APPENDIX G – SYSTEMS GENERAL REQUIREMENTS

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1 Introduction

This Appendix G [Systems General Requirements] sets out the requirements and processes to be employed by the Primary Contractor to confirm and validate that the Systems achieve the requirements of this Agreement, including Article 13 [Systems], Part 2 of Schedule 4, and that the Evergreen Line is ready for Service Commencement.

The Systems for the Project, and the applicable references in Article 13 [Systems], Part 2 of Schedule 4, are identified in the following table:

Table 1: Systems

Discipline	**Technical Requirements Reference**
Automatic Train Control	Article 13.5
Communications	Article 13.6
Central Control Room and Equipment	Article 13.7
Supervisory Control and Data Acquisition	Article 13.8
Power Distribution and Back-Up Power	Article 13.9
Guideway Equipment	Article 13.10
Station Equipment	Article 13.11
Vehicles *	N/A

*Vehicles are included here for reference purposes only. Vehicles and all associated vehicle borne equipment, including VOBCs and communications equipment, other than modifications to existing vehicle borne equipment necessary to support the additional geography of the Evergreen Line, are not included the scope of this Agreement. With respect to modifications to existing vehicle borne equipment, the Primary Contractor shall be responsible for updating VOBC software on existing VOBC versions (Mark I and II) to include loop channels and loop lengths for the Guideway (the software is to be installed is to be installed by others). Automatic speed control adjustments for Trains on the Evergreen Line are not included as part of the Work.

Notwithstanding the foregoing, for the purposes of this Appendix G, "Systems" also include:

(a) the Tunnel Ventilation System; and

(b) the emergency ventilation system required for the Ioco Station in accordance with Article 11.3.10 Enclosed Station Emergency Ventilation], Part 2 of Schedule 4.

Section 15 [Systems Documentation Submittals] of this Appendix G sets out the timing of submissions of the submittals required under this Appendix. Unless otherwise noted in this Appendix G, the Primary Contractor shall submit all submittals to the Province's Representative for review, acting reasonably, in accordance with the Review Procedure.

The Primary Contractor shall submit a request in accordance with Section 16 [Request for Amendment/Exemption from Systems General Requirements] of this Appendix G if the Primary Contractor proposes an addition or amendment to or an exemption from any part of these Systems General Requirements.

2 Systems Plan

The Primary Contractor shall prepare and submit to the Province's Representative a plan (the "**Systems Plan**") for the Work and the Equipment in respect of the Systems, which plan shall describe the organisation and process by which the Primary Contractor proposes to do the following:

- transform the requirements set out in Article 13 [Systems], Article 7.4 [Tunnel Ventilation System Requirements], and Article 11.13.10 [Enclosed Station Emergency Ventilation], all of Part 2 of Schedule 4, into a working rail transit system while ensuring that the functionality of the Existing SkyTrain System is maintained, through the use of an iterative process of definition, analysis, categorisation, design, testing, and evaluation;

- integrate related technical parameters and provide compatibility of physical, functional, and operational interfaces in a manner that optimises the Design of the Systems Equipment;

- integrate availability, reliability, maintainability, safety, quality assurance, testing, and human factors into the total engineering effort;

- show how the risks identified in the Systems Risk Management Plan are being mitigated; and

- show how existing functionality and operational capability of the Existing SkyTrain System will be maintained within the Integrated SkyTrain System.

3 Design Life of the Systems

Unless specified otherwise at sections 3.(a) through 3.(c) below, all Systems supplied by the Primary Contractor shall be designed for an operating life of 30 years, with appropriate maintenance as defined by Existing SkyTrain System maintenance manuals or by the Primary Contractor, with the exception of the following, which shall be designed for an operating life for the periods indicated:

(a) PC type computer equipment - 10 years;

(b) communications equipment (excluding PC type computer equipment) - 20 years; and

(c) batteries for UPS systems or substation control power - 10 years.

4 Systems Design Management

This Section 4 describes the design management requirements for the Systems portion of the Project, including:

- Requirements Specification Process;
- Systems Management Plan;
- Systems Design Reviews;
- Configuration Management Plan;
- Interface Management Plan; and
- Systems Software Design Management Plan.

4.1 Requirements Specification Process

The requirements referred to herein apply to the Systems as identified in Table 1 in Section 1 [Introduction] of this Appendix G, and to the TVS.

4.1.1 Requirements Analysis Process

The Primary Contractor shall proceed with the requirements analysis in the following four major stages:

a) Requirements Specifications

The Primary Contractor shall clearly define and analyze the Systems technical requirements set out in Article 13 [Systems], Article 7.4 [Tunnel Ventilation System Requirements], and Article 11.13.10 [Enclosed Station Emergency Ventilation], all of Part 2 of Schedule 4, and these Systems General Requirements, in an electronic requirements database, which database shall be used to track the status of each requirement throughout the project lifecycle. The Primary Contractor shall use Windows-based database software with sufficient capacity to track all of these requirements.

The database shall provide a listing of all explicit and implicit requirements, ensuring that all requirements are:

- unambiguous;
- complete;
- verifiable;
- understandable;
- consistent;
- traceable; and
- usable.

The Primary Contractor shall organize the requirements database by:

- source (e.g., document and specific section reference);
- type (e.g., information only, functional, operational);
- discipline (e.g., ATC, communications, power supply and distribution);
- verification method (see section 4.1.1(b) of this Appendix G);
- supporting document identification (see sections 4.1.1(c) and (d), both of this Appendix G); and
- status, as open or closed.

The requirements database shall include a category to identify whether each requirement is a safety requirement.

The requirements database shall clearly separate safety requirements from all other requirements.

The Primary Contractor must be able to produce reports from the requirements database that include:

- all requirements (the "**Requirements Specifications**"); and/or
- safety requirements only for the Systems (the "**Safety Requirements Specifications**").

The Primary Contractor shall submit the following :

(a) a preliminary version of each of the Requirements Specifications and the Safety Requirements Specifications at the SPDR;

(b) a final version of each of the Requirements Specifications and the Safety Requirements Specifications at the SFDR; and

(c) an electronic version of each of the Requirements Specifications and the Safety Requirements Specifications every six months after the SPDR.

b) Requirements Verification Categorization

The Primary Contractor shall assign all requirements to one or more of the following verification methods:

- analysis;
- demonstration;
- test; and
- review.

The preference shall be to verify a requirement by test wherever practicable.

The Primary Contractor shall submit to the Province's Representative a report describing the Primary Contractor's verification method assignment of each of the requirements (a "**Requirements Verification Categorization Report**") and the safety requirements for the Systems only (a "**Safety Requirements Verification Categorization Report**").

c) Requirements Verification Plan

The Primary Contractor shall prepare and submit to the Province's Representative a plan to demonstrate how the Primary Contractor will verify all requirements by:

- analysis, which shall have a traceable reference to a specific document (including a specific section reference relevant to the analysis), discussion paper or notes which are archivable and retrievable and will verify compliance with the applicable requirement;
- demonstration, which shall have a traceable reference to a specific observation report which is archivable and retrievable and will verify compliance with the applicable requirement;
- test, which shall have a traceable reference to a specific test procedure, complete with test identification and test objective, which is archivable and retrievable and will verify compliance with the applicable requirement; and
- review, which shall have a traceable reference to a specific supporting document (including a specific section reference relevant to the analysis), discussion paper or notes which is archivable and retrievable and will verify compliance with the applicable requirement.

The net result of this stage is a plan which will demonstrate compliance of the Systems to the requirements generally (the "**Requirements Verification Plan**") and a plan which will demonstrate compliance with the safety requirements (the "**Safety Requirements Verification Plan**").

Any requirements which cannot be verified by the Primary Contractor prior to Service Commencement because of the specific nature of the applicable requirement, such as the System Availability Demonstration, will be identified specifically within the applicable plan as verifiable only after Service Commencement.

d) Requirements Verification Reports

The Primary Contractor shall submit to the Province's Representative a final report verifying compliance with all requirements (the "**Requirements Verification Report**") and a final report verifying compliance with all Safety requirements (the "**Safety Requirements Verification Report**").

As part of the Requirements Verification Reports, the Primary Contractor shall, as applicable, confirm that all documentation defined in each of the Requirements Verification Plan and the Safety Requirements Verification Plan as being complete and archived, the exception being those requirements flagged as verifiable only after Service Commencement.

The completion test of this stage is that all requirements will have traceable and retrievable supporting documentation (e.g. test reports, analysis reports, drawings).

4.2 Systems Management Plan

The Primary Contractor shall submit a plan to the Province's Representative (the "**Systems Management Plan**"), which plan shall include:

(a) a Systems design review and audit schedule;

(b) for each submittal to be submitted under Appendix G, the content, format and deadline for submission;

(c) a drawing submission schedule; and

(d) a drawing tree illustrating the Primary Contractor's drawing hierarchy.

As part of the Systems Management Plan, the Primary Contractor shall propose appropriate metrics to measure the progress of the design within each subsystem. The Primary Contractor shall report progress against these metrics in monthly progress reports.

4.3 Systems Design Reviews

The design review of the Systems shall consist of three formal design reviews (the SCDR, the SPDR, and the SFDR as set out in Sections 4.3.1 through 4.3.3 of this Appendix G) and each formal design review shall include the following:

(a) The Primary Contractor shall submit the Design Review package submission for each design review, including all related documentation, to the Province's Representative;

(b) The Province's Representative shall provide its comments on the applicable design review package to the Primary Contractor within 15 Business Days after the Province's Representative has received the design review package; and

(c) A formal design review meeting between the Primary Contractor and the Province's Representative shall be held no more than 30 Business Days after the Province's Representative has received the applicable design review package, which meeting will include, at a minimum, the following:

(i) an overview presentation of the design by the Primary Contractor to the Province's Representative;

(ii) a review of the comments of the Province's Representative and the Primary Contractor's response to the comments; and

(iii) additional comments presented by the Province's Representative.

The Primary Contractor shall submit a follow up report, documenting all comments of the Province's Representative raised during the design review and the Primary Contractor's responses to those comments within 15 Business Days of the formal design review meeting.

The Primary Contractor shall, as a result of each of the design reviews, refine the plans and issues identified in the Systems Plan, as applicable. This shall include, but not be limited to, risk mitigation, maintenance of functionality commensurate with that of the Existing SkyTrain System and requirements analysis.

The Province's Representative may, in its discretion, require additional design reviews, audits or inspections, in particular to minimize schedule or technical risks. The Primary Contractor shall perform any additional design reviews, audits or inspections required by the Province's Representative.

4.3.1 Systems Concept Design Review (SCDR)

The SCDR for the Systems Work shall, at a conceptual level, establish the definition, internal and external interfaces and operations of each of the Systems and subsystems included in the Systems Work. The documents listed in Section 15.2 [Systems Concept Design Review (SCDR) Submissions] of this Appendix G shall be submitted by the Primary Contractor to the Province's Representative as part of the design review package submissions at the SCDR.

4.3.2 Systems Preliminary Design Review (SPDR)

The SPDR for the Systems Work shall include a functional description of each Systems component, including drawings, schematics and renderings as appropriate. The Primary Contractor shall, as part of the SPDR, finalize all interface specifications and shall demonstrate compliance with all requirements.

As part of its design review submissions package at the SPDR, the Primary Contractor shall demonstrate that all comments and open issues from the SCDR have been resolved by the Primary Contractor. The SPDR design review package submissions shall include an assessment of all technical and program risks, and shall present the proposed mitigation for such risks. The Primary Contractor's submissions to the Province's Representative for review at the SPDR stage shall include those described in Section 15.3 [Systems Preliminary Design Review (SPDR) Submissions] of this Appendix G.

4.3.3 Systems Final Design Review (SFDR)

The SFDR shall confirm that the design of all Systems components is complete and that the construction and the Systems Equipment manufacturing can proceed. As part of its submissions at the SFDR, the Primary Contractor shall demonstrate that all comments and open issues from the SPDR have been resolved by the Primary Contractor.

As part of its design review submissions package at the SFDR stage, the Primary Contractor shall provide all Contractual Technical Specifications for each Systems component listed in Table 1 in Section 1 [Introduction] of this Appendix G and the TVS.

The design review submissions package at the SFDR shall include an assessment of all technical and program risks and shall present the proposed mitigation for such risks. The Primary Contractor's submissions to the Province's Representative for review at the SFDR stage shall also include those documents described in Section 15.4 [Systems Final Design Review (SFDR) Submissions] of this Appendix G.

4.4 Configuration Management Plan

The Primary Contractor shall, as part of its design review submissions package at the SCDR stage, submit a plan (the "**Configuration Management Plan**") which describes how the configuration of the Evergreen Line and the Existing SkyTrain System affected by the Systems Work will be controlled and documented,

from the existing configuration through the design phases to as-built or as delivered hardware and software.

4.5 Interface Management Plan

As part of its design review submissions package at each design review, the Primary Contractor shall submit a plan (the "**Interface Management Plan**"), which identifies all internal and external systems interfaces and describes the process for managing these interfaces, and includes an organizational structure and procedures that will ensure the coordination of interface data amongst the disciplines. As part of the Interface Management Plan, the Primary Contractor shall provide the Province's Representative with design criteria that clearly define the interface requirements among all aspects of the Evergreen Line.

The initial Interface Management Plan shall be submitted by the Primary Contractor at the SCDR, with updates at each of the SPDR and the SFDR.

4.5.1 Design – Construction Interface Manual (DCIM)

The Primary Contractor shall submit a Design - Construction Interface Manual (DCIM), which manual shall contain sufficient detail to ensure all components of the Work are integrated.

4.5.2 Systems Cut-Over Plan

The Primary Contractor shall develop and submit to the Province's Representative a plan (the "**Systems Cut-Over Plan**") to show how the Primary Contractor will design, construct, install, verify, and test changes to the Existing SkyTrain System without disrupting the safe, uninterrupted public use of the Existing SkyTrain System, and will minimize changes to existing interfaces and will manage the implementation of unavoidable changes to existing interfaces. The Systems Cut-Over Plan shall identify strategies to fall back to redundant subsystems or previous Software versions in case of a catastrophic failure of newly cut-over Systems Equipment.

The Primary Contractor shall, as part of the Systems Cut-Over Plan, describe how it shall demonstrate to the satisfaction of TransLink that the Systems are in a state of operational readiness.

The Systems Cut-Over Plan shall include a schedule of specific access requirements, including dates, activities, and specific room access.

The Systems Cut-Over Plan shall provide that all software changes are to be delivered in a staged manner to reduce any risk.

The Systems Cut-Over Plan shall make full use of the simulation system.

4.6 Systems Software Design

The Primary Contractor shall ensure that all Systems software implemented on the Project is designed in accordance with international standards as agreed with the Province's Representative. All software shall be fully integrated by the Primary Contractor with the Existing SkyTrain System.

4.7 Systems Software Design Management Plan

The Primary Contractor shall, as part of its design review submissions package at the SCDR, submit a plan (the "**Systems Software Design Management Plan**"), which plan shall, at a minimum, identify the personnel responsible for software design and their lines of communication, the managerial and technical processes to be used in software design and development, software quality assurance, integration of off-the-shelf software with software developed by the Primary Contractor for the Evergreen Line and integration of all software with the Existing SkyTrain System.

4.8 Systems Design Considerations

The Primary Contractor shall apply a design philosophy that addresses continued performance and ease of operation and maintenance. The detailed design philosophy shall adhere to the following principles in a manner that is consistent and permits integration with the Existing SkyTrain System:

- Minimizing changes to the design of the Existing SkyTrain System; and
- Maximizing compatibility with the design of the Existing SkyTrain System, with respect to:
  - interchangeability;
  - modular design;
  - maximizing use of standard off-the-shelf components;
  - design for maintainability (access, diagnostics);
  - design for availability and reliability;
  - applicable wiring standards;
  - wire identification;
  - spare wires, cable and fibres ; and
  - suitable outdoor enclosures.

5 Systems Assurance

5.1 Systems Assurance Plan

The Primary Contractor shall develop and implement a plan (the "**Systems Assurance Plan**") in general accordance with EN 50126-1 and 50126-2 and EN 50128 standards, which plan shall integrate systems assurance into the design, construction, and testing processes to ensure that the Evergreen Line achieves reliability, availability, and maintainability (RAM) requirements. The Systems Assurance Plan shall describe how Systems assurance will be integrated into the Primary Contractor's delivery of the Systems Work and the Systems Equipment and shall identify the personnel responsible for Systems assurance and their lines of communication.

5.2 RAM Program Plan

The Primary Contractor shall develop and implement a plan (the "**RAM Program Plan**") in general accordance with the applicable provisions of EN 50126-1 and 50126-2. The RAM Program Plan shall

define the management of all RAM activities for the Evergreen Line to ensure a systematic and documented process. The RAM Program Plan shall include a documented set of time-scheduled activities, resources and events, which shall establish the organizational structure, responsibilities, procedures, activities, capabilities and resources and which together shall ensure that the Evergreen Line will satisfy the RAM targets specified in the RAM Program Plan.

The design of the Systems components of the Evergreen Line shall incorporate applicable RAM design features, which features shall reduce the probability of failures and the associated impact on passenger service through the use of the following techniques in a manner that is consistent and permits integration with the Existing SkyTrain System:

- application of selected redundancy;
- use of components with proven reliability;
- minimization of single point failures which interrupt service;
- minimization of Systems Equipment operation stresses; and
- provision of operate-around-failure capabilities.

As part of the RAM Program Plan, the Primary Contractor shall translate the foregoing criteria into:

- the allocated MTBF and MTBSAF requirements for the Systems and the subsystems;
- particular attention to maintainability features with MTTR requirements; and
- SPFMA for efficient operation of the Evergreen Line.

The System Performance Demonstration shall confirm that the performance of the Evergreen Line will be equal to or exceed that of the Existing SkyTrain System.

5.3 RAM Analysis Report

To verify compliance of the Evergreen Line with the requirements of the RAM Program Plan, the Primary Contractor shall undertake RAM analysis and submit a report of such analysis to the Province's Representative (the "**RAM Analysis Report**"), which report shall provide the Province's Representative with details of RAM calculations and allocations used to substantiate the design of the Systems Equipment. The RAM Analysis Report shall estimate the Systems Equipment MTBF and MTBSAF based on the following inputs:

- predicated or actual (field data) reliability of each LRU and LLRU;
- reliability block diagram of each subsystem;
- preventive and corrective maintenance activities;
- MTTR of each subsystem;
- Systems FMEA based on operational reliability; and
- Spare Parts lists.

6 Systems Risk Management

The Primary Contractor shall incorporate risk management into its overall design, construction, and testing program for the Systems. Risk management of the Systems shall be used by the Primary Contractor to identify all potential risks to successful completion of the Systems Work, including technical risks, cost and schedule risks, and risks of integrating with the Existing SkyTrain System.

6.1 Systems Risk Management Plan

The Primary Contractor shall implement and maintain a plan (the "**Systems Risk Management Plan**") which describes the personnel responsible for Systems risk management and their lines of communication, the processes and procedures to be used for risk identification, risk analysis, risk evaluation, risk mitigation, and risk monitoring, and which also describes how the Primary Contractor will record and track its risk management activities from commencement of the Systems Work through Substantial Completion. The Systems Risk Management Plan shall be submitted as part of the design review submissions package at the SCDR and shall be updated and resubmitted by the Primary Contractor as part of the design review submissions packages at each of the SPDR and the SFDR.

The Primary Contractor shall provide status updates on risks in monthly progress reports.

7 Electromagnetic Compatibility

The Primary Contractor shall ensure that the Evergreen Line, including the Systems Equipment, is electromagnetically compatible with its environment and that the Evergreen Line will not produce electromagnetic emissions, whether conducted, radiated or induced which in any way interfere with the normal operation of the Integrated SkyTrain System or adjacent third party infrastructure and systems.

The Primary Contractor shall ensure that the Systems Equipment, including electrical and electronic Systems Equipment and other systems function correctly and reliably in the presence of electromagnetic emissions, whether generated by the Integrated SkyTrain System or the surrounding environment. Such environment includes:

- transmission and communications equipment or systems;
- microwave facilities and transmissions;
- television and radio transmitters and repeaters (transmission and reception equipment);
- radar systems;
- computer equipment and accessories;
- electric motors and controls;
- power tools and welders;
- miscellaneous systems and equipment, including portable electronic equipment, heart pacemakers, x-ray equipment and power substations and equipment;
- automotive vehicles;
- telecommunications equipment;

- mobile and cellular telecommunications equipment;
- road or highways authority equipment; and
- high-voltage power lines and transmission cables.

The Primary Contractor shall develop, implement and maintain an Electromagnetic Compatibility Control Plan that demonstrates the methods, measures and processes that the Primary Contractor will implement in order to identify, assess and, as required, mitigate the potential contributors to the electromagnetic environment, and all potential receivers of electromagnetic interference that may impact on or be impacted by the Systems Equipment, adjacent third party equipment, infrastructure and systems, and that includes the following information:

- interference emission and susceptibility requirements and rationale for selection, including applicable support computations;
- design techniques to reduce interference coupling;
- safety grounding protection requirements for personnel and equipment;
- electromagnetic compatibility evaluation and analysis;
- problem area definition and fix recommendation if applicable;
- compliance verification requirements for operational components and associated testing equipment;
- critical compatibility demonstration requirements including critical circuit definition and success criteria; and
- configuration control method.

8 Systems Safety

8.1 Systems Safety Program Plan

The Primary Contractor shall, in accordance with internationally recognized standards as agreed with the Province's Representative, prepare and periodically update a plan for reviewing and implementing safety requirements (the "**Systems Safety Program Plan**"), which plan shall focus on requirements to safely transport the public and protect employees from operational hazards, such as derailment, collision, fire and smoke conditions after Substantial Completion. The content and level of detail shall be relevant to a modern automated rail transit system. The Systems Safety Program Plan shall, at a minimum, define the Primary Contractor's safety organization, safety related activities and responsibilities for implementation, verification methods for safety requirements and procedures for interfacing with the Province, local emergency service organizations, and the British Columbia Safety Authority (BCSA). The Systems Safety Program Plan shall include a schedule and process for auditing compliance against safety requirements.

Protection from construction and environmental hazards shall be covered in the Health and Safety Program and shall not be included in the Systems Safety Program Plan.

8.2 Systems Safety Analyses

8.2.1 Preliminary Hazard Analysis

The Primary Contractor shall complete and submit a Preliminary Hazard Analysis (PHA) for the Systems Work to identify hazards, associated causal factors, level of risk and proposed design mitigation measures.

The Primary Contractor shall track all hazards identified in the PHA in a hazard log (the "**Hazard Log**") until all mitigation measures have been verified by the Primary Contractor. The Hazard Log shall be kept up to date and shall be submitted as part of the design review submissions package at each design review and shall be available for inspection at any time on written request by the Province's Representative. An updated Hazard Log shall be submitted to the Province's Representative with the Final Systems Safety Report (see Section 8.2.5 [Final Systems Safety Report] of this Appendix G).

8.2.2 Operational and Support Hazard Analysis

The Primary Contractor shall complete an Operational and Support Hazard Analysis (O&SHA) for the Systems Work to identify operations hazards, associated causal factors, level of risk, and proposed mitigation measures. The scope of the O&SHA shall include normal operations, testing, installation, maintenance, repair, training, storage, handling, transportation and emergency/rescue operations.

8.2.3 Fault Tree Analysis

The Primary Contractor shall complete a Fault Tree Analysis (FTA), which will be presented in the form of a logic flow diagram for analyzing hazards that result from component failures, design weaknesses, or human errors.

8.2.4 Failure Modes, Effects and Criticality Analysis

The Primary Contractor shall complete a failure modes, effects and criticality analysis (FMECA) to evaluate the effects of potential failures of subsystems on the Integrated SkyTrain System to the extent within the scope of the Work , their likelihood of occurrence, methods of detection and related failure management, where required. The Primary Contractor shall indicate in its Systems Safety Program Plan which approach will be used to perform the FMECA (i.e. hardware FMECA or functional FMECA).

8.2.5 Final Systems Safety Report

The Primary Contractor shall submit a report (the "**Final Systems Safety Report**") to provide the Province's Representative with assurance with respect to the safety of the Integrated SkyTrain System to the extent within the scope of the Work. The Final Safety Report shall clearly demonstrate that all hazards identified in previous analyses have been eliminated or their associated risks have been reduced to an acceptable level as determined by the Primary Contractor in accordance with recognized international standards.

The Final Systems Safety Report shall be submitted by the Primary Contractor to the Province's Representative after the Primary Contractor has successfully completed all testing and commissioning, and shall include the completed Safety Requirements Verification Report.

9 Verification and Validation Testing

The Primary Contractor shall be responsible for undertaking and passing all necessary testing activities for the Systems, including all materials (including Spare Parts) furnished and all work performed under these Systems General Requirements. The Primary Contractor shall demonstrate to the satisfaction of TransLink that the Systems are in a state of operational readiness.

In accordance with Sections 8 [Systems Safety] through 12 [Systems Equipment Readiness Reviews] inclusive, all of this Appendix G, the Primary Contractor shall develop, organize, and implement test and commissioning plans that verify that the Systems meet all functional, safety, systems assurance, and performance requirements.

The Primary Contractor shall ensure that factory and site tests are performed and deliverables are not shipped until all required factory inspections and tests have been completed and all deficiencies corrected. The Primary Contractor shall further ensure that site testing confirms that the Systems have been properly installed and satisfy all performance, safety, reliability, and functional requirements set out in this Agreement.

All factory and site tests shall be undertaken at the Primary Contractor's expense.

Prior to the start of a test, the Primary Contractor shall, in accordance with Sections 10.2 [Systems and Subsystems Test Plans] and 10.4 [Test Procedures], both of this Appendix G, submit to the Province's Representative all test plans and procedures for the applicable test, and shall ensure that all relevant prerequisite testing has been completed.

The Primary Contractor shall ensure all inspection and testing is undertaken in compliance with the requirements specified in ISO-9001, clauses 4.10 [Inspection and Testing] and 4.11 [Control of Inspection Measuring and Test Equipment].

9.1 Test and Commissioning Strategy and Plans

The Primary Contractor shall develop and implement a testing and commissioning strategy for the Systems and testing and commissioning plans in accordance with Sections 9 [Verification and Validation Testing] and 10 [Systems Test Documentation], both of this Appendix G.

The Primary Contractor shall support all applications to BCSA required for the movement of Trains on the Evergreen Line for inspection, testing, and operations purposes. The Primary Contractor shall coordinate directly with the relevant applicant and with BCSA as required to satisfy this requirement.

9.2 Submittals

The Primary Contractor shall submit test documentation for the Systems to the Province's Representative, including the following:

- Validation, Inspection, and Test Plan as part of the design review submissions package for the SFDR, which plan shall comply with Section 10.1 [Validation, Inspection, and Test Plan] of this Appendix G and shall demonstrate that the Primary Contractor has considered all of the testing requirements in the Project Agreement and has made adequate provisions for testing in the Construction Schedule;

- System Test Plan and a Test Plan for each subsystem as part of the design review submissions package for the SFDR, which plans shall comply with Section 10.2 [Systems and Subsystems Test Plans] of this Appendix G and shall include a listing of the tests required to fully verify that the Systems meets all functional, safety, and performance requirements under this Agreement;
- Safety Commissioning Test Plan, which plan shall comply with Section 10.3 [Safety Commissioning Test Plan] of this Appendix G and shall include a listing of the tests required to fully demonstrate that the Evergreen Line satisfies the safety requirements while operating under actual service conditions. The Safety Commissioning Test Plan shall be submitted by the Primary Contractor to both BCSA and to the Province's Representative;
- 90-day Look Ahead Schedules detailing all of the testing and safety testing activities and the TransLink Resource and Vehicle requirements (provided that such TransLink Resource and Vehicle requirements shall be required to be reasonable, including having regarding to TransLink's requirements in relation to the operation and maintenance of the existing SkyTrain System and the then current availability of such TransLink Resources and Vehicles to TransLink) proposed for the period covered. The first schedule shall be submitted to the Province's Representative 60 Business Days prior to the first scheduled test and a revised schedule shall be submitted periodically to the Province's Representative as required by the Province's Representative;
- Test procedures, which procedures shall comply with Section 10.4 [Tests Procedures] of this Appendix G and shall be submitted to the Province's Representative no less than 20 Business Days prior to any test activities with respect to the applicable test procedures;
- Test reports, which reports shall comply with Section 10.5 [Test Reports] of this Appendix G and shall contain the results of all tests conducted at any factory or field location. All test reports shall be certified and signed by an approved member of the Primary Contractor's staff;
- A report in searchable PDF format to be submitted on a monthly basis that complies with the requirements of Section 10.6 [Failure Reporting, Analysis, and Corrective Action System] of this Appendix G;
- A 30-day Look Ahead Schedule for all commissioning and safety commissioning activities, with each day's activities and TransLink Resource and Vehicle requirements identified (provided that such TransLink Resource requirements shall be required to be reasonable, including having regarding to TransLink's requirements in relation to the operation and maintenance of the existing SkyTrain System and the then current availability of such TransLink Resources and Vehicles to TransLink), which schedules shall be submitted to the Province's Representative no less than 20 Business Days prior to the start of commissioning of any Systems. The schedules shall be updated and submitted to the Province's Representative on a weekly basis; and
- Two spare copies of the applicable test procedures upon request by the Province's Representative on the day of the test.

10 Systems Test Documentation

10.1 Validation, Inspection, and Test Plan

The Primary Contractor shall develop and implement a plan (the "**Validation, Inspection, and Test Plan**") which plan shall describe the Primary Contractor's overall strategy for the validation, inspection, and test processes for the Systems, including the responsibilities of individuals and the documentation of the validation test results, and which plan shall include the following items:

- a flow diagram, indicating the logical sequence of validation, inspections and tests, starting with material receiving tests and inspections and concluding with the System Performance Demonstration;
- validation, inspection and test schedule;
- responsibilities of the Primary Contractor;
- record-keeping assignments, procedures, and forms;
- procedures for performing validation;
- procedures for monitoring, correcting, and re-testing deficiencies;
- procedures for controlling and documenting all changes made to the Systems and software after the start of testing; and
- description of approach to managing the required TransLink Resources and Vehicles.

10.2 Systems and Subsystem Test Plans

The Primary Contractor shall develop and implement test plans for each discipline and element of the Systems (the "**Systems and Subsystems Test Plans**"), which plans shall include the relevant test processes and documentation for each test. The tests shall demonstrate that the Primary Contractor has supplied complete, safe and operable Systems for the Evergreen Line. The Systems and Subsystems Test Plans shall include the following:

- test schedule;
- responsibilities of the Primary Contractor;
- block diagrams of the hardware test configuration including external data transmission interfaces, and detailed descriptions of any and all test and / or simulation equipment;
- estimated duration of each test;
- the required TransLink Resources and Vehicles; and
- calibration and its traceability to known standards of hardware, software, simulation tools and test equipment to be used for testing.

10.3 Safety Commissioning Test Plan

The Primary Contractor shall develop and implement a plan (the "**Safety Commissioning Test Plan**"), which plan shall demonstrate how the safety requirements will be verified as compliant. The plan shall

describe the Primary Contractor's overall commissioning test process for the Systems and documentation of the commissioning test results, and shall include the following:

- commissioning test schedule;
- safety test schedule, which schedule shall also be delivered by the Primary Contractor to BCSA;
- responsibilities of the Primary Contractor;
- record-keeping assignments, procedures, and forms;
- procedures for monitoring, correcting, and re-testing deficiencies;
- procedures for controlling and documenting all changes made to the hardware and software after the start of testing; and
- the required TransLink Resources and Vehicles.

10.4 Test Procedures

The Primary Contractor shall develop and implement test procedures which describe individual test cases and the steps comprising each case. The test procedures shall include:

- the objective of the test;
- for each test case, the requirement(s) to be demonstrated and verified;
- whether the test demonstrates a safety requirement;
- the required setup and conditions for each test case, including descriptions of the test equipment and data to be supplied by the Primary Contractor;
- descriptions, listings, and instructions, for all test software tools and displays;
- step-by-step descriptions of each test case, including the inputs and user actions for each test step;
- the expected results for each test case including the pass/fail criteria; and
- descriptions of the techniques and scenarios to be used to simulate system field inputs and controlled equipment.

10.5 Test Reports

The Primary Contractor shall prepare and maintain complete test reports of all factory and field subsystem acceptance test results obtained during performance of test procedures. The test reports shall signed by an approved member of the Primary Contractor’s staff. Any tests reports that demonstrate safety requirements shall be delivered to both BCSA and the Province’s Representative. The test reports shall include the following:

- reference to the corresponding test procedure;
- date the test procedure was performed;
- description of any test conditions, input data, or user actions differing from that described in the test procedure;
- results for each test case including a passed/failed indication;

- identification of the Primary Contractor's tester;
- reference to any test results requiring action under Section 10.6 [Failure Reporting, Analysis, and Corrective Action System] of this Appendix G;
- copies of reports, display copies, and any other hard or soft copy generated as a result of the execution of the test procedure; and
- configuration data that fully describes the Equipment and software that was tested, including software version and build numbers / identifiers for every software module.

10.6 Failure Reporting, Analysis, and Corrective Action System

The Primary Contractor shall, during the periods of field testing, demonstration, and warranty, establish and maintain a closed-loop failure reporting, analysis, and corrective action system (the "**Failure Reporting, Analysis, and Corrective Action System**") to determine the cause of all test failures, unscheduled part removals, and other deficiencies related to the Systems.

The Primary Contractor shall, on a monthly basis, prepare and submit a Failure Reporting, Analysis and Corrective Action System Report, which report shall document the results of the Failure Reporting, Analysis, and Corrective Action System, and shall include the following:

(a) failure reports for any items that fail any test conducted under this Agreement or which are otherwise determined to have failed;

(b) deficiency reports; and

(c) the Primary Contractor's systematic evaluation of the failure reporting data to identify and monitor failure trends, such as no-trouble-found incidents and new failure effects.

The Province's Representative shall also have access, via the Internet, to the failure reporting system and its databases to both review and comment upon deficiency reports.

10.7 Authorization to Move Trains and Commissioning

The Primary Contractor shall provide to TransLink, BCSA and the Province's Representative all documentation, records, test results or other material directly related to the Design and Construction of the Project that is required in order for TransLink to make application for the issuance of Operating Permits, or modification to the existing Operating Permit, to allow:

(a) the movement of Trains on the Evergreen Line

(b) the testing of Train operation between the Evergreen Line and the Existing Millennium Line;

(c) Trial Running involving the movement of Trains on the Operational Evergreen Line, which Trial Running will include the turnback of Trains arriving at Lougheed Town Centre Station on the Future Millennium Line. During Trial Running, passengers will exit all outbound Trains arriving at the new side platform at Lougheeed Town Centre Station and will not be permitted to travel on the Evergreen Line; and

(d) Service Commencement, involving the carrying of passengers on the Evergreen Line.

11 End-Product Audits

At the discretion of the Province's Representative, the Province's Representative may require that the Primary Contractor undertake end-product audits of the Systems components, including new upgrades to equipment on the Existing SkyTrain System during the integration and test phase of the Project, to demonstrate and confirm that:

- end product verification is compliant with all requirements and that product verification outcomes compare favourably against configuration documentation (drawings, test procedures, authorised changes, software development files, as-built/as-coded documentation, etc.); and
- the as-built/as-coded configuration has been favourably examined against its configuration documentation (drawings, bill of materials, specifications, code lists, manuals, compliance test, compliance data, etc.).

12 Systems Equipment Readiness Reviews

At the discretion of the Province's Representative, the Primary Contractor shall undertake readiness reviews prior to the activation of any Systems Equipment, which reviews shall, during the integration and test phase of the Project, demonstrate that delivered end products from lower level systems have been validated, that validation tests are adequately planned, and that each set of integrated products forming a composite end product is ready for end product verification and validation, if required. The Primary Contractor shall support readiness reviews with the appropriate personnel, documentation, and other resources as required by the Province's Representative.

13 Verification Testing

13.1 Systems Equipment Tests

Sample units of Systems Equipment and associated software from production shall be subjected by the Primary Contractor to routine quality control inspections and testing.

The Province's Representative shall be allowed access to witness testing at any facility where Systems Equipment or software is manufactured or developed.

13.2 First Article Inspection

A first article inspection ("**FAI**") shall be conducted by the Primary Contractor on the first production unit of any Systems Equipment prior to the first shipment from the factory to ensure the units are suitable in all respects for the purpose intended by the Primary Contractor. The FAI testing undertaken by the Primary Contractor shall include the following, where applicable:

- electrical and mechanical construction testing;
- vibration and impact resistance testing;
- temperature and humidity testing;
- functionality, performance, and timing testing;

- accelerated life testing; and
- EMC testing.

Any Systems Equipment which does not have a proven history shall be subject to qualification testing by the Primary Contractor. The Province's Representative shall be allowed to monitor and review all qualification testing.

13.3 Factory Acceptance Tests

The Primary Contractor shall undertake or cause to be undertaken factory acceptance tests ("**FAT**") on all Systems Equipment, where appropriate and reasonably practicable, in a factory environment that is generally representative of the actual operating environment.

The Province's Representative shall be allowed to review and verify the functional implementation of the System software informally in conjunction with scheduled Project meetings at the Primary Contractor's facilities.

The Primary Contractor shall notify the Province's Representative in writing a minimum of 30 Business Days in advance of each test/inspection and shall include a detailed schedule of the applicable test.

Upon completion of the testing, a FAT review shall be undertaken by the Primary Contractor and the Province's Representative to confirm that the System or subsystem under test is fit to be deployed and installed.

13.4 Post Installation Checkout (PICO) Tests

PICO testing shall be undertaken by the Primary Contractor on all Systems Equipment and software after it has been installed at the site where it will function after Service Commencement. PICO testing shall be performed to demonstrate that all Systems Equipment and software functions properly in the installed environment. All Systems Equipment shall be verified by the Primary Contractor against the installation drawings to verify correct installation and that the Systems Equipment has not been damaged subsequent to shipment from the factory.

The PICO testing undertaken by the Primary Contractor shall include a complete system inspection including but not limited to verification of proper installation, grounding, cabling, conformance to plans and drawings, neatness, accessibility and confirmation of installed versions of the Equipment and software comprising and related to the Systems. All cables shall be tested for opens, shorts, grounds and high resistance.

13.5 Site Acceptance Tests

Following the PICO testing, site acceptance testing shall be performed by the Primary Contractor on the installed Systems Equipment in accordance with the procedures developed pursuant to Section 10.4 [Test Procedures] of this Appendix G. The site acceptance testing procedures may include tests performed during the FAT, but shall also focus on those requirements which could not be verified during the FAT.

Site acceptance testing shall be performed by the Primary Contractor to verify that the Systems Equipment and software has been properly installed and to demonstrate that the Systems Equipment

satisfies all performance, safety, reliability, and functional requirements while communicating with a full complement of devices under actual operating conditions. The proper operation and performance of all features and functions as defined in the Systems test plans shall be verified by the Primary Contractor during site acceptance testing.

13.6 Integrated System Testing

13.6.1 System Integration Tests

Upon successful completion of site acceptance testing on two or more related subsystems, these subsystems shall be integrated together by the Primary Contractor to commence integrated system testing, which testing shall demonstrate inter-subsystem functionality and performance under normal, abnormal, and emergency scenarios.

13.6.2 Trial Running

Tests and procedures shall be developed and implemented by the Primary Contractor to demonstrate that the Evergreen Line functions as part of the Integrated SkyTrain System, is capable of operating in accordance with the service plans, and is ready for Service Commencement (collectively "**Trial Running**").

Prior to the start of Trial Running, the Primary Contractor shall:

- prepare and submit to the Province's Representative and BCSA the Trial Running Test Plan and Procedure;
- successfully complete all construction and testing including system integration tests; and
- successfully complete a pre-system commissioning review with the Province's Representative, and others as specified by the Province's Representative, to confirm that the Evergreen Line is fit to commence Trial Running.

Trial Running shall occur in two stages over an aggregate period of 15 Days (the "**Trial Running Period**") as detailed in Sections 13.6.2.1 [Trial Running Stage 1] and 13.6.2.2 [Trial Running Stage 2] of this Appendix G. At any point during Trial Running, the Province's Representative may elect to terminate Trial Running and establish a new Trial Running commencement date. Trial Running shall exercise and confirm the operating availability of the Evergreen Line in simulated operating scenarios over full regular scheduled service using the peak and off-peak schedules for an extended period. Passengers shall not be carried on the Evergreen Line during Trial Running, but appropriate dwell times at all Stations shall be observed. Trial Running shall also include a variety of failure management scenarios that could reasonably be expected to occur during use of the Evergreen Line.

13.6.2.1 Trial Running Stage 1

Trial Running Stage 1 shall take place over the first five days of the Trial Running Period.

The purpose of Trial Running Stage 1 shall be to simulate operational failure scenarios which could be reasonably be expected to occur during use of the Evergreen Line or any part thereof for the purpose of transporting passengers, and shall apply only to the Evergreen Line from Burquitlam Station to Douglas College Station.

13.6.2.2 Trial Running Stage 2

Trial Running Stage 2 shall take place over approximately 10 days following the Trial Running Stage 1 days.

The purpose of Trial Running Stage 2 shall be to verify and demonstrate the readiness of the Operational Evergreen Line for full operation.

During Trial Running Stage 2, the Primary Contractor shall demonstrate three consecutive days of operation, using a regular weekday schedule, with no more than 20 cumulative Delay Minutes, calculated in accordance with the BCRTC Service Delay Allocation Methodology.

The Primary Contractor shall support the application for an addendum to the Operating Permit for the Existing SkyTrain System in order to accommodate passenger movements on the new Evergreen Line platform at Lougheed Town Centre Station. The Primary Contractor shall coordinate directly with the applicant and BCSA to meet this requirement, ensuring that all related documentation, including email communications, is copied to the Province's Representative.

13.6.2.3 Trial Running Test Report

Once Trial Running has been completed, the Primary Contractor shall prepare and submit a report (the "**Trial Running Test Report**") outlining the significant events of Trial Running, the data captured and the conclusions made. For the purposes of this Section 13.6.2.3 [Trial Running Test Report], the 15 Business Day period referred to in Section 2.1(b) of Schedule 2 [Representatives, Review Procedure and Consent Procedure] shall be reduced to 5 calendar days. Without limiting the generality of Article 4.1.1(a)(i) [Required Activities], Part 3 of Schedule 4, the documentation, records, test results and other material to be provided by the Primary Contractor under the said Article 4.1.1(a)(i) shall include the Trial Running Test Report to which there has been no objection by the Province's Representative, acting reasonably, under the Review Procedure. Notwithstanding Article 4.1.2.5(a) [Inspection for Substantial Completion], Part 3 of Schedule 4, the Primary Contractor shall not be required to deliver the Trial Running Test Report as part of the documents to be provided to the Independent Certifier and the Province's Representative under the said Section 4.1.2.5.

13.7 Test Suspension

If, at any time during any site acceptance testing or integrated system testing, the Province's Representative believes that the quantity or severity of deficiencies or the inefficient usage of TransLink Resources warrants suspension of any or all testing, the test(s) shall be halted, remedial work shall be performed, and the complete test repeated. The repeat of a test shall be scheduled for a date and time agreed upon by both the Province's Representative and the Primary Contractor.

14 Systems Certification

Following Trial Running and prior to applying for Substantial Completion, the Primary Contractor shall submit the following to the Province's Representative:

- certification that each Systems component listed in Table 1 of this Appendix G and the TVS is ready to carry passengers; and

- Systems Engineer of Record certification that the Integrated SkyTrain System to the extent within the scope of the Work is ready to carry passengers.

15 Systems Documentation Submittals

The submissions required by this Appendix G have been summarized in the table below. The tables in this Section 15 are not intended to be exhaustive of the submission requirements set out in the technical requirements of Article 13 [Systems], Part 2 of Schedule 4, the TVS requirements in Article 7.4 [Tunnel Ventilation and Fire and Life Safety] and the emergency ventilation system for Ioco Station in Article 11.13.10 [Enclosed Station Emergency Ventilation], both Part 2 of Schedule 4, and this Appendix G. The tables identify submissions to be provided to BCSA, where applicable.

15.1 Systems Plan Submissions

Document	Reference	Submission Schedule	BCSA*
Systems Plan	Appendix G, Section 2	In accordance with the Systems Management Plan	N/A
Systems Management Plan	Appendix G, Section 4.2	60 Business Days after the Effective Date	N/A
Interface Management Plan	Appendix G, Section 4.5	In accordance with the Systems Management Plan	N/A
Systems Risk Management Plan	Appendix G, Section 6.1	In accordance with the Systems Management Plan	N/A
Spare Parts Plan[1]	Part 3, Article 3.6.2	In accordance with the Systems Management Plan	N/A
System Expandability Plan	Part 2, Article 13.12.1	Prior to Substantial Completion	N/A
O & M Training Plan	Part 3, Article 3.5.1	In accordance with the Systems Management Plan	N/A

[1] Article 3.6.2(a) [Spare Parts Lists, Spare Parts Plan and Provisioning Conference] of Part 3 requires that the Spare Parts Plan address Systems elements, the mechanical, electrical and elevator elements of the Stations and such other Spare Parts as the Primary Contractor considers are required to operate the Evergreen Line.

15.2 Systems Concept Design Review (SCDR) Submissions

Document	Reference	Submission Schedule	BCSA*
Systems Concept Design Review Package	Appendix G, Section 4.3.1	In accordance with the Systems Management Plan	
Preliminary Hazard Analysis and Hazard Log	Appendix G, Section 8.2.1	In accordance with the Systems Management Plan	FR
Radio propagation survey	Part 2, Article 13.6.4	In accordance with the Systems Management Plan	N/A
Plan for signage proposed to meet the requirements of Article 13.10.5	Part 2, Article 13.10.5	In accordance with the Systems Management Plan	N/A
RAM Program Plan	Appendix G, Section 5.2	In accordance with the Systems Management Plan	N/A
System Performance and Failure Management Analysis	Part 2, Article 13.3.4	In accordance with the Systems Management Plan	N/A
Electromagnetic Compatibility Control Plan	Appendix G, Section 7	In accordance with the Systems Management Plan	N/A
Configuration Management Plan	Appendix G, Section 4.4	In accordance with the Systems Management Plan	N/A
Systems Software Design Management Plan	Appendix G, Section 4.7	In accordance with the Systems Management Plan	N/A
Systems Assurance Plan	Appendix G, Section 5.1	In accordance with the Systems Management Plan	N/A

15.3 Systems Preliminary Design Review (SPDR) Submissions

Document	Reference	Submission Schedule	BCSA*
Systems Preliminary Design Review package	Appendix G, Section 4.3.2	In accordance with the Systems Management Plan	N/A

Document	Reference	Submission Schedule	BCSA*
preliminary power system load flow analysis	Part 2, Article 13.9.3.1	In accordance with the Systems Management Plan	N/A
preliminary power system short circuit, protection, grounding, harmonic and power factor analyses	Part 2, Article 13.9.3.1	In accordance with the Systems Management Plan	N/A
preliminary ATC software design specification	Part 2, Article 13.5.9	In accordance with the Systems Management Plan	N/A
ATC Software Quality Assurance Plan	Part 2, Article 13.5.9	In accordance with the Systems Management Plan	N/A
ATC Software Development Plan	Part 2, Article 13.5.9	In accordance with the Systems Management Plan	N/A
Design-Construction Interface Manual	Appendix G, Section 4.5.1	In accordance with the Systems Management Plan	N/A
preliminary Communications subsystems software documentation	Part 2, Article 13.6.12	In accordance with the Systems Management Plan	N/A
human factors report	Part 2, Article 13.7.1	In accordance with the Systems Management Plan	N/A
preliminary SCADA subsystem software documentation	Part 2, Article13.8.4	In accordance with the Systems Management Plan	N/A
preliminary Control Room layout	Part 2, Article 13.7.1.1	In accordance with the Systems Management Plan	N/A
preliminary Computer Room layout	Part 2, Article 13.7.2	In accordance with the Systems Management Plan	N/A
preliminary TIDS software documentation	Part 2, Article 13.11.4.2.5	In accordance with the Systems Management Plan	N/A

Document	Reference	Submission Schedule	BCSA*
Systems Cut-Over Plan	Appendix G, Section 4.5.2	In accordance with the Systems Management Plan	N/A
Hazard Log	Appendix G, Section 8.2.1	In accordance with the Systems Management Plan	FR
Systems Safety Program Plan	Appendix G, Section 8.1	In accordance with the Systems Management Plan	I

15.4 Systems Final Design Review (SFDR) Submissions

Document	Reference	Submission Schedule	BCSA*
Systems Final Design Review packages	Appendix G, Section 4.3.3	In accordance with the Systems Management Plan	N/A
System Performance and Failure Management Analysis	Part 2, Article 13.3.4	In accordance with the Systems Management Plan	N/A
safety distance calculations	Part 2, Article 13.3.5	In accordance with Systems Management Plan	N/A
human factors report	Part 2, Article 13.7.1	In accordance with Systems Management Plan	N/A
final power system load flow analysis	Part 2, Article 13.9.3.1	In accordance with the Systems Management Plan	N/A
final power system short circuit, protection, grounding, harmonic and power factor analyses	Part 2, Article13.9.3.1	In accordance with the Systems Management Plan	N/A
final ATC software design specification	Part 2, Article13.5.9	In accordance with the Systems Management Plan	N/A
Design-Construction Interface Manual	Appendix G, Section 4.5.1	In accordance with the Systems Management Plan	N/A

Document	Reference	Submission Schedule	BCSA*
final communications subsystems software documentation	Part 2, Article13.6.12	In accordance with the Systems Management Plan	N/A
final SCADA subsystem software documentation	Part 2, Article13.8.4	In accordance with the Systems Management Plan	N/A
final Control Room layout	Part 2, Article 13.7.1	In accordance with the Systems Management Plan	N/A
final Computer Room layout	Part 2, Article 13.7.2	In accordance with the Systems Management Plan	N/A
final TIDS software documentation	Part 2, Article 13.11.4.2.5	In accordance with the Systems Management Plan	N/A
Contractual Technical Specifications	Appendix G, Section 4.3.3	In accordance with the Systems Management Plan	N/A
Hazard Log	Appendix G, Section 8.2.1	In accordance with the Systems Management Plan	FR
Operational and Support Hazard Analysis	Appendix G, Section 8.2.2	In accordance with the Systems Management Plan	FR
Fault Tree Analysis	Appendix G, Section 8.2.3	In accordance with the Systems Management Plan	FR
Failure Modes, Effects & Criticality Analysis	Appendix G, Section 8.2.4	In accordance with the Systems Management Plan	FR
Validation, Inspection, and Test Plan	Appendix G, Section 10.1	In accordance with the Systems Management Plan	N/A
Systems and Subsystem Test Plans	Appendix G, Section 10.2	In accordance with the Systems Management Plan	N/A

15.5 Systems Assurance Submissions

Document	Reference	Submission Schedule	BCSA*
Systems Cut-Over Plan	Appendix G, Section 4.5.2	In accordance with the Systems Management Plan	N/A

15.6 Systems Safety Submissions

Document	Reference	Submission Schedule	BCSA*
Safety Commissioning Test Plan	Appendix G, Section 10.3	60 Business Days prior to first test	I
Safety Requirements Specification	Appendix G, Section 4.1.1(a)	In accordance with the Systems Management Plan	I
Safety Requirements Verification Categorization Report	Appendix G, Section 4.1.1(b)	In accordance with the Systems Management Plan	I
Safety Requirements Verification Plan	Appendix G, Section 4.1.1(c)	In accordance with the Systems Management Plan	I
Safety Requirements Verification Report	Appendix G, Section 4.1.1(d)	25 days prior to Substantial Completion	I
Final Systems Safety Report (including Hazard Log)	Appendix G, Section 8.2.5	In accordance with the Systems Management Plan	FR
90 Day Look Ahead Schedule detailing safety test activity	Appendix G, Section 9.2	60 Business Days prior to first test and updated as required by the Province's Representative	I
30 Day Look Ahead Test Schedule detailing safety commissioning activities	Appendix G, Section 9.2	20 Business Days prior to start of commissioning and updated weekly	I

15.7 Verification Testing Submissions

Document	Reference	Submission Schedule	BCSA*
test procedures	Appendix G, Section 10.4	25 days prior to the carrying out of any test by the Primary Contractor	N/A
90-Day Look Ahead Schedule detailing test activity	Appendix G, Section 9.2	80 days prior to first test and updated as required by the Province's Representative	N/A
30 Day Look Ahead Test Schedule detailing commissioning activities	Appendix G, Section 9.2	10 days prior to start of commissioning and updated weekly	I
test plan for Travel Time Demonstration	Part 2, Article 13.4.1	10 days prior to start date for test	N/A
Report setting out results of Travel Time Demonstration	Part 2, Article 13.4.1	20 Business Days after completion of test	N/A
Availability Demonstration test plan	Part 2, Article 13.4.2	30 Business Days prior to start date for test	N/A
Report setting results of Availability Demonstration	Part 2, Article 13.4.2	20 Business Days after completion of test	N/A
TIDS Performance Demonstration test plan	Part 2, Article 13.4.3	30 Business Days prior to start date for test	N/A
Report setting results of TIDS Performance Demonstration	Part 2, Article 13.4.3	20 Business Days after completion of test	N/A
test reports	Appendix G, Section 10.5	20 Business Days after completion of applicable test	N/A
Failure Reporting Analysis and Corrective Action System Report	Appendix G, Section 10.6	Monthly	N/A
Requirements Specifications	Appendix G, Section 4.1.1	In accordance with the Systems Management Plan	N/A
Requirements Verification Categorization Report	Appendix G, Section 4.1.1(b)	In accordance with the Systems Management Plan	N/A

Document	Reference	Submission Schedule	BCSA*
Requirements Verification Plan	Appendix G, Section 4.1.1(c)	In accordance with the Systems Management Plan	N/A
Requirements Verification Report	Appendix G, Section 4.1.1(d)	15 days prior to Substantial Completion	N/A
Trial Running Test Plan and Procedure	Appendix G, Section 13.6.2	20 Business Days prior to the start of Trial Running	I
Trial Running Test Report	Appendix G, Section 13.6.2.3	10 Business Days after completion of Trial Running	I
Documentation package to allow the movement of Trains on the Evergreen Line	Appendix G, Section 10.7	20 Business Days prior to the movement of trains on the Evergreen Line	I
Documentation package to allow the testing of Train operation between the Evergreen Line and the Existing Millennium Line	Appendix G, Section 10.7	20 Business Days prior to the testing of train movement between the Evergreen Line and the Existing Millennium Line	I
Documentation package to allow Trial Running involving the movement of Trains on the Operational Evergreen Line.	Appendix G, Section 10.7	20 Business Days prior to Trial Running	I
Documentation package to allow Service Commencement involving the carrying of passengers on the Evergreen Line	Part 3, Article 4.1.1(a)(i),	20 Business Days prior to Substantial Completion	I

15.8 Operation and Maintenance Documentation

Document	Reference	Submission Schedule	BCSA*
Manual Delivery Plan	Part 3, Article 3.3.1	In accordance with the Systems Management Plan	N/A

Document	Reference	Submission Schedule	BCSA*
Spare Parts Lists	Part 3, Article 3.6.2	In accordance with the Spare Parts Plan	N/A
Primary Contractor redlining input to the System Operations Manuals – Preliminary	Part 3, Article 3.3.3.2	6 months after SFDR	N/A
Primary Contractor redlining input to the System Operations Manuals – Final	Part 3, Article 3.3.3.2	25 days before Substantial Completion	N/A
RAM Analysis Report	Appendix G, Section 5.3	20 Business Days before Trial Running	
Maintenance Manuals and Operations Manuals for Systems	Part 3, Articles 3.3.2 and 3.3.4	15 days before Substantial Completion	N/A
Record Drawings	Part 3, Article 3.2.1.1	15 days before Substantial Completion	N/A

*Note: "I" – to BCSA for information
"FR" – upon formal request by BCSA
"N/A" – Not applicable

16 Request For Amendment/Exemption for Systems General Requirements

In the event that the Primary Contractor proposes to make an addition or revision to or requires an exemption from the requirements in this Appendix G, such addition, revision or exemption shall be handled through the Systems Request for Amendment/Exemption (SRFAE) procedure that is set out in this Section 16. The objective of the SRFAE procedure is to resolve technical issues through initial review of the request by the appropriate discipline professional of the Primary Contractor and, where appropriate, determination of the request by the Systems Engineer of Record.

The SRFAE procedure shall apply to any person under contract with the Primary Contractor, including design consultants, suppliers, contractors and subcontractors. It is the responsibility of the person who proposes additions, revisions or exemptions from this Appendix G, as originator, to complete an SRFAE in the form of Attachment A to this Appendix G to forward to the discipline professional who will review and document the SRFAE and submit it to the Systems Engineer of Record for approval or rejection.

When an addition, revision or exemption from this Appendix G is proposed, the originator proposing it shall complete Part 1 of the SRFAE form. The SRFAE form is designed to accommodate only one request for addition, revision or exemption from this Appendix G; however, in the event that multiple requests relate to the same provision, they may be combined on one form for expedited response and close out. The originator must include on the SRFAE form, as a minimum, the following:

- originator (Name)

- company/organization
- date
- originator reference number
- identification of the type of requested amendment/exemption and the code document affected
- description of the existing requirement
- the proposed amendment/exemption
- any pertinent background information

Upon receipt of the completed SRFAE form, the discipline professional will review the SRFAE and determine whether further review and determination on the request is warranted or a simple verbal or e-mail clarification or response is sufficient, followed by a formal close-out of the RFAE form.

Should further review and determination on the request be required, the discipline professional will forward the request to the Systems Engineer of Record with a recommendation for acceptance or rejection and supporting rationale. After review of the SRFAE, the Systems Engineer of Record will decide whether to accept or reject the SRFAE, and will forward the determined SRFAE to the Province's Representative and with a copy to the discipline professional.

Upon receipt of the determined SRFAE from the Systems Engineer of Record, the discipline professional shall forward the determined SRFAE to the originator and all other affected parties. If the SRFAE is approved, the new/revised provision shall be included in the Systems General Requirements.

The Primary Contractor shall track and maintain all SRFAEs. Each SRFAE shall be produced and distributed in Microsoft Word format. Each SRFAE which is approved or rejected shall be converted to PDF format for distribution of the response.

The Primary Contractor shall inform BCSA of any approved SRFAE that relates to safety requirements upon receipt of the applicable SFRAE.

An addition, revision or exemption approved pursuant to this SRFAE process shall not result in a change to the Contract Price or Project Schedule.

Attachment A to Appendix G of Schedule 4

Systems Request For Amendment/Exemption (SRFAE)

PART 1 – To be completed by Originator

Originator (Name):	**Date:**	**Submitted to:** Discipline Professional
Organization:	**SRFAE No.**	

Requested Amendment/Exemption:

☐ Add new requirement

☐ Revise existing requirement

☐ Request exemption from a requirement

Existing Requirement: What is the requirement you are addressing? Describe the requirement.

Proposed Amendment/Exemption: Describe the requested exemption, change or addition to the requirement. What is the reason for the request?

Other Comments and/or Information: (e.g., impact on other requirements or design areas, attached supporting material such as drawings)

PART 2 – To be completed by discipline professional

Received By:	**Date Received:**
Section reference number :	
☐ **Further review required** ☐ **Further review not required** **Comment:**	**Date Forwarded:**
	Forwarded To: ☐ Returned to Originator ☐ Systems Engineer of Record

Recommendation: ☐ **Accept** ☐ **Reject**

Rationale: (Describe basis for recommendation) ☐ **Additional information attached (Part 4)**

PART 3 – To be completed by Systems Engineer of Record

Received By:	**Date Received:**
☐ **Accepted** ☐ **Rejected** **Comment:**	**Date Forwarded:**
	Forwarded to:

PART 4 – Additional Comments

Prepared By:	**Date:**

Rationale to Support Recommendations for Acceptance: