Maintenance Capability.

Below is a figure showing contractual relationship between Alstom Transport acting as subcontractor, and the RTP proponent. Details on how the Vehicle and the Train Control are integrated and interfaced are given in sections (iii)-B and C and (vii).

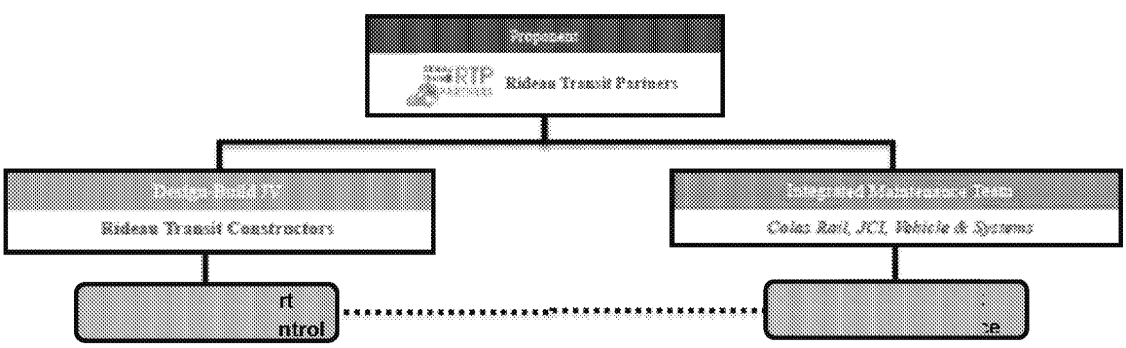
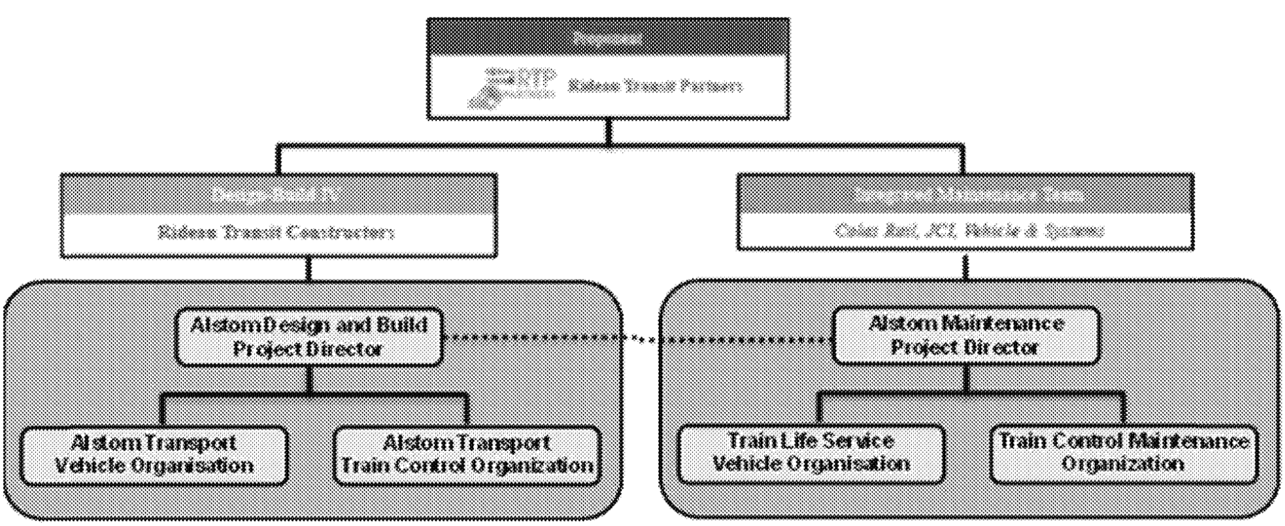


Figure 1: Case where either vehicle or Train Control is awarded to Alstom



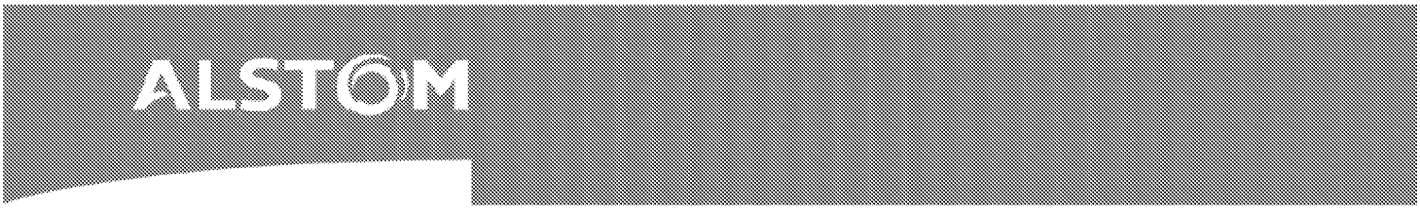
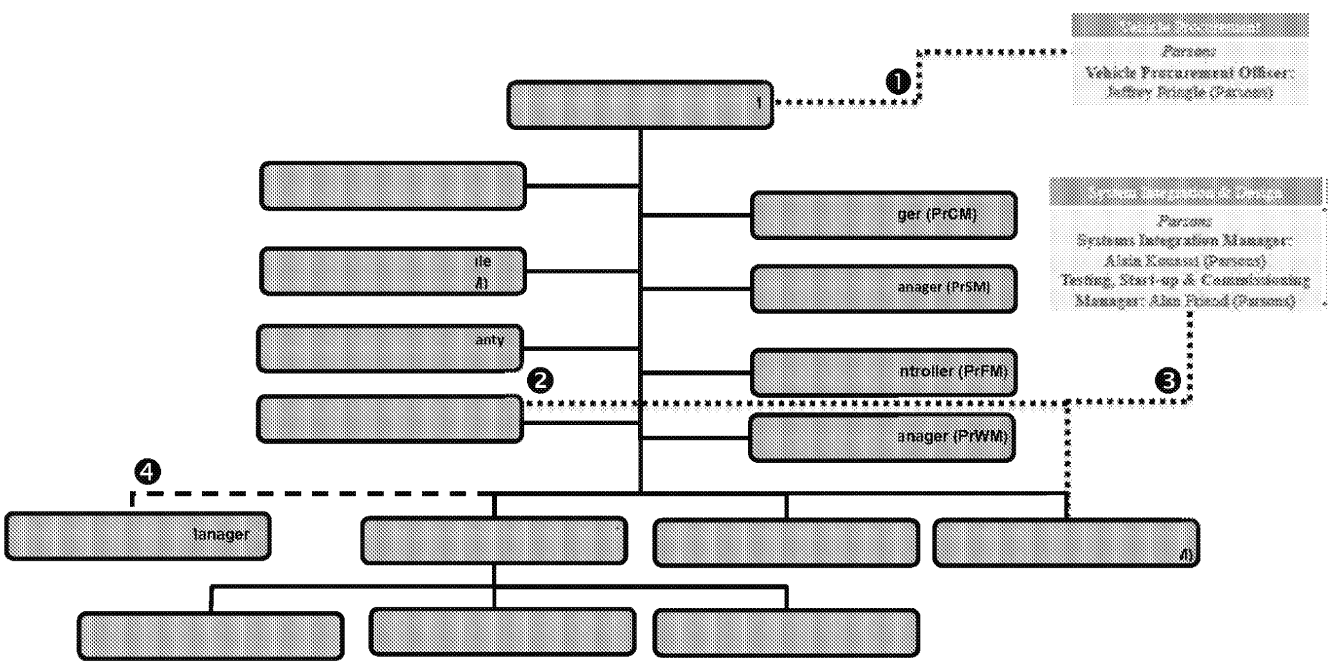


Figure 2: Case where vehicle and Train Control are awarded together to Alstom

Vehicle and Train Control organization in figures 1 and 2 are detailed below

Vehicle Organization Chart

ALSTOM will assign a dedicated Vehicle Management Structure. In line with the standard Project Management procedures of ALSTOM Transport, the Project organization will be the following, with a perspective on how it integrates with the overall RTP organization from a Design and Build standpoint. A special focus on maintenance will also be given below



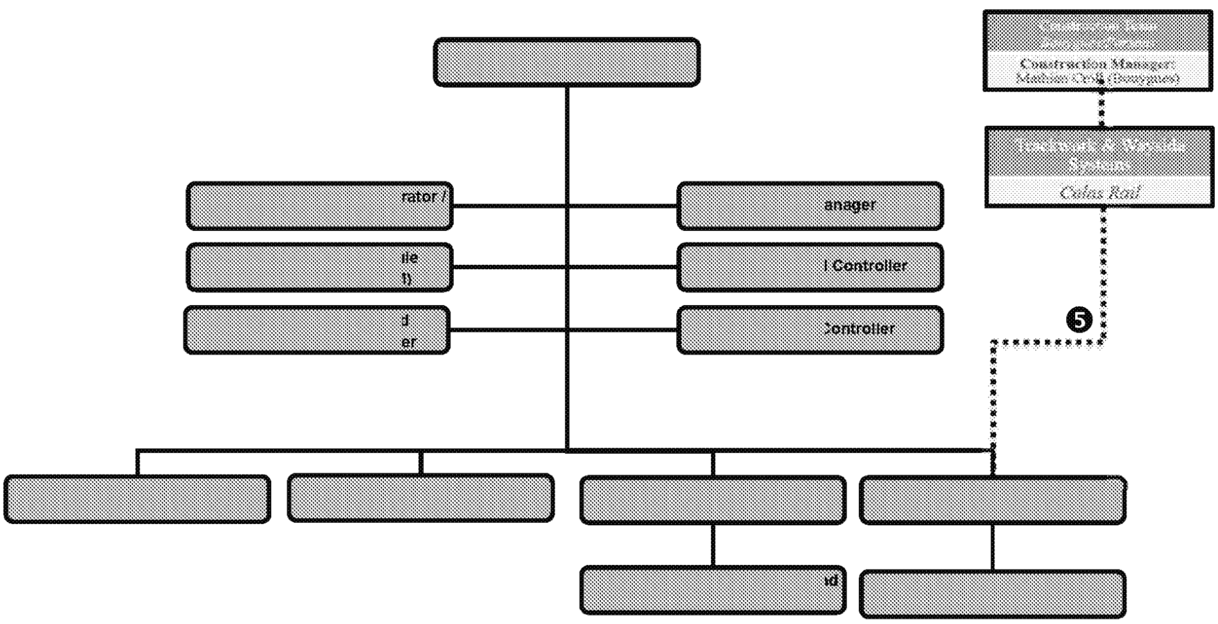
The primary contact point for this subcontract is the RTP Vehicle Procurement Officer, Jeffrey Pringle. In that position, M Pringle will manage all aspects of the subcontract.

As show in the figure above, the main interfaces are the following:

- ❶ - At Project Management level
  This is the main interface, allowing coordination in all aspects of the project: planning consolidation, contract performance and monitoring,
- ❷ - At design level
  The Vehicle Technical Manager. He coordinates Interface resolution, including interface with Civil Works (CW), such as Vehicle dynamic envelope to be taken into account for CW design. He has the authority, reporting to the Vehicle Project Manager, to address all design issues relative to the Vehicle and the related interfaces. He is a member of the RTP Design and Integration Team.
  In that position, he ensures Design coordination, including documentation, data such as energy needs, ECM…
- ❸ - At Test and Commissioning (T&C) level.
  The Vehicle is part of the overall T&C plan. For that purpose a T&C plan is issued by RTP with inputs from Alstom, in line with the Project schedule. Milestones for vehicle site delivery are for instance identified to ensure running proper sub-system testing before the final Commissioning.
- ❹ - At Maintenance level

Even if it is run under a separate contract, Maintenance is involved at early stages of the project and is part of the Alstom internal gate review. Goal is to anticipate Maintenance mobilization. This is part of Alstom standard Project Management process.

Train control Project Organization Chart



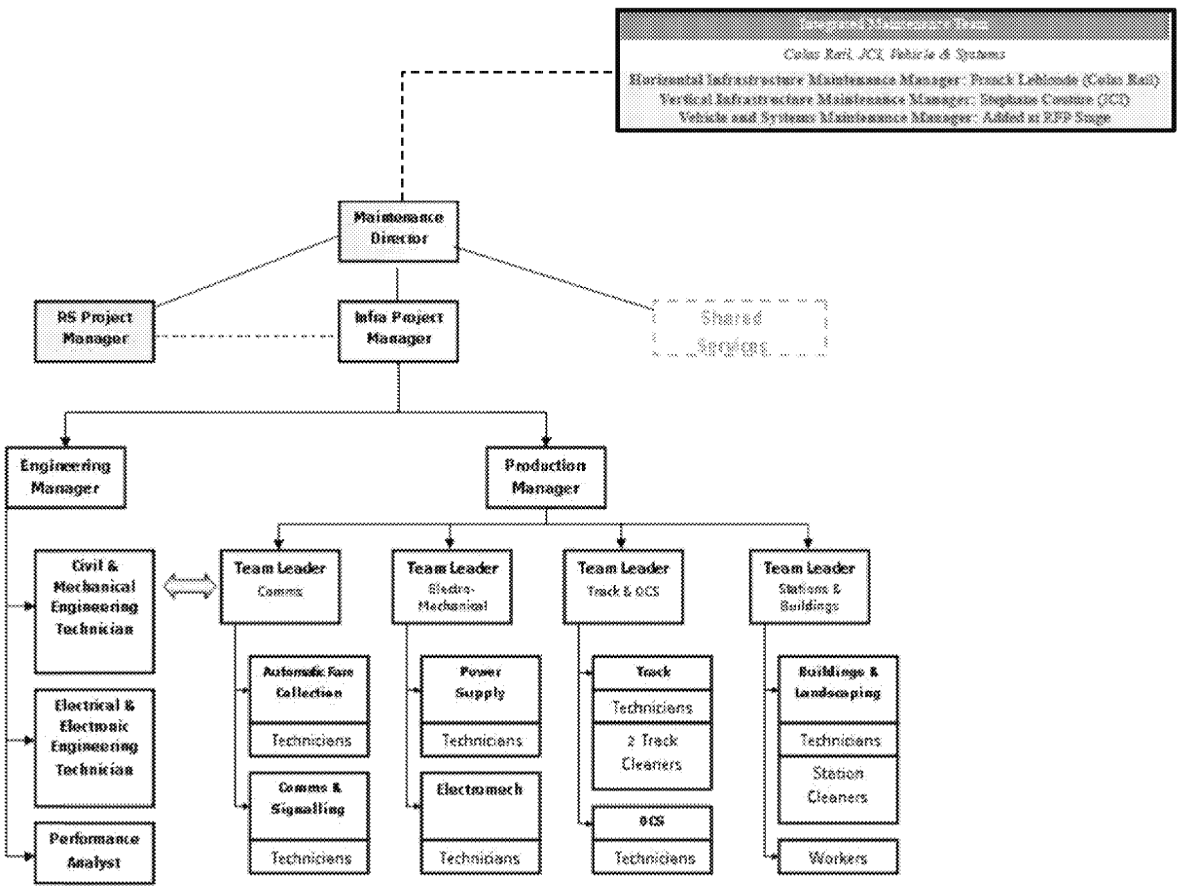
The same principles apply to the Train Control Scope (❶ to ❹ in Vehicle section above). In addition to the Interfaces described in the Vehicle section above, the only additional interface is the Installation of the wayside equipment where works coordination is n needed between, CW, Track, Catenary…

For that purpose, The Project Installation Manager ensures proper information coordination of works planning, supply, with the Track work and wayside System Construction Managers, this latter being part of the overall Construction team led by Mathieu CROL.

ALSTOM

Maintenance Organization Chart

The Maintenance of the Alstom Scope, whether it consist of Vehicle alone, Train Control alone or both together, is performed directly within the Integrated Maintenance Team. See figure below:



The maintenance organization is mobilized at the early stages of the design to ensure proper design to maintenance. Special care is given to interfaces. As the project enters into commissioning phase the maintenance team completes mobilization, and at Commercial service, takes full responsibility of the maintenance, with a handover period managed with the Vehicle Design and Build team.

More details are shown in Sections (iii)-B and C and (vii).

B. Details about the roles and responsibilities of the Vehicle and Train Control Key Individuals.

Vehicle

As Alstom will undertake an optimization in the selection of the most appropriate vehicle for the Ottawa project, and then supply this optimized vehicle, including design, construction, assembly, test and commission, and Quality assurance:

Responsibilities and Contributions on this Project

» He will be responsible for the successful planning and execution of the design, construction, assembly and test & commissioning of Alstom vehicles for the Ottawa project with respect to budget, delivery timelines, expected quality.
» Reporting to the Director of E&M Systems Integration he will organize and lead the Vehicle project team, identify roles, responsibilities and objectives to project team members and define interfaces.
» He will define, monitor and report project dashboard and key performance indications.
» He will define the project risk management plan and constantly review and update, vehicle project performance, identify risk and opportunities and follow up these with action to improve the project outcomes.
» He will have full responsibility for the vehicle within the project throughout its full life cycle and take necessary actions to improve the project process.
» He will control and manage relationships with relevant stakeholders and the customer (in relation to the vehicle.

Train Control

<u>Train Control Project Manager</u>
Reporting hierarchically to Alstom Transport Information Solutions Urban organization and operationally to the Customer Director, the Project Manager is the official interface between the customer and the Alstom organization. He/she is responsible for the whole project and manages the successful achievement of the project. He/she manages the project in conformity with the contract and with the ALSTOM procedures and rules. He/she is the primary contact with customer and partners for:

- Daily contact with customer's Project Management Team for project progress and related issues,
- Capturing the needs of the customer and make sure they are understood by the Alstom organization and management,
- Managing the day to day relationship with partners,
- Drives and makes decisions to ensure successful project execution (decides for resolving key issues within the project and ensures that all decisions are executed),
- Ensures project costs and deliveries objectives are met,
- Manages at project level all project reviews and gate reviews including organization and reporting,
- Defines, commits and implements the project safety policy,
- Ensures that Health and Safety ALSTOM requirements are fulfilled at all times and that Health & Safety is properly integrated,
- Provides leadership and manages the Project Core Team (establishes an effective and efficient Project Core Team and ensures that ways of working are applied to all project activities).

The Project Manager is based in Ottawa.

<u>Train Control Project Engineering Manager</u>

Reporting hierarchically to the URBALIS Engineering Director and operationally to the Project Manager, the Project Engineering Manager is the most senior technical manager and is responsible for overall technical definition and integration of the CBTC system in accordance with the requirements of the contract, including:

- Management of the engineering team, including the subsystem engineering managers,
- Capture of the customer technical requirement and production of the technical and functional specifications,
- Definition of the system architecture,
- Definition of the general performance for the System and ensuring its implementation,
- Management of the scope of work such that each Sub-System is interfaced with one another to ensure a fully integrated system which meets the performance requirements is delivered to the customer,
- Implementation of the methods and Engineering tools,
- Identification and management of technical risks in accordance with the Project Management process,
- Definition of internal and external interfaces until agreed and integrated within the respective designs,
- Management of the Configuration Management Process as far documentation is concerned and chaired the Configuration Control Board (CCB),
- Management of the operability of the System as well as the coordination for the Operation and Maintenance manual,
- Demonstration of the Contractual performance,
- Management of the "as-designed", "as-delivered" and "as-installed" configuration (software + hardware),Coordination with the Installation Manager to assure the proper installation of the system,
- Coordination with the Project Test & Commissioning Manager to assure the proper validation of the system.

The Project Engineering Manager will share his time between Ottawa and Paris Engineering back-office to ensure efficient coordination of the teams.

Maintenance

Responsibilities

- Financial responsibility :
  - Ensure the profitability of the Project,
  - Optimise the performance of the global system, so as to minimise the losses of availability/quality leading to penalties, and taking in account the costs of Maintenance,
  - Make sure the maintenance services are duly and on-time paid,
  - Check and validate the accountancy conducted by the Site controller.
- EHS responsibilities :
  - Make sure the staff can work safely, without harm to their health, and without harming other workers or people around,
  - Make sure the work done by the City Tramway Consortium is respectful for environment and that all kind of pollution, noise included, are minimised,
  - Check and validate the Quality plan, the Environmental Plan and the Health and Safety Plan proposed by the EHS manager. By the way, ensure that the City Tramway Consortium meets the requirements of ISO 9001:2000, ISO 14001, and Safety Processes and Practices meet the requirement of OSHAS 18001,
- Legal responsibilities :
  - Make sure City Tramway Consortium respects all the legal requirements, particularly concerning the work legislations,
  - Keep informed about any change of law which may affect the contract.
- Human Resources responsibility :
  - Manage all the team leaders and support staff, delegate tasks to appropriate competent people
  - Monitor and evaluate the performance of the management team, following City Tramway Consortium Guidelines,
  - Evaluate the needs for recruiting, and assist the HR Manager in the recruiting process
  - Lead implementation of organisational changes. Ensure the Organisational chart is kept up to date.
  - Develop and maintain constructive relationships with workers and staff representatives, with the help of the HR Manager.
- Customer relationships :

- Develop and maintain a robust and professional working relationship with customers and suppliers, with a view of ensuring both the continued viability and profitability of City Tramway Consortium.
- Lead the City Tramway Consortium team at monthly Customer Review Meetings.

- Other relationships :
  - Manage relations with local authorities

Manage 3rd parties relationships, preserving at all times the interests of City Tramway Consortium, and maintaining at all times the good image of City Tramway Consortium.

C. Update to the Proponent's team organization chart.

See above

(iv) Technical Submission Requirements

A. The technical submission requirements for the Vehicle and Train Control package shall follow the Technical Submission Requirements for Vehicle and Train Control outlined in Section 5.4 of Part 1 of Schedule 3 of this RFP, and all other additional information that may provide clarity and further detail of the Vehicle and Train Control.

Refer to Answer to Section 5.4 attached.

B. Description of how the Vehicle and Train Control package will be commissioned and placed into Revenue Service.

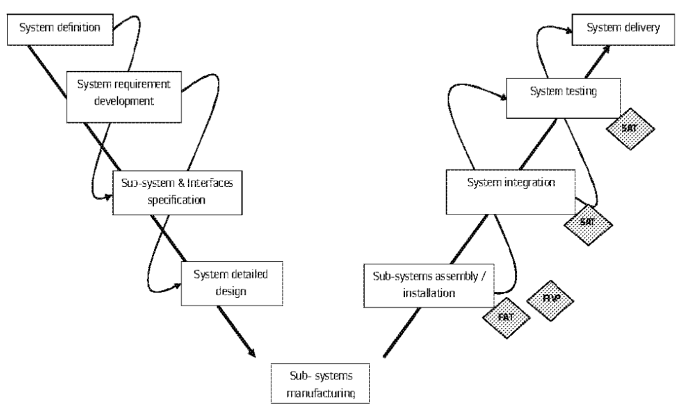
The Ottawa LRT is a Turn Key project. That means The EPC Test & Commissioning Team is responsible of the overall Testing and Commissioning of all the lots and their integration.

Under the Coordination of this T&C Team, Alstom will perform its T&C at sub-system level, but will also support the on-site system level T&C, giving inputs, dedicating T&C personnel throughout the whole T&C period including preparation prior to the T&C activities.

As a prominent turnkey rail system designer, ALSTOM has a proven capability to set-up design and validation process to successfully deliver public rail transportation systems.

Thanks to experienced experts, supported by a solid organization and strengthened by many successful projects, ALSTOM can guarantee the delivery to site of vehicles and train control systems in compliance with the RFP requirements.

The success of ALSTOM is based on its ability to master both the design and validation part of any sub-system development according to the "V" cycle diagram.



The development 'V' cycle diagram

The validation starts at factory level to ensure proper compliance of the equipment built with RFP requirement.

In addition to this equipment acceptance, Alstom has put in place an integration acceptance step of those equipment using FIVP. This is a key success factor of the validation process is the capability of ALSTOM to set-up Factory Integrated Validation Process (FIVP) ensuring the safe factory validation of about 70% of all equipment integration process prior to shipment (risk mitigation prior to shipment).

That reduction of validation and acceptance activities on-site is beneficial for the project overall schedule. For more details, please refer to chapter iv-A (Answers to schedule 3-1, section 5.4) where the Train Control T&C plan is detailed.

Test activities prior to commissioning:

Prior to the site commissioning, the vehicles and their equipment undergo production (routine) tests and qualification (type) tests.

The qualification activities are conducted following bottom up approach:

- Equipment type testing.

- Initial Integration and tuning testing
- Train level type testing on completed train.
- Train Static Type Testing
- Train Dynamic Type Testing

If a test has already been performed on a different project using the same equipment under the same conditions, a waiver can be requested and the previous test report will be made available.

Equipment and subassembly test are performed at the manufacturers 'facilities that can be an ALSTOM factory or an equipment supplier's factory.

All test on assembled vehicles and train consists are intended to be performed in Canada.

Similar activities applied to the control package (refer to chapter iv-A - Answers to schedule 3-1, section 5.4, where the Train Control T&C plan is detailed).

Commissioning of the vehicles and of the train control package

The vehicles are shipped from the assembly factory to the Ottawa LRT Maintenance and Storage Facility (MSF) where a dedicated ALSTOM T&C team takes them over. The ALSTOM team is composed of dedicated test and commissioning personnel assisted by the ALSTOM maintenance and warranty personnel assigned to the Ottawa LRT. Prior to their arrival on site, most people have taken part to the vehicle tests in the assembly factory. They can be supported, as required, by experts from ALSTOM component factories or equipment suppliers experts.

Their main tasks are:

- Re-couple the vehicles to form the train consists at the MSF.
- Run the train-consist static routine (production) tests at the MSF.
  - At that stage on board train control equipment are functionally checked if this has not been done already in the assembly factory.
- Perform the routine (production) dynamic tests on a section of track that is already built and that can be used safely to run the rolling stock. In particular, traction and brake performances are checked to ensure the train is safe to operate.
  - At that stage some dynamic vehicle / train control test can be performed if the section of track is equipped with beacons.

The rolling stock is then ready for the integration testing which purpose is to demonstrate that the various systems of the transit system operate satisfactorily.

Prior to running the vehicles all the subsystems, their interfaces and all the transfer functions must have been tested, the OCC powered on and the track gauge test completed.

In that respect the ALSTOM Signalling personnel install and the integration of all the trackside control equipment. They also test the interfaces and transfer functions with other systems.

Once all the foregoing I completed, the dynamic integration tests can then be performed under the responsibility of the JV T&C team of which ALSTOM is a part.

A test program agreed by all stakeholders lists all the commissioning activities.

The main dynamic commissioning activities for the vehicle and train control package are:

- Check Train Management Function (e.g.: check vehicle / control system identification)
- Control Train Movement
- Ensure Passenger Safety

- Operate a train Operation Timetable
- Regulate Train Traffic
- Check Performances

Specific tests are run to demonstrate that the safety requirements of the Ottawa LRT system are fulfilled either in normal or degraded mode (i.e. braking distances, running behaviour…).

All running train configurations are experimented, on both the depot tracks and the main line, either in normal or degraded service conditions.

In particular, Test procedures are run to demonstrate the operation of the signalling system in the conditions of absolute capacity and to demonstrate the operational performance of the rolling stock under worst case conditions. This why a **Running Test** consisting in simulating the line operation based on peak time "time tables" is performed. Such a test has usually a duration of 2 to 3 days.

Because the foregoing tests are directly related to the Line Operation, the teams in charge of operating the Ottawa LRT transit system is invited to attend them.

Placing into revenue service

The trial running starts after completion of the integrated tests, once all stakeholders have agreed that the system is safe and ready for operation.

That period corresponds to the progressive putting into operation of the integrated System. This activity is usually under the supervision of the Operator with the support of EPC Team.

The start of this period should also match the end of the training of the Operator staff, which means that the Operation Regulation and Standard Procedures have previously been completed and validated.

Under the responsibility of EPC Team, The ALSTOM commissioning team including the maintenance personnel is available on site to assist the operator during that period

The "rise to power" is carried out gradually to lead to the last phase which consists of the simulation of the revenue service of the line, with all trained manpower in place, without passenger.

All day-to-day operation conditions are to be met according to the timetables so as to assess the performance of the System.

In addition, evacuation exercises are led at different location (tunnel, station, open air), in liaison with the Ottawa city's Authorities (Fire Department, Police Department, the Health Services)

the Ottawa city's Authorities (Fire Department, Police Department, the Health Services)

Quality management and risk mitigation

- **Quality assurance**
  In order to support risk mitigation, ALSTOM has implemented a strong quality policy per the latest standards (ALSTOM Transport is certified ISO 9001)

  This ALSTOM quality plan is deployed in all phases of the project, from design to T&C to allow traceability and consistent open issues closing, as shown below:

- **Processing the anomalies**
  In the framework of the quality management, a failure or non-conformance of an equipment or material occurring at any test stage will be recorded, documented and reported by ALSTOM to the stakeholders.

Any failure or non-conformance (NC) is managed according to a specific NC Control Procedure. A Change Control Board (CCB) whose members come from design team, but also project management takes in charge the follow-up of the NC until it is resolved at which point it has the responsibility to close the issue. NC leadtime for closure and numbers are Key performance indicators used by the project manager to assess level of risk and put if need be additional/specific effort for closure.

- **Regression testing**

  The purpose of a regression test is to check that after a change of hardware or software configuration, the performance has not been degraded, putting project objectives in question. ALSTOM controls the test and records all the parameters, results, like with any other test.

- **Configuration management**

  Throughout the test process ALSTOM manages the configuration of every subsystem or system according to the project configuration management plan.

  Thus the technical description of every system or subsystem (vehicle, train control …) is known at any time and its evolution can be mastered.

A few references

This process has been implemented in many ALSTOM projects successfully delivered high capacity rail systems, including at least the vehicles and CBTC based train control packages similar to Ottawa requirements, among which:

Project	Type	In service
Singapore North-East Line	Driverless CBTC	June 2003
Lausanne m2	Driverless CBTC	October 2008
Singapore Circle Line	Driverless CBTC	May 2009

(v) Key Individuals and Experience

A. Description of three (3) previous projects illustrating where the Vehicle and Train Control package has been successfully implemented.

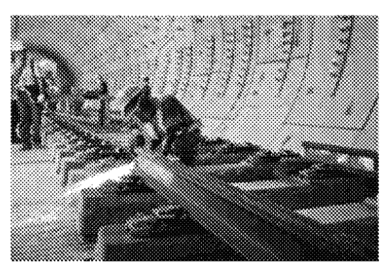
Train Control

Beijing L2 and Beijing Airport Link

These 2 lines were put in service for the Beijing Olympic Games in 2008, which was bringing a high level of visibility and pressure. The Urbalis CBTC Signalling System has been installed in 10 Bombardier Trains on BJ Airport Link and on more than 60 trains on BJL2 (12 of them old-type Chinese trains).
The operation of the new BJAL line is full driverless mode and the revamped BJL2 line is operated in ATO mode with driver. The same Urbalis CBTC Signaling system will be implemented for Ottawa LRT project.
Alstom's reputation in China was particularly enhanced as the Beijing customers « were very satisfied and relieved that the project objectives were met despite the very tight time schedules.

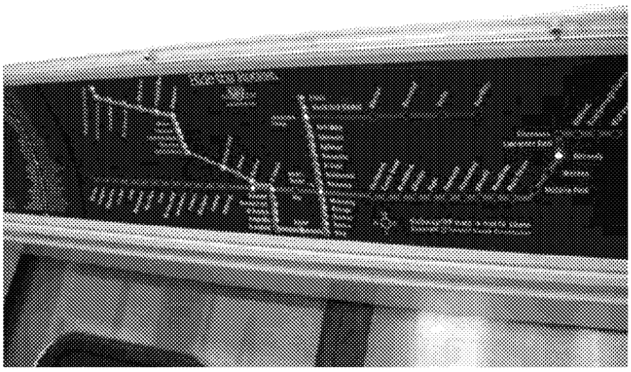
Singapore North-East Line (NEL) and Circle Line (CCL)

These 2 new lines were equipped with Urbalis driverless CBTC systems. NEL was the world's first driverless CBTC on a heavy metro line, in service since 2003, and CCL the longest line with driverless CBTC, in service since 2009. The system was installed on 40 trains for NEL and 46 for CCL, all of them Alstom Metropolis trains.



Toronto YUS CBTC Project

ALSTOM Urbalis CBTC system is currently in design and installation phase on the Toronto YUS revamping project. The first revenue service of this line is forecasted in 2013. ALSTOM Urbalis equipment is validated using AREMA Standards.
Toronto iVPI (Rochester Interlocking) will be installed for the 2nd part of the line (AREMA compatible).
Signaling equipment meets the standards for bungalow area (-40°C/+75°C) and station area (-25°C/+75°C). All ALSTOM equipment for Toronto could be installed in these 2 areas (winterization requirement).
It is worth noting that Alstom's VPI2 interlocking has been installed on the Sheppard Line, also in Toronto, to TTC's full satisfaction.

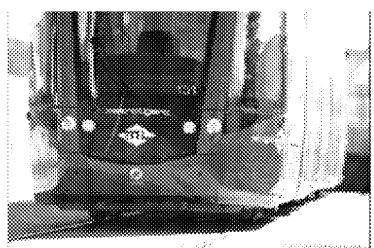
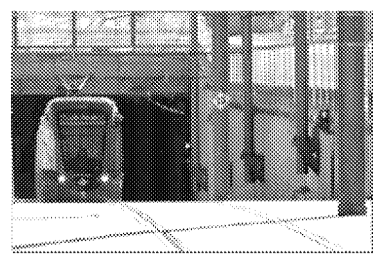



Madrid LRT L1

This line is in service since 2007.

Eight ALSTOM Citadis trains with URBALIS solution are running on this line. ATO is deployed in tunnel and a mixed traffic is in service outside the tunnel. This shows Alstom has a strong reference in this type of operation .

The operation of Ottawa LRT is similar to the Madrid tramway.

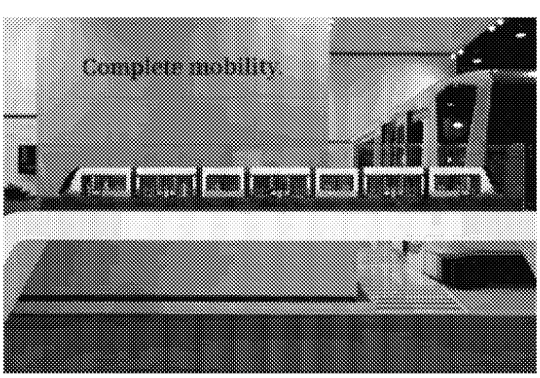




Dubai Al Safouh LRT

This new LRT line in Dubai is being equipped with the Urbalis CBTC system. All at grade stations will be equipped with platform screen doors (PSD), allowing the stations to be air-conditioned.

The passenger keeps then the same comfort whether waiting in the stations or sitting in the vehicle.

Moreover the line (elevated or at-grade) will also be equipped with the catenary-free APS technology (traction power system under the line). 25 Alstom Citadis LRT vehicles will be equipped. The line will enter revenue service in 2014



About winterization subject of Train Control Products, the reference datasheets of equipment installed outside are attached to this document to prove ALSTOM equipment can be installed in a winterized country:

- On-Board Beacon Antenna
- On-Board Odometer

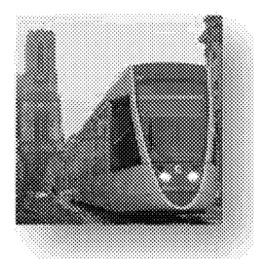
- Trackside Beacon
- On-Board DCS Antenna
- Trackside DCS Antenna and Trackside Modem Box
- Example of Trackside P80 point machine

All other equipment are installed in some protected areas (climatized rooms for trackside equipment, protected areas for on-board equipment)

Vehicle

<u>Nantes (France)</u>
The line is in service since June 2011
7 trains are already running on this line with a good feed-back from SNCF regarding the reliability and availability.
The train is a 4 cars train from CITADIS –DUALIS range powered by bi-voltage 25kV and 750V.
17 others trains will be produced soon in order to be put in commercial service in the Nantes suburb from late 2012.
Speed : 100 kph

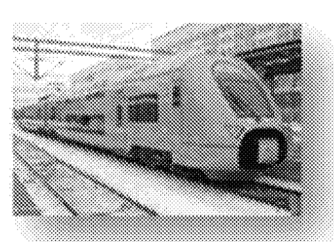
<u>Reims (France)</u>
The line is in service since October 2010
The contract is a turnkey contract.
Trackworks with Appitrack & Power supply with APS
Alstom was awarded the full system maintenance from start-up of operation (Trams & infrastructure)
Speed : 80 kph



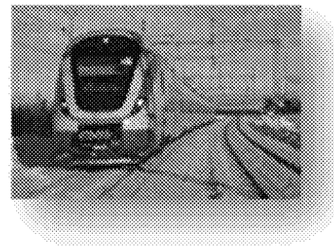
<u>Barcelone (Spain)</u>
The line is in service since April 2004
The contract is a turnkey contract.
Alstom was awarded the full system maintenance from start-up of operation (Trams & infrastructure)
Speed : 80 kph

<u>Winterisation return of experience</u>

SWEDEN
The line is in service since 2004
Range : Coradia Nordic type X40 qty of trains : 43
Speed : 160 kph



SWEDEN



The line is in service since 2002
Range : Coradia Nordic type X60 qty of trains : 71+12
Speed : 200 kph

NAM return of experience

US – New york

The 62 trains are in service since 2005
Steel wheels - Stainless steel carbodyshell
Speed : 68.5 kph

ALSTOM

B. Identify, and provide a brief experience summary, for each Key Individual identified below:

i- Train Control and Integration Manager

Project Manager Train Control and Integration (Hugues Mellerio)

- Nationality: French
- Age: 51
- Languages: French (mother tongue), English (fluent)
- Higher Education & Qualification: Electronics engineer, ESME SUDRIA, Paris
- Experience: 22 years (10 years in ALSTOM TRANSPORT)
    - Project Manager in Train Control (6 years, Beijing, Dehli, Bangalore)
    - Senior Bid Manager (4 years)

Project Engineering Manager Train Control and Integration (Jean-Marc Morin)

- Nationality: french
- Age: 53
- Languages: French (mother tongue), English (fluent)
- Higher Education & Qualification: Engineer degree in computer science from ENSEEIHT
- Experience: 29 years (10 years in ALSTOM TRANSPORT Information Solution)
    - Project Engineering Manager (10 years)

Project Engineering Manager Train Control and Integration (Didier De Hauteclocque)

- Nationality: French
- Age: 55
- Languages: French (mother tongue), English (fluent)
- Higher Education & Qualification: Electronics engineer, ESEO, France
- Experience: 31 years (22 years in ALSTOM TRANSPORT Information Solution)
    - Senior System Architect (2 years)
    - Project Technical Manager (3 years)
    - System Manager (3 years)
    - Chief System Designer (9 years)
    - ATS System Design Manager (5 years)

ii- Vehicle Maintenance Manager

on

ce

Brian Ealey 30 years' experience in the maintenance of rail vehicles including metro's Electrical Multiple Units (EMU) light rail vehicles and suburban diesel and multiple units (DMU). Maintenance management experience at all levels from multi-skilled technician thorough supervisory management and senior management.

Project management 10 years' experience in the project management for the introduction of new trains onto both new and existing infrastructure.

Vehicle maintenance management had the full responsibility for safety of the vehicle and the workforce. Full responsibility for the contracted vehicle availability and reliability. The direct management of the vehicle commissioning and warranty teams. Direct interface with customer project, railway operational and senior managers. The management of subcontractors for products and services.

Project management the full responsibility for starting up projects including the worksites, recruitment and employee training. The development of maintenance strategies including Reliability Centred Maintenance (RCM) and Condition Based Maintenance (CBM). Direct interface with customer project, railway operational and senior managers also customer and Alstom subcontractors.

iii- Vehicle Supply Lead

Mr. WURSTEISEN Train Control and Integration Manager

Mr. WURSTEISEN has had over 22 years of progressive and extensive experience managing the manufacturing, delivery, testing and commission, of major electric vehicle programs, including those for both LRT and subway (metro) systems, integration of CBTC train control on these vehicles. Among his many accomplishments he was formerly the Director of Traction Engineering at Alstom's Charleroi manufacturing facility, and the RAMs Engineering manager for the R160 vehicle program for New York City.

Tony Sanchez – project technical Manager - Alstom

Current activity:

With Alstom April 2005 to present:
Mr. Sanchez is currently the Engineering Director for the Rochester Rolling Stock group. His is responsible for the overall management, control and performance of the engineering department. His role includes all activities related to design, system qualification and engineering support to other departments such as sourcing, production, quality etc., resource management and budget/schedule performance on all RS engineering projects. Projects include Metros, Locos, Bi-level Coaches and Single Level Coaches. Mr. Sanchez joined Alstom in 2005 as a Project Engineering Manager for the R160 NYCT project.

Previous to Alstom:
Siemens Transportation Systems Inc. – Sacramento CA, 2000 – 2005: Engineering Project Manager for Houston, San Diego and Charlotte S70 LRV projects as well as system engineer for various LRV projects with an emphasis on systems integration of rail vehicle on-board systems.
Union Carriage and Wagon Co, Nigel South Africa 1994 – 2000: Electrical Design Engineer. Responsible for all aspects of electrical and electronic design for local and international rail projects (locomotives, electrical multiple units, metro cars and coaches).

Other Experience:
Mr. Sanchez worked as Electrical engineer on various South African Coal and Gold mines after graduating in 1989 to 1994, where he was involved in various activities from new projects involving high voltage power distribution and protection to maintenance of the electrical equipment.

(vi) Maintenance Capability

A. Describe how the Vehicle and Train Control maintenance team, and its members, will integrate and coordinate with other maintenance and rehabilitation activities.

The ALSTOM Transport (Alstom) Vehicle/Train Control Maintenance Team will be integrated into the Light Rail Transportation System (LRT) Project during its design phase and will become increasingly more implicated into the LRT System operations and into the integration of its maintenance and rehabilitation requirements with the City's Operational Units and other on-site maintenance teams during the life of the Project

- **Vehicle/Train Control Maintenance**

The Vehicle and Train Control Maintenance Team will be combined under one "Maintenance" organisation. This Maintenance Organization, under the direction of by an Alstom Maintenance Director, will be responsible for the Alstom scope of supply to the City. Maintenance will be supported by a dedicated, combined Alstom vehicle and train control engineering team under the direction of an Alstom Engineering Manager.

Fleet management will be a key element in the role of the Maintenance Organization. The Vehicle Maintenance Team will interface daily with the vehicle Operator at both the start and end of shifts. The Train Control Maintenance Team will be available at all times to support the City's Operational Units but will not normally have contact with the operator, apart from when applying for access to the lines.

Both the vehicle and train control systems will be monitored via remote diagnosis through data and system download analysis designed to best suit the City's Operational requirements. Maintenance Technicians will perform fault finding and fault rectification processes and procedures to the vehicles and the train control systems and will perform all Project specific preventive maintenance and inspection requirements. When required, these same Maintenance Technicians will perform all required line replaceable unit exchange on both vehicle and train control equipment. .

Line Support Technicians will support the activities of the Maintenance Technicians and will respond to both vehicle and the train control system defects. Both the Line Support Technicians and the Maintenance Technicians will be key members of an emergency response team responsible for conducting repairs to trackside train control equipment and, when required, re-railing of vehicles.

The Maintenance Organization will have a single procurement and warehousing system which will use the same Maintenance Management Information System (MMIS) to control and manage maintenance requirements for the vehicle and train control systems.

- **Critical interfaces**

System Maintenance will be delivered to the City in a seamless fashion through critical interfaces between the Alstom Maintenance Organization and other on-site Maintenance Teams

Joint Safety Committee

The Joint Safety Committee will perform a pivotal role in managing the safety of the City's Tramway System. The Committee will consist of permanent representatives from the Operator, Infrastructure maintainer (including Train Control Maintainer and Civil Works Maintainer), Rolling Stock Maintainer, Safety Representatives from the various on-site Trade Unions and the Railway Safety Authority. Representatives of the Emergency Services and of the Utility Services providers will be invited to participate as active members of the Committee when appropriate.

The Joint Safety Committee will accept or reject proposals for:-

- Organisational changes
- Equipment changes (other than like-for-like replacements)
- Changes to the General Maintenance Plan
- Operational and Engineering Rule changes
- Changes to the Response and Recovery Plan
- Other changes to the Safety Case

Decisions of the Joint Safety Committee will be based on the agreement of four out of the five representatives. However, the Railway Safety Authority representative will have the right to veto all decisions which are deemed to be unsafe.

Operator Interfaces

The Maintenance Organization and the Operator will co-operate at all times to achieve a safe and reliable tram service for the travelling public. The Operator must allow the Maintenance Organization as much access as possible to the LRT System and the Maintainer must use best endeavours to carry out his work without interference with the revenue service.

In order to maintain and to ensure the highest level of safety, the interface between the Operator and the Maintenance Organization must be managed closely through a meeting structure ranging from daily tram operating meetings, weekly engineering meetings, monthly progress meetings and six month staff liaison meetings. The activities of both parties must be carried out in accordance with strict Operating and Engineering Rules established under the guidance of the Alstom Maintenance Director and designed to minimise conflicts and prevent service disruption to the public.

Rolling Stock Maintainer Interfaces

The Rolling Stock physically interfaces with the Infrastructure at track, pantograph, third rail, signalling and communications levels. To ensure optimum reliability and performance at these interfaces, the maintainers of both the Rolling Stock and of the Infrastructure must establish a superb working relationship. This physical interface will be managed formally by the Alstom Engineering Manager but informal contact will occur at all levels of operations.

City Tramway Authority Interfaces

The Alstom Maintenance Organization will liaise with the City Tramway Authority via the Operator.

The Alstom Maintenance Organization will be support this interface by collecting data requested by the City and reporting it on time and in the required format. The Alstom Maintenance Organization must allow the City free access to the LRT System when requested, subject to compliance with safety regulations.

Railway Safety Authority Interfaces

At a formal level, the Alstom Maintenance Organization will liaise with the Railway Safety Authority via the Operator. While the Operator is ultimately responsible to ensure the safe operations of the LRT System, the Alstom Maintenance Organization together with all other members of the Joint Safety Committee will be responsible to the Railway Safety Authority to ensure all staff complies with all safety requirements. The Railway Safety Authority will have a permanent seat at Joint Safety Committee, has the right to inspect all aspects of the City's LRT System operations, has the right to speak with any member of staff at any time, without notice and has the right to veto all decisions of the Joint safety Committee which are deemed to be unsafe.

Third Parties affected by Maintenance Activities

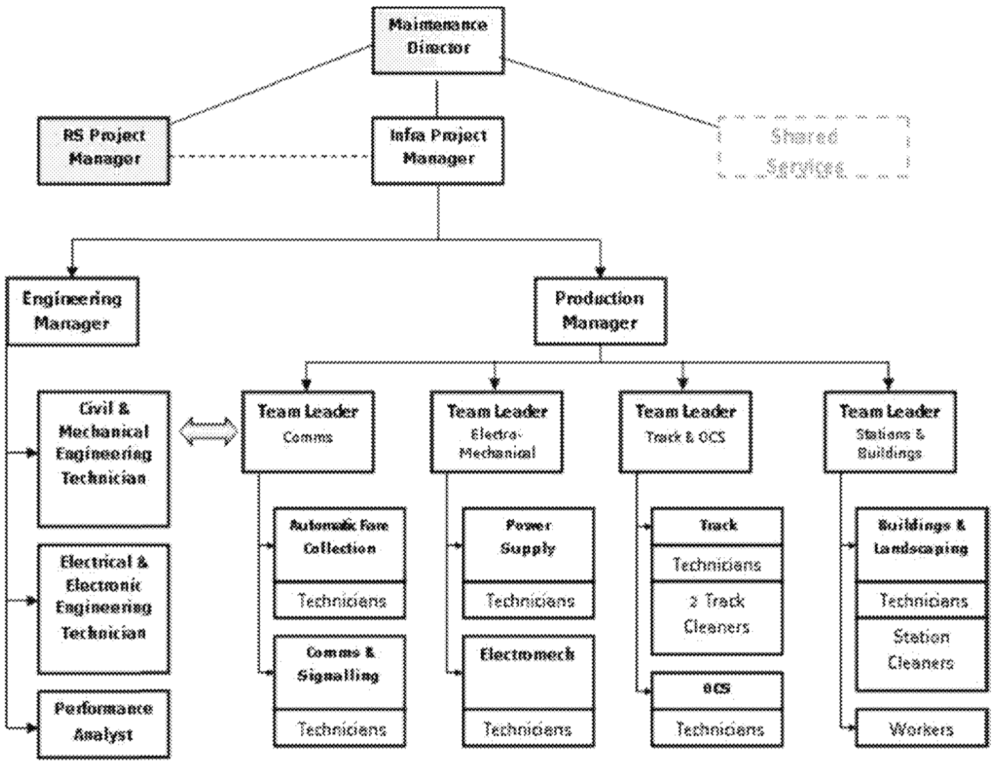
The Operator will be responsible for liaising with people affected, or likely to be affected by maintenance activities. The Alstom Maintenance Organization must inform the Operator at least four weeks prior to the start of any activity likely to affect the occupants of local premises to permit adequate notices of pending work to be issued to both local residents and to the local environmental health department of the proposed work.

The Operator will be responsible to receive messages from Third parties and to manage complaints from the public concerning service provided by the Operator. The Alstom Maintenance Organization will support the Operator in this activity, by providing written responses to the public on behalf of the Operator and by implementing any actions as may be necessary to alleviate identified problems.

- **Maintenance organisation**

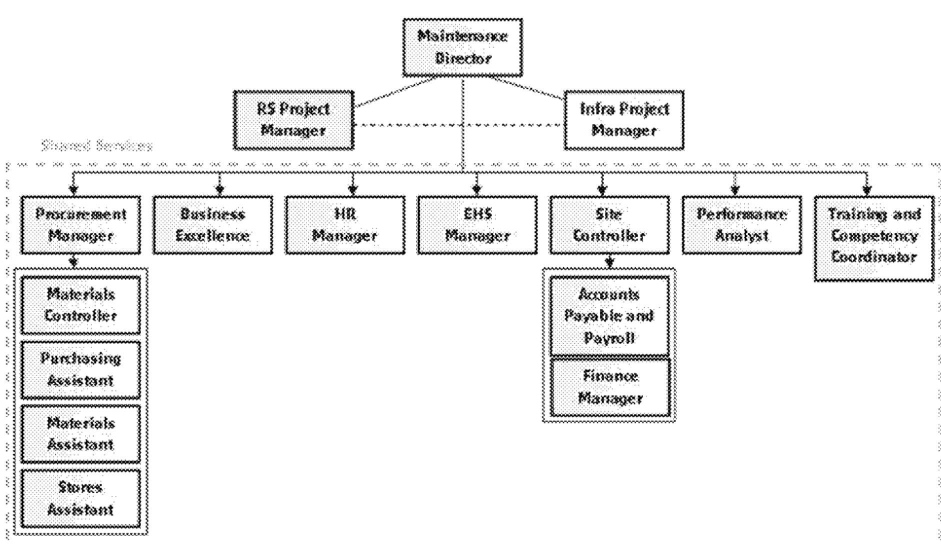
Alstom has experience in maintenance operations of LRT Systems under many different contractual structures and with many different scopes (reference §C herein). is the role of the Alstom Maintenance Director is to ensure that all the interfaces among the different stakeholders (maintenance teams, operators, non-maintenance parties, etc.) are established and maintained in an efficient manner for all the sub-systems and for all the interfaces for the benefit of the City.

The key individuals proposed to lead the maintenance and rehabilitation management under the direction of the Alstom Maintenance Director are presented pictorially in the following LRT System chart:



Alstom will manage the maintenance of the LRT System through a series of activities and controlled/monitored through reports and weekly and monthly meetings. All the key Project members, covering all sub-systems and services will participate in these meetings. The key outputs of these meetings are plans of activities (coordinated with the Operator), previous month workload analysis, specific training needs and plans, shifts planning, resources planning, among others.

Work activity leaders, the Quality, Environment and Planning leaders, the Alstom Maintenance Director the Alstom Engineering Manager, and the Operator's representative will attend the weekly and daily Maintenance Activity Plan meetings. The key outputs for these meetings are analysis of work requests, prioritizing the work, analysing the safety and environmental condition for the working teams, issuing/confirming safety instructions, establishing responsibilities for ensuring the availability of special apparel, assignment of the maintenance work, duration of the work, etc.



Responsibilities for the "Shared Services" identified in the LRT System chart will be managed by the maintainer of each subsystem. Some are more critical to the short term operations than others (e.g. material management and payroll).

However the Alstom experience has demonstrated that all of these Shared Services must be managed efficiently in order to deliver a high performance maintenance organisation and that significant synergies can be achieved if the number of maintenance organisations is limited. In addition the number of suppliers will be kept to a minimum as the Alstom experience has demonstrated that fragmented suppliers with small scopes of supply are unlikely to accept the levels of performance being required of the Alstom Maintenance Director and therefore represent a significant technical risk to manage. This solution is a trade-off between the level of redundant non-productive costs with many small suppliers and the acceptable risk for the Alstom Maintenance Director and his organisation to deliver a system performance.

ALSTOM

B. Describe the implementation strategies

Training of the Operator by the Constructor for Operation and Maintenance

Objective of the O&M Support Services during final testing

The objective of the Alstom training process is to ensure that all personnel required to operate and maintain the railway system are able to perform all the operation and maintenance tasks related to the different subsystems and equipment necessary for the functioning of railway system efficiently and safely.

To achieve this objective, the primary focus of the Alstom Training Program is a number of underlying principles based on our past experiences during the execution of a number of similar projects. These principles include:

- competencies of our staff tailored to the specific project requirements;
- demanding excellence in promoting the delivery of customer service;
- maximising use of Alstom capabilities and resources;
- capitalising on all aspects of the design, testing, commissioning and trial operation phases as hands-on learning experiences for the operator's staff;
- providing multi-disciplined resources to ensure a well-rounded training of the operator's staff;
- developing a team of customer-focussed, true professionals on the operator's team

Operations and maintenance training outlined herein includes Train Control equipment which will be a critical part of any operations training and will need to be incorporated into the other operations sub systems (AVLS, OCC, SCADA, Coms etc.) whether or not such are included in the Alstom responsibility and scope.

General Design of the Training Services

Type of Training

The training principle adopted by Alstom is that of a "step-by-step training" cascaded approach in 2 cycles.

In general, Alstom expert trainers train key members of the operations staff to prepare them for revenue service requirements. These key staff members then deliver the same training courses to other staff before the commencement of revenue service. The final stage of this initial transfer of competency is to be carried out during the "Trial Running" period during which the level of "know how" of the operations staff must be clearly demonstrated.

Not all participants in the training programs are assured a pass. Trainees who fail to demonstrate acceptable operational knowledge at the end of the training program are not qualified as properly trained employees. There is however some flexibility allowed in order to minimize the training cost for the operator. In certain cases, if there are positive potentials identified in the trainee's profile and overall delivery during the training, the trainers may recommend additional training days to reinforce the training of those trainees who have failed the initial program but who may benefit from the additional training period and additional assessment.

Cycle 1 "Training of the Key Instructors"

This cycle will consist of training given by Alstom to a group of 10 City and/or Operator trainees who will become Key Instructors. The attendees will be dependent on the timing of the training program and employee availability.

This training will include but not be limited to the technical knowledge (utilization and operating instructions) of the system and its subsystems and will encompass the operation method of the specific railway system.

Two main training groups will be considered -

- Key instructors for the operation of the railway system
- Key instructors for the maintenance of the railway system

To optimize the training of the two groups of "key instructors", Alstom will divide the Cycle 1 training into four stages:

- Stage 1 : Common Trunk for Maintenance and Operation (General knowledge of system and sub-system of the LRT System)

  "Common Trunk" targets the two groups of future "key Instructors" (maintenance and operation). The general knowledge of the system and of each sub-system is of key importance in this stage. The training will allow the future "key Instructors" to acquire a global vision of the equipment and general features of the railway system on which they are going to work on. Furthermore this will allow them to more easily integrate the specific knowledge related to their jobs and to understand with more clarity the various relationships between each piece of equipment and the different skill sets employed across the railway system. Stage 1 will also encompass the training related to safety rules such as, walking on tracks, electric danger, track possession procedures, fire safety, etc.

- Stage 2 : Training in the “use of the systems and equipment” (Systems Familiarization)

  The stage 2 targets employees who will be responsible for driving the rolling stock, for operating the railway system from within the OCC and/or for intervening for operation purposes on site.

  This stage will focus on:
  - General description of the entire system
  - Description of the sub-systems
  - Training in driving under both normal and downgraded conditions to ensure familiarity with the various sub-systems
  - Training in the “use of equipment” interfacing with the operating system (key points, safety devices, traction apparatus, signalling, etc.)
  - Training in the “use of all equipment” of the entire main transport system and sub-systems

  Familiarization of the various systems and sub-systems for the trainees will be through these “hands-on/full-use” training sessions which will include both theoretical and practical sessions. During the practical sessions, the trainees will have the opportunity to visualize the complete range of control and monitoring systems, wherever they are located in tunnels, in the yard and/or within the OCC.

  Trainees will operate and control the systems themselves, and will be placed in situations equivalent to those they will meet in their professional activities thereby ensuring familiarization with the systems and their behavior.

- Stage 3 : Training of the Job of Operator

  Stage 3 Training focusses on the “Job of Operator” for normal modes of operation as well as for degraded and/or emergency modes of operation. Throughout the training, the railway system regulation will be used to support the courses and training drills so that the trainees will immediately become familiar with the strict operation and philosophy of the applicable regulations. The Training is structure to cover:
  - Organizational aspects of operations and the various jobs involved,
  - Jobs within the operation,
  - Operation philosophies and strategies,
  - Operation principles and Regulation,
  - Operation scenarios and procedures,

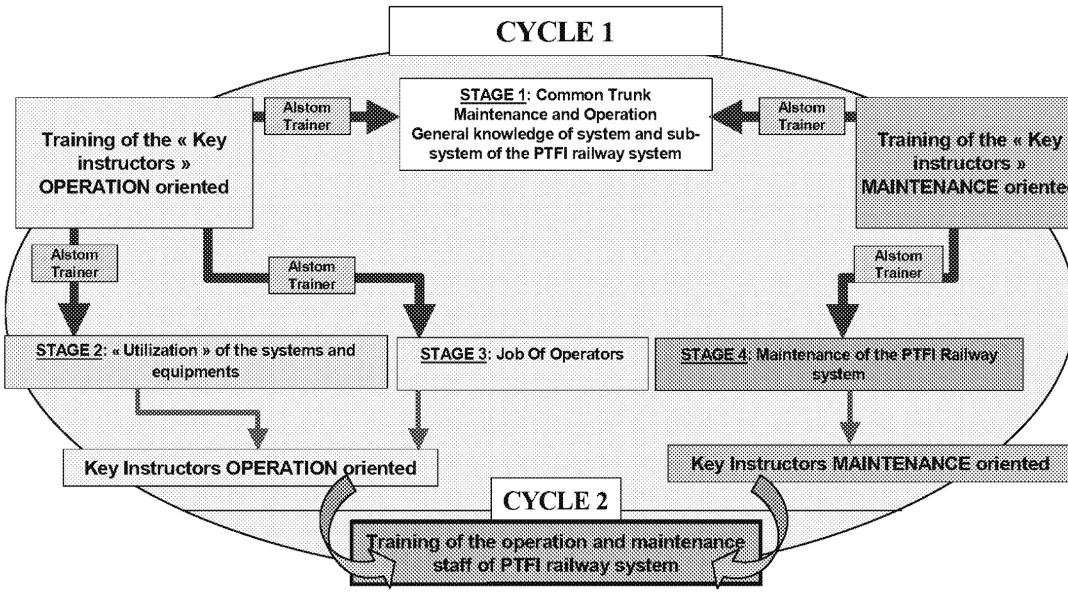
- Stage 4: Training for Maintenance of the Railway System

  Stage 4 Training focusses on the trainers of future maintenance operators. Stage 4 is designed around 3 main principles:
  - Training in mechanical maintenance of systems, sub-systems and equipment
  - Training in electrical maintenance of systems, sub-systems and equipment,
  - When applicable, training in computer maintenance (use, administration and management) of systems, sub-systems and equipment.

  Stage 4 uses description and presentations as wells as “hands-on use” of each of the modules before starting the maintenance itself. In addition to maintenance training, this Stage ensure hands-on use of all sub-systems to ensure that maintenance personnel are properly trained in the event that the trainee must intervene in the operation of a sub-system

Cycle 2 “Training of the operation and maintenance staff of the railway system”

Cycle 2 training will be given by the Key Instructors (previously trained by Alstom in Cycle 1) to create teams to operate and to maintain and to operate the railway system. This training for all operating and maintenance personnel will be completed in time to allow Key instructors to finalize their courses and other training materials and to train the relevant number of both operation and maintenance staff needed before the commencement of the commissioning stage of the LRT System



Mobilisation of the Alstom Maintenance Organisation

Mobilization for a maintenance project will vary from one project to another. Irrespective of the scheduling, the Alstom Maintenance Organisation must be involved in the Project as early as possible. Where construction is involved, Alstom Maintenance Engineering will monitor the Project from the early stages of design to ensure that maintenance needs are designed and constructed into the project. Only as construction comes to an end, will the Alstom Maintenance Director be appointed.

The Alstom Maintenance Engineer, the first person to arrive on site, will establish required Alstom office facilities and begin the process of preparing Alstom Maintenance Organisation's accommodation for the arrival of the remainder of the workforce, spares and equipment as well as the preparation of the depot building. Assistance will be provided by the shared services representatives from Finance, Procurement, Buildings Managers as and when appointed to the Project Team.

Recruiting Process

There will be several phases of Recruitment depending on the project. These phases are broadly as follows:-

- Preparatory phase

During this phase the Alstom Engineering Manager will be appointed. The role of the Alstom Engineering Manager will be to influence the design and construction process to ensure optimum maintainability of the LRT System. As the project moves from the design phase to the construction phase, the Alstom Engineering Manager will become more involved and work more and more on site. Towards the end of construction, the Alstom Maintenance Director will be appointed and the mobilisation phase will begin.

- Mobilisation phase

The Alstom Engineering Manager and the Alstom Maintenance Director will confirm the organisation they need to recruit and start the process by appointing an Alstom Human Resources Manager. These three will have considerable experience in their fields and of the internal processes applicable to the required teams for the organisation for LRT System Maintenance Projects. These individuals will be recruited internally from within Alstom and/or associate companies and may well be expatriates to Canada and/or staff seconded from other established projects.

The remainder of the Alstom Management Team will be recruited in accordance with the previous mobilisation experience which they have prior to the start of the maintenance phase of this LRT System Project. The Finance and Procurement

Managers will be recruited/appointed next followed by the Quality Manager and HSE Advisor. The Production Managers will be appointed thereafter.

Alstom Management support staff will be appointed in a similar order to the managers. These individuals will prepare for the appointment of the main workforce who will start to arrive from approximately three months prior to the start of the maintenance of the LRT System. A significant portion of this workforce will be taken from the commissioning and testing teams from previous projects which will have had previous hands-on experience with the system design and operation.

Training Process

The training will follow the same methodology as described above. The trainees for the initial training program during the Mobilization Phase will be members of the Alstom Maintenance Organization.

Documentation Production

Key Documents required to be produced during the Mobilisation Phase include:-

- General Maintenance Plan
- Annual Maintenance Plan
- Method Statements
- Risk Assessments
- Safety Policy Statement
- Health & Safety Plan
- Environmental Management Plan
- Quality Plan

In addition to the existing models at the Alstom Engineering Manager's disposal, the Alstom Engineering Manager will ensure that the documentation that is supplied is the most suitable to the LRT System project. This may include site visits to operations with similar parameters and constraints in order to benefit from the all available return of experience – in particular with local enterprises that would share the same environmental issues.

Receipt of Initial Spares and Maintenance Equipment

- Initial Spares

A stock of Initial Spares will be supplied by the Alstom Construction Organisation. These spares will consist of at least 6 months supply of consumables and replacements for small parts likely to need replacement from time to time as a result of incidents and failures.

It will be the responsibility of the Alstom Procurement Manager to ensure the parts are accurately logged into the stores as they arrive and stored in appropriate storage conditions to ensure they remain fit for use when required.

- Maintenance Machines and Tools

Major Maintenance Machines and Tools required specifically to maintain particular assets of the LRT System will be supplied by the City Authority as per specifications provided by Alstom. Special tools may be provided direct from the asset supplier but general purpose machines may be supplied by appropriate specialist equipment manufacturers.

ALSTOM

C. The Proponent must articulate and demonstrate how prior experiences and/or lessons learned on high capacity rail systems will be implemented for this Project.

Maintenance and Rehabilitation is a core activity for Alstom. This represents approximately 30% of its business through a dedicated organisation. This structure is complemented by a comprehensive system and set of processes for monitoring all aspects of every project's experience in all areas from product design and production, installation, commissioning and maintenance. Every process is studied, reviewed and compared on a regular basis to assure constant excellence and improvement in customer service. In this manner, maintenance processes are adapted and changed for the specific requirements of the project in hand – as for winterisation in very cold climatic conditions.

Alstom tools and processes for improved asset management

Alstom has developed integrated tools and systems that greatly improve asset management to ensure end of life hand-back standards are achieved. Some examples are:

- Alstom Safety Management System (SMS)
- Design for Quality (DFQ) the process for ensuring the quality of design
- Design for maintainability (DFM) the process for continually improving the maintainability of vehicles and products.
- Alstom Production System (APSYS) the tools used to develop and implement the best processes in build, installation and maintenance
- Products designed for maintainability (DFM) based on the return of experience from Alstom and customer maintenance organizations continually fed back to the product builder
- Condition Based Monitoring (CBM) systems, such as Traintracer, enable the service provider to determine wear levels on main components and sub-systems;
- E-documentation which links the maintainers via a web page to field operators
- e-Catalogue links Maintainers to their specific project's parts inventory to enable faster on-line ordering to occur

Alstom Experience at Maintaining Asset Value during the Contract Duration

Overhauls and Handover

With long maintenance contracts there is a requirement to address significant capital expenditure programmes during the course of the contract as well as operational expenditure on preventive and corrective maintenance. These investments will be in the form of overhauls of major subsystems or complete systems that will ensure continued performance for a significant period of time. At that time, the City may wish to benefit from the opportunity to possibly upgrade the equipment to provide higher performances and/or to rehabilitate in kind. Such decisions will be made during open discussions between the City and Alstom to best benefit the City. Whichever solution were to be selected, this to-be-agreed work would not be considered as part of the asset management programme.

For the Ottawa LRT System, the asset management at the end of the contract will be measured against a number of indicators during 3 major inspections, one of which will be the Remaining Design Life of principle System Elements. In addition, overhauls of systems and sub-systems will be planned to allow at least 10 years of operational life after the Handover of the LRT System without the complete system element needing replacement. This will be most critical for the elements that include sub-systems with the shortest product life expectancy (e.g. - IT, Telecoms, etc.) which will therefore need to be planned during the closing years of the contract. Obsolescence will also need to be taken into account in the lead up to the Handover of the LRT System with a decision to stock or replace any components that may be at risk after the end of the contract.

Alstom has delivered maintenance services to many world-wide Transit Agencies and Operators as noted in the following table. Alstom has responded to end of life and obsolescence issues on infrastructure and rolling stock equipment. Alstom has sound experience in producing renewal plans for all its products and hand-back condition reports in the case of projects that have already been completed.

Project	*Km*	*End*	*Track*	*Power Supply*	*OCL*	*Signalling Telecom*	*Station Utilities*	*Depot*	*Rolling Stock*
Reims Tramway Line 1	11.5	2036	✓	✓	✓	✓	✓	✓	✓
Jerusalem Tramway Line 1	14	2032	✓	✓	✓	✓	✓	✓	✓
Barcelona Trambesus / Trambaix	30	2029	✓	✓	✓	✓	✓	✓	✓
Algiers Tramway Line 1	16.3	2016	✓	✓	✓	✓	✓	✓	✓
Dublin Tramwy Lin 1 & 2	40	2014	✓	✓	✓	✓	✓	✓	✓
Bordeaux Tramway Lines	5	2013		✓					✓
Merval Suburban Line	43	2012		✓		✓			
Athens Suburban Line	110	2012			✓	✓	✓		
Madrid Barcelona High Speed Line		2009		✓					
Cairo Metro Line 1 & 2	61	2008		✓		✓	✓		✓
Brasilia Metro Line	40	2007	✓	✓	✓	✓	✓	✓	✓
Cairo Alexendria Main Line		2007				✓	✓		
Paris Suburban Lines A & B	208	2005				✓			

Other long term Alstom service contracts include:

- Parla Tram: over 38 years of operation (complete system)
- Valenciennes tramway: 15 years of operation (Rolling Stock)
- London Underground: 25 years of operation (Rolling Stock)
- Valparaiso Metro: 30 years of operation (Rolling Stock),
- Italy NTV VHST: 30 years of operation (Rolling Stock)
- Bucharest Metrorex: 15 years of operation (Rolling Stock)

Alstom's return of experience can be further demonstrated through 2 processes that have been developed to optimise maintenance at Alstom.

Alstom LIFE CYCLE COSTING MODEL (LCC)

The life cycle costing model forecasts the whole life cost of maintenance for a vehicle through forecasting consumption and cost in 3 key areas: -

1. Preventative material consumption
    - Planned materials, filters, oils etc.
    - Change on condition materials, brake pads, pantograph carbons, wheels etc.
2. Corrective material consumption
    - Unplanned materials
    - Non reparable components
    - Repairable components
3. Man-hours consumed
    - Preventive maintenance man-hours (Including daily pre-revenue service testing)
    - Overhaul man-hours
    - Corrective maintenance man-hours

Preventive Maintenance

The preventative maintenance plan is built into the model and driven by the planned annual mileage. Each maintenance revision has a Bill of Materials (BOM) and the man-hours required to deliver the operation. The BOM is created from the scope of work in the plan and the change on condition parts based on return of experience from maintenance of similar vehicles. Using this method a confident cost forecast can be allocated the full cycle of preventative maintenance revisions.

Overhaul

The same process is employed for the vehicle overhaul with a BOM based on the overhaul scope and man-hours based on return of experience.

Corrective Maintenance

The cost of corrective maintenance is achieved by forecasting the cost by vehicle system e.g. traction, braking, doors. Each system is treated individually using the predicted and return on experience Mean Distance Between Failure (MDBF) for the major components in the system. The cost of the component and the man-hours required for fault finding and correction calculates into the cost of corrective maintenance.

LCC Creation and Validation

Alstom uses Reference Solutions within its Reference Libraries as the basis for the modelling. This process involves a PDCA-type (Plan Do Check Act) review that takes place at least once a year between the design/manufacturing team and the maintenance team. Previous results in LCC optimisation are reviewed, new actions are proposed along with new LCC targets for the coming year. It is this closed-loop approach that enables Alstom to consistently improve their LCC forecasts year-on-year over the life of the product and not only the project.

The full LCC cost for a reference solution is established using data from the Alstom Maintenance Management Information System (MMIS) which is a key module of the integrated Enterprise Resource Management (ERP) system. A standard coding system is used for MMIS work orders on all Alstom maintenance contracts. This standardisation allows for performance and cost analysis between vehicles, system, sub-systems down to individual components. The data from all maintenance projects is captured in a fully automated data warehouse. The quantity of current data being added to the warehouse weekly and the automated reporting allows for the reference vehicle data to be accurate and up to date. This data is used to continually update the reference vehicles LCC.

Alstom MATERIAL SUPPLY AND MANAGEMENT

Material management and procurement is managed using the Alstom Enterprise Resource Planning systems (ERP) Material Resource Planning (MRP) module. The ERP uses the Life Cycle Costing (LCC) model data at the commencement of a project to establish the initial stock levels. The ERP then continually takes the following data from the Maintenance Management Information System (MMIS):-

- The preventative maintenance plan
- The BOM for all the activities in the maintenance plan
- The current vehicle mileage
- The forecasted vehicle mileage
- The consumption of material with the work type that consumed the material

Using the above data, as materials are drawn from stock to a vehicle, the MRP systems forecasts the future needs for that material and adjusts the stock level against the forecast and the lead time to replenish. The strength in the MRP is that it looks forward based on continually readjusting the forecast. If the fleet mileage changes either an increase or a decrease then the MRP detects this and readjusts the stock levels based on a change. As a project becomes mature the MRP can detect changes caused by seasonal events and rebuilt its forecast to manage these infrequent events.

The generation of purchase orders to replenish stock is automated in the MRP.

Stock Value

By the use of the MRP forecasting, stock is maintained at an optimal level. The Alstom MRP system is then further overlaid with software designed to fully optimise stock levels.

Data analysis and KPI's

Data from the MRP forecast is used to drive KPI's on material consumption and to detect unplanned changes to material consumption in either direction. If the cause of this change of consumption cannot be detected through mileage or maintenance plan changes this report is relayed back the maintenance organisation to investigate the cause of the change. This reporting process has proved to be beneficial in the early detection of equipment failures.

RAILSYS - Alstom's Maintenance Knowhow Transformed into a Single ERP System

ALSTOM

Since 2003 Alstom has continued to develop RAILSYS - an ERP system that is 100% dedicated to the maintenance needs of railway rolling stock and railway infrastructure equipment. Alstom is the only railway manufacturer-maintainer to have invested in such a system. RAILSYS enables the local Alstom Maintenance Team to provide the Client with reports that are built on a very detailed level of data that is specific to its complete railway system, not only data from collected from its vehicles. In addition, as the data is managed centrally by the Alstom Maintenance Platform, RAILSYS allows Alstom maintenance teams world-wide to benefit from the return of experience of systems which in return provides design and maintenance benefits to Alstoms' Clients.

The maintenance programs to be developed for the Ottawa LRT System will fully benefit from application of RAILSYS. The implementation of the benefits of RAILSYS will begin through open discussions among the City, its Operators and the Alstom Maintenance Organization once the Alstom Maintenance Director and Alstom Engineering Manager are in place.

Obsolescence Management Plan

Obsolescence Management is based on a transparent approach that will allow the City to select from various Obsolescence Management Solutions to be proposed by the Alstom Maintenance Organization which is best suited to the City's operational needs. The selected Obsolescence Management Plan which will be based on the following criteria and objectives:

- The dedicated plan will be implemented at the beginning of the Maintenance Contract;
- New obsolescence information will be gradually added and revised throughout the Contract as it is made available;
- The Obsolescence Management Plan takes into account technology, complexity, costs and operational considerations and operational constraints;
- The Obsolescence Management Plan is used throughout the entire life of the products and parts in order to best identify the activities and associated responsibilities related to the Obsolescence Management;
- Various options will be available to manage obsolescence and the choice of these options must be regularly reviewed with our customer. The decision will be based on Life-Cycle Cost considerations as well as practicality and sustainability solutions. These include -
    - To define all interfaces so that the consequences of obsolescence in all cases are limited to the exchange of a module (transparent with technology);
    - To manage the elements, materials, and used processes in the product/part to treat obsolescence;
    - To manage the evolution of the equipment with the obsolescence of the components or materials;
    - T analyse the possible "end of life" storage of certain components;

Maintenance of Rail Vehicles and Signalling during Winter and Summer Operations

Winter Operation

Research carried out by Alstom and practical project experience has shown that a disciplined preventive maintenance regime and other protective measures are the most cost effective solution to managing winter conditions, especially when conditions fluctuate year on year. Capital expenditure (product design or corrective equipment) is never sufficient if specific preventive maintenance tasks are omitted.

The winterisation of vehicles will be a planned maintenance activity in the autumn to be completed before the onset of winter. Although a planned activity the long term weather will be continually reviewed at the weekly meetings and if there is a change in the normal weather pattern then any vehicle which has not been winterised will be immediately targeted for winterisation.

Alstom experience of vehicle maintenance in Sweden

Alstom's train building experience in Sweden and Finland, combined with its Design for Maintainability processes, has allowed it to develop a specific range of solutions for winter conditions. The following systems are subject to additional disciplined preventive maintenance regimes and other protective measures to prepare the vehicle for winter: -

- HVAC
  - Air inlet grill heater functional check
  - HVAC control software change to winter settings
  - Electrical and functional check of all heater elements
  - Change to winter grade filters
- Auxiliary convertor case heating electrical and functional check
- Pantograph carbon change to winter grade
- Sanding heater electrical and functional check
- Passenger foot step heater electrical and functional check (If fitted)
- Coupler heater electrical and functional check
- Change of window washer fluids and other fluids to winter grade

Where necessary, protective covers are fitted to external equipment which are vulnerable to ingress of snow (e.g. coupler skirts, horn covers, snow air filters etc.). All fluid pipelines are heated or insulated and the aerodynamics are managed to limit the build-up and compacting of snow into ice. Snow ploughs will be added to ends of the vehicles, along with brushes, to clear snow from the track.

Even with these on-board measures, it will be critical that attention is focussed on the infrastructure - the operating environment of the vehicle. The use of customised railway snow blower machines will be required prior to the first operation of the LRT System Trams and/or throughout the night in the event of heavy forecasted snowfall. Snow will be then be manually collected at designated snow storage zones next to the right of way and removed by digger and truck. If this preventive work is managed correctly then low floor vehicles should not encounter any increased difficulty. Experience with high floor commuter trains in Scandinavia has demonstrated that the exposed under-frames collect snow and ice very rapidly resulting in a long de-icing process which directly impacts vehicle availability for both the maintainer and the operator.

If the climatic conditions are severe then an overhead line heating system may be installed at construction to prevent ice formation during long periods of time. This often comprises of a heating cable that is attached directly to the contact wire. If this system is not in place then regular preventive inspections/cleaning will need to be added to the infrastructure maintenance plan.

All trackside components for the signalling system will be installed in heated central or local technical rooms. Alstom proposes to use P80 Switch Machines which can operate at up to -40°C for track products for installation with and control by the signalling system. These P80 Switch Machines have been installed in and have operated successfully in Nordic countries. If climatic conditions dictate, these P80 Switch Machines can also be heated.

The seasonal preventive maintenance plan will be modified in a similar fashion as to that to be implemented for the rolling stock. This would include the application of anti-freeze agents to unheated switches (e.g. "Kilfrost" which Alstom uses in northern Europe for the maintenance of depot switches) to prevent freeze-ups.

Summer Operation

Rolling stock will be returned to summer operating mode through a planned maintenance activity in the spring to be completed before the onset of summer by reversing the winter operation process. Although a planned activity the long term weather will be continually reviewed at the weekly meetings and if there is a change in the normal weather pattern then any vehicle which has not been prepared for the summer will be immediately targeted for preparation for summer operations.

The focus of summer operations will be the HVAC cooling systems which will not have been used during the winter months. The HVAC will be subject to full inspection and functional testing. Filters will be changed to summer grade. Snow covers will be removed and all fluids will be replenished with summer grade fluids.

(vii) Resumes of Key Individuals (limit of 3 pages per resume).

Hugues MELLERIO **Project Manager** **Alstom Transport**	
Nationality: **Age:** **Languages:**	French 51 French (mother tongue), English
Higher education & qualification:	
	Electronics engineer, ESME SUDRIA, Paris
Experience:	**22 years**
10 years **2010-xxxx** **2008-2010** **2007-2008** **2001-2006**	**Alstom Transport Information Solutions** **Project Manager** • Project Director: Bangalore Metro lines 1 & 2, India, Urbalis signalling system (100+ Meuros) • Project Director, Urbalis signalling system projects: Delhi metro lines 1 & 2, initial contract and contract BS01 for extensions (100+ Meuros) • Project Manager, CBTC signalling system projects in China: - Beijing Metro Line 2 Revamping (30 Meuros) - Beijing Airport Link driverless line (25 Meuros) • Senior bid manager: management of tenders for Multisystem Mass Transit, Main Line Railway or LRT projects – Signalling, ATS, SCADA, Radio, Telecom and Passenger Information systems (from 10 to 300 Meuros)
1998-2001 **1992-1998**	**GTMH, France** • Project Manager in Electrical Subsystems for Transport Department of Installation Major • Marketing strategy, tender and project realisation for traffic monitoring systems and electrical systems for motorways • Tendering, design, implementation installation of very low voltage systems • Project Manager in Electrical Subsystem for Very Low Voltage Department
1989-1992	**Forclum, France** • Project Manager in Automation systems for Installation Major • Tendering and sales for SCADA systems.
1988-1989	**Chauvin-Arnoux, France** • Sales Engineer: temperature monitoring and control equipment

Jean-Marc MORIN Project Manager Alstom Transport	
Nationality: **Age:** **Languages:**	French 53 French (mother tongue), English (fluent)
Higher education & qualification:	
	Engineer degree in computer science from ENSEEIHT (Toulouse, 1982)
Experience:	**29 years**
10 years **2010-xxxx** **2001-2010**	**Alstom Transport Information Solutions** **Project Engineering Manager** • Head of system engineering department in Rochester (ALSTOM Transport) **Project Engineering Manager** • STM ICC: control center for Montreal metro (controlling 4 lines – 75 km, 68 stations) based on Iconis™ product • Beijing Line 2: Urbalis™ CBTC signalling system in major metro revamping project, completed in 2 years for Beijing Olympic Games • Delhi SYS1 project: Urbalis™ signalling system for 2 new lines in India • Hong Kong LAR four tracking project • Bid Technical Manager on the Beijing Line 2 and Line 4 tenders
2 years **1999-2001**	**TRANSWITCH, France** Technical director for R&D on internet routers products • In charge of microprocessor architecture • Definition of engineering process & tools • Coordination of hardware and software developments
10 years **1989-1999**	**DGA, France** System manager for submarine weapon systems • Specification and preliminary design • Performance allocation, modelling and monitoring • Engineering process & tools definition • Development follow up
3 years **1986-1989**	**AEROSPATIALE (AIRBUS), France** Project Manager for software developments
4 years **1982-1986**	**IGL, France** Developer then project Manager for software development

Didier DE HAUTECLOQUE Project Engineering Manager Alstom Transport	
Nationality: **Age:** **Languages:**	French 55 French (mother tongue), English
Higher education & qualification:	
	Electronics engineer (ESEO Ecole Supérieure d'Electronique de l'Ouest, France)
Experience:	**31 years**
22 years	**Alstom Transport Information Solutions** **Chief System Designer and Project Technical Leader**
2009-....	• Senior System Architect: urban signalling system tenders (CBTC systems)
2007 -2009	• Project Technical Manager: Bosphorus Crossing & Commuter Rail (Turkey). Signalling & train control system (CBTC) with ERTMS level 1 backup, trackside and trainborne equipment, centralised traffic control
2005-2007	• System manager for signalling tenders: responsible for giving technical strategy according to customer requirements and Alstom solutions, supervising subsystem deliveries, leading performance simulations
2003-2004	• In charge of securing deliveries of products and integrated system for Athens Olympic Games (ASR project, GREECE)
2001-2003	• Chief system designer, SINGAPORE Circle line driverless metro
1994-2000	• Chief system designer, Lantau & Airport Railway (HONG-KONG)
1989-1994	• ATS system design manager, Automatic Train Supervision
1984-1989	**SINFOR, France** • Software engineer (shipbuilding industry)
1980-1984	**SCHLUMBERGER, France** • Electronic design engineer (factory automation)

ALSTOM

Experience Summary

don

ɔndon

ıance

Brian Ealey 30 years' experience in the maintenance of rail vehicles including metro's Electrical Multiple Units (EMU) light rail vehicles and suburban diesel and multiple units (DMU). Maintenance management experience at all levels from multi-skilled technician thorough supervisory management and senior management.

Project management 10 years' experience in the project management for the introduction of new trains onto both new and existing infrastructure.

Vehicle maintenance management had the full responsibility for safety of the vehicle and the workforce. Full responsibility for the contracted vehicle availability and reliability. The direct management of the vehicle commissioning and warranty teams. Direct interface with customer project, railway operational and senior managers. The management of subcontractors for products and services.

Project management the full responsibility for starting up projects including the worksites, recruitment and employee training. The development of maintenance strategies including Reliability Centred Maintenance (RCM) and Condition Based Maintenance (CBM). Direct interface with customer project, railway operational and senior managers also customer and Alstom subcontractors.

Selected Project Experience

Alstom TLS Naperville Il USA. June 2009 – to date - **Industrialization and Transit Manager.**

The role is to develop and improve the performance of the renovation and modification business and the development of the in-house repair and remanufacture business through the implementation of best practice processes. The role includes development and standardization of business systems and processes also to develop the transit maintenance and renovation business within the USA and Canada.

Burlington Northern and Santa Fe Railroad (BNSF) Project Improvement Team Leader. March 2008 to June 2009 –

In this role I lead a small team responsible for improving both the operational and financial performance of the BNSF diesel electric locomotive project. Since January 2009 I also took on the additional role of Engineering Manager for the BNSF project. The project was restructured and delivering fully the contracted service for availability and reliability with the financial improvements.

Train System Improvement Team Leader. London Underground Northern Line. 2006- February 2008

The role was to manage improvements to the traction and pneumatic systems also maintenance operations with the introduction of advanced tools, condition based maintenance and best practice preventative and corrective maintenance. The development and delivery of a pneumatic and braking overhaul on 636 cars.

Return on Experience Manager UK. 2006

The role was to report on vehicle and organisational performance feeding back data to Rolling Stock builders and other internal maintenance business to improve new vehicle builds and maintenance operational performance.

I had corporate responsibilities for the development of the company Maintenance Management Information System with a light version for tram projects.

ALSTOM

During my time in this role I was part of the team who developed world wide automated vehicle performance reporting using data warehouses. The role also included support to maintenance projects worldwide for maintenance and organisational development as and when required.

Maintenance Business Improvement Team Leader. Dublin City Luas Tram 2005-2006

This role required the development and implementation of a new organisation to overcome the existing organisational and tram performance problems. This support resulted in a new maintenance and technical staff structure with new grades and working practices. During this time I also acted as mentor and coach for the new Production Manager.

Maintenance Operations Director, Bucharest Metro Romania 2004-2005

In this role I took over the existing vehicle maintenance operations and 1700 employees from the client Metrorex. I was responsible for the development and implementation of new work methods, safety and quality systems to European standards. The introduction of advanced maintenance tools also coaching and development of the local managers in the use on Maintenance Management Information System.

The role also required the setting up of an asbestos removal facility including an in-house fully accredited air sampling laboratory to full European and World Health Authority standards for the removal of asbestos from 326 metro cars.

Maintenance Operations Director for Alstom Metro Trains London Underground. 2002-2004

Responsible for the delivery of the contracted train maintenance services service to London Underground for the Northern and Jubilee Lines (990cars) The contracted services were for the maintenance of the customer owned trains on the Jubilee Line also for the leased trains and track side communications equipment on the Northern Line. The total number of trains in maintenance was 165 x 6 cars with a total workforce of 240 people. The role of the Operations Director was to manage the Maintenance Operations, Engineering and Material Provision departments.

Continuous Improvement Manager for Alstom Transport UK. 1999 to 2002

Developing and implementing improvement processes, procedures and practices throughout UK maintenance sites.

Contract Manager for the Alstom London Underground Jubilee Line train maintenance project. 1996 to 1999

In this position I was the senior manager responsible for starting up of the train maintenance contract from an existing London Underground depot, the recruitment and development of a workforce and the introduction of a fleet of 59 trains with the maintenance delivery strategy and the development of quality, health and safety systems to ISO standards.

In 1998 I was required to transfer all the above operations to a new depot at Stratford Market, which included the enabling of the site and the running of the site as a full maintenance facility whilst building work was completed.

Fleet and depot management positions within London Underground on the Northern line. 1991 to 1995

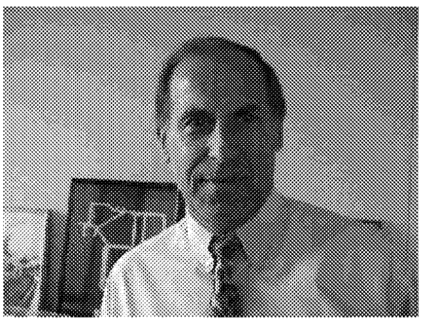
First Line manager on London Underground Victoria and District Lines. 1985 to 1991

Current Projects

MARTA Business Process Reengineering (2010 to date)
New Jersey Transit Condition Based Maintenance and technical support (2008 to date)
Caltrans passenger door modifications (2009-2012)
Caltrans collision repairs (2009 to date)

Michel Wursteisen

Mr. Wursteisen has had over 22 years of progressive and extensive experience managing the manufacturing, delivery, testing and commission, of major electric vehicle programs, including those for both LRT and subway (metro) systems, integration of CBTC train control on these vehicles. Among his many accomplishments he was formerly the Director of Traction Engineering at Alstom's Charleroi manufacturing facility, and the RAMs Engineering manager for the R160 vehicle program for New York City.



A. Role on this Project: Light Rail Vehicle (Procurement) Manager

Mr.Wursteisen will be the Light Rail Procurement Vehicle Manager. As Alstom will undertake an optimization in the selection of the most appropriate vehicle for the Ottawa project, and then supply this optimized vehicle , including design, construction, assembly, test and commission, and Quality assurance.

Responsibilities and Contributions on this Project

» He will be responsible for the successful planning and execution of the design, construction, assembly and test & commissioning of Alstom Citadis vehicles for the Ottawa project with respect to budget, delivery timelines, expected quality.

» Reporting to the Director of E&M Systems Integration he will organize and lead the Vehicle project team, identify roles, responsibilities and objectives to project team members and define interfaces.

» He will define, monitor and report project dashboard and key performance indications.

» He will define the project risk management plan and constantly review and update, vehicle project performance, identify risk and opportunities and follow up these with action to improve the project outcomes.

» He will have full responsibility for the vehicle within the project throughout its full life cycle and take necessary actions to improve the project process.

» He will control and manage relationships with relevant stakeholders and the customer (in relation to the vehicle.

B. Education / Training (including specialized training courses)

» Institut Polytechnique Grenoble

» Languages: English, French

» Project Management Courses – Alstom University

» Project Risk Management – Alstom University

» ISO procedures, FMC testing training, Inductive Conductive ATC

» Procurement Management – Alstom University

» Performance Management Training

» Alstom propulsion training

C. Project Specific Experience and Qualifications

RELEVANT PROJECT EXPERIENCE

#1

Project Name:	**Singapore MRT**	**Location:**	**Singapore**
Role on Project:	Project Manager	**Involvement Duration:**	10 years
Project Type:	Rolling Stock – Driver less Metro	**Delivery Method:**	Manufactured in France, Test & Commissioned in Singapore. Separate Vehicle procurement with integration responsibilities to CBTC, track, power, construction
Size / Value:	150 k€	**Completion Date:**	12/2008

Project Description:

Design, construction, testing and commission of 25 trains sets of 6 cars (150 subway cars) – First high capacity CBTC driverless in the world – coordination/integration interface with other activities such as CBTC train control and signalling, Operations Control Centre (OCC), power supply and SCADA system, trackwork, and workshop

Challenges Overcome and Contribution:

- First CBTC Metropolis- driver less- new system in the world
- Complex CBTC system, involving tunnel operations, integration with different system wide contractors (E
- Many stakeholders: client (LTA) operator (SMRT), partner (STE) different Alstom unitis, Civilw works companies and other contractors.
- High technology level, difficult climate conditions (high heat and humidity conditions, full system integration and system wide interfaces.

Responsibilities Summary:

- Project Manager for Vehicles
- Planning and execution of design, construction, assembly and test and commissioning of vehicles
- Organize and lead the project team
- Define, monitor and report project dashboard and key performance indicators
- Full responsibility for vehicles throughout their lifecycle
- Control and manage relationships with relevant stakeholders and the customer

Project Relevance

- All Singapore lines are driverless rail (automated train control provided by Alstom)
- Close relation with operator to successfully handover the line
- Subsequent conversion and integration of existing stations in extensions
- Full System integration (interfaces to ATC, track, power etc.
- Sustainability implementation and certifications in programs comparable to LEED and GREENROADS

Rail project in densely populated urban and commercial areas.
Train s operate in tunnels and mined underground stations, including experiences with fire and life safety systems.
Environmental management system programs.
Quality management systems and controls.
Schedule, budget and risk management performance
Vehicular, pedestrian, emergency project development areas.

Reference:

Company Name: LTA
Location: Singapore
Preferred Language: English

ALSTOM

RELEVANT PROJECT EXPERIENCE

Project Name:	**Istanbul LRT**	**Location:**	**Istanbul, Turkey**
Role on Project:	Project manager	**Involvement Duration:**	2 years
Project Type:	Citadis tramway (LRT)	**Delivery Method:**	Manufactured in France and Poland; Test & Commissioned in Istanbul, Turkey Separate Vehicle procurement with integration responsibilities to train control, track, power, construction.
Size / Value:	72 k€	**Completion Date:**	12/2011

Project Description:

7 Citadis 301, capable of 100 km per hour with Permanent Magnet traction motors (air cooled)

Challenges Overcome and Contribution:

» New product
» Project Delivery schedule was very fast
» Complex project in tunnel, automated train control, integration with different system wide contractors (vehicle supplier, ECS, tunnel ventilation, fire detection/protection).
» Many stakeholders: client (LTA), operator (SMRT), partner (STE), different Alstom units, Civil works companies, System wide contractors (ECS, tunnel ventilation, fire detection/protection)
» Safety to be ensured in tunnel with construction work still on going during the T&C period.
» Scope included in factory and at customer location installation, test and commissioning of all vehicle systems and performance metrics, train control, train operation, and telecom subsystems new vehicles.
» Full System integration and system wide test and commissioning.

#2

Responsibilities Summary:

» Project Manager for Vehicles
» Planning and execution of design, construction, assembly and test and commissioning of vehicles
» Define, monitor and report project dashboard and key performance indicators
» Organize and lead the project team
» Full responsibility for vehicles throughout their lifecycle
» Control and manage relationships with relevant stakeholders and the customer

Project Relevance

» LRT vehicle very similar to Ottawa requirements
» Design build project?
» Conversion and integration of existing bus line to LRT
» IS THERE TUNNEL SECTION?
» Environmental management system programs
» Quality management systems and controls,
» Schedule, budget and risk management for large complex project
» Full system integration including responsibilities for signalling and train control
» Rail project in densely populated urban and commercial areas (Istanbul is a city of over 10 million people
» Vehicular, pedestrian, emergency and BRT traffic management within and adjacent to the LRT project development areas.

Reference:

Company Name:	Ulasim
Location:	Istanbul
Contact / Title	XXXXX / XXXX
Phone:	XXXXX
Email:	XXXXX
Preferred Language:	English

ALSTOM

RELEVANT PROJECT EXPERIENCE

#3

Project Name:	SNCF double deck EMU	Location:	france
Role on Project:	Project manager	Involvement Duration:	3 years
Project Type:	Vehicle Contract EMU	Delivery Method:	Manufactured in France
Size / Value:	500 k€	Completion Date:	12/2000

Project Description:

[80 double deck EMU trains for SNCF (5 car trains = 400 double deck electric multiple unit cars)

Challenges Overcome and Contribution:

» New product with new traction drive system, based on extensive optimization discussions with Customer.

» Planning and delivery on a very tight timeframe.

» Scope included in factory and at customer location installation, test and commissioning of all vehicle systems and performance metrics, train control, train operation, and telecom subsystems new vehicles.

Responsibilities Summary:

» Project manager

» Planning and execution of design, construction, assembly and test and commissioning of vehicles

» Define, monitor and report project dashboard and key performance indicators

» Organize and lead the project team

» Full responsibility for vehicles throughout their lifecycle

» Control and manage relationships with relevant stakeholders and the customer

Project Relevance

» Major vehicle procurement program

» Electrical powered vehicles

» High standards for reliability and maintainability

Reference:

Company Name:	SNCF
Location:	Paris
Contact / Title	XXXXX / XXXX
Phone:	XXXXX
Email:	XXXXX
Preferred Language:	french

D. Other Relevant Projects

PROJECT NAME	ROLE	RELEVANCE
New york Metro	Engineering manager	XXXX
VAL Orly/Toulouse	Project manager	XXXX

E. Current Project Involvement

PROJECT NAME	LOCATION	ROLE	COMPLETION DATE
Citadis istanbul	istanbul	¨project management	12/2011

Tony Sanchez – project technical Manager - Alstom

Current activity:

With Alstom April 2005 to present:
Mr. Sanchez is currently the Engineering Director for the Rochester Rolling Stock group. His is responsible for the overall management, control and performance of the engineering department. His role includes all activities related to design, system qualification and engineering support to other departments such as sourcing, production, quality etc., resource management and budget/schedule performance on all RS engineering projects. Projects include Metros, Locos, Bi-level Coaches and Single Level Coaches. Mr. Sanchez joined Alstom in 2005 as a Project Engineering Manager for the R160 NYCT project.

Previous to Alstom:
Siemens Transportation Systems Inc. – Sacramento CA, 2000 – 2005: Engineering Project Manager for Houston, San Diego and Charlotte S70 LRV projects as well as system engineer for various LRV projects with an emphasis on systems integration of rail vehicle on-board systems.
Union Carriage and Wagon Co, Nigel South Africa 1994 – 2000: Electrical Design Engineer. Responsible for all aspects of electrical and electronic design for local and international rail projects (locomotives, electrical multiple units, metro cars and coaches).

Other Experience:
Mr. Sanchez worked as Electrical engineer on various South African Coal and Gold mines after graduating in 1989 to 1994, where he was involved in various activities from new projects involving high voltage power distribution and protection to maintenance of the electrical equipment.

Annex 1 - iv-A Technical Submission Requirements

ALSTOM

OTTAWA LRT

VEHICLE AND TRAIN CONTROL

PREQUALIFICATION

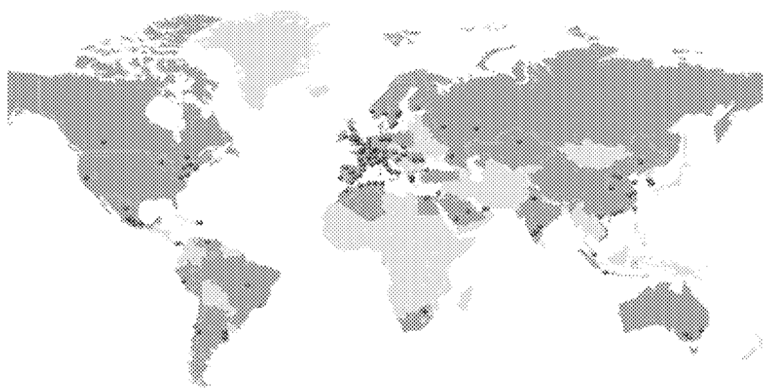
SECTION 5.4

ALSTOM

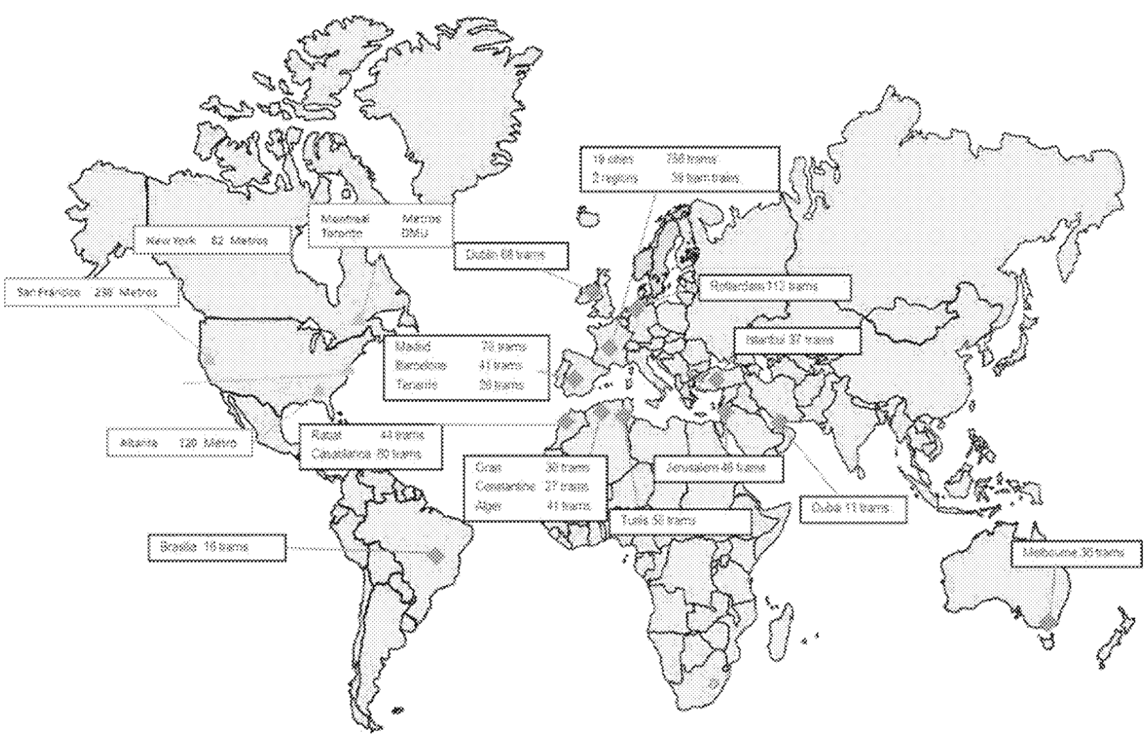
INTRODUCTION

Alstom Transport is a supplier of railway equipment and services of worldwide scope and renown, offering a wide range of products and facilities fully capable of meeting customer's specific product and project needs.

ALSTOM TRANSPORT achieves customer excellence through a global presence with Centers of Excellence and satellite Operational and Maintenance facilities to design, develop, manufacture and project manage all aspects of a new projects or developments.



This geographical diversity has contributed to the successful delivery of Tramway projects over the last 25 years. During this period, Alstom has developed a wide range of Tramways which have been build and delivered to more than 40 cities in 12 different countries throughout the world. To date, over 1500 "CITADIS" have been manufactured by ALSTOM TRANSPORT.



The Proponent shall address the Vehicle and Train Control design at an appropriate level of detail, as set out in or otherwise referenced in Schedule 15-2 of the Project Agreement, and is to include the following:

Light Rail Vehicles

A. An acceptable strategy to meet the Canadian Content Policy, including:

Proponents must certify that the Vehicles proposed in their Proposals meet the requirements of the Canadian Content Policy, including the required twenty-five percent (25%) Canadian content require requirement for the Vehicles.

Proponents must also expressly provide their consent to the disclosure, verification and audit of the information forming the basis of their certification, during the evaluation stage, and any other steps taken before Commercial Close and, for the Successful Proponent and Vehicle manufacturer, during and after the term of the Project Agreement.

Proponents must demonstrate that the overall Canadian content of the transit vehicles proposed meets the minimum of 25% threshold, calculated as a percentage of the total final costs to the manufacturer, less applicable taxes. Proponents are required to provide sufficient information to demonstrate their compliance with the Canadian Content Policy. In particular, Proponents must address and provide information about expenditures for eligible costs in respect of transit vehicles for the following items and which are directly related to the transit vehicle manufacturing process, distribution and acquisition, including:

- Labour
- Sub-components and components:
- Project management
- Engineering
- Manual
- Special tools
- Test equipment
- Freights; and
- Warranty.

1 – LOCAL CONTENT

ALSTOM confirms compliance to the minimum 25% local content required by this contract through the current footprint in North America and more specifically in Canada.

Local resources

The map below shows the multi-specialized facilities in North America and Canada. Over 2000 employees are based in Canada, of which 460 work on railway equipment,

ALSTOM

The major centers are:

Alstom Transport Information Solutions in Montreal:

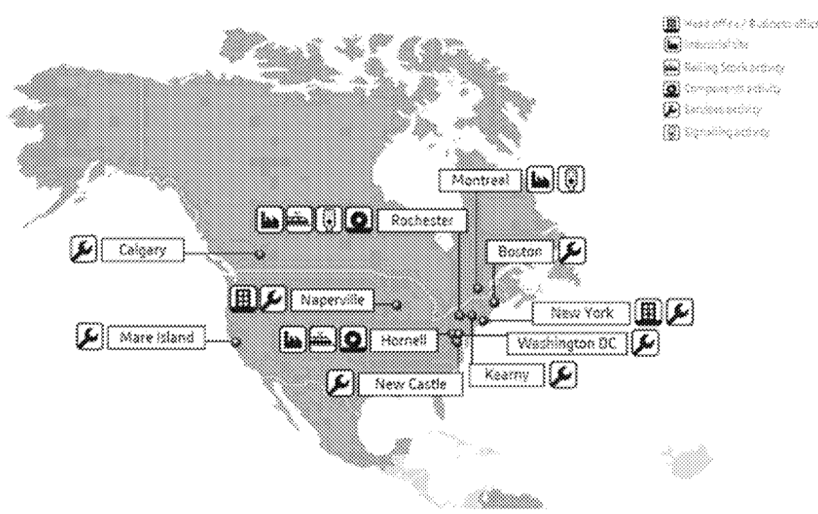
This site is Alstom Center of Excellence for Passenger Information Systems, Security systems for both onboard and wayside. Activities include the software and hardware design, development, manufacturing, commissioning, product training and after-sales services.

This site also deploys and delivers to North American customer the ICONIS™ ATS and SCADA (Integrated Control Center) solution. The site has over 50 active projects across 17 countries.

Railway maintenance center in Montreal and a Trucks manufacturing facilities in Sorel-Tracy:

Alstom was awarded by the STM (Société de Transport de Montreal) a $1.2 B CAD contract in consortium with Bombardier for the manufacturing of 465 metro cars. This project has a Canadian content requirement of 65%.

In order to meet its share of contribution to this Canadian content, ALSTOM has transferred the entire procurement, assembly and production of the Trucks from the Center of Excellence in Le Creusot, France to a new industrial facility within the existing ALSTOM industrial site in Sorel-Tracy, Quebec. A total of 62 (minimum) new employees will be employed starting July 2012. The capacity at the new facility is planned such that the production can be increase and if necessary doubled. This site is currently forecasted to have a load until year 2020 and is part of Alstom's strategy to cater to other potential contract in North America.



Local Sourcing

At the present time, we are already working with Canadian suppliers or with other qualified suppliers working through joint ventures or as subsidiary to Canadian companies.

Example of potential key railway suppliers:

Passenger doors: VAPOR   Brakes: Faiveley   Internal appointments: CEIT

Vapor Rail Une compagnie Wabtec A Wabtec company   Faiveley TRANSPORT   CEIT Groupe

Final assembly

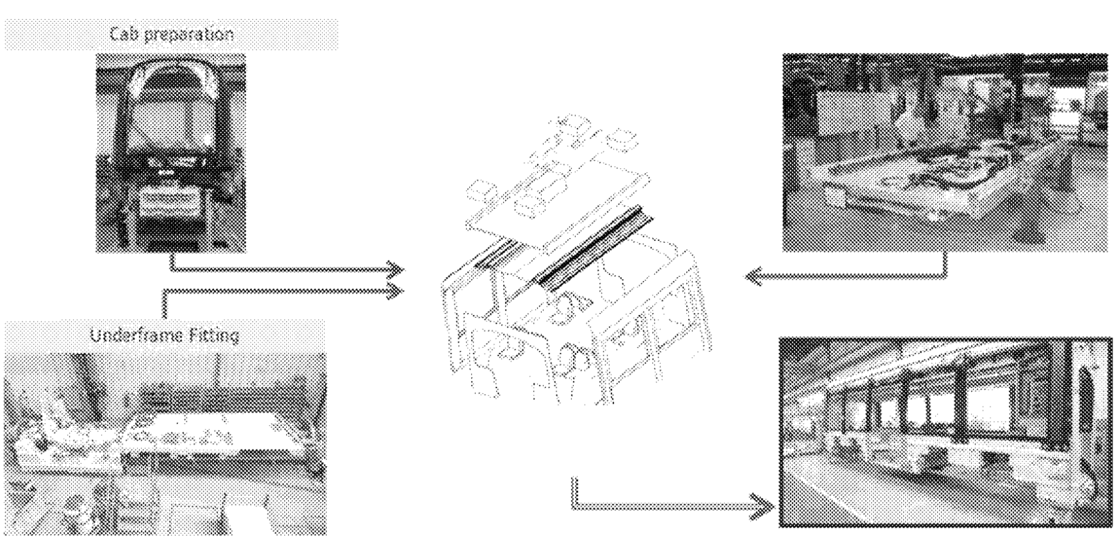
The train will be fully validated and certified in our Center of Excellence in Hornell, New York. As part of Alstom industrial process, a Transfer of Technology is planned to ensure that sub-components and train assembly are performed in Canadian production sites.

Alstom transport has 12 rolling stock manufacturing units in Europe, North and South America and Asia. All of them are similarly organized uses a production system taking into account World Class Manufacturing (WCM) principles and tools, called APSYS (Alstom Production SYStem)

This approach and process has been successfully executed by ALSTOM TRANSPORT on major projects as show below:

Equipment	Location	Year	Number of units
High Speed Train	Korea	1994	34*20 carriages
Subway	Melbourne	2001	58*3 carriages
Tram Madrid	Spain	2005	70*3 carriages
Locomotives	China	2007	500 carriages
Tram Istanbul	Poland	2009	35*6 carriages
Trucks Montreal	Canada	2012	465 cars * 2 Trucks

The modularity of the CITADIS product line significantly simplifies the Transfer of Technology. The transfer of modules to local suppliers and the production and final assemblies of these modules can readily be carried out without difficulty in the Canadian shops specifically fitted out



Likewise, ALSTOM TRANSPORT ensures commissioning and follow-up of warranty through the Canadian teams.

Based on past experience, a typical local content breakdown is illustrated below:

item	% item / Total	% Localisation	LOCAL CONTENT
Labour	7%	100%	7%
Sub-components and components:	64%	20%	13%
Project management	7%	25%	2%
Engineering	15%	5%	1%
Manual	0%	0%	0%
Special tools	1%	0%	0%
Test equipment	2%	75%	1%
Freights	1%	100%	1%
Warranty	4%	100%	4%
TOTAL	100%		**28%**

The breakdown indicated in this table is a typical breakdown and is provided for information purpose only.

If Proponents have additional items which they feel should be taken into account in the evaluation of their compliance with the Canadian Content Policy, they are required to itemized those particular items and indicate how they factor into the Proponent's compliance with the Canadian Content Policy.

Recent Canadian experiences:

STM Control Center Contract:

Contract was awarded to ALSTOM TRANSPORT in 2003. A deployment center was created in Montreal in 2004. All adaptation to standard ICONIS platform, application software, testing and commissions, project management, procurement, and Quality control were executed by a local team and supported by an expert team expatriated from St. Ouen, France. The local team in Montreal grew to over 100 professionals (Engineers, Technicians, Software developpers, etc.) and currently has 80 professionals actively involved in ICONIS project activities and development.

STM Metro – MPM-10 Contract:

Contract was awarded to the Bombardier Transport and ALSTOM Transport consortium in 2010. The contract has a 65% Canadian content to which ALSTOM will be supplying critical systems such as Automatic Train Control (ATS), Trucks, Traction, Braking System, Passenger Information System, and On-Board Security/surveillance System.

In addition to the existing installations and facilities in Canada, Alstom is opening a new facility within the Sorel-Tracy industrial complex for the manufacturing and assembly of Trucks. This Transfer of Technology ensures compliancy to a minimum of 30% Canadian content of the above sub-systems,

ALSTOM

A list of proposed sub-suppliers for all major LRV systems;

List of leading potential suppliers for LRT OTTAWA

(in blue for suppliers located in Canada)

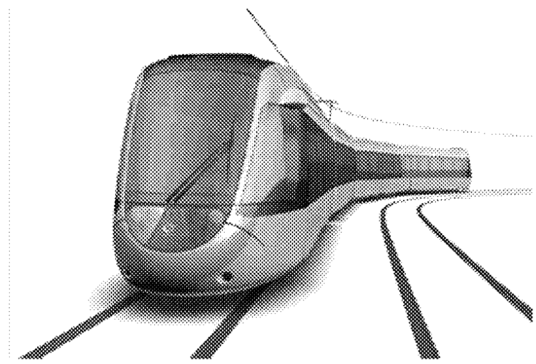
ITEM	SUPPLIER
BATTERIE	SAFT
CVS	ABB / TRANSTECHNIK GMBH & CO. KG
BRAKE	KNORR (Kingston (CAN / FAIVELEY
WINDOWS	DIAZ / PRELCO
WINDSHIELD	ST GOBAIN / PRELCO
HVAC	FAIVELEY / THERMOKING / VAPOR Stone (Plattsburg (US) & (CAN)
DOORS	VAPOR Stone (US & CAN) / IFE (Westminster (US) or KB Kingston (CAN) tbc) / FAIVELEY
PANTOGRAPH	FAIVELEY (Greenvile SC (US)) / SCHUNK
CUBICLES	SANMINA-CONVERTEAM
CAB STRUCTURE	ZTS / FABSPEC
ROOF STRUCT	W GESSMANN GMBH
RETROVISION	FAIVELEY
AIR PRODUCTION	DURR GMBH & CO KG/ FAIVELEY
COUPLEURS	FAIVELEY / DELLNER
CABLES	NEXANS / OMERIN
INTERIOR GARNISHING	CEIT / KN
LINE INDUCTOR	TRANSRAIL B&V / IEC HOLDEN
BOGIE	ALSTOM LE CREUSOT
TRACTION	ALSTOM SESTO
TCMS	ALSTOM VILLEURBANNE
PA/PIS	ALSTOM MONTREAL
ALUMINIUM PROFILE	SAPA - ALCAN
SEATS	KIEL (US) / SAIRA (CAN & NY)

ALSTOM

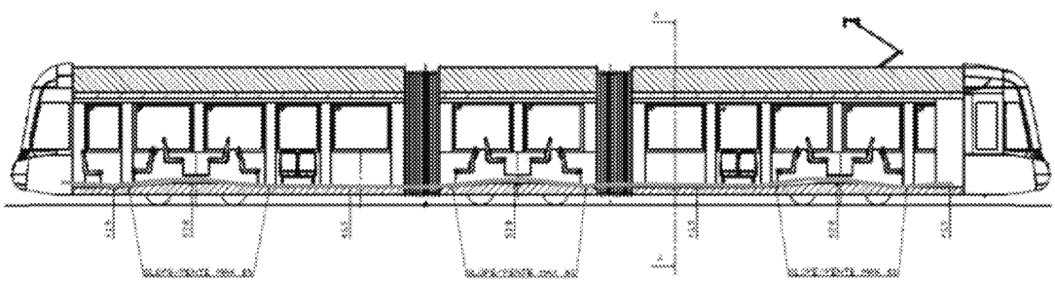
The type of LRV proposed (general arrangement, performance level, etc.);

3 – DESCRIPTION OF PRODUCTION PROPOSED

To meet widespread requirements requested by the industry, an innovative product line termed CITADIS DUALIS - a variant of the CITADIS product range was created by ALSTOM. Just like the CITADIS tramway, the interior and exterior design is adaptable to customer specifications and its modularity allows, train formation consisting of 3, 4 or 5 bodies and used in multiple units.



Capable of running on 750V, 25 kV or 1500 V power, the Citadis Dualis is compatible with both a regional or urban network. Equipped with a high power but compact motor, it integrates a « dropped floor » design and ensures a commercial service speed of 100 km/h.



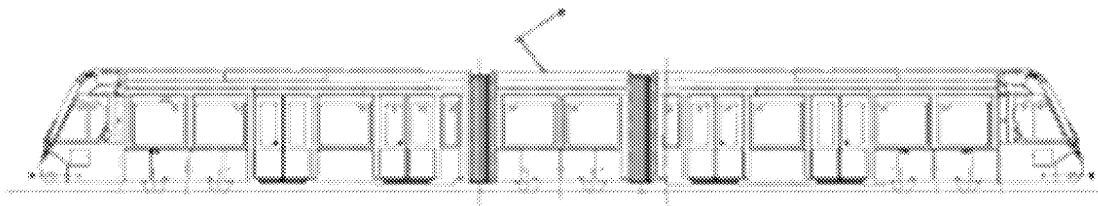
Compliant with EN 15227 crash standards, it has SNCF homologation and has been running in commercial service on the Nantes-Clisson (France) since June 2010.

In the framework of the OTTAWA contract, the CITADIS DUALIS train consisting of 3 carriages is proposed.

ALSTOM

Composition of train:

The train will consist of 3 carriages 30 meters long and 2.65 m wide equipped with a 100% low floor.



It can be proposed either in the dual or single cabin version, running in multiple 5-train units.

The capacity of the train will be about 200 passengers under AW2 conditions (4 passengers / m2).

The dimensions of the vehicle comply with tables 4-3.1 and 4-3.2 of the RFP. The maximum weight of the train under AW0 conditions is 47 tons and 71 tons under AW4 conditions calculated on the basis of a mean weight of 70 kg per passenger. The weight distribution of the train complies with chap. 3.8 of the RFP.

The traction/braking performance of the vehicle complies with table 4-3.4 of the RFP, particularly with respect to:
Commercial speed : 100 km/h
Acceleration : 1.34m/s2 under AW2 conditions

Overall, the train is designed to provide 100,000 kilometers of commercial service per year when supported by optimized maintenance, for a period of 30 years

Noise performance :
The train complies with requirements on emission of noise and in particular the following
Parked:

- 68 dBA inside the train
- 70 dBA outside the train, at a distance of 20 meters.

Running at a speed of 100 km/h:

- 78 dBA inside the train
- 80 dBA outside the train, at a distance of 20 meters.

EMC performance:

The train complies with standards governing EMC.

Fire-Smoke hazard standards

The train complies globally with standards NFPA 130, 49 CFR part 238 and BSS 7239. The floor and ceiling are designed in compliance with standards ASTM E119, NFPA 130 and 49 CPR part 238.

Environmental requirements:

The train is compatible with the environmental requirements stipulated inthe contract ingress of water indicated in paragraph 3.4

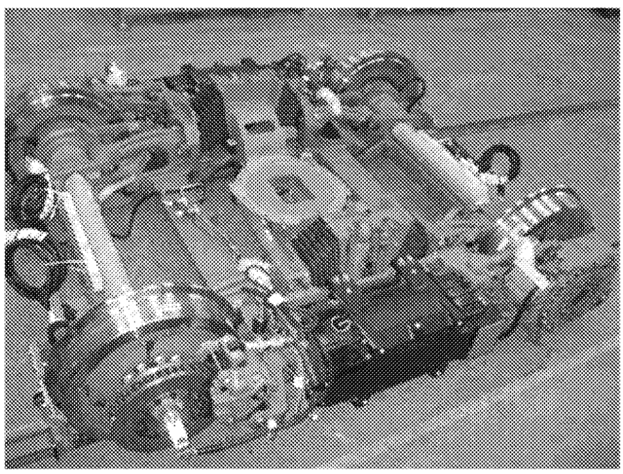
Interfaces with the environment:

The vehicle shall be compatible with the different interfaces (tunnels, traction power, Train control, signalization, SIV, other equipment present in the depot)

Operation in Multiple units:

Each end of the train is equipped with an automatic and foldable coupler to accomplish the coupling and uncoupling operations needed to form a multiple unit convoy

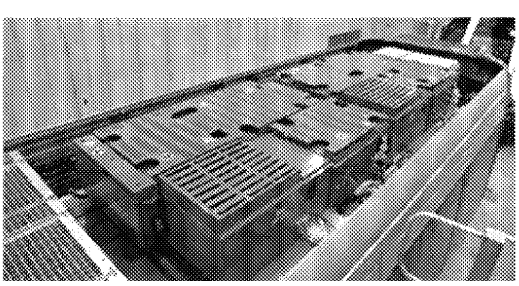
Trucks:

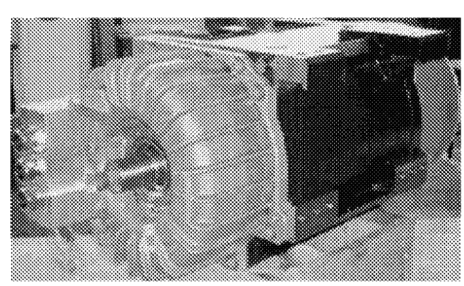


Each carriage will be equipped with a truck: a power truck for the end carriages and a trailer truck for the central carriage. Each axle of each truck is equipped with an independent disk brake. An automatic leveling system will maintain the level of the floor of the carriage constant with relation to that of the platform.

Traction:

Each power Truck is equipped with 2 independent axles moved by a synchronous electric motor with a permanent magnet (PMM) controlled by a traction box mounted on the roof.





Current collection & Auxiliaries :

A current collection system by pantograph supplies the train with power at 1500 volts for the traction drive and a auxiliary converter that in turn supplies the air conditioning system, the compressor, low truck voltage network and the battery charger. The train is equipped with 2 independent battery boxes.

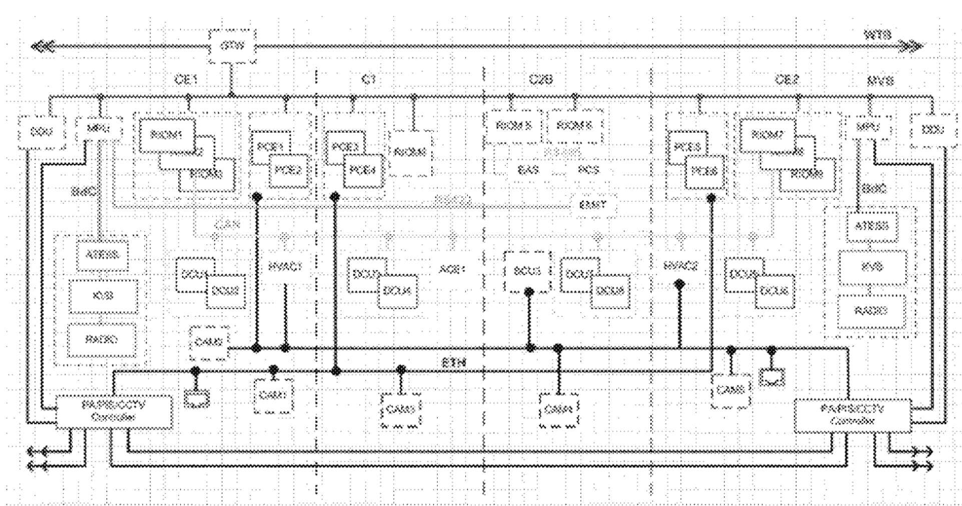
Train Control & Monitoring System (TCMS):

The Train Control and Monitoring system (TCMS) aims to process a maximum of functions. The TCMS is the combination of hard wired logic and data processing. The TCMS software is developed according to the SIL 0 level defined EN50128 using an internal development platform and a dedicated programming language based on standardized programming language for industrial automation.

Hard-wired logic will therefore be maintained for safety circuits, function that needs high availability (mainly for degraded mode), simple function (i.e: windscreen washing), or power circuits.

The TCMS interfaces a large number of sub-system, such as Brake, HVAC, Traction, PACIS, Recorder, Auxiliaries and many others through different networks such as MVB, CAN or Ethernet networks.

The architecture of the TCMS consists of 2 redundant MPU (Main Processor Unit), 2 Driver display units, several Remote Input/Ouput Module (riom) and WTB gateways. The RIOM interfaces Low voltage logic and acts as gateway for CAN or RS485 networks. The MPUs and DDUs are also connected to an Ethernet Network used for maintenance purposes and PACIS function.



TCMS architecture of a Citadis Dualis

The MPUs centralizes the default and events at train levels, based on data send by sub-system control units or monitoring data computed by the MPU software. These data are used to display train status to the driver and assistance for driving. Maintenance Data are also stored in FIFO memory. It can be displayed for maintenance purposes on dedicated DDU pages and can be locally or remotely retrieved. The maintenance data aims to identify the LRU in default, as detailed defaults are available locally on each subsystem.

Passenger doors:

The train is equipped on each side with 4 bi-parting sliding plug powered per train face. There is also an obstacle detection system to ensure passenger safety , a tried and proven control panel system controls door closing and opening in accordance with the protocol described in the specification. Door lock-out systems enable the door to be isolated in complete safety whilst keeping the remainder of train in service. The train is also equipped with internal lock release systems to enable doors to be opened in the event of an emergency in complete safety. Each door will also be equipped with a pushbutton to enable the passenger to open the door manually

Intercar gangway:

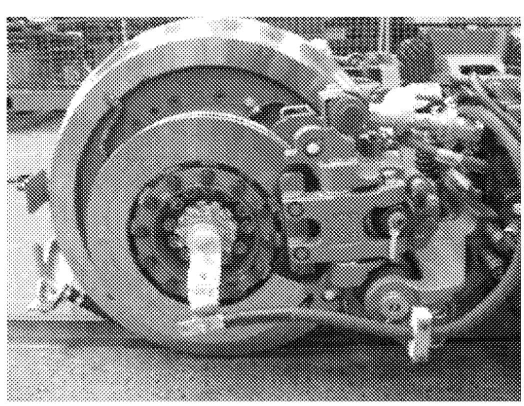
An intercar gangway is installed between each car offering a 1.2-meter wide passage via a double row of bellows. The floor and roof in the gangway are designed to accommodate the relative movement of parts when passing through curved track sections.

Heating and air conditioning system:

The heating and air conditioning system comprises 2 units mounted on the roof on the end cars, together with a heating system and ducts fitted into the carbody, providing a temperature of 19 to 22°C inside the car regardless of the external climatic conditions in ASHRAE. It is endowed with a control system enabling the temperature inside the train to be adjusted and kept constant to within plus or minus 2°C around the level selected.
A separate independent system will be installed above the driving cab to ensure the comfort of the driver.

Braking system:

The braking system appropriately combines mechanical and electric braking systems for the different braking scenarios through a tried and proven electronic control system. All the bogeys are equipped with a hydraulic braking system , a mechanical parking brake and a magnetic track brake.
Operating in conjunction with the disk brake system, a sanding box and wheelslide prevention system are installed on the train

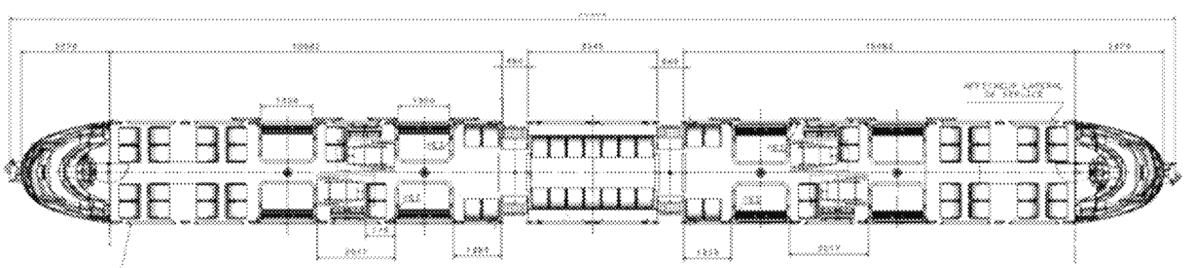


Carbody shell:

The outer faces are straight and endowed with upper and lower trimming insignia making for a harmonious appearance. The design proposed for the ends of the train will be contemporary whilst at the same time complying with applicable crash requirements. The carbody shell is in steel / aluminum or FRP and is designed for an expected service life of 40 years. The vehicle is insulated in order to comply with the stipulations of the specification within a temperature gradient around the temperature selected, for conditions of performance down to an external temperature of –25°C. It is dimensioned to meet the requirements indicated in tables 4-3.6. and 4-3.7 (compression, static load in either direction, coupling at different speeds).

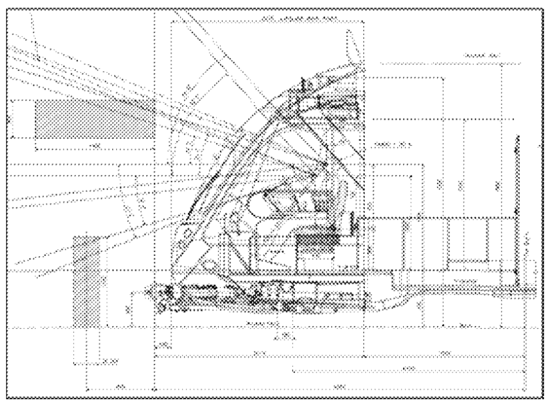
Internal diagram in passenger areas:

A combination of lateral, longitudinal and flip seats will enable passengers to move about inside the train, particularly during rush hour periods. The train will be provided with 4 clear areas equipped with flip seats to provide access for wheelchairs, prams and bikes…Holding bars will run along the full length of the train to enable the passengers to stand in a safe and table position. The inside of the vehicle is designed to be covered adhesive film. An LED lighting system will be built into the ceiling to enable and lighting zones to comply with the different scenarios indicated in the Request for Tender.
Wide dark-tinted window bays provide natural lighting inside the train.
Destination display panels will be situated on the front and on each side of the train.
The side faces will enable messages concerning information and safety of the passengers to be displayed.



Cab equipment:

Rules of ergonomic practice have been adopted in designing the cab (lighting, angle of visibility cone, accessibility of controls, heated driver's seat) together with the applicable standards (dimensions of side windows and windscreen). The cab is separated from the passenger compartment by a partially glazed partition and fitted with a lockable door. It is installed with all the necessary equipment for driving the train in full safety (windscreen wipers, lights, klaxons…). A mock-up constructed during the design phase shall enable the different aesthetic , ergonomic and functional aspects of the driving cab space to be validated. The driver has at his disposal several screens, including a rear-view screen displaying the sides of the train when in a station and on track thanks to video cameras. The driver's desk shall include all the necessary equipment to enable the driver to communicate with the operating system or passengers.



Ergonomic study for SNCF

Technical documentation:

The following is a list of the principal documents which shall be provided to the customer:

- The train technical file
- The homologation and security folder
- The maintenance folder
- The train validation plan (traction, braking, air conditioning/heating , noise abatement, EMC, carbody shell ...)
- Report on conformity with fire-smoke standards
- Report on routine series tests for each train

Aesthetic design of train:

The Design & Styling Department of Alstom Transport provides assistance in finalizing the internal and external design of the train to meet the desires of the end customer.

Performance, reliability and safety of the proposed vehicle in similar climatic conditions;

AVAILABILITY PERFORMANCES

CITADIS DUALIS has been designed in such a way that it allows quick replacement of defective parts. Under the French SNCF operating conditions, this design allows us to ensure a high level of availability equivalent to those specified in the RFP (99, 99%).
Similar Process will be used for Ottawa LRT project

SAFETY PERFORMANCES

The safety holds an central place within ALSTOM Transport. A dedicated organization is in charge of this activity structured in network within Alstom share best practices. A project safety Assurance Manager is appointed for every project. Fire and smoke specialists provide support to the Project Team.
The ALSTOM's commitment is to supply a reliable and safe rolling stock. The development and manufacturing of the CITADIS DUALIS are based on the European standards:

- EN50126 "specification and demonstration of the reliability, the availability, the maintainability and the safety (RAMS)"
- EN50128 "Communication, signalling and processing system – software for railway control and protection systems"
- EN50129 "Communication, signalling and processing system – safety related electronic systems for signalling

This section shows typical levels of security for key equipment on the existing CITADIS DUALIS:

- Non-compliance with the performance of an emergency braking CITADIS DUALIS (4 cars) in a single unit at maximal load activated at 100 km /h and 1.5 m / s ² is <10-7 / h
- Inadvertent opening of a door of a passenger CITADIS DUALIS (4 doors per side) in a single unit is <10-9 / h
- Inadvertent de-coupling between CITADIS DUALIS trains in multiple units without activating an emergency braking is <10-9 / h
- No release of the emergency brake and safety device (command + execution)$<10^{-9}$/ h
- SSIL 2 on traction and passenger access doors software

Those levels will be implemented on the Ottawa LRT, in compliance with the NFPA130 standard, or winterisation requirement. Safety studies are an integral part of development described in Section Design for Quality and are part of Project design reviews deliverables.

RELIABILITY

Aside from Safety, please find below Current Citadis service proven reliability figures

Reminder of the definitions

Amongst all the failures counted, 3 levels should be distinguished for which target values of the failure rates have been defined, namely:

Categories	Definition
A	Service failure means that the train cannot continue to maintain business operations or failures that have greater impact on business operations, including : - Rescue: requiring another train to trail the failing train to the depot - Transfer of passengers in another train (not in station)
B	Failure which is not A type and : - Delay > 5 mn - Withdrawal : train set without passengers to return at depot - Exchange of the train set at the beginning of the mission
C	Failure which is not A and B type : - Exchange of the train set at the end of day - Exchange of the train set at the end of round trip - Failure detected in maintenance - …

The above table does not include failures caused by vandalism, accidents or incorrect manoeuvres by a passenger or operating agent.

Reliability commitments for the CITADIS DUALIS

The following are our reliability commitments for a CITADIS DUALIS :

Final objective:

Categories	FPMK	MDBF (km)
A	1,8	555 555
B	15	66 666
C	300	3 333

These target failure rates correspond to a measurement made on the fleet of vehicles as a whole, on reaching maturity. The failure rates will be determined each month for the fleet of vehicles as a whole.

The failure rate commitments of above table are final objectives, assuming a minimum fleet of CITADIS DUALIS with each vehicle running 110,000 km every year.

These commitments concern the basic vehicles, excluding options and “invited” functions, like PIS, dispatching, Reliability growth

The following is the reliability growth curve, on the basis of the above assumptions:

Operating phase	Reliability
When the fleet starts commercial service	$5 \lambda o$
12 months after starting commercial service	**2** λo
Between 13th and 24th months after starting commercial service	λo

Achievement of objectives

The reliability will be calculated each month with a confidence level
The final reliability commitment for the fleet shall be considered as achieved when the following condition is met:
an MKBF $_{bome\ sup}$. [Measured over a 6 sliding month basis] $\geq$ $MKBF_{commitment}$
(or expressed by the failure rate: λ_{inf} [Measured over a 6 sliding month period] $\leq \lambda_{commitment}$).

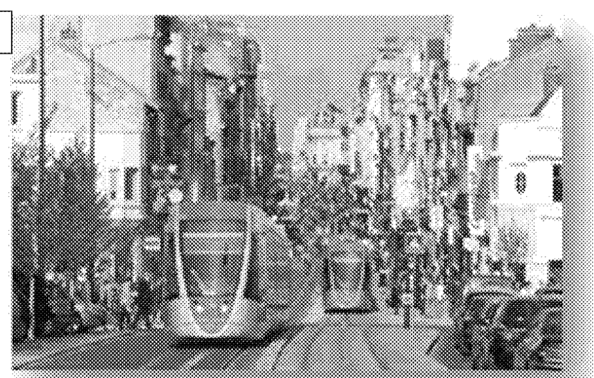
Service history of proposed vehicle (agencies used, years in operation, and number of cars);

REX of the existing product

CITADIS product range

Reims:

This is a turnkey project /PPP project
N° of trains: 18
Commissioning date: October 2010
Tram life service: ALSTOM



Barcelona:

This tramway is a turnkey project
N° of trains: 41
Commissioning date: April 2004

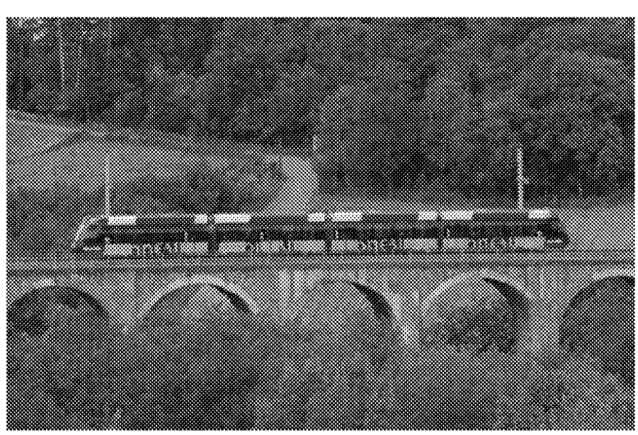
CITADIS-DUALIS product range

Nantes

N° of trains: 7
Commissioning date: June 2011.
The trains consists of four 25 kV/750 V cars operated by the SNCF.
Additional order of 17 trains currently being manufactured and will be progressively broughtt into service by end of 2012

Lyon

N° of trains: 24
Commissioning date: May 2012
CITADIS DUALIS 1500 V/ 750 V. Trains are undergoing validation and homologation in the Lyons region (France).

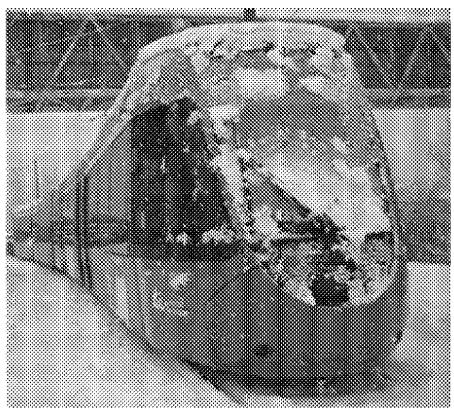


Redesigns/modifications/variances intended for the Project application of the proposed vehicle; and

WINTERISATION

Adaptation of the present CITADIS DUALIS range

As already pointed out, the CITADIS DUALIS range is already designed for commercial service at a temperature of –25°C (standard EN 50125-1).



CITADIS DUALIS during traction test

Backed by our experience on regional trains in Sweden and Finland and our partnership with Transmasholding for Russian and Kazakh trains, the Citadis Dualis product will be specifically adapted to take into account the climatic requirements of OTTAWA (very low temperature, snow and ice). In order to guarantee the performance requirements specified some adaptations will be implemented as follow:

Most of the adaptations involve the following:

- protection of the electronic equipment
- replacement of certain materials (steel, joints,..)
- reinforcement of the insulation and the draining
- heating of certain articles sensitive to dew points condensation such as nozzles, pneumatic circuit pipes, threshold…

The full winterization analysis of the Citadis product range has already been performed by our engineers as several offers have been realized, elected and under contract negotiations for St-Petersbourg and Kazakstan where similar or more stringent climatic requirement are specified.

ALSTOM

Successful winterisation experience: Winterization of the CORADIA Duplex range

As an example, in 2000, winterisation works was carried out similar on our Coradia Duplex range of trains (TER 2Nng => X 40) :

- TER2Nng operating in France (climate requirements of EN50125-1)
- winterised X40 operating in Sweden (climate requirements of up to -40° C)

The technical adaptations are similar to those planned for winterizing the CITADIS DUALIS (heating, insulation, drainage, etc.) with the addition of a "workshop plugs" to:

- maintain the trains ready for commercial service in case of absence of catenary voltage.
- progressively heat up the train following extended parking time at very low temperature.

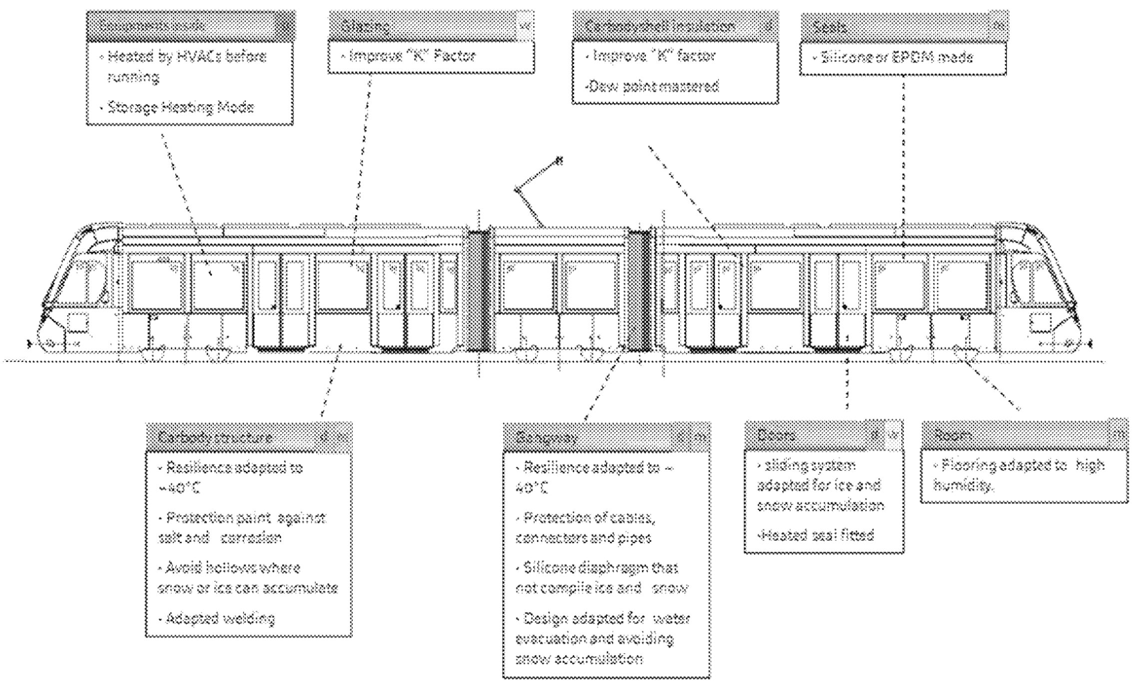
The Coradia X40 trains are also fitted with devices that automatically close the circuit breaker following disappearance/re-appearance of the catenary voltage. These devices enabled us to guarantee quick operability of the train and to attain the contractual requirements for availability and reliability in commercial service. In fact, the progressive temperature rise and/or the temperature hold of the equipment allow the use of standard proven equipment and also make it possible to avoid "stress" that could shorten their standard service life. As to the bogies, passageways and inter-carbody links (cables and pipes), a de-icing/snow removal procedure makes it possible to ensure service under the best conditions, with the frequency adapted to the climatic conditions. On Coradia X40, it included two devices:

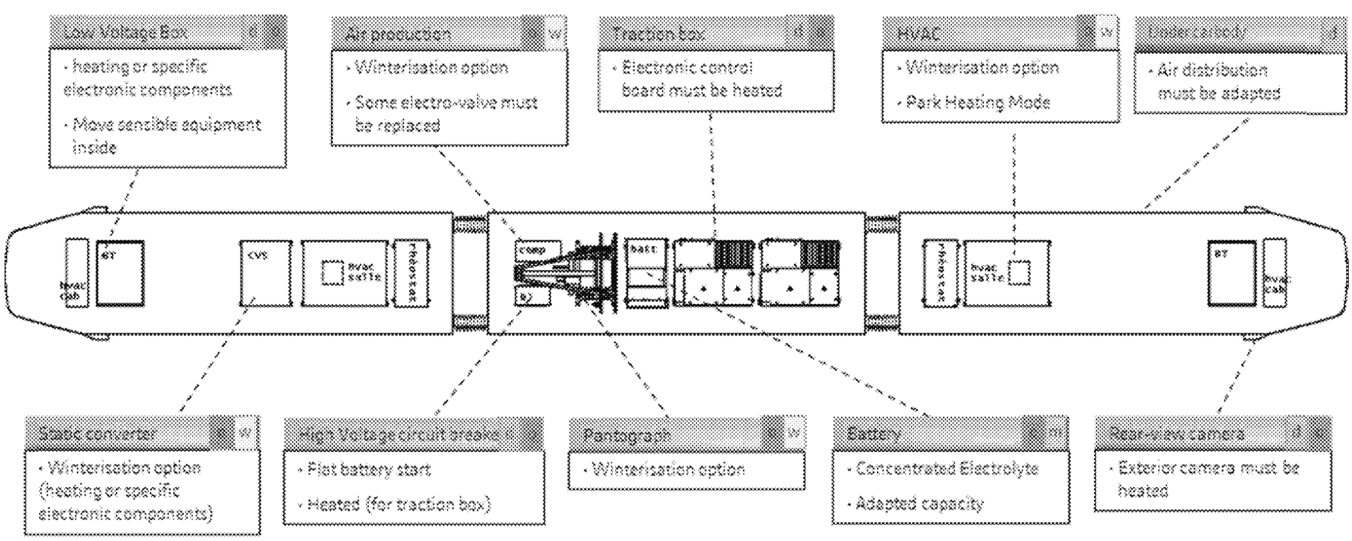
- spraying of the bogie to remove ice and snow (on the exterior)
- blowing of hot air on the entire train (in the depot)
  Winterisation of the Coradia duplex was perfectly executed within the contractual schedule and fully met the required performance criteria.

Description of adaptations planned for the current CITADIS DUALIS range:

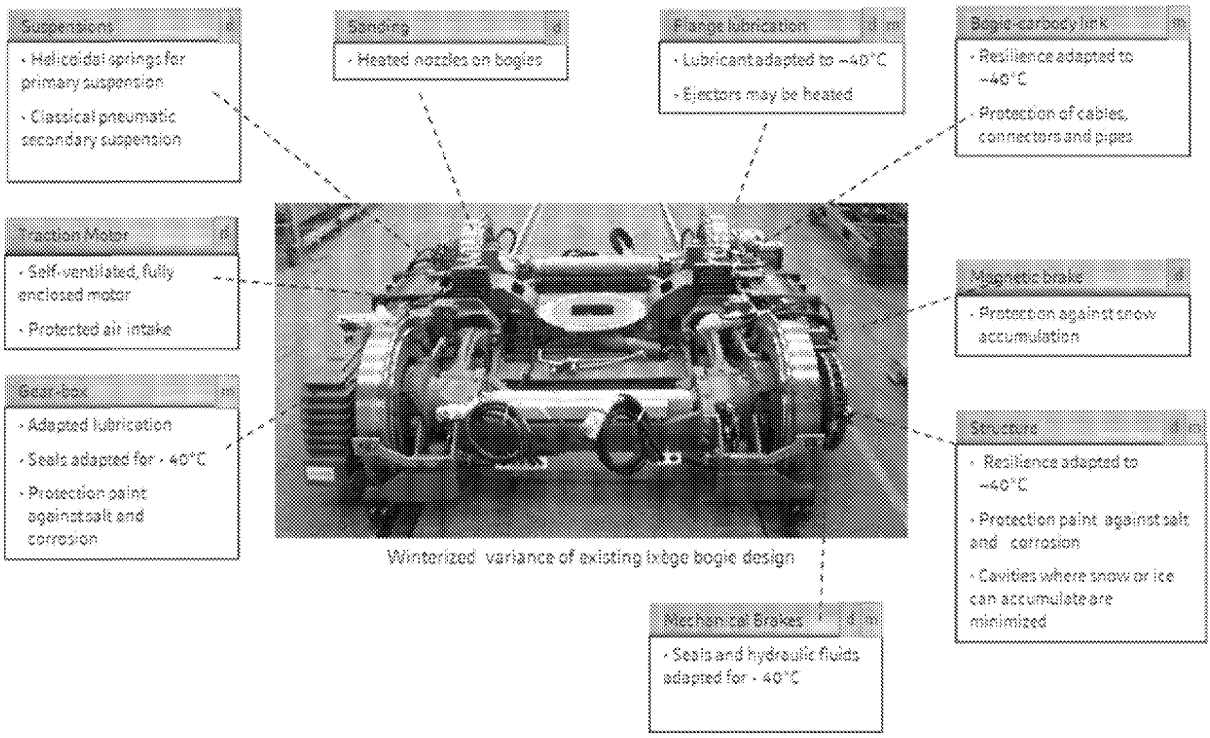
Please find enclosed the detail of the adaptations analysed and required for the Ottawa project under the climatic conditions stipulated and performance requirements.
The colour codification shown in the schematics corresponds to the adaptations described hereunder:

- d — "Design" – Adjustment of the sub-assembly design as a function of winterisation adaptations
- o — "Operational" - Prerequisites of operating conditions
- w — "Winterisation option" - option already included in the supplier range
- m — "Material" – Change or reinforcement of material subjected to T° constraints


Equipments inside
- Heated by HVACs before running
- Storage Heating Mode
Glazing
- Improve "K" Factor
Carbodyshell insulation
- Improve "K" factor
-Dew point mastered
Seals
- Silicone or EPDM made
Carbody structure
- Resilience adapted to -40°C
- Protection paint against salt and corrosion
- Avoid hollows where snow or ice can accumulate
- Adapted welding
Gangway
- Resilience adapted to -40°C
- Protection of cables, connectors and pipes
- Silicone diaphragm that not compile ice and snow
- Design adapted for water evacuation and avoiding snow accumulation
Doors
- sliding system adapted for ice and snow accumulation
-Heated seal fitted
Floor
- Flooring adapted to high humidity.


Low Voltage Box
- heating or specific electronic components
- Move sensible equipment inside
Air production
- Winterisation option
- Some electro-valve must be replaced
Traction box
- Electronic control board must be heated
HVAC
- Winterisation option
- Park Heating Mode
Undercarbody
- Air distribution must be adapted
Static converter
- Winterisation option (heating or specific electronic components)
High Voltage circuit breake
- Flat battery start
- Heated (for traction box)
Pantograph
- Winterisation option
Battery
- Concentrated Electrolyte
- Adapted capacity
Rear-view camera
- Exterior camera must be heated

ALSTOM



Winterized variance of existing Ixège bogie design

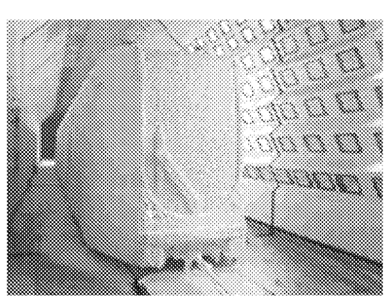
All of the modifications described above do not form major challenges for Alstom and remain within the normal course of customisation adaptations required on our proven and standard products within the specific context of each project.

These technical arrangements, associated with the adapted operational provisions (storage, pre-heating) agreed upon beforehand, will guarantee commercial service at up to – 38° C and will not impact train performance, as required by Ottawa. However, the provisions that are finally retained by Alstom, within the OTTAWA framework, will depend on the train operation and storage conditions specified by the operator.

Validation of adaptations required by winterisation:

For upstream validation of all the adaptations implemented within the scope of CITADIS DUALIS winterisation, a specific plan for component or train level validation will be set up in laboratories and/or on the track.
Climatic tests can be performed in several locations depending on the required test :

- Up to -25°C in La Rochelle ,FR
- Up to -30°C in Hornell, NY or in Ottawa, ON -38°C.
- Up to -40°C In Vienna (included a wind chamber)

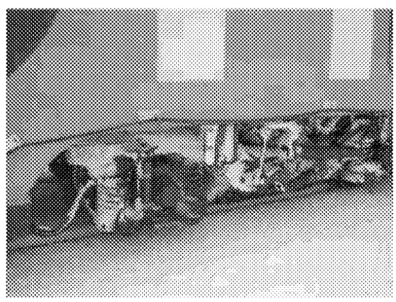


Climatic type test in Vienna

This test is aimed at verifying the static performance levels of the vehicle (heating/air conditioning – temperature distribution inside the vehicle – behaviour of battery/CVS, etc.) in the contractual temperature range mentioned in the contract.

Other type tests at train level will be performed on track. The main verifications to be done are the following:

- stabling or parking in extreme cold
- start up of stabled train during extreme cold (electronics, batteries, pantograph, auxiliary air compressor, braking oil systems, heating of the cab and of passengers compartments ...)
- start up during snowy conditions (pantograph, windshield heating and wiper, ventilation systems ...)
- operation during extreme cold in particular due to icing following the way out of tunnels or depots (pantograph, gangways, traction with ice on catenary, doors, bogies, wheel speed systems, hoses..)
- operation during snowy conditions (air intakes of traction, heating and other systems, pantograph, doors, bogies ....)



X40 Winter Test in Sweden on Luleå – Ånge line (13 km)

With Regards to the signaling system, all trackside components will be installed in heated central or local technical rooms. The onboard components all operate at down to -40°C.

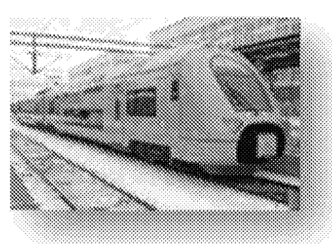
For the track products we propose the proven P80 switch machine which operates at down to -40°C and is installed in Nordic countries. This switch machine can be heated if required.

Please refer to the attached datasheets.

The following section illustrates different trains which have been commissioned and are in commercial service by ALSTOM TRANSPORT for operating conditions similar to those of OTTAWA.

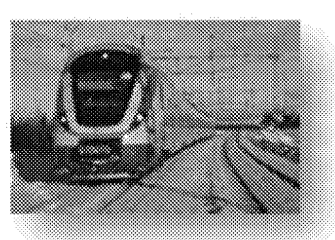
SWEDEN

Coradia Nordic product range type X40
Qty of trains: 43
Commissioning date: October 2004



SWEDEN

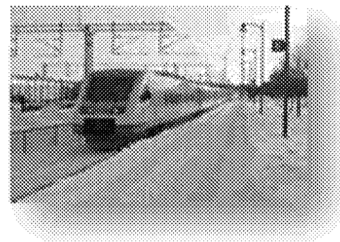
Coradia Nordic product range type X60
Qty of trains: 71+12
Commissioning date: 71 trains in 2002
12 trains in 2010



ALSTOM

FINLAND

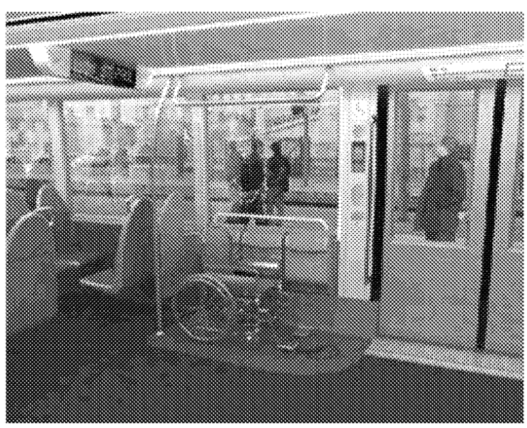
Pendolino product range
Qty of trains: 42
Commissioning date: 2002



ADA/ADOA adaptation

Specific NAM standards fit verification will be worked out on the Ixége type bogeys.

Regarding ADA, a leveling system already in service in the MP05 METRO and X40, will be reused to ensure a constant distance between the height of the platform and that of the train floor, regardless of the loads in the train. No specific maintenance will be required to this leveling device. Our interior design focuses on facilitating circulation of disabled persons and the overall flows of passengers aboard the train.



Adaptation to NFPA130 / FIRE & SMOKE STANDARDS

The product shall be NFPA-certified. This Certification will be done with the support of North-American Center of Excellence in Hornell, who have already accomplished similar certifications for projects with New York, Chicago or Atlanta.

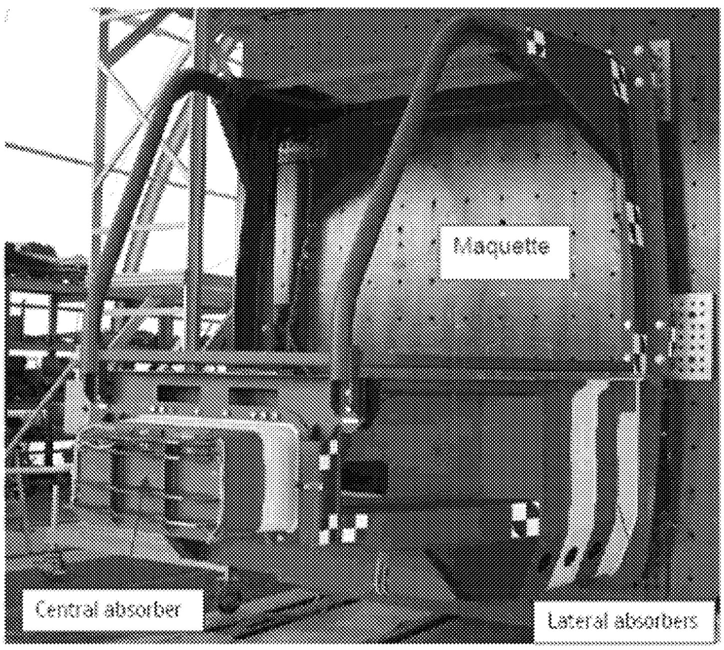
The CITADIS DUALIS product shall be suitably adapted to fully comply with NFPA 130. Minor modifications such as specific wiring assembly rules and material modification will be implemented. These NFPA 130 material adaptations are well known to our supplier base.

Adaptation to ASME

With the current design, the driver's cab and the driver himself are protected via a system anti-crash compliant to the EN 15227. Current CITADIS DUALIS trainset exceeds the crash requirements as defined in the standard EN 15227 C-III.

Although the ASME and EN 15227 are comparable, a complete validation process for OTTAWA LRT will be performed again using calculation note and / or full-scale test.

The design will be done in partnership with Alstom Reichshoffen site (France, Alstom Transport Center of Expertise in for body structure and passive safety. It is equipped with a platform crash test, used for the CITADIS DUALIS cabin in 2009 (see photo below)



Vehicle testing and commissioning schedule and strategy

VALIDATION / ROUTINE TESTS

Control of design

Alstom relies on a proven DFQ (Design for Quality) design validation process which systematically validates and ensures that contract requirements and milestones are fully meet and respected.
Design reviews with suppliers, the customer, and internal partners (Truck, traction, signalization , infrastructure …) take place at regular intervals as each design phase is accomplished.
GO-NO GO project reviews are organized with the full Project core team and platform management to ensure that the project progress matches and complies with the contract milestones.

All the above are embodied in the V-cycle illustrated below.

ALSTOM

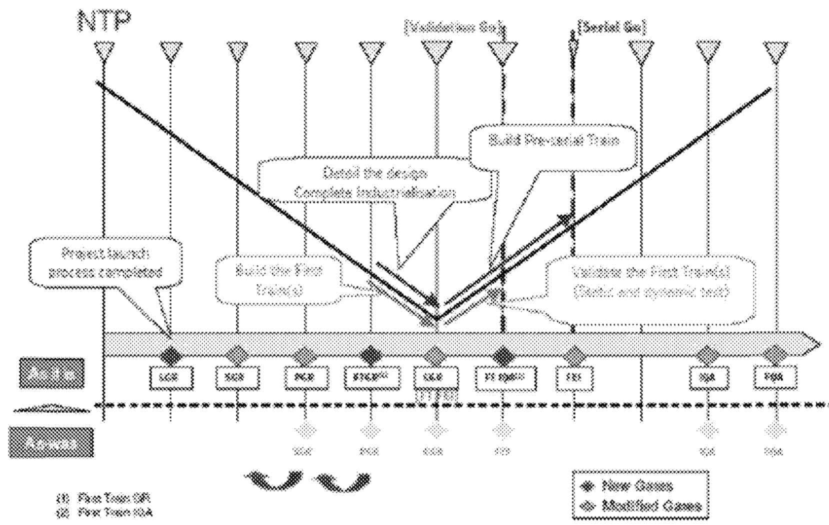


Figure z – Jalons GR

Control of purchases

We attach the utmost importance to validating the quality of our outsourced products. To this end, a specific quality process termed SFQ (Sourcing for Quality) is set up and a dedicated person (the SQA) shall stand warrant for compliance of procedure for issuing orders, right up to delivery of the First Article at the site. In particular, the SQA shall ensure compliance with the contracts specifications and quality of the human and material resources applied to ensure quality throughout execution of the order.

Control of industrialization

Control of industrialization is a major parameter for successful transfer of technology to another production site and to provide the customer with the necessary and sustainable quality level.
Accordingly, during manufacture of the first train and with each stage in manufacture of its subassemblies, formal meetings are organized by the PrIM (Industrialization Project Manager) in the workshop with all the entities involved (Design office, Industrialization , logistics , supplier quality, industrial quality, team leader, …) in order to check that all the parameters have been brought together to ensure high quality series manufacture of the product.

Control of validation

Validation of the train takes place in several stages:
Validation of each individual subassembly:

- Validation of subassembly combines several parameters, depending on the subassembly concerned:
- Material tests in compliance with the applicable standards
- Static, dynamic and endurance performance tests
- Integration tests
- FAI (First Article Inspection) at the supplier's plant

Validation on the train during the pre-testing manufacture phase:

- Validation of manufacture by GO/NO-GO during each key subassembly manufacture stage
- Validation of the electrical circuits

Validation on the train by type tests:

As a general rule, these test are conducted once and once only on the complete manufacturing line, enabling the functional performance of the train to be verified during normal and degraded operation in accordance with the specification, before starting series manufacture :

For example :

- Compliance of the gauge limits under extreme operating conditions
- Compliance with acoustic, EMC , climatic constraints…
- Compliance with traction/ braking performance
- Functional compliance of « guest » equipment (SIV, signalization)…

The location of these tests varies (ALSTOM test tack, customer test rack, external laboratory…)

Validation on the train by routine tests:

As a general rule, these test are carried out on each manufacture item or each train in order to check the functional performance of the train in the normal operating mode :

For example :

- Weighing the train
- Tightness of the train
- Functional tests, doors …

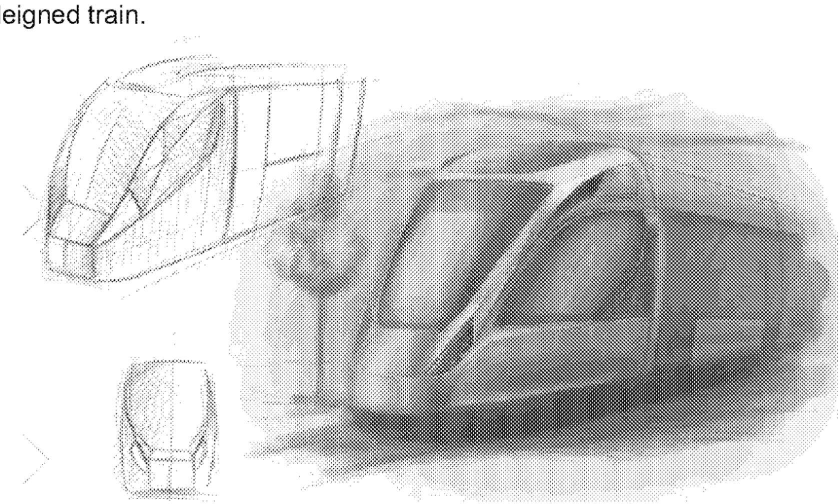
A preliminary plan summarizing equipment's compliancy is presented to the customer during the tendering phase. If the equipment has already been validated against given references/specifications, the test will not be repeated if the test results exist and are made available. If the equipment has already been validated in accordance with an equivalent reference, Alstom will be responsible to demonstrate equivalency and provide the relevant test reports.

ALSTOM TRANSPORT KNOW-HOW

Design for Aesthetic: The Alstom Interactive Design Cell

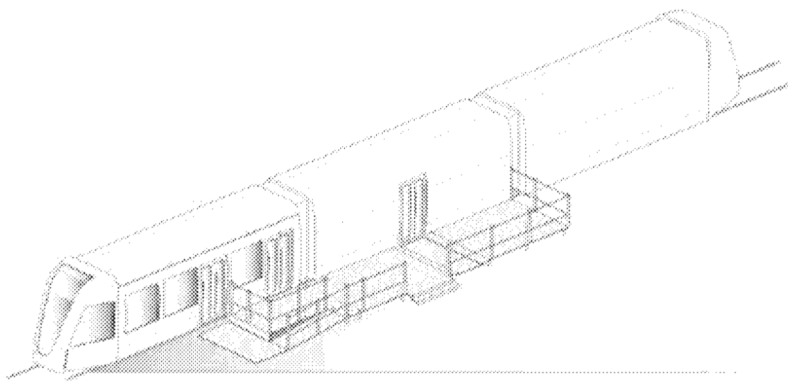
In view of the feedback gained from experience in aesthetic choices in a number of cities for their public transport systems, our Design & Styling department has set up specific cell dedicated to interactive design.

During sketching sessions conducted directly with our Designers, the customer can proceed by successive approaches by successive real-time iterations in order to define the feature, the lines and the physiognomy of what is to become THE CUSTOMER'S personally deigned train.

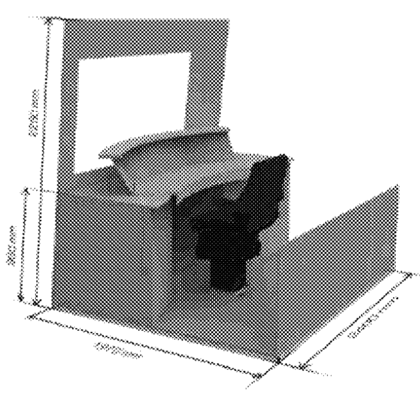


Design Close to the Customer:

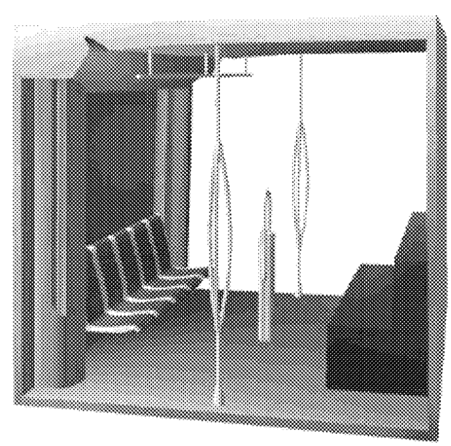
To perfectly match the needs of the customers, the drivers and the passengers, we may execute a number of mock-ups to validate different technical, functional or ergonomic aspects before launching final production of the train.



Mock-up for passengers or authorities



Functional cab mock-up



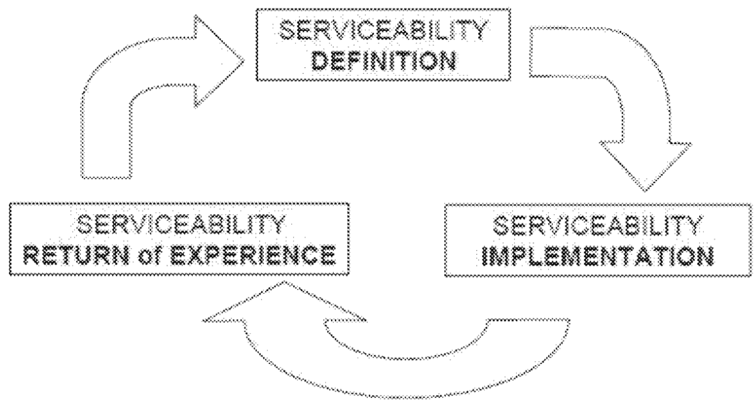
functional passenger area

Design for Serviceability:

In its constant quest to optimize maintenance of its equipment and continuously improve reliability, Alstom Transport includes a TLS (Train Life service) manager in its rolling stock project team right from the beginning of the design phase. This manager will provide his experience gained from existing equipment already in service and ensure optimized

ALSTOM

maintenance of the equipment. He will also set the target levels for cost of acquisition of each subassembly throughout the lifetime of the train.



The contemporary and up-to-date design permitsthe CITADIS DUALIS product to provide an optimized maintenance through:

- Return of experience gained through the CITADIS product range plus further return of experience gained in today's CITADIS-DUALIS products
- « Sensitive » equipment of the Ixége type by locating it outside the bogey unit itself
- Mounting equipment such as air conditioning, batteries, and traction boxes on the roof of the vehicles.

Design for Ecology :

Respect of the environment is a key focal point for the ALSTOM Group. At ALSTOM TRANSPORT, we take care to limit the consumption of the train by applying leading-edge technology and providing our customer with a product featuring a high recyclability ratio.
The CITADIS-DUALIS Product offers the following major advantages:

- Recovery braking
- PMM motors (lower in weight, with better power ratings)
- 94 % recyclability

Train Control

Identification of the proposed train control system, proposed train control system software and hardware including software validation data and a customer reference list.

Proposed train control system

The URBALIS solution is Alstom's standard solution for mass transit CBTC applications.
This URBALIS solution is service proven since 2003, the first application being the successful Singapore NEL.
The URBALIS system is a radio-based CBTC based on a proven moving block principle. The solution is able to perform all ATC, Interlocking, TMS and Maintenance functions required for automatic mass transit rail operation with Train Drivers or for Driverless operation.

The URBALIS moving block principles enables it to achieve the requested performances for Ottawa LRT in particular in terms of headway, RAMS and stopping accuracy. The URBALIS solution has the highest level of safety either with driver or driverless operation.
Also, its advanced and modular architecture enables it to achieve other important performance goals namely regarding expandability.
URBALIS is already compliant with AREMA standards (please refer to Toronto YUS project. Design in closing phase. No deviation left. Refer also to Amtrak already in service).

Primary components of the proposed Urbalis™ system

A Traffic Management System for Automatic Train Supervision function (COTS based), based on the ICONIS™ Alstom solution, with:

- Central TMS servers,
- Front-End Processors,

Interlocking sub-system for Interlocking function

- Central Smartlock Interlocking or Distributed Smarlock Interlocking
- IO modules, based on the Alstom Smart IO product,

ATC sub-system for Automatic Train Control

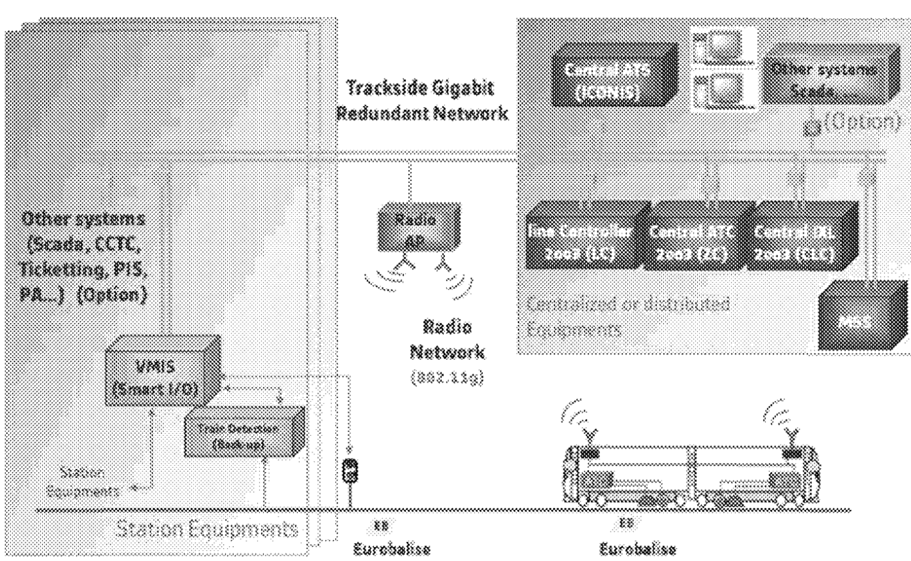
- Carborne Controller,
- Zone Controller,
- Line Controller,
- Data Storage Unit,

Maintenance Support System (MSS) for maintenance supervision (COTS based),

Data Communication System which is made of:

- Fixed Transmission Network (COTS based),
- Radio Transmission System through the free propagation medium (COTS based).
- Network Management system IP and FTN (NMS)

Below an architecture schematic of the proposal CBTC system for Ottawa LRT project :



URBALIS Networked CBTC: General Architecture

CBTC references list

Project	Type	In service
Singapore North-East Line	Driverless CBTC (distributed interlocking and train control architecture)	June 2003
Beijing Line 2	CBTC revamping	June 2008
Beijing Airport Link	Driverless CBTC	July 2008
Lausanne m2	Driverless CBTC	October 2008
Singapore Circle Line	Driverless CBTC (distributed interlocking and train control architecture)	May 2009
Milan Line 1	CBTC revamping	December 2009
Shanghai Line 10	Driverless CBTC	April 2010
Sao Paulo Line 2	« Driverless ready » CBTC (mainline interlocking and train control interfaced with depot interlocking and train control and with Line 1&3 interlocking and train control)	August 2010
Shenzhen Line 2	CBTC	December 2010
Beijing Fangshan Line	CBTC	December 2010
Shenzhen Line 5	CBTC	June 2011
Sao Paulo Line 1	« Driverless ready » CBTC (mainline interlocking and train control interfaced with depot interlocking and train control and with Line 2&3 interlocking and train control)	2012
Sao Paulo Line 3	« Driverless ready » CBTC (mainline interlocking and train control interfaced with depot interlocking and train control and with Line 1&2 interlocking and train control)	2012
Santiago Line 1	« Driverless ready » CBTC revamping (mainline	2012

	interlocking and train control interfaced with depot interlocking and train control)	
Beijing Line 9	CBTC	2012
Beijing Line 6	CBTC	2012
Shanghai Line 12	CBTC	2012
Shanghai Line 13	CBTC	2012
Shanghai Line 16	CBTC	2012
Guangzhou line 6	CBTC	2012
Wuhan Line 2	CBTC	2012
Wuhan Line 4	CBTC	2012
Mexico Line 12	CBTC	2012
Toronto YUS Line	CBTC revamping (train control interfaced with non-ALSTOM distributed interlocking architecture)	2013
Kunming Line 1	CBTC	2013
Malaga LRT	CBTC	2013
Ningbo Line 1	CBTC	2014
Panama Line 1	CBTC	2014
Al Safouh LRT	CBTC	2014
Taichung Green Line	Driverless CBTC	2018

Architecture

As can be seen from the above table, Alstom is able to offer both a centralised interlocking and train control architecture, with the central interlocking (CLC) installed in a central equipment room, as well as a distributed or semi-distributed architecture, based on iVPI with equipment installed in CIHs, as mentioned in the RFP.

A functional description of the train control system and backup methodology in case of communication failure and methodology for broken rail protection.

System principles

A limited set of basic principles is used in order to provide the best easy-to-operate system. These principles are described hereafter:

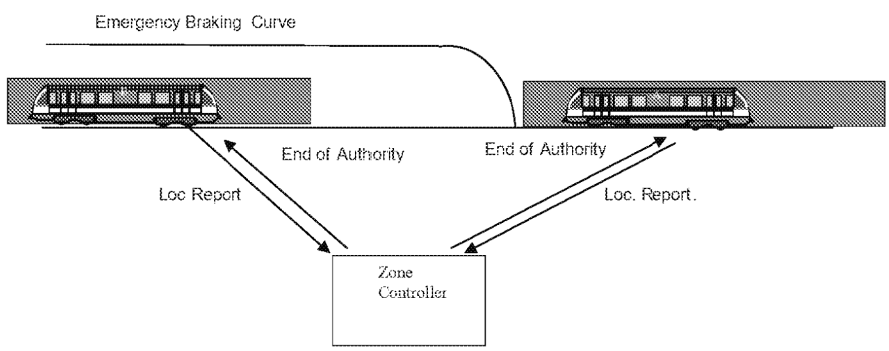
Separate ATC and interlocking functions: A separate ATC and Interlocking ensures that the line will continue to be operated in degraded operation with safeguarding from the Interlocking if a failure occurs in the ATC sub-systems. The CBTC system takes in charge the train separation function in order to reach improved headway performances fully independent of train detection devices' occupancy status.

Separate vital and non-vital functions: This is a requirement of the European standards. By placing the vital functions in hardware different from those used in non-vital functions the safety assurance demonstration is simplified.

Provide fault tolerant data transmission system: The data transmission system plays a major role in the CBTC train control system. Therefore the redundant network covers the whole line and the radio transmission system allows for direct communication between all trains and all trackside equipment at all times, even in case of single point failure.

Use full Redundancy: A high availability is requested in particular for driverless mass transit applications. Full redundancy is used for all critical paths and equipment. In the event a common mode failure should occur, the line can continue to operate under planned degraded modes.

Use moving block principles and "distance to go" principles:



URBALIS™ Moving Block Principle

The URBALIS™ Moving Block system is based upon the following concepts:

Positive detection of Trains: trains localize themselves, and provide regularly their position to the Trackside equipment by means of Localization Report messages. The train localization is elaborated at initialization, re-localization or for precise berthing purposes by using a proven onboard odometer system, and information transmitted via spot (intermittent) transmission (trackside beacons). The Localization Report messages are periodically sent to the Zone Controller (ZC). Each Zone Controller is in charge of a geographical zone.

Moving Block Protection: the Zone Controller collects all trains positions in its area. It attributes a required safety envelope (called Automatic Protection, AP) to each train taking into account: the location, speed and train attributes indicated in the Localization Report, an anticipation component, hence making relevant the Automatic Protection till the reception of the next localization from the train.

After updating all the AP, the ZC equipment calculates for each train the relevant movement authority, and sends it to the train through the End of Authority message (EOA).

The movement authority domain for a defined train is defined by searching ahead of the considered train, the first point to protect such as the AP associated to a preceding train, an uncontrolled route, an undetected point, etc.

Each train is able to determine its speed and distance profile up to the End-of-Authority (considered as a "brick wall").

In the nominal situation described above, the updating of AP is independent of track occupancy from conventional train detection system. For movement authority, the track occupancy status from the conventional train detection system is not used as well, but the route has to be set accordingly. If the route is not set, or if the CBTC train runs in the unauthorized direction, then it receives a restrictive EOA.

For availability and robustness purposes, the URBALIS system is tolerant to the loss of some messages. The shape of AP takes into account (in the anticipation component) possible losses.
For safety purpose, the messages have time validity. When a message is out of date, a restrictive EOA is applied.
In case of degraded situation (non-communicating train), or for non-equipped trains, the ZC performs a tracking of these trains through the occupancy of track circuit areas.

Backup methodology in case of communication failure

Trackside ATC failure:

In case of total trackside ATC failure, fallback interlocking operation is possible. Train spacing function is ensured by line side signaling. Restricted Manual mode is available to drive the train at a limited speed. The speed limit is controlled by onboard ATC.
In case of trackside ATC restart, the system operation is recovered when all train locations are discriminated by the trackside ATC. Trains are discriminated on secondary detection boundary with condition on secondary detection device length for tail discrimination. Typically, the train locations are fully discriminated when they stop in a station.

On board ATC failure:

In case of loss of localization, the on board ATC applies EB until the train is stopped. Then the train shall be driven manually until the train is localized.
In case of onboard software reset, the on-board restart time is lower than one minute. Then the train shall be driven manually until the train is localized.

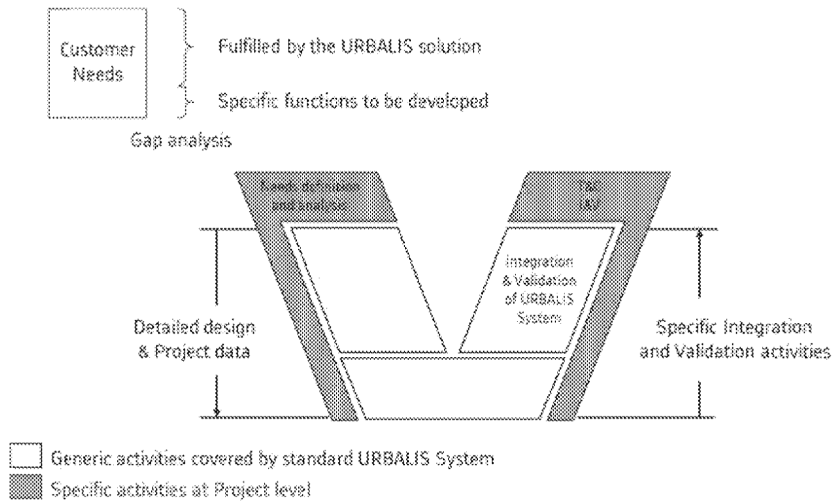
Broken Rail detection

ALSTOM proposed track circuits solution for the secondary detection.
When ATC detects a default between the information coming from the Interlocking and the information coming from the train located on the track, failure information is generated on this track circuit. The Maintenance System generates an alarm sent to the ATS operator.

A train control installation, testing and commissioning schedule and strategy.

For Urbalis deployment process, the tests and commissioning are starting in factory.
Before sending hardware on site, some Factory Acceptance Tests are performed in the ALSTOM factories or in ALSTOM partnerships.
The Urbalis Software is validated in a Factory Integration and Validation Platform for generic and specific parts.

The schematics below shows the Design, Integration and Validation Process of Urbalis Solution :

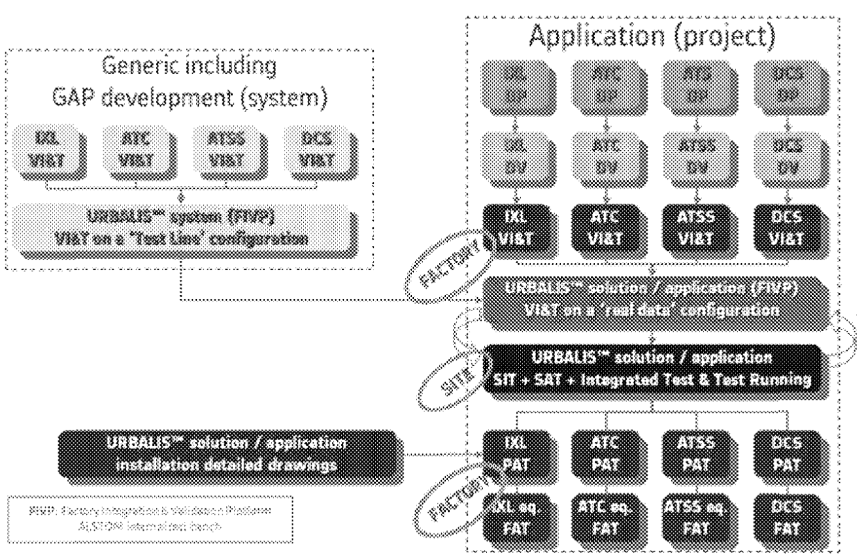


URBALIS™ system deployment for CBTC application

URBALIS™ solution is a generic platform configurable with parameters. This generic platform is already integrated and validated with generic data, and it is instantiated for deployment with specific project data.

The benefits of this strategy are multiples :

- No need to redevelop a new solution for each project
- The solution built on experiences then it is benefits from previous projects
- The solution is proven, mature and safety mastered
- The "platforming" method allows better ability to react and better traceability with regard to the specifications changes.



Overall view applied for the Testing Strategy

According to this organization and strategy, 70% of all Integration and Validation Process is performed in factory.

From installation phase to revenue service, the commissioning is composed of different progressive activities:

- Vehicule and Train Control Static Tests
- Vehicule and Train Control Dynamic Tests
- Train Control Trackside Integration Tests

- Train Control On-Board Integration Tests
- Vehicule and Train Control System Acceptance Tests
- System Trial Running

A description of the proposed yard operation and control strategy.

ALSTOM has several operation strategy processes for the depot management.

- The depot could be full CBTC signalized, meaning there is no stop between the exit of the mainline and the stabling where the trains shut down during the service end. Trackside Train Control and Interlocking equipment manage the system in this case. This solution brings same level of signaling features in depot than in mainline. Usually, a test track is installed somewhere in the depot to test the train after maintenance or for the project commissioning.
- The depot could be partial signalized. In fact, there is also an interlocking in the depot. A full CBTC signalized test track as for the first example to perform the same functions is also installed but a driver should drive the train from a transfer track or transfer yard to the stabling area. In this case, the train can run from the mainline to the transfer track in a CBTC mode (ATO for example). The train stops on the transfer track then the driver manages the CBTC mode selector to a manual mode to run the train to the stabling yard. ALSTOM recommends to cover by communication radio all parts of the stabling because of automatic software uploads during the nights for the CBTC on-board equipment.

Below is a table summarizing the different configuration already in service for depot operation :

References	Highest CBTC mode	IXL in depot	CBTC in depot	CBTC Test Track	Transfer Track	Option on-board software upload
Singapore NEL	Driverless	Yes	Yes	Yes	No	No
Lausanne m2	Driverless	Yes	Yes	Yes	No	No
Singapore CCL	Driverless	Yes	Yes	Yes	No	No
Beijing L2	Manual	Yes	No	Yes	Yes	Yes
Beijing Airport Link	Driverless	Yes	Yes	Yes	No	Yes
Milan L1	Manual	Yes	No	Yes	Yes	Yes
Shanghai L10	Driverless	Yes	Yes	Yes	Yes	Yes
Sao Paulo L123	Manual	Yes	Yes	Yes	Yes	Yes
Shenzhen L2-L5 Guangzhou L6 Beijing L9, Beijing Fangshan	Manual	Yes	No	Yes	Yes	Yes

For information, the following configuration has been chosen for Toronto YUS :

References	Highest CBTC mode	IXL in depot	CBTC in depot	CBTC Test Track	Transfer Track	Option on-board software upload
Toronto YUS	Manual	Yes	No	Yes	Yes	Yes

A train control preventive and corrective maintenance plan.

Please refer to the attached document « Maintenance Organization Plan » which is an example of what we would supply for a standalone Signaling system at the tender stage. For general considerations on Alstom's maintenance strategy, please also refer to « vi Maintenance Capability »

ALSTOM uses obsolescence monitoring for all of its projects :
ALSTOM obsolescence management strategy is aimed at covering or mitigating risk of manufacturing and software upgrade. An Obsolescence Management Plan is supplied during the project phase for validation by the customer.

Life Cycle Duration:

For all Signaling equipment, the life cycle duration is approximately 30 years.
The proposed interlocking equipment has a 1,100,000 hr MTBF. Some internal electronic boards have a 500,000 hr MTBF.
The proposed point machines have a life limit of 1,000,000 movements.
For each type of equipment, preventive maintenance is performed during the proposed equipment life cycle. Details of this preventive maintenance will be given during tender phase.
A typical maintenance plan is provided for reference

Operational Performance Requirements

- The Proponent must address the operational performance at an appropriate level of detail as set out in or otherwise referenced in schedule 15-2 of the Project Agreement and must address the following:
- Validation of operational capabilities and capacity through system performance simulations;
- Capability to reliably support the headways required (including single track operation);
- Terminal operations;
- Station dwell time analysis;
- Validation of Operating Scenarios 1 and 2;
- Approach to expansion of the system to accommodate Operating Scenario 3; and
- Projected end to end trip times for manual and ATO modes.

Headway, Trip time and Power supply sizing are identified as main system performance drivers, which require subsystem co-ordination because of strong interactions between them, and resulting from the integration of many external and internal interfaces.

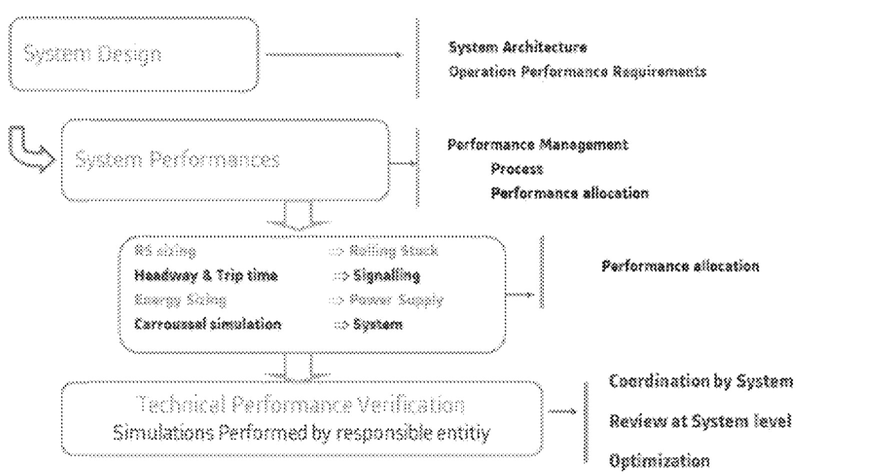
The main impacted Electro- Mechanical subsystems are the followings, and are the ones responsible to carry out the related simulations during the design phase

Subsystem	Required type of performance
Power Supply	DC traction power
Train Control System	Theoretical headway in relation with the required operational headway Performance of the ATP/ATO train driving system to result in high commercial speed
Vehicle	Riding performance (relation to speed, curves and cant) Performance of the traction/braking equipment
System	Carrousel simulation and fleet sizing verification

This approach is integrated into a performance based system design process :

- Identify system fundamental performance requirements
- Allocates the responsibility of each performance to responsible entity,
- Define the reference for Project Technical Data, including operational assumptions and sizing conditions (train load, train driving mode,
- Optimize equipment sizing and architecture
- Validate the chosen solutions

The activity articulates as follows:



System Performance Principle

The activities carried out by ALSTOM for the Vehicle and Train Control systems are the following:

- Headway simulation and trip time calculation
- Vehicle Sizing

The Vehicle and Train Control subsystems are managed like the other lots from a system perspective at EPC Design Coordination level. This ensures proper interfaces management and subsystem performances and requirement allocation and validation (V cycle)

Required transport Capacity

The Request for Proposal identifies 3 operating scenario:

Operating Scenario 1, Opening day operation: 3.25 minutes peak headway and 12,000 PPHPD
Operating Scenario 2, Year 2031 operation: 2.1 minutes and 18,600 PPHPD
Operating Scenario 3: Ultimate capacity operation: no more than 2-minute peak period Headways and 24,000 PPHPD
This implies that although the system will be deployed for the initial stage, then implication of future expansion is to be considered for sizing and simulations. In particular, Headway simulations are to be carried out for ultimate capacity.

Some other requirements are captured in the RFP and will be reflected into the sizing conditions, such as:
Vehicle load standard, Maximum Trip times during peak period or Single track operation during maintenance:

Vehicle Capacity and Headway

A preliminary Vehicle diagram as indicated in the RFP is the following:

- Seated capacity: 62 pass.
- Total capacity (4 pass/m²) : 200 pass.
- Total capacity (3.33 pass/m²) : 177 pass.

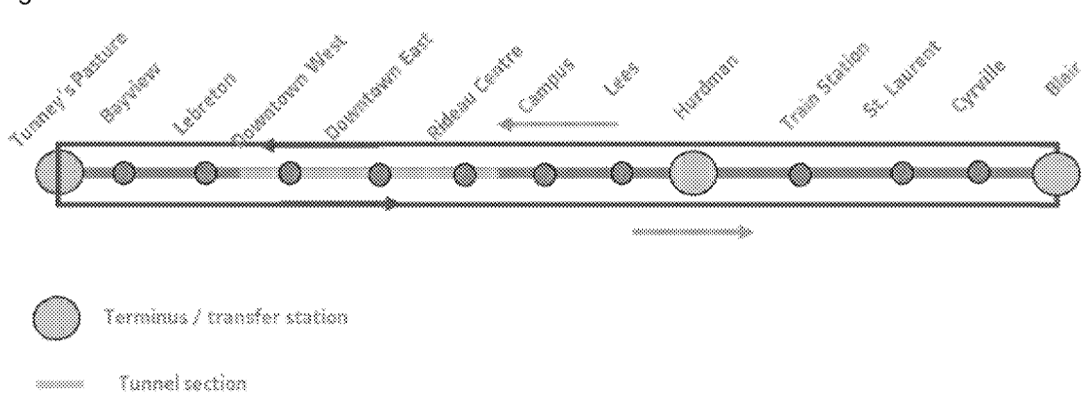
The operating scenario is addressed as follows:

Scenario	Vehicle length	Train transport capacity (Passengers)	Peak Headway (sec)	Transport capacity (pphpd)
Scenario 1	max 120 (4 x 30 m)	708 (3.33 pers/m²)	205	12433
Scenario 2	max 120 (4 x 30 m)	708 (3.33 pers/m²)	135	18880
Scenario 3	max 150 (5 x 30 m)	885 (3.33 pers/m²)	130	24507

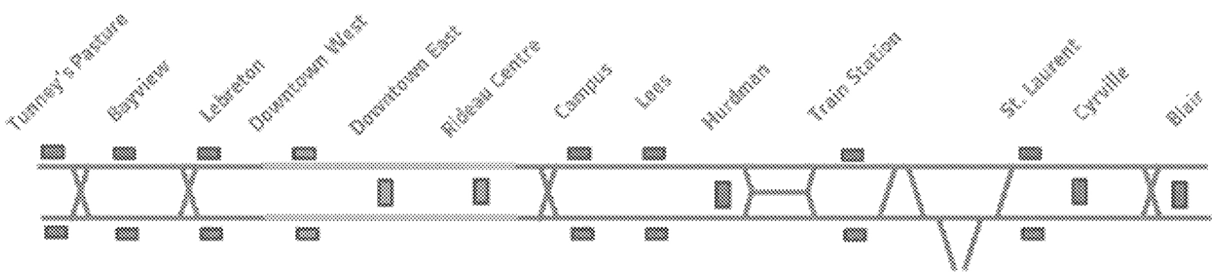
This calculation is to be confirmed with the proposed Vehicle and will define the peak target operational headway for each scenario.

Track layout

The following figure identifies the transfer station and central tunnel section:



The track layout as shown on the track drawings is the following:



Based on this track layout and considering also the traction Power single line diagram and sectioning, it is possible to propose partial service definition. Partial service definition will only consider the requirement for single track operation for maintenance purpose.

Considering the anticipated alternate platform operation at terminus with crossover located in front of terminus station, then Blair's configuration with central platform is more convenient from operational point of view compared to Tunney's Pasture's configuration where passengers will have to choose the right platform the take the next train.

Simulations data

In order to perform simulations with regard to operational capabilities and capacity, data are required, such as:

- Alignment

Revised alignment has been posted on the 25th Nov 11

- Speed

Speed limits in curves are given on the alignment : this can be considered as preliminary data but will have to be confirmed and optimized by the system integration entity.

- Dwell time

The Passenger flow data is required to assess the dwell time considering the Vehicle door width characteristics and traffic flow sizing assumption. This calculation is under the responsibility of the system integration entity.

- Operation

Some operational assumptions are required for carousel simulations : trip time recovery margin, driver reaction delay.

Nevertheless, ALSTOM solutions have definitively the capacity to achieve the required performances:

As an example, minimum Urbalis headway capability is 90s in service (Beijing L2 or CCL for instance), above the 132s in scenario 2, and achieving the ultimate headway as described in scenario 3.

Same for Vehicle capacity, the preliminary calculation shows compliance with the RFP.

Technical Performance Verification

A review is performed by the system integrator is order to verify that each identified performance is addressed and achieved.

In case of deviation, then solutions are elaborated and their impact and the overall system evaluated.

Also optimizations are analyzed.

ALSTOM

Non-Revenue Vehicles

A list of proposed vehicles indicating vehicle purpose, specification and performance.

Description of which maintenance vehicle tasks are anticipated to be outsourced.

ALSTOM

General Description

A towing rail/road vehicle equipped with a crane and elevator platform.
The Unimog is used for the installation and maintenance of the OCS (overhead contact system) and particularly for the contact wire unwinding operations in the event of a severed line.
Suitable as a safe and mobile scaffolding platform for the workers in charge of OCS maintenance activities at height
Can be used for towing heavy plant equipment, like the wire unwinding trailer

Advantages

- Pulling power for re-railing of trams
- Rapid adaptation between rail and road
- Powerful crane 14t/m

UNIMOG U1450 Technical specifications

Total mass 10 t
Load max 0.5 t
Dimensions
Length 5 500 mm
Width 2 500 mm
Height 3 800 mm
Kinematic Gauge UIC 505.1
Gauge 1 435 mm
Serial number: 427 112 1w 173 834

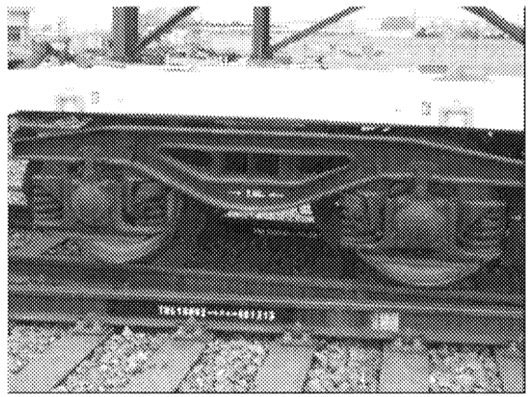
Performance on road 90 km/h
Performance on rail 25km/h
Working Radius ≥25m
Towing power on the flat: 1200 t

Lifting system
A 'Centrama' design.
Serial number: BBC 001 3A
New lifting system is similar to VX 750 with a 1m extension.
Maximum elevation of basket floor: 5 m 50
Unimog can be driven from the basket on rails

Lifting system basket:
Length: 1 730 mm.
Width: 2 005 mm.
Height: 1 180 mm.
Load capacity: 265 Kgs.

Crane PM 14023 :
N° Equipment 15228
Load capacity :
6 500 Kgs at 2 m.
5 200 Kgs at 2 m 40.
3 290 Kgs at 4 m.
2 170 Kgs at 5.9m.
Guiding system:
Guiding system on rail guiding wheels (400 mm diameter for a gauge of 1435 mm).
Each homing head equipped with a hydraulic jack for lowering and lifting.
Front and rear homing heads with 2double pressure gauge monitoring.
Jamming on front wheel to drive on rails.
Console in cab.

gon



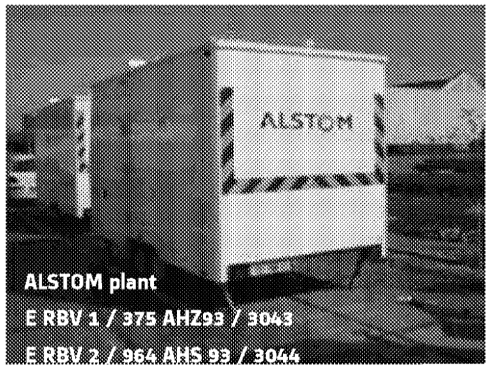
ALSTOM plant E CVL 5

ALSTOM plant E CVL 10

ALSTOM plant E VLU 3

ALSTOM plant E CVL 1

ALSTOM plant E CVL 2

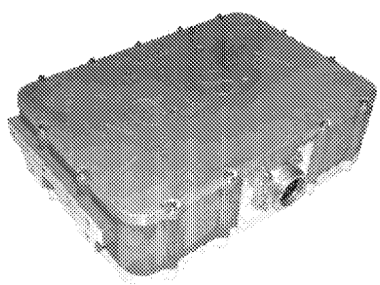


ALSTOM plant
E RBV 1 / 375 AHZ93 / 3043
E RBV 2 / 964 AHS 93 / 3044

Annex 2 – Train Control Product Sheets

Way side Electronics
Information Solutions

EUROANTENNA



General description

EUROANTENNA is fixed under the train.
The aim of the antenna's electronics is to :

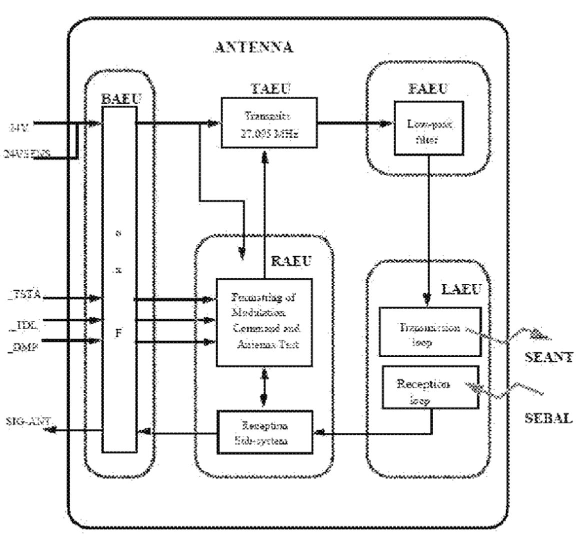
- supply the power needed to energize a EUROBALISE located on the tracks .
- sense and preamplify the signal sent by the EUROBALISE.
- check and report to the BTM* on the antenna's operation.

Application

Typical application

Compact EUROBALISE is a product developed for ERTMS (European Rail Traffic Management System). She energizes EUROBALISE and receives Eurotelegrams. These Eurotelegrams are used by the train's speed control system.

Internal Architecture



- BAEU Bornier Antenna Electronic Unit (input/output signals filtering board)
- FAEU Filter Antenna Electronic Unit (filter for the transmission loop)

* BTM Balise Transmission Module (antenna data and signal processing equipment)
- FSK Frequency Shift Keying
- LAEU Loop Antenna Electronic Unit (board supporting the compact antenna's transmission/reception loops)
- RAEU Reception Antenna Electronic Unit (reception board)
- TAEU Transmission Antenna Electronic Unit (transmission board)
- SEBAL Eurobalise transmission signal
- SEANT Antenna transmission signal

Technical features

Main characteristics

Power supply (DC Voltage)	24 V
Power consumption	60 W
maximum distance for the power source	30 m

Operating conditions

Temperature	-40°C to +70°C
Storage Temperature	-40°C to +85°C

Mechanical Outline

Size

Width/Height/Depth	345/127/448 (mm)
Weight	15Kg

Maintenance

Preventive Maintenance
recommended to change shocks absorbers after 18750 hours service time.

Annually control

- Antenna not damaged
- Link cable not damaged
- Antenna connector plug insertion, check it is correctly screwed.
- Earth bond electrical test, to check continuity between antenna and body/bogie
- No wires broken on the shocks absorbers

Reliability & quality

MTBF (depending on configuration and environment)

As an indication	>20 years

ALSTOM

Compliance w/ standards

Protection against solid foreign	IP 65 (screen)
Sinusoidal Vibration	EN 50155 (EN61373)
Random Vibration	EN 50155(EN61373)
Shocks	EN 50155(EN61373)
Humidity	EN 50155 (EN 50125-1)
Altitude	EN 50155
Immunity	EN 50121 -3-2
Emission	EN 50121 -3-2
Fire-Smoke	NF F 16-101
Earthing	NF F 60100
Functioning Safety	SIL 4

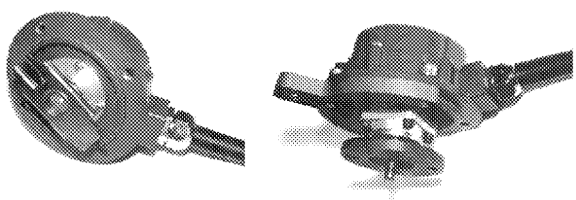
Major references

SCMT Italia
SBB Switzerland
TASS United Kingdom

Vital Carborne Electronics
Information Solutions

WHEEL SENSOR

The wheel sensor provides information of train speed, and instantaneous acceleration.



General description

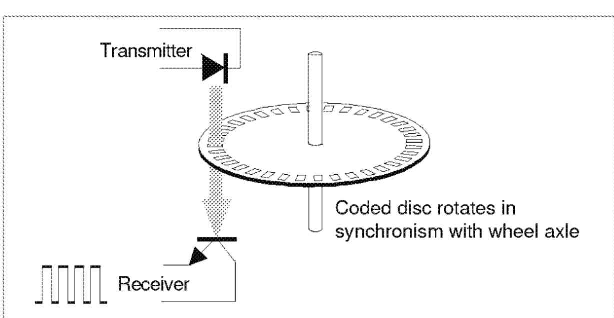
The optical axle and sensor described here is based on optical principle. The sensor is mechanically linked to the rotating axle by a drive element. It contains a punched code disc and several optical probes arranged on the circumference of the code disc. The electronic circuits of each probe are based on LED and phototransistor. When the disc rotates, the continuous light beam from the LED is transmitted through the holes to the phototransistor, providing a pulse signal at the frequency of disc rotation. As a result, the output signal is square wave at a frequency proportional to the rotation speed of wheel.

Application

Typical application

The wheel sensor plays the role of speed measurement device.

Internal Architecture



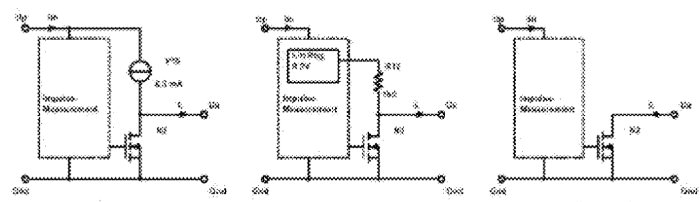
Technical features

Main characteristics

Electrical characteristics

Nominal Power supply	10 to 30 V dc
Power consumption	<900 mW by sensor
Max output frequency	3000 Hz
Discs	1 or 2 tracks coded from 1 to 200 (400) Holes by track
numbers of sensors by generator	generator 5.8600 generator 5.8601 1-4 sensors generator 5.8602 1-4 sensors generator 5.8604 max 6 sensors generator 5.8610 max 3 sensors
numbers of turn	3200 /min
Couple of training	< 6 Ncm

The choice of the type of sensor depends on the electric interface of equipment connected to speed sensor.



tension type 41 — courant type 42 — opened connector type 43

Operating conditions

Temperature	-40°C to +70°C

Mechanical Outline

Size

Diameter/Height	155/66 (mm)
Weight	2,4 kg

Maintenance

Preventive Maintenance

Every 6 months	Control if saw them of fixation are squeezed well. Control the cable of connecting and, if necessary, replace it.
After 10 years or after 2 000000 km	The wheel sensor must be cleaned.

Reliability & quality

Typical operational MTBF (depending on configuration and environment **)**

MIL-HDBK-217F notice 2 (1995) 186 500h

Compliance w/ standards

Sinusoidal Vibration	EN 50155-2-1
Shocks	EN 50155-2-1
High Voltage	EN 50155-2-1
Humidity	EN 50155-2-1
Cold	IEC 60068-2-1
Heat dries	IEC 60068-2-2
Change in temperature	IEC 60068-2-14

ALSTOM

CEM	EN 50121-3-2
Field of interference	EN 50011
Radiated, RF, EMG field Immunity test	EN 61000-4-3
Fast transient Burst	EN 61000-4-4
Immunity to conducted disturbances	EN 61000-4-6

Major references

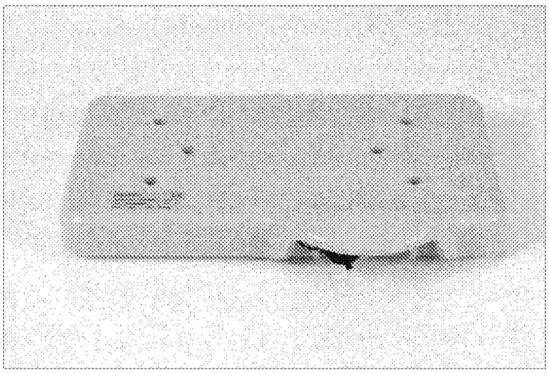
SA-NBS Project(Switzerland)	550 Units	ERTMS level 2
Athens / Rotem (Greece)	30 Units	ERTMS level 1
CFL (Luxembourg)	46 Units	ERTMS level 1
M6 (Belgium)	56 Units	ERTMS level 2

Project		SBB (ICBI, Re460, Re465,Am841)	SBB (Re420, Re620, Re 425, Tm234, Mermec)	CFL	Athene / Rotem / BTW_EMD	SBB ICN	ETR 470
Wheel Sensor Reference		5.8600.094/10	5.8600.094/11	5.8600.094/14	5.8600.094/15	5.8600.094/16	5.8600.094/22
Drawing N°		5.0086.001	5.0086.001	5.0086.001	5.0086.000	5.0086.001	5.0086.001
Sensor location	Outer track A - Type 5.8600.120/	43	43	43	43	43	43
	Outer track B - Type 5.8600.120/	43	43	43	43	43	43
	Inner track C - Type 5.8600.120/	43	42	43	41	42	42
	Inner track D - Type 5.8600.120/	42	42	42	41	42	42
Electrical Adjustement		C - D / 90°	C - D / 90°	C - D / 90°	C - D / 90°	C - D / 90°	C - D / 90°
N° of pulses	ref	5.8600.861/08***	5.8600.861/08***	5.8600.861/08***	5.8600.861/04	5.8600.861/08***	5.8600.861/08***
	Outer track	2*20 spec code	2*20 spec code	2*20 spec code	2*20 spec code	2*20 spec code	2*20 spec code
	Inner track	32	32	32	100	32	32
Cable set	ref	5.8600.168/19	5.8600.168/18	5.8600.112/01	5.8600.112/01	5.8600.168/17	5.8600.112/03
	Free end cut	-	-	X	X	-	X
	with connector	X	X	-	-	X	-
Connector type	ref	5.8600.160/01 Harting 16 pol. Neg.	5.8600.160/01 Harting 16 pol. Neg.	-	-	5.8600.160/01 Harting 16 pol. Neg.	-
	coding	none*	none*	-	-	none*	-
Cable lenght	Customer lenght (l)	1765 mm	1300 mm	3000 mm	3000 mm	1980 mm	3000 mm
	Freecable lenght (L)	1495 mm	1030 mm	2685mm	3685 mm	1710 mm	2685mm
Driver	ref	5.8400.174/01	5.8400.176/03	5.8400.169/01 8.2115.429/10	5.8400.174/01 8.2115.429/10	5.8400.174/01	5.8400.174/03
Accessary data	ref	5.8600.177	5.8600.177	5.8600.177	5.8600.177	5.8600.177	5.8600.177

*** Codedisc mounted upside down (printed side to bearings)
* 4xM5x10 instead of coding
Position of connector according to drawing 5.8600.010 Bl.4 / Fig B

Way side Electronics
Information Solutions

Class A
COMPACT EUROBALISE



General description

The Compact EUROBALISE is installed on the middle of tracks with an adapted support.

It's intended to transmit information in the form of coded messages to the onboard Compact EUROBALISE system when the train passes by. These Eurotelegrams are used by the train's speed control system, therefore the Compact EUROBALISE has safety constraints with a level of "SIL 4".

The Compact EUROBALISE is an active electromagnetic transponder which receives through its antenna loop the power from the EUROANTENNA located on the train or from the BEPT during the programming / maintenance operations.

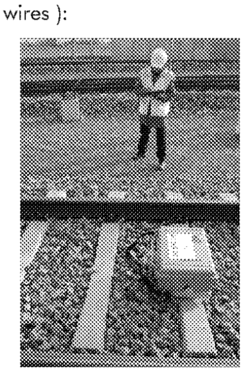
Application

Typical application

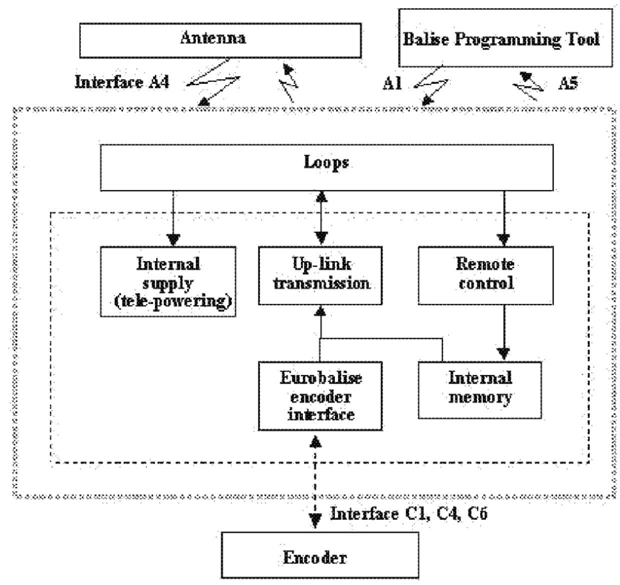
Compact EUROBALISE is a product developed for ERTMS (European Rail Traffic Management System).
Compact EUROBALISE is fully ERTMS Class A compliant (UNISIG subset 036 & subset 085)
It sends to the train a telegram corresponding to the state of the signalling from a fixed message in its memory or from an EUROCODER. At the level 2 and 3 of ERTMS, the telegram is always fixed on the Compact EUROBALISE memory.

Air-gap programming (wireless)

The programming of the Compact EUROBALISE is performed without cable to be connected to the balise (Also the programming tool operates without wires):



Internal architecture



Interfaces :

- A1 : transmits the message to the train.
- A4 : transmits the electrical power to the Compact EUROBALISE and discriminates ERTMS and KER.
- A5 : allows the reprogramming of the Compact EUROBALISE message memory.
- C1 : transmits the message from the EUROCODER to the Compact EUROBALISE.
- C4 : transmits the "presence train" information to the EUROCODER.
- C6 : transmits the electrical power to the Compact EUROBALISE input circuits.

Technical features

Main characteristics

Balise tele-powering signal 27.095 MHz

Up-link data transmission 4.24 MHz
FSK Modulation
565 Kbits/s

Balise reading with a train speed up to 500km/h

Transmission telegrams
- Short format ⇨ 210 users bits ⇨ 331 transmitted bits
- Long format ⇨ 830 users bits ⇨ 1023 transmitted bits

Interfaces

Encoder interfaces : differential bi phase, 565 kbits/s

ALSTOM

Operating conditions

Temperature -40°C to 70°C

Storage Temperature -40°C to 85°C

Mechanical Outline

Size

Width/Height/Depth 450/320/59 mm

Weight 7Kg

Maintenance

Tools BEPT

Reliability & quality

MTBF (depending on configuration and environment**)**

UTE C 80-180 >1 000 000h

Compliance w/ standards

Protection against solid foreign bodies and rain(EN60529) IP 67

Functioning Safety SIL 4

Basic standard(test reference)	**Comments**
Vibration EN 50125-3	5g, 10min
Shocks EN 50125-3	30g acceleration, 8ms
Humidity EN 50125-3	Classification 4K3

EMC EN 50121-4 (Ed 2000)

Basic standard(test reference)	**Comments**
EN 61000-4-2 Electrostatic discharges	NA contact discharges +/- 4,6,8kV discharges
EN 61000-4-3 Radiated electromagnetic field	10 V/m (80-1000MHz)
ENV50204 RF electromatic field-keyed carrier	900 MHz (20 V/m)
EN 61000-4-4 Electrical fast transient burst	+/-2kV (1) +/-2kV (2)
EN61000-4-5 Surge immunity	+/-2kV (1) +/-2kV (2)
EN61000-4-6 Conducted discharges	10 Vrms (1) 10 Vrms (2)
EN61000-4-8 50 Hz magnetic field	100 A/m
EN61000-4-9 Pulse magnetic field	+/-300 A/m

(1) :The both ending of the cable shield and the encoder connected to the ground reference plane.
(2) :The cable shield connected to the Encoder, the encoder and the shield at Eurobalise level insulated to the ground references plane.

Major references

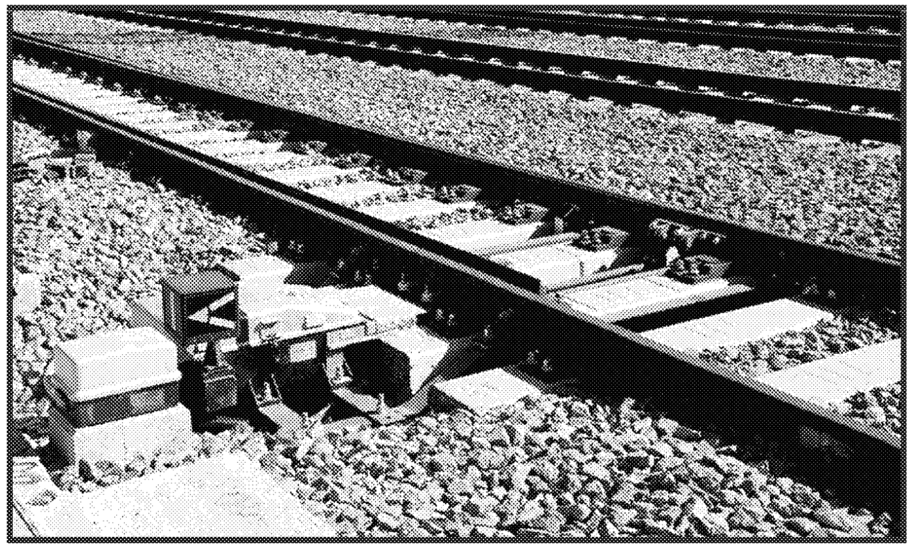
SCMT Italy
Betuweroute (Belgium – Netherlands)
China

ALSTOM

SMARTWAY™ Point Machine P80

MAJOR REFERENCES

- Italy: RFI mainlines, urban lines in various cities
- Greece: Ergose Athens Suburban line
- Tunisia: SNCFT mainlines
- Bangladesh: national railway
- Kazakhstan: national railway
- Vietnam: national railway
- Chile: Santiago urban lines
- Argentina: Buenos Aires urban lines
- Brazil: VALE & MRS freight lines



GENERAL DESCRIPTION

The P80 is part of the SMARTWAY range of point machine among the MET (in sleeper electromechanical point machine) and the SO (in tie electrohydraulic point machine). The P80 is Alstom wayside electromechanical point machine.

The mechanism (motor, clutch, electrical contacts and optional devices) is integrated and sealed in a single housing without any internal adjustment needed. Customers can specify point locking can be embedded in the point machine or in the turnout according to their requirements.

APPLICATION

The P80 is available in "trailable" and "non trailable" versions, ideal for rails weighing 65/60/50 Kg/m, with single switch and double-slip switch and for tangent up to 1:14.

The P80 is suitable for all types of lines: mainlines, metro lines, freight lines.

The P80 is available in back drive configuration and with external clamp lock.

KEY FIGURES

- Developed in 1980: service proven over **20 years** and in **9 countries** on **3 continents**
- In 2010: more than **10 000 P80 point machine** in revenue service worldwide
- MTBF > **500 000** hours

THE BENEFITS

- Service proven product, first certified in Italy
- Significantly reduced maintenance: no clutch on the switch turnout area, no internal adjustment needed, integration of a sensing function to automatically check the Superstructure robustness and fixation
- Easy installation: no need for external device installation up to 180 km/h thanks to internal locking homologation
- Reduced number of equipment: detection of the trailing without external device
- Suitable for wide temperature range and polluted environment: operational temperature from -40° to 70°

Alstom Transport
48, rue Albert Dhalenne
93482 Saint-Ouen Cedex FRANCE

ALSTOM

TECHNICAL KEY FEATURES

> Functional

- The P80 provides the main functions for a point machine (motorization, locking and controlling).
- The trailability feature ensures that standard operating conditions may be programmed to be restored automatically after trailing has occurred (no human action required).
- To avoid extreme stress when the tongue encounters an excessively hard obstruction the clutch device disconnects the kinematic chain motor-approach rod and cuts off the power supply to the motor. This device has lifetime settings (no maintenance needs).

> Configuration

- The P80 is manufactured in two versions: single switch and double-switch versions (Double English turnout).
- The double- switch version has 4 detection rods.
- All the versions can be operated manually by hand crank.
- The standard configuration is trailable but the P80 can also be configured as non-trailable by installing an additional device.
- There are different type of installation:
  - Single switch right installation
  - Single switch left installation
  - Double switch right installation
  - Double switch left installation

> Environment

Operating temperature	-40°C to 70°C
Humidity	0 to 100%

> Electrical & Mechanical

- Weight: 240 Kg
- Size: 913x565x334 mm

Version	220 DC motor	250 3 phase motor	Double switch	Russian	Italian
Power supply	144 ± 15%	3 x 380 ± 15% Vac 50 Hz 3 x 220± 15% Vac 50 Hz	144 ± 15% Vdc	220 ± 15% Vdc	144 ± 15% Vdc

> Safety & Reliability

Mean Time Between Failure > 500 000 hours in operation

Version	220 DC motor	250 3 phase motor	Double switch	Russian	Italian
Operating time at 120 Vdc	3 ± 10% s	5 ± 15% s	2,5 s	2 s	2.5 s
Absorbed current during switch operation	2 ÷ 3 A	1.5 A 2.6 A	2 ÷ 3 A	2 ÷ 3 A	2 ÷ 3 A
External stroke	220 ± 1 mm	250 ± 2 mm	149÷153 mm	149÷153 mm	149÷153 mm
Sensitive Force (Stock rail checking)	NA	NA	200 ÷ 300 kg	200 ÷ 300 kg	200 ÷ 300 kg
Throwing Force (max load with obstacle)	≥ 500 kg	≥ 500 kg	>680 kg	≥ 550 kg	≥ 600 kg
Trailing force	770 ÷ 950 kg	770 ÷ 950 kg	950 ÷ 1150 kg	770 ÷ 950 kg	900 ÷ 1100 kg
Max speed	≤ 250km/h	≤ 250km/h	≤ 180km/h	≤ 180km/h	≤ 180km/h

> Maintenance

The clutch-less system significantly reduces maintenance (a spring-loaded device ensures the clutch functions) and allows stability and internal adjustment elimination.

ALSTOM

Annex 3 – Train Control maintenance Plan

THE SIGNALLING PROGRAMME
S-BANE SIGNALLING SYSTEM TENDER

PROPOSAL TO BANEDANMARK

BAFO

Appendix 5 – Attachment 12 –
The Tenderer's Maintenance Organisation Plan

TABLE OF CONTENTS

1 INTRODUCTION

This document presents the Maintenance Organisation Plan suitable to perform the maintenance services for which the Supplier (Alstom) is responsible for; this document could be renamed as "Maintenance Project Management Plan", in Project phase.

The Maintenance Plan will then be tailored to address project specific needs during the development phase of the S-Bane project, while keeping its structure and scope.

It has to be noted that such document will be reviewed, agreed and finalised during the Maintenance Preparation Sub-project; then submitted to the Customer for validation.

2 MAINTENANCE MANAGEMENT PLAN

These paragraphs present the organisation and the associated workflows defined by Alstom to manage the Maintenance Project or Maintenance Service Project (here after the "Maintenance Project").

2.1 Project Structure and Organisation

2.1.1 Partners, Customer and / or Consortium Organisation

All relevant information regarding partners, System owner's company, operator(s) will be collected: their structure, characteristics, the terms of agreement, the scope of their work and importance within the Maintenance Contract will be collected, as well as the main contact names and positions.

2.1.2 Supplier's Project Organisation

The Organisation Chart that the Supplier intends to deploy in the frame of the Maintenance Project dedicated to the Delivery is the following:

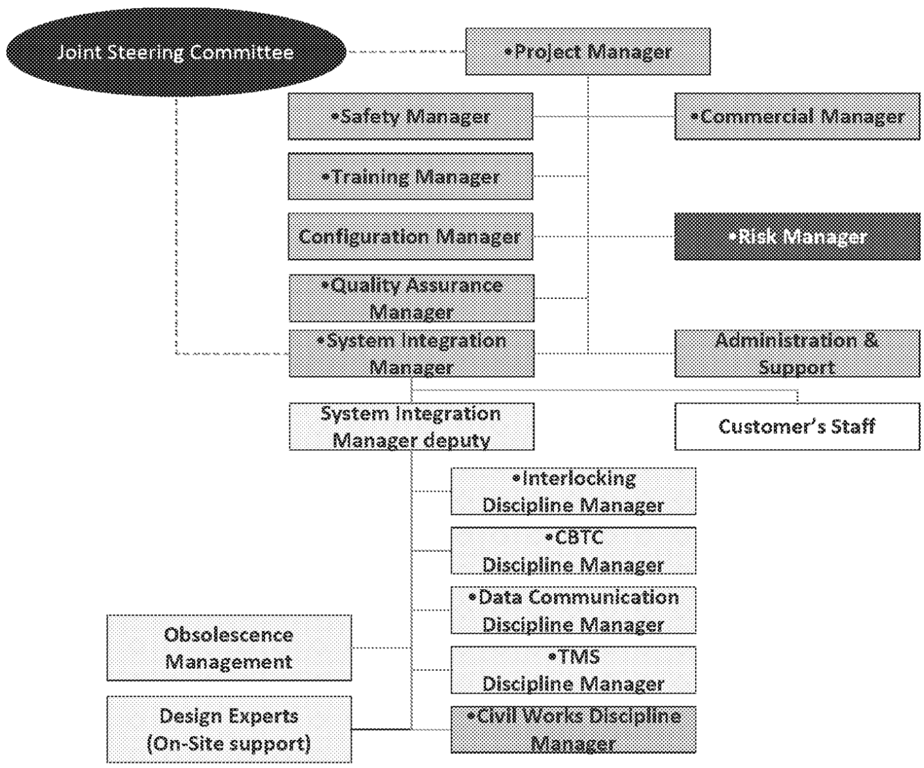


Figure 1. Maintenance Project Organisation chart

The Organisation Chart of the Maintenance Project will be redefined (it may be different depending on the stage of the maintenance project) and shared with the Customer; it has to be noted that such document will be reviewed, agreed and finalised during the Maintenance Preparation Sub-project; then submitted to the Customer for validation.

2.1.2.1 Roles and Responsibility

The Key Roles and Responsibilities are the following:

- Maintenance Manager,
- Production Manager,
- Production Team Leaders,
- Multi-Skilled Technicians (MST),
- General Operative,
- Infrastructure Engineering Manager,
- Infrastructure Maintenance Engineer,
- Business Excellence Manager,
- Material Manager,
- Materials Controller,
- Project Cost Controller,
- EHS Advisor.

The relevant Job Description are defined based on Alstom's maintenance projects guidelines and return of experience.

It is also mandatory to define the Project's Key relationships between participants and their important aspects (interdependencies in terms of information and decision, key success factors, mechanisms for collaboration, etc).

2.1.2.2 Key Function

The Key Function are the following, thanks to Customer's classification:

- Project Manager
- Safety Manager
- Training Manager
- Quality Assurance Manager
- System Integration Manager
- Commercial Manager
- Risk Manager (BDK Posted Staff)
- Civil Works Discipline Manager

The relevant Job Description are defined based on Alstom's maintenance projects guidelines and return of experience.

2.2 Projects Core Activities

2.2.1 Project Management

The project follows the principles and processes defined in Alstom:

- following Project Management Process guidelines for processing of financial data,
- managed through Quality, Cost, Delivery objectives with a specific focus and management of the Risks and Opportunities,
- subject to Project Gate Reviews to ensure that the Customer's satisfaction is monitored and achieved, in line with internal operational and financial objectives.

2.2.2 Engineering and Planning

Engineering and planning comprises of:

- defining the maintenance activities to be carried, in line with the requirements of the Contract(s),
- producing the instructions required by the Production team to perform the maintenance activities,
- assisting the Production and Material Management teams in all technical issues.

2.2.3 Materials Management

The Material Management comprises:

- Sourcing,
- Purchasing,
- Storing.

All Spare Parts, Consumables and material required for the proper execution of the Contract(s) obligations.

2.3 Project Execution Strategy

2.3.1 Risk and Opportunity Management

The principles and work process applied when dealing with Risks and Opportunities throughout the entire duration of the project rely on:

- risk management methodology/procedure to be used,
- programme of risk sessions,
- planned reviews of status on specific risks.

The main risks and related mitigation plan will be tracked and reviewed throughout the maintenance period. Our risk assessment plan and related mitigation plan are subject to review and approval from Alstom's Top Management. They have to state the basic coverage strategies adopted, the main features of the action plans developed as well as the people responsible for leading those actions (List of risks, severity and probability, allocations, mitigation actions, responsibilities, schedule, etc).

2.3.2 Time Management

We apply the basic methods and work principles shared within the maintenance project community for creating the planning of the project and following its progress during the project (including data collection process and planning network, LCC, Reliability Data, Annual Maintenance Plan, etc).

The Customer master programme is the major Input data (including the key Milestones for deliverables and customer meetings).

Our Internal project master plan covers the General programme of the project, rendering explicit the key interdependencies to be managed over time and the way different parts will be integrated into the whole including:

- Master plan showing links to entity project plans
- Main tasks and their critical paths, showing interdependencies between actors
- Critical paths for decision making on key issues and information exchange.

2.3.3 Cost Control

A file summarizing the financial conditions will be created, describing:

- The contractual financial conditions with the different participating entities (internal and external) and of main procedures.
- The actions or approaches for cost optimisation in the framework of the project (and not only within Alstom's units and/or Businesses).

Including:

- R&D reallocation, capital, project cost breakdown
- Procedures for internal billing and payments
- Procedures for invoicing and payments with the customer
- Taxation, import duties, cash flow.

Cost monitoring systems will be identified, as well as cost optimisation actions:

- Cost optimisation that are specific to the project
- Transversal actions that are required for the project to reach its cost objectives (product development, investments, etc.).

2.3.4 Resources Management

The Staffing Plan is a key aspect of the Maintenance Project Management Plan.

For instance, it has to identify the type of resources required for staff defined in the organisation structure (core project team and entity project teams) with profiles, number and minimum of competency required. Requirements schedule with dates indicating duration of employment on the project for each of the members including entity resources with names assigned.

Alstom will provide an updated list of contacts for all major Maintenance Staff. This list will include, at least, the following information:

- Name,
- Position within the maintenance organisation including whether the person is a Key Resource,
- Working areas,
- Key Resource CV,
- Office address,
- E-mail address,
- Telephone number(s),
- Fax number(s).

Also, Alstom will provide a Role & Responsibility description for all Key Functions. This description will include the following information:

- Key Function ID,
- A short, but precise description of the Key Function,
- A short, but precise description of the Key Function's main tasks and responsibilities in the maintenance,
- A short, but precise description of the Key Function's authorities,
- A short, but precise description of the Key Function's required education and experiences.

In terms of team development and management, the training plan summary is part of the scope of the Maintenance Project Management Plan.

All the HR management principles/arrangements have to be clarified

- Expatriation rules summary and procedures (if applicable)
- Appraisal principles (see Matrix Appraisal approach), etc.

2.3.4.1 "On Site" / "On-Shore" Maintenance Resources

2.3.4.1.1 Customer's Staff:

- Preventive Maintenance,
- Corrective Maintenance, levels 1 (L1) and 2 (L2).

2.3.4.1.2 Supplier's Staff:

- Project Management,
- Scheduling of the Maintenance tasks,
- Spare Parts and consumables management,
- and all other services related to Maintenance Management…

2.3.4.2 "Off-Shore" Maintenance Resources

2.3.4.2.1 Customer's Staff:

Not Applicable.

2.3.4.2.2 Supplier's Staff:

- Corrective Maintenance, level 3 (repairs),
- Renewals and Refurbishment management.

2.3.4.3 Calculation principles applied for determining the numbers of staff

The Calculation Principles applied for determining the number of Customer's Staff is based on the "System Maintenance Plan - variant Regular" (for both Preventive and Corrective Maintenance); the results of the application of such methodology is given throughout the dedicated Price Schedule (see M3.6 for Preventive) as part of the Appendix 12 – Delivery Payment and Payment Schedule as well as other Prices.

Please refer to the dedicated appendix related to the Preventive and Corrective Maintenance workload estimation.

2.3.4.4 Location of the different Maintenance Staff

2.3.4.4.1 Customer's Staff:

Not Applicable.

Nevertheless, it has to be noticed that the Customer's Staff has to be quite closed to the Supplier's Staff for Maintenance and Support Organisation needs.

2.3.4.4.2 Supplier's Staff:

- "On-Shore", based in **Copenhagen**, mainly in the facilities (as part of the Customer's Participation) restricted to Maintenance Project resources, at the Old freight TCC depot;
- "Off-Shore", based either in Saint-Ouen (France) or Villeurbanne (France) depending the services and/or resources involved.

2.3.4.5 Employment Schedule for the Maintenance Staff (workload)

2.3.4.5.1 Customer's Staff:

The Employment Workload related to the Customer's Staff, dedicated to Maintenance, will increase progressively, from the Partial Acceptance of the Early Deployment Phase as part of the Delivery (in fact few months before this Partial Acceptance, for training of maintenance resources during "On Site" Test & Commissioning or even Installation activities prior to the Partial Acceptance) up to the Partial Acceptance of the last phase of the Roll-Out Phase as part of the Delivery. Then the Employment Workload related to the Customer's Staff, dedicated to Maintenance, will be nominal and stable.

The Employment Schedule of the Customer's Staff, dedicated to Maintenance, could be discussed and reviewed during progress and periodical meetings between the Supplier and the Customer.

2.3.4.5.2 Supplier's Staff:

The Employment Workload related to the ("On-Shore") Supplier's Staff, dedicated to Maintenance, will be nominal and stable, from the kick-off of the Maintenance and Support Project.

2.3.4.6 Training Schedule of the Maintenance Staff

2.3.4.6.1 Customer's Staff:

The training of the Customer's Staff, dedicated to Maintenance, will be held during the Maintenance Preparation Sub-project (on a non recurrent basis) and also during the Maintenance and Support Project (on a recurrent basis); moreover, the Customer's Staff, dedicated to Maintenance, will be trained during the execution of "On-Site" activities (such as "On Site" Test & Commissioning or even Installation activities prior, to the Partial Acceptance, during the deployment of Partial Deliveries).

2.3.4.6.2 Supplier's Staff:

Not Applicable.

Please refer to the dedicated document "Appendix 5 – Attachment 9 – The Tenderer's Customer Participation Specification".

2.3.5 Quality Management

This aspect will be covered by the dedicated Maintenance Project Quality Plan, if any and/or relevant.

2.3.6 Project Work Process and Communication

All the basic principles of the joint work process and definition of clear communication rules both internally and externally have to be defined, especially in the following areas:

- Meetings and reviews: types, objectives, participants, schedule, frequency, typical agenda, prerequisites, inputs, expected outputs and possibly venue including:
- Project progress
- Ad hoc meetings for particular decision-making, problem solving
- Co-ordination meetings on main sections of train/signalling systems and main interfaces
- Risk management meetings
- Customer project progress meetings.

The Reporting process shall also be clarified:

- Type and frequency of all reports both internal/external with details of authors, content, distribution (including reports not directed to hierarchy for approval)
- Details of reporting process (e.g. flow chart) including approval system
- Applicable communication rules with the customer (formal and informal communication: written communication, frequency of customer visits to the site, approval process for visits, etc)

Internal communication Rules, methods and systems / channels of communication must be set up and agreed as early as possible (mobilisation).

Some principles have to be defined regarding Communication media, as well as Document management and control rules (may be part of the Quality Project plan).

2.3.7 Warranty Management

Maintenance during the warranty period is used as a basis for Return on Experience (REX) from Alstom as the Maintainer to the Engineering and New build project team.

Depending on contractual specifications, in some cases Alstom might report to the Customer or to the Operator.

Each Project partner shall set up the internal organization to deal with the assistance activities.

The Maintainer will appoint his Representative, who shall be the sole authority for presenting defects and warranty claims, as interface with the Customer / Operator / New build project team ("Constructor") at Mobilisation phase of the Contract.

The New build project team will appoint a single point of contact with the maintainer. He will be responsible for receiving the Defect Notification, distribution to the relevant partner, and updating the relevant documentation.

The Maintainer Representative shall forward to the Constructor written Defect Notification, using the formal "Defect Notification Form" .

The applicable formal procedure for Defect Notification will be defined in details, as it is very important to perform the remedial works as soon as possible, but also the ensure the defect are treated whilst continuously optimising this process.

2.3.8 Performance Measurement

The set of Key Performance Indicators (KPI) and objectives shall be defined as soon as possible, some general and some specific to the project (based on customer requirements, key success factors, and strategic objectives...), to monitor the progress of the project and measure the performance of different project contributors.

3 ANNEXE: MTBF/ MTTR DATA BASE

According to the architecture defined for the S-bane Signalling system (Delivery) the MTBF/ MTTR data will be the ones presented and reminded into the dedicated Price Schedule, as part of the Appendix 12 Delivery Payment and Payment Schedule as well as other prices.

ALSTOM

4 ANNEXE: LIST OF MAINTENANCE TOOLS

The following specific tools should be used for the maintenance of the S-bane Signalling equipment (Delivery) that will be installed within the main contract

4.1 Tools identical to T&C tools

4.1.1 ATC Trackside

SUB-SYSTEM	KIND OF TOOLS	NAME AND FUNCTION
TRACKSIDE ATC	Software	OMAP software + OMAP database (software for trackside analysis logs)
	Hardware	Laptop
	Equipment	Laser
	Equipment	BEPT (Beacon Encoder Programming Tool)
	Tools	Digital display multimeter
	Tools	Insulated tools sets
	Tools	Complete sets of mechanical engineering tools
	Tools	Lighting
	Tools	Power supply extension cord
	Tools	Low voltage cables
	Hardware	Ethernet cable
	Hardware	RS 232 cable with SUB DB9
	Tools	Cabling Tools
	Tools	Identity device programmer
	Software	USB Key programmer
	Hardware	Polyswitches resettable fuses

4.1.1.1 ATC OnBoard

SUB-SYSTEM	KIND OF TOOLS	NAME
ONBOARD ATC	Hardware	Laptop with Ethernet and Serial port
	Hardware	BDM for ColdFire 52xx/53xx/54xx
	Hardware	HE10 cables minimal to program UNIVIC boards.
	Hardware	Straight cables Ethernet
	Hardware	Crossover cables Ethernet
	Hardware	M12-RJ45 cables
	Software	A data plug programmer
	Software	OVLI Software (ATC data verification software tool)
	Software	OMAP Software + OMAP database (software for trackside analysis logs)
	Software	TFTPD32

	Software	FTP Sofware
	Software	Train Tracer
	Software	Extraputty
	Hardware	Data plug manager
	Software	Usb-serial driver & Converter
	Software	PROGCFZ - ColdFire Programmer
	Hardware	Cable - 1 mm² - 200m
	Tools	F21+4 Harting connectors (09 06 025 3203)
	Tools	Extraction tool
	Tools	Insertion tool
	Tools	Crimping pliers
	Tools	Extractor / inserter
	Tools	F48 Harting connectors
	Tools	Multi-meter

4.1.1.2 IXL and track equipment

SUB-SYSTEM	KIND OF TOOLS	NAME
SML400	Equipment	SDM (Diagnostic and Maintenance System) Local Maintenance Terminal Maintenance Server
	Hardware	Laptops
	Hardware	Compact Flash Card
	Tools	Digital display multimeter
	Hardware	RJ45 Cable
SMIO	Hardware	Test Module Board
	Hardware	CKPT - Programmer tool
	Hardware	Probe programmer
	Software	SmartIOCAA
	Software	SmartIODAA
	Tools	Crimps contact AWG 20-16 (0,5-1,5 mm²)
	Tools	Crimping tool
	Tools	Removal tool
	Tools	Cable - 1 m² - 50 m for test
	Tools	Torx screwdriver
	Tools	Insulated tools sets

EQUIPMENT	KIND OF TOOLS	NAME
AXLE COUNTER	Tools	Iron Plate

EQUIPMENT	KIND OF TOOLS	NAME

POINT MACHINE	Tools	Insulated tools set
	Tools	Mechanical tools set
	Tools	Torque screwdrivers sets
	Tools	Torque wrenches sets
	Tools	2-4 mm detection checking tool
	Tools	Hand crank
	Tools	Digital display multimeter

4.1.1.3 ATS

SUB-SYSTEM	KIND OF TOOLS	NAME
ATS	Software	FTP Sofware
	Hardware	USB Key 2G
	Software	Matrikon
	Software	VNC Viewer Free Edition

4.1.2 Dedicated maintenance tools

Specific tools for maintenance:

- CVM Test bench for Maintenance UNIVIC Level 2. (for on-board sub-contracts)

Equipment have also their own maintenance equipment in their system which helps the maintenance team for the monitoring of the system .They are deliver with the equipment but not specifically as maintenance tools: It is:

- SDM for the Interlocking (one per CLC),
- The NMS IP and SDH are used by Maintenance team,
- ATS Maintenance workstation.

Annex 4 – Train Control Acronyms

Abbreviations and acronyms

AP	Automatic Protection
ATC	Automatic Train Control
ATP/ATO	Automatic Train Protection/Automatic Train Operation
ATS	Automatic Train Supervision
CBTC	Communication-Based Train Control
CLC	Central Logic Computer
COTS	Components Off The Shelf
EB	Emergency Braking
EMC	Electro-Magnetic Compatibility
EOA	End Of Authority
IXL	Interlocking
LRT	Light Rail Transit
SCADA	Supervisory Control And Data Transmission
MSS	Maintenance Support System
MTBF	Mean Time Between Failures
NMS	Network Management System
PACIS	Passenger Address and Communication Interphone System
PPHPD	Passengers Per Hour Per Day
RAMS	Reliability Availability Maintainability Safety
TCMS/TMS	Train Control and Management System/ Train Management System
ZC	Zone Controller