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General Comments

Vehicle

	Design Consultation Team General Feedback	Proponent Response
1.	Alstom states compliance with EN 15227 crashworthiness, but there is no mention of EN 12663 structural strength. Please provide information.	*The CITADIS DUALIS product range is designed to comply with the dimensioning criteria (i.e. vertical stress, longitudinal stress, etc.) defined in European Standard EN 12663 (July 2001) for vehicles of category IV.* *The dimensioning for the fatigue loads for the carbodyshell is compliant to EN 12663.*
2.	No brake rates are detailed. Please provide information.	*Please find hereafter our detailed values for braking (to be precised during the design phase of the Ottawa project):* • *Full service blended electric + friction brake rate at AW3 loading.* *Established average deceleration at 100 km/h: 1,00 m/s²* *Established average deceleration at 80 km/h: 1,34 m/s²* *Jerk: 0,8 ≤ j ≤ 1,2 (m/s3)* • *Maximum service brake rate (electric/friction blended + Track brakes) at loads up to AW3* *Average deceleration at 100 km/h: 1,80 m/s²* *Average deceleration at 88 km/h: 2,00 m/s² (21% of solicited adhesion)* *Jerk: ≤ 6 (m/s3)* • *Full service brake rate (friction only) at loads up to AW3* *Established average deceleration at 80 km/h: 1,5 m/s²* • *Emergency Brakes - Friction only at loads up to AW3:* *21% of maximum adhesion ;* *Established average deceleration at 80 km/h: 1,8 m/s²* *Jerk : ≤ 6 (m/s3)* *Friction brake + Track brake:* *Established average deceleration at 50 km/h: 2,5 m/s²* *Jerk : ≤ 6 (m/s3)"*

	Design Consultation Team General Feedback	Proponent Response
3.	Noted that traction motors are permanent magnet rather than induction. Is the spin-slide' system integral to the propulsion or braking controls? Please provide information.	*Yes, the propulsion electronic control includes a 'spin-slide' system for each motor. On the motorized bogie the braking control & the slide system, both for dynamic and friction, is directly and completely managed by propulsion control unit. On the trailer bogie a Braking control unit is present to manage slide system on that bogie.*
4.	An internal door release is mentioned but no information on external releases. Please provide information.	*In addition to the internal manual lock-release system, provision is made for an external manual lock-release system at each door to enable doors to be safely opened from the exterior.*
5.	HVAC system maintains ±2 C, rather than 0.2C. Please clarify.	*There is a typing mistake in our prequalification document. Please refer to section "Heating and Air Conditioning System under Type of LRV Proposed: Heating and air conditioning system, read 0.2 °C instead of 2°C.We confirm that our vehicle complies with the Ottawa specification and allows adjustments and modification to settings, including a ±2°C set point adjustment for all switching points and set point accuracy of ±0.2°C.*
6.	The shell is steel/aluminium or FRP. Please provide information on exact type proposed for Ottawa.	*The carbody shell consists of:* • *Under frame structure is made of HSLA steel, protected by stainless steel subfloor pans. At locations where clearances prohibit the application of the subfloor pan (body bolster, head sill, draft sill ...) , it is replaced by a corrosion and impact resistant Sigmacoat (or equivalent) protective coating of about 3 mm . This is a proven technology currently used on our Swedish EMU train underframes (exposed to similar winter climate and conditions in OTTAWA) with satisfactory results relative to ice impact and corrosion resistance after seven years in revenue service.* • *Sidewalls are made of HSLA steel structure clad with FRP panels.* • *Roof is made of HSLA steel structure and stainless steel pans.* • *Cab structure is made of HSLA steel with FRP front end.* *It is designed for an expected service life of more than 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 - 38°C. It is dimensioned to meet the requirements of the specification indicated in tables 4-3.6.and 4-3.7 (compression, static load in either direction, coupling at different*

	Design Consultation Team General Feedback	Proponent Response
		speeds)
7.	The vehicle car is rated to -25C and not compliant. Please provide more detail on the measures to improve climatic performance as applied to Ottawa.	*Please refer to the pre-qualification document (Section "Type of LRV Proposed") concerning the carbodyshell, the stated temperature of "-25°C" as mentioned is a mistake. The correct statement is the following "The vehicle is insulated in order to comply … to an external temperature of -38°C".* *Additional details regarding measures Alstom will implement to meet the Ottawa conditions are described in Section "Redesigns/Modification/Variances Intended for the Project Application of the Proposed Vehicle" under Winterization.* *These winterisation adaptations will be presented in more details during the Design Review.*
8.	Reliability data not specified. Please provide information.	*Our train design has prioritized the availability performances with regard to the reliability (redundancies) to improve service efficiency. Reliability figures will be similar or better than APTA requirement for A , B and C as shown below :* • *Traction equipment and controls: Mean Distance Between Critical Failures (MDBCF) of 50,000 mi (80,000 km).* • *Friction braking: MDBCF of 50,000 mi (80,000 km).* • *Communications equipment: MDBCF of 75,000 mi (121,000 km).* • *Side doors and control equipment: MDBCF of 85,000 mi (136,000 km).* • *Lighting equipment: MDBCF of 350,000 mi (563,000 km).* • *Auxiliary electrical apparatus: MDBCF of 100,000 mi (160,000 km).* • *HVAC equipment: MDBCF of 100,000 mi (160,000 km).* • *Couplers and draft gear: MDBCF of 100,000 mi (160,000 km).* • *Trucks and suspension: MDBCF of 170,000 mi (272,000 km).* • *Train-to-wayside communications equipment: MDBCF of 170,000 mi (272,000 km).*
9.	The technical documentation includes routine tests, but nothing mentioned about qualification tests. Please provide information.	*Qualification tests are part of the Master plan which will be issued at the tender stage. This master plan will include all the necessary tests required in the chapter 3.34 of schedule 15-2 Design and Construction - Part 4 Design and Construction Requirements – Vehicles and Systems – Article 3 : Revenue Vehicles – Clause 3.34: Vehicle Testing.*

	Design Consultation Team General Feedback	Proponent Response
10.	Two cities are listed with Citadis Dualis. Neither is yet in revenue service. This is insufficient for service proven requirement. Revenue service in other cities' are requested	*The two cities listed are in revenue service.* *The CITADIS DUALIS is part of the CITADIS product line. The first CITADIS application was the Montpellier Tramway in 1999. To this date more than 1300 CITADIS units have been put in service all over the world in about 35 cities cumulating more than 100 million km.* *CITADIS DUALIS (the latest variant of the CITADIS product line) is based on the same architecture principles and sub components than the CITADIS vehicles. CITADIS DUALIS is part of the latest version of the CITADIS product based on our Ixége bogie and PMM traction drive. This family Includes 37 ISTANBUL LRVs in revenue service since January 2011 and 48 SNCF dual voltage TTNG. The 7 first TTNG have successfully started revenue service in June 2011 in Nantes*

Train Control

	Design Consultation Team General Feedback	Proponent Response
1.	Given the potential impacts of UTO on system capex affordability, Safety and Security, when operating in association with a low floor LRV. Please detail how the following statement (Schedule 15-2 section 5.4 (d)) will be met for the proposed alignment and future expansion. *"A Driver may be required to take control of Train operation even during ATO operation. The interface with the Train Control system shall be such that a Driver may assert control of the Train with the same Master Controller handle movement as would be used if the CBTC system were in ATP Only Mode. For example, it may be necessary for the ATO function to monitor the* *Master Controller output as well as its own propulsion and braking requests and output to the trainlines the more restrictive of the two."*	*We note the reference to Unattended Train Operation (UTO). RTG understands that the PSOS precludes UTO on the mainline, and we emphasized in DPM#1 that we agreed with this requirement and that our proposal will fully comply with it. Our position has not changed. Our Vehicle and Train Control Pre-Qualifying submissions do not propose UTO on the mainline.* *The Sponsors have made it clear in the PSOS that they require that the Deadman device and the Master Controller be monitored during ATO mode operation. Our proposal will comply with these requirements. If the Train Operator pulls back on the Master Controller while in ATO mode the onboard Train Controller will reduce speed appropriately, in the same fashion as driving in ATP-Only mode. None of our potential Train Control suppliers has expressed any technical concern with implementing this function. Again it is a clear requirement with which our proposal will comply.*

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RTGroup PreQualification Package evaluation (Alstom)

Schedule 2 Part 11.1, 11.2	Sub heading	Status	Design Consultation Team Feedback	Proponents Response
Cover letter		☑		
Exec summary		☑		
Organisation ,structure and integration into proponents team		☑		
Technical submission requirements of section 5.4 Part 1 schedule 3				
Light Rail Vehicles	• 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	☑	25 % content. Several sub suppliers have been mentioned to achieve some local content, but additional details of how engineering and labour will be in line with Canadian content requirements are requested. No Consent provided at this time.	*Please refer to the attachment which contains a revised table of breakdown of local content including a slight difference relative to labour (85% instead of 100%) and consequently a total of 27% (instead of 28%).* *Local Canadian Engineering activity will consist of PA-PIS system development and the activity associated with the reliability growth follow up team.* *The local Canadian labour will be used for the final assembly of the train at a local Canadian facility and the labour required to assemble the bogie and the PA-PIS system*

Schedule 2 Part 11.1, 11.2	Sub heading	Status	Design Consultation Team Feedback	Proponents Response
	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		Noted: 28% Canadian content.	

Schedule 2 Part 11.1, 11.2	Sub heading	Status	Design Consultation Team Feedback	Proponents Response
	▪ Warranty. ○ 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.		Additional items and detail provided.	
	• A list of proposed sub-suppliers for all major LRV systems;	☑		
	• The type of LRV proposed (general arrangement, performance level, etc.)	☑		
	• Performance, reliability and safety of the proposed vehicle in similar climatic conditions;	☑		
	• Service history of proposed vehicle (agencies used, years in operation, and number of cars);	☑	Only 24 + 7 vehicles. 2011, 2012. Therefore insufficient service history information to determine compliancy. Please provide additional details.	*The CITADIS DUALIS is part of the CITADIS product line. The first CITADIS application was the Montpellier Tramway in 1999. To this date more than 1300 CITADIS units have been put in service all over the world in about 35 cities cumulating more than 100 million km.* *CITADIS DUALIS (the latest variant of the CITADIS product line) is based on the same architecture principles and sub components than the CITADIS vehicles. CITADIS DUALIS is part of the latest version of the CITADIS product based on our Ixége bogie and PMM traction drive. This family Includes 37 ISTANBUL LRVs in revenue service since January 2011 and 48 SNCF dual voltage TTNG. The 7 first TTNG have successfully started revenue service in June 2011 in Nantes*

Schedule 2 Part 11.1, 11.2	Sub heading	Status	Design Consultation Team Feedback	Proponents Response
	• Redesigns/modifications/variances intended for the Project application of the proposed vehicle; and	☑	Alstom may also provide interior mock ups; viewed as beneficial. Comprehensive but general list including smoke, ADA compliancy. Further details are required of the specific options available for the Ottawa vehicle. Please confirm the use of an interior mock-up.	*MOCK-UP:* *As explained in our preliminary document, it is common practice for ALSTOM to design the interior and exterior of the vehicle in close collaboration with the customer. ALSTOM have a Design and Style team based in St-Ouen who specialize in interior and exterior design of rail vehicles. Design concepts will be produced by this team during the tender phase. During the project phase, for LRV OTTAWA, the D&S team will collaborate with the Ottawa authorities to define the specific design for the Ottawa LRV. During this stage the various design reviews will be supported by the 3D room located in our facility in Paris. In addition, mock-ups will be produced if necessary. Once the design has been finalized with RTG and the City a full scale mock-up will be built for review and final validation.* *SMOKE COMPLIANCE:* *All materials, equipment and devices used on the CITADIS DUALIS will be selected to mitigate risks to passengers and operational personnel.* *The materials and equipment utilized will minimize the emissions of fumes or gases during in the event of a fire, and will meet the requirements of NF F 16-101 and NF F 16-102 standards.* *All materials and equipment used will be accompanied by validated according to fire and smoke test reports. For the OTTAWA project, we will implement the necessary changes to comply with NFPA 130 standards. ALSTOM is accustomed to adapt designs to the local fire-smoke standards (DIN, NFPA, BS ...). As an illustration Alstom have converted an existing RATP*

Schedule 2 Part 11.1, 11.2	Sub heading	Status	Design Consultation Team Feedback	Proponents Response
				Metro design to meet NFPA 130 for Montreal Metro. The requirements of these standards is well understood and under control at our centre of excellence in Hornell, NY, United States who will be responsible for validating the train
	• Vehicle testing and commissioning schedule and strategy	☑	No reference to the PSOS listed tests. Please provide details.	*ALSTOM complies with the chapter 3.34 of schedule 15-2 Design and Construction - Part 4 Design and Construction Requirements – Vehicles and Systems – Article 3 : Revenue Vehicles – Clause 3.34 : Vehicle Testing* *Indeed, the items listed in (a) to (g) are consistent with our usual railways qualification and are similar to the process already used to certify our CITADIS DUALIS with SNCF and verify the compliance of serial production trains.* *In order to be fully in line with the final customer and the authorities, a preliminary Master Test plan will be created by the Validation Manager during the Tender phase. After contract award, it will be further refined. The master Test plan will include the following tests as mentioned in the chapter (i) to (v) :* *• Component Qualification tests* *• Component production tests* *• Vehicle production tests* *• On-site commissioning tests* *Qualification testing:* *Static qualification testing will take place at our Alstom plant prior to sending the vehicles for dynamic testing to a facility with a test track where comprehensive dynamic testing will be performed.* *Routine testing:* *All vehicles will undergo static testing at our Alstom plant prior to shipping to Ottawa. Dynamic testing will be performed on the OLRT test track prior to vehicle acceptance and are part of the*

Schedule 2 Part 11.1, 11.2	Sub heading	Status	Design Consultation Team Feedback	Proponents Response
				on-site commissioning tests.
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.	☑	Please provide contacts at the agencies running these systems.	*Please refer to Appendix TC1 attached: list of our customer contacts (refer to our references list included in our prequalification file)*
	• A functional description of the train control system and backup methodology in case of communication failure and methodology for broken rail protection.	☑	Please provide details of the interface to station announcements or passenger information systems and open data.	*Please refer to Appendix TC2 attached: technical note with details of PIS and PAS interfaces*
	• A train control installation, testing and commissioning schedule and strategy.	☑	Installation steps and schedule are not presented. Please provide additional information.	*Please refer to Appendix TC3 attached: typical installation plan* *Schedule of installation is made for each project according to its characteristics and time constraints*
	• A description of the proposed yard operation and control strategy.	☑		
	• A train control preventive and corrective maintenance plan.	☑		
Key individuals and experience		☑		
Maintenance capability		☑		
Resumes of key individuals		☑		

CORRECTION ON LOCAL CONTENT BREAKDOWN

Based on previous experience, the proposed industrial scheme, local sourcing, warranty and commissioning, the local content breakdown of the rolling stock could be as follows:

item	% item / Total	% Localisation	Local content
Labour	*8%*	85%	*7%*
Sub-components and components:	*64%*	20%	*13%*
Project management	*6%*	25%	*2%*
Engineering	*14%*	5%	*1%*
Manual	*0%*	0%	*0%*
Special tools	*1%*	0%	*0%*
Test equipment	*2%*	75%	*1%*
Freights	*1%*	100%	*1%*
Warranty	*3%*	100%	*3%*
TOTAL	**100%**		**27%**

The breakdown provided in this table is estimative at this stage and could be subject to adjustment during detailed analysis in tender stage. However our commitment for a minimum 25% local content would not be affected.

APPENDIX TC 1

CUSTOMERS CONTACTS LIST IN RELATION WITH OUR REFERENCES LIST

- Singapore North-East Line & Circle Line: Ong Boon An, Project director, Land Transport Authority. Phone: +65 6299 7188 (DID); email: Boon_Ann_ONG@lta.gov.sg
- Beijing Line 2: Fang Wei, Beijing Metro Operation Company
  Tel.: (86) 10-62292116
- BJAL: ZHANG Liang, Beijing Mass Transit Railway Operation Corp. Ltd.
  Mobile phone: +86 13901231571
- Lausanne: Marc Badoux, Project Director, Métro Lausanne-Ouchy SA
  Phone: +41 21621605, Cell: +41 763570605
- Toronto: Helena Chaplin, Project Manager - YUS ATC Resignalling, Toronto Transit Commission
  Tel. +1 416 393 4429; mailto: helena.chaplin@ttc.ca
- Madrid LRT Line 1: Metro de Madrid, Calle Cavanillas 58, 28007 Madrid, Spain. Tel.: +34 902 444 403
- Al Safouh: Road Transport Authority, RTA Building, Al Marakesh Road, Umm Romoul Area, P.O. Box 118899, Dubai, United Arab Emirates. Tel.: +971 4-284-4444
- Milan: Mr. Andrea ANTONIELLI – Program Manager, ATM
  e-mail: Andrea.Antonielli@atm-mi.it
- Shanghai Line 10: Mr DING Jianzhong, Deputy GM of E&M department, Shanghai Shentong Metro Group
  Mobile phone: +86 13601752384
- Shenzhen Line 2 & Line 5: LI De Tong (Project Manager), Shenzhen Metro Co. Ltd.
  Phone: +86-755 23992716; e-mail: lidt@shenzhenmc.com
- Beijing Line 9 and Fangshan Line: Mrs. Zhang Yan Bin, Business No. 6 Dept.
  e-mail: zhangyb807@126.com
- Sâo Paulo: Carlos Eduardo Paixâo de Almeida, Representative Project Manager, Companhia do Metropolitano de São Paulo
  Phone: +55 11-3371-7411
- Santiago Line 1: Augusto LUCERO ALDAY, Metro S.A.
  Tel.: +56 2-250-39-31
- Beijing L6: Beijing MTR Construction Administration Corp., No. A-2, Baiwanzhuang Street, Xicheng District, Beijing 100037, China
- Shanghai Line 12/13/16: Xu Jing, Shanghai Shentong Metro Group Co., Ltd.
  Phone: +86 021 63189188-7571616
- Guangzhou: Guangzhou Metro Corporation
  Phone: +86 20-83289033
- Wuhan: Wuhan Metro Group Co. Ltd. No.99, Jinghan Ave.,Qiaokou Dist. Wuhan, Hubei 430036. China. Tel.: +86 2783749000
- Mexico: Ing. Sotero Diaz, Dirección General Proyecto Metro
  Phone: +52 55-5688-7499

- Kunming: Hongbo MENG, Vice Director of Equip. Dept., Kunming Rail Transit Co.,Ltd.
  Phone: +86 138 8808 3645; e-mail: mhb_can@126.com
- Malaga LRT: Gonzalo Blanc, Metro de Málaga
  Phone: +34 952 061 640
- Ningbo: Ningbo Rail Transit (Group) Co., Ltd., Room 412, No. 668, North Liyuan Road, Haishu District, Ningbo, China. Tel.: +86 0574-83884579
- Panama Line 1: Roberto ROY, Oficinas de la Secretaria del Metro de Panamá del Ministerio de la Presidencia
  Fax: +507 212-1711
- Taichung Green Line: M. Zen-Yui LO, SEMPO Signalling RE
  Phone: +886 (02) 23671818 Ext 351; e-mail: zylo@trts.dorts.gov.tw

APPENDIX TC 2

TECHNICAL NOTE

Interface with the Passenger Information System (PIS)

and with the Passenger Announcement System (PAS)

1. Interface with the Passenger Information System (PIS)

ATS provides information to the Passenger Information System (PIS) concerning the arrival of trains at each station:

- Train waiting for departure at terminus,
- Forecast train arrival in an intermediate platform,
- Train arrival in an intermediate platform,
- Non stop train in a station,
- Forecast and arrival in a terminus platform (end of the revenue service).

Management of Passenger Information Displays (PID), which display information concerning the two next trains on the platform, is done by the PIS.

Text is displayed in English, with Latin fonts.

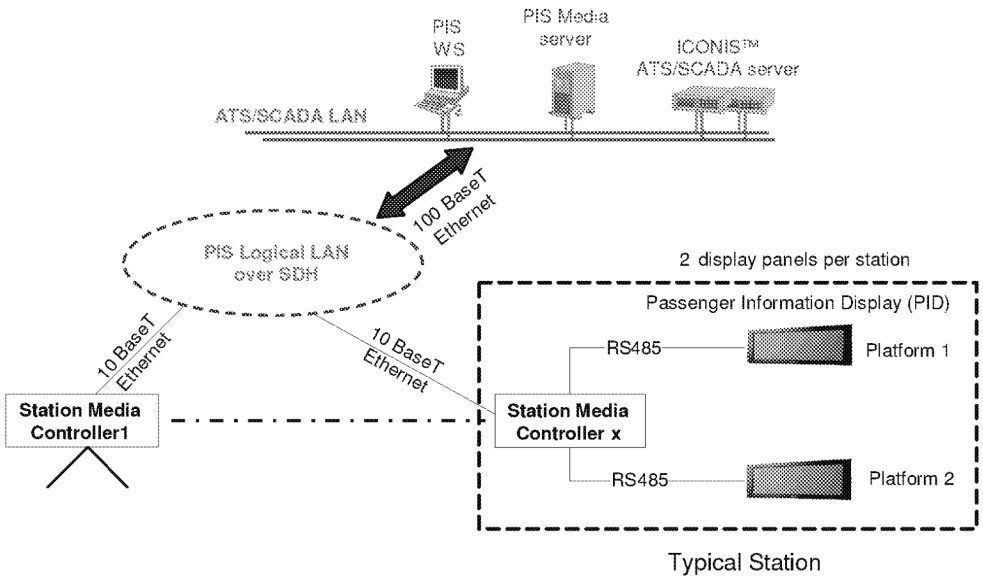

Figure 1. PIS Interface

The interface between ATS and PIS uses TCP/IP protocols for Ethernet LAN data transmission.

A TCP/IP port connects the redundant ATS server to the centralised PIS Media Server.

Communication between both systems is bi-directional. PIS Media Server creates two sockets. Each socket is unidirectional. The first socket waits for a connection from ATS. The second socket tries to establish connection to ATS in the predefined sequence.

The PIS Media server supports dual connection to the redundant ATS server. If connection to one sever is lost, PIS Media server automatically attempts connection to the corresponding redundant ATS server.

When the PIS Media Server loses communication with ATS, ATS is not able to send messages to wayside PID. In this case, the PIS Media Server instructs the Station Media Controllers (SMC) to clear the PIDs.

If the SMC loses communication with the PIS Media server, the SMC instructs the PIDs to clear its displays.

2. Interface with the Passenger Announcement System (PAS)

ATS provides information to the Passenger Announcement System (PAS) concerning the next 2 trains at each station:

- Train waiting for departure at terminus,
- Forecast train arrival in an intermediate platform,
- Train arrival in an intermediate platform,
- Non stop train in a station,
- Forecast and arrival in a terminus platform (end of the revenue service)
- Train service information like train evacuation event

It is assumed that the interface between ATS and PAS uses Modbus on TCP/IP protocols for Ethernet LAN data transmission. A TCP/IP port connects the redundant ATS local servers to the local PAS server.

The PAS server supports dual connection to the redundant ATS servers. If connection to one server is lost, PAS server automatically attempts connection to the corresponding redundant ATS server.

OTTAWA LRT
PREQUALIFICATION
TRAIN CONTROL

APPENDIX TC_3

TYPICAL INSTALLATION PLAN
For example

6.6 - Trackside Installation Plan (extract)

ALSTOM

TABLE OF CONTENTS

1 OVERVIEW

The installation is the first on-site activity of the signalling integration & validation phase of the TWE line Project.

During this stage, the C1652B installation will be co-ordinated with that of the Civil Works Contractors and interfacing Contractors.

This Installation Plan outlines the process and means which will be deployed by ALSTOM, to complete the installation of the C1652B signalling System in a methodical and timely manner. The Installation Plan also ensures that installation work, safety and quality, follows the best up-to-date railway practices, as well as the Engineer's specific requirements.

The installation activities described hereafter includes C1652B organisation, planning, methods and communications related to installation works. Upon completion of site installation of C1652B equipment, simple static tests (details of which are given in their relevant sections) will be performed to ensure a proper installation and connection with adjacent equipment before starting testing activities.

This Installation Plan is compliant and consistent with the overall Project Management Plan (PMP).

2 MANAGEMENT PHILOSOPHY

The installation of the signalling System is a multitask process supported by a dedicated and efficient organisation. For co-ordination works and system interfaces, the C1652B Installation Teams interact with:

- The Engineer and/or his representatives,
- The Civil Work Contractors,
- Other System Wide Contractors (SWC)
- A C1652B Site Safety Manager (RSO), hierarchically independent from the Project Installation Manager and responsible for the site safety policy.

The key elements of the installation management philosophy rely on a dedicated Installation team based in Singapore to achieve installation works, especially in charge of progress reporting and conflict management internal to C1652B and with other parties,

3 INSTALLATION SCOPE OF WORK

The installation scope of work concern fixed equipments installation, which are located in 4 major types of work areas:

- Stations (including platforms, concourse area, PSC room,)
- Signalling Equipments rooms
- Trackside - Tunnel and Viaducts sections with equipment to be installed along side of the track.
- Depot/ Operation Control Centre

3.1 Major Types of equipment

Equipment Type	Stations	SER	Trackside	DCC
ATS cubicles (servers)		X		X
ATS workstations	X	X		X
Maintenance Support System workstation				X
ATC cubicles (ZC/LC)		X		
Beacons			X	
CBI cubicles (CLC)		X		
System Diagnostic Maintenance		X		
SMART IO cubicles		X		
Relay frames (and relays)		X		
Backbone Telecom Network cabinet		X		
Network Management system cabinet		X		
TRE box			X	
Mast & antennas			X	
Track circuit cubicles		X		
Track circuits			X	
Point Machines			X	
Signals			X	
Optic fibre		X	X	
Signalling cable	X	X	X	
Ethernet cable	X	X		X
Power cable	X	X	X	X
RF cable			X	

Equipment Type	Stations	SER	Trackside	DCC
Power Distribution cubicles		X		
Emergency Stop Plunger	X	-		
EVSCP box	X	-		
Head Wall / Tail Wall	X	-		

3.2 Installation activities

3.2.1 Station

The main types of installation tasks in station are:

- Installation and marking out for all platform equipment,
- Platform cables pulling
- Wire to wire continuity (bell test) and insulation testing of platform cables,
- Workstations installation in PSC
- Head Wall and Tail Wall (HW/TW) units mounting
- Emergency Stop Plunger (ESP) mounting
- Tail cable layout and termination,
- Wire to wire test of all cables including wire count, insulation test and circuit book bell test from platform to SER

3.2.2 Signalling Equipment Room

The main types of installation tasks in Signal Equipment Rooms are:

- Installation of equipment: cubicles, cables racks, Relay Rack, panels, HMI Units, etc,
- Cable routing installation: mounting and fixing of all the cable trays, trunks or pipes used for internal cabling,
- Cable layout: laying of internal cables between equipment,
- Cable termination: termination of all cables ends,
- Wire to wire (bell and insulation) tests for all internal cables.

3.2.3 Trackside

The main installation tasks inside tunnel/viaducts and stabling areas in the depot, are:

- Installation and marking out for all trackside equipment,
- Erection of concrete bases for signals and masts when needed,
- Main cables pulling, laying and termination. The main cables correspond to the general Communication Back Bone (CBN) and Radio Optic Fibre, power cables, signalling cables. This will be carried out by the mean of works trains.
- Installation of trackside boxes and equipment,
- Tail cable layout and termination,
- Wire to wire test of all cables including wire count, insulation test and circuit book bell test from SER to platform or trackside,
- Trackside wiring: point machine, signals,
- Connection to rail: track circuit, track bonding,
- Track circuits installation,
- Point machines equipment mounting,
- Beacons mounting,
- Signals mounting,
- TRE and antennas mounting

3.2.4 Operated Control Centre

- Installation of workstations, printers,
- Cables pulling, laying and termination
- ODS installation

4 INSTALLATION PROCESS

4.1 Installation Principles

The main activities of the installation process are the following.

- Installation surveys, design studies and drawings
- Organisation of the installation works packages and scheduling of concurrent installation works including others Contractors installation works.
- Installation requirement: before any installation works a hand-over inspection between the Engineer and the C1652B Installation Team will take place to allow initiation of the authorisation. Access to site will be qualified before starting the installation works.
- Organisation/scheduling of work trains services. Works trains will be used for track installation, cable laying and transporting materials and equipment to the appropriate erection site for the completion of the related works.
- Equipment delivery: equipment and parts packaging and delivery shall be prepared station by station. Co-ordination of cable delivery schedule to coincide with the needs of the site installation activity plans.
- Equipment storage: storage organised to minimise handling in accordance and to ensure proper protection until transfer to installation site.
- Control and reporting of installation work progress with site risk management. Resolution of work site hazards with reactive updating of the installation work schedule.
- Validation of internal and external interfaces implementation between subsystems.
- Installation tests corresponding to: visual installation checks, equipment conformity, continuity and insulation check, measurement of earth continuity,
- Inspection and acceptance. After equipment installation and unit test completion, two kinds of inspections and acceptances will be formalised by the c1652BInstallation Team:
    - Contractor self inspections described in Method statements
    - Contractor and Authority Engineer joint inspections.

4.1.1 Prerequisites

The start of the C1652B installation work is dependent on the appropriate work by others having been completed:

- Degree of civil completion and prerequisites, tunnel and stations as-built survey. Inspections between CWC and Using SWC will be performed jointly and should be witnessed by LTA.
- Lighting, ventilation availability.

- CD blast doors access and construction.
- The technical rooms shall be clean, dry and waterproof, with floor, wall and ceiling finishes completed (e.g. plastering, painting, base coat, tiling, etc...).
- Control Room False Ceiling or Raised Flooring shall be installed with openings for cable passages. The rooms are to be handed over in accordance with the Degree of Finishes table as per the terms of the contract.
- Temporary power supply shall be available as per the terms of the contract.
- Specified lighting levels shall be provided in the equipment rooms and areas for equipment transportation and installation.
- Civil work along the cable routes including the water proofing and the installation of cable hangers and for cable laying shall be completed.
- Access to various areas and rooms must be made available when required as per the agreed and coordinated CIP. Whenever required, either the permanent or temporary lockable door for equipment room shall be installed by the CWC, as laid down in the Degree of Finishes table as per the terms of the contract.
- Wall/floor openings as depicted in the CSD/SEM drawings shall be checked and verified on site.

4.2 Installation works phasing

The different activities will be carried out in the different main works areas.

- Trackside and depot
- Signalling Equipment Room
- Stations
- Depot control room

A set of activities shall be carried out on night time during engineering hours to prepare connection with EW line. These activities will mainly concerns trackside with:

- Optic fibre installation, radio and mast installation, beacons installation.
- Some additional tasks shall be carried out in workshop

5 COORDINATED INSTALLATION PROGRAMME

The Civil Contractors (CWC) jointly with C1652B and the other System Wide Contractors (SWC) develop the Co-ordinated Installation Programme (CIP). The CIP developed and managed by the CWC who are responsible for collecting the inputs from C1652B and all other SWC's and solve the

conflicts. The starting point for the development of the CIP is the Schedule of Dates, Schedule B of the C1652B Particular Specification (PS). The Civil Contractors and Track work contractors precede the signalling System on site. The civil work and track work are completed in stages, allowing the C1652B installation to begin progressively. This schedule of dates should normally coincide with the commencement of the CWC's CIP Interface meetings following their Final CSD submission.

Major equipment deliveries are coordinated with all Civil Works Contractors (CWC) for integration into their station CIP's.

6 INSTALLATION STANDARD & GUIDELINES

Installation equipment shall comply with the latest Singapore regulations and relevant international codes and standards.

7 QUALITY ASSURANCE

In consistency with the C1652B Quality Plan, the installation activities will be controlled in accordance with the requirements of the ISO 9000 series of Quality Assurance standards to ensure the installation works completion with the required level of quality.

The Project installation manager and his team will be responsible for maintaining the quality standards for the installation.

Quality Assurance system will monitor and audit the compliance with the QA standards and will assist in the management of installation related documentation.

The documentation describing the installation design and the procedures related to installation works will be under the control of the Quality Assurance system.

Inspection of the installation works by the Project Installation Managers will be carried out by the way of inspection checklists. These lists permit to keep track of the inspection and to flag and record installation anomalies if any as well as the corrective actions to be implemented.

The Quality Manager shall audit the site installation works according to the Installation Plan corresponding to the installed subsystem. The results of the audit will be notified in an « In Progress Inspection » form. Quality discrepancy will be identified and the corrective action initiated.