# Guidebook for Carrying Out Modification Work to Rapid Transit System (RTS) Stations or Railway by Private Developer

**Revision 1** 



Brought to you by

INFRASTRUCTUTR PROTECTION DIVISION

**DEVELOPMENT & BUILDING CONTROL SUBGROUP** 





# **REVISION HISTORY RECORD**

Revision No.	Effective Date	Reason for Changes	Page No
0	September 2019	Initial version	All documents
1	October 2021	1. Clear definition of maintenance responsibility	
		2. Introduction of LTA asset handover process	
		3. Streamling the submission requirements and processes	All documents
		4. Introduction of submission checklists	
		5. Finetuning design requirements to align with other technical agencies	



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# PART I – INTRODUCTION

#### 1. SCOPE

- 1.1 The Code of Practice for Railway Protection (CPRP) covers the submission procedures and requirements for obtaining approval for development and building proposals, permit to commence engineering works within the railway protection zone and railway corridor. Technical requirements for compliance at the design and construction stages of development are also stipulated.
- 1.2 This guidebook is prepared to provide additional guidance to Private Developers (the Developer), Qualified Person (QP), builders and any parties, who intend to carry out development and building works above and/or adjacent to the Rapid Transit Systems (RTS) which involve modification<sup>1</sup> to existing RTS structures, facilities and systems, but are not familiar with the regulatory requirements, processes and procedures with some basic information on how to approach, plan, design, construct and implement the requirements.
- 1.3 The application and interpretation of this document in designing the permanent and temporary works of the future development should be entrusted to the appropriate QP and the construction should be carried out under the direction of the respective QP in line with the statutory requirements.
- 1.4 The submission process stipulated in this guidebook is applicable to any future development by private developer where the proposed development is integrated with existing Rapid Transit System. It also contains the submission requirements and technical design requirements to be complied with by the Developer and his appointed qualified person and/or builders.
- 1.5 Proposed development and building work integrated with existing Rapid Transit System may be initiated by the Developer to enhance the connectivity of the precincts, and it is subjected to the review and approval by the Authority; or it may be stipulated in Urban Redevelopment Authority (URA)'s Government Land Sales (GLS) agreements.

<sup>&</sup>lt;sup>1</sup>A modification is defined as one that results in a change to the system design, construction, relocation, renewal, addition, alteration, disposal and/or decommission, or any functional and/or control features related to the software and/or hardware, and maintenance regime(s) of the assets serving the Working Network, and shall have the same meaning as set out and defined in the Licence applicable to each Licensee. This include changing/replacement to alternative parts or components that are not from the Original Equipment Manufacturer (OEM) will constitute a modification requiring LTA approval before being carried out if the components have an impact on the safety and/or operational performance of the Working Network. For changes in maintenance regimes, where do not affect safety and/ or operational performance and Failure Review Board (MFRB) and do not need to be submitted to LTA for approval before being carried out. Periodic update to LTA will suffice. – Extracted from MODIFICATION PROCEDURES FOR RAPID TRANSIT SYSTEM (ROAM/GP/001 REV 0)



- 1.6 Typical development and building work integrated with existing Rapid Transit System includes, but not limited to, the following:
  - a. Underground Pedestrian Link (UPL) connection at station concourse level into unpaid / paid areas via the station knock-out panels
  - b. Elevated Pedestrian Link (EPL) connection to elevated station
  - c. At-grade connection to station entrance including covered linkways, pedestrian overhead bridges, bus shelters and taxi stands, where applicable.
  - d. Replacement of station entrance roof
  - e. Relocation of station ventilation shafts
  - f. Relocation of escape staircase
  - g. Relocation of the station entrance to integrate into the new development
  - h. Relocation of at-grade enclosure and its associated installation, e.g. cooling tower enclosures, etc.
- 1.7 LTA exercises statutory easement rights in, under or over state land under Rapid Transit Systems Act for construction, operation, and maintenance of the RTS structures, facilities, and systems. When the State land with the existing RTS facilities is sold, LTA would create rights under Section 6 of the Rapid Transit Systems Act to enter the private land to continue operation and maintenance of these facilities. In the event the existing facilities are altered or modified, LTA will similarly exercise rights under the Rapid Transit Systems Act on the new or modified facilities for operation and maintenance.

#### 2. DUTIES AND RESPONSIBILITIES

- 2.1 It is envisaged that the development and building work integrated with existing Rapid Transit System will affect either existing permanent or temporary facilities, structures, architectural finishes and fixings and electrical and mechanical services' and systems' equipment in the station which requiring them to be modified, altered, relocated, demolished, rebuilt, upgraded or replaced, all works involved shall be carried out by the Developer at his expense. This includes the supply, delivery, installation, testing and commissioning of any new facilities including associated and consequential works that are required as a result.
- 2.2 The Developer and his appointed QP shall be responsible for the design and supervision of the modification works including the checks on the adequacy of the existing structures, services and systems and assess the effects these works would have on the existing structures, services and systems. The Developer shall engage QP to submit and obtain clearances for development and building plans from all

competent technical departments in accordance with Planning Act, Building Control Acts, Fire Safety Act and Rapid Transit Systems Act respectively.

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- 2.3 The design and specifications of any addition, alteration, modification, upgrading, supply, delivery and installation of plant and equipment for civil, structure, architecture, electrical and mechanical services and systems and any other systems of the station and rapid transit facilities shall comply with LTA design criteria, workmanship, standards and specifications.
- 2.4 The Developer is responsible for the design, modification, procure, supply, delivery and installation including additional new equipment, testing and commissioning and handing over to the Authority any of the reinstated works such as the electrical and mechanical services and systems, station control, monitoring and communication systems or architectural and structural works related to the operation of the railway which are not specified or foreseen in this document.
- 2.5 There shall be a minimum Defect Liability Period (DLP) of <u>12 months</u> for electrical and mechanical related assets commencing from the date of CERTIFICATE OF TRANSFER OF CARE CUSTODY AND CONTROL (TCCC) endorsed by all parties or otherwise advised by LTA. The Developer shall warrant all plants, materials and equipment supplied and all workmanship performed by him to be free from defects of whatever nature and he shall replace, repair or make good, at no cost whatever to LTA, and all plant, materials and equipment which are found to be defective during the 12-month's period. The Developer shall continue to maintain the new or modified facilities till TCCC is endorsed by LTA and Railway Operator, or otherwise advised by LTA.
- 2.6 The Developer, his appointed contractor and specialist shall provide Deed of Warranty (DOW) for architectural and structural related assets to LTA and Railway Operator. The requirements are stipulated in <u>Chapter 20 of LTA Materials and</u> <u>Workmanship Specification for Architectural Works</u>. A copy of the DOW template will be shared with the Developer upon request. Similarly, the start date of the DOW shall commence from the date of CERTIFICATE OF TRANSFER OF CARE CUSTODY AND CONTROL (TCCC) endorsed by all parties or otherwise advised by LTA.
- 2.7 In addition, it is also assumed that in the event the works have been completed but Railway Operator has not taken over the new or modified facilities, the Developer shall be responsible not only for the maintenance, but also the operation of the new or modified facilities. The Developer shall also ensure that the new or modified facilities are free from any defects before handing over to Railway Operator.
- 2.8 The Developer shall include the costs of all materials and works including any services in relation to the proposed development which may or may not be expressly specified or implied but are necessary for the satisfactorily completion of the works to satisfy the requirements of Land Transport Authority.



- 2.9 For works not relating to the operation and maintenance of the existing Rapid Transit System, e.g. modifications to existing, and provision of additional commercial mobile radio coverage, SCDF radio coverage verification, etc. the Developer shall consult the Mobile Network Operators (MNOs) for the requirements of the mobile network infrastructure and SCDF on the performance of their radio system within the Rapid Transit System.
- 2.10 The Developer shall note that any new structural<sup>2</sup> and architectural components located within the development boundary shall be owned and maintained by the developer. LTA will create rights under Section 6 of the Rapid Transit Systems Act for those areas within the development demarcated to be handed over to Railway Operator for operation and maintenance.
  - a) "Operation and maintenance' in the above sentence are construed as day-to-day maintenance of the asset offered for operational use by LTA and his licensed Rail Operators. This typically means regular cleaning, clearing of debris etc. to be undertaken by Railway Operator when they utilize the space/ area for their operations.
  - b) LTA and his licensed Railway Operator will take over catwalks, gratings, grilles, trellis and etc within the cooling tower/vent shaft area if those serve the station operation.
  - c) Five-yearly structural inspections as stipulated under the Building Act will be undertaken by the Developer for those structures built within the development boundary.
  - d) The Developer shall also ensure that the cooling tower/vent shaft building façade is cleaned regularly to prevent malfunction or avoid malfunction of the cooling tower/vent shaft.
- 2.11 The Developer should appoint a project coordinator<sup>3</sup> representing himself to oversee the project from planning, design, construction to completion stage. The project coordinator will work closely with the appointed QPs from various disciplines, Railway Operator, and the Authority to ensure statutory compliance and smooth execution of the project.

<sup>&</sup>lt;sup>2</sup> 'Structural' components are defined as those 'structural elements' under the Building Control Act which come with ST approvals. These include staircases, be it RC or Steel; definition extracted from the Building Control Act: "structural elements" means those parts or elements of a building which resist forces and moments, and includes foundations, beams, columns, shear cores, structural walls, struts, ground anchors, slabs, trusses, staircases, load bearing walls and all other elements designed to resist forces and moments but does not include doors, windows and non-load bearing walls.

<sup>&</sup>lt;sup>3</sup> Project coordinator refers to the owner/developer's representative.



2.12 The Developer should also appoint contractor(s) that possess the necessary experience / expertise to undertake / execute the necessary works within the affected RTS station affected by the commercial development and integration with the said RTS station.

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PART II – SUBMISSION PROCEDURE AND REQUIREMENTS

# 1. SCOPE

- 1.1 The various submission stages required for private development integrated with RTS is shown in *Diagram A*. The general submission procedures and requirements for obtaining approval for each stage are stipulated in the <u>Code of Practice for</u> <u>Railway Protection (CPRP)</u>. This Guidebook focuses and highlights the specific requirements for RTS-integrated development at each stage of the submission.
- 1.2 The appointed QP of relevant discipline shall arrange pre-consultation with LTA and Railway Operator to present his proposal prior to any official submission. The QP may be allowed to proceed with the official submission if all stakeholders are satisfied with the proposal presented during the pre-consultation meeting.
- 1.3 The pre-consultation meeting allows the reviewers from LTA and Railway Operator to have a better understanding of the proposals. At the same time, the reviewers from LTA and Railway Operator will be able to provide advanced comments so that QPs can prepare/revise the proposals accordingly. This will expedite the overall reviewing and approval process and reduce the number of iterations.



# Diagram A – Submission Stages for RTS-integrated Development

# 2. DEVELOPMENT PROPOSAL

2.1 Development Proposal shall be prepared in accordance to the requirements stipulated in Part II Section 1 and Section 9.4 of the CPRP. In addition, the following information shall be provided to LTA for review:

- a. A copy of Drainage Department's clearance letter on the proposed flood threshold levels for all entrances and openings in the development if it is connected or integrated with the rapid transit systems
- b. Maintenance boundary, responsibility, and regime
- c. <u>Appendix F</u> Security Checklist
- d. Relevant Architectural Checklist if the proposed work falls within station maintenance boundary:
  - Architectural Checklist for Covered Linkway
  - Architectural Checklist for Floor Finishes
  - Architectural Checklist for Pedestrian Underpass

# **3. BUILDING PROPOSAL**

- 3.1 Building Proposal shall be prepared in accordance to the requirements stipulated in Part II Section 2 and Section 9.4 of the CPRP. In addition, the following information shall be provided to LTA for review:
  - a. Signage proposal

# 4. ENGINEERING WORK INVOLVING MODIFICATION REQUEST (MOD)

#### 4.1 General

4.1.1 This section stipulates the procedures and requirements for obtaining a permit to commence engineering work involving modification request to modify the existing rapid transit system. The overall submission process for engineering work involving modification request is appended in *Flowchart A* below.





Flowchart A – Overall Submission Process for Engineering Work involving MOD

#### Note:

QP is required to submit the proposal to Railway Operator first and obtain an acknowledgment letter before proceeding to Corenet to make an application to LTA/DBC.

Submission to SMRT and SBST-NEL can be made via email to the appointed coordinator.

Submission to SBST-DTL shall be made via the Maximo system.

A – prior to issuing the Engineering Work Permit, DBC will inform all stakeholders (LTA internal divisions and railway operators) that the proposal is acceptable with no further comments. There will be internal communication/process between LTA and railway operator to allow Railway Operator to proceed with his internal approval process in the system.

B – Upon receiving confirmation from LTA, Railway Operator to proceed with his internal approval process in the system.

4.1.2 The concurrence submission workflow saves the industry the troubles to deal with various divisions within LTA and Railway Operators as DBC will be the main point of contact and any response from LTA internal divisions and Railway Operators will be reverted collectively to the industry as "ONE LTA".



- 4.1.3 The Developer and his appointed QPs shall carefully plan the programme timeline for any modification work to be carried out within station premises. The following should be considered:
  - Processing time for each submission: 20 working days
  - Resource availability from Railway Operator to supervise the approved modification work or grant access to sensitive areas
  - Works to be carried out by proprietary contractors only
- 4.1.4 The Developer and his appointed QPs shall split the submissions in accordance to the affected area/trade/service as per the suggested list below. The splitting shall be discussed amongst the Railway Operator, LTA and the Developer and his appointed QPs when the scope of modification has been identified. This will also help in expediting the reviewing and approval process.
  - a. Architectural & Structural related work
  - b. Electrical Services (ES)
  - c. Communications System
    - Video Surveillance System (VSS)
    - Public Address (PA) System
    - Radio System
    - Telephone and Ancillary (TAA) Communications System including firemen intercom
    - Station Travel Information System (STIS) including Passenger Information Display (PID)
  - d. Environmental Control System (ECS)
  - e. Tunnel Ventilation System (TVS)
  - f. Pumps (Sanitary / Drainage)
  - g. Supervisory Control System / Integrated Supervisory Control System (SCS/ISCS)
  - h. Lifts/Escalators
  - i. Fire Protection System (FPS)



- j. Access Management System (AMS)
- k. Fare System (FS)
- 1. Maintenance Management System (MMS)

#### 4.2 Architectural and Civil/Structural related MOD

- 4.2.1 The design and specification of the proposed architectural and civil & structural related modification works shall comply with, but not limited to, the following:
  - a) Building Control Act and its Regulations
  - b) Code of Practice for Railway Protection
  - c) LTA Civil Design Criteria for Road and Rail Transit Systems
  - d) LTA Materials & Workmanship Specification for Architectural works
  - e) LTA Materials & Workmanship Specification for Civil & Structural works
  - f) LTA Architectural Design Criteria (ADC)
- 4.2.2 The appointed QP shall also include a standard declaration in the first page of the design report as given below:

I, \_\_\_\_\_, PE no., \_\_\_\_\_, being the qualified person appointed under the Rapid Transit Systems (Development and Building Works in Railway Corridor and Railway Protection Zone) Regulations, hereby certify that the engineering works in the railway protection zone as shown on these plans have been designed in accordance with the Code of Practice for Railway Protection and other conditions imposed by the Land Transport Authority and these works will not affect the structural integrity of the existing railway structures.

# 4.2.3 The QP endorsed design details and calculations shall be included in the design report submitted to LTA, but not be limited to the following: -

- a. Enlarged interfacing details between new structure and existing RTS structure
- b. Connection details at the interface
- c. Details of drill in bolts or bars at the interface
- d. Load transfer to existing railway structures



- e. Capacity check of existing structures
- f. Strengthening works, if any
- g. Making good of existing structures
- h. Waterproofing details (type of waterproofing materials, layout of the grout tube and etc.)
- i. Test report to prove the performance of the proposed membrane (water migration test, membrane peel test)
- j. Track record/project history for the proposed type of materials
- 4.2.4 The application for permit to commence a specific phase of engineering work involving modification request shall be submitted by the appointed qualified person. The submission checklist for Architectural and Civil/Structural related MOD can be found in <u>Appendix A</u>.

#### 4.3 Electrical and Mechanical (E&M) Service and System related MOD

- 4.3.1 The design and specification of the proposed E&M related modification works shall comply with the requirements stipulated under Chapter 3.
- 4.3.2 The submission checklist for E&M related MOD can be found in <u>Appendix B</u>.

#### 5. COMPLETION OF MODIFICATION (COM)

#### 5.1 General

- 5.1.1 Upon the satisfactory completion of the modifications, the appointed QP shall retrieve and update all relevant LTA existing documents and as-built records within **3 months** upon completion of the modification work.
- 5.1.2 The existing LTA document and as-built records that are to be updated shall include but not limited to the following:
  - a. As-built drawings (Sepia, PDF and DGN/DWG format)
  - b. Additional documentations if any (Test Record, Inspection Record, Warranty, Interface Control Document, Interface Data Document, etc.)
- 5.1.3 Please refer to *Flowchart B* for the process to retrieve and update LTA existing asbuilt records. A copy of Request Form will be shared upon request.



Flowchart B - Process for requesting of LTA as-built drawings/documents

- 5.1.4 General requirements for updating of LTA as-built drawings:
  - a. To cloud out the areas of changes or modifications on the original LTA as-built drawings;
  - b. To update the revision letter with a triangle next to the clouded area;
  - c. To make reference to QP's new as-built drawing and to indicate the new drawing number where appropriate;
  - d. To indicate relevant LTA as-built drawing number in QP's new as-built drawing for cross reference;
  - e. To indicate the revision letter, the date of updating, description of changes, approved AFM/MCRF numbers with short description of project title in the title block;
  - f. Endorsement by qualified person, drawn and checked by relevant parties where appropriate
- 5.1.5 The appointed QP should make necessary arrangement with the Authority to return all updated as-built drawings:
  - a. Hardcopy format QP to return 1 set of updated hardcopy with 1 set of PDF in DVD
  - Dwg/dgn format QP to return 1 set of updated <u>dwg/dgn</u> with 1 set of PDF in DVD
  - c. PDF format QP to return 1 set of updated PDF in DVD

- d. QP's new drawings QP to provide 1 set of new <u>dwg/dgn</u> with 1 set of PDF in DVD
- 5.1.4 The submission document checklist for Closure of Modification (COM) can be found in <u>Appendix C</u>.

#### 5.2 Submission Process



Flowchart D – Overall Submission Process for Closure of Modification (COM)

# Note:

- 1. QP is required to submit the proposal to Railway Operator first and obtain an acknowledgment letter before proceeding to Corenet to make an application to LTA/DBC.
- 2. Submission to SMRT and SBST-NEL can be made via email to the appointed coordinator.
- 3. Submission to SBST-DTL shall be made via the Maximo system.
- 4. A prior to issuing the "No Further Comment" letter, DBC will inform all stakeholders (LTA internal divisions and Railway Operators) that the proposal is acceptable with no further comments. There will be internal communication/process between LTA and Railway Operator to allow Railway Operator to proceed with his internal approval process in the system.

- 5. B Upon receiving confirmation from LTA, Railway Operator to proceed with his internal approval process in the system. Railway Operator will issue the approved COM to the QP and DBC via email.
- C QP will proceed to return all as-built drawings/record to LTA Record Centre. Developer will proceed to submit TCCC for asset handover. QP can apply for CSC if all COMs are approved.

#### 5.3 Documents to submit

The following documents shall be submitted concurrently to LTA/DBC and Railway Operator's coordinator for review:

- a. Cover letter from QP's office indicating the COM number, title and revision number
- b. Approved AFM/MCRF form
- c. Completed COM form
- d. <u>Appendix C</u> Document Checklist for Submission of Closure of Modification (Com)
- e. <u>Appendix E</u> Drawing List for Submission of COM
- f. Supporting documents/drawings

# 6. HANDOVER OF LTA ASSET

6.1 Upon completion of the proposed modification work, the Developer will hand over all defect-free assets to LTA and Railway Operator. The Developer is required to comply with **Flowchart C** prior to the submission of CERTIFICATE OF TRANSFER OF CARE CUSTODY AND CONTROL (TCCC) form as the official handover record.



Flowchart C – Overall handover process

- 6.2 The Developer shall submit the proposed Joint Testing and Commissioning (T&C) and Defect Inspection schedule at least <u>6 months</u> in advance to LTA. Prior to the proposed opening of the affected area or Temporary Occupation Permit (TOP), the Developer and his contractor shall conduct internal T&C to ensure that all RTS systems are in working conditions. Internal T&C records for respective trades/services shall be submitted to LTA and Railway Operator prior to arranging T&C inspection with LTA/DBC. Internal T&C report is to be endorsed by the main contractor, his service provider/system specialist and qualified person of the relevant discipline. Railway Operator's endorsement as a witness will be on case by case basis and subject to Railway Operator's assessment.
- 6.3 The developer shall comply with the TOP requirements stipulated by other technical agencies.
- 6.4 The developer is required to submit the final joint T&C inspection schedule for respective trades/services at least <u>two weeks</u> in advance so that LTA/DBC can coordinate with PTO and LTA internal divisions to arrange for the Joint T&C and Defect Inspection.
- 6.5 Upon receiving the proposed schedule, LTA/DBC will liaise with Railway Operator and respective LTA internal divisions to confirm the Joint T&C and Defect Inspection date.

- 6.6 Joint T&C and Defect Inspections will be carried out according to affected location/trade/service. Developer is required to prepare the test report (with scenario) and attendance list to facilitate the joint inspection.
- 6.7 The developer will note down the comments (if any) during the Joint T&C and Defect Inspections and prepare the defect list (refer to <u>Appendix G</u>) accordingly. Developer and his contractor will also rectify the defects and provide before and after photos accordingly for LTA and Railway Operator's acceptance.
- 6.8 The developer will ensure that the rectification work is satisfactory before calling for re-inspection. The developer is required to submit the signed defect list to LTA and Railway Operator first before calling for re-inspection.
- 6.9 The Developer shall submit final T&C record which will comprise of:
  - a. T&C test reports (to be endorsed by the main contractor, his service provider/system specialist and qualified person of the relevant discipline; Railway Operator relevant discipline, LTA RAOM and PSS sign off as the witness)
  - b. Defect list (refer to LTA template)
  - c. Attendance list (to be prepared by the developer)
- 6.10 The developer will be allowed to open the affected area for public access / TOP if
  - a. LTA and Railway Operator are satisfied with the final T&C record submitted;
  - b. The developer complies with the TOP requirements stipulate by other technical agencies (i.e. BCA, SCDF etc); and
  - c. There are no outstanding issues concerning safe station operation.
- 6.11 Concurrently, the Developer shall submit COM to LTA and Railway Operator to facilitate the subsequent asset handover. (Please refer <u>here</u> for COM process). Please note that the 12-month Defect Liability Period commences from date of TCCC is signed by LTA and Railway Operator. Prior to that, the responsibility to maintain the assets is still with the Developer. There is no Defect Liability Period for architectural and structural related assets. However, the Developer must ensure that the warranty provided complies to LTA M&W specifications. The Developer, his contractor and specialist are required to submit Deed of warranty for respective architectural and structural assets. A sample of Deed of warranty will be sent to the Developer upon request.
- 6.12 The Developer and his contractor should also provide training to the Railway Operator. Such training can be carried out whenever the Developer and his contractor is ready. Training record/materials should be submitted under COM.

Land Transport Authority Once COM is approved, the Developer can proceed to submit TCCC for LTA & Railway Operator endorsement. The trade/service is considered LTA asset once TCCC is endorsed. The submission of TCCC should also include a copy of virus-

6.14 LTA and Railway Operator will conduct internal verification upon receiving the TCCC form and required documents. This process will take about 14 working days.

free DVD with all required documents (final version).

6.15 LTA and Railway Operator will sign on the TCCC form after the internal verification. This process will take about 14 working days.

# 7. DISPOSAL OF LTA ASSET

6.13

- 7.1 The Developer shall submit a written request to dispose of LTA assets due to the proposed modification works. The disposal process and approach shall comply with LTA's requirements.
- 7.2 Any proceeds arising from the disposal shall be returned to LTA with a declaration letter and invoice.

# 8. CERTIFICATE OF STATUTORY COMPLETION

- 8.1 An application for clearance of Certificate of Statutory Completion shall be accompanied by, but not limited to, the following items:
  - 1) Proof that all monitoring instruments installed have been removed and the drilling holes have been made good
  - 2) As-built drawings and As-built design documents endorsed by QP / PE / LEW (including new development and updated station as-built for affected areas)
  - 3) Endorsed Maintenance agreement / undertaking letter if any
  - 4) Updated Maintenance Boundary Plan
  - 5) Railway Operator's endorsed Completion of Modification (COM) forms

# PART III – DESIGN REQUIREMENTS AND CONSIDERATION

#### 1. **GENERAL**

- 1.1 Provisions were made in the design and construction of the Rapid Transit Systems (RTS), to integrate RTS stations with future developments on adjacent land into multi-dependent development units. The concept envisaged was that these future developments will be built over and/or abutting the RTS structures. This will enhance the attractiveness of these developments as they will be provided with convenient public transport access. The RTS stations or railway involved were therefore designed and constructed to accommodate these developments. Certain railway related facilities such as fire protection (active and passive), building services, environmental control, security surveillance and communication equipment, etc. will be affected by the developments without affecting the RTS.
- 1.2 RTS is an important component of the public transportation system in Singapore. The fundamental concerns of the Authority are the operational safety, fire safety and flood protection, security and structural integrity of the RTS. Developments proposed above and/or adjacent to the station therefore must be designed and constructed such that they do not endanger the RTS structures and the railway operation. The safety and convenience of the traveling public shall always be protected in the design and construction of the development; and there shall be no service disruption.
- 1.3 The development shall be planned such that it does not impact on the businesses and retail activities in the station commercial areas. If it does, the developer shall resolve the commercial issues directly with the station operator/manager of the commercial space and forward a copy of the operator's concurrence to support his development proposals.
- 1.4 The layout of the future development around existing RTS stations, ventilation shafts and other substructures or facilities at ground level shall be designed for convenient commuter access from the major roads or commercial centres and access required for maintenance purposes by the Authority's and/or Operator's staff and agent authorised by the Authority or Operator. In addition to these, access to the station by other agencies, such as the Singapore Civil Defense Force to the firefighting staircase and other related firefighting facilities are also reserved.

#### 2. DESIGN FOR OPERATION AND MAINTENANCE (DFOM)

2.1 The Developer shall incorporate Design for Operation and Maintenance concept in the design of any facility, structure, architectural finishes and fixings, E&M services and equipment which to be handed over to the Authority or Railway Operator upon completion of works.

- 2.2 The DFOM shall take into consideration the maintainability during the service life of E&M services and systems assets. All E&M services and systems assets shall be designed with consideration of the maintenance access to the services, systems, equipment, etc. and shall ensure that regular maintenance can be carried out safely, easily and efficiently with minimal impact to operations. The designs shall be optimal between performance and risks with consideration for both short term and long-term impacts.
- 2.3 The DFOM shall take into consideration of the feedback from Railway Operators.
- 2.4 The DFOM shall include but is not limited to the following:
  - a. Safety To mitigate safety related risks associated with maintenance means and equipment;
  - b. Simplicity Ease of maintenance and avoid or minimize requirement for specialised skill levels and tools;
  - c. Human factors and ergonomics Maintain productivity without compromising safety and while minimizing physical demands placed on the maintenance crew;
  - d. Accessibility and Maintainability Provide safe access to ensure ease of maintenance;
  - e. Standardisation Minimise variation in design and maintenance procedures for better efficiency;
  - f. Redundancy strategy Sufficient space and provisions for future needs; and
  - g. Cost effectiveness Compare the relative costs and outcomes of different designs.
- 2.5 The detailed specifications / requirements of the services and systems affected by the proposed works will be provided after the Developer has presented the proposed scheme to LTA.

#### **3. SITE SURVEY**

- 3.1 The setting out of the stations and other MRT structures is based on the MRT Survey Grid system adopted for the whole Mass Rapid Transit System. This survey coordinate system is different from the Singapore Government Cadastral Survey Grid system.
- 3.2 The responsibility of determining the exact locations of the stations and other MRT structures affected by the future development rests solely with the Developer.
- 3.3 A survey of the section of the MRT structures affected by the proposed works must be carried out by a registered land surveyor in order to determine in plan and level

the relative position of these structures with respect to the proposed development. Survey plan showing the location of the station, tunnels and the limits of the reserve lines of the protection zone as defined in the CPRP in plan and sections from the proposed development endorsed by a Registered Surveyor shall be prepared. This survey plan must contain information such as the survey system used.

- 3.4 Application for station/tunnel access shall be made by the appointed Registered Surveyor to LTA with the following information provided:
  - MRT line affected
  - Chainage
  - Name of station/affected area/room
  - Project reference number and project title
- 3.5 A separate application for security screening will be required for access into the sensitive rooms for survey or work.

# 4. PUBLIC TRANSPORT SECURITY REQUIREMENTS

#### 4.1 Scope

- 4.1.1 The aim of this section is to provide the QPs / Developers as much information with regards to security related requirements during the A&A works. These A&A works, by design or work processes, may potentially weaken the existing security mitigation measures or introduce new security vulnerabilities.
- 4.1.2 This section also includes the A&A Security Checklist for the Contractor to identify if there are possible security vulnerabilities in the A&A works. This is to safeguard our infrastructures by ensuring existing security measures are not weakened or compromised by the A&A works.

# 4.2 Definition

- 4.2.1 Hand / toe-holds may include, but are not limited to, light-poles, sign-boards, staircase balustrades, handrails, covered walkways or any constructs more than 30mm in horizontal width.
- 4.2.2 Horizontal surfaces less than 30mm width but strong enough to withstand the weight of a typical human standing atop shall also be considered as hand / toe-holds. Such surfaces may take the form of, but shall not be limited to, metallic signages, tempered glass panels, iron posts etc.



Figure 1: Example (non-exhaustive) of scaling atop connections / sheltered walkways to MRT Stations via railing

- 4.2.3 Ledge that allow placement of items refers to architectural / structural finishes and treatments of more than 50mm horizontal width, and between the height of 1600mm to 3000mm in height, at any point of the feature as measured from the top of the FFL to the said horizontal recess or ledge.
- 4.2.4 The following, non-exhaustive, are examples of A&A works that may introduce security vulnerabilities:
  - a. New structures near / linking MRT Station or MRT Viaduct e.g. New Buildings, Pedestrian Overhead Bridge (POB), Underpass, Covered Walkways, Integrated Entrance, Signage, Bus Stops etc;
  - b. New machine installations or structures within MRT Station e.g. Top Up Kiosk (TUK), Top Up Machine (TUM), Signage, Escalators, Lifts etc;

# 4.3 Adjacent areas of MRT Station or MRT Viaduct

- 4.3.1 There shall be no hand / toe-hold within the:
  - a. 3000mm spherical distance from any gaps (more than 150mm) along the façade of the MRT Station that allows access into the premise. (refer to Figure 2);
  - b. 3000mm spherical distance from the edge of rail viaduct (refer to Figure 3);

c. 3000mm distance from the soffit of rail viaduct to FFL (refer to Figure 3);



Note: Illustration not drawn to scale





Note: Illustration not drawn to scale

# Figure 2: Spherical clearance from edge of viaduct / soffit of rail viaduct

4.3.2 In the event new structures (e.g. Covered linkways) are unable to meet the standoff indicated in the earlier paragraph, the minimum height of the new structures shall be designed to be no less than 3000mm, as measured from the top of the soil,



driveway or Finished Floor Level (FFL) to the soffit of the structure. There shall not be any hand / toe-holds between the top of the soil, driveway or Finished Floor Level (FFL) to the soffit of the structure.

4.3.3 New structures overlooking tracks (e.g. link bridges or POB) shall be suitably treated to prevent items from being thrown onto the tracks through the use of physical barriers that is no less than 3000mm in height with any gaps / openings on the physical barriers to be no more than 50mm in height or width.



Figure 3: POB with Physical Barrier to prevent things from being thrown onto the tracks

- 4.3.4 A&A work's hoardings surrounding any part of the MRT Station or MRT Viaduct shall be erected at least 3000mm, as measured from the top of the soil, concrete sill, driveway or Finished Floor Level (FFL). There shall be no hand / toe-hold on the surface of the hoarding facing the public area, which will aid a person to scale over into the hoarded area, MRT Station or MRT Viaduct. The spacing between base of the hoarding to the FFL shall not be more than 150mm. This is to prevent intrusion into its premises.
- 4.3.5 In the event the existing security shutter is removed due to the A&A works, proper mitigation measures are to be provided to secure the station during and after the A&A works, subjected to the approval of the Authority.
- 4.3.6 New entrance/s, created by the A&A works (e.g. connection via Knock-Off-Panel, at-grade entrance), shall comply to the requirements stated in Clause 5.5 (Security Grilles / Shutters) and Video Surveillance System (VSS) Standards.



# 4.4 Creation of Hiding Spaces

- 4.4.1 A&A work's hoardings within MRT Station shall be erected full height or no less than 3000mm, as measured from the top of the Finished Floor Level (FFL) to prevent items being thrown into the worksite from the public assessable areas.
- 4.4.2 The proposed work and the logistics provided at the work area shall not create blind spots and/or hiding places that could be exploited.

#### 4.5 Relocation or Addition of Critical Rooms

- 4.5.1 In the event the A&A works consist of relocating existing critical rooms or adding new critical rooms, LTA Public Transport Security (PTS) shall be consulted to ensure that proper security measures have been adopted.
- 4.5.2 Similarly, if the restricted areas around the existing critical rooms are converted to public accessible areas, LTA PTS shall be consulted on possible mitigation measures.

#### 4.6 Security Clearance

- 4.6.1 Each member of the project team working on the project, depending on his/her level of access to sensitive information in relation to the project, shall be required to undergo the necessary security clearances by the Authority and/or other relevant agencies before being allowed to commence work on the project. The Authority and/or other relevant agencies reserves the right not to grant an individual the necessary security clearance without explanation. For security clearance to access sensitive information, please submit an email request to <u>DBC</u>.
- 4.6.2 When access into critical room such as VSS server room is required, a different application for security clearance into operational areas is required for every member of the Contractor's team. Only upon security clearance will contractor be allowed to access to critical room. For security clearance to access critical room, please submit an email request to DBC.

#### 4.7 A&A Security Checklist

- 4.7.1 The objective of the A&A Security Checklist is to identify if the A&A works weaken the existing security mitigation measures or introduce new security vulnerabilities of the MRT Station or MRT Viaducts. This is achieved by confirming the compliance of A&A works' design with the security requirement listed in the checklist.
- 4.7.2 The Developer, the appointed QPs and contractors shall use the A&A Security Checklist to validate the A&A design is in compliance with the security requirement listed in the checklist. Where possible, the The Developer, the appointed QPs and contractors shall review their A&A works and achieve the requirements listed within the checklist, in order to mitigate identified security risk.



- 4.7.3 In the event, the A&A works weakens the existing security mitigation measures or introduce new security vulnerabilities, a "tick" will be reflected in the "Yes" column of the A&A Security Checklist. This means the A&A works have not complied with the security requirements. As such, further consultation with LTA Public Transport Security (PTS) is required to address and close the gap.
- 4.7.4 The Qualified Person shall submit the Security Checklist (refer to Appendix E) to LTA for review and acceptance.
- 4.7.5 Based on the scope of the A&A works, LTA PTS will decide, based on the scope of the A&A, whether to issue the Contractor the full security guidelines or only the relevant security requirement for compliance. Below are two possible scenarios:
  - a. Minor A&A works e.g. A private developer intends to connect its premise to a MRT Station via a Knock-Out Panel only. MRT Boundary remains unchanged.
    - For this direct connection to the station, two possible areas of concern are security shutter design and VSS coverage;
    - LTA PTS will extract and share with the Contractor the relevant security requirements from the main security guidelines.
  - b. Major A&A works e.g. A developer intends to integrate a residential development with one of the MRT station's entrance, including changing of the entrance façade.
    - The A&A may affect several security elements therefore LTA PTS will share the full security chapter with the Contractor, upon successful security clearance.

# 4.8 A&A works at Special Infrastructure

- 4.8.1 Under the Ministry of Home Affairs' (MHA) Infrastructure Protection Act (IPA), a Security-By-Design review is required if specific A&A works are carried out at a Special Infrastructure (SI). The Contractor will be informed by the Authority if the A&A works occurs at a SI. The specific A&A works refer to:
  - a. Any extension of the SI;
  - b. Any alteration, extension, repair, dismantling or demolition works carried out to the structure or glazing of the SI;
  - c. Any installation or relocation of critical asset in the SI;
  - d. Any alteration, extension, repair, dismantling, or demolition works affecting the perimeter of the SI.

4.8.2 In the event that the A&A works require a Security-By-Design review, the Contractor shall engage a competent security and/or blast consultant to perform the necessary assessments and documentation submission to MHA.

#### 4.9 Other Security Requirements

4.9.1 Depending on the nature and extent of the A&A works, the contractor shall comply with the requirements stated in the main Security Guidelines for MRT Stations issued by the Authority.

# 5. **ARCHITECTURE**

#### 5.1 General

- 5.1.1 The architectural layout and overall architectural design of the future development above and/or adjacent to the RTS structures is the responsibility of the Developer. The Developer and his appointed QP shall take into consideration the constraints placed on his architectural layout and design due to the presence of the RTS structures.
- 5.1.2 The essential criteria in the station layout is to provide adequate space for the movement of commuters from the station entrances to the platform level in the most direct way and this free access should not be interfered with. The positions of the existing entrances, firefighting stairs, ventilation shafts and other facilities of the station both at ground level and below ground will dictate, to a large extent, the overall design of the development.
- 5.1.3 The primary purpose of the station is designed as a facility for the movement of people. Hence the access route to and from the station must not be compromised. The prime considerations of pedestrian movement in RTS station design are the provision for both clarity and safety, with spaces organized for maximum efficiency and smooth passenger flow. These issues should be fully catered for in the design and configuration of spaces in the future development.
- 5.1.4 The Developer shall include in his design provisions for incorporating these RTS structures into his development taking into consideration the technical, operational and maintenance requirements that must be met.
- 5.1.5 LTA has also released a publication of 'Quick Guide Series for Development Related Proposals', titled 'Design Requirements for RTS-integrated Developments' with the aim to clarify on LTA's design requirements for developments that are integrated with existing RTS. The Quick Guide incorporates diagrammatic explanations and photos to provide details on which allow a quicker and clearer understanding of the design requirements, best practices as well as various lessons learnt from past RTS integration projects. A publication of this guide is available at LTA's corporate website, under <u>Industry & Innovations > Industry Matters ></u> <u>Development & Construction Resources> Building Works & Restricted Activities</u>

in Railway Protection Zone > Codes of Practice, Standards, Specifications, Guides & Forms.

#### 5.2 Station Entrance

- 5.2.1 The entrances to the station at ground level are positioned such that they are easily recognizable and accessible in relation to the roads and other developments in the vicinity and the flow of pedestrian and passenger traffic. These entrances at the ground level lead directly to the station concourse or via an intermediate level. The materials used for the finishes in and around the entrances are similar to those used within the station in order maintain a seamless look with the station. Station sign with the Transit Logo is prominently displayed at the entrance for high visibility and easy identification. The Developer and his QP must comply with those requirements and provide signs meeting this within the development if the station entrances are affected.
- 5.2.2 The width of the station entrances is evaluated by considering the projected passenger flow during peak period together with the necessity for evacuation of passenger from the station in an emergency. These have been designed based on the prevailing guidelines and any other mandatory requirements of the Fire Safety Department (FSD), Singapore Civil Defense Force (SCDF). The design of the new station entrance into the future development shall take these into considerations and comply with the prevailing fire code and CPFPRTS requirements.
- 5.2.3 All station entrances are provided with canopies or roof to adequately protect them from the weather. Canopies and roof are constructed with adequate projection and fascia or parapets to cover the structural elements of the roof and provide sufficient upstand against rainwater spillage. The rainwater should be collected and discharged to the surface drainage network. The Developer and his QP shall take into consideration of weather protection for a reconstructed station entrance (i.e. relocated or integrated into the future development) to prevent any water from splashing into the station which may pose safety concerns.
- 5.2.4 The entrances to certain stations may form part of an integral development and special consideration shall be given in the design solution or layout around it. The layout of the future development at ground level shall be designed such that access to the station entrances from the roads and other premises in the vicinity are not adversely affected. Free and easy access to the station entrances shall be maintained for the benefit of the traveling public. The entry/exit points to the station shall be separated from or independent of the entry/exit points to the development to avoid congestion. LTA will exercise permanent right under Section 6 the Rapid Transit Systems Act for station entrances located in the development.
- 5.2.5 The future development must be designed and constructed such that the safe operation of the MRT station including its entrance, physically disabled and handicap facilities are not affected during both construction and upon completion

of the development. Barrier free access to the station must be incorporated into the proposal for easy access to the station from the development and where the station entrances are affected. The construction works must also not cause any nuisance or inconvenience to the public.

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- 5.2.6 The entrances to the station shall have a fire separation of at least 2 hours from the future development in accordance with the CPRP and CPFPRTS if they are integrated into the development.
- 5.2.7 The affected station entrance shall remain open during the construction. A protected passageway for commuters' access to the station entrances shall always be provided during the construction of the future development. Construction works at the area including demolition and removal of the existing entrance canopy and services, construction of the building over the entrance, and etc., shall be planned and scheduled so that access to the station via the entrances are maintained operational and safe.
- 5.2.8 VSS cameras shall be provided at these station entrances in compliance to LTA's requirements
- 5.2.9 Passenger Information Displays (PIDs) shall be provided at these station entrances in compliance to LTA's requirements.

#### 5.3 Fire Safety

- 5.3.1 Fire Protection within station
- 5.3.1.1 The fire protection standards within the station and means of escape from the station have been designed to comply with the prevailing requirements of the FSD which covers the fire protection requirements for all aspect of fixed guideway transit system and for life safety from fire in the transit system. The design of any new development linked to the station shall meet with the similar or higher level of fire protection and prevention adopted in the station.
- 5.3.1.2 All interfaces between the future development and RTS structure and all rail commuters' access routes, fire escapes, etc. shall conform to the latest requirements of CPFPRTS.
- 5.3.1.3 The construction of the future connection must take consideration that the development's works shall not obstruct any fire exit to the point of safety at any times. If there are any needs to replace finishes or carry out any alteration of the station areas, the developer shall submit the detail of the works to LTA and any other authorities to ensure that these works are complied with all the relevant safety requirements. A copy of SCDF's approval shall also be submitted to LTA for record.
- 5.3.1.4 The Developer shall ensure that the station transit public areas shall be separated from the construction works with at least 2-hr non-combustible fire-resistant



protection/barrier. This may be in the form of protected passageway from station public areas leading up to the point of safety at entrance level. LTA's minimum width requirement for the passageway shall also be complied with considering all the working spaces required within the construction areas. This fire barrier or protected passageway shall not be removed until the development is completed for occupation or until the temporary fire permit of the development is obtained. The Developer shall seek approval from LTA prior to the removal of the fire barrier or protected passageway.

- 5.3.1.5 Construction works affecting the access to the station for construction of the protected passageway over the entrance subway, etc., shall be planned and scheduled so that safe access to the station via the entrance subway are maintained at all times during operational hours. The Developer shall submit the proposal to LTA and relevant authorities for review and acceptances before commencement of works. The passageway shall not compromise the fire escape provision for the rapid transit systems. Should the protected passageways and the location of the point of safety be temporarily altered, the Developer shall demonstrate that the exit capacity of the station is not reduced, and the exit time of the station complies with CPFPRTS requirements. In addition, the Developer shall also make provision for ventilation, emergency lighting, fire safety sign, normal lighting, etc. The design of these facilities shall be subjected to the approval of LTA and other relevant authorities.
- 5.3.1.6 The development and construction work's access shall not affect the station's breeching inlets, fire hydrant, firefighters intercom and other fire access's ways including the turning facilities for the fire engine. Should it become necessarily to temporarily divert the above provision due to the construction work, the Developer shall obtain approval from LTA and other relevant authorities. The Developer shall appoint a QP in the appropriate discipline, in accordance with the Fire Safety Act, to prepare plans of the temporary diversion of fire safety works. Works shall be coordinated with the LTA and the Railway Operator. Upon completion of the diversion works, the QP shall submit a copy of the letter to LTA to confirm that the said works have been carried out in accordance with the requirements of the Fire Safety Act.
- 5.3.2 Fire Separation
- 5.3.2.1 The future development shall be fire separated from the RTS station with at least 2 hours fire resistant construction. Where fire shutter is provided for fire separation, 1 set of such fire shutter shall be provided within the boundary of the future development. An Interface Terminal Box (ITB) shall be provided within the station boundary for electrical control interface (Please refer to Figure 2). The fire shutter shall be closed upon activation of any one of the following:
  - a. Activation of any one of the localised smoke detectors installed on both sides of the shutters

b. Activation of adjacent fire alarm zone from the future development



Figure 5: Typical Fire Shutter Provision at the interface between RTS and Development Premise

- 5.3.2.2 The developer shall provide monitoring cables from the fire shutters to the station's ISCS/SCS following the station existing monitoring and control convention.
- 5.3.2.3 A means shall be provided to silence the audible alarm but not to cancel the visual alarm.
- 5.3.2.4 Upon activation of the localized standalone smoke detectors, an alarm signal shall be sent to the fire alarm panels of both the station and the future development. Where motorized fire shutter is provided, the said shutter shall remain closed and be rendered inoperative until the fire alarm has been reset. This alarm signal is not used to trigger the building fire alarm but is intended to provide the status that the shutter is activated and is used as a means to reset the fire alarm panel to reopen the fire shutter after its activation. Therefore, the smoke detector located at the side of the fire shutter shall not form part of the building fire alarm.
5.3.2.5 Land Transport Authority the development is maintained, inspected, tested and certified by a Qualified Person as required under the CPFPRTS and CPRP.

- 5.3.2.6 In the event of a fire emergency, the fire shutters will close to fire-separate the station from the future development. As such, the future development shall be designed with escapes independent of the RTS station.
- 5.3.2.1 Fire shutters shall not be used as security shutters. The reset device for fire shutters at public areas shall be extended to an accessible height (1.5m to 1.8m) and concealed within openable wall cladding.

# 5.4 Flood Protection

- 5.4.1 All entrances/exits of any development connected to the station / station underpass shall be located at the same level or higher than the threshold level of the station. The Developer shall ensure that the proposed connections to the station from the future development do not constitute a route for floodwater into the station both during construction period of the development and its permanent state.
- 5.5.2 Where connection is made underground to link to RTS station, the threshold level of any opening within the development shall not be lower than the platform/threshold and crest levels specified in the Code of Practice on Surface Drainage and approval from Drainage Department of PUB shall be obtained. A copy of Drainage Department's approval shall also be submitted to LTA. Breakthrough of connection to the MRT station shall only be made after all entrances, openings, services penetration, etc. to the development has reached the approved platform and crest threshold levels.
- 5.5.3 The Developer shall submit proposals for flood protection of the RTS station during construction of the Development to LTA and PUB for review and acceptance. The construction works shall be planned and programmed such that there is no possibility of floodwater inundating the station and the RTS at any stage of the work. The Developer shall ensure that the RTS will not be subjected to flooding when the knock-out panels at concourse level of the station are removed. Method statement and construction sequence for removal of the knock-out panels shall be submitted to LTA for approval.

# 5.5 Security Grilles / Shutters

5.5.1 The developer shall provide motorized security grilles or shutters within the station boundary where there is any connection between the station and the future development. These motorized grilles or shutters shall also be provided at the station entrances. This is to allow the station to be closed after operation hours and for security reasons. The design of the security grilles shall meet LTA specifications.

- 5.5.2 Motorized grilles or shutters provided at the station entrances shall be designed with opening to allow fresh air circulation and allow smoke to escape during fire. The bottom/base of the grilles or shutters must be in perforated finish (about 600mm high) to prevent rodents. Such openings shall not be bigger than 150mm in either height (h) or width (w) so as to prevent intrusion into the station.
- 5.5.3 Motorized grilles or shutters provided at the underground connection shall be of full perforated panels to prevent rodent.
- 5.5.4 The motorized security grille/shutter shall be interfaced with the station's Integrated Supervisory Control System (ISCS) following the station existing monitoring and control convention.





- 5.5.5 The security grille/shutter shall be located within the RTS station boundary and handed over to LTA/Railway Operator upon completion for their control and maintenance after satisfactory commissioning and at a time to be agreed with LTA. The Developer shall design, provide, and install all necessary equipment and accessories, cable, conduits and their supports, update of existing hardware and software in the station and other associated works required.
- 5.5.6 Lockset of all doors, grilles and shutters which are to be handed to LTA/Railway Operator shall be provided with key cylinder compatible to those used in the station.

5.5.7 Access keys to the grilles/shutters provided at all connections/links to the station shall be handed over to and kept by LTA/Railway Operator before the opening of the access connection to the public.

- 5.5.8 The security grille/shutter shall be kept shut during non-operational hours of the access connection. LTA/Railway Operator reserves the right to keep the shutter closed as and when necessary.
- 5.5.9 The access connection provided within the development's boundary and its connection to the street shall be made available to all commuters at all time within the operational hours of the railway.
- 5.5.10 VSS cameras and PID shall be provided at the interface within station boundary. The provision and siting of the VSS cameras and PIDs shall comply to LTA's requirements.
- 5.5.11 Shutter control panel and top drum should place in the secure side to prevent breakin and tempering.
- 5.5.12 Shutter control panel should be locked (with key) and installed at least 1.2m away from the shutter (or RTS station's boundary) to prevent tampering.

# 5.6 Finishes

- 5.6.1 The material selected for the finishes in the station are of a high quality in order to project the prestigious and highly visible nature of the MRT system. The materials used are also generally robust, durable and hard wearing, maintenance free and non-combustible. The floors in the public area in the station are generally finished in granite. The walls are cladded with durable hard-wearing material generally comprising of granite slab, vitreous enameled steel panels or glass-fibre reinforced concrete panels. Ceilings are suspended from the soffit of floor slabs and are generally made of aluminum egg-crate panels, glass-fibre reinforced concrete panels, and etc.
- 5.6.2 The Developer shall adopt the architectural finishes for the future development that is best suited to his needs. However, due consideration should be given such that the finishes in the development are compatible with and complement the architectural treatment of the MRT station. Interface details of finishes at the subway or at the connections with the station shall be complied to Architecture Design Criteria of LTA. Samples of the proposed materials shall be submitted to LTA for approval.

# 5.7 Firefighters Access and Emergency Stairs

5.7.1 The architectural layout of the future development shall be designed to ensure that the entrance/exit to the station firefighting stairs and/or emergency stairs is not obstructed. Where they are incorporated into the future development, a 2-hour fire

Land Transport Authority separated passageway of not less than the width of the existing stair shall be provided leading to the exterior. Entry point to firefighting's staircase shall be visible and located within 18 m from the fire engine accessway. Entrance/exit points to the stair are to be provided with suitable signs so that they are easily recognisable by the SCDF.

- 5.7.2 All at-grade doorways, including the stair cores of emergency stairwells, leading into the interior spaces of the station, shall not have vision panels installed and such omissions subjected to the approval of relevant authorities / agencies such as FSD. If the use of vision panels is unavoidable, consideration must be taken to ensure that the doors cannot be opened through the act of shattering the vision panels and reaching in to activate the unlocking mechanism (release button, break glass, pushbars, door-knobs and etc.) either by hand or through the use of simple tools such as a rod or stick.
- 5.7.3 VSS Cameras shall be provided for every station emergency exit and entrances to station emergency exit escape routes in compliance to LTA's requirements.

## 5.8 Pedestrian Connection

- 5.8.1 Connections for the convenience of pedestrian to access the MRT station shall be provided either by covered walkways to the MRT station entrances at grade or underground pedestrian links which are seamlessly connected to the underground MRT station at concourse.
- 5.8.2 Proposed connection to the station concourse from the future development shall be designed to ensure smooth circulation of commuters. Connection can only be made into the free area in the station. Free area is a public circulation space in which information and ticket machines are located to which there is no charge for access.
- 5.8.3 The Developer shall provide a convenient and barrier-free thoroughfare for pedestrian access. This thoroughfare shall be opened and accessible for the general public during operating hour or revenue service of the rapid transit system.
- 5.8.4 The layout of the pedestrian passageway within the development from the entrances of the development to the access connections or links with the station shall be direct and whenever possible with line of sight and unhindered to allow free and convenient flow of passenger to and from the development in line with the design concept of the station.
- 5.8.5 The architectural finishes and E&M services and systems within the station affected by the construction of the pedestrian access are to be removed by the Developer. All materials removed shall be returned to LTA and the Railway Operator, unless otherwise directed by LTA. The architectural finishes and E&M services and systems within the station affected by the construction of the access connection are to be rebuilt or reinstated by the Developer at his expense. The materials/equipment used shall be compatible with those within the station.

- 5.8.6 The underground pedestrian link to the station where provided from the future development shall not be used as part of the escape route for occupants in the development to comply with the requirements of SCDF.
- 5.8.7 Barrier free access to station lift for the physically handicap with the associated ramp shall be incorporated within the development. The route to the lift shall remain accessible, direct and visually obvious to the public. The Developer shall provide barrier free route from this lift to the nearest development drop-off point.
- 5.8.7 The Developer shall ensure the following in their design of the access routes:
  - a. Tactile routes installed in accordance with the <u>Guide to the layout of the Tactile</u> <u>Guidance System in MRT and LRT Station</u>.
  - b. Accessible to people with disabilities in accordance with the prevailing Code on Barrier Free Accessibility in Buildings.
  - c. The floor of the development adjacent to the interface shall be screeded to fall away from the station underpass. The covered cut-off drain linking the scupper drain along the side of station diaphragm wall at the interface must be protected, properly treated with finishes, etc. to the requirements of LTA.
  - d. The developer shall refer to the Infrastructure Design Criteria of LTA for technical design criteria regarding Emergency Access, Handrails and Railings, Slipping and trip hazards, Avoidance of obstructions/Hazards, Public Health, Weather Protection, Visual Contrast, and etc.

# 5.9 Ventilation Shaft

- 5.9.1 The station ventilation shafts including the tunnel ventilation shafts shall be designed and positioned such that mutual recirculation will not occur if they are extended within the development. Openings of the ventilation shafts shall be arranged in such a manner that no smoke from the exhaust ventilation shaft and tunnel ventilation shaft can re-enter the station via the intake ventilation shaft and station's entrances (including the exit points of the firefighting's stair and emergency stairs) and no smoke from exhaust ventilation shaft recirculated into the tunnels via tunnel ventilation shaft when in supply mode. Any gratings, grilles or louvres shall be designed to prevent unauthorised entry to the shafts. The openings of all ventilation shafts shall also be meshed and sloped to prevent the introduction of foreign objects through throwing.
- 5.9.2 Engineering Analysis including Computational Fluid Dynamics (CFD) simulations shall be carried out during the design stage by a suitably Qualified Person to demonstrate that there is no smoke recirculation and smoke short-circuiting between vent shafts, station entrances and openings. The simulations shall model the louvre positions, wind effect, surrounding buildings and etc. A copy of CFD report shall be submitted to LTA for review and approval during design stage.

- 5.9.3 Consideration shall be given to ensure that exhaust air discharge of the development is not close to the station's intake openings and entrances. Likewise, intake points including windows of the development shall be designed to prevent smoke due to a fire in the station or tunnel from entering and endangering the development by the station exhaust and tunnel ventilation shafts' outlets. In the event of fire in the station or trackway, replacement air for the station smoke purging system and trackway emergency ventilation system will be supplied from station entrances. The design of the development shall take this into consideration to ensure life safety of passengers in the event of fire emergency in station, trackway and tunnels.
- 5.9.4 A 2-hour fire rated partition shall always be maintained between the individual ventilation shafts and there shall be a 2-hour fire separation between the ventilation shafts and development. The use of dry wall partitions will not be permitted. In order to limit the risk of unauthorised amendments or alteration to the fire partition, reinforced concrete construction for the wall shall be used.
- 5.9.5 All ventilation shafts shall be designed such that the bottom of the openings shall be no less than 5000mm as measured from the top of the ground, soil or FFL as well as any footholds.
- 5.9.6 Cat ladders are to be provided by the developer for maintenance access within the ventilation shafts. Details are to be submitted for LTA's acceptance and approval.
- 5.9.7 Where vent shafts are incorporated in the development, the location of openings shall comply with the relevant prevailing requirements. Vent shafts designed with side discharge shall be equipped with louvres to prevent the ingress of rainwater. Where vertical discharge is proposed for the vent shafts, the Developer shall provide the drainage system, including pumping system where necessary, to prevent accumulation of water. Frames shall be robust and protected against corrosion. Details or the louvres shall be submitted to LTA for review and acceptance.
- 5.9.8 The Developer shall ensure that the sound level emitted from the operating of outdoor E&M equipment, and from the ventilation shafts when the indoor equipment is operating shall comply with the noise criterion stipulated by the authorities.
- 5.9.9 Care should be taken to ensure that the operation of the ventilation shafts will not be affected at all times during and after construction of the development and any modification works to the shaft. There should be no restriction to free flow of air around the vent shafts and no ingress of rainwater into the stations through the vent shafts during and after construction. The 2-hour minimum fire compartmentation between individual vent shafts and minimum separation between vent shaft outlets to prevent short-circuiting of air shall always be observed. The Developer shall submit for review his proposal for the design and construction of the vent shafts.

5.9.10 Construction activities in the vicinity of the ventilation shaft will generate dust pollution, smoke and exhaust fumes and other environmental pollution which will affect the performance of the environmental control equipment as well as the fire and smoke detection system of the station. Effective measures to minimise dust pollution, etc. shall be implemented.

# 5.10 Relocation of Cooling Towers, Sprinkler Water / Cooling Tower Make-up Water Tank and other At-grade Equipment

- 5.10.1 The cooling towers, sprinkler / cooling tower make-up water tank and other equipment for certain MRT stations are located on the station roof or at ground level near to the station. The cooling towers, sprinkler / cooling tower make-up water tank and equipment may be relocated to the roof or podium of the future development. The new locations on the development shall be submitted to the Authority for review and acceptance.
- 5.10.2 The Developer shall ensure that the operations of the existing cooling towers, sprinkler / cooling tower make-up water tank and other equipment serving the station are not affected at any time during the construction of the future development. Construction activities shall be planned to take into consideration this requirement.
- 5.10.3 Pipe and cable shafts shall also be incorporated in the future development for connecting the pipework and cabling to the relocated equipment and installations. These pipe and cable shafts shall have a fire separation of at least 2 hours from the future development. Maintenance access via fire doors to the pipe and cable shafts shall be provided at every floor in the future development. These shall be located at easily accessible location such as a lobby or corridor.
- 5.10.4 Water tap and floor traps shall be provided at the cooling tower area and other equipment for cleaning purposes.

# 5.11 Signage

- 5.11.1 Signage at the future development
- 5.11.1.1 'Transit Facility' in this clause on signage refers to the MRT Station and connected public linkages, such as, public subways / underpasses / overhead-bridges / walkways, taxi stands, pickup / drop-off points, bus stops, etc.
- 5.11.1.2 The Developer shall provide a comprehensive interior and exterior wayfinding signage system to direct commuters to the Transit Facilities. Signs with comprehensive information shall be displayed at strategic locations around and within the Development to enable the public to clearly identify, be informed of and easily orientate themselves to the Transit Facilities.
- 5.11.1.3 The wayfinding and information signage for the Transit Facilities can be integrated with the signage of the Development. However, the information depicting the



Transit Facilities shall be clearly identifiable using standard public transit pictograms and associated text messages. Graphic elements and text message for the Transit Facilities shall be prominently designed.

- 5.11.1.4 The signs shall be implemented with good wayfinding and signage practice and shall be consistent with LTA's Signage Guidelines e.g. availability of relevant information, strategically located signs, continuity of directions from signs to signs, with a sense of assurance/affirmation for users, clear sight-lines, clear of distractions and clutter, good legibility, consistent brand recognition (of the Transit Facilities), and depiction (of the Transit Facilities) on the entire gamut of sign types such as identity signs, directional signs, and information signs e.g. map directories, floor directories, index directories, dynamic signs, and etc.
- 5.11.1.5 The major Transit Facility / Facilities shall be prominently indicated on information signs at all levels of the development.
- 5.11.1.6 Entrances/Exits and Linkages (which include subways / underpasses / overheadbridges / walkways / passageways and etc.) of the Development leading to the major Transit Facilities shall have clear signage (lit and non-lit), identifying and indicating the access to these Transit Facilities. Where existing entrance of the Transit Facility is modified or subsumed, identification of the Transit Facility shall be addressed with signage in conformance with the LTA's public transit signage guidelines.
- 5.11.1.7 Particularly for the integrated entrance at street level: large, prominent and integrated sign(s) shall be provided at this entrance to give the public clear identification of access to the MRT station and underpass.
- 5.11.1.8 The signage system shall make use of standard public transit pictograms and dimensions, in conformance with the LTA's signage graphic standards:
  - a. The MRT transport mode Logo the icon symbolising the MRT transport mode and/or facility.
  - b. The BUS transport mode logo the icon symbolising the Bus transport mode and/or facility (to be designated as 'Bus Interchange').
  - c. The TAXI transport mode logo the icon symbolising the Taxi transport mode and/or facility.
  - d. The Underpass pictogram the icon symbolising an underpass/link facility
  - e. Signage on UPL to entrances / exit
  - f. Signage for Maintenance Service Please call 1800-Call-LTA Quote Underpass No xxxxx.
  - g. Signage on Imposed Load Diagram

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- 5.11.1.9 The signage strategy shall be presented to the LTA during the design stage. The wayfinding system and signage layout shall be carried out in consultation with LTA, with drawings submitted for review and approval.
- 5.11.1.10 Upon completion of the signage installation, an audit of the installed signs at site shall be carried out by the LTA. Where there are apparent inconsistencies or erroneous information, or where signage is found to be deficient, or can be further improved, all which might have slipped through the design reviews or due to lack of information during the design review stage, further signage works shall be carried out by the successful developer to provide a comprehensive wayfinding signage system.
- 5.11.1.11 During the initial period upon the opening of the new development and new underpass connection to the MRT station, prominent temporary signs shall be placed at strategic locations around and within the Development and new underpass to guide commuters to the MRT station.
- 5.11.1.12 During the initial period after the opening of the new development, the Developer / building-management shall monitor and document feedback from the public (including those channeled via the LTA) on wayfinding to the Transit Facilities. Where signage can be further improved to address the feedback, the Developer / building-management shall carry out signage improvement works.
- 5.11.1.13 Upon completion, the signage shall be always well maintained by the Developer/building-management.
- 5.11.1.14 During the construction of the development, good quality temporary signs (one-toone replacement and additional signs as necessary or instructed) shall be adequately provided for re-direction of pedestrian / commuter traffic. Commuters should be able to easily identify the operational Transit Facility. These temporary signs shall comply with the LTA's public transit signage guidelines in terms of artwork / graphics. The design and locations of the signs shall be provided in consultation with LTA.
- 5.11.2 Public Transit Signage around and within the MRT station
- 5.11.2.1 In respect of wayfinding and public transit signage affected by the new development, the Developer shall plan, design, supply, delivery and install a comprehensive Public Transit Signage System in conformance with the LTA's Signage Guideline Manuals around and within the Transit Facility, involving the following:
  - a. Relocate existing public transit signs;
  - b. Provide new public transit signs;

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Update existing public transit signs such as sign face panel and information posters e.g. locality map and exit directories with current information for wayfinding from the Transit Facility / Facilities to the new development;

- d. Existing signs with their physical condition affected by the building construction shall be made good; they shall be replaced by new signs where they cannot be repaired to their original condition.
- e. Updating/adding of street-marker signs along streets leading to the station entrance.
- f. Where illuminated signs are required, works for the new and/or relocated signs shall include all necessary electrical works.
- g. The signage layout, detailed design and construction shall be carried out in consultation with LTA, with drawings submitted for review and approval.
- 5.11.2.2 Upon completion of the signage installation, an audit of the installed signs at site shall be carried out by LTA. Where there are apparent inconsistencies or erroneous information, or where signage is found to be deficient, or can be further improved, all of which might have slipped through the design reviews or due to lack of information during the design review stage, further signage works shall be carried out by the Developer so as to provide a comprehensive public transit signage system at the MRT Station.
- 5.11.2.3 Proposed signage shall not obstruct the existing Video Surveillance System cameras.

# 6. CIVIL & STRUCTURAL

#### 6.1 Design Consideration and Limitation

- 6.1.1 The MRT station was designed against the possibility of flotation due to differential water pressure. It is always essential to ensure during the construction of the future development that the station box is not subjected to any net uplift pressure due to the presence of high ground water table and excessive lateral movement. The developer must also limit the extent of water table draw-down on the excavation side so as to not adversely impact the short term differential settlement of the station structure.
- 6.1.2 The design of the building, choice of construction material, etc. shall take this into consideration to ensure that the measures would not be required when the development is completed. Design checks on the long-term stability of the station against uplift or possible lateral shift shall be carried out and submitted to LTA for review and acceptance. These checks shall be carried out on the station structure.
- 6.1.3 The Developer shall ensure that resistance to uplift of the station shall not be disturbed or removed before sufficient superstructure load is imposed on the station

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box. Calculations in support of these are to be submitted to LTA for approval before commencement of the work if these are to be removed.

- 6.1.4 The future development shall be designed with foundation having compatible settlement characteristics with the MRT structure to ensure that loads greater than those that have been designed by LTA are not transferred to the RTS structure as a result of differential settlement, etc. A geotechnical assessment shall be submitted to LTA for review and acceptance.
- 6.1.5 At the interface, the station underpass structure and the future development structure shall be designed to be able to move vertically independently of each other but at the same time be able to transmit horizontal loads. Suitable bearings or other approved materials shall be provided at the interface to ensure that both vertical movement and horizontal load transfer are achievable. No vertical load transfer is allowed at the joint between the station underpass and the future development. Details of this and all relevant calculations such as estimate of the relative vertical deflection and/or displacement expected, and the loading transmitted are to be submitted to LTA for acceptance.
- 6.1.5 The wind speed adopted for the design for all permanent structures with design life of 50 years and 100 years, shall be 22 m/s 10-min mean wind velocity and 25 m/s 10-min mean wind velocity accordingly.

## 6.2 Construction Below Ground

- 6.2.1 The Developer shall design both his temporary and permanent works to ensure that ground movements in the vicinity of the MRT structures / station underpass structures are kept to a minimum. These works shall be designed such that no overloading or excessive deflection is caused at any stage of the construction to the MRT structures / station underpass structures. The construction sequence and the method of construction adopted for any excavation works shall be planned and executed so as not to disrupt the live rail operation and disturb the subgrade beneath the MRT structures, to minimise ground movement and avoid endangering the strength and stability of the structures. In addition, he must recognize that the use of proven techniques and good workmanship are essential in restricting ground loss.
- 6.2.2 The basement shall be constructed with every effort made to support the exposed ground quickly and adequately, and to minimise the inflow of water into the excavation. In compressible ground, provisions shall be made to ensure that over-excavation and heaving do not take place.
- 6.2.3 The method of construction for any proposed basement shall take into account the following:
  - a. The geology along the length and depth of the basement and the MRT structures / station underpass structures;



- b. The foundation of the MRT structures / station underpass structures;
- c. The hydrogeology and strata permeability;
- d. The degree of settlement which would be expected. In this context the location of the works in relation to existing MRT structures / station underpass structures shall be considered;
- e. The depth of construction required;
- f. Control over heave and instability of the base of the excavation;
- g. The method for waterproofing the completed structure as no dewatering is permitted.

## 6.3 Knock-Out Panel (KOP)

- 6.3.1 Where provision for knockout panels is made at the wall of existing MRT stations, the knockout panel needs to be removed and reinforcements cut by the Developer to achieve the required opening for future connection to the development site to MRT station. The opening shall be made good and corrosion protection to steel reinforcements shall be provided. Details of the method, material, etc. shall be submitted to LTA for acceptance.
- 6.3.2 The station structure had not been designed to support additional load. The future development connection at the knock-out panels must not transfer moment, shear, axial load, or any other force to the station structure. As-built drawings of the existing KOP and the surrounding structures with drawings of strengthening where required shall be submitted to LTA for review and approval. The design shall be supported by QP endorsed calculations and declaration. The Developer is to carry out surveys on the actual position of the knockout openings in the station wall prior to removing the knock-out panels. A full method statement of the works to be carried out is to be submitted to LTA for review and approval.
- 6.3.3 The Developer shall take into consideration the sequence of knock-out panel removal when planning his construction sequence and where necessary to provide temporary supports to the panels and structure. The beams and supports are part of station structure and extreme care must be taken not to damage them during demolition of knock-out panels. This must be assessed by a professional engineer and details must be submitted to LTA for acceptance.
- 6.3.4 Works within the ventilation shaft would affect the performance of the environmental control systems and mechanical ventilation equipment of the station and the Developer must comply and adhere to all conditions by the Railway Operator to ensure that station operation and railway safety are not affected.

6.3.5 All knock-out panels provided in the station abutting the development shall be removed or retained by the Developer as these are designed to make provision for the new development. New solid fire rated wall shall be constructed to seal the openings at the boundary between the station and the development where no access connections are proposed to be provided.

# 6.4 Waterproofing

- 6.4.1 Typical details of water proofing systems constructed for existing stations/tunnels are given below:
  - a. The station roof/tunnel has been provided with waterproof treatment. The waterproofing system consists of a membrane bonded to the roof. There is an un-reinforced concrete protective layer above the membrane.
  - b. There is no waterproofing membrane provided for the diaphragm walls. There are, however, water bars provided between all the joints in the diaphragm wall panels. For the future connection through knock-out panels, the diaphragm wall shall require water proofing around the connection.
- 6.4.2 Entrance subway walls are provided with waterproof treatment. A bonded membrane water proofing system has been used on the roof and walls of the subways. The membranes are protected by concrete protection, but the Developer shall use the utmost care in excavating above and around the subways to protect the waterproofing membrane. The details of the waterproofing system to be adopted at all knock-out panels in the subways shall be in accordance with LTA's Design Criteria and M&W Specifications and shall be to the approval of LTA.
- 6.4.3 In order to prevent the possible damage to station structure and waterproofing system, the Developer must study the structure details and waterproofing drawings, verified against the actual details of the as-built drawings and prepare the necessary precautionary and contingency measures. The Developer shall note that precaution must be taken to ensure that no water leak into the station especially through the station movement / construction joints during construction of the development above and next to the station. If it is necessary to remove the waterproofing system for construction of future integration adjacent to the roof etc., the waterproofing system shall be reinstated and made good. Details for the remedial works shall be submitted to LTA for review and acceptance.
- 6.4.4 The waterproofing at KOP interface shall be detailed to the criteria in LTA M&W Specification Chapter 14. The grout tubes at KOP shall be injected before removal of the KOP regardless of any leakages observed. Such details shall be clearly indicated in the proposal to LTA for review and approval.
- 6.4.5 The Developer shall be responsible for the maintenance, management and replacement of the waterproofing system at the joint between the development and the station structure within the warranty period.

- Land Transport & Authority The Developer shall note that any removal of existing waterproof membrane due to
- 6.4.6 the integration works will void the warranty of the existing waterproofing system of the RTS structure. The Developer must replace with a warranty meeting LTA's conditions. The period of warranty shall be ten years from date of handover. The extent of areas for the waterproofing warranty shall be extended <u>3m</u> beyond and allround the affected waterproofing area.
- 6.4.7 At the interface, the station underpass structure and the future development structure shall be designed to be able to move vertically independently of each other but at the same time be able to transmit horizontal loads. Suitable bearings or other approved materials shall be provided at the interface to ensure that both vertical movement and horizontal load transfer are achievable. No vertical load transfer is allowed at the joint between the station underpass and the future development. Details of this and all relevant calculations such as estimate of the relative vertical deflection and/or displacement expected and the loading transmitted are to be submitted to LTA for acceptance.
- 6.4.8 Along the perimeter of the interface between the station underpass and the future development, an effective waterproofing system taking into account all hydrostatic pressure and relative movement between the structures shall be provided to prevent ingress of water into the station. Details of the waterproofing system shall be submitted to LTA for acceptance. These shall include but not be limited to the following:
  - Existing waterproofing system and the proposed waterproofing system a.
  - b. Water bar around the perimeter of the interface
  - Expandable water seal around the perimeter of the interface c.
  - d. Re-injectable grout tube
  - Waterproofing membrane around the external surface of the joint capable of e. accommodating any movement expected
  - Surface sealant where required at the joints f.

#### 6.5 **Consideration during construction**

- 6.5.1 The Developer shall not carry out construction activities from the station side at the operation and public corridor areas for safety reasons.
- 6.5.2 The Developer shall take into consideration the following constraints imposed by an operating rapid transit system in developing his design and planning the construction of the Development:

- a. Safeguarding the integrity of station structures to ensure safety of the operating railway
- b. Providing adequate and safe space for the movement of commuters at the affected station entrance subway;
- c. Should the Developer propose or plans to carry out any wet work in the vicinity of these walls, these walls have to be rendered waterproof and appropriately sealed to prevent water from seeping into the station underpass.
- d. The Developer shall ensure that no activities are carried out next to the station which would jeopardise the station operation or create nuisance to the Railway Operator personnel, station tenants and travelling public and passengers such as noise and vibration from construction activities.

#### 6.6 Demolition

- 6.6.1 The Developer shall take all reasonable care and precaution when demolishing or cutting away existing work in the station underpass to ensure that no adjacent structure is damaged. Should there be any damage it shall be made good at the expense of the Developer to the satisfaction of LTA.
- 6.6.2 The Developer shall inform and obtain permission from LTA before any demolition works affecting RTS structures including the landscaped areas at ground level above the station is carried out. The Developer shall ensure that the following are observed during the demolition work:
  - a. The Developer shall protect MRT finishes and services during the demolition work. Permanent finishes and services at least 2m away from the demolition should be removed and carefully stored by the Developer for reinstatement. The Developer shall repair and reinstate the finishes in accordance to LTA requirements. Any damage shall be repaired or replaced by the Developer at his own cost.
  - b. A temporary full height fire-rated hoarding is to be erected within the railway premises with a minimum 1.2m wide clear passage for maintenance and access. The hoarding must be durable to resist the abuse expected and is to be well made and maintained throughout the works by the Developer.
  - c. Adequate provision must be provided to prevent water seepage into railway premises.
  - d. All floors and walls affected by the construction are to be protected by suitable means.
  - e. All materials used within the station shall be non-combustible.



- f. Dust control
- 6.6.3 The Developer shall programme his work and plan his method of construction such that there is no possibility of flooding to the MRT structures at any time during the construction. Any demolition work on the knock-out panels in the station underpass can only commence after the completion of the substructure of the development above the threshold level of the MRT station including all entrances to the development and the sealing of any openings below that of the station threshold level.

#### 6.7 Drainage, Sewer and Water Supply of MRT Station

- 6.7.1 The layout of the surface level drainage system, external lighting and cable routes, sanitary system and water supply pipeline from the underground station are located or routed to ground level. The Developer shall ensure that these facilities serving the station are not disrupted during the course of his construction works above or adjacent to the station.
- 6.7.2 Drains are provided next to the paved walkway and at the sides of the station to collect any rainwater runoff. These are channeled to discharge into the Public Storm Drains. Water collected at the station entrances canopy, cooling tower enclosures, air-cooled condensing units' enclosure are also discharged into the surface drains.
- 6.7.3 The incoming water supply to the station is tapped off from the PUB mains nearest to the station.
- 6.7.4 Waste or foul water from the station are discharged through the sanitary pipes from the station to the public sewer.

#### 6.8 Drainage (Storm and Foul)

- 6.8.1 The Developer shall not break, divert or utilise either temporarily or permanently the station storm or foul water drainage system without the prior written consent of LTA. Should the Developer wish to alter the station drainage system, the design, construction and maintenance of the affected works including all manhole connection, making all necessary submissions to the relevant authority for approval, etc., shall be undertaken by the Developer at his cost. The Developer shall also ensure that there are no disruptions to the existing drainage system while the alteration works are being carried out. Details are to be submitted to LTA for review and acceptance.
- 6.8.2 The drainage system of the future development shall not be allowed to discharge into the station drainage system. A separate system for the drainage of storm and foul water from the development shall be provided.

## 7. ELECTRICAL AND MECHANICAL SERVICES AND SYSTEMS



## 7.1 General

- 7.1.1 This part of the document covers the requirements of the electrical and mechanical services in the MRT station.
- 7.1.2 In any case, when undertaking his design, the Developer shall comply with all prevailing Statutory and Regulatory Requirements and Code of Practices, Singapore Standards. Design reports, method statements, calculations, simulations, drawings, test procedures and test reports shall be duly checked and endorsed by a Professional Engineer (PE) / Licensed Electrical Worker (LEW) / Fire Safety Engineer (FSE).
- 7.1.3 It is not envisaged that there will be a need to move any of the plant or equipment from the current location. However, should the Developer wish to propose such a relocation, this can be considered on receipt of a detailed proposal and justification for such a move. LTA will identify the implications and restrictions of the proposal on a case by case basis, as it is not practical to list out all the considerations of locating each and every element of the station equipment. The consideration for approval of the proposal will include potential disruption to passengers and the transit operation.
- 7.1.4 The Developer shall be responsible for and implement at his own cost any modification to the existing electrical or mechanical services or systems on the operating railway which may have to be relocated or modified to suit his development proposal. This shall include the supply of new equipment to replace the existing equipment and modification, expansion and replacement of the existing control and monitoring system as necessary. All new material and equipment proposed shall meet with the requirements and specifications of LTA. All equipment and accessories removed shall be returned to LTA and Railway Operator.
- 7.1.5 The Developer shall also provide the necessary drawings, operation and maintenance and maintenance manuals, training to Railway Operator, warranty, licensed software, etc. for any new equipment, supplied and installed by them as a result of the proposed modifications, diversions, extensions and alteration works, etc. The materials and equipment used in any modifications, diversions, extensions, replacement and/or additions to the E&M systems shall meet LTA's specifications and are subjected to the approval of LTA and the Railway Operator.
- 7.1.6 If the plant and equipment serving the station or tunnel are relocated, the Developer shall make modifications to the equipment, pipework, cabling, etc. where necessary to ensure the proper, safe and efficient operation of the system. The Developer may consider providing new plants rather than relocating the existing ones if it is found to be more practical and feasible to do so. The Developer shall submit his proposal for approval. All modification works and replacement of existing plants shall be at the Developer's expense.

- The Developer shall supply, delivery, install, test and commission all new installations or modifications to the acceptance of LTA before connecting them to the existing station facilities and this shall include factory acceptance test for major equipment such as switchboard, chiller, smoke control fan, control system, etc.
- 7.1.8 The installation programme of the replacement services must be agreed with LTA and the Railway Operator noting that interruptions to the station and tunnel systems will be kept to a minimum and passenger service must not be disrupted in any way.
- 7.1.9 Where existing warranty of the as-built station E&M equipment and installation is affected due to the Developer's proposed works, all costs to provide the necessary warranty to LTA and the Railway Operator for that duration of warranty period, which has been forfeited as a result of the Developer's proposed works, shall be included.
- 7.1.10 The Developer shall permit LTA, its Representatives and the Representatives of the Railway Operator to enter the Development without charge and every part thereof with or without workmen, materials, specialist services or vehicles for the purpose of constructing, operating and maintaining rapid transit systems. The Developer shall undertake to ensure that access is available to officers of the LTA, its agents, Railway Operator and their nominated contractors into the premises of the Development at all time for the purpose of gaining access to carry out installation, maintenance or repair works necessary on all equipment and services associated with the station.
- 7.1.11 Where new equipment is supplied by the Developer, remote monitoring and control facilities shall be provided to interface with the existing monitoring and control system in the stations, operation centres including the Land Transport Operation Centre (LTOC), Operation Control Centre (OCC) and Backup Operation Control Centre (BOCC) and other areas, as per existing design.
- 7.1.12 The Developer shall coordinate closely with relevant personnel from LTA and Railway Operator on all aspects relating to the installation of the E&M services and systems and associated equipment.
- 7.1.13 Should it become necessary to temporarily divert any of the station's fire protection works including firefighting facilities, the Developer shall forward the proposal prepared and endorsed by the relevant QP to LTA for review and acceptance. The design and construction of all temporary fire safety facilities shall comply with CPFPRTS. Diversion works shall not proceed unless the Developer has obtained clearance from LTA. Upon completion of the temporary diversion works, QP shall submit a copy of his letter to LTA to confirm that the works have been carried out in accordance with the Fire Safety Act.
- 7.1.14 The Developer shall ensure that the equipment can be easily accessible for maintenance. Access for future replacement of the equipment shall be provided.

- 7.1.15 The Developer shall not provide jointing to cables and shall provide new cables and cable containments for the modified works. If providing of new cables and cable containments are not feasible, the Developer shall justify to LTA on the constraint at site.
- 7.1.16 The PUB water main and water meter, sump/ejector pipes, sewer manhole and inspection chamber are located at ground level near the station. Equipment and installations for Telecom services, incoming Telecom cables, and commercial telephone services such as cellular hand phone equipment, paging equipment, and etc.; these shall not be disrupted during the construction of the development.
- 7.1.17 Developer shall ensure that all electrical and mechanical systems installed by him within the development have no detrimental effect on the operation of all LTA system within the station and railway. The system to be supplied shall be electromagnetically compatible with its environment and with all the components, sub systems and etc. in the vicinity. The equipment shall not produce intolerable emissions within its environment and shall comply with appropriate internationally recognised standards (e.g. EN61000-6-2and EN61000-6-4). It is also recommended to ensure sufficient cable separation between different types of cable from the Developer and LTA system in cable running/route. If required, he shall carry out all necessary tests and measurements to ascertain it to the satisfaction of LTA.

# 7.2 Ventilation Shaft

- 7.2.1 The functions of the ventilation shafts are described as follow. Fresh air for ventilation of the station is taken from the ventilation supply shafts (VS) while air is exhausted through the ventilation exhaust (VE) shafts. Tunnel Ventilation (TV) shafts are for ventilation of the tunnels. The piston effect brought about by train movements through the tunnels are relieved through the TV shafts. In the event of fire, the VE shafts acts as exhaust shafts for the purging of smoke from the station. TV shafts may act as exhaust shafts for the purging of hot gases and smoke from the tunnels and may also act as intake shafts supplying air into the tunnel during fire emergency, congested/peak hour operations and tunnel maintenance activities. Replacement air for the station smoke purging system and trackway emergency ventilation system will be supplied from the station entrances.
- 7.2.2 Tunnel ventilation fans, under-platform exhaust fans, station smoke extraction fans and the associated equipment and accessories shall be rated to operate with air temperature of 250°C for minimum of 2 hours.
- 7.2.3 The Developer shall ensure that the ventilation shafts opening locations and details comply with the requirements in the CPFPRTS including the following requirements:
  - a. There is no short-circuiting of air between the different ventilation shafts.

- b. No smoke and/or hot gases emitted from the exhaust systems re-enter the station via intake vent shafts, escape/ firefighting's staircase and station entrances, etc.
- c. No exhaust air, hot gases and/or smoke discharged from the Development's exhaust outlets and cooling towers shall enter the station and tunnels via the VS shafts, TV shafts, escape/ firefighting 's staircase or station entrances.
- d. Intake openings of the development shall be located such that exhaust or smoke and hot gases emitted from the station's VE and TV shaft openings are not drawn into the development.
- e. Louvres and screens shall be fitted to the vent shaft openings to prevent ingress of rain water, birds and entry of unauthorized persons. Louvres shall have a weather resistance of 95% and be provided with bird screens of not larger than a 10mm mesh. The external maximum permissible face velocity is 3 m/s for exhaust air and supply air. Frames shall be robust and protected against corrosion.
- f. No discharge shall be under any canopy or overhang or into any means of escape or fireman staircase.
- g. The side discharge ventilation shafts shall be equipped with louvres to prevent ingress of rainwater. Where vertical discharge is proposed for the ventilation shafts, the developer shall provide a drainage system, including pumping system where necessary, to prevent accumulation of water in the shaft bottom.
- 7.2.4 The Developer shall liaise with LTA and their appointed contractors/consultants on the input criteria and scenarios for the simulations. The Developer shall then submit a report endorsed by a suitably qualified person for LTA and related authorities for approval.
- 7.2.5 The following serves as a guide or a minimum requirement to prevent re-circulation of air/smoke:
  - a. VE, TV and VS shaft louvres should be facing a different façade from one another. If they are facing the same façade, VE shaft shall be designed to be at least 1m higher than TV shaft, and TV shaft shall be at least 1m higher than VS.
  - b. The openings for VE and TV shafts must be raised at least 1m above the station door height / entrance, or other intake openings of buildings. The bottom of the louvers shall be at least 3m above any adjacent horizontal surface.
  - c. VS shall not be less than 2.1m above the outside floor level when the air intakes are adjacent to open car parks and busy thorough fares.
  - d. The openings for VE, TV and VS shafts and other openings into any building, such as a station entrance shall be a minimum of 5m apart horizontally from one



another. All of the above shall also be applicable to open vent shafts (vertical discharge), without louvres.

- 7.2.6 The developer shall use proven computational fluid dynamics (CFD) software to carry out simulations to demonstrate the adequacy of the location of station entrances and ventilation shaft openings to prevent smoke recirculation between the various ventilation shaft openings and entrances.
- 7.2.7 Where vent shafts are incorporated in the development, the location of openings shall comply with the relevant prevailing requirements. The vent shafts designed with side discharge shall be equipped with louvres to prevent the ingress of rainwater. Where vertical discharge is proposed for the vent shafts, the Developer shall provide the drainage system, including pumping system where necessary, to prevent accumulation of water. Louvres shall have a weather resistance of 95% and provided with bird screens of not larger than 10mm mesh and shall be designed such that there is minimal pressure drop through them. Frames shall be robust and protected against corrosion. Details or the louvres shall be submitted to LTA for review and acceptance.
- 7.2.8 If it is necessary to modify the MRT ventilation shafts, pressure drop calculations and the impact on the tunnel ventilation / ventilation supply / exhaust fans shall be prepared / assessed by the Developer and submitted to LTA for review and acceptance. Tunnel ventilation / ventilation supply / exhaust fans, associated power supply, control and monitoring shall be upgraded to overcome the additional pressure drop through the relocated/modified ventilation shafts, such that the performance of the ventilation systems i.e. air flow are not compromised.
- 7.2.9 The Developer shall ensure that the sound level emitted from the operating of outdoor E&M equipment, and from the ventilation shafts when the indoor equipment is operating shall comply with the noise criterion stipulated by the authorities.
- 7.2.10 Care should be taken to ensure that the operation of the ventilation shafts will not be affected at all times during and after construction of the development and any modification works to the shaft. There should be no restriction to free flow of air around the vent shafts and no ingress of rainwater into the stations through the vent shafts during and after construction. The 2-hour minimum fire compartmentation between individual vent shafts and minimum separation between vent shaft outlets to prevent short-circuiting of air shall be observed at all times. The Developer shall submit for review his proposal for the design and construction of the vent shafts.
- 7.2.11 Construction activities in the vicinity of the ventilation shaft will generate dust pollution, smoke and exhaust fumes and other environmental pollution which will affect the performance of the environmental control equipment as well as the fire and smoke detection system of the station. Effective measures to minimise dust pollution, etc. shall be implemented.



## 7.3 Cooling Towers and Piping

- 7.3.1 The Developer shall maintain and protect the cooling towers and the associated services which are located within the development site until the completion and the satisfactory commissioning of the new facilities relocated within the development.
- 7.3.2 Where new cooling towers are provided, the changeover from the existing cooling towers to the new cooling towers can only be carried out during the non-revenue hours of the railway. This must not disrupt the operation of the station.
- 7.3.3 The proposed new location of the cooling towers at the development and their associated water tanks, pipework and cabling shall be submitted to the Authority for review and acceptance. Routing of the cable and pipes from the station box to the cooling towers shall be as direct as possible.
- 7.3.4 These cables and pipes shall be contained within dedicated pipe and cable shafts within the development.
- 7.3.5 An enclosure shall be provided for the cooling towers to prevent unauthorised entry and tampering of the system and for security reasons. Access to the enclosure for maintenance purpose, etc. shall be through doors or gates provided with locksets, which have key cylinder compatible to the system used on the MRT system. The keys shall be handed over to the Authority after the successful commissioning of the cooling tower system. The cooling tower enclosure shall be regarded as part of the railway premises.
- 7.3.6 Drainage points should be provided at the cooling tower area for draining of water from the cooling towers and water tanks.
- 7.3.7 Water for the cooling tower make-up tank, cleaning and maintenance at the new location shall be supplied from PUB water mains in the station. The Developer shall provide a booster pumping system including the control and monitoring of the LSC and OCC which is to be located in the station to deliver the water up to the water tank if the pressure of the existing PUB water mains at the station is not sufficient.
- 7.3.8 General lighting and switch socket outlets shall also be provided at the cooling tower area.
- 7.3.9 Lightning protection system shall be provided to the cooling tower enclosure, the cooling towers and the water tanks, if the enclosure is outdoor.
- 7.3.10 Water tap and floor traps shall be provided at the cooling tower area for cleaning purposes.
- 7.3.11 The Developer shall ensure that exhaust air from the station vent shafts and Development does not enter the cooling towers. The Developer shall also ensure

that air discharge from the cooling towers to do not enter the station through the vent shafts and development through ventilation inlets and open windows, etc.

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## 7.4 Pipe and Cable Shaft

- 7.4.1 The water pipes and electrical cables between the new cooling tower and water tank location and the station shall be run in duct shafts of 2-hour fire resistance construction within the development. The use of dry wall partitions will not be permitted. Separate duct shafts shall be provided for the water pipes and electrical cables. The pipe and cable shafts shall be fire-stopped at every floor of the development. This pipe and cable shaft shall be regarded as part of the railway premises.
- 7.4.2 The pipe and cable duct shafts shall be adequately sized such that it is possible to remove one service from its supports without disturbing the remainder.
- 7.4.3 Fire-rated access doors of adequate size shall be provided to the pipe and cable shafts at every floor of the development for inspection and maintenance of services. Suitable landing platforms within the pipe and cable shafts should be provided at every floor. The key cylinder for these doors shall be compatible with those used in the station. All keys shall be handed to the Authority, for security reasons.
- 7.4.4 Fire protection, general lighting and switched socket outlet shall be provided within the pipe and cable shafts.
- 7.4.5 Details and layout of the pipe and cable shafts shall be submitted to the Authority for review and acceptance.

## 7.5 Electrical Services (ES)

- 7.5.1 General
- 7.5.1.1 The electrical services comprise mainly of low voltage distribution system, lighting, small power, earthing, equipotential bonding and lightning protection system. When there is an addition and alteration work to existing electrical services of RTS, the Developer shall design, supply, deliver, install, test and commission the new electrical services to comply with the design criteria and performance requirement of the Authority.
- 7.5.1.2 The Developer shall conduct electrical load measurement on the loading profile over a duration of one week to assess whether the spare capacity of the existing transformer or Low Voltage main switchboard / sub-board / distribution board has adequate capacity to support the additional electrical loading.
- 7.5.1.3 In the event that the spare capacity of the existing transformer or LV main switchboard / sub-board / distribution board is not sufficient to support the increase in electrical loading due to the development, the Developer shall provide additional

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and/or upgrade the transformers and/or LV Main Switchboards / sub-board / distribution board, including all cablings and cable support systems. The Developer shall also provide local and remote control and monitoring to this new equipment through the ISCS/SCS as per the design criteria and performance requirement of the Authority where applicable. The Developer shall submit to LTA for review and acceptance on the justification of the electrical loading and the detailed design of the modification works required.

- 7.5.1.4 Where there are commuter facilities proposed for the development, the design shall comply with LTA's Architectural Design Criteria for commuter facilities which is available from LTA website.
- 7.5.2 Lighting System
- 7.5.2.1 Temporary and permanent lighting, including emergency lighting, for the addition and alteration works to the existing development affected by the development shall be provided by the Developer. The lighting schemes and lighting luminaires of the development shall blend in with the existing development subject to Authority's approval.
- 7.5.2.2 The lighting control for the lightings from station concourse to subway leading to entrances shall be controlled and monitored by the lighting control panels in the station. The lighting control scheme shall subject to the Authority's approval.
- 7.5.2.3 All lightings in Developer's area shall tap from the power supply of the development. For lighting at areas connecting to the station, lighting operation time shall be coordinated with respective operators and subject to Authority's approval. For lighting within station's boundary, the power supply shall be tapped from the station subjected to the Authority's approval.
- 7.5.2.4 All lightings and the associated cablings, cable support system and pipes that are not in use shall be dismantled and removed by the Developer.
- 7.5.2.5 All removed lighting fittings (inclusive of the associated control gear) and the associated cablings, cable support system and pipes shall be cleaned, individually packed and returned to the Railway Operator or the party appointed by the Authority.
- 7.5.2.6 Where the existing lighting levels are affected by the construction of the development, additional light fittings including emergency lights shall be provided to ensure that the level of illumination is maintained. The cost of such provision, operation and maintenance shall be borne by the Developer.
- 7.5.2.7 If the station beacon signs or totem poles are to be relocated, new cabling including cable support system from the distribution board shall be provided and properly terminated to the relocated beacon signs or totem poles.



- 7.5.3 Low Voltage Distribution System
- 7.5.3.1 The low voltage distribution system comprises mainly of switchboards, cables, cable support system, underground pipes, switched socket outlets and isolators.
- 7.5.3.2 The Developer shall ensure that works are carried out without any disruption to the power supply, train operation, existing kiosks and commercial shops. Details for the modification works are to be submitted to LTA for review and acceptance.
- 7.5.3.3 For any new or modification works to existing development due to the Development, the Developer shall provide new circuit breakers, DBs, cables and cable support system where possible, subject to Authority's acceptance.
- 7.5.3.4 The Developer shall not provide jointing to cables and shall provide new cables and cable containments for the modified works.
- 7.5.4 Earthing System and Equipotential Bonding
- 7.5.4.1 Earthing system provided shall comply with SS 551.
- 7.5.4.2 All exposed metal parts shall be equipotential bonded in accordance to SS 638.
- 7.5.4.3 Details of the proposed diversion of earth cable routing and the method of construction shall be submitted to LTA for review and acceptance before commencement of works.
- 7.5.4.4 Test results are to be submitted to LTA on completion of works. Test report shall be endorsed by a PE.
- 7.5.4.5 The earth resistance shall be less than 1 ohm.
- 7.5.5 Lightning Protection System
- 7.5.5.1 The Developer shall design, supply and install the lightning protection system in compliance with the requirements of SS 555 and SS 551.
- 7.5.5.2 The Developer shall engage a QP to supervise the lightning protection system installation and submit the certificate of supervision of lightning protection system to the Authority.
- 7.5.5.3 Any holes drilled in roof coverings and any penetrations through waterproofing membranes by the Developer shall be rendered watertight to the acceptance by the Authority.
- 7.5.5.4 The lightning protection system shall be electrically continuous. All exposed metallic structures within 2 metres shall be bonded to the lightning protection system.



- 7.5.5.5 All metal structures shall be bonded to the rebars of the floor slab by means of a purpose made clamp or weld.
- 7.5.5.6 The earth electrodes complete with hot-dipped galvanised lightning pit haunched in concrete shall be provided.
- 7.5.5.7 The total earth resistance of the lightning protection system shall not exceed 10 ohms.
- 7.5.5.8 The lightning pits shall not be located along the walkway of the commuters. Details of the proposed location of the lightning pit shall be submitted to LTA for review and acceptance before commencement of works.

## 7.6 Environmental Control System (ECS) and Tunnel Ventilation System (TVS)

- 7.6.1 Air-conditioning System (A/C) and Mechanical Ventilation System (M/V)
- 7.6.1.1 Areas within the station are either air-conditioned or mechanically ventilated. Where the proposed development is connected to the part of the station which is airconditioned, the area at the access connection shall be provided with airconditioning or other approved alternative to prevent leakage of cooled station air. The air-conditioning of the area just adjacent to the station shall be designed such that a slight positive pressure is provided over that of the station. Details of this design shall be submitted to LTA for review and acceptance.
- 7.6.1.2 The public areas of the station and subway are air conditioned to a specification of 25 °C and 27 °C respectively at all times during revenue hours. For subway / linkway forming part of 24-hour access, it shall be A/C during revenue hour and mechanical ventilated to minimum 10 ACH during non-revenue hour. If any access is provided through the development to the concourse public area, the design has assumed that all areas in the immediate vicinity of the station access to the development are maintained at the same temperature. The Developer shall forward proposals to achieve this for LTA's review and approval.
- 7.6.2 Thermal Comfort

CFD simulations shall be conducted for the affected existing station public areas (inclusive of platform, concourse, entrances, linkway, and etc.) under natural ventilation to demonstrate that the temperature and air flow can achieve human comfort in accordance with any local and international guidelines for similar tropical weather condition. The Developer shall propose the necessary and reasonable measures to enhance the human comfort. For naturally ventilated plant rooms affected by the A&A works, the Developer shall also conduct CFD to demonstrate that the room temperature requirements are met.



# 7.6.3 Smoke Purging System

Where doors or barriers are provided at station entrances that are used as routes for fresh air make-up, they shall open automatically during a fire. Make-up air velocity through the entrance openings shall not exceed 5m/s.

7.6.4 Engineering Smoke Control System – for station with retail area

Engineered smoke control system complying with SS 553 and Code of Practice for Fire Precaution in Buildings shall be provided for the commercial spaces above the CPFPRTS allowable quantum or commercial floor of underground stations as required by the CPFPRTS.

7.6.5 Ventilation Shafts

Ventilation shafts namely ventilation exhaust (VE), ventilation supply (VS) and tunnel ventilation (TV) are connected from the station box / tunnel and then vent to atmosphere. The developer shall be responsible for building the above-mentioned vent shafts within the development in accordance with following specification:

- a. Sizes or cross- section area for each of the vent shafts shall be coordinated with LTA.
- b. Maximum static pressure drop along the entire length of the ventilation shafts from fan discharge to atmosphere, including the louvres shall be not more than 150Pa. The pressure drop across the louvres shall not exceed 50 Pa.
- c. The developer shall also ensure that the sound level emitted from the louvres of the ventilation shafts comply with the noise control requirements of National Environment Agency (NEA) for the surrounding environment.
- d. A 2-hour fire rated partition shall be maintained at all times between the individual ventilation shafts. There shall also be a 2-hour fire separation between the ventilation shafts and development. In order to limit the risk of unauthorised amendments or alteration to the fire partition, reinforced concrete construction for the walls shall be used. The use of dry wall partitions will not be permitted.
- e. The Developer shall submit, for LTA's review and approval, an engineering analysis prepared by a registered Professional Engineer (PE) to demonstrate that the above requirements have been fulfilled. The analysis shall include pressure drop calculations for ventilation shafts (including louvres) and noise level test reports for the louvres.
- 7.6.6 Air-cooled Condensing Units Enclosure
- 7.6.6.1 The developer shall provide an enclosure for the air-cooled condensing units to prevent unauthorized entry, tampering with the system. Access to the enclosure for

maintenance purpose, etc. shall be through doors or gates provided with locksets, which have key cylinders compatible to that used on the RTS. The keys shall be handed over to LTA after the successful commissioning of the air-cooled split-type air conditioning system. The air-cooled condensing unit enclosure shall be regarded as part of the RTS premises.

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- 7.6.6.2 The proposed location of the air-cooled condensing units at the development and their associated pipeworks and cabling shall be submitted to LTA for review and acceptance.
- 7.6.6.3 The developer shall maintain and protect the air-cooled condensing units and the associated services which are located within the development site until the completion and the satisfactory commissioning of the facilities located within the development.
- 7.6.6.4 Water tap and floor traps shall be provided at the location of relocated air-cooled condensing unit area for cleaning purpose.
- 7.6.6.5 The Developer shall ensure that exhaust air from the station ventilation shafts and development does not enter the air-cooled condensing units. The Developer shall also ensure that air discharge from the air-cooled condensing units does not enter the RTS through the ventilation shafts.

# 7.7 Fire Protection System (FPS)

- 7.7.1 Automatic Fire Alarm System
- 7.7.1.1 The Developer shall ensure that the existing operation and performance of the station are not affected and the station is not rendered, unprotected by automatic fire alarm system during and after the relocation and modification works. If the facilities are to be relocated, any modification necessary to ensure that the station automation fire alarm system operate and perform satisfactorily shall be at the developer's expense. The Developer shall engage QP to redesign, submit application and supervise the modification works.
- 7.7.1.2 If the entrance is removed, the existing automatic fire alarm system and associated cabling shall be removed and terminated by the Developer. New devices shall be supplied and installed to provide coverage over the station entranceways and be connected to the existing fire alarm system within the station.
- 7.7.2 Sprinkler System
- 7.7.2.1 The Developer shall ensure that the existing operation and performance of the station are not affected and the station is not rendered, unprotected by sprinkler systems during and after the relocation and modification works. If the facilities are to be relocated, any modification necessary to ensure that the station sprinkler system operate and perform satisfactorily shall be at the developer's expense. The

Developer shall engage QP to redesign, submit application and supervise the modification works. He shall submit the necessary hydraulic/pressure head calculations, etc. to LTA for approval.

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- 7.7.2.2 The sprinkler control valve, pumps, control panel and water tanks shall be housed in compartment(s) with a minimum of 2-hour's fire separation with the future development. The sprinkler control valve, pump, control panel and water tank room(s) shall be adequately ventilated with lighting and drainage facilities and sprinkler protected. These room(s) shall be easily accessible by the firefighters and the Railway Operator staff to carry out maintenance work including resetting of pumps etc.
- 7.7.2.3 If the sprinkler water tank(s) are to be relocated, water supply with sub-metering shall be provided by the Developer at the sprinkler water tank room for make-up, filling of tank, cleaning, etc. if the pressure of the existing PUB water mains at station is not sufficient to deliver the water up to the new water tank location. The water supply from the developer's system shall be reliable and available on a 24-hour basis with a minimum supply rate of 5.0 l/sec for filling of the tank. Pipework and cabling shall be run in duct shafts, of 2-hour fire resistance within the development.
- 7.7.2.4 Breeching inlets, fire control panel and firemen intercom shall not be obstructed at any time during and after the construction of the future development. Fire engine accessway is provided within 18 m from the breeching inlets, firefighters intercom. Adequate and ready fire engine accessway for SCDF shall be safeguarded during construction and maintained at all times.
- 7.7.2.5 If the entrance is removed, the existing sprinklers and associated pipeworks shall be removed and terminated by the Developer. Sprinklers shall be supplied and installed to provide coverage over the station entranceways. The sprinklers shall be connected to the existing sprinkler system within the station.
- 7.7.2.6 Sprinklers from the development's sprinkler system shall be provided to protect the space above the open entrance and the adjacent area. However, for enclosed entrances, the existing sprinklers under the present roof canopies shall be reinstated. The new roof/ceiling should preferably be at the same level or lower than the existing level. If not the design of the station's sprinkler system shall be checked to ensure that the new height will not affect the sprinkler performance.
- 7.7.3 Dry Riser System

The Developer shall ensure that the existing operation and performance of the station are not affected and the station is not rendered, unprotected by the dry riser system during and after the relocation and modification works. If the facilities are to be relocated, any modification necessary to ensure that the dry riser system operate and perform satisfactorily shall be at the Developer's expense. The

Developer shall engage QP to redesign, submit application and supervise the modification works. He shall submit the necessary hydraulic/pressure head calculations, etc. to LTA for approval.

## 7.8 Plumbing and Sanitary System (P&S)

- 7.8.1 PUB Incoming Bulk Meter
- 7.8.1.1 All water supply pipes enter the Station through the Bulk Water Meter / Valve Chamber. Any alteration due to the development shall safeguard the continuous water supply to the station at ALL time.
- 7.8.1.2 If the Developer proposes to relocate the bulk meter / valve chamber, the new location shall be to the approval of the Public Utilities Board (PUB), LTA and the Railway Operator. Relocation shall be carried out by a Licensed Plumber at the expense of the Developer and in accordance with applicable PUB water supply regulations.
- 7.8.2 Water Services

Any proposed relocation or alteration of the Water Services must take into account the need for continuous water supply to the Station at ALL times. The relocation or alteration shall be carried out by a Licensed Plumber at the expense of the Developer and in accordance with applicable PUB water supply regulations.

- 7.8.3 Sanitary Works
- 7.8.3.1 All vent pipes and discharge pipes ejecting foul water/sewerage that exit the Station shall terminate in a 'swan neck' that is above the design flood level stipulated by Sewerage Department, PUB for the site through the exhaust ventilation shafts. The Developer shall ensure that the 'swan neck' is maintained for all sanitary outlets from the Station.
- 7.8.3.2 Any proposed relocation or alteration of the Sanitary Plumbing System must always consider the need for continuous discharge of foul water/sewerage from the Station. The proposed sanitary system shall take account of all pipes from the station, and shall ensure ease of access to and maintenance of these pipes after the completion of the development.
- 7.8.3.3 Any resulting changes necessary to the sanitary/sewerage pipes and chambers are to be made at the expense of the Developer. The Developer shall also demonstrate with calculations that such alterations will not affect the operation of the Station Ejector Pumps.
- 7.8.4 Pumped Drainage System
- 7.8.4.1 At all the Entrances (including the Vent Shaft/ Cooling Tower Enclosure/ Air-Cooled Condensing Units Enclosure and Tunnel Access Shafts), there are numerous



discharge pipes that serve the Station and Tunnel Pump Sumps. They are routed through the exhaust ventilation shafts.

- 7.8.4.2 All drainage pipes that exit the Station shall terminate in a 'swan neck' arrangement that is above the design flood level specified by Drainage Department, PUB for the Site. The Developer shall ensure that such a 'swan neck' is maintained for all drainage outlets from the Station and Tunnel. All alteration of the drainage system must take into account the need for continuous discharge of water from the Station and Tunnel at ALL time.
- 7.8.4.3 If the Developer proposes any alteration to the Entrances, the Developer shall at his own expense, design and construct to the satisfaction of LTA, the Railway Operator and ENV an integrated surface water drainage system for the Entrances and the Site. This drainage system shall accommodate all drainage pipes from the station and tunnel, and shall ensure ease of access to and maintenance of these pipes after the completion of the development. The Developer shall also demonstrate with calculations that such alterations will not affect the operation of the Station and Tunnel sump pumps. Any resulting changes necessary to the pumps and/or drainage pipes are to be made at the expense of the Developer to the approval of the Railway Operator, LTA and PUB.

# 7.9 Lift and Escalators (L&E)

- 7.9.1 There are escalators and associated control panels mounted at accessible locations on the station entrance structures. If the Developer needs to modify the entrance structure, the escalator control panels must remain at their existing locations. The lift/escalators must always remain in operation when the Station is operational.
- 7.9.2 In the event the lift and escalators are replaced, the proposed new equipment and finishes shall be subjected to the acceptance of LTA. The lift and escalator shall comply with local standards SS550 and SS626 as well as European standard EN81 and EN115.
- 7.9.3 Station passenger lifts shall be of machine roomless type and shall have a minimum rated load (capacity) of 1125kg and rated speed of 1.0m/s in either direction. For both glass and stainless steel lift cars, they shall have an internal dimension of approximately 1650(Width) by 1600(Depth) and 2300(Height) mm clear. Dimensions of a through-cage lift car shall vary. Both car and landing entrance clear opening width and height for station passenger lift shall not be less than 1100mm and 2100mm respectively. The design life shall be of minimum 20 years.
- 7.9.4 Escalators shall be heavy duty, public service type and equipped with dual rated speed and energy saving functions. The primary rated speed shall be 0.75m/s and the alternative rated speed shall be 0.5m/s. Whenever there is an automatic change of the operating speeds from primary rated speed to alternative rated speed or vice versa, the change shall be gradually ramped up/down safely over a period of at least



30 seconds with passengers riding on the escalators via controlled acceleration/deceleration of speed for all loading conditions. The escalator step width shall be 1m with upper transitional radius of 3.6m and lower transitional radius of 2m. The design life shall be of minimum 30 years.

7.9.5 Escalators shall be reversible and capable of continuous operation in both directions for a period of 20 hours a day, 7 days a week 365 days per annum, within the environmental conditions prevailing at each station and under a loading cycle as follows:

3 hours	40% full load
2 hours	100% full load
8 hours	50% full load
2 hours	100% full load
5 hours	40% full load

7.9.6 The lifts and escalators shall comply with the EMC requirements EN 50121-5 (IEC 62236-5).

## 7.10 Communications System (COMMS)

- 7.10.1 General
- 7.10.1.1 The Rapid Transit System (RTS) communication sub systems (the "Communications System") which may be affected by the Developer's development and building works typically include, but not limited to, the following:
  - a. Video Surveillance System (VSS)
  - b. Public Address (PA) System
  - c. Radio System
  - d. Telephone and Ancillary (TAA) Communications System
  - e. Station Travel Information System (STIS)
- 7.10.1.2 The Communications System comprises frontend field equipment such as cameras, public address speakers, radio antenna infrastructure (including leaky coaxial cables), telephones, intercom system, passenger information displays, transmission systems, cables, cable supports and backend switching, processing, control,



monitoring, management and storage systems including servers, computers, data networking equipment, etc.

- 7.10.1.3 The Developer shall co-ordinate with the relevant parties, conduct studies and surveys to ascertain the scope of modifications to the Communications System as a result of the Developer's development and building works. The Developer shall be fully responsible for all modifications, upgrades, etc. to the existing Communications System, including the power supplies, power distribution, cables, cable supports, installation accessories, mounting supports, etc. for the Communications System.
- 7.10.1.4 The scope of work by the Developer shall also include all modifications, upgrades, etc. on the other related systems which are not identified herein, but are required arising from the Developer's development and building works.
- 7.10.1.5 The Developer's scope of work on the affected Communications System shall include detailed design, manufacture, delivery to site, installation, interfacing with existing systems, testing and commissioning of the affected Communications System. This includes the addition of new, and relocation/diversion of existing frontend equipment, cables, cable supports, enclosures, mounting accessories, power supplies, power distribution, etc. All provisions of hardware, software, firmware, configuration changes, upgrades, replacements, modifications, expansions, licenses (both hardware and software), databases, etc. shall be the responsibility of the Developer. The Developer shall also be responsible for upgrades of Railway Operators' existing maintenance spares due to modifications to the existing Communications Systems.
- 7.10.1.6 All modifications, including addition of new system/equipment to the Communications System shall be carried out in compliance with the requirements of the Code of Practice for Fire Precautions in Rapid Transit Systems (CPFPRTS), Fire Code, SS546, all other applicable codes and statutory requirements such as BCA's Code on Accessibility in the Built Environment, etc. LTA's design criteria and performance requirements applicable to the Communications System, including modes of operations, management functions, maintenance provisions, system resilience and architecture, etc. shall be maintained, unless otherwise accepted or required by the LTA. This shall include all endorsements/submissions by QP to LTA and the relevant authorities, where required for compliance with the applicable standards, codes and statutory requirements.
- 7.10.1.7 Unless otherwise accepted by LTA, all new systems and equipment to be supplied by the Developer shall be the same as the existing ones. They shall be fully compatible for operation, interfacing and integration with the existing Communications System, as well as all other interfacing systems such as the integrated supervisory control system, access management system, clock system, etc. All provisions necessary to interface and integrate the new communications

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system equipment with the existing Communications System and other interfacing systems shall be the responsibility of the Developer.

- 7.10.1.8 Where RTS entrances are altered or new access/links are added, the Developer shall ensure that Communications System equipment such as passenger information displays, video surveillance cameras, public address speakers, radio system antennas and all other affected communications equipment and associated cables and cable supports are relocated/diverted, and new equipment added where required.
- 7.10.1.9 The Developer shall ensure that the operation and performance of the Communications System shall not be affected or interfered by the operation of the communications system or any equipment / system (including wireless system) within the Developer's development.
- 7.10.1.10 Design submissions including detailed calculations, simulation plots, drawings, technical/product specifications, installation designs, work method statements, test procedures, etc. shall be submitted to LTA for review and acceptance. Approval of LTA shall be obtained prior to commencement of modification works to the Communications System by the Developer. The Developer shall also be responsible for the production of new as-built drawings, as well as updating of existing as-built drawings in the formats required by LTA.
- 7.10.1.11 The selection and design of public area equipment, e.g. cameras, speakers, monitors, etc. and their associated installation accessories such as mounting brackets, trimmers, etc. shall blend in with the station architectural designs, and subject to the acceptance of LTA.
- 7.10.1.12 All tests, checks and measurements on existing Communications System prior to, and post modifications at the affected stations, Operation Control Centres, including the Land Transport Operation Centre (LTOC) and premises of other agencies where required shall be conducted and properly recorded by the Developer. Such measurements and checks shall include functional tests, sound pressure level and intelligibility performance of public address system, coverage and field of view of video surveillance cameras, radio coverage and RF signal level, video signals level, etc.
- 7.10.1.13 The Developer shall supply all test equipment necessary for the testing and commissioning of the affected Communications System. All test equipment shall be accompanied with valid calibration certificates.
- 7.10.1.14 The Developer shall liaise directly with the relevant authorities and services providers, and be responsible for applying and obtaining all approvals, licenses and permits for his works, including all one-time and recurring fees and charges for the implementation, testing, commissioning and operation of the affected Communications System until the handover of the affected Communications System to LTA/Railway Operator(s).

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- 7.10.1.15 Communications System equipment made redundant due to the Developer's development and building works shall be properly decommissioned and removed. This shall include the decommissioning and recovery of cables associated with the decommissioned equipment, as well as the disposal and/or delivery of the decommissioned equipment to locations to be determined by LTA, and in accordance with procedures to be determined by LTA.
- 7.10.2 Video Surveillance System
- 7.10.2.1 Video Surveillance System (VSS) is also referred to as the Closed Circuit Television (CCTV) system. It comprises frontend equipment such as cameras, video monitors, video transmission infrastructure (including Power-over-Ethernet, coaxial, fibre optic, etc.), power distribution, networking equipment and backend systems including VSS video management, monitoring and control systems, local and remote viewing facilities, video recording system, etc.
- 7.10.2.2 The Developer shall be responsible for all provisions, including modifications, configuration changes, testing and commissioning, etc. required on the VSS due to the addition, relocation or removal of VSS cameras. All functionalities of the existing VSS, including system and equipment monitoring and management, fault reporting, selection and viewing of camera images currently available in the system and at all existing locations such as the equipment rooms, Railway Operator's Passenger Service Centre (PSC), Operation Control Centres (OCC), premises of LTA and other external agencies shall be maintained and updated by the Developer due to his works.
- 7.10.2.3 The Developer shall be responsible for all provisions necessary to interface and integrate the new VSS cameras and associated equipment with the existing VSS and other interfacing systems such that the same mode of operation, level of performance and maintenance are maintained as per existing VSS design, unless otherwise required or accepted by LTA.
- 7.10.2.4 Where VSS surveillance coverage is affected by the Developer's development and building works (including temporary hoardings), the Developer shall make all provisions including adding, relocating and/or adjusting cameras to maintain the surveillance coverage provided by the existing VSS.
- 7.10.2.5 New structures or hoardings shall not obstruct or render ineffective, the coverage of existing VSS cameras. This shall include any new landscaping and structures at and around MRT station entrances. The Developer shall be responsible for all provisions to ensure that the required VSS surveillance coverage is provided.
- 7.10.2.6 VSS coverage for new structures and fixtures such as lifts, escalators, staircases, entrances, etc. shall comply with the VSS design criteria and performance requirement of LTA. The Developer shall also be responsible for the provision of VSS signage.

7.10.2.7 Where the Developer's development and building works affect more than 20% of the existing cameras, the Developer shall make all provisions to comply with the requirements stipulated in the latest edition of the VSS standards for MRT Stations.

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- 7.10.2.8 The Developer shall be responsible for new VSS surveillance coverage, where required to meet security or RTS operation requirements due to the Developer's development and building works. The Developer shall co-ordinate with, and to consult LTA on the exact surveillance coverage required.
- 7.10.2.9 The Developer shall propose for the acceptance of the LTA, the specifications and location of the new/relocated cameras. VSS surveillance coverage designs plots incorporated on station drawings shall be submitted to LTA for review and acceptance. LTA's acceptance of the coverage design shall be obtained prior to commencement of works by the Developer.
- 7.10.2.10 Upon completion of modification works, the updated as-built VSS coverage plans shall include both new, relocated and existing VSS cameras. Updated as-built plans shall be submitted to LTA for acceptance.
- 7.10.2.11 Coloured prints of camera coverage showing the field of views of the new and relocated cameras shall be submitted together with the coverage plans for final acceptance by LTA.
- 7.10.2.12 The new VSS cameras shall be connected to the existing VSS backend system. The Developer shall be responsible for all upgrades, replacement, modifications, etc. on the VSS backend system, including storage, switches, transmission network, database and graphical user interface (GUI) updating, configuration settings, etc.
- 7.10.2.13 VSS cameras shall be recorded in compliance with the design and performance requirements of LTA, including resolution, frame rate, duration, etc. The Developer shall expand the capacity of the video recording facilities (including 100% spare provision for the new hard disks) and all associated modifications where required to accommodate the new VSS cameras.
- 7.10.2.14 The Developer shall verify the performance of the existing cameras to be relocated (such as signal level, surveillance coverage, etc.) before the relocation for subsequent performance verification of the cameras re-instated by the Developer.
- 7.10.2.15 The Developer shall provide the necessary openings of ceiling panels for the installation of the new cameras. Openings shall be covered with trimmers.
- 7.10.2.16 Camera housing and bracketry for the new cameras shall be same or equivalent to the existing ones installed in the station. Where required by LTA, dome camera housings shall be provided by the Developer at no additional cost.
- 7.10.2.17 Camera mounting shall be designed to allow easy access for maintenance purpose.
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- 7.10.2.18 Cameras shall be installed at suitable height such that they are not subjected to public vandalism. Camera housings shall be vandal resistant. The overall bracket and housing design shall be aesthetically pleasing with no cable exposure. The flexible conduit, cable and bracketry interface shall be easily disconnected such that the housing can be easily removed for maintenance.
- 7.10.2.19 Existing VSS cameras may be reused or relocated where practical, subject to the acceptance of LTA.
- 7.10.2.20 All VSS cameras shall remain in operation at all times. There shall be no down-time for the existing cameras, unless accepted by LTA.
- 7.10.3 PA System
- 7.10.1 The PA system in RTS station is used for the broadcast of live and pre-recorded announcements for routine operation and incident management. It is the one-way emergency voice communication system in RTS. The PA system comprises PA speakers, PA circuits, ambient noise sensors, paging consoles, workstations, amplifiers, controllers, monitoring and management systems, recording facilities, etc. The PA System is interfaced with other communication sub systems such as radio, telephone system, voice recording, clock system, etc. as well as other RTS systems such as the integrated supervisory control system, etc.
- 7.10.2 At areas affected by the Developer's development and building works, PA speakers shall be added, relocated, removed/decommissioned or replaced as appropriate.
- 7.10.3 Where required, the Developer shall expand, modify and upgrade the existing PA backend equipment (including providing additional PA amplifiers) to accommodate the new speakers, as well as all provisions on interfaces. Power amplifier(s), if added, shall be fully compatible, and be integrated with the existing PA System. The amplifier and fault detection features shall be as per the existing PA System design. All resiliency designs and provisions of the existing PA System, including PA speaker circuits interleaving design shall be maintained.
- 7.10.4 All modifications to the PA system shall be carried out in full compliance with the requirements of CPFPRTS and SS546, including all submissions to be made by the Developer's QP to the relevant authorities.
- 7.10.5 The new PA speakers to be provided shall be same as or equivalent to the existing ones used in the station. All PA speakers shall come complete with the necessary accessories and finishes such as speaker support, fittings, enclosure, trimmers, etc. The Developer shall co-ordinate with LTA and Railway Operator on the speaker type and colour. The proposed type of speaker shall be subject to the acceptance of LTA.
- 7.10.6 The new PA speakers shall be connected to existing PA zone(s) or to new zone(s) as appropriate. The Developer shall co-ordinate with the Railway Operator for the

zone(s) which the new PA speakers are to be connected to, including the required loudspeaker circuit(s).

- 7.10.7 At the interface boundary areas, the Developer shall ensure that the PA announcement within the station will remain audible and intelligible.
- 7.10.8 The Developer shall verify the performance of the existing PA system (such as intelligibility and sound pressure level, etc.) for subsequent performance verification of the new PA system installed by him. The Developer shall ensure that the Speech Transmission Index (STI) and the Sound Pressure Level (SPL) are the same as or better than the existing levels.
- 7.10.9 All performance calculations and simulation plots, including achievable STI and SPL distribution shall be submitted by the Developer for the review and acceptance of LTA. Where required, the Developer shall engage acoustic consultant for the design of the PA system.
- 7.10.4 Radio System
- 7.10.4.1 The Radio System in RTS is a two-way radio communication system comprises radio frequency (RF) antenna infrastructure (spot antennae and leaky coaxial cables) and associated radio system equipment such as splitters, couplers, combiners, base stations, repeaters, etc.
- 7.10.4.2 The Developer shall be responsible for the provision of new antennas, LCX cables, amplifiers, repeaters, splitters, couplers, etc. as well as the relocation/diversion of existing RF antenna infrastructure where required due to the Developer's development and building works.
- 7.10.4.3 Where modifications to the Radio System is required due to the Developer's development and building works, the Developer shall make all provisions to ensure that the RF coverage, signal level and quality in RTS premises, including stations, trackside and depots as provided by the existing Radio System (including coverage for the SCDF radio network and those provided by aboveground high point antennae), are maintained.
- 7.10.4.4 RF signal propagation shall be achieved by the use of antennas/LCX cables as appropriate. The Developer shall provide full details of the proposed antennas, LCX cables, low loss co-axial cables and associated RF splitters/couplers, etc. for the review and acceptance of LTA.
- 7.10.4.5 The Developer shall ensure that sufficient clearance is maintained for the antennas/LCX cables for electromagnetic compatibility considerations.
- 7.10.4.6 Antennas, LCX cables, low loss coaxial cables and all RF distribution devices shall be installed in such a manner that will facilitate easy accessibility, maintenance and testing.

- 7.10.4.7 Detailed radio link budget calculations shall be submitted for review and acceptance by LTA. Verification of the existing radio coverage performance prior to the modification and alteration works shall be carried out by the Developer. The results of such verification shall be used for subsequent performance verification by the Developer.
- 7.10.5 Telephone and Ancillary Communications System (TAA)
- 7.10.5.1 The Telephone and Ancillary (TAA) Communications System (including multichannel voice recorder system) in RTS provides two-way, wired voice communication between fixed locations as well as recording of voice communications. The TAA System comprises PABX (private automatic branch exchange) system, station intercom, fire-fighters intercom, 2-way emergency voice communication, emergency fire phone, hotline telephones, voice recording system, hearing enhancement system, blue light station, etc. The TAA System is also interfaced with other communication sub systems such as the Radio System, VSS, PA system, clock system, etc. as well as other rail systems such as the integrated supervisory control system.
- 7.10.5.2 At areas affected by the Developer's development and building works, TAA System equipment shall be added, relocated, removed/decommissioned or replaced as appropriate. Examples of such works would include the relocation/addition of fire-fighters intercoms at ground level breeching inlets, provision of emergency fire phones where public areas have been extended and etc.
- 7.10.5.3 Where required, the Developer shall also expand, modify and upgrade the existing TAA backend system equipment, e.g. the addition of subscriber line modules, updating of databases, etc.
- 7.10.5.4 All modifications to the TAA System shall be carried out in full compliance with the requirements of CPFPRTS and SS546, including all submissions to be made by the Developer's QP to the relevant authorities.
- 7.10.6Station Travel Information System (STIS)
- 7.10.6.1 The STIS provides train arrival/departure times and other travel related information to the commuters. The Developer shall undertake all provisions, including configuration changes, testing and commissioning on the proprietary STIS due to addition, relocation or removal of Passenger Information Displays (PIDs).
- 7.10.6.2 The Developer shall be responsible for the design, supply, installation, testing and commissioning of the new PIDs which includes the following:
  - a. Software and database configuration changes, modifications to the existing proprietary STIS.

- b. All provisions necessary to interface and integrate the new PIDs, including all associated equipment, with the existing STIS and interfacing systems (such as Integrated Supervisory Control System, Maintenance Management System, etc).
- c. Co-ordinate with interfacing contractors and Railway Operators for the implementation of the new PIDs, or modifications to existing PIDs.
- 7.10.6.3 The Developer shall provide new PIDs at new entrances, and linkways to the station. For alterations to existing entrances, linkways and station areas in which existing PIDs are affected, the Developer shall temporarily relocate or permanently shift existing PIDs, and/or provide new PIDs to ensure that the existing coverage to commuters are not affected.
- 7.10.6.4 New PIDs provided by the Developer shall be identical with the current PIDs and fully compatible with the existing STIS.
- 7.10.6.5 The Developer shall take due precaution and care in the handling of existing equipment. The Developer shall make the necessary repairs to its original condition if the equipment under the Developer's care are mishandled, damaged, scratched or malfunction during the works.
- 7.10.6.6 The Developer shall appoint specialist with technical expertise to execute the backend software configuration works for the proprietary STIS to include the new PIDs or modifications to existing PIDs.
- 7.10.6.7 The Developer shall be responsible for the design and fabrication of the brackets and mounting poles complete with Professional Engineer (PE) endorsement. The mounting pole and finishes shall be similar with the existing STIS design.
- 7.10.6.8 The Developer shall provide all necessary data cables, electrical cable, cable infrastructure, interface termination box, and patch cables, all provision are to be according to the existing STIS design.
- 7.10.6.9 Electrical power supply cable shall be laid from a DB room or DB located in CE/ISCS room in the station to the PIDs. This cable is terminated with proper cable lug and sleeve at DB end and at the PID end as per existing STIS design completed with Licensed Electrical Worker (LEW) endorsement.
- 7.10.6.10 The Developer shall ensure the loading of existing electrical circuits are not overloaded with the introduction of the additional PIDs. Where necessary, the Developer shall upgrade the existing DB to facilitate the new installation.

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## 7.11 Integrated Supervisory Control System (ISCS) / Supervisory Control System (SCS)

- 7.11.1 As in integral part of the MRT operations, all station equipment (Electrical, Mechanical, Communications and Station Travel Information System, etc.) are monitored and controlled by station and OCC staff via ISCS / SCS. In the event that station layout is changed or station equipment is added, removed or shifted, the Developer shall undertake all necessary works for the existing ISCS / SCS to be updated and configured to reflect all the changes taking place.
- 7.11.2 The updates of the proprietary ISCS / SCS software where applicable shall include, but not limited to the following:
  - a. Remote Terminal Unit (RTU)
  - b. Programmable Logic Controller (PLC)
  - c. Station and OCC servers
  - d. Multi-Functional Terminals (MFT)
  - e. OCC Central and Station Database
  - f. Graphical User Interfaces (GUI)
  - g. Maintenance Operation Centre (MOC) or similar if applicable
  - h. ISCS / SCS MFT at the Land Transport Operations Centre (LTOC)
  - i. Overview Display System (ODS) if applicable
  - j. All software upgrade shall include both OCC and BOCC
- 7.11.3 The Developer shall provide all necessary equipment modules and / or input & output, remote IO and multiplexor cards with necessary spares provision to serve the changes in the new development. In the event that the station PMS/RTU could not be expanded further due to system expansion limitation, the Developer shall provide separate equipment that shall be seamlessly integrated to the present ISCS / SCS to support monitoring and control functions of the station equipment. The provision for all necessary equipment modules and/or input & output cards and spares to serve the changes in the modification works, are to be provided for within the capacity of the existing system.
- 7.11.4 The Developer shall provide all necessary provision for the interfacing cables, cable infrastructure, and Interface Terminal Box (ITB) that shall adhere to the existing ISCS / SCS installation practice.

- 7.11.5 Cables and its infrastructures that are made redundant as a result of the points' removal are to be dismantled and removed. The Developer shall make good or reinstate walls, claddings, ceiling, and etc. thereafter during the execution of the works or to replace those modular pieces that are not repairable.
- 7.11.6 The cable insulation and continuity tests shall be carried out before the cables are terminated. The Developer shall check installation quality prior to operational testing by visual inspection be carried out.
- 7.11.7 The Developer shall be responsible for design, supply, installation, interfacing works co-ordination, testing and commissioning of the ISCS / SCS.
- 7.11.8 The Developer shall ensure that the modification work to ISCS / SCS including software, patches, hardware are fully compatible with the existing ISCS/SCS system and shall not cause any impact to the system and operations.
- 7.11.9 The Developer shall engage the relevant ISCS / SCS specialists to perform all SCS / ISCS related works including updating of relevant documentation.
- 7.11.10 Upon completion of modification works, the updated as-built ISCS / SCS documents shall include changes to ICD, IDD, wiring diagrams, single line drawings, cable route drawing and power drawings.

### 7.12 Access Management System (AMS)

- 7.12.1 Station security is managed by Access Management System which secures and monitors all accesses to non-public areas through card access system. In the event that the entrances are altered or new space is added which requires new doors, the Developer shall ensure that the access management system equipment are relocated or added to provide similar security and monitoring.
- 7.12.2 AMS is to maintain security within the station. For instances, offices or equipment rooms, any compartmentalized space for authorized personnel and illegal intrusion will be secured and monitored. In the event that rooms with AMS doors are shifted or removed or new doors are added, the Developer shall undertake all provisions to ensure the AMS operations is maintained.
- 7.12.3 The Developer shall undertake to update the existing AMS proprietary software in the station, adjacent stations, OCC servers, BOCC servers and workstations including Graphical User Interface (GUI). The Developer shall update the Architectural layout of the GUI for new space/room added or removed due to the development works. This shall also include the supply of hardware (such as door controller, electromagnetic lockset, card reader, break glass, installation, cable, etc.) for the affected doors. The provision shall be fully compatible with the existing design.

7.12.4 All doors that are affected by the proposed changes in the architectural layout, whether the AMS doors are shifted, removed or new doors added shall adhere to the guideline stipulated in LTA Architectural Design Criteria (ADC) and Code of Practice for Fire Precautions in Rapid Transit Systems (CPFPRTS) by SCDF.

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- 7.12.5 The station AMS support daily security operations in the station. It consists of integrated contactless card-based Access Control System (ACS) and Intrusion Detection System (IDS) to monitor and regulates the movement of personnel within the station boundary.
- 7.12.6 The Developer shall be responsible for the design, supply, delivery to Site, installation, coordination, testing, commissioning and decommissioning of the AMS equipment for any relocation, addition or removal of AMS doors due to the development works. All existing functions and interface designs, both within the existing AMS and with external interfacing systems, shall remain unchanged unless specified otherwise.
- 7.12.7 The Developer shall submit method of statement that outlines the overall sequence of activities that will enable the concurrent or sequential execution of installation, testing and commissioning of additional AMS equipment and decommissioning of any unused AMS equipment for LTA's review and acceptance, prior to commencement of the A&A works. The Developer shall ensure that the works to be executed shall have no disruption to revenue service of the operational railway.
- 7.12.8 The Developer shall provide necessary updates to the AMS equipment and interfaces that are affected by the A&A works. The update shall include, but not limited to, station, OCC, backup OCC and adjacent stations to the Site. As the AMS systems are proprietary, the Developer may be required to engage the existing vendors / contractors to provide the relevant proposals for the changes.
- 7.12.9 As far as feasible and practicable, all hardware and firmware/software proposed by the Developer shall be the same or superior to the existing AMS equipment and fully compatible for operations with the existing AMS and its external interfacing systems. The Developer shall submit justification for LTA's review and acceptance if alternative hardware or firmware/software is proposed.
- 7.12.10 The fire escape doors on the North-South East-West Line (NSEWL) are monitored and controlled by SCS under the Emergency Door Release (EDR) and Emergency Gate (EG)—in lieu of AMS. The EDR/EG are released by SCS reaction program whenever SCS receives a fire summary alarm from the Main Alarm Panel (MAP). The electro-magnetic lock and its door-end devices of EDRs at the platform level are typically installed only at one end of the exit staircase within the station box whereas the other end leading out of the station box at ground level is released manually.



### 7.13 Maintenance Management System (MMS)

- 7.13.1 Maintenance Management System is provided to manage all maintenance activities for equipment, spares, consumables and E&M facilities. In the event the station equipment and devices are removed, relocated and/or added to the station inventory, the Developer shall undertake to update and configure the data inside MMS to reflect the changes. Updating of MMS is not required for NSEWL.
- 7.13.2 The Developer shall consolidate all information that are required to update of MMS database. All data to be registered shall conform to the formats used in the existing MMS database. The Developer shall provide a single point of contact to support the Railway Operator and to ensure that the data provided is adequate for the MMS database update.
- 7.13.3 The Developer shall provide a list of assets based on the Asset Naming Convention / Equipment Naming Convention document which include as a minimum, the following information for all equipment that are provided, deleted or modified within this contract:
  - a. Asset ID / Code
  - b. Description
  - c. Serial Number
  - d. Parent-Child Hierarchy
  - e. Maintenance data
  - f. Any other data to be provided for consistency with the existing database
- 7.13.4 The Developer shall ensure that there is no duplication of any Asset ID or Serial Number in the list that is provided.
- 7.13.5 The Developer shall effect necessary changes and update to the existing MMS software configuration and its database.
- 7.13.6 The Developer shall be responsible for design, supply, delivery, installation, interfacing works, co-ordination, testing and commissioning of the MMS.
- 7.13.7 The Developer shall ensure that all contractors provide a comprehensive list of assets within the scope of their equipment supply up to Line Replaceable Unit (LRU) level. All asset/item codes used must be consistent with all actual equipment installed on site.



### 7.14 Automatic Fare Collection System (AFC) and Ticketing Machines

- 7.14.1 In the event the traffic figure submitted by the Developer requires the existing fareline to be extended or expanded, the Developer shall:
  - a. be required to engage AFC contractor who will be appointed by LTA to supply, deliver, install, test and commission the AFC gates and ticketing machines. The engaged AFC contractor is to also provide operations and maintenance training to the Railway Operator for any new models that the AFC gates and ticketing machines.
  - b. comply with the interface requirements with the existing AFC equipment installed in the affected MRT station and submit the installation details for LTA's acceptance.
  - c. coordinate with the Railway Operator for the installation, test and commissioning of the AFC gates and ticketing machines.
  - d. update and submit to LTA all necessary as-built drawings upon completion of the works.
  - e. coordinate with Railway Operator and provide the service to update the equipment and parts information into Railway Operator's MMS.

For the avoidance of doubt, the Developer shall provide gate cabinets and ticketing machines that are equipped with necessary Contactless Card Reader.

- 7.14.2 In the event that a new AFC gate line is created or extended, the Developer shall also provide VSS cameras to provide frontal surveillance coverage of commuters entering and exiting the station via the fare gates, as well as public monitors at each AFC gate line at the paid area for the display of assigned station VSS images in sequence. The design and provision of VSS including required architectural mountings shall comply with the prevailing requirements set out by MHA and LTA.
- 7.14.3 The Developer is also required to bear all charges incurred for the following:
  - a. All necessary addition and modification to the power and network setup and lay the trunking, power and network cables for the AFC gates and ticketing machines.
  - b. Liaise with the Railway Operator to carry out the above works in the hours defined as nonrevenue hours if required.
  - c. When Railway Operators attendance is required.

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### PART IV – RAILWAY OPERATOR' REQUIREMENTS

#### 1. GENERAL

- 1.1 The Developer shall comply with the Railway Operators' rules and requirements when working in, on or near the railway system and in railway premises. This shall include the requirement to engage ceiling panel specialist for opening and reinstatement of ceiling panels, etc. It may be necessary for supervisors and workers employed to carry out the works to attend training courses conducted by the Railway Operator before they are allowed to work in the railway premises.
- 1.2 It is highlighted that the Railway Operator will require their personnel to be in charge for access to track and station areas and premises when working, monitoring inside these areas, and etc. The Railway Operator will charge for their services and attendances rendered and the Developer shall be responsible for all these cost and associated costs.
- 1.3 The equipment and facilities in the MRT station may be sensitive to vibration. The Developer shall ensure that any works to be carried out shall not cause vibration which may affect the equipment, facilities including finishes in the MRT station. This may include facilities such as, but not limited to, Automated Teller Machines, and other electronic machines, and etc.
- 1.4 The Developer shall note that any work that affect the railway operation can only be carried out during the time where the railway is not in operation. This is generally from **0100 hrs to 0500 hrs** but may be subject to change from time to time. The Developer shall obtain Permit-To-Work (PTW) or equivalent approval from the Railway Operator to carry out works within the railway premises.



### APPENDICES

<u>APPENDIX A – SUBMISSION CHECKLIST FOR ARCHITECTURAL AND</u> <u>CIVIL/STRUCTURAL RELATED MODIFICATION</u>

<u>APPENDIX B – SUBMISSION CHECKLIST FOR ELETRICAL AND MECHANICAL</u> <u>RELATED MODIFICATION</u>

<u>APPENDIX C – DOCUMENT CHECKLIST FOR SUBMISSION OF CLOSURE OF</u> <u>MODIFICATION (COM)</u>

<u>APPENDIX D – CERTIFICATE OF TRANSFER OF CARE CUSTODY AND CONTROL (TCCC)</u> <u>BY PRIVATE DEVELOPER</u>

APPENDIX E – DRAWING LIST FOR SUBMISSION OF COM

APPENDIX F – SECURITY CHECKLIST

<u>APPENDIX G – SAMPLE OF LTA DEFECT LIST AND RECTIFICATION RECORDS</u>

APPENDIX H – SAMPLE OF DEED OF WARRANTY (TO BE SHARED UPON REQUEST)

APPENDIX I – ASSET LISTING (TO BE SHARED UPON REQUEST)

# APPENDIX A – SUBMISSION CHECKLIST FOR ARCHITECTURAL AND CIVIL/STRUCTURAL RELATED MODIFICATION

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Note:

- Appendix A and supporting documents in full set are required to be attached for each of the submission/resubmission
- A pre-consultation with LTA and railway operator is required prior to any official submission.
- All drawings, design loadings, calculations and method statement shall be duly endorsed by a Qualified Person (QP) / Professional Engineer (PE).

1.	COVER LETTER FROM QP'S OFFICE		
	Project reference number and project title		Modification number
	Title of the proposed modification work		Revision number (i.e, A, B and etc.)
2.	DESIGN REPORT / ENGINEERING IMPACT AS	SESSM	ENT REPORT
	QP declaration		
	Design brief		OP endorsed design drawings & calculations
	Design assumptions and considerations		including the relevant as-
	To assess the effects of the proposal on the existing RTS structures		built drawings (cloud the affected area/section in the relevant as-built drawing) that affected
	Design codes, if any		Rapid Transit Systems (RTS) structures as mentioned in <b>4.2.3</b> of the Guidebook
	Material Specification		
	Track Record		
3.	METHOD STATEMENT	1	
	Layout / sectional plans		For proposal involving crane, hoisting or
	Write-up and/or plans indicating the		heavy equipment with respect to elevated RTS
	sequence of work		a Names and competency cortificate of
	Safe work procedures		operators/supervisors.
	Fall prevention plan		<ul> <li>b. Valid test certificates of lifting equipment/machine</li> </ul>
	Complete list of machinery, equipment, etc. to be used and the relevant specification;		<ul> <li>c. PE endorsed calculations to check on the stability of the working platform / foundation and its access.</li> <li>d. Endorsed form 'Undertaking for supervision of Heavy Machineries within Railway Protection Zone'</li> </ul>
4.	HAZARD ANALYSIS		

			Land Transport Authority		
	Identify all possible risks that may be		Description of the safety and		
	posed to the RTS structures		precautionary measures		
5. I	NVENTORY LIST				
	A list of LTA assets to be decommissioned	or disp	posed of with photos and quantity		
6. <b>C</b>	CONTINGENCY PLAN / EMERGENCY PROCED	URE			
	Please refer to the guidelines given in Part IV Appendix B of CPRP.				
7. P	PRE-CONDITION SURVEY REPORT				
	Photographic record and detailed assessment of existing condition prior to the				
	commencement of work				
8. A	COPY OF COMPLETED FILLED MODIFICATION	ON APP	LICATION FORM (AFM/MCRF FORM)		
	The form can be obtained from the projec	t coor	dinator assigned by Railway Operator		
9. A	CKNOWLEGEMENT LETTER FROM RAILWAY	Y OPER	ATOR		
	A copy of acknowlegement letter/email fr received the same set of proposal from Q	om the P's offi	e Railway Operator to acknowlege that they have ce.		

### Land Transport Authority

# APPENDIX B – SUBMISSION CHECKLIST FOR ELETRICAL AND MECHANICAL RELATED MODIFICATION

### NOTE:

- a. Appendix A and supporting documents in full set are required to be attached for each of the submission/resubmission.
- b. A pre-consultation with LTA and railway operator is required prior to any official submission.
- c. All design drawings and calculations shall be endorsed by a Qualified Person (QP) / Professional Engineer (PE) / Licensed Electrical Worker (LEW) from relevant discipline.

#### PART 1 GENERAL

1. (	COVER LETTER FROM QP'S OFFICE						
	Project reference number and project title	t 🗆	Modification number				
	Title of the proposed modificatio work	n 🗆	Revision number (i.e, A, B etc.)				
2. 1	METHOD STATEMENT						
	Sequence of works/installation detai	s 🗌	Layout/Sectional plans of the proposed modification work				
	Single line diagram and calculations		Cable routing				
	Test plans and test procedures		Factory Acceptance Test (FAT) reports, Site Acceptance Test (SAT) reports and etc				
	Technical brochure / specification test reports and certificates for equipment and materials	5, 🗆 or	Layouts/drawings reflecting the changes/amendments to existing as-built drawings (cloud the affected area/section in the relevant as-built drawings)				
	<ul> <li>For proposal involving crane, hoist structures, the following must be su</li> <li>e. Names and competency certifications</li> <li>f. Valid test certificates of lifting edge</li> <li>g. PE endorsed calculations to check and its access.</li> <li>h. Endorsed form 'Undertaking for Protection Zone'</li> </ul>	<ul> <li>For proposal involving crane, hoisting or heavy equipment with respect to elevated RTS structures, the following must be submitted:</li> <li>e. Names and competency certificate of operators/supervisors.</li> <li>f. Valid test certificates of lifting equipment/machine</li> <li>g. PE endorsed calculations to check on the stability of the working platform / foundation and its access.</li> <li>h. Endorsed form 'Undertaking for supervision of Heavy Machineries within Railway Protection Zone'</li> </ul>					
3. I	INVENTORY LIST						
	A list of LTA assets to be decommiss	A list of LTA assets to be decommissioned or disposed of with photos and quantity					
4. 1	PRE-CONDITION SURVEY REPORT						
	Photographic record and detailed as routings, cable support system, equi of work.	Photographic record and detailed assessment of existing condition (including cable routings, cable support system, equipment layout, etc.) prior to the commencement of work.					
5. /	A COPY OF COMPLETED MODIFICATION A	PPLICAT	ON FORM (AFM/MCRF FORM)				
	The form can be obtained from the	project c	oordinator assigned by Railway Operator.				

### 6. ACKNOWLEGEMENT LETTER FROM RAILWAY OPERATOR

A copy of acknowlegement letter/email from the Railway Operator to acknowlege that they have received the same set of proposal from QP's office.

## PART 2 DEPENDS ON THE TYPE OF E&M SERVICE/SYSTEM AFFECTED, THE FOLLOWING DETAILS ARE REQUIRED TO BE INCLUDED IN THE SUBMISSION:

S/N		E&M Services and Systems	Additional Submission Requirements
1	Electrical Services (ES)		a. Single-line diagrams for the new and affected electrical distributions
			b. Lighting and power layout plans
			c. Cable support system and cable routing layout plans
			d. Equipment layout plans
			e. Earthing layouts and schematics
			f. Electrical switchboards or distribution boards manufacture drawings
			g. Electrical loadings under normal and emergency operation scenarios including any other scenarios if any
			<ul> <li>Electrical calculations such as voltage drop calculations, fault level calculations, circuit breaker and cable sizing calculations, protection settings and discrimination curves, electrical equipment sizing</li> </ul>
			<ul> <li>Lighting design calculations and simulations including emergency and outage scenarios</li> </ul>
			j. Lightning protection system design and layout
2		Fire Protection	a. Fire shutter activation provisions and sequence
		System	b. Cable routing from ITB for fire shutter to MAP
		(FPS)	c. Calculations of sprinkler water storage capacity, pump, and pipe sizing
3		Environmental	a. Vent shaft pressure drop calculation
		Control System	b. Cooling load calculations
	(ECS) and Tunnel Ventilation System (TVS)		c. Fan static calculations and pump hydraulic calculations
			d. Calculations for duct and pipe sizing
			e. Calculations of noise control and acoustic treatments
			f. Fan flow rate calculation
			g. Computational Fluid Dynamics (CFD) Report

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		h. Single-line drawings and calculations
		i. Control and monitoring for proposed equipment
4	Lift and Escalator	a. Type, speed, and capacity (for lift) catalogue
	(L&E)	b. Control, monitoring and intercom (for lift) of the new proposed equipment
5	Plumbing and Sanitary	a. Calculations of water / sewage storage capacity, pump, and pipe sizing
-	(P&S)	
6	Video Surveillance System	<ul> <li>Proposed camera layout and surveillance coverage plots, proposed camera text</li> </ul>
	(VSS)	<ul> <li>Amendment to existing single line and wiring diagrams, schematic and power drawings</li> </ul>
		c. System configuration and recovery image
		Please note that the proposed camera layout and surveillance coverage plots shall be endorsed by LTA Public Transit Security (PTS) division.
7	Public Address	a. Acoustic design submission
	(PA)	b. Layout of speakers
		c. A copy of approval from SCDF
		d. Test reports, SAT, ITC, pre and post modification acoustic performance (STI and SPL) measurements
8	Radio	a. Proposed radio coverage
		b. RF Link budget calculations
9	TelephoneandAncillary(TAA)CommunicationsSystem(includingmulti-channel voicerecorder system)	a. A copy of approval from SCDF
10	Station Travel	a. Electrical single-line drawings and calculations
	(STIS)	<ul> <li>PE endorsement and calculation for the mounting of the Passenger Information Display (PID) and the mounting location</li> </ul>
11	Supervisory Control System / Integrated	a. Submission of the drawings for new PLC, ITB, equipment racks, etc.
	Supervisory Control System	<ul> <li>Submit amendment to existing ICD / IDD document reflecting the changes</li> </ul>
	(SCS/ISCS)	c. GUI / Software update for in depot, all stations, MOCC, BOCC and LTOC

			Land Transport Authority
		d.	Submit software release notes
12	Access	a.	Cable routing, single-line diagram
	Management System	b.	Drawings reflecting the changes to existing as built and proposed new addition
	(AMS)	C.	GUI / Software / database update in stations, MOCC and BOCC
		d.	Submit software release notes
13	Maintenance	a.	Compilation of changes to the assets
	Management System	b.	Update the assets listing, obtained from Operator
	(MMS)	C.	Submit amendment to existing ICD / IDD document reflecting the changes
		d.	Software update
		e.	Software / database update in stations, MOCC and BOCC
		f.	Submit software release notes
14	Automatic Fare Collection (AFC)	a.	AFC gates, Ticketing Machines proposal, where required shall be in accordance with the technical specifications provided by LTA and from Contractors identified /appointed by LTA

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# APPENDIX C – DOCUMENT CHECKLIST FOR SUBMISSION OF CLOSURE OF MODIFICATION (COM)

Note:

• Appendix C and supporting documents in full set are required to be attached for each of the submission/resubmission

PROJEC	CT REFERENCE NO.:				
PROJEC	CT TITLE:				
NAME	OF DEVELOPER/COMPANY:				
MAIN (	CONTRACTOR'S COMPANY NAME:				
APPRO	VED MOD NO.:				
MOD T	ITLE.:				
S/N	Docume	nt	Attached	Not Applicable	REMARKS
1	As-built drawings endorsed by QP/	LEW			
2	O&M manuals (including Mainter	nance Manual for Specialist			
2	Structures and Architectural Featur	es)			
4	Endorsed Testing & Commissioning	records			
5	Listing of Spares Provision	, , , , , , , , , , , , , , , , , , , ,			
6	Training manuals				
7	Outstanding works/ Defect list (LTA	template)			
8	Defect liability periods				
9	QA/QC certification				
10	Software Licence certificates				
11	As-Built/ Post/ Final Contract Doc System Design				
12	Factory Acceptance Test (FAT) & Sy Reports				
13	Relevant agency approval (PUB dra etc) if any	inage department, SCDF and			
14	Approved calculations/design repo	rt if any			
15	RI inspection if any				
16	Point of contact for warranty peri	od			
17	Updated MMS records (if any cha	nges to equipment listing)			
18	Asset Listing stating the descript number if available) of asset, dat value of transfer (LTA template)	ion and details (e.g. serial e of transfer, location, and			
19	Maintenance Agreement (with In-p if any				
20	Approved material specification				
21	List of approved suppliers, contract this contract with their address number and contact person to facil required	ors & Specialist involved in , company name, contact itate future follow-up where			
22	* Others, please specify:				

## Land Transport Authority APPENDIX D – CERTIFICATE OF TRANSFER OF CARE CUSTODY AND CONTROL (TCCC) BY PRIVATE DEVELOPER

CER	CERTIFICATE OF TRANSFER OF CARE CUSTODY AND CONTROL (TCCC) BY PRIVATE DEVELOPER (Projects Facilitated by DBC)					
PR	OJECT REFERENCE NO.:					
PROJECT TITLE						
	NAME OF					
C	DEVELOPER/COMPANY:					
	MAIN CONTRACTOR'S					
	COMPANY NAME:					
	APPROVED MOD NO.:					
	MOD TITLE.:					
A. Des	cription of Work/System	/Sub-System Handed Ove	r to LTA/Railv	vay Operator:		
B The	following documents a	re attached and submitted	d in a virus-fr	ee DVD for re	cord Please	
indica	te " $\vee$ " where applicable.					
S/N	Doc	ument	Attached	Not	REMARKS	
				Applicable		
1	As-built drawings endo	rsed by QP/LEW				
2	O&M manuals (includir	ng Maintenance Manual				
	for Specialist Structures	and Architectural				
2	Features)					
3	List of items with warra	anties/ Extended				
4	Endorsed Testing & Cor	, mmissioning records				
5	Listing of Spares Provisi	on				
6	Training manuals					
7	Outstanding works/ De	fect list (LTA template)				
8	Defect liability periods					
9	QA/QC certification					
10	Software Licence certifi	cates				

			Land Transport <b>Q</b> Authority
11	As-built/ Post/ Final Contract Documer	nts	
	Delivery (FCDD) for System Design		
12	Factory Acceptance Test (FAT) & System	1	
	Acceptance Test (SAT) Reports		
13	Relevant agency approval (PUB drainage	2	
1.4	department, SCDF and etc) if any		
14	Approved calculations/design report if a	iny	
15	RI inspection if any		
16	Point of contact for warranty period		
17	Updated MMS records (if any changes	to	
	equipment listing)		
18	Asset Listing stating the description and	details	
	(e.g. serial number if available) of asser	t, date of	
	transfer, location, and value of transfe	r (LIA	
19	Maintenance Agreement (with In-princi	nle	
15	approval from Railway Operator) if any		
20	Approved material specification		
21	List of approved suppliers, contractors 8	k l	
	Specialist involved in this contract with	n their	
	address, company name, contact numb	er and	
	contact person to facilitate future follov	/-up	
	where required		
22	* Others, please specify:		
C. Rec	ommendation and Acceptance		
To be	filled by the Developer:	To be filled by RAOM	Division
		(AEINF/AESYS/AEPS):	
TRANS	SFERRED FROM:	ACCEPTED BY:	
Name Designation (Director and Above)		Name	Designation (D/DD)
 Signat	ure Date	Signature	Date
Signat		S.D. Maran C	

To be filled by DBC (Infr	astructure Protection	Division):
RECOMMENDED BY:		
Name		Designation (Deputy Director)
Signature		Date
To be filled by RAOM Div (AEINF/AESYS/AEPS):	vision	To be filled by Railway Operator (SMRT/SBST):
TRANSFERRED FROM:		RVIEWED BY (SBST ONLY):
Name	Designation (D/DD)	Name Designation (SBST – Head of Department)
Signature	Date	Signature Date
		ACCEPTED BY:
		Name Designation
		(SMRT – PRESIDENT TRAINS / SBST – Head of Engineering)
		Signature Date



### APPENDIX E – DRAWING LIST FOR SUBMISSION OF COM

### (You may request the excel working copy from DBC OIC if required)

### Note:

• Appendix C and supporting documents in full set are required to be attached for each of the submission/resubmission

Project Reference No.:				
	Project Title:			
Ap	proved MOD No.:			
	MOD Title.:			
S/NO	DRAWING NO.	Submission Revision	Tittle	Remarks
1				Drawings loaned from LTA Record Centre
2				Drawings provided by Railway Operator
3				Drawings by Developer's project team
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

## APPENDIX F.1 – SECURITY CHECKLIST FOR ADDITIONS & ALTERATIONS (A&A) WORKS AT MRT STATIONS BY PRIVATE DEVELOPERS

Date of Review:	Conducted by:	
Company:	Designation:	
Project Reference Number:		
Project Title:		
Location (affected MRT station):		

Note to user:

- 1. Hand / toe-hold refers to any horizontal flat surface, gaps and recessed areas of more than 30mm in width.
- 2. If any of the "Yes" column is checked, please provide the relevant details, with clear indication of the MRT Station, to LTA PTS for consultation.
- 3. Please note that there may be a need to conduct Security-By-Design (SBD) studies by a competent Security Consultant as regulated by Ministry of Home Affairs' (MHA) Infrastructure Protection Act (IPA).
- 4. LTA will assess and inform the QP.

S/N	A&A Security Requirement	Yes	No	Illustrations /Examples
1	Is the A&A work's structures / fixtures / equipment / hoarding within the 3000mm spherical distance from any gaps (more than 150mm) along the station's façade? Note: If "No" column is selected, please skip to question 4.			Public area MRT Station MRT Station's soffit 2 3000mm 2 150mm gap spherical clearance from edge of facade FFL Note: Illustration not drawn to scale

				Land Transport Authority
<u>S/N</u>	A&A Security Requirement	Yes	No	Illustrations /Examples
2	If S/N 1 is checked "Yes", is the A&A's hoarding1: less than 3000mm in height; with any hand / toe-hold on the surface of the hoarding facing the public area, which will aid a person to scale over the hoarding; or base to FFL has gaps that's larger than 150mm in height?			Public area MRT Station Hoarding No hand / toe-hold (ledge of more than 30mm)
	1 Hoarding here refers to any hoardings enclosing any part of the MRT Station or MRT Viaduct			Gap less than 150mm Note: Illustration not drawn to scale
				Public area MRT Station
3	If S/N 1 is checked "Yes", is the final structure of the A&A work: less than 3000mm in height; or has hand / toe-hold that allows a person to reach the gap along the station's façade? Note: If "Yes" column is selected, please provide mitigation measures to prevent possible intrusion into the MRT Station.			FFL Covered Linkway Note: Illustration not drawn to scale
4	If the A&A work is within the MRT Station, is the hoarding less than 3000mm or not flushed to the ceiling of the station? Note: If "Yes" column is selected, please provide mitigation measures to prevent possible hiding areas within the MRT Station.			

				Land Transport Authority
<u>S/N</u>	A&A Security Requirement	Yes	No	Illustrations /Examples
5	Is the A&A site within 50m of any MRT Station's entrance (on street level)? Note: If "Yes" column is selected, please survey and highlight possible cameras that could be affected by the A&A infrastructure. Upon LTA PTS's assessment, if required, contractor / developer is to engage a CCTV specialist to perform all CCTV related works.			MRT Station Entrance 50m Radius
6	In the site assessment and survey, are there any other MRT Station's cameras that are near or facing the A&A site? Note: If "Yes" column is selected, please survey and highlight possible cameras that could be affected by the A&A infrastructure. Upon LTA PTS's assessment, if required, contractor / developer is to engage a CCTV specialist to perform all CCTV related works.			
7	Are any of the A&A's structures / fixtures / equipment / installations (within the MRT Station): above the height of 1600mm and less than 3000mm as measured from the top of the FFL; and with horizontal surface of more than 50mm at the top? Note: If "Yes" column is selected, please provide sloping roof topping or alternative solution to eliminate possible hiding spaces within the MRT station.			Top surface >50mm     Top surface       1600mm
8	Are any of the A&A's structures / fixtures / equipment / installations (within the MRT Station) placed between 50mm and			

	0
Land Transport	Authority

S/N	A&A Security Requirement	Yes	No	Illustrations /Examples
	1000mm away from any permanent structures? Note: If "Yes" column is selected, please provide solution to eliminate possible hiding spaces within the MRT station.			
9	Does the A&A work affect any of the MRT Station's entrances e.g. Change in façade design or removal / relocation of security shutters? Note: If "Yes" column is selected, please provide the details for LTA's assessment. In addition, please provide mitigation measures to prevent possible intrusion into the MRT Station.			
10	Does the A&A work introduce new entrance or connection to the MRT Station? Note: If "Yes" column is selected, please provide the details for LTA's assessment. In addition, please provide mitigation measures to prevent possible intrusion into the MRT Station.			

## APPENDIX F.2 – SECURITY CHECKLIST FOR ADDITIONS & ALTERATIONS (A&A) WORKS AT MRT VIADUCTS BY PRIVATE DEVELOPERS

Date of Review:	Con	ducted by:
Company:	Desi	gnation:
Project Reference Number:		
Project Title:		
Location (affected MRT station):		

#### Note to user:

- 1. Hand / toe-hold refers to any horizontal flat surface, gaps and recessed areas of more than 30mm in width.
- 2. If any of the "Yes" column is checked, please provide the relevant details, with clear indication of the MRT Viaduct, to LTA PTS for consultation.

S/N	A&A Security Requirement	Yes	No	Illustrations / Examples
1	Is the A&A work's structures / fixtures / equipment / hoarding within the 3000mm spherical distance from the edge and soffit of the MRT Viaduct? Note: If "No" column is selected, please skip to question 4.			FFL     y       FFL     rrain Track       Height       clearance       from soffit       y       Note: Illustration not drawn to scale
2	If S/N 1 is checked "Yes", is the A&A's hoarding1: less than 3000mm in height; with any hand / toe-hold on the surface of the hoarding facing the public area, which will aid a person to scale over the hoarding; or base to FFL has gaps that's larger than 150mm in height? 1 Hoarding here refers to any hoardings enclosing any part of the			Public area MRT Viaduct Hoarding No hand / toe-hold (ledge of more than 30mm) Gap less than 150mm
	MRT Station or MRT Viaduct			Note: Illustration not drawn to scale

				Land Transport <b>Authority</b>
S/N	A&A Security Requirement Ye	es N	١o	Illustrations / Examples
3	If S/N 1 is checked "Yes", is the final structure of the A&A work: less than 3000mm in height; or has hand / toe-hold that allows a person to reach the edge or the soffit of the MRT Viaduct? Note: If "Yes" column is selected, please provide mitigation measures to prevent possible intrusion into the MRT Viaduct.			Train Track Covered Linkway Note: Illustration not drawn to scale Train Track Train Track Covered Linkway Covered Linkway Note: Illustration not drawn to scale
4	Does the A&A site or final structure overlook the existing rail tracks? Note: If "Yes" column is selected, please provide mitigation measures for possible intrusion, and prevent items from being thrown onto the tracks.			

### APPENDIX G – SAMPLE OF LTA DEFECT LIST AND RECTIFICATION RECORD

(You may request the excel working copy from DBC OIC if required)

#### Notes:

- 1. This list is to be prepared by the developer/his representative during Joint Testing & Commissioning (T&C) and Defect Inspection with LTA and PTO.
- 2. This list is to be submitted as part of the T&C records.
- 3. The developer/his representative is required to prepare an attendance list and submit as part of the T&C records.
- 4. T&C records comprise of the following:
  - a. T&C test reports (endorsed by service provider, QP of relevant discipline and PTO and LTA RSE as witness)
  - b. Defect list
  - c. Attendance list

F	Project Reference No:							
	Project Title:							
	Name of							
	Developer/Company:							
C	Contractor's Company							
	Name:							
	Date of Joint T&C							
Inspection:								
Location(s) inspected:								
	Service(s) affected							
(Approved AFM no and								
title):								
Start Time:								
	End Time:							
	Attendees	Doveloper team to pr	conaro the	attanda	nealist and attack	for record		
	Attenuees.	Developer team to pr	epare the	allenua	ance list and attact	i tor record.		
S/N	Defect Descriptions	Party who raised	Photog	graph	R	ectification Work		Remarks
S/N	Defect Descriptions	Party who raised the comments (i.e.	Photog	graph	R R (Si	ectification Work gnature with date)		Remarks
S/N	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Photog	graph	R (Si, Checked by	ectification Work gnature with date)	Accepted by	Remarks
S/N	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Photog	graph	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO	Remarks
S/N	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Photog Before	graph	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who	Remarks
S/N	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Photog Before	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the	Remarks
S/N	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Photog	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the comments)	Remarks
<b>S/N</b>	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Photog Before	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the comments)	Remarks
<b>S/N</b> 1 2	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Before	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the comments)	Remarks
S/N 1 2 3	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Before	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the comments)	Remarks
S/N 1 2 3 4	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Before	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the comments)	Remarks
<b>S/N</b> 1 2 3 4 5	Defect Descriptions	Party who raised the comments (i.e. Name/Department)	Before	After	Checked by Contractor Rep	ectification Work gnature with date) Inspected by Consultant Rep	Accepted by LTA/PTO (Party who raised the comments)	Remarks

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