Document Management Sheet – Employer's Requirements

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Trams for Edinburgh

..connecting our Capital

Edinburgh Tram Network

Employer's Requirements

Edition: v3.6, March 2008

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PRO-INFRACO-1399	3.6	DRAFT	14/03/2008	2

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Table of Contents

1 Introduction

1.1 Summary of Overall Scope

Without prejudice to the Infraco's other obligations, and unless otherwise expressly agreed with **tie** in accordance with this Agreement, the Infraco shall, as a minimum, be fully responsible for the works and services described as follows:

- to carry out and/or manage to completion the design of the Edinburgh Tram Network, including the management coordination, and specification and implementation of the necessary works for the modification of the Urban Traffic Control System;
- to procure and install all materials and equipment, required for the complete operating Edinburgh Tram Network, as summarised and as further detailed within these Employer's Requirements;
- to supply documentation as defined within these Employer's Requirements, including design documentation, as-built documentation, statutory information, as-built information, maintenance documentation and training documentation;
- to energise the Edinburgh Tram Network including liaison with and management of all interested and affected parties;
- to provide access and support for driver training;
- to provide comprehensive management and technical and maintenance services and Deliverables to ensure that all of the above is delivered in full compliance with these Employer's Requirements.

1.2 Infraco Works

Summary Scope of Infraco Works

Detailed requirements associated with the infrastructure and equipment for the Infraco Works are described within other Sections of these Employer's Requirements.

The scope defined within this section is limited to a summary of the principal elements of the Infraco Works:

- the supply of Trams in accordance with the Tram Supply Agreement;
- the provision of maintenance as defined in the Tram Maintenance Agreement and Section 40 (Maintenance) of these Employers Requirements;
- Provision of Trackwork - A total of approximately 18.8km and 5.5km (for phases 1a and 1b, respectively) of track kilometres, on street and off street trackform;
- Provision of Tramstops - A total of 22 Tramstops and 1 staff only Tramstop for Phase 1a, and 9 Tramstops for Phase 1b, together with associated infrastructure;
- Tramstop furniture, systems and equipment;
- Interchange facilities as provided in the design information;
- Points and crossings including point machines, their power supplies, point heating and the control thereof, detection and indication;
- Traffic / tram signals;
- Tram detection system;
- The provision of all 11kv, 400volt and 230 volt power supplies;
- Traction substations and d.c. traction distribution;
- OLE (Including all trackside isolators);

- Supervisory control, and communication systems and sub-systems including all field, Tram (free issue for installation by Tram Supplier) network and central control and interface equipment;
- Develop and manage an EMC strategy that includes appropriate immunisation of all Third Party neighbouring systems including Network Rail.
- Accept delivery of fixed and portable Ticket Vending Machines from **tie** and then undertake the installation of such machines and the provision of the necessary supporting infrastructure (including power supplies, communication links and foundations). The maintenance of these machines is not within the scope of the Infraco;
- Provision of the Depot containing:
  - A depot building containing a maintenance workshop and associated workshops, offices, stores and equipment;
  - The Control Centre (First Floor) and associated equipment room (Ground Floor);
  - The Edinburgh Tram Network administration offices;
  - A depot yard and stabling area;
  - A traction power substation;
  - A building services transformer and associated works;
  - All necessary services and utility connections;
  - A boiler house;
  - Hard-standing for a diesel alternator; and
  - The Depot access road.
- Provision of Tram associated road works;
- Provision of traffic management;
- Provision of road furnishings;

- Provision of bridges, structures and retaining walls, including the necessary services and facilities e.g. lighting, drainage, fencing and guardrails, earthing and bonding etc.;
- Civil works including earthworks (inclusive of contamination removal, demolition, Site clearance, excavation, bridges and structures, all necessary temporary works and drainage;
- Demolition/modification of certain buildings as identified in the design phase.
- Relocating the War Memorial at Haymarket Junction (the Infraco shall be required to seek approval from **tie** prior to such re-location and **tie** shall be required to confirm consent for such re-location);
- Landscaping including, hard landscaping, soft landscaping, boundary treatments;
- Provision of lighting;
- Provision of **s**ignage;
- Provision of **f**encing; and
- The provision of all temporary works and installations (to allow construction of the Edinburgh Tram Network and achievement of delivery of the Edinburgh Tram Network into service) including the provision of connections to appropriate power supplies.

1.3 Phase 1a Scope Statement Regarding Inclusion for the Phase 1b Option

Phase 1a shall meet these Employer's Requirements and provide full functionality as a standalone tram network. The scope for Phase 1a shall include the following elements in order to facilitate the addition of Phase 1b as an option instructed later under this Agreement.

1. The structure, earthworks and necessary works at Roseburn Junction shall include all sub-structure, structures, earthworks, ductwork, drainage and fitting out to bottom of rail fixing, including the provision for the OLE spur connection for Phase 1b from Phase 1a and OLE supports, for the delta connection of Phase 1b with Phase 1a. The structure, earthworks and works shall extend as a minimum such that the subsequent construction of Phase 2b does not interfere with the operation of Phase 2a except to the extent allowed by the possessions detailed below.

2. Plain line shall be installed along the Phase 1a route through the Roseburn Junction, however the Infraco shall ensure that the design and construction shall provide for the turnouts to be installed in a maximum of one 54 hour possession of the Phase 1a inbound and outbound tracks between Murrayfield and the Western end of Haymarket Yards turnback. Traction power supply sectioning shall allow the turnback of service trams throughout the possession. In addition, up to 28 normal night-time possessions shall be available for preparatory works and commissioning works.

3. The central supervisory, control and communications systems provided by the Infraco for Phase 1a shall have sufficient capacity and functionality to accommodate the incorporation of Phase 1b. This shall include all software, firmware, databases with the same control and indication functionality as for Phase 1a. All central control system hardware shall be provided to allow the connection of the Phase 1b infrastructure by means of cable connection alone.

4. The central supervisory, control and communications systems shall be designed and configured such that the commissioning of Phase 1b infrastructure shall be possible without material impact on the passenger services operating on Phase 1a or the operational Control Centre prior to assimilation of Phase 1b with Phase 1a.

5. Documentation, drawings, manuals, spare parts and training shall be provided for Phase 1a on a standalone basis, but shall be in the form that is expandable to accommodate Phase 1b as and when constructed..

2 Operations and Performance

2.1 Scope

The scope of this Section of the Employer's Requirements defines the Operations & Performance requirements applicable to the Edinburgh Tram Network (ETN) which the Infraco must comply with.

2.2 Network Description and Principles

The Edinburgh Tram Network will operate as a 'line-of-sight' tramway, with tramway signalling provided at road junctions and at tramway junctions where appropriate. A fleet of Trams will serve the ETN providing level boarding with low level platforms located along the routes.

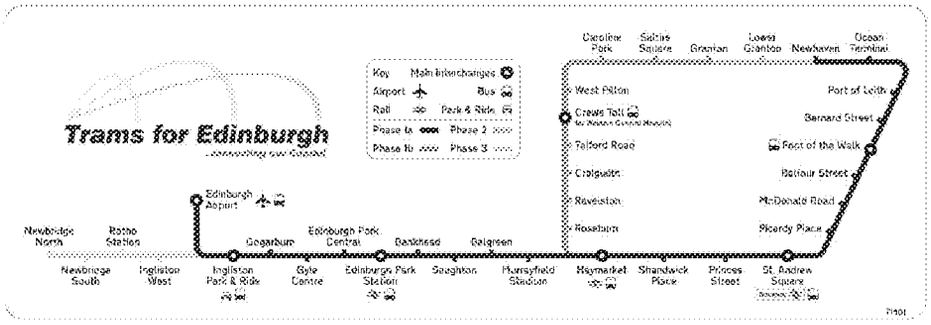

Figure 1

For ease of reference, a diagram of the Edinburgh Tramway Network is shown in Figure 1 above.

The route in the city from Newhaven to Haymarket (approximately half of Phase 1a) and from West Granton Access to Granton Square (approximately a third of Phase 1b) runs mainly on-street with varying degrees of segregation. The Roseburn corridor (approximately two thirds of Phase 1b) is a segregated off-street alignment, shared with a combined footpath and cycleway. Most of the route between Haymarket and the Airport (the remaining half of Phase 1a) is segregated from road traffic.

The whole ETN will consist of double track.

The Depot, located at Gogar, will provide maintenance and stabling facilities for the entire fleet of Trams operating on the ETN. It will also contain the administration and management offices, including an operations and Control Centre, from where the ETN will be managed and maintained.

Transport Services shall be operated in accordance to a timetable, as agreed between the Operator and **tie**, to achieve reliable and consistent operation at the required tram frequencies.

Throughout these Employer's Requirements reference is made to three timetables that shall be progressively introduced in response to patronage demand growth. These are intended to allow for reliability growth and Operator familiarisation with the Edinburgh Tram Network. The following definitions shall apply:

- **Operational Timetable**

  A timetable developed by **tie**, which provides Trams at a frequency of twelve Trams per hour in each direction on the common section between Haymarket and Ocean Terminal. Six Trams per hour in each direction are operated on the sections between Haymarket and the Airport and between Ocean Terminal and Newhaven. For Phase 1b, Trams at a frequency of six trams per hour in each direction on the section between Haymarket and Granton square shall be operated. The Operational Timetable shall be in effect from the Service Commencement Date for a minimum of one year.

- **AM and PM Peak Enhanced Timetable**:

  A timetable developed by **tie**, which provides Trams during the AM and PM peaks at a frequency of sixteen Trams per hour in each direction on the common section between Haymarket and Ocean Terminal. For Phase 1b providing Trams at a frequency of eight trams per hour in each direction on the section between Haymarket and Granton square for the AM and PM peak times only, reverting to the Operational Timetable during the inter peak period. The AM and PM Peak Enhanced Timetable shall be introduced no earlier than one year after the Service Commencement Date and shall be operated for a minimum of six months.

- **Enhanced Timetable:**

  A timetable developed by **tie**, which provides Trams at a frequency of sixteen Trams per hour in each direction on the common section between Haymarket and Ocean Terminal. For Phase 1b providing Trams at a frequency of eight Trams per hour in each direction on the section between Haymarket and Granton square. The Enhanced Timetable shall be introduced no earlier than two years after the Service Commencement Date.

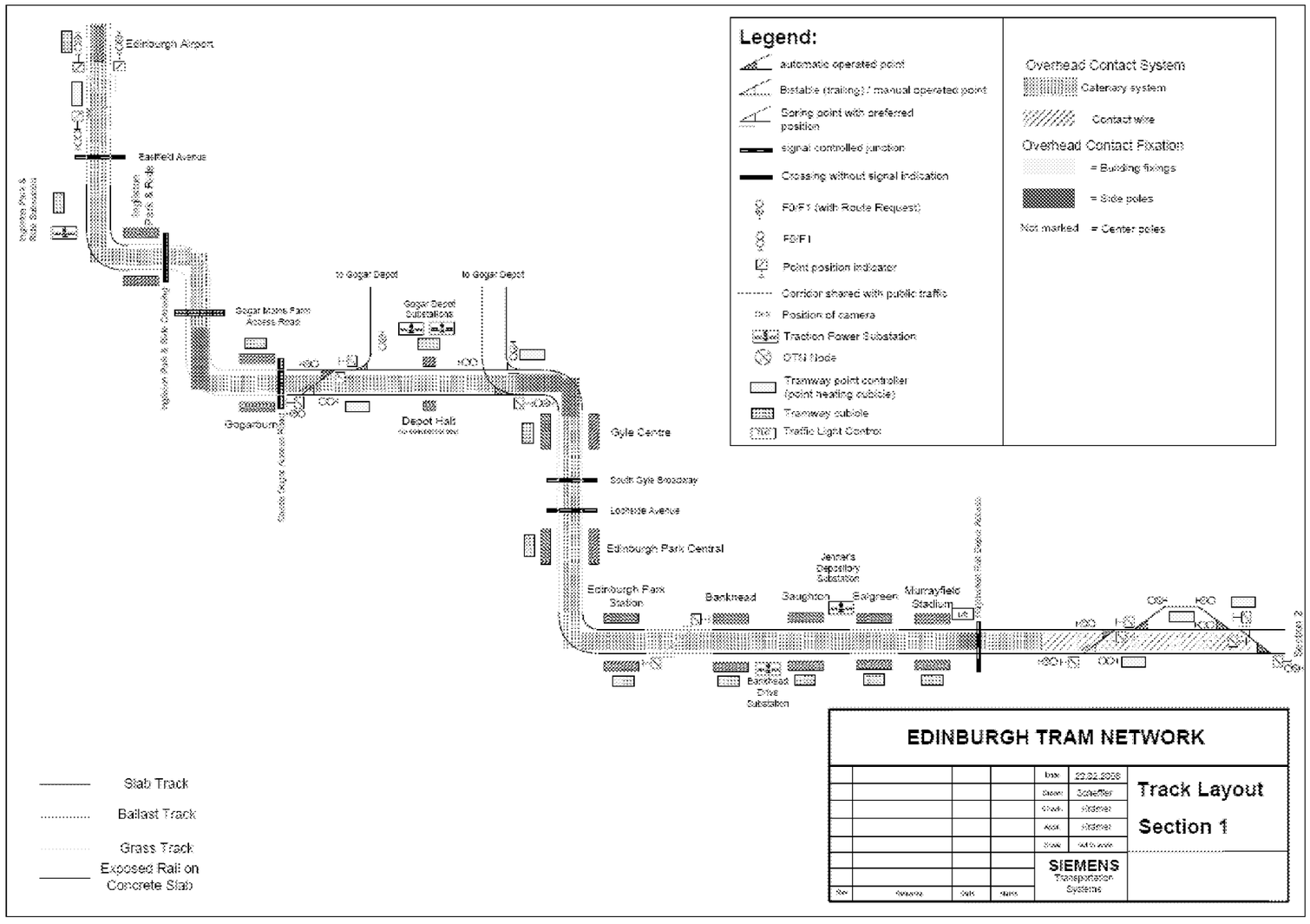

Figure 2 – Edinburgh Tram Phases 1a and 1b Network Diagram

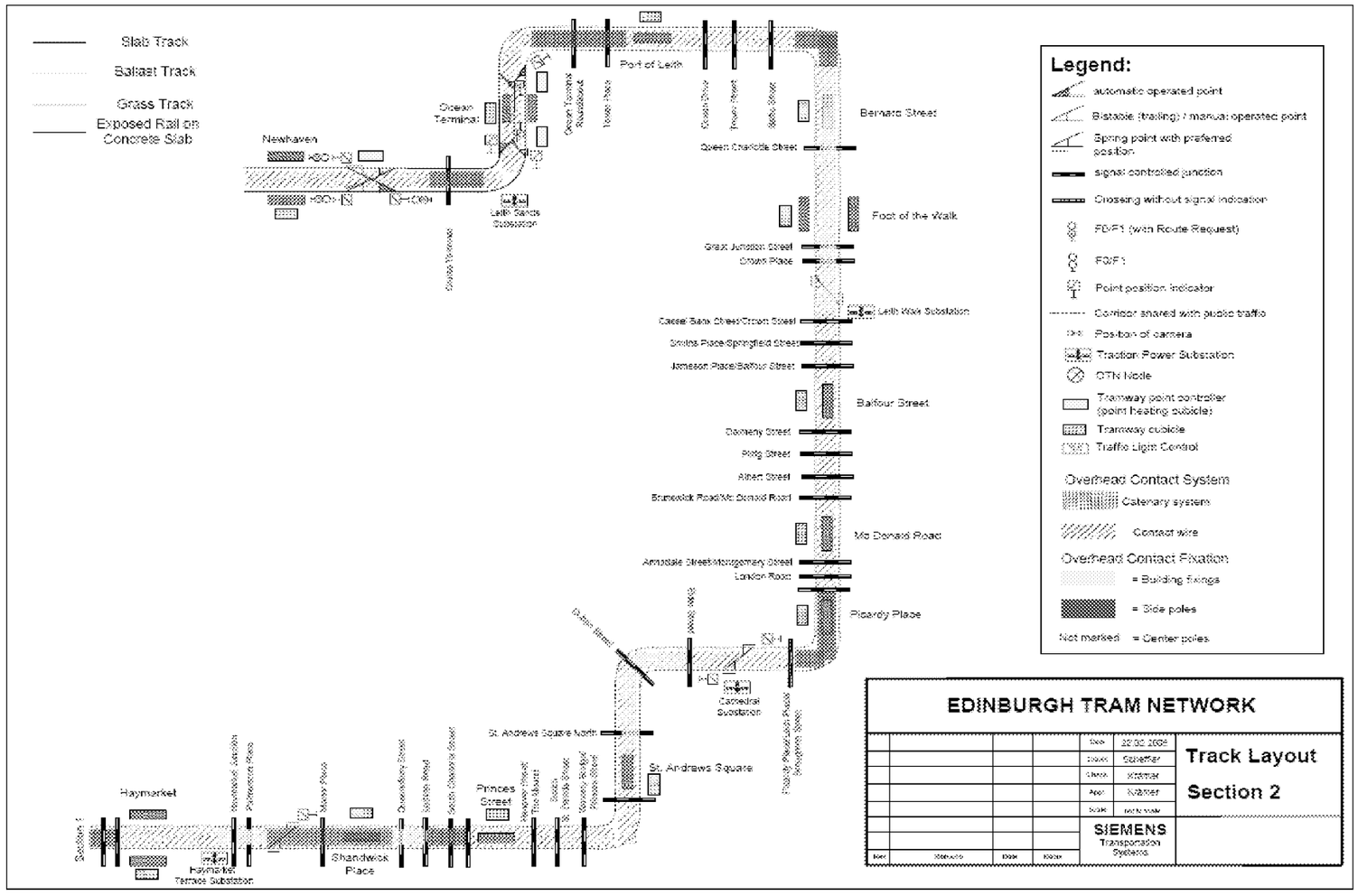

Figure 3 – Edinburgh Tram Phases 1a and 1b Network Diagram

2.3 Specific Operations and Performance Requirements

2.4 Tramstop Location and Types

The Tramstop location and types are detailed in the following table. The acronyms given are provisional.

ID	Tramstop	Platform Style
	PHASE 1a	
AIR	Edinburgh Airport	1 Centre
IPR	Ingliston Park and Ride	2 Side
GBN	Gogarburn	2 Side
DEH	Depot Halt (Staff Only)	2 Side
GYL	Gyle Centre	2 Side
EDP	Edinburgh Park Central	2 Side
EPS	Edinburgh Park Station	2 Side
BNK	Bankhead	2 Side
SGT	Saughton	2 Side
BAL	Balgreen	2 Side
MUS	Murrayfield Stadium	2 Side
HAY	Haymarket	2 Side
SHP	Shandwick Place	1 Centre
PST	Princes Street	1 Centre
SAS	St Andrew Square	1 Centre
PPL	Picardy Place	1 centre
MDR	McDonald Road	1 Centre
BFS	Balfour Street	1 Centre
FOW	Foot of the Walk	2 Side
BER	Bernard Street	1 Centre
POL	Port of Leith	1 Centre
OCT	Ocean Terminal	1 Centre, 1 Side

NEW	Newhaven	2 Side

	PHASE 1b	
GRT	Granton	1 Centre
SSQ	Saltire Square	2 Side
CPK	Caroline Park	2 Side
WPN	West Pilton	2 Side
CTL	Crewe Toll (for Western General)	2 Side
TEL	Telford Road	2 Side
CRA	Craigleith	2 Side
RAV	Ravelston	2 Side
ROS	Roseburn	2 Side

Table 1 – Edinburgh Tram Phases 1a and 1b Network Tramstop Location and Details

2.5 Expansion (including Line 3)

The Infraco shall ensure that the ETN shall be designed to permit expansion to include the following elements:

- Phased implementation of the ETN and associated fleet increases (including the implementation of the Phase 1b Option);
- Addition of Phase 2 of the ETN (as shown in Figure 1), including provision of Lower Granton Road stop, to close the loop along the sea front between Newhaven and Granton Square using the powers in the Edinburgh Tram (Line One) Act 2006;
- Addition of Phase 3 of the ETN (as shown in Figure 1), including associated stops at Ingliston West, Ratho Bridge and Newbridge South, from Ingliston Park and Ride to Newbridge using the powers in the Edinburgh Tram (Line Two) Act 2006;
- Addition of Line Three (From the junction of Princes Street/South St. Andrew Street to Royal Infirmary);

Extensions to the ETN set out above are not currently covered by these Employer's Requirements. However, the ETN must be designed in such a way as not to impede this future expansion.

For the avoidance of doubt, the following are covered by these Employer's Requirements.

- Future frequency increases beyond the enhanced service frequency of 8 & 8 tph;
- Increased operating hours beyond the scheduled last Tram of 23:59 and before the scheduled first Tram at 06:00;
- Associated impacts of increased staff numbers from 361 initially anticipated up to a maximum of 403 e.g. accommodation at the Depot.

2.6 Depot Locations

The Edinburgh Tram Network Depot is located at Gogar and shall be capable of providing capacity for the stabling of 27 trams of 44m in length, clear of fouling points in the stabling area.

The Depot shall be capable of future expansion to provide the capacity required for the identified future service frequencies and/or the requirements for Line Three, such that the Depot can be extended to stable 36 Trams of 44m in length, clear of fouling points in the stabling area.

2.7 Service Patterns, Operating Hours and Frequencies

The ETN shall support a daily service, all year round. The proposed initial service patterns, operating hours and frequencies are as follows:

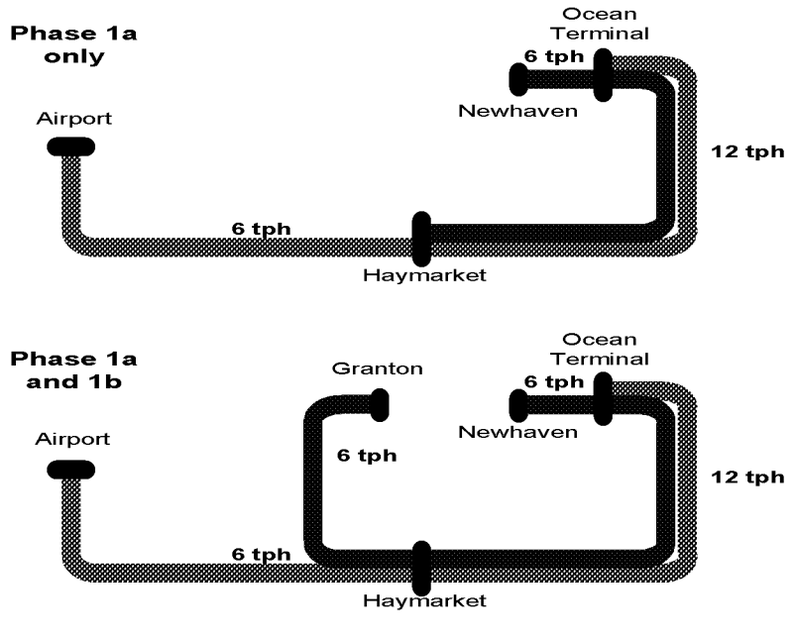

Figure 4 - Service Patterns for the Operational Timetable 6 & 6 Tram per hour scenario

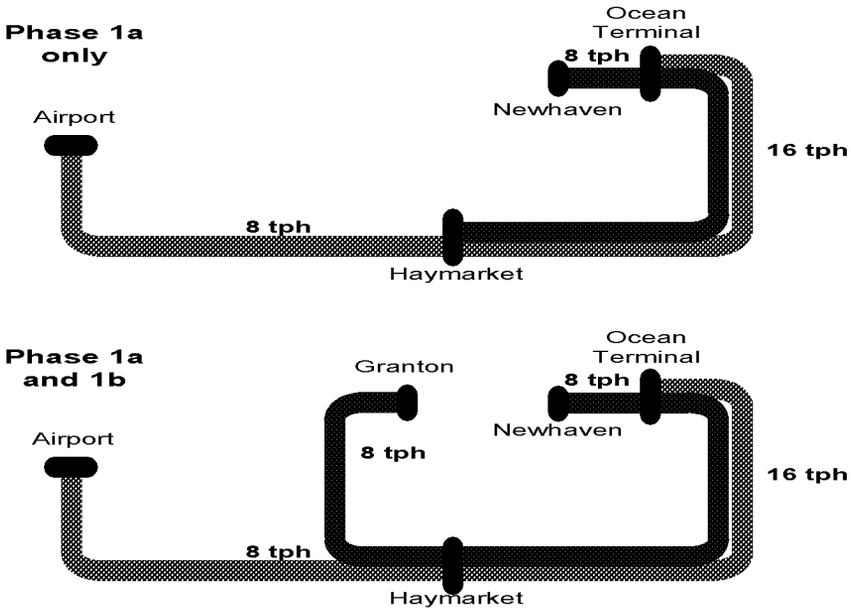

Figure 5 - Peak Service Patterns for the Enhanced AM & PM Peaks Timetable and the Enhanced Timetable 8 & 8 Tram per hour scenario

2.8 Operating Hours and Frequencies

The first and last Tram services and frequencies for 6 & 6 Tram per hour scenario are shown in Figure [4] - service patterns for the Operational Timetable 6 & 6 Tram per hour scenario and for 8 & 8 Tram per hour scenario in Figure [5].

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These scenarios are based upon the following assumptions and conditions:

- The two balanced services combine to give a total of 12 or 16 Trams per hour per direction on the common section between Ocean Terminal and Haymarket are required during the daytime to replace withdrawn bus services (and therefore demand and capacity) on Leith Walk;
- For the purposes of ramping up/down service Short workings between Edinburgh Airport (Phase 1a) / Granton Square (Phase 1a & Phase 1b) or Haymarket (Phase 1a only) and St. Andrew Square are based on terminating Trams at St. Andrew Square. The location of the turnback is at York Place;
- Edinburgh Airport service Tram frequency is ramped up/down from Ocean Terminal. Granton Square (Phase 1a & Phase 1b) or Haymarket (Phase 1a only) service Tram frequency is ramped up/down from Newhaven;
- Trams going into service between Gogar Depot and Ocean Terminal/Newhaven will run "in service" from the Gyle (first tram Gyle to Ocean Terminal approx. 05:15 Monday to Saturday inclusive);
- Haymarket (Phase 1a only) or Granton Square (Phase 1a & Phase 1b) service Trams going out of service running between Newhaven and Gogar Depot will run "in service" as far as the Gyle;
- St. Andrew Square curtailed Trams going out of service running between St. Andrew Square and Gogar Depot will run "in service" as far as the Gyle;
- Edinburgh Airport service Trams going out of service will run "in service" from Ocean Terminal to Edinburgh Airport with a short "dead run" from Edinburgh Airport to Gogar Depot;

- The period of time between the last Tram returning to the depot at night and the first Tram leaving the Depot in the morning Monday to Saturday inclusive is anticipated to be 4hrs 30 min, although this may be subject to amendment. Work requiring possessions will have to be agreed with the Operator. Subject to agreed possessions, work may be allowed on the Edinburgh Tram Network infrastructure for 3 hours and 45 minutes, depending on location, each night and allowing time for the implementation and withdrawal of isolations and/or possessions; and

- The provision of Transport Services is based on the requirement to always have a Tram present at the Airport Tramstop.

Table 2 – First and Last Tram Times for the 6 & 6 Tram per Hour Operational Timetable

1b	Airport to Ocean Terminal	0	6		6[a]	0
1b	Ocean Terminal to Airport	6	6		6	0
1b	Granton to Newhaven	0	6		6[b]	0
1b	Newhaven to Granton	6	6		6[c]	0

Note: The numbers in individual cells give the service frequency starting from the time at the top of the relevant column.

		Sunday (trams per hour)					
Network / Phasing	**Service frequency commencing at:**	first tram **07:00**	**07:45**	**08:00**	**08:20**	**23:15**	last tram **23:59**
1a	Airport to Ocean Terminal	0	6	6	6	6[a]	0
1a	Ocean Terminal to Airport	6	6	6	6	6	0
1a	Haymarket to Newhaven	0	0	6	6	0	0
1a	Newhaven to Haymarket	0	0	0	6	0	0

1b	Airport to Ocean Terminal	0	6		6[a]	0
1b	Ocean Terminal to Airport	6	6		6	0
1b	Granton to Newhaven	0	6		6[b]	0
1b	Newhaven to Granton	6	6		6[c]	0

Notes:

[a] from approx 2 23:15 Trams run from the Airport - City Centre only

[b] from approx 2 23:15 Trams run from Granton - City Centre only

[c] from approx 2 23:15 Trams run from Newhaven - Haymarket continuing in service on TL2 to Gyle

First and last Tram services and frequencies for 6 & 6 tram per hour Operational Timetable

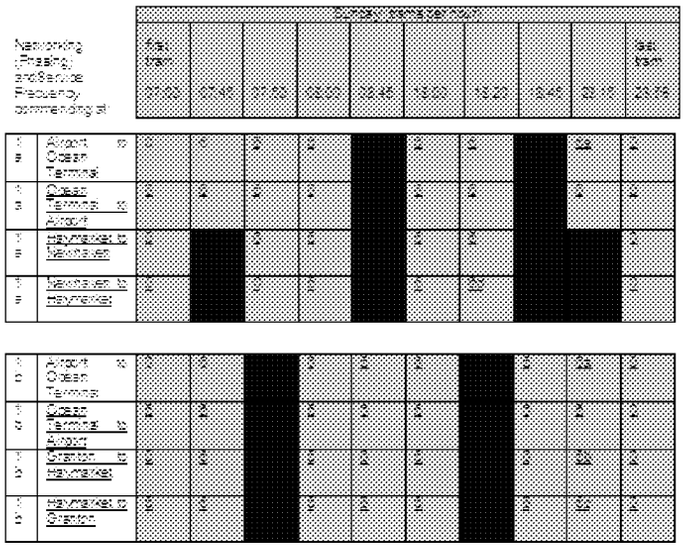
Table 3 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario

	Networking (Phasing) andService Frequency commencing at:	06:00	06:45	07:00	07:20	07:45	09:45	15:45	19:00	19:45
1 a	Airport to Ocean Terminal	0	6	8	8	8	6	6	8	6
1 a	Ocean Terminal to Airport	6	6	8	8	8	6	6	8	6
1 a	Haymarket to Newhaven	0		6	8	8	6	6	8	6
1 a	Newhaven to Haymarket	0		0	6	8	6	6	8d	6
1 b	Airport to Ocean Terminal	0	6	8		8	6	6	8	6
1 b	Ocean Terminal to Airport	6	6	8		8	6	6	8	6
1 b	Granton to Haymarket	0	6	8		8	6	6	8	6
1 b	Haymarket to Granton	6	6	8		8	6	6	8	6

Table 4 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario

Phase	Service Frequency	Saturday (trams per hour)				
	commencing at:	First tram 06:00	06:45	07:30	07:50	23:15
1a	Airport to Ocean Terminal	0	6	6	6	6a
1a	Ocean Terminal to Airport	6	6	6	6	6
1a	Haymarket to Newhaven	0	0	6	6	0
1a	Newhaven to Haymarket	0	0	0	6	0
1b	Airport to Ocean Terminal	0	6	6	6	6a
1b	Ocean Terminal to Airport	6	6	6	6	6
1b	Granton to Newhaven	0	6	6	6	6b
1b	Newhaven to Granton	6	6	6	6	6c

Table 5 - First and Last Tram Times for the Enhanced AM & PM Peak Timetable



Notes:

a) from approx. 23:15 Trams run from Airport – St Andrew Sq. only.
b) from approx. 23:15 Trams run from Granton – St Andrew Sq. only.
c) from approx. 23:15 Granton Trams run from Newhaven – Haymarket continuing in service on to Gyle.
d) from approx. 19:20 (18:%0 Saturday and 18:20 Sundays) Haymarket Trams running from Newhaven – Haymarket continue in service to Gyle.

The numbers in individual cells give the service frequency starting from the time at the top of the relevant column.

Table 6 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced Timetable

Network (phasing) and service frequency commencing at:		Monday - Friday (trams per hour)									
		06:00	06:45	07:00	07:20	07:45	19:00	19:20	19:45	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	8	8	8		8	8		8[a]	0
1a	Ocean Terminal to Airport	8	8	8	8		8	8		8	0
1a	Haymarket to Newhaven	0		8	8		8	8			0
1a	Newhaven to Haymarket	0		0	8		8	8[d]			0
1b	Airport to Ocean Terminal	0	8	8		8	8		8	8[a]	0
1b	Ocean Terminal to Airport	8	8	8		8	8		8	8	0
1b	Granton to Newhaven	0	4	4		8	8		4	4[b]	0
1b	Newhaven to Granton	4	4	8		8	4		4	4[c]	0

Network (phasing) and service frequency commencing at:		Saturday (trams per hour)									
		first tram 06:00	06:45	07:30	07:50	08:15	18:30	18:50	19:15	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	8	8	8		8	8		8[a]	0
1a	Ocean Terminal to Airport	8	8	8	8		8	8		8	0
1a	Haymarket to Newhaven	0		8	8		8	8			0
1a	Newhaven to Haymarket	0		0	8		8	8[d]			0
1b	Airport to Ocean Terminal	0	8	8		8	8		8	8[a]	0
1b	Ocean Terminal to Airport	8	8	8		8	8		8	8	0
1b	Granton to Newhaven	0	4	4		8	8		4	4[b]	0
1b	Newhaven to Granton	4	4	8		8	4		4	4[c]	0

Network (phasing) and service frequency commencing at:		Sunday (trams per hour)									
		first tram 07:00	07:45	07:50	08:00	08:45	18:00	18:20	18:45	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	6	6	6		6	6		6[a]	0
1a	Ocean Terminal to Airport	6	6	6	6		6	6		6	0
1a	Haymarket to Newhaven	0		6	6		6	6			0
1a	Newhaven to Haymarket	0		0	6		6	6[d]			0
1b	Airport to Ocean Terminal	0	6		6	6	6		6	6[a]	0
1b	Ocean Terminal to Airport	6	6		6	6	6		6	6	0
1b	Granton to Newhaven	0	6		6	6	6		6	6[b]	0
1b	Newhaven to Granton	6	6		6	6	6		6	6[c]	0

Note: The numbers in individual cells give the service frequency starting from the time at the top of the relevant column.

Notes:

[a] from approx 23:15 trams run from Airport - St Andrew Sq only

[b] from approx 23:15 trams run from Granton - St Andrew Sq only

[c] from approx 23:15 Granton trams run from Newhaven - Haymarket continuing in service on to Gyle

[d] from approx 19:20 (18:50 Saturdays and 18:20 Sundays) Haymarket trams running from Newhaven - Haymarket continue in service to Gyle

2.9 Service Frequencies and Expansion

The design of the ETN shall support the Operational Timetable and Enhanced Timetable service frequencies set out in Table 2 – First and Last Tram Times for the 6 & 6 Tram per Hour Operational Timetable, Table 3 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario and Table 4 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario. In addition to this, the ETN shall operate the same service pattern as set out in Table 4 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario above, but with the Trams per hour increased by 50% throughout without upgrade or loss of performance for up to a maximum of 2 hours between Ocean Terminal and Picardy Place, and indefinitely between Picardy Place and the Airport.

The service patterns for the ETN are defined as the Operational Timetable (as shown in Table 2 – First and Last Tram Times for the 6 & 6 Tram per Hour Operational Timetable), the AM and PM Peak Enhanced Timetable (as shown in Table 3 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario) and the Enhanced Timetable (as shown in Table 4 - First and Last Tram Times for the 8 & 8 Tram per Hour Enhanced AM & PM Peak Scenario).

A simulation indicating the power consumption of the ETN service patterns as defined above and considering the braking energy regeneratated by the Tram shall be performed during design phase.

2.10 Special Working and Degraded Operation

Special working is required at certain times of the year, as detailed in Table 8 - Reconfiguration of Service due to the Closure of Princes Street to allow for the short workings on the network routes, when sections of the ETN shall be closed to allow for example Hogmanay, the Edinburgh Festival and other special events and festivals.

The design of the ETN shall allow services to be turned back at the locations detailed in Table 7 - Turnback Locations. The precise chainages where turnbacks are to be installed is shown on the alignment drawings.

ID	Location
	PHASE 1a
EPS	Edinburgh Park Station
HAY	Haymarket Yards
SHP	Shandwick Place
PPL	Picardy Place
FOW	Foot of the Walk (Leith Walk)

OCT	Ocean Terminal
	PHASE 1b
CTL	Crewe Toll

Table 7 - Turnback Locations

Note that Trams may also be turned back at Gogar Depot, and the facility to allow this shall be provided by the Infraco.

The individual services will be reconfigured to operate using the turn-back facility nearest to the affected area. An example is the requirement to close Princes Street for Hogmanay. In this situation the services shall be reconfigured as detailed in Table 8 - Reconfiguration of Service due to the Closure of Princes Street.

Service alteration for Closure of Princes Street			
Original Route of Service	**Affected Area**	**Trams / Hour**	**Revision**
Between Airport and Ocean Terminal	Princes St. section closed	6 or 8	Services run between Airport and Shandwick Place. No service runs between Shandwick Place and Picardy Place. Services run between Picardy Place and Newhaven
Between Haymarket and Newhaven (Phase 1a only)	Princes St. section closed	6 or 8	No service runs between Haymarket and Picardy Place[a]. Services run between Picardy Place and Newhaven
Between Granton Square and Newhaven (Phase 1b)	Princes St. section closed	6 or 8	Services run between Granton Square and Shandwick Place. No service runs between Shandwick Place and Picardy Place. Services run between Picardy Place and Newhaven

a – Assumption that no services will run the short leg Haymarket to Shandwick Place when Princes Street is closed.

Table 8 - Reconfiguration of Service due to the Closure of Princes Street

2.11 Journey Time and Runtime

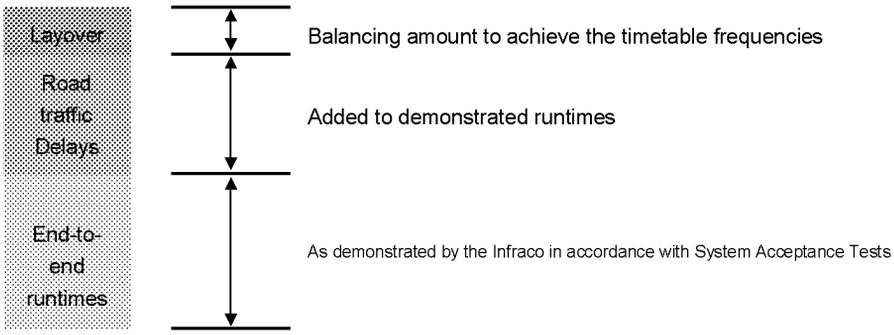


Figure 6 - Maximum Journey Times

The required maximum journey times for the Edinburgh Tram Network, quoted as operational journey time including dwell times of 25 seconds at each Tramstop, as defined during Preliminary design shall be as follows:

Phase 1a Airport to Ocean Terminal	in either direction including 25 secs dwells at Tramstops	42mins 18 secs
Phase 1b Granton Sq to Newhaven	in either direction including 25 secs dwells at Tramstops	39mins 26 secs

For the avoidance of doubt these are end to end journey times and the Infraco shall demonstrate during System Acceptance Tests defined in Section **Error! Reference source not found.Error! Reference source not found.** (Testing and Commissioning) of these Employer's Requirements the trip times which can be achieved by the Trams running on the ETN infrastructure as developed and adjusted from the above base line in accordance with Section 2.12. These do not include layover time at the turnback stops as shall be agreed between the Operator and **tie** in order to develop the Operational Timetable.

2.12 Journey Time and Runtime

The Infraco shall continue to develop and refine the runtime model as the design progresses and, at a frequency of no less than every three months or upon **tie**'s request, provide updated reports demonstrating that the maximum run times can be achieved. The Infraco shall also prepare a model of the electricity consumption linked to the run time model and shall use reasonable endeavours to optimise the system design and construction to minimise electricity usage.

Reference should be made to the Runtime Simulation Stage 3 Report (ref: ULE90130-SW-REP-00238-V3) for vehicle performance characteristics and actual driver operations.

The operational and modelling assumptions that shall be used in all modelling of runtime and operational timetables are set out in Table 9 - Operational and Modelling Assumptions.

Table 9 - Operational and Modelling Assumptions.

Item	Value	Notes
Door Performance	12 seconds	Defined as the time for the doors to open and close including DDA requirements and passenger and driver reaction times.
Boarding and Alighting Time	13 seconds	Defined as the time between the doors being fully open and the sounding of the door closing tone.
Dwell Times	25 seconds a constant in modelling and during end to end journey time tests, to be refined for the purposes of the timetables to be Tramstop specific	Average dwell, made up of the door performance time and the boarding and alighting time
Loading	AW2 all seated 4 pass/m2 standing	
Gradient	+/- 8% Max. Note: This value is the maximum allowable gradient for track design.	Gradient data for the complete ETN has been developed in the design phase This identified major gradients at St. Andrew Square and the line alongside Gogar Depot

Table 9 - Operational and Modelling Assumptions

2.13 Operational Allowances and Rules for Timetabling

An operational allowance will be added to the end to end runtimes demonstrated through testing to meet those quoted in this section to ensure a robust Operational Timetable is constructed.

Requirement	Allowance
Operational Journey time allowance	Newhaven to Haymarket = 1.5 minutes Ocean Terminal to Airport = 1.5 minutes Newhaven to Granton Square = 45 secs (Phase 1b only)
Layover	4 minute minimum or 10% of timetabled runtime, whichever is the greater taken at the terminus for each end to end trip with the exception of the Airport Tramstop where a Tram is required to always be present. Crew change-over locations to be determined as the Operational Timetable is refined.

Table 10 - Operational Runtime Allowances

2.14 Miscellaneous Operational Requirements

2.15 Comfort Break Facilities

Facilities shall be available for driver comfort breaks at the nominated layover locations detailed in Table 11 – Layover Facilities Table 11 - Layover Facilities

Location	Comments
Edinburgh Airport	Crew Change Facility[1]
Ocean Terminal	Normal Terminus
Granton Square	Normal Terminus
Haymarket	Crew Change Facility

Table 11 - Layover Facilities

[1] *Damian has already instructed this change.*

At these locations access shall be provided to a suitable toilet with hand washing facilities.

Crew Change Facility

A crew changing facility shall be provided adjacent to the Haymarket Tramstop. This facility shall provide tram crew with access to a toilet with hand washing facilities, a drinking water supply, suitable heating, power, lighting, drainage and connection to the telephone network.

2.16 Performance and Reliability

The design and construction of the ETN shall be demonstrated by RAMS analysis to enable the individual systems availability targets stated in these Employer's Requirements to be met. It shall enable an overall tram punctuality for System technical causes of at least 99% in accordance with the calculation of the Punctuality Service Element contained in Schedule 6 of the Agreement.
As measured on a 28 day basis at the following monitoring points along the route at least 99% of the Trams shall be no earlier than one minute and no greater than two minutes late, caused by technical failure, compared to the scheduled headway.

Monitoring points

a) Phase 1a: for the purposes of monitoring arrival and departure headways between Trams:

- Edinburgh Airport.

b) Phase 1a: for the purposes of measuring departure headways between Trams only:

- Edinburgh Park Station;
- Haymarket;
- Foot of the Walk;
- Leith; and
- Picardy Place.

c) Phase 1b: for the purposes of measuring departure headways between Trams only:

- Crewe Toll (northbound only); and
- Granton Square.

The performance mechanism for Infraco is contained within this Agreement. The design of the ETN shall be such that it allows the ETN to operate safely and effectively in all modes.

Normal Mode being that used to establish the operational timetable. Degraded Mode being restricted operation due to failures or disruption on the tramway or the adjacent highway network.

2.17 Network and Service Pattern

See figures [Figure 3 – Service Patterns for the Operational Timetable 6 & 6 Tram per hour scenario] Figure 4 - Service Patterns for the Operational Timetable 6 & 6 Tram per hour scenario and [Figure 4 – Peak Service Patterns for the Enhanced AM & PM Peaks Timetable and the Enhanced Timetable 8 & 8 Tram per hour scenario] Figure 5 - Peak Service Patterns for the Enhanced AM & PM Peaks Timetable and the Enhanced Timetable 8 & 8 Tram per hour scenario for further information.

- for daily service patterns; and

- [xx AR] Trams to be co-ordinated between OCT and HAY to give an even headway pattern in both directions.

2.18 Layovers

The Operational Timetable and the Enhanced Timetable developed by the Operator and the Infraco's Proposals shall allow for the following:

- An operational Tram can always be present at the Airport Tramstop;

- Additional layovers to be added to the minimum values to deliver the required headways where appropriate. This additional layover maybe apportioned along the route; and

- The minimum layover requirements are as set out in these Employer's Requirements and these shall be apportioned at the terminus Tramstops only.

Allowance for perturbations that are not road traffic delays:

- These shall be apportioned along the route, as can be seen in Figure 6 - Maximum Journey Times.

2.19 Calculation of Minimum Round Trip Times

In this section, the minimum round trip times for each of the service options are calculated. The calculations add up the elements that are required to establish the round trip times, and the source of each element is stated.

Table 12 - Ocean Terminal – Edinburgh Airport Service (Phase 1a and Phase 1b)

OCT – AIR

00:42:18	OCT - AIR (includes dwell time)[a]
00:04:52	AM junction delay (OCT - HAY)[b]
00:01:30	additional delay between HAY - AIR[c]
00:00:10	10 seconds on each leg for crossover at terminal Tramstop[d]
00:48:50	Total

AIR – OCT

00:41:59	AIR - OCT (includes dwell time)[a]
00:06:01	AM junction delay (HAY - OCT)[b]
00:01:30	additional minutes of junction delay between AIR - HAY[c]
00:00:10	10 seconds on each leg for crossover at terminal Tramstop[d]
00:49:40	Total

Layovers

00:04:55	Minimum layover at OCT end for Airport service[e]
00:10:00	Minimum layover at AIR end for Airport service[f]
00:07:30	Minimum layover at AIR end for Airport service[f]
00:14:55	Total min layover for 6 & 6 tram per hour scenario
00:12:25	Total min layover for 8 & 8 tram per hour scenario
01:53:25	Minimum round trip time for 6 & 6 tram per hour scenario
01:50:55	Minimum round trip time for 8 & 8 tram per hour scenario

Notes:

[a] Data from 'Edinburgh Tram Network Stage 3 Runtime Simulation Report' (Doc Ref: ULE90130-SW-REP-00238 v2).

[b] Data from 'Mott Macdonald Report - Traffic Interface Report' (Doc Ref: 0003048//REVC/241103). AM Junction delays between Haymarket and Leith Walk have been used as greater than PM delays.

[c] of additional junction delay between Haymarket and Edinburgh Airport.

[d] Estimate of additional time to move through the crossover at the terminus / turnback

e Layover calculated from [Table 17 – Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario)] Table 17 - Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario)

[f] Based on Headway of 10 or 7.5 minutes, from the requirement for Airport layover in Section 32.

Table 13 - Newhaven – Granton Square Service, (Phase 1b only)

NEW – GRT

00:02:49	NEW – OCT (includes 25s dwell time)[a]
00:36:28	OCT – GRT (includes dwell time)[a]
00:04:52	AM junction delay (NEW - HAY)[b]
00:00:45	additional delay between HAY - GRT[c]
00:00:10	10s on each leg for crossover at terminal Tramstop[d]
00:45:04	Total

GRT – NEW

00:37:00	GRT - OCT (includes dwell time)[a]
00:02:26	OCT - NEW (includes 25s dwell time)[a]
00:06:01	AM junction delay (NEW - HAY)[b]
00:00:45	additional delay between NEW - HAY[c]
00:00:10	10s on each leg for crossover at terminal Tramstop[d]
00:43:56	Total
00:04:15	Minimum layover at NEW end for Granton service[e]
00:04:07	Minimum layover at GRT end for Granton service[e]
00:08:22	Total min layover
01:37:22	Minimum round trip time

Notes:

[a] Data from 'Edinburgh Tram Network Stage 3 Runtime Simulation Report' (Doc Ref: ULE90130-SW-REP-00238v2).

[b] Data from 'Mott Macdonald Report - Traffic Interface Report' (Doc Ref: 0003048//REVC/241103)(AM Junction delays between Haymarket and Leith Walk have been used as greater than PM delays)

[c] Transdev estimate of additional junction delay between Haymarket and Granton Square.

[d] Transdev estimate of additional time to move through the crossover at the terminus / turnback

[e] Layover calculated from [Table 17 – Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario)] Table 17 - Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario).

Table 14 - Newhaven – Haymarket Service (Phase 1a only)

NEW - HAY

00:02:49	NEW - OCT (includes 25 seconds dwell time)[a]
00:18:58	OCT - HAY (includes dwell time)[a]
00:04:52	AM junction delay (NEW - HAY)[b]
00:01:30	Additional delay between NEW - HAY
00:00:10	10 seconds on each leg for crossover at turnback[c]
00:00:54	Additional movement from HAY to turnback[e]
00:29:13	Total

HAY - NEW

00:19:11	HAY - OCT (includes dwell time)[a]
00:02:51	OCT - NEW (includes 25 seconds dwell time)[a]
00:06:01	AM junction delay (HAY - NEW)[b]
00:01:30	Additional delay between HAY- NEW
	10 seconds on each leg for crossover at terminal
00:00:10	Tramstop[c]
00:00:54	Additional movement from turnback to HAY[e]
00:29:07	Total
00:04:00	Minimum layover at NEW end for Haymarket service[d]
00:04:00	Minimum layover at HAY end for Haymarket service[d]
00:08:00	Total min layover
01:06:20	Minimum round trip time

Notes:

[a] Data from 'Edinburgh Tram Network Stage 3 Runtime Simulation Report' (Doc Ref: ULE90130-SW-REP-00238v2).

[b] Data from 'Mott Macdonald Report - Traffic Interface Report' (Doc Ref: 0003048//REVC/241103). AM Junction delays between Haymarket and Leith Walk have been used as greater than PM delays.

[c] Transdev estimate of additional time to move through the crossover at the terminus / turnback

[d] Layover calculated from [Table 17 – Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario)] Table 17 - Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario)

[e] Transdev estimate of runtime between HAY and Haymarket Turnback (20kph over 300m = 5.6m/s over 300m = 54 seconds)

2.20 Summary to Establish Fleet Size

The minimum round trip times determined in Section 2.19 above are used in Tables 15 to 18 to determine the tram Peak Vehicle Requirement (PVR) and fleet size for Phase 1a & Phase 1b:

	OCT - AIR service	NER - HAY service	NER - GRS service
Service used on Phase	1a and 1b	1a only	1b only
Headway (min:sec)	10:00	10:00	10:00
Trams per hour	6	6	6
Minimum round trip time (hr:min:sec)	01:53:25	01:06:20	01:38:52
Actual round trip time needed to provide required headways and minimum layover (hr:min:sec)	02:00:00	01:10:00	01:40:00
Total additional layover to achieve headways (min:sec)	06:35	03:40	01:08
Peak number of trams	12	7	10

Table 15 - Number of Trams needed for each service (based on 6 & 6 Trams per hour scenario)

Network Option	1a	1a and 1b
PVR	19	22
Standby/maintenance/repair/training	3	3
Total tram fleet required	22	25

Table 16 - Number of Trams needed for each Phase (based on 6 & 6 Trams per hour scenario)

	OCT - AIR service	NEW - HAY service	NEW - GRT service
Service used on Phase	1a and 1b	1a only	1b only
Headway (min:sec)	07:30	07:30	07:30
Trams per hour	8	8	8
Minimum round trip time (hr:min:sec)	01:50:55	01:06:20	01:37:22
Actual round trip time needed to provide required headways & minimum layover (hr:min:sec)	01:52:30	01:07:30	01:37:30
Total additional layover to achieve headways (min:sec)	01:35	01:10	0:08
Peak number of trams	15	9	13

Table 17 - Number of Trams needed for each service (based on 8 & 8 Trams per hour scenario)

Network Option	1a	1a and 1b
PVR	24	28
Standby/maintenance/repair/training	3	3
Total tram fleet required	27	31

Table 18 - Number of Trams needed for each Phase (based on 8 & 8 Trams per hour scenario)

2.21 Tram Fleet Kilometre Usage

The journey times and fleet sizes calculated above can be used to derive an approximate annual fleet and per Tram kilometre run of:

INITIAL OPERATING TIMETABLE

6tph	Daily	Days	Km	6tph	Daily	Days	Km
Weekdays	5531	261	1443591	Weekdays	7103	261	1853883
Saturdays	5363	52	278876	Saturdays	6950	52	361400
Sundays	5318	52	276536	Sundays	6815	52	354380
Total			**1999003**	**Total**			**2569663**
Per Tram 27 trams			**74037**	**Per Tram 27 trams**			**95173**
ENHANCED AM & PM PEAK SERVICE							
8tph	**Daily**	**Days**	**Km**	**8tph**	**Daily**	**Days**	**Km**
Weekdays	6217	261	1622596	Weekdays	7840	261	2046240
Saturdays	5363	52	320150	Saturdays	6950	52	361400
Sundays	5318	52	276536	Sundays	6815	52	354380
Total			**2219282**	**Total**			**2762020**
Per Tram 27 trams			**82196**	**Per Tram 31 trams**			**89097**
FLAT DAYTIME PEAK SERVICE							
8tph	**Daily**	**Days**	**Km**	**8tph**	**Daily**	**Days**	**Km**
Weekdays	7436	261	1940796	Weekdays	9347	261	2439567
Saturdays	7292	52	379184	Saturdays	9224	52	479648
Sundays	5318	52	276536	Sundays	6815	52	354380
Total			**2596516**	**Total**			**3273595**
Per Tram 27 trams			**96167**	**Per Tram 31 trams**			**105600**

Figure 7 – Operational Timetable

The principal assumptions are:

- 'Empty' running to and from the Depot is included;

3 General

3.1 Definitions

In these Employer's Requirements, Schedule 1 (Definitions and Interpretation) and the following definitions shall apply:

Table 19 - Definitions

Term	Definition
Act	An Act of Parliament or the Scottish Parliament following consideration and approval of a Bill
AFC	Automatic Fare Collection (see also TVM)
AIP	Approval in Principle for structures
ALARP	As low as reasonably practicable
Approval	(see Consent); also an approval of detail by an authority where consent is deemed to be granted by with prior conditions.
AutoCAD	Proprietary software used for engineering design
AW0 – AW5	Standard loading conditions for Tram Vehicles defined at Section 22.2.3
BRB	British Railways Board
BS	British Standard
CAA	Civil Aviation Authority
Case for Safety	All necessary documentation, information and other requirements pursuant to the Railways and Other Guided Transport Systems (Safety) Regulations 2006;
CAR	Corrective Action Report
CCTV	Closed Circuit Television
CIBSE	Chartered Institute of Building Services Engineers
CMS	Central Management System
COCP	Code of Construction Practice
COMP	Code of Maintenance Practice
Communications Plan	The Plan to be developed in accordance with the Employer's Requirements
COSHH	Control of Substances Hazardous to Health Regulations 1998
DAT	Delivery Acceptance Test
DCCB	Direct Current Circuit Breaker
DDA	Disability Discrimination Act
Developed	The enlarged Kinematic Envelope that takes into account all of the possible effects of

Term	Definition
Kinematic Envelope (DKE)	curvature, including superelevation of the track together with end and centre throw of the Tram. It is speed dependent and unique to a particular location at a given speed (See also Static Envelope, Dynamic Envelope and Kinematic Envelope) (See also RSPG Part 2 Section G – Guidance on Tramways).
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DSD	Drivers Safety Device
Dynamic Envelope	The Static Envelope enlarged to the maximum possible displacement of the Tram in motion on straight track. It takes into account suspension characteristics and allowances for maintenance and wear of Trams. (End and Centre throw is not included.) (See also Static Envelope, Kinematic Envelope and Developed Kinematic Envelope.) (See also RSPG Part 2 Section G – Guidance on Tramways)
EDMS	Electronic Document Management System
EIA	Environmental Impact Assessment
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMP	Environmental Management Plan
Enhanced Timetable	The Timetable described at Part 1a with 16 trams per hour Hay to Oct
ES	Environmental Statement
FAT	Factory Acceptance Test
GDPO	Town and Country Planning (General Development Procedure)(Scotland) Order 1992
GPR	Ground penetrating radar
Grandfather Rights	A longstanding right where the original reason and date of the granting of the right is unknown
GSN	Goal Structured Notation
HCI	Human Computer Interface
HF	Human Factors
HLM	High Level Model
HMRI	Her Majesty's Railway Inspectorate (or the appropriate approval regime in force)
HS	Historic Scotland
HSCB	High Speed Circuit Breaker
HVAC	Heating, Ventilating and Air Conditioning
ICP	Independent Competent Person
ISO	International Organisation for Standardisation
ITSO	Integrated Transport Smartcard Organisation - a non profit sharing, member owned organisation supported by the Department for Transport

Term	Definition
ItN	Invitation to Negotiate
JRC	Joint Revenue Committee
Kinematic Envelope (DKE)	The Dynamic Envelope enlarged to allow for the permitted tolerances in track gauge, alignment, level and cross-level and the dynamic and static effects of track wear. It is speed dependant. See also Static Envelope, Dynamic Envelope and Developed Kinematic Envelope. (See also RSPG Part 2 Section G – Guidance on Tramways)
LBC	Listed Building Consent
LHMP	Landscape and Habitat Management Plan
Lifecycle Replacement Plan	The Plan to be developed in accordance with the Employer's Requirements
Line 3	A planned extension of the Edinburgh Tram Network to the south east. Line 3 is not currently being progressed although some safeguarding provisions are required.
LRU	Line Replaceable Unit
LRV	Light Rail Vehicle
Maintainer	Infrastructure and Tram Vehicle maintenance
Markov Analysis	Reliability modelling method
MUDFA	Multi-Utilities Diversion Framework Agreement
MX	Proprietary software used for engineering design
NCR	Non Conformance Report
NR	Network Rail
OEM	Original Equipment Manufacturer
OLE	Overhead Line Equipment
Operational Timetable	The Timetable described at [Table 2 – First and Last Trams for the 6 & 6 Tram per Hour Operational Timetable Table 2 – First and Last Tram Times for the 6 & 6 Tram per Hour Operational Timetable - Hay to Oct
ORR	Office of Rail Regulation
ORS	Operational Radio System
OTMR	On Tram Monitoring and Recording
PA	Public Address System
Pan	Pantograph
PCC	Point Control Cabinet
PCS	Point Control System
PHC	Point Heating Cabinet
PHP	Passenger Help Point
PEHP	Passenger Emergency Help Point

Term	Definition
PID	Passenger Information Display
Prior Approval	Written approval by any approving body evidencing prior consent.
QA	Quality Assurance
Quality Management Plan	The Plan to be developed in accordance with the Employer's Requirements
RAMS	Reliability, Availability, Maintainability and Safety
RSPG	Railway Safety Principles and Guidance
RSP2	Ralilway Safety Publication 2 – Guidance on Tramways
RTPI	Real Time Passenger Information
RVAR	Rail Vehicle Accessibility Regulations
Safety Management Plan	The Plan to be developed in accordance with the Employer's Requirements
SAT	System Acceptance Test
SCADA	Supervisory, Control and Data Acquisition
SCC	Supervisory Control and Communications
SCT	Site Commissioning Test
SEPA	Scottish Environment Protection Agency
Shadow Running	Validation of the Operational Timetable without carrying passengers
SIT	System Integration Test
SP	Swept Path
SSSI	Site of Special Scientific Interest
STAG	Scottish Transport Assessment Guidance
Static Envelope	The maximum cross-section of Trams loaded or unloaded at rest on straight and level track, taking account of tolerances in the manufacture of the trams and the effects on the suspension of tram loading and tram loads arising from the wind and other weather. See also Dynamic Envelope, Kinematic Envelope, and Developed Kinematic Envelope. (See also RSPG Part 2 Section G – Guidance on Tramways)
Sub-System	An individual technical element e.g. communications, Tram etc.
SUC	Statutory Utility Company
SUDS	Sustainable Urban Drainage System ('soakaways')
The System	Collectively the technical sub-systems that together form the Edinburgh Tram Network.
System Interface	The interaction point between the sub-systems
Test Plan	The proposals developed by the Infraco for the structured and programmed testing of the components and the System

Term	Definition
Test T1 – T5	Formal Test requirements defined at Tests and Commissioning
TPDS	Tram Position and Detection System
Tramway Path	The area reserved for a moving tram in its environment. (See also RSP2 – Guidance on Tramways)
Transdev	"Transdev Edinburgh Tram Limited" (TETL) the Edinburgh Tram Network Operator
TRO	Traffic Regulation Order
TRY	Test Reference Year
TTRO	Temporary Traffic Regulation Order
TSS	Traction Sub-Station
TSS	Technical Support Services – advisors to **tie**.
TVM	Ticket Vending Machine (see also AFC)
UTC	Urban Traffic Control
UPS	Uninterruptible Power Supply
WBS	Work Breakdown Structure
WEBS	West of Edinburgh Busway Scheme

3.2 Infraco Services

3.3 General

This section provides a summary of the services that shall be required to be undertaken by the Infraco throughout the duration of the Infraco Works, or during particular stages of the Infraco Works, as appropriate.

3.4 Management and Technical Services

3.5 Summary of Deliverables

This section summarises the Deliverables that shall be provided by the Infraco. The Deliverables shall be provided in accordance with the requirements of the Agreement and shall be reviewed in accordance with the Review Procedure.

The Infraco shall complete the Deliverables set out hereunder, in the timescales agreed, and as identified in the Submittal Programme referred to.

In addition to the required Deliverables, this section also develops, where appropriate, the management and technical systems and services that shall be required to be provided by the Infraco to meet these Employer's Requirements. The Infraco shall develop and submit the following Deliverables for approval by **tie** in accordance with the Review Procedure.

Table 20 - Table showing Summary of Deliverables

Communications, Meetings and Reporting
Communications Plan
Meetings Schedule
Progress Photos
Progress Reports
Site Reports
Topics Register
Programme
Programme to include Design, Construction, Snagging, Commissioning, training, shadow running and opening to passenger service
Time Chainage Diagram
Management Plans
Construction Health and Safety Plan

Construction Plan
Construction Stage Environmental & Sustainability Management Plan(s)
Documentation associated with the completion of all research, surveys and inspections
Environmental Action Plan (EAP)
Infraco KPI Reporting
Infraco Performance Measurement
Network Rail Interface Plan
Overall Approvals Management Plan and Approvals Management Plan
Project Health & Safety File
Project Management Plan
Quality Forms (associated with the Project Safety and Quality Interface document)
Quality Management Plan
Research, Surveys and Inspections
Safety Forms associated with the Project Safety and Quality Interface document.
Safety Management Plan
Schedule of Internal Audits
System Safety Management Plan
Testing and Commissioning Plans
Training Plans

Design Deliverables

Earthing and Bonding Plan
Case for Safety for the Network or Geographical Sections as applicable
Design Stage Configuration Management Plan
Design Stage Verification & Validation Plan
Detailed Cause Consequence Analysis
Functional Hazard Analysis
Hazard Log & Risk Register
Interface Control Documents
Interface Schedules
List of Applicable Standards
Procurement Plan
Requirements Specification / Database
Scheme Plan
Road Network Plan of affected areas
System Architecture Specification
System Design Specification
System Design Test Specification
System Interface Management Plan
System Interface Register

Detailed drawings and other detailed design documentation
Archaeological & Heritage Mitigation Plan
Boundaries Treatment Management Plan
Construction Advice
Construction Site Drainage Plan
Initial and Final Buildability Reports
Landscape and Habitat Management Plan
Method of Working around Protected Species
Other construction advice as noted
Procedures for dealing with Unidentified Apparatus or Recorded Artificial Obstructions
Schedule 3 (Code of Construction Practice) Deliverables
Schedule and Conditional Surveys of Structures / Buildings Documentation (Dilapidation)
Strategy for controlling Invasive and Alien Species
Survey Photographs of Reinstatement Work
Temporary Works, Security and Fencing Arrangements Plan
Waste Management Plan

Cost Management
Actual / Planned / Forecast Spend Tables / Curves
Change Control Schedule and background information
Cost Loaded Programme / Earned Value Analysis based on WBS structure
Cost Report
Schedule of Compensation Events and background information
Value Management Estimates / Analysis

Risk
Commissioning Risk Control Report
Construction Risk Control Report
Infraco Assumptions Register
Infraco Risk Management Plan
Infraco Risk Register
Operational and Maintenance Report
Residual Risk Control Report
Risk Progress Reports

Traffic Management and TTROs
Access Control Permit Procedures
Access Control Permits and Permits to Work
Permits to Work and Utility Permits to Work Procedures
Traffic Management and Work Site Staging Plan
TTRO Obligations and Traffic Management Procedures

Method Statements
Method Statements
Schedule and Conditional Surveys of Structures / Buildings and Documentation (to avoid delay to the Service Commencement Date)
Survey Photographs of Reinstatement Work
Surveys of Structures which may affect Progress
Stakeholder Management Deliverables
Communications Log
Information for the **tie** monthly newsletter
Procurement Schedule
Traffic Routing Map
Weekly Newsletter
Weekly updates of Progress
Other Deliverables as defined below:
Asset Register
Documentation - As-built Design Drawings
Infrastructure Maintenance Plan
Maintenance Plan
O&M manuals
Overall Approvals Management Plan and Approvals Management Plan
Overall Test and Commissioning Plan
Simulation
Spare Parts manuals
Spare Parts, Tools & Test Equipment
Staffing Plan and Recruitment, Retention and Training Plan
System Acceptance
System Integration – including System Integration Plan

3.6 Design

3.6.1 General Obligations

The Infraco shall be responsible for the complete design of the Edinburgh Tram Network including the achievement of full compliance with the Employer's Requirements. The Infraco shall be responsible for achieving the following:

- The Deliverables necessary to enable the Edinburgh Tram Network to be procured, constructed, tested, commissioned and brought into commercial service and consistent with the requirements for training and Case for Safety (taking account of the need to fully co-ordinate these activities, including with other physically-related projects, so as to minimise overall disruption) to meet these Employer's Requirements and the Programme.

- The Infraco shall produce a tram service simulation that will demonstrate that its implementation of the design will achieve the required run times, power consumption and service performance where defined in these Employer's Requirements;

- The Infraco shall ensure that the design covers all aspects of the Edinburgh Tram Network and the associated works as defined in these Employer's Requirements;

- The Infraco shall approach the design and technical services in a structured manner using a recognised 'V' life cycle model with regard to the integration of design engineering, systems engineering and safety engineering activities;

- The Infraco shall be responsible for ensuring that there are no gaps and omissions in the specification and design of the Edinburgh Tram Network;

- The Infraco shall demonstrate that the design has properly considered and adopted the most advantageous whole life cost solutions;

3.6.2 Design Approach

The design approach shall be as set out in the SDS Agreement. The Infraco shall:

- Adopt, develop and adapt the SDS Management Plans covering Configuration Management and Verification and Validation.

- Undertake such supplementary safety analysis that will allow further development of the Case for Safety concurrent with any design undertaken to prove that the Edinburgh Tram Network is acceptably safe;
- Where any new technologies are proposed by the Infraco, submit reports and presentations analysing and assessing the options and justifying the final selections of technologies in terms of time, cost, quality, safety, risk and maintainability, for review by **tie**;
- Prepare and maintain the Risk and Hazard Log;
- Prepare and maintain the System Architecture Specification;
- Prepare and maintain the System Design Specification;
- Prepare and maintain the System Design Test Specification;
- Prepare and maintain the Functional Hazard Analysis;
- Prepare and maintain the Detailed Cause Consequence Analysis;
- Prepare and maintain the Requirements Specification / Database;
- Prepare and maintain the Scheme Plan;
- Prepare and maintain the Procurement Plan;
- Prepare and maintain the Interface Schedules;
- Prepare and maintain the Earthing and Bonding Plan;
- Prepare and maintain the detailed drawings and other detailed design documentation;

3.6.3 Transport Modelling

The Infraco shall procure that the SDS provider performs its obligations in respect of transport modelling as such obligations are set out in the SDS Agreement. In respect of detailed traffic signal modelling, Infraco shall provide adeq uate modelling upon which to base its design.

- detailed traffic junction design recognition and evaluation and wider area effect assessment;
- temporary traffic diversion and traffic regulation order impact analysis as defined in section [12.12]

3.6.4 Environmental

All equipment shall meet its required operational functionality in accordance with these Employer's Requirements. The Edinburgh Tram Network and its components shall take cognisance of, inter alia, the following factors: electrical interference, dust, vibration, supply voltage variations, radio signal variations, solar radiation, temperature, humidity, salt, mist, wind, precipitation, snow etc.

Table 21 shows average temperature and humidity conditions for the region. Based on the given information all equipment shall be suitable for a working life as defined in Design Life of these Employer's Requirements under maximum ambient temperature range from – 9° to + 28 ° C, unless otherwise agreed by **tie**.

Edinburgh (eastern Scotland)

Sunshine (average hours per day)		Temperatures								Precipitation and humidity				Wet days (more than 0.1 mm/0.004 in)	
		Average daily minimum		Average daily maximum		Highest recorded		Lowest recorded		Relative humidity 900 x		Average monthly precipitation			
		°C	°F	°C	°F	°C	°F	°C	°F	%		mm	in		
Jan	2	1	34	6	42	14	57	-8	17	84		57	2	17	Jan
Feb	3	1	34	6	43	14	58	-9	15	83		39	2	15	Feb
March	4	2	36	8	46	20	68	-6	21	81		39	2	15	March
April	5	4	39	11	51	22	72	-4	25	75		39	2	14	April
May	6	6	43	14	56	24	76	-1	31	76		54	2	14	May
June	6	9	49	17	62	28	83	3	37	75		47	2	15	June
July	5	11	52	18	65	28	83	6	42	78		83	3	17	July
Aug	4	11	52	18	64	28	82	4	40	80		77	3	16	Aug
Sept	4	9	49	16	60	25	77	1	33	80		57	2	16	Sept
Oct	3	7	44	12	54	20	68	-2	28	82		65	3	17	Oct
Nov	2	4	39	9	48	19	67	-4	24	83		62	2	17	Nov
Dec	1	2	36	7	44	14	58	-7	20	84		57	2	18	Dec

Based on readings for 30 years at 55°55' N, 3°11' W, altitude 134 m/440 ft.

Where equipment is enclosed in equipment housings / enclosures the equipment contained therein shall be capable of operating at an external ambient temperature 15°C higher than the upper limit and at a temperature of 5°C lower than the figures in Table [21] taking into account any heat generated by the equipment.

All equipment housings / enclosures that contain electronic equipment shall be so equipped to minimise the occurrence of condensation within the enclosure.

The following data in Figures [8 & 9] are based on the Edinburgh Test Reference Year (TRY) as given by CIBSE. It is a synthesised weather year based on 20 years of record data. CIBSE recommend that this type of weather data be used for analysing energy use and overall environmental performance.

Temperature

Dry Bulb Temperature	MAX 26.7°C	MIN –10.1°C	MEAN 8.43°C
Wet Bulb Temperature	MAX 18.9°C	MIN –10.7°C	MEAN 6.82°C

Figure 8 - Dry Bulb Temperature Analysis 1: Number of Hours per Year That the Dry Bulb Temperature is Greater Than the Given Value

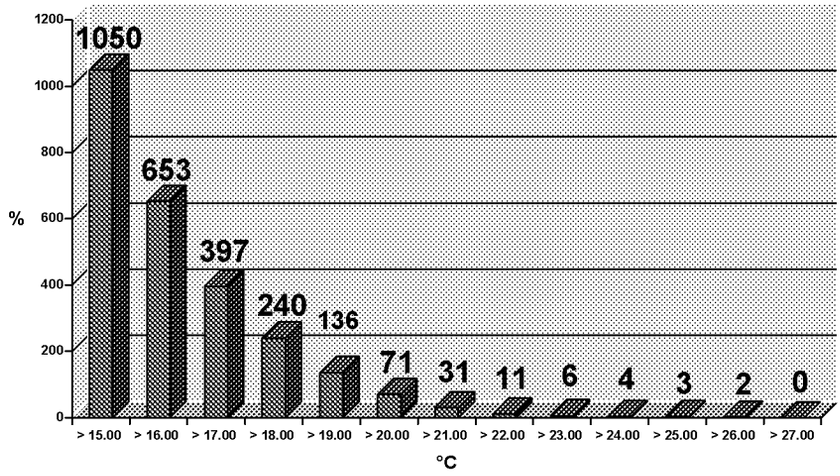
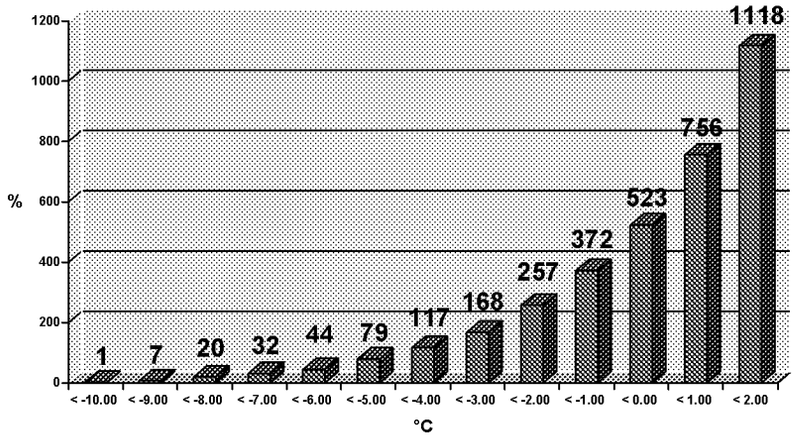


Figure 9 - Dry Bulb Temperature Analysis 2: Number of Hours per Year That the Dry Bulb Temperature is Less Than the Given Value



Wind Speed MAX 19.5m/s MIN 0m/s MEAN 4.6m/s

3.7 Construction-related Deliverables (Schedule 3 Requirements)

The following deliverables, from and with regard to *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)* are highlighted for submission in accordance with the Review Procedure:

- In accordance with Schedule 3 (Code of Construction Practice and Code of Maintenance Practice), the Infraco shall compile a schedule of all buildings, or other structures, which may be at risk of physical damage as a result of the Infraco Works. Furthermore records of the condition and surveys of any defects shall be prepared by the Infraco;

- Under Schedule 3 (Code of Construction Practice and Code of Maintenance Practice) there is a requirement for the Infraco to undertake works to address defects in existing structures, caused by the Infraco Works. Where such work is completed the Infraco shall be required to take appropriate photographs to fully demonstrate the quality of the reinstatement works;

- The Infraco shall prepare and develop the "Waste Management Plan" in accordance with *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*

- The Infraco shall prepare and develop the "Construction Site Drainage Plan" in accordance with *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*.

- The Infraco shall prepare and develop the "Landscape and Habitat Management Plan" in accordance with *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*.

- The Infraco shall develop "Mitigation Measures for Working around Protected Species" in accordance with *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*.

- The Infraco shall develop the strategy for controlling "Invasive and Alien Species", in accordance with the requirements of *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*. This shall be further developed, and services shall be implemented by the Infraco, as further described in *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*.

- The Infraco shall develop an "Archaeological and Heritage Mitigation Plan" in accordance with the requirements of *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*. This shall be further developed, and services shall be implemented by the Infraco, as

further described in *Schedule 3 (Code of Construction Practice and Code of Maintenance Practice)*.

3.8 Construction Advice and Buildability

The Infraco shall be required to develop an Initial Buildability Report and Final Buildability Report in accordance with the Review Procedure.

The Initial Buildability report shall be required to address the following.

- Be structured to reflect the various sections of the works and/or manageable elements within these sections.
- Achieve economically efficient design and buildability in accordance with Good Industry Practice.
- The Initial Buildability Report shall include proposals in relation to buildability, Temporary Works, access to premises or properties and the staging of Work Sites. The Infraco shall propose cost and time-saving initiatives and explore mitigation measures which are reasonably predicted by Infraco to be required to protect the interests any of third parties affected by the Infraco Works.

The Infraco shall provide a Final Buildability Report in accordance with the Review Procedure, which shall address the following.

- The Infraco shall propose construction methods which shall be utilised in respect of the Infraco Works. The Infraco shall also advise **tie** on the time and cost implications of any alternative solutions proposed by the Infraco in the Initial Buildability Report and which have been accepted by **tie**. The Infraco shall initiate the requirements for Temporary Works, and the programme for approvals for such Temporary Works and their execution.
- Notwithstanding the Infraco's obligations with respect to compliance with the third party agreements, the Infraco shall advise **tie** on the potential impact of the Infraco Works upon neighbouring occupiers and users of nearby roads, railways, buildings and airport facilities and the Infraco shall plan the execution of the Infraco Works in such a way as to minimise disruption and prevent nuisance.
- The Infraco shall advise **tie** on the provision and layout of the main site office and local Work Sector / Work Section facilities and services to be provided or secured by the Infraco. **tie**'s requirements for office accommodation at the main site office are expressed in this section.

The Infraco shall prepare, maintain and comply with plans, schedules and drawings that shall show the Infraco's proposals for temporary works, security and fencing arrangements throughout the duration of the Infraco Works ("Temporary Works, Security and Fencing Arrangements Plan").

3.9 Site Support Facilities for tie

The Infraco shall be responsible for the provision, servicing, maintenance and removal of the specified **tie** office accommodation and transport for the use of **tie** officers and staff

The Infraco shall provide and maintain fully serviced office accommodation and furnishings throughout the duration of the Infraco Works, in accordance with the following requirements:

- Office accommodation to accommodate 10 desks (Infraco supply) each with at least one secure lockable drawer, a swivel cloth upholstered chair. ;
- Three separate offices with a minimum working space of $16m^2$;
- 2 meeting rooms suitable for sitting up to 20 and 8 people respectively;
- Male and female toilets. Minimum area $3m^2$ each;
- Changing/Locker facilities;
- Kitchen facilities;
- Drying facilities;
- Male & Female shower room;
- Parking for up to 15 cars.

The Infraco shall prepare and submit an office layout based on the accommodation description set out below for approval by **tie**.

The Infraco shall integrate this accommodation with the Infraco's own accommodation and, subject to proposals which are acceptable to **tie**, the meeting rooms and welfare facilities may be shared by the Infraco.

3.9.1 Fittings and Furnishings

The Infraco shall also provide the following as minimum requirements:

General Office

- 7 x 4 drawer lockable metal filing cabinets
- 6 wall mounted notice board 1m high 1.5m wide
- 10 waste paper baskets
- 10 telephones connected to 2 lines
- 1 fax machine connected to a separate dedicated line
- 1 high output combined printer and photocopier capable of producing A4 and A3 black and white copies
- 10 connections to internet via broadband, all able to connect at same time
- 1 plan layout table 1 x 2 m
- 1 A0 drawing board and drafting equipment
- 10 desk lamps
- 10 letter tray/ filing baskets
- 2 m of book shelves at 6 of the desks
- 6 large white boards

Meeting Rooms

- Suitably sized tables and the requisite number of chairs for each of the two meeting rooms referred to above.

- 3 flip charts and flip chart paper as required and 1 large wall mounted white board in each meeting room

Changing / drying room

- Lockers c/w locks and keys for 30 people
- 4 chairs
- 30 coat pegs mounted on wall
- 1 boot pull.

General

- A security alarm system
- Access doors, fitted with five lever mortice locks and 6 sets of keys

3.9.2 Services

The Infraco shall provide, install and maintain all the services i.e. Gas, electric, water, drainage, telephone (two lines), broadband etc necessary to ensure effective occupation by **tie** of the accommodation for the duration of the Infraco Works

The Infraco shall provide install and maintain a printer/photocopier capable of producing A4 and A3 size black and white photocopies. The Infraco shall ensure that sufficient stocks of consumables (including paper and toner) are available at all times. Subject to acceptable proposals, the photocopier / fax may be shared by the Infraco and **tie**.

The Infraco shall provide tea, coffee, sugar fresh milk and a supply of drinking water for use by **tie** for the duration of the Infraco Works.

The Infraco shall arrange for the servicing and daily cleaning of the accommodation.

Toilet paper, paper towels, soap, and detergents shall be provided by the Infraco as required.

3.9.3 Equipment

The Infraco shall provide the following equipment for the exclusive use of **tie** throughout the duration of the Infraco Works:

- 10 x 10m long steel tape measures
- 10 x 50m long tape measures
- 10 x high output hand-held torches
- 2 approved electronic utility tracers for tracing/locating cables and pipes
- other consumables as may be required by **tie** (i.e. marker paint etc.).

The Infraco shall provide surveying/setting out services to **tie** as reasonably required, in connection with the Infraco Works.

3.9.4 Site Vehicles

The Infraco shall provide, licence, insure (comprehensive for any qualified driver together with any authorised passengers and the carriage of goods or samples), service and maintain four 4 wheeled road vehicles (suitable for the Edinburgh Tram Network) and visitor transport for the exclusive use of **tie**'s representative and staff to enable them to carry out their duties for the duration of the Agreement. The number and type shall be to the specific approval of **tie**.

The vehicles shall be delivered and maintained by the Infraco in good, roadworthy condition.

The Infraco shall provide fuel, oil and maintenance in conformity with the vehicle manufacturers' recommendations and shall clean the vehicles inside and outside as required by **tie**.

A suitable replacement vehicle shall be provided by the Infraco in the event any vehicle being out of service for more than 24 hours.

The Infraco shall ensure that each vehicle shall be fitted with approved warning beacons and any other safety equipment as required for work on roads or within the boundaries of the Edinburgh International Airport.

3.10 Spare Parts, Tools and Test Equipment

The Infraco shall be responsible for the provision, delivery, offloading and placing into stores of the necessary Spares Parts, Tools & Test Equipment.

Detailed requirements and deliverables in respect of the Spares Parts, tools and Test Equipment responsibilities are included in the Agreement.

3.11 Documentation

The Infraco shall be responsible for the provision of all as built / constructed / manufactured drawings, manufacturers information, test certification and other documentation to be provided inaccordance with the Agreement.

Detailed requirements and Deliverables in respect of the documentation responsibilities are included within the Agreement and the Maintenance section of these Employer's Requirements.

3.12 Training

The Infraco shall be responsible for all necessary initial training associated with the operation and maintenance of the Edinburgh Tram Network. Detailed requirements and deliverables in respect of the Training responsibilities are included within Section 40 (*Maintenance*) of these Employer's Requirements.

4 Use of Industry Standard Equipment

The Infraco shall base its system supply on Commercial Off the Shelf (COTS) equipment and software. The use of proprietary equipment and software which is not available on a COTS basis is prohibited unless prior written agreement has been obtained from **tie,** other than that which is specified in the Infraco Proposal.

This is to allow the maintenance, extension and modification of the ETN by third party suppliers and maintainers if necessary.

All electronic interfaces between subsystems shall use open standards and shall utilise non-proprietary protocol.

5 System Identity and Branding

A single system identity shall be applied to the ETN. This shall be developed by **tie** through a specialist contractor appointed by **tie**. The output of this contract with the specialist contractor shall be a documented set of design guidelines which shall be incorporated into this Agreement [XX Schedule ?] and which shall be complied with by the Infraco in respect of the Infraco Works. The design guidelines shall include the following elements:

- Logo and other elements of the ETN's graphic identity;
- Signage;
- Application of the systems identity to the following:
  - Ticket machines;
  - Stop furniture;
  - Passenger information;
  - Depot.
- Tram livery;
- Tram interior;
- Uniforms;
- Pictograms;
- Other aspects of the ETN which are visible to the public.

6 Design Life

The equipment and systems to be supplied for the Edinburgh Tram Network shall be designed and built by the Infraco to a standard that shall ensure the System as a whole is capable of continuous operation for a minimum period of 15 years from the Service Commencement Date for each Phase.

Individual items of Infrastructure and equipment shall have a design life as indicated in the table below. Where the design life for an item of equipment is not specified, a minimum of 15 years shall be assumed. All design lives are from the Service Commencement Date for each Phase.

Item of Equipment or System	Design Life
Trams	30 years
Structures	120 years
Track Bed	50 years
Track	25 years
Rails in Straight Lines	20 years
OLE	30 years
Power Cables	30 years
Substations and Substation Equipment	30 years
Tramstop Platforms	50 years
Tramstop Superstructure (including shelters and poles)	25 years
Tram Position and Detection equipment	15 years
Passenger Information Displays	10 years
Telephone Handsets	10 years
Telephone PABX	15 years
Voice recorder	15 years
PA Controller	10 years
Loudspeakers	15 years
Hand Portable Radio Handsets	5 years
Vehicle Mobile Radio Equipment	7 years

Item of Equipment or System	Design Life
Radio Base Station Equipment	15 years
Radio Masts and Antennae	15 years
Passenger Help Points	15 years
CCTV cameras	7 years
CCTV Digital Video Recorders	7 years
SCADA outstations	20 years
Fibre Optic Cabling and Patch Panels	25 years
Fibre Optic Switches, Routers, Hubs	15 years
Other communications equipment	15 years
Cabinets	25 years
UPS systems (excluding batteries)	15 years
Copper Communications Cables	25 years
Batteries (if employed)	4 years
Workstations including Monitors	5 years
Servers	5 years
Standard hand tools	5 years
Portable electrical tools	7 years

Table 22 - Equipment Design Life

7 Extensibility

The table below sets out the assumptions being made in the design of Phase 1a and Phase 1b to allow Phases 2 and 3 to be added with minimum change, and also for future increase in service levels on Phase 1a/1b (over the "8+8" pattern) and for the addition on the proposed Line 3 (assumed routing Bridges-Princes St-Haymarket).

Area	Topic	Phase 1a/1b Design Basis	Provision for Phases 2 and 3	Provision for Phase 1a/1b increased service	Provision for ETL3 (Edinburgh Tram Line 3)	Provisions for other purposes
Track Layout	Roseburn Junction/Delta	Design for full delta	n/a		n/a	n/a
	Balgreen loop and crossover	Design for loop and crossover	n/a		n/a	n/a
	Granton Square	Design for interim terminus	Design for track continuation; build initial as over-run for terminus	n/a	n/a	n/a
	Newhaven	Design for interim terminus	Design for track continuation	n/a	n/a	n/a

Area	Topic	Phase 1a/1b Design Basis	Provision for Phases 2 and 3	Provision for Phase 1a/1b increased service	Provision for ETL3 (Edinburgh Tram Line 3)	Provisions for other purposes
	Ingliston Junction and P&R Tramstop	Make provision for Phase 3 and long-term aspirations	Alignment design not to preclude an allowance terminating Phase 3 service at Ingliston P&R and for East-West continuation from Phase 1	n/a	n/a	n/a
	Track alignment at Princes St/South St Andrew St Junction	Make Provision for Line 3	n/a	n/a	Alignment to allow pointwork and appropriate future traffic management(See CR078)	n/a
Modelling	Network modelling inc. for TSJs	To support 8+8 service	None	None	None	n/a
Traction Power	Traction Power Supply system (Substations/OLE/cabling)	To support 8+8 service +50% addition	Part of basic design	In basic design	Effectively in basic design, as an alternative use of the increased service design provision	n/a

Area	Topic	Phase 1a/1b Design Basis	Provision for Phases 2 and 3	Provision for Phase 1a/1b increased service	Provision for ETL3 (Edinburgh Tram Line 3)	Provisions for other purposes
	Definition of Power characteristics (and other parameters for modelling)	Full traction characteristic of the selected tram	n/a	n/a	n/a	n/a
Depot	Stabling sidings	Design for 35, build for 27	Inc. in 8 extra	Inc. in 8 extra	Not specifically included	n/a
	Workshop	8 Berths theoretical maximum; (practically:4 berths plus 2 service roads)	Initial design would accommodate	Initial design would accommodate	Not specifically included	n/a
	Depot staff accommodation	Numbers to be accommodated nominally match fleet that could be accommodated	Initial design would accommodate	Initial design would accommodate	Not included	n/a
	Depot car parking	See drawings	n/a	n/a	Not included	n/a
	Depot Control Centre	Design for 5 desks; provide 3	Design layout would accommodate	Initial provision would accommodate	Design layout would accommodate	n/a

Area	Topic	Phase 1a/1b Design Basis	Provision for Phases 2 and 3	Provision for Phase 1a/1b increased service	Provision for ETL3 (Edinburgh Tram Line 3)	Provisions for other purposes
	Depot stores	Design basis	Would accommodate	Would accommodate	Not included	n/a
						n/a
SCC	ODN capacity					
	General capacity	There is an initial +50% requirement above the calculated maximum usage	TBA	TBA	TBA	n/a
	Route coding capacity	3-digit route-coding included	Included in base	n/a	Included in base	n/a
	Radio system capacity	A minimum[2] of two channels at each base station	TBA	TBA	TBA	n/a
Roads	Traffic Signalled Junction design and modelling (inc. at temporary termini)	Phase 1a/1b only	Possibly ductwork at temporary termini	n/a	None	n/a

[2] *The word maximum would allow no channels to be provided and still be compliant! Two channels ok as a minimum.*

Area	Topic	Phase 1a/1b Design Basis	Provision for Phases 2 and 3	Provision for Phase 1a/1b increased service	Provision for ETL3 (Edinburgh Tram Line 3)	Provisions for other purposes
	Traffic Management layout at Princes St/South St Andrew St	Phase 1a only	n/a	n/a	None	n/a
	Traffic signalling ductwork	Design basis	n/a	n/a	n/a	Allowance in design at locations where additional signals might be provided
Tramway Ducting	Ductwork and access chambers	A minimum of 20% addition of the number of ducts	Initial design would accommodate	Initial design would accommodate	Initial design would accommodate	n/a
Utilities	Cross-track ducts	Where agreed with the SUCs, provision of secondary spare duct	n/a	n/a	n/a	Provision in design basis

Table 23 - Extensibility Assumptions

8 Standards

8.1 Principles

Where there is no relevant standard specified in the Agreement, the Infraco Works shall comply as a minimum with relevant current British or European Standards, DfT and/or Scottish Government Publications, Standards and Technical Memoranda or IEC/ISO Standards in accordance with the order of precedence set out in section [8.2].

The Infraco Works shall comply with the ORR Safety Publication 2 and with the requirements of HMRI. Where standards do not exist, the Infraco Works shall comply with Good Industry Practice and all relevant codes of practice and guidance notes. Materials or equipment provided shall be in accordance with regulations and standards appropriate to the United Kingdom or the country of manufacture, but only where in the opinion of **tie**, compliance with the regulations and standards appropriate to the country of manufacture ensures an equivalent or higher quality than the regulations and standards appropriate to the United Kingdom. In such situations, the onus will be on the Infraco to prove that they are of an equivalent or higher quality.

Where standards are specified in these Employer's Requirements, these shall include any successor or replacement standards, announced or in force before Effective Date, which provide an equivalent or improved quality and standard.

The Infraco shall comply with standards reasonably required by the relevant Roads Authority, including any local standards and amendments to the Design Manual for Roads and Bridges.

The Infraco shall be responsible for identifying all proposed departures from standards: in these instances, the Infraco shall seek the formal approval of **tie**, and provide all details justifying the departure from standards.

The Infraco shall be responsible for making any necessary applications [ex Sharon F to check] [Has this been agreed? Subject to final agreement on Consents clauses in main agreement] to the relevant Roads Authority for departure from standards and for complying with the resulting consequences, including those arising from the failure of an application for such departure.

The Infraco shall ensure that all materials, construction and workmanship comprised in the Infraco Works meet the requirements of the British or European standards relevant to the materials used. Materials used should have a British Board of Agrément Certificate wherever reasonably possible which identifies a lifespan for that material.

8.2 Hierarchy of Precedence [xx] Sharon F to double check whole.

In general, regulations should take precedence over standards. The precedence shall be as follows:

1) European Union Regulations and directives;

2) British United Kingdom regulations [excluding such as are not applicable in Scotland];

3) Scottish Government regulations;

4) (Non European Union) International regulations.

The Infraco Works shall conform and shall be carried out with the following requirements:

(i.) Statutory documents (Acts of UK and/or Scottish Parliament? and UK and/or Scottish? Statutory Instruments);

(ii.) European Union Sstandards [should these be at (i) to be consistent with the precedence hierarchy above?];

(iii.) British Standards Institution standards;

(iv.) Scottish Government ~~DfT~~ Standards and guidance;

(v.) Local Authority sStandards (CEC);

(vi.) Statutory Utility sStandards;

(vii.) International Industry sStandards [HMRI(ROGS)/Network Rail/Third Party Agreements requirements?].

The hierarchy of standards shall be as above. When there is a conflict between the standards listed above that cannot be resolved, then the highest (in the above list) shall take precedence.

8.3 The Infraco's Responsibilities

The Infraco in its system integrator role and as the system designer shall be responsible for:

- As appropriate, the development of, and compliance to, robust management processes in respect of compliance with Law and any other relevant standards or regulations included in section [8.2].
- The identification and selection of appropriate standards for all aspects of the Infraco Works
- The identification and definition of any application limits of such standards for all aspects and at all stages of the Infraco Works (such as design, construction, testing and commissioning, operation, and maintenance) in particular at the network, System and subsystem level.
- The identification and successful resolution of any conflicts within and between the obligations contained within this section [8] and Law.

8.3.1 Applicable Standards

Applicable standards are listed in the following table.

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transiops	Depot	Trams
BS 8500 – 1: 2002	Concrete – Complementary British Standard to BS EN 206-1. Method for specifying and guidance for specifier	x	x	x			x		x	x	
BS 8500 – 2: 2002	Concrete – Complementary British Standard to BS EN 206-1. Specification for constituents material and concrete	x	x	x			x		x	x	
BRE Special Digest Nr 1	Concrete in aggressive ground.	x	x	x			x		x	x	
BS 4449: 1997	Specification for carbon steel bars for reinforcement of concrete	x	x	x			x		x	x	
BS 6744: 2001	Stainless steel bars for the reinforcement and use in concrete – Requirements and test methods	x	x	x			x		x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS EN 10210 S355 J2H	Steelwork: Hollow sections	x					x				
BS EN 10025 S355J2G3	Steelwork: All other sections	x					x			x	
BS 5400 -	Steel, Concrete and Composite Bridges	x									
BS 5400 - Part 1: 1988	General Statement (see BD 15/92)	x									
BS 5400 Part 2: 1978	Specification for Loads (See BD 37/01)	x									
BS 5400 Part 3: 2000	Code of Practice for Design of Steel Bridges	x									
BS 5400 Part 4: 1990	Code of Practice for Design of Concrete Bridges (see IA.5 and BD 24/92)	x									
BS 5400 Part 5: 1979	Code of Practice for Design of Composite Bridges (see BD 16/82)	x									
BS 5400 Part 9: 1983	Bridge Bearings (see BD 20/92)	x									
BS 5400 Part 10: 1980	Code of Practice for Fatigue (see BD 9/81)	x									

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS 5930: 1999	Code of Practice for Site Investigations	x	x	x					x	x	
BS 8666: 2000	Scheduling, Dimensioning, Bending and Cutting of Steel Reinforcement for Concrete	x	x	x			x		x	x	
BS EN 206-1: 2000	Concrete - Specification, performance, production and conformity (AMD 13189)	x	x	x			x		x	x	
BS 8500-1: 2002	Concrete – Complimentary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier.	x	x	x			x		x	x	
BA 47/99 (Aug '99)	Waterproofing and Surfacing of Concrete Bridge Decks	x									
BA 41/98 (Feb '98)	The Design and Appearance of Bridges	x									
BA 42/96 (Nov '96)	The Design of Integral Bridges	x									
BA 55/00 (May '00)	The Assessment of Bridge Substructures & Foundations, Retaining Walls & Buried Structures	x									

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BA 57/95 (Aug '95)	Design For Durability	x									
BD 2/79 (Jun '88)	Technical Approval of Highway Structures on Motorways and other Trunk Roads, Part IV: Procedures for Lighting Columns	x		x							
BD 2/89 (Oct '89)	Technical approval of DTp highway structures on motorways and other trunk roads Part 1, General Procedures	x									
BD 7/81 (Aug '81)	Weathering steel for highway structures	x									
BD 9/81 (Dec '81)	Implementation of BS 5400 Pt 10, CP for fatigue	x									
BD 12/95 (Feb '96)	Design of Corrugated Steel Buried Structures with spans not exceeding 8m (including circular Arches)	x									
BD 13/90 (Feb '91)	Design of Steel Bridges Use of BS 5400: Part 3: 1982	x									

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BD 15/92 (Dec '92)	General Principles for the Design and Construction of Bridges Use of BS 5400: Part 1: 1988	x									
BD 16/82 (Dec '82)	Design of composite bridges - Use of BS 5400 Pt 5: 1979 including Amendment No. 1 (Dec '87)	x									
BD 20/92 (Oct '92)	Bridge Bearings Use of BS 5400: Part 9: 1983	x									
BD 21/97 (Aug '97)	The Assessment of Highway Bridges and Structures Amendment No. 1 (Aug '97)	x									
BD 24/92 (Nov '92)	Design of Concrete Highway Bridges and Structures Use of BS 5400: Part 4: 1990 Including Interim Advice Note IA.5 July 1996	x									
BD 28/87 (Jul '87)	Early thermal cracking of concrete including Amendment No. 1 (Aug '89)	x									
BD 30/87 (Jul '87)	Backfilled retaining walls and bridge abutments	x									

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BD 31/87 (Jan '88)	Buried concrete box type structures	x									
BD 33/94 (Nov '94)	Expansion Joints for Use in Highway Bridge Decks	x									
BD 37/01 (Aug '01)	Loads for Highway Bridges	x									
BD 42/00 (May '00)	Design of Embedded Retaining Walls and Bridge Abutments	x									
BD 43/90 (Apr '90)	Criteria and Material for the Impregnation of Concrete Highway Structures	x									
BD 44/95 (Jan '95)	The Assessment of Concrete Highway Bridges and Structures Including Interim Advice Note IA.4 July 1996.	x									
BD 47/99 (Aug '99)	Waterproofing and Surfacing of Concrete Bridge Decks	x									
BD 48/93 (Jun '93)	The Assessment and Strengthening of Highway Bridge Supports	x									
BD 49/93 (Jan '93)	Design Rules for Aerodynamic Effects on Bridges	x									

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BD 52/93 (Apr '93)	The Design of Highway Bridge Parapets	x									
BD 56/96 (Nov '96)	The Assessment of Steel Highway Bridges and Structures	x									
BD 57/95 (Aug '95)	Design for Durability	x									
BD 58/94 (Nov '94)	The Design of Concrete Highway Bridges and Structures with External and Unbonded Prestressing	x									
BD 60/94 (Apr '94)	The Design of Highway Bridges for Vehicle Collision Loads	x									
BD 70/97 (Feb '97)	Strengthened/Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments (use of BS 8006:1995)	x									
BD 74/00 (May '00)	Foundations	x					x			x	
TD 9/93 (Jun '93)	Highway Link Design	x									

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
TD 27/96 (Aug '96)	Cross sections and headrooms	x									
ASO10	Railway sleepers – Jarrah, Karri and Wandoo.		x								
ASO11	Railway crossing timbers – Jarrah.		x								
BS EN 13674-1:2003	Specification for railway rails (partially replaces BS11)		x								
BS47	Fishplates for railway rails.		x								
BS EN 13043:2002	Aggregates for bituminous mixtures and surface treatments for roads.		x	x						x	
BS64	Specification for normal and high strength steel bolts and nuts for railways rail fishplates.		x								
BS729	Specification for hot dip galvanised coatings on iron and steel articles.		x								
BS EN 1097-3:1998	Testing aggregates. (partially replaces BS812)		x								

Specification No.	Specification Title	Structures	Track	Roads	Power Distr	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS970	Specification for wrought steels for mechanical and allied engineering purposes.		x								
BS1377	Methods of tests for soils for civil engineering purposes.	x	x	x			x			x	
BS3100 (withdrawn)	Specification for steel coatings for general engineering purposes.		x				x			x	
BS4921	Specification for sheradised coatings on iron and steel.		x				x			x	
BS EN 10270-1:2001	Specification for patented cold drawn steel wire for mechanical springs.		x								
BS6906	Methods of tests for geotextiles.		x								
BS EN 1562	Founding. Malleable cast irons.		x								
BS EN 1563	Founding. Spheroidal graphite cast iron.		x								
BS EN 13481-2	Performance requirements for fastening systems for concrete sleepers.		x								
BS EN 13481-3	Performance requirements for fastening systems for wooden sleepers.		x								

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 10002 – 1	Tensile testing of metallic materials (method of test at ambient temperature).		x								
BS EN 10025	Hot rolled products of structural steels. General technical delivery conditions		x							x	
ENAAA-2	Railway applications – Track – Fastening Systems Part 2: Performance requirements for fastening system for concrete sleepers.		x								
ISO/R887	Plain washers for metric bolts, screws and nuts.		x								
RT/E/S/40045	Network Rail Standard Electric Points Heating.		x								
UIC605OR	Protection from corrosion – measures to be taken on direct current catenaries to reduce the risks on adjacent piping and cable systems.		x								
UIC860	Technical specification for the supply of rails.		x								

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transkips	Depot	Trams
UIC861-2	Standard sections for points rails adapted to the UIC54 and 60kg/m rail sections.		x								
UIC861-3	Standard 60kg/m rail profiles – types UIC60 and 60E.		x								
UIC863	Technical specification for the supply of non-treated track support (wooden sleepers for standard and broad-gauge track and crossing timbers).		x								
UIC863-1	Use of non-European timbers for the manufacture of sleepers.		x								
UIC864-1	Technical specification for the supply of sleeper screws.		x								
UIC864-2	Technical specification for the supply of steel track bolts.		x								
UIC864-3	Technical specification for the supply of spring steel washers for use in permanent way.		x								

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
UIC864-4	Technical specification for the supply of fishplates or sections for fish-plates made of rolled steel.		x								
UIC864-5	Technical specification for the supply of rail seat pads.		x								
UIC864-6	Technical specification for the supply of baseplates and for sections for baseplates made of rolled steel.		x								
UIC864-7	Rolled profiles for baseplates for UIC rails.		x								
UIC864-8	Rolled profiles for fishplates for 54kg/m and 60kg/m rails.		x								
UIC866	Technical specification for the supply of cast manganese steel crossings for switch and crossing work.		x								
BS 1363-2:1995	13A plugs, sockets-outlets and adaptors. Part 2, Spec. for 13A switched and unswitched socket-outlets				x			x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS 1363-4:1995	13A plugs, socket-outlets and adaptors. Part 4, Spec. for 13A fused connection units switched and unswitched				x			x	x	x	
BS 3573:1990	Polyolefin copper-conducted telecommunications cables							x	x	x	
BS 4533-102.1:1990	Luminaires. Particular requirements. Part 102.1 Fixed general purpose luminaires				x				x	x	
BS 4579-1:1970 (withdrawn, replaced by BS EN 61238-1)	Performance of mechanical and compression joints in electric cable and wire connectors. Part 1 Compression joints in copper conductors				x	x	x	x	x	x	
BS 4579-2:1973	Performance of mechanical and compression joints in electric cable and wire connectors. Part 2 Compression joints in nickel, iron and plated copper conductors				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS 4662:1970 (withdrawn. replaced by BS 4662:2006)	Specification for boxes for the enclosure of electrical accessories				x	x	x	x	x	x	
BS 4737-4.1:1987	Intruder alarm systems in buildings. Part 4.1 Codes of practice. Code of practice for planning and installation				x				x	x	
BS 5225-1:1975	Photometric data for luminaires. Part 1 Photometric measurements				x				x	x	
BS 5225-3:1982	Photometric data for luminaires. Part 3 Method of photometric measurement of battery-operated emergency lighting luminaires				x				x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS 5266-1:1999	Emergency lighting. Part 1 Code of practice for the emergency lighting of premises other than cinemas and certain other specified premises used for entertainment				x				x	x	
BS 5266-3:1981	Emergency lighting. Part 3 Specification for small power relays (electromagnetic) for emergency lighting applications up to and including 32A				x				x	x	
BS 5467:1997 (equivalen european harmonisation document to be provided)	Specification for 600/1000V and 1900/3300V armoured electric cables having thermosetting insulation				x		x		x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS 546:1950	2-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors. See also Supplement No 1:1960 Specification for plugs made of resilient material				x				x	x	
BS 5486-11:1989 (withdrawn, replaced by BS EN 60439)	Low-voltage switchgear and control gear assemblies. Part 11 Specification for particular requirements of fuseboards				(withdrawn, replaced by BS EN 60439)x			x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS 5486-12:1989 (withdrawn, replaced by BS EN 60439)	Low-voltage switchgear and control gear assemblies. Part 12 Specification for particular requirements of type-tested miniature circuit-breaker boards				x			x	x	x	
BS 5499-1:2002	Graphical symbols and signs. Part 1 Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout				x				x	x	
BS 5499-3:1990	Fire safety signs, notices and graphic symbols. Part 3 Specification for internally-illuminated fire safety signs				x			x	x	x	
BS 5499-5:2002	Graphical symbols and signs. Safety signs, including fire safety signs. Part 5 Signs with specific safety meanings				x			x	x	x	
BS 5649-2:1978	Lighting columns. Part 2 Dimensions and tolerances			x					x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS 5649-5:1982	Lighting columns. Part 5 Specification for base compartments and cableways			X					X	X	
BS 5649-7:1985	Lighting columns. Part 7 Method for verification of structural design by calculation			X					X	X	
BS 5733:1995	Specification for general requirements for electrical accessories				X	X	X	X	X	X	
BS 5839-1:2002	Fire detection and alarm systems for buildings. Part 1 Code of practice for system design, installation, commissioning and maintenance				X				X	X	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS 6004:2000 (equivalen european harmonisatio n document to be provided)	Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750V, for electric power, lighting and internal wiring				x	(pl eas e pro vid e eq uiv ale n eur op ea n har mo nis atio n doc um ent)x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Trainstops	Depot	Trams
BS 6121-2:1989 (withdrawn, replaced by BS EN 50262)	Mechanical cable glands. Part 2 Specification for polymeric glands				(withdrawn, replaced by BS EN 50262)x	x	x(withdrawn; refer to "Power")	x	x	x	
BS 6133:1995	Code of practice for safe operation of lead-acid stationary batteries								x	x	
BS 6290-2:1999	Lead-acid stationary cells and batteries. Part 2 Specification for the high-performance Plant positive type								x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr	Fare Collection	OLE	SC & C	Transdepo	Depot	Trams
BS 6290-4:1997	Lead-acid stationary cells and batteries. Part 4 Specification for classifying valve regulated types								x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Trams/Depot	Depot	Trams
BS 6346:1997 (equivalent european harmonisation document to be provided)	600/1000V and 1900/3300V armoured electric cables having PVC insulation				x(please provide equivalen european harmonisation doc	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS 6651:1999 (withdrawn, replaced by BS EN 62305)	Code of Practice for protection of structures against lightning	x			(withdrawn, replaced by BS EN 62305)x	x	x(withdrawn; refer to "Power")	x	x	x	
BS 6701:1994	Code of Practice for installation of apparatus intended for connection to certain telecommunication systems				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Pwr Collection	OLE	SC & C	Transdep	Depot	Trams
BS 6724:1997 (equivalent european harmonisation document to be provided)	600/1000V and 1900/3300V armoured electric cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire				x	x	x	x	x	x	
BS 7001:1988	Interchangeability and safety of a standardized luminaire supporting coupler								x	x	
BS 7211:1998 (equivalent european harmonisation document to be provided)	Thermosetting insulated cables (non-armoured) for electric power and lighting with low emission of smoke and corrosive gases when affected by fire				x	x	x	(refer to "Power")x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS 7430:1998	Code of practice for earthing	x			x	x	x		x	x	
BS 7654:1997	Single phase street lighting fuses (cut-outs) for low-voltage public electricity distribution systems. 25A rating for highway power supplies and street furniture			x					x	x	
BS 7671:2001	Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition			x	x	x	x	x	x	x	
BS 7919:2001 (equivalent european harmonisation document to be provided)	Electric cables. Flexible cables rated up to 450/750V, for use with appliances and equipment intended for industrial and similar environments			x	x	x	x	x(refer to "Power")	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 12613:2001	Plastic warning devices for underground cables and pipelines with visual characteristics			x	x	x	x	x	x	x	
BS EN 40-1:1991	Lighting columns. Part 1 Definitions and terms			x					x	x	
BS EN 40-3-1:2000	Lighting columns. Part 3-1 Design and verification. Specification for characteristic loads			x					x	x	
BS EN 40-3-2:2000	Lighting columns. Part 3-2 Design and verification. Verification by testing			x					x	x	
BS EN 40-5:2002	Lighting columns. Part 5 Requirements for steel lighting columns			x					x	x	
BS EN 40-6:2002	Lighting columns. Part 6 Requirements for aluminium lighting columns			x					x	x	
BS EN 50085-1:1999	Cable trunking and cable ducting systems for electrical installations. Part 1 General requirements			x	x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS EN 50085-2-3:2001	Part 2-3 Particular requirements for slotted cable trunking systems intended for installation in cabinets				x	x	x	x	x	x	
BS EN 50086-2-1:1996	Conduit systems for cable management. Part 2-1, Particular requirements. Rigid conduit systems				x	x	x	x	x	x	
BS EN 50171:2001	Central power supply systems				x	x	x	x	x	x	
BS EN 50173-1:2002	Information technology. Generic cabling systems. General requirements and office areas				x	x	x	x	x	x	
BS EN 50174-1:2001	Information technology. Cabling installation. Part 1 Specification and quality assurance				x	x	x	x	x	x	
BS EN 50174-2:2001	Information technology. Cabling installation. Part 2 Installation planning and practices inside buildings				x	x	x	x	x	x	
BS EN 50262:1999	Metric cable glands for electrical installations				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 50310:2000	Application of equipotential bonding and earthing in buildings with information technology equipment				x	x	x	x	x	x	
BS EN 54-10:2002	Fire detection and fire alarm systems. Part 10 Flame detectors. Point detectors				X				x	x	
BS EN 54-11:2001	Fire detection and fire alarm systems. Part 11 Manual call points				X				x	x	
BS EN 54-1:1996	Fire detection and fire alarm systems. Part 1 Introduction				X				x	x	
BS EN 54-2:1998	Fire detection and fire alarm systems. Part 2 Control and indicating equipment				X				x	x	
BS EN 54-3:2001	Fire detection and fire alarm systems. Part 3 Fire alarm devices. Sounders				X				x	x	
BS EN 54-4:1998	Fire detection and fire alarm systems. Part 4 Power supply equipment				X				x	x	
BS EN 54-5:2001	Fire detection and fire alarm systems. Part 5 Heat detectors. Point detectors				X	x		x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 54-7:2001	Fire detection and fire alarm systems. Part 7 Smoke detectors. Point detectors using scattered light, transmitted light or ionization				X				x	x	
BS EN 55015:2001	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment							x	x	x	
BS EN 60051-1:1999	Direct acting indicating analogue electrical measuring instruments and their accessories. Part 1 Definitions and general requirements common to all parts				x				x	x	
BS EN 60081:1998	Double-capped fluorescent lamps. Performance specifications				x				x	x	
BS EN 60188:2001	High-pressure mercury vapour lamps. Performance specifications								x	x	
BS EN 60269-1:1999	Low-voltage fuses. Part 1 General requirements				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 60400:2000	Lamp holders for tubular fluorescent lamps and starter holders				x				x	x	
BS EN 60432-2:2000	Safety specification for incandescent lamps. Part 2 Tungsten halogen lamps for domestic and similar general lighting purposes				x				x	x	
BS EN 60439-1:1999	Specification for low-voltage switchgear and control gear assemblies. Part 1 Type-tested and partially type-tested assemblies				x	x		x	x	x	
BS EN 60439-2:2000	Specification for low-voltage switchgear and control gear assemblies. Part 2 Particular requirements for busbar trunking systems (busways)				x	x		x	x	x	
BS EN 60439-3:1991	Part 3 Particular requirements for low-voltage switchgear and control gear assemblies for installation in places where unskilled persons have access to their use.				x	x		x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS EN 60439-4:1991	Part 4 Particular requirements for assemblies for construction sites (ACS)				x	x	x	x	x	x	
BS EN 60439-5:1996	Part 5 Particular requirements for assemblies intended to be installed outdoors in public places. Cable distribution cabinets (CDCs) for power distribution in networks				x	x	x	x	x	x	
BS EN 60454-1:1995	Pressure-sensitive adhesive tapes for electrical purposes. Part 1 General requirements				x	x	x	x	x	x	
BS EN 60529:1992	Degrees of protection provided by enclosures (IP code)				x	x	x	x	x	x	
BS EN 60598-1:2000	Luminaires. Part 1 General requirements and tests								x	x	
BS EN 60598-2-18:1994	Luminaires. Part 2-18. Particular requirements. Luminaires for swimming pools and similar applications								x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr	Fare Collection	OLE	SC & C	Transdepo	Depot	Trams
BS EN 60598-2-22:1999	Luminaires. Part 2-22. Particular requirements. Luminaires for emergency lighting								x	x	
BS EN 60598-2-23:1997	Luminaires. Part 2-23. Particular requirements. Extra low voltage lighting systems for filament lamps								x	x	
BS EN 60598-2-2:1997	Luminaires. Part 2-2. Particular requirements. Recessed luminaires								x	x	
BS EN 60598-2-3:2003	Luminaires. Part 2-3. Particular requirements. Luminaires for road and street lighting			x					x	x	
BS EN 60598-2-5:1998	Luminaires. Part 2-5. Particular requirements. Floodlights								x	x	
BS EN 60896-2:1996	Stationary lead-acid batteries. General requirements and methods of test. Part 2 Valve regulated types								x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 60898-1:2003	Circuit-breakers for overcurrent protection for household and similar installations. Part 1 Circuit-breakers for a.c. operation				x	x		x	x	x	
BS EN 60898-2:2001	Part 2 Circuit-breakers for a.c. and d.c. operation				x	x	x	x	x	x	x
BS EN 60921:1991	Ballasts for tubular fluorescent lamps. Performance requirements				x	x	x	x	x	x	
BS EN 60923:1996	Auxiliaries for lamps. Ballasts for discharge lamps (excluding tubular fluorescent lamps). Performance requirements				x	x	x	x	x	x	
BS EN 60925:1991	Performance requirements for d.c. supplied electronic ballasts for tubular fluorescent lamps				x	x	x	x	x	x	
BS EN 60927:1997	Auxiliaries for lamps. Starting devices (other than glow starters). Performance requirements				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 60929:1992	a.c. supplied electronic ballasts for tubular fluorescent lamps. Performance requirements				x	x	x	x	x	x	
BS EN 60947-2:2003	Low-voltage switchgear and control gear. Part 2, Circuit-breakers				x	x	x	x	x	x	
BS EN 60947-3:1999	Part 3, Switches, disconnectors, switch-disconnect TBA ors and fuse-combination units				x	x	x	x	x	x	
BS EN 60947-4-1:2001	Part 4-1, Contactors and motor-starters. Electromechanical contactors and motor-starters				x	x	x	x	x	x	
BS EN 61008-1:1995	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). Part 1 General rules				x	x	x	x	x	x	
BS EN 61008-2-1:1995	Part 2-1 Applicability of the general rules to RCCBs functionally independent of line voltage				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 61009-1:1995	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs). Part 1 General rules				x	x	x	x	x	x	
BS EN 61009-2-1:1995	Part 2-1 Applicability of the general rules to RCBOs functionally independent of line voltage				x	x	x	x	x	x	
BS EN 61048:1993	Capacitors for use in tubular fluorescent and other discharge lamp circuits. General and safety requirements				x	x	x	x	x	x	
BS EN 61049:1993	Capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements				x	x	x	x	x	x	
BS EN 61347-2-1:2001	Lamp control gear. Part 2-1 Particular requirements for starting devices (other than glow starters)				x	x	x	x	x	x	
BS EN 61347-2-3:2001	Lamp control gear. Part 2-3 Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Pwr Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 61347-2-7:2001	Lamp control gear. Part 2-7 Particular requirements for d.c. supplied electronic ballasts for emergency lighting				x	x	x	x	x	x	
BS EN 61347-2-8:2001	Lamp control gear. Part 2-8 Particular requirements for ballasts for fluorescent lamps				x	x	x	x	x	x	
BS EN 61347-2-9:2001	Lamp control gear. Part 2-9 Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)				x	x	x	x	x	x	
BS EN 61537:2002	Cable tray systems and cable ladder systems for cable management				x	x	x	x	x	x	
BS EN 61558-1:1998	Safety of power transformers, power supply units and similar devices. Part 1 General requirements and tests				x	x	x	x	x	x	
BS EN 61558-2-9:2003	Part 2-9 Particular requirements for transformers for Class III handlamps for tungsten filament lamps				x	x	x	x	x	x	
BS EN 62035:2000	Discharge lamps (excluding fluorescent lamps). Safety specifications				x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 62040-1-1:2003	Uninterruptible power systems (UPS). Part 1-1 General and safety requirements for UPS used in operator access areas				x	x	x	x	x	x	
BS EN 62040-1-2:2003	Uninterruptible power systems (UPS). Part 1-2 General and safety requirements for UPS used in restricted access locations				x	x	x	x	x	x	
BS IEC 1008-2-2:1990	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCCBs). Part 2-2 Applicability of the general rules to RCCBs functionally dependent on line voltage				x	x	x	x	x	x	
BS 5489-1:2003	Code of Practice for the Design of Road Lighting				x	x	x	x	x	x	
GM/TT0146	Lighting of Railway Premises (Railway Group Standards)								x	x	
GI/RT7010	Lighting of Railway Premises (Railway Group Standards)								x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
GI/GN7607	Guidance for Low Voltage Electrical Installations (Railway group guidance notes)				x	x	x	x	x	x	
GI/RT7007	Low Voltage Electrical Installations (Railway Group Standards)				x	x	x	x	x	x	
GPGLRP3	Good Practice – Lighting for Railway Premises				x			x	x	x	
										x	
EN50121 Pts 1-5	Railway applications electromagnetic compatibility				x	x	x	x	x	x	
2004/40/EC	European directive				x			x		x	
EN50128: 2001	Railway Applications – Communications, signalling and processing systems – software for railway control and protection systems.				(not applicable)x			x		x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdev	Depot	Trams
ENV50129: 1998	Safety related electronic systems for signalling.				(not applicaqble)x			x		x	
IEC61508: 1998	Functional safety of electrical/electronic/programmable electronic safety related systems.							x		x	
	Methods for assessing the safety integrity of safety related software of uncertain pedigree (SOUP), Health and Safety Executive				(not applicable)x			x		x	
	Edinburgh Tram Earthing Systems Policy	x	x		x	x	x	x	x	x	

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
EN50128: 2001	Railway Applications – Communications, signalling and processing systems – software for railway control and protection systems.				(not applicable)x	x	x	x	x	x	
IEC61508: 1998	Functional safety of electrical/electronic/programmable electronic safety related systems.				(not applicable)x			x			
MPT 1331	Code of Practice for Radio Site Engineering							x			
MPT 1362	Code of Practice for installation of mobile radio equipment in land based vehicles							x			
MPT 1327	A Signalling Standard For Trunked Private Land Mobile Radio Systems (June 1997)							x			

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
G1/RT7015	Railway Group Standard (Feb 2003)					x					
BS EN50126	Railway applications- The specification and demonstration of Dependency, Reliability, Availability, Maintainability and Safety,		x		x	x	x	x	x	x	x
BS EN50149	Railway applications – Fixed installation-Copper and Copper alloy grooved contact wire,						x				
BS EN50119	Railway applications - Fixed installation-electric traction-Overhead Lines.						x				
BS EN50206-2 –	Pantographs for Light Rail vehicles						x				
BS EN50125-1	Railway applications - Fixed installations, Environmental conditions						x				
BS EN50317,	Railway applications - Fixed installations, Requirements for and validation of measurements of dynamic interaction between pantograph and contact line						x				

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN50151	Railway applications - Fixed installations, Special requirements for composite insulators						x				
BS EN50345	Railway applications - Fixed installations, Insulating synthetic rope assemblies for support of overhead contact lines						x				
BS EN50318	Railway applications - Fixed installations, validation of the simulation of dynamic interaction between pantograph and contact line						x				
BS EN 50122-1	Railway Applications – Fixed Installations Part 1: Protective provisions relating to electrical safety and earthing				x		x				
BS EN 50122-2	Railway Applications – Fixed Installations Part 2: Protective provisions against the effects of stray currents caused by d.c. traction systems				x						

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS EN 60146	Semiconductor convertors – General requirements and line commutated convertors				x						
BS EN 50123	Railway Installations – Fixed installations – d.c. switchgear				x						
IEC 850 (IEC 60850)	Supply voltages for traction systems										
BS 2618	British Standard Specification for Electrical Traction Equipment				(not applicable)x						
BS 6290	Batteries				x						
BS 7354	Battery Duty Calculations.				x						
CP 1013	Earthing.				x						
BRB Spec. DC 112	DC Power Cables.				x		x				

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
BS 6360 (IEC 60228)	Cable Conductors.				x		x				
BS 6899 Type GP2	DC Power Cable Insulation.				x		x				
IEC 228 (BS 6360)	Conductors for Multicores.				x		x				
DMRB	The United Kingdom Design Manual for Roads and Bridges (as amended by any City of Edinburgh Council -specific requirements)	x		x							
TSM	Traffic Signs Manual			x							
MCDHW	The Manual of Contract Documents for Highway Works;			x							
SHW	Specification for Highway Works;			x							
HCD	Highway Construction Details.			x							
CEC	'Edinburgh Standards for Streets'.			x							
NRSWA	New Roads and Street Works Act 1991			x							

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
CEC	Measures Necessary Where Apparatus is Affected by Major Works (Diversionary Works)			x							
CEC	Specification for the Reinstatement of Openings in Roads			x							
	Code of Practice for the Co-ordination of Street Work and Works for Road Purposes and Related Matters			x							
	Utility specific specifications (to be advised by each utility)			x							
RSPG Part 1, 1966	Railway Safety Principles and Guidance, Safety Principles	x	x	x	x	x	x	x	x	x	x
RSPG Part 2, Section G	2005, Railway Safety Principles and Guidance, Tramways	x	x	x	x	x	x	x	x	x	x
RVAR	Railway Vehicle Accessibility Regulations								x		x
GM/RC1500	1994-12, 2001-10 Code of Practice for EMC between the railway and its neighbourhood				x	x	x	x	x	x	x

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
EN55013	Sound and television broadcast receivers and associated equipment. Radio disturbance characteristics. Limits and methods of measurements.							x		x	x
GE/RT8015, 2002	Electromagnetic compatibility between railway infrastructure and trains.										x
ECE 43	1990-08, Uniform Provisions Concerning the Approval of Safety Glazing and Glazing Materials (Rev1 08.1990).								x	X	x
prEN13129-3	2003-10, Railway Applications – Air conditioning for urban and suburban rolling stock – Part 1: Comfort parameters										x
BS EN 779	2002-12-05, Particulate air filters for general ventilation - Determination of the filtration performance									x	x
BS 857	1967-06-30, Specification for safety glass for land transport										x

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Tramstops	Depot	Trams
BS 6853 1999-01-15	Code of Practice for fire precautions in the design and construction of passenger carrying trains or European equivalent Standard										x
BS EN 50121-3-1 2000-12-15	Railway Applications - Electromagnetic compatibility - Rolling stock - Train and complete vehicle										x
BS EN 50125-1	Railway Applications – Environmental conditions for equipment										x
BS EN 50155-3-1 2000-12-15	Railway Applications – Electronic Equipment used on Rolling Stock										x
BS EN 50215 1999-09-15	Railway Applications - Testing of rolling stock after completion of construction and before entry into service										x
BS EN 60077-1 2002	Railway Applications – Electric Equipment for Rolling Stock										x

Specification No.	Specification Title	Structures	Track	Roads	Power Distr.	Fare Collection	OLE	SC & C	Transdep	Depot	Trams
prEN ISO 3095 1975-09	Acoustics; Measurement of noise emitted by rail bound vehicles										x
prEN ISO 3381 1976-02	Acoustics; Measurement of noise inside rail bound vehicles										x
EN 12663-2000	Railway applications, Structural requirements of railway vehicle bodies										x
EN 13749-2005	Methods of specifying structural requirements of bogie frames										x
VDV 164 1995-04	System for fault detection, fault registration and fault message (FERM) on guided public transport vehicles										x
IEC 60494-2, 2002-08	Railway applications - Rolling stock; Pantographs; Characteristics and tests - Part 2: Pantographs for metros and light rail vehicles						x				x

Table 24 - Applicable Standards

9 Geotechnical

Where the Infraco Works may affect geotechnical and geo-environmental features, including but not limited to, aquifers, ground water and surface watercourses, the Infraco shall comply with the requirements of relevant third parties, the Scottish Environment Protection Agency (SEPA) or other statutory consultees and environmental legislation.

The Infraco shall agree the criteria and methods for the identification, classification, treatment and disposal of material with SEPA, the relevant local environmental health authority or other relevant authority as appropriate. The Infraco shall obtain all necessary consents for the removal, disposal or re-use of materials. Materials not suitable for re-use shall be transported off Site to a licensed facility in accordance with the requirements of the applicable relevant authority and environmental legislation.

The Infraco shall not carry out works or activities which would result in any Site or any land licensed to the Infraco under the Agreement or any adjacent or adjoining property being classified as contaminated land under the Environmental Protection Act 1990, the Contaminated Land (Scotland) Regulations 2000, the Contaminated Land (Scotland) Regulations 2005 and the guidance contained in the Scottish Executive Statutory Guidance for the the Contaminated Land Regime, Edition 2 dated May 2006 and/or any similar environmental legislation, or that would preclude such a classification being removed.

The Infraco shall assess the risk of the ingress of landfill gases, coalfield gases and other hazardous ground gases and implement appropriate measures to mitigate such risks.

The Infraco Works shall be designed and constructed to accommodate reasonably foreseeable changes in the existing and potential future nature and level of ground water, where reasonably practicable.

10 Environment

10.1 Environmental Considerations

10.1.1 General

Environmental Statements have been prepared for Line One and Line Two in accordance with the standing orders of the Scottish Parliament, which require that projects approved by private Act of Parliament must be subject to Environmental Impact Assessment (EIA). EIA in Scotland is governed by the Environmental Impact Assessment (Scotland) Regulations 1999 (S.I. 1999 No. 1). The Environmental Impact Assessments (EIAs) have been undertaken to identify the construction and operational effects of building and operating a tram network in Edinburgh. Each assessment has been documented in a comprehensive Environmental Statement which describes:

- The design of the project and the way it will be constructed and operated;
- Its impacts on the physical, natural and human environment; and
- The measures that will be undertaken to minimise these impacts.

The Environmental Statements report the assessment of the following environmental topics which should be considered by the Infraco:

- The proposed scheme – including an explanation of the need for the scheme, alternatives considered, route alignment and infrastructure description, construction and operational activities;
- Approach to the EIA – summarising the legal requirements, scope and methods used in undertaking this EIA;
- Policy context – provides a review of compliance of Line One and Line Two to relevant national, regional and local policies;
- Traffic and transport;
- Land use - including potential impacts to the agricultural use of land along the route;
- Geology, soils and contamination – including references to hydrogeology and waste management;

- Landscape and visual amenity;
- Ecology and nature conservation;
- Surface water – including water quality and hydrology;
- Heritage - including archaeology;
- Socio-economic effects;
- Noise and vibration;
- Air quality - including local air quality (PM10, NO2), global air quality (CO2) and dust; and
- Cumulative impacts.

The Infraco shall ensure that the environmental impact caused by the Infraco Works shall be no worse than that contained in the Environmental Statements.

10.1.2 Freedom of Access to Environmental Information

The attention of the Infraco is drawn to the requirements of the Environmental Information (Scotland) Regulations 2004 (SSI 2004/520). This Statute permits public access to environmental information held by a Scottish public authority.

10.1.3 Relevant Legislation, Regulations and Guidance

The following are a series of project specific documentation governing various aspects of the environmental considerations of the Edinburgh Tram Network design, construction and operation.

10.1.4 Code of Construction Practice

A code of construction practice was prepared in consultation with the City of Edinburgh Council (CEC), Scottish Natural Heritage (SNH), the Scottish Environmental Protection Agency (SEPA) and Historic Scotland, in order to define **tie's** minimum standards of construction practice. Compliance with this code is a legal requirement of the Edinburgh Tram (Line One) and (Line Two) Acts (2006) under Section 66 and this code has been developed by **tie** and this developed version is included in Schedule 3 (Code of Construction Practice and Code of Maintenance Practice).

The Code of Construction Practice sets out policies, legislation and guidance relating to the impact of the proposed construction works on the environment and the amenity and safety of residents, businesses, the general public and the physical surroundings adjacent to the ETN. The Code of Construction Practice also provides a list of environmental protection measures to be implemented during the construction of the ETN.

10.1.5 tie's Noise and Vibration Policy

tie's Noise and Vibration Policy (NVP/001 V1.01) sets out the mitigation approach for noise and vibration impacts during the operation of the Tram in Edinburgh. Mitigation requirements relating to noise and vibration impacts during the construction of the ETN route are outlined in the Code of Construction Practice. Compliance with the Noise and Vibration Policy is a legal requirement under Section 66 of the Edinburgh Tram (Line One) and (Line Two) Acts (2006). Other legal requirements relating to noise insulation are set out in Sections 63, 64 and 65 of the respective Acts. The Noise and Vibration Policy has been developed by **tie** and this developed version is included in Schedule 3 (Code of Construction Practice and Code of Maintenance Practice).

10.1.6 The Tram Design Manual and Urban Design Briefs

A Design Manual and urban design briefs have been prepared for the ETN. Both sets are regarded as supplemental guides to deemed consent for Line One and Line Two under the section 11 (Class 29) of the General Permitted Development (Scotland) Order 1992.

Although permitted development status exists for the ETN it is nonetheless necessary to gain prior approval from the City of Edinburgh Council before the Infraco Works can commence. The Design Manual and urban design briefs are both designed as guides in informing both the design process and the prior approval process. It is therefore important that the Infraco gives appropriate consideration to the contents of the Design Manual and the briefs as major component in the integration of a tram design into the urban fabric of the City.

10.1.7 Landscape and Habitat Management Plan

The Landscape and Habitat Management Plan (LHMP) details the proposals for retention, protection and enhancement of existing planting and habitats, within the Roseburn Corridor. It also sets out details of replacement planting and habitat which are lost as a consequence of the development. The plan will be updated by the Infraco as new information on habitat, landscape proposals and Tram design becomes available. The plan will also include proposals for noise mitigation for properties adjacent to the ETN. Revisions to the LHMP will require to be approved by the City of Edinburgh Council Planning Authority. The procedure for updating the LHMP is set out within Section 68 of the Edinburgh Tram (Line One) Act (2006).

10.1.8 Badger Mitigation Plan

The Badger Mitigation Plan sets out the scope and form of the proposed mitigation measures for avoiding/ reducing adverse impacts on badgers within the Roseburn Corridor. The Plan will be updated by the Infraco as new information on badger social groups and the ETN design becomes available. Revisions to this Plan will be agreed with SNH, CEC and the Edinburgh and Lothians Badger Group (ELBG) and approved by the CEC Planning Authority.

In preparing the detailed environmental design and implementation (including maintenance and monitoring periods) proposals for landscape and ecology the Infraco will ensure that all commitments given in the Environmental Statement and arising from the Scottish parliamentary process relating to the Tram Legislation (including the detailed agreements following discussions with stakeholders) are met.

10.1.9 Protected Species Plan

The Protected Species Plan identifies the constraints governing how all protected species (predominantly located in the Gogarburn area) are to be dealt with.

10.1.10 Archaeological Requirements

All Infraco Works are to be carried out in compliance with the approved AHMP relevant to that location.

10.1.11 Landscape Design

The landscape design shall include, for construction, aftercare and maintenance / monitoring, ongoing for the whole Term. The detailed landscape design shall be in accordance with the environmental objectives, principles and requirements given in the Environmental Statements, to ensure that the Edinburgh Tram Network as constructed and operated is in compliance with the Environmental Statements, and any subsequent side agreements entered into between the CEC, **tie** and various third parties.

10.2 Ecological Design

The ecological design shall include, for construction, aftercare maintenance and monitoring:, the ecological mitigation proposals will cover the wholeTerm.

The ecological design shall be in accordance with the environmental objectives, principles and requirements given in the Environmental Statements, to ensure that the Edinburgh Tram Network as constructed and operated is in compliance with the Environmental Statements prepared for Parliament, and any subsequent side agreements entered into between the CEC, **tie** and various third parties (e.g. Scottish Natural Heritage, New Ingliston Limited, Edinburgh and Lothian Badger Group).

The updated and ongoing ecological surveys and mitigation works to be carried out by Infraco shall take into account seasonal constraints and variations and will accommodate ongoing relevant surveys begun by other parties (e.g. biological water quality monitoring). The Infraco shall ensure that the construction, maintenance and monitoring of the Infraco Works complies with all existing UK and EU Environmental legislation concerned with the protection of species and habitats including but not limited to:

- Wildlife and Countryside Act 1981 (as amended in particular by Variation of Schedules 1988, 1992 & 1998);
- The Conservation (Natural Habitats, & c.) Regulations 1994 (as amended);
- Protection of Badgers Act 1992; and
- Countryside and Rights of Way Act 2000 in so far as it extends to Scotland.

The Infraco shall not commence works within any part of the Site until the necessary update surveys of ecological interest in respect of that part of the Site have been undertaken and a survey report has been submitted to **tie**. Any relevant findings of such surveys shall be included into the Infraco's Landscape and Habitat Management Plan and the Construction Environmental Management Plan (CEMP).

The Infraco shall ensure that:

- Details of all species protected by Law and any structure or place used for shelter or protection by any such species protected by Law within the Site are kept confidential and not disclosed to any person except insofar as is essential for carrying out the Infraco Works; and

- All necessary current licenses, and named license holders, are available before the commencement of any Infraco Works, which may affect species protected by Law and or any structure or place used for shelter or protection by any such species protected by Law.

In the event that the Infraco identifies or becomes aware of any species protected by Law, or any structure or place used for shelter or protection by any species also protected by Law, which could be directly or indirectly affected by the Infraco Works and for which appropriate protection measures have not previously been agreed, the Infraco shall notify **tie** immediately and shall:

- Cease all Infraco Works that may adversely affect such species, structure or place;

- Provide Scottish Natural Heritage and **tie** with any further information of which the Infraco is aware relating to such species, structure or place as may be requested;

- Consult upon and agree mitigation and/or monitoring measures with Scottish Natural Heritage and **tie** in relation to such species, structure or place; and

- Obtain any necessary licenses to carry out the agreed measures.

The Infraco shall ensure that all construction work is carried out with due regard to the seasonal interests of any flora, fauna or habitat and in particular, all species listed for any degree of protection under Law. The Infraco shall make due allowance for the seasonal constraints in preparing the Programme.

10.3 Construction of Ecological Measures

10.3.1 General

Special ecological measures shall include but not be limited to the requirements for carrying out the Infraco Works:

- fencing;
- safe passage for wildlife;
- the location of nesting or roosting boxes;
- the location of habitat creation measures to be inspected;
- the known location of protected species, and
- the list of licenses obtained or required for working with or within the vicinity of Protected Species; and
- maintaining access to foraging and water.

10.3.2 Site Supervision of Landscape and Ecological Works

The Infraco shall ensure that the environmental Site works shall be inspected and monitored by Infraco's environmental clerk of works who will be supported by Infraco's landscape architect and ecologist, as necessary.

10.3.3 Landscape Works

Planting, seeding and aftercare works shall be carried out by the Infraco.

The Infraco will be responsible for locating all services routes prior to any landscape work being carried out.

10.3.4 Completion of the Planting Works and Completion of the Landscape and Ecological Aftercare Works

On practical completion of the landscape and ecological implementation works and on completion of the three years landscape and ecological aftercare works. The Infraco shall submit the required certificates and arrange a formal inspection of the Infraco Works with **tie**.

A separate inspection shall be arranged with relevant landowners for any areas of off-site planting.

10.3.5 Construction Environmental Management Plan (CEMP)

The Infraco shall prepare a Construction Environmental Management Plan (CEMP) including specific management / action plans or Method Statements, as necessary, to convey the required level of information for the following:

- Drainage features, including oil interceptors and pollution control valves, treatment of run-off, (including run-off volumes) and the location and appearance of any balancing ponds and/or swales, access or proposed access to the same;
- Carriageway surfacing;
- Working times;
- Noise reduction and abatement;
- Pollution control and contingency plan (see below);
- Discharge, land drainage and abstraction licenses to comply with EA requirements;
- Protection of retained vegetation;
- Maintenance e.g. de-icing;
- Sourcing of construction materials;

- Waste disposal, including disposal of construction waste, arisings, spoil, miscellaneous solids and liquids;
- Topsoil and subsoil handling (strip, storage, amelioration and re-use);
- Management and disposal of any excess soil or spoil arising from the works; and
- Site compounds.

The specific requirements of the pollution control and contingency plan are as follows:

- Compliance with the SEPA pollution prevention guidance;
- Identification and categorisation of surface waters vulnerable to Site works and an assessment of the earthworks that are likely to give rise to silty run off, the routes this is likely to take and the methods to prevent damage from silt;
- Precautions for handling of fuel, oil and other liquids during the works, in particular, near rivers, streams and watercourses;
- Requirements for pollution control equipment;
- How mud and dust will be controlled;
- How water supply boreholes and wells will be protected;
- The measures to be taken to protect watercourses and associated wildlife from, for example, chemical spillages or the introduction of sediment-laden run off; and
- Discharge criteria for suspended solids in run off from the Site during construction and proposals for monitoring and control.

11 Surveys

Surveys and investigations shall be undertaken by the Infraco as required to facilitate the design, construction and maintenance of the Edinburgh Tram Network.

Before commencing any Infraco Works (including investigations) where either the Infraco or **tie** considers there to be potential for a future claim from adjacent property owners or occupiers, the Infraco shall carry out a detailed condition inspection of the relevant properties and infrastructure which may be affected by the Infraco Works. If any such inspection is carried out, this shall be done in conjunction with the owners or occupiers concerned. A condition survey report shall then be prepared and agreed with the owner or occupier.

Condition survey reports prepared under the preceding paragraph shall include photographic evidence of the existing condition of the relevant property or infrastructure including evidence of critical dimensions such as existing crack widths.

The Infraco shall undertake sufficient surveys to prepare a topographical survey model. Relevant sections of the topographical survey model shall be updated by the Infraco at least every six months throughout the period of the Infraco Works, where work has been undertaken in relation to the sections concerned.

The topographical survey model shall include all Works as constructed and the Infraco shall include in each updated topographical survey model all then existing fixtures including:

- principal cabling;
- street furniture;
- structures and buildings;
- trackwork;
- drainage;
- power supply systems including OLE structures;
- ducting and draw pits.

These surveys shall include aspects concerned with:

- dimensions
- condition; and
- inspection for assessment.

The Infraco shall update the photographic records (excluding aerial photographs) and other such data contained in the topographical survey model at intervals of not less than six months.

The Infraco shall provide access to and copies of, when requested, all reports of investigations carried out as part of the Infraco Works.

12 Project Management Processes

12.1 Communication – General

The Infraco shall develop and maintain a "Communications Plan" and this shall be submitted to **tie** in accordance with the Review Procedure.

The Communications Plan shall illustrate how all the communication processes, activities and issues are to be managed, progressed and satisfactorily resolved. The Communications Plan shall detail how the Infraco will communicate with Sub-Contractors, the Operator, **tie**, the MUDFA Contractor, key stakeholders and third parties. The Communications Plan shall also include the intended processes for dealing with enquiries, particularly complaints, from all sources. The Infraco shall refer to the Stakeholder Services in this Section of the Employer's Requirements, in order to ensure that the Communications Plan includes all necessary requirements.

The Infraco shall implement all the requirements of the Communications Plan.

The Infraco shall liaise with the relevant parties to ensure that the Infraco is copied into all relevant communications that are generated by others, in order to ensure that any relevant construction related issues, such as Temporary Works and practical constraints, are identified and addressed.

12.1.1 Meetings

The Infraco shall work with **tie** to develop the meetings schedules and requirements for progress reporting throughout the duration of the Infraco Works. The following table provides an outline of the minimum requirements:

Meetings	Frequency	Chaired by / Minutes taken
Safety Meeting	Weekly	Infraco
Management Review Meetings	Two monthly	**tie**/Infraco alternately
Project Progress Meetings	Four weekly (Fortnightly prior to Site start)	**tie**

Meetings	Frequency	Chaired by / Minutes taken
Design and Planning Meetings	Fortnightly	Infraco
Stakeholder & Third Party Meetings	As required	**tie**
Site Meetings	Weekly	Infraco
Cost Review Meetings	Four weekly	**tie**
Risk Review Meetings	Four weekly	**tie**

Table 25 - Table showing meeting schedules

The primary purpose of these meetings shall be to enable the Infraco to advise on:

- Any safety issues;
- The current state of the programmed Infraco Works;
- Progress made in the various activities;
- Communication issues;
- Third party issues; and
- Commercial issues (Including change control).

The Infraco shall develop and maintain a comprehensive meetings schedule indicating those meetings which the Infraco shall chair and those meetings which the Infraco shall attend.

Prior to commencement on Site, progress meetings shall be held every two weeks. The purpose of these meetings shall be to review progress made by both Parties, and identify and agree actions required.

The Infraco shall provide an agenda, for all meetings to which they are designated as chair. The Infraco shall also provide appropriate documentation in advance of each of the meetings, as defined in the following sections, or otherwise as agreed with **tie**.

12.1.2 Progress Reporting

Progress reports shall be submitted by the Infraco to **tie** no later than three Business Days before each progress meeting.

The Infraco's progress reports shall contain comprehensive information and shall be structured in a manner which is commensurate with **tie**'s own reporting structure. The various sections of the progress reports shall require to be agreed with **tie**, but should include the following:

1. Executive Summary;
2. Health & Safety Report;
3. Quality & Environment;
4. Financial Summary Report; and
5. Project Performance / Programme.

Information provided within the progress reports shall include, but not be limited to, the following:

- Health & safety report including a summary of H&S records
- Summary financial information summarised from the separate cost report including summary and headline data on planned spend/actual spend, forecast spend and summary of costs for Compensation Events and future forecast.
- Planned versus actual resource summary;
- Physical progress against Milestones anticipated/required completion dates;

- Four weekly forecast of all activities;
- Eight weekly critical impact notice (including all information on any internal or external factor which may affect programme delivery);
- Labour histograms detailing planned, actual and forecast across all disciplines;
- The activities commenced or completed since the previous report and upon what dates;
- The expected remaining duration of all activities commenced but not completed;
- Any other additional activities with expected durations, methods, and resource requirements and sequence assumptions;
- Schedule and programme for the delivery of method statements, permits and isolations for the next four weeks;
- Any changes to expected durations, method, resource requirements and sequence assumptions;
- Forecast completion dates for all Infraco Works in each geographical section and intermediate geographical section including any slippage or advance upon the Planned Service Commencement Date and/or the Planned Sectional Completion Dates (as appropriate);
- Programme comparison between actual vs. planned;
- Schedule of information received;
- Schedule of outstanding information;
- Progress photographs;
- Top 10 opportunities; and
- Top 10 risks.

12.1.3 Progress Photos

The Infraco shall on a monthly basis throughout the period until the Service Commencement Date procure that photographs covering all of the Infraco Works are taken by a professional photographer whose appointment the Project shall be approved by **tie**, such approval not to be unreasonably withheld or delayed.

tie shall determine the scope of the photographs referred above.

The Infraco shall ensure that:

- A minimum of 50 digital colour photographs shall be taken on a monthly basis;
- All photos shall be provided in electronic format in a form to be agreed with **tie**;
- One set of 10 inch x 8 inch size prints shall be prepared from the colour photographs referred to above;
- All prints referred to above shall be presented in albums with individual clear plastic wallets and marked on the reverse side with the date that the photograph was taken, the name and address of the photographer, identification reference number and a brief description of Work being undertaken and the direction from which the photograph was taken;
- All prints and negatives shall be delivered to **tie** within two weeks of being taken; and
- Except where **tie** have provided their prior written consent, the photographs shall not be used for any purpose other than as set out in the Agreement.

The Infraco shall procure that all Intellectual Property in respect of the photographs vests in **tie**.

12.1.4 Site Meeting Report

A report shall be submitted by the Infraco to **tie** no later than one Business Day before each site meeting. The report shall include reference to any significant issues (associated with safety, programme, design, cost, planning and consultee aspects), which have arisen since the previous monthly progress report.

The site meeting report shall also identify actual manpower resources (labour returns), plant and equipment that have occurred on site, for the previous week.

12.1.5 Topic Register

It is **tie**'s intention to continue to develop and maintain a "Topics Register" for the Infraco Works. The Topics Register is used to record all issues as they arise that require to be specifically addressed. The record is then amended as appropriate to track the manner in which issues have been progressed or resolved to the satisfaction of **tie**. The Infraco is required to add to, or respond to issues as appropriate and attend regular review meetings at which the Topics Register shall be updated and actions assigned by **tie**.

The Infraco shall participate in the management of the Topics Register.

12.1.6 Work Breakdown Structure

An agreed Work Breakdown Structure is included in the Introduction of these Employer's Requirements. The Infraco shall adopt this WBS to ensure a recognised, structured analysis, by all parties, when interrogating the programme and cost analysis. The WBS may be further developed by the Infraco with the written consent of **tie**.

Accordingly there shall be a requirement for the Infraco to adopt all aspects of the WBS in the development of programme and cost documentation.

12.2 Programme Management

The Infraco shall undertake programme management including the implementation, regular updating and management of a fully detailed comprehensive Programme illustrating how the Infraco proposes to execute the whole of the Infraco Works in compliance with the Project Programme.

This Infraco Programme shall be prepared using Primavera software in a version compatible with that of **tie**.

This Programme shall be in Primavera P3e (Version 6 or otherwise as agreed with **tie**) format and accompanied by a time chainage programme illustrating the same information. The Programme shall be cost and resource loaded and coded to reflect the Infraco's WBS activities as detailed in section [39] of these Employer's Requirements.

The Infraco shall be responsible for liaising directly with **tie**, CEC (and other appropriate third parties) to maximise delivery of the ETN but minimise disruption to public transport and other services, and ensuring that any necessary diversion routes are agreed in recognised time periods prior to the commencement of Infraco works. The Infraco shall also take note of the constraints as identified in 39 of these Employer's Requirements.

The Programme shall be submitted to **tie** in accordance with the Review Procedure within a period which shall ensure that the Infraco Works can be progressed and monitored by the Infraco and **tie** against the details contained therein. The Programme shall clearly identify the following:

- the commencement, construction and completion constraints for all elements of the Infraco Works, separated into sectors by WBS code;
- all Milestones;
- the constraints, procedures, documentation and approvals specified in the Agreement;
- the Infraco manufacture and construction execution strategy, Infraco Works and site testing and commissioning, all constraints, procedures, documentation and approvals periods;
- seasonal constraints and constraints applied by CEC and other third party and statutory bodies as defined in the Agreement;
- the required design approvals and notices;
- all works to be undertaken by any Sub-Contractor;
- sufficient detail to illustrate the integration of the Deliverables with the proposed dates of possessions and the commencement and completion of construction for all elements of the Infraco Works, by WBS code;
- all other projects affecting the Infraco Works and how they are integrated into the Infraco Works. For example, any street works to be carried out by CEC, and works by or on behalf of all third parties (including landowners and developers);

- any witnessing, inspections, testing etc of the Infraco Works which requires to be carried out by third parties;
- long lead time materials and works;
- the identification and duration of all advance works, other than those already underway;
- the requirements and approval periods for traffic management, TROs, TTROs, and including any third party's requirements for notices and road closures;
- the commencement, completion dates and relationships of intermediate geographical section of the Infraco Works within each geographical section of the Infraco Works;
- the links and relationships between all activities and the justification of the underpinning logic;
- all design, manufacture and construction periods;
- the identification and timing of inputs and approvals required from **tie**, third parties, and any Approval Bodies are clearly identified; and
- the interface and relationship with the MUDFA Works;

The Programme shall meet the following minimum requirements:

- shall be in Primavera P3e (Version 6) for detailed implementation;
- shall follow and fully reflect the **tie**'s Work Breakdown Structure ("WBS") included within these Employer's Requirements.
- shall be cost and resource loaded down to coded activities;
- all resource reporting and progress reporting shall be coded to suit the activities contained within the WBS;
- records of time spent against activities shall be completed weekly against planned works as generated by Primavera;

- Any deviations shall be reported in the progress report and include notification of remedial actions for authorisation by **tie**;
- weekly records shall be collated and delivered to **tie** by 09:00hrs on the Tuesday following the week to which the records relate;
- the Programme shall also take into account programming input and attendance at meetings, both as required by **tie**; and
- the Programme shall also contain cost/spend tables and cumulative curves to match the achievement of major milestones and activities within the WBS.

The Infraco shall take into account the availability of alternative materials or components when developing the Programme. The Infraco shall identify those materials and components which require advance ordering and processing. Any advanced orders which are approved shall be identified and defined in the Programme.

The Infraco shall update the Programme every four weeks in line with **tie** reporting periods to take full account of the Infraco progress in completing the Infraco Works.

A hard and soft copy updated Programme and an Infraco Progress Report shall be submitted by the Infraco to **tie** no later than three Business Days before each four weekly progress meeting.

12.3 Time Chainage

The Infraco shall also produce, manage, develop and work in accordance with its Time Chainage Diagram.

The Time Chainage Diagram shall be submitted to **tie** in accordance with the Review Procedure to ensure that the Infraco Works can be progressed and monitored by the Infraco against the details contained therein but in any case, the Time Chainage Diagram shall be submitted not later than six weeks after the Commencement Date. The Time Chainage Diagram shall be updated regularly and be available for inspection or distribution on a monthly basis, during the course of the Infraco Works.

The Time Chainage Diagram shall fully reflect, accommodate and comply with the information detailed on the Programme.

12.4 Planning and Other Consents

The responsibility for the Consents is as set out in Clause 19 of the Agreement.

12.5 Project Management Plan

12.5.1 General

The Infraco shall submit and maintain a plan describing the approach to project management for the delivery of the complete scope of the Infraco Works. This project management plan shall include sections to clearly and separately describe the approach to the specific topics set out below.

12.5.2 Resource and Competence

A description of the procedures employed to ensure that the required resource and competence level throughout the duration of the Infraco Works shall be achieved.

12.5.3 Documentation

Identify key policies and procedures to deliver such works, infrastructure and equipment to programme, specification, budget and otherwise safely and efficiently and in a manner which is fully integrated with the activities of other relevant contractors.

The approach to the development of a suite of project specific documentation, indicating how they shall effectively be integrated with, and reflect, the Infraco's corporate procedures and policies (including any Joint venture or consortia procedures).

Templates that shall be used for the procurement and delivery of the service deliverables, which shall be required to be prepared by the Infraco.

Outline proposals covering the suite of required documentation including training, maintenance and operations manuals, as-built drawings, design Information, testing procedures and proposals, and certification and records (e.g. testing).

12.5.4 Regulations

Management arrangements and procedures for ensuring/monitoring compliance with all applicable Regulations (e.g. HMRI), Law, and the requirements of the Agreement and its Schedules.

12.5.5 Procedures

Details of internal procedures for decision making and review in your management team with particular emphasis on safety, programme, budget, quality, the management and control of non-compliance and the implementation of continuous improvement.

12.5.6 Proposals on reporting and controlling design information requirements

Procedures which shall be followed in obtaining outstanding consents and approvals for the works.

Definition of the process for managing the approvals interface with **tie**, HMRI, Planning Authority, Roads Authority, Network Rail, the Operator and third parties with whom agreements have been entered into.

12.5.7 Interface Plans

Given that successful co-operation between the Operator, Infraco, and **tie** is essential to the delivery of a successful project, a description of the key areas of this interface and details which demonstrate how this is successfully achieved.

Details of supply chain process/procedures, in particular provide details of the criteria for selection of sub-contractors/suppliers for this project.

Details of how the Tram Provider shall be managed.

Details regarding the commissioning and handover of the Edinburgh Tram Network or Geographical Sections thereof to the Operator shall be provided.

12.5.8 Design

Clear definition of the areas where the Infraco shall undertake design work and an explanation of where the Infraco believes this deviates from the previous design work done.

12.6 Construction Management Plan

The Infraco shall submit and maintain a Construction Plan relating to the Programme. This Construction Plan shall include sections to clearly and separately describe the approach to the specific topics set out below.

12.6.1 Mobilisation

Detailed mobilisation plan, to incorporate comprehensive details of all aspects of mobilisation including, but not limited to, number of work sites, the facilities on each, a general arrangement drawing of main sites, lay down areas, materials storage, welfare and car parking. This should detail timescales and immediate resource availability and should also provide details of the permissions required and assumptions made.

12.6.2 Plant

A description of the plant that will be used for the construction of the project and of how long the plant will be used. This should include description in relation to plant used for specialist purposes such as rail laying or wire stringing (these should be separately identified).

12.6.3 Sub-Contractors

Details of the sub-contractor management and control process during the construction phase, including how the performance of sub-contractors will be measured and reviewed and how sub-contractor compliance with standards will be assured.

12.6.4 Method Statements

A description of the process by which method statements shall be developed and approved, and a schedule summarising those method statements that are anticipated. An initial schedule shall be submitted in accordance with the Review Procedure and this shall be updated from time to time with agreement from **tie**.

12.6.5 Avoidance of Disruption

Description of the management process for ensuring that traffic disruption is kept to a minimum, particularly in relation to Traffic Management and TTRO requirements. Details of procedures of how unforeseen works (that are out with the area covered by the Temporary Traffic Restriction Order, but are necessary to complete the Infraco Works within the TTRO area) shall be dealt with.

Proposals for maintaining reasonable access to premises at all times and what measures The Infraco might employ when access is denied taking into account the requirements of the Disability Discrimination Act 1995.

Details of how it is proposed to liaise with all potentially affected third parties, and an assessment of the likely identities of such parties.

12.7 Network Rail Interface Plan

The Infraco shall submit and maintain a plan describing the approach to managing the ongoing interface requirements with Network Rail. The plan should identify the critical activities and the key risks associated with this interface and proposals to mitigate these risks. Notwithstanding the Infraco's responsibility of complying with the Agreement (including compliance with the Third Party Agreement and the Asset Protection Agreement) the Plan should address the following issues.

- A description of procedures for gaining access to Network Rail's infrastructure both in terms of the approval process and the physical access proposals;
- Confirmation, in terms of safety and in terms of undertaking the Infraco Works, the personnel utilised shall be appropriately qualified, skilled, experienced and adequate in quantity;
- The proposed Possession Strategy for works on or adjacent to Network Rail infrastructure, to include identification of Possessions & Isolations on Programme taking cognisance of lead time;
- Summary of the required method statements for principal construction activities associated with Works adjacent to Network Rail infrastructure;
- The proposals which allow access for Network Rail to maintain their infrastructure;
- Details as to how the Railway Group & Network Rail Line standards shall be complied with;
- Specific details of how Network Rail's infrastructure and rail vehicles shall be protected from injury/damage arising from the works activities;
- Details of how staff and any third parties shall be protected from injury from Network Rail's infrastructure or vehicles using it;
- The strategy for Red & Green Zone working;

- Proposals for competencies, making specific reference to management of the certification of personnel and operatives in accordance with the National Competency Control Agency "Sentinel" systems and procedures;

- A specific accident/incident procedure with regard to Network Rail infrastructure which details action to be taken, including the communications regime;

- Proposals for security and prevention of trespass onto site, especially onto adjacent Network Rail property;

- Proposals with regard to work in and around First Scotrail's Haymarket Depot and its associated stabling & sidings. There shall be a requirement to highlight proposals for ensuring access to Haymarket Depot is maintained for staff; road and rail vehicles, especially if rail vehicles require access/egress to the depot by road. There shall be a requirement to identify how First ScotRail operations shall not be restricted.

12.8 Quality Management

The Infraco shall undertake the Works fully in compliance with quality management processes and procedures referenced in ISO 9001 and ISO 9004.

The Infraco shall develop and maintain a Quality Plan to meet the requirements of ISO 10005 - 1995, and which fully defines all quality aspects of the Works. The Quality Plan shall be submitted in accordance with the Review Procedure. The Quality Plan shall demonstrate an integrated quality management system relating to the design, construction, testing and commissioning of the system and shall show how Infraco and its Sub-Contractors shall comply with the requirements of the Quality Plan.

The Infraco shall have all associated documentation readily available for internal review and review by **tie**. Regular internal audits shall be undertaken by the Infraco to ensure full compliance with ISO 9001 and ISO 9004 in accordance with Clause 5.1 of the Code of Construction Practice. The Infraco shall prepare and submit in accordance with the Review Procedure a "Schedule of Internal Audits" for agreement with **tie**. This shall define the planned nature and timing of the internal audits. Furthermore **tie** reserve the right to undertake external audits in accordance with paragraph 5.2 of the Code of Construction Practice and Code of Maintenance Practice.

The Infraco shall ensure that their management system for the Infraco Works is developed to ensure that it aligns with the requirements of the Tram Project Quality policy Statement (DEL.HSQE.103).

Quality control including materials and works on Site shall also be undertaken in accordance with the requirements of paragraph 3.2 of the Code of Construction Practice. The Infraco shall be required to comply with these Employer's Requirements including the completion of forms and other systems in order to assist **tie** in complying with **tie**'s own safety and quality management systems.

12.8.1 Document Standards and Control

All Deliverables that are shared with, or issued to, **tie** shall be posted and reside within **tie**'s document management system. The official version of any project document shall be the version that exists within **tie**'s document management system. Access shall be granted to **tie**'s document management system on a named basis, and access levels shall be determined by **tie**. The Infraco also agrees to abide by **tie**'s document management procedure as notified to Infraco from time-to-time.

Documents from external parties should be uploaded to the project extranet for processing by document control. The extranet will also be the official conduit for issuing project information. In exceptional circumstances where documents must be exchanged by email, only the Document Control team will receive and issue this information. They will then handle all appropriate processing and distribution.

Deliverables shall conform to the following standards:

Acceptable File Types

- MS Office Suite 2003;
- MS Project 2003;
- MS Visio 2003;
- Portable Document Format (PDF) – Fully-searchable (OCR) Acrobat Reader v7 compatible;
- Compressed Files/Folders – WinZip v10 compatible;
- Graphics – GIF, TIFF, JPG, JPEG, or BMP;
- Audio – Audio files should be saved in MP3 format;
- Video – WMV or MPEG format with WMV preferred;

- Drawings – DWG (inclusive of used templates) and DCF.

Acceptable File Sizes

In general, all files should be optimised to keep their size to a minimum. For email correspondence the maximum allowable attachment size is 10MB. Individual files in excess of 50MB are only acceptable with prior agreement from **tie**.

Project Applications

- Collaboration – SharePoint 2007 (hosted by **tie**);
- Project Planning – Primavera v6;
- Risk Management – Active Risk Manager (hosted by **tie**);
- Deliverables. In addition to Deliverables conforming to the above, they should specifically be supplied in complete, self-contained and fully editable formats.

Typical examples include;

- Drawing Deliverables should be supplied as complete DWG files (inclusive of used templates) as well as the DCF print snapshot;
- Documents should be in Word 2003 (or previous) format;
- Spreadsheets should be in Excel 2003 (or previous) format and include the associated macros, equations, and functions.

Illegal Characters

As a matter of best practice the following characters should not be used in filenames to minimise the risk of error in software applications:

&	**¦**	**$**
~	**¬**	**£**
*****	**^**	**?**
%	**; (semi-colon)**	**!**
#	**, (comma)**	**@**
****	**‘ (apostrophe)**	**=**
/	**` (single quote)**	
<	**“**	
>	**. (dot)**	
{	**: (colon)**	
}		

12.9 Infraco Performance Measurement

As part of the overall project reporting regime, a four weekly report incorporating performance against Key Performance Indicators (KPI) shall be required from the Infraco. These shall be project, as opposed to company, specific.

A fundamental consideration is that the KPIs agreed must be measurable and without dispute, thus they shall be fact based. The outputs shall be compared on a four weekly basis against both four weekly and rolling targets. A colour coded "traffic light" visual warning shall be used.

The KPIs agreed are split into a number of different areas. The following provides the breakdown of components within each of the areas. Deductions against the failure to achieve the agreed KPIs are set out in Schedule 45.

Table 26 – Table showing indication of Safety KPIs

Safety
Accident Frequency Rate (AFR)
Equivalent Fatality Rate (EFR)
Lost Time Accidents (LTA)
RIDDOR
Road Traffic Injuries
Road Traffic Damage (caused by Infraco actions)
Accident Investigations (late receipt)
HSE inspections, observations, improvement notices and prohibitions
Working at height
PPE – not using/not using correctly
Review of Accident Book entries
Possible 3rd Party specific (e.g. Network Rail)
NCRs
CARs (non-completion/late response or action)
Procedure compliance
Test failures (to include concrete and welding)
Safety Tours
Safety Inspections
Security
Achievement of programme
Snagging correction

Method Statements/Risk Assessments – failure to operate in compliance therewith
Late Possessions / Overruns
Reporting
Spills
Working hours contraventions
Complaints
Pollution – water courses; noise; light; dust; others
Trespass
COSHH contraventions
Signage and warning signage
Specific parameters may need to be devised relating to programme, performance, reporting and other specific issues that are important to **tie**.

The Infraco shall submit samples, manufacturers' literature, documentation and other such materials to demonstrate compliance with the Employer's Requirements, from time to time, for review by **tie**, in advance of the associated materials or equipment being procured. The Infraco shall prepare a Schedule of Procurement Proposals to identify all such proposed submissions and their timing for approval by **tie**.

12.10 Cost Management and Reporting

The Infraco shall carry out a pro-active role in cost management and reporting. A cost report shall be submitted by the Infraco to **tie** no later than 3 Business Days before each cost review meetings / or at a 4 weekly period, to be agreed with **tie**. In addition cost summary information shall be provided for inclusion in the Progress Reports.

The Infraco cost reports shall contain comprehensive information and shall be structured in a manner that is commensurate with **tie**'s own reporting structure. The cost reports shall be required to provide information, including the following:

- Executive summary and narrative on significant changes from the previous report;
- Actual / Planned / Forecast Spend Tables / Curves to match the achievement of major deliverables and activities within the Work Breakdown Structure;
- Change Control Schedule and background information;
- Schedule of Compensation Events and background information;
- Value management estimates / analysis;
- Schedule of status of completion of Construction Milestones and Critical Milestones;
- Copy of the progress statements included in Monthly Progress Monitor.

The Infraco shall also be required to provide value engineering estimates and reports. These reports shall be provided by Infraco from time to time, as proposed by the Infraco or as required by **tie**, for the purpose of achieving better value.

12.11 Risk Management

12.11.1 Project Objectives

tie is dedicated to ensuring that a consistent approach to risk management is adopted across the ETN, which shall enable an informed view of risk to be taken.

ETN project risk management's mission is "to successfully manage all risks to and opportunities for the project thus ensuring that a supported and fully functioning operational service is delivered within budget and on time.

The key drivers within this mission are to:

- Promote and support proactive management of risk and opportunity;
- Integrate risk awareness / management, and not risk aversion, into the project culture;
- Manage risk in accordance with best practice;
- Reduce risk exposure to acceptable levels;
- Capitalise on opportunities;
- Ensure that all identified risks are owned and managed by the party best able to manage them;
- Provide assurance and enhanced information to managers and stakeholders.

tie maintains a project risk management plan and risk register covering the strategic, project management and commercial aspects of the ETN and shall continue to do so throughout the Term and operation. **tie** seeks to have all service providers, including the Infraco, contributing towards this risk register.

12.11.2 Risk Deliverables

The Infraco shall provide various Deliverables, as described in this section, to assist **tie** in meeting **tie**'s risk management obligations associated with strategic, project management and commercial aspects of the ETN. The required procedures for managing hazards and risks associated with obligations associated with safety are not covered in this section.

The Infraco shall be responsible for the production, management, development, regular maintenance and necessary updating and distribution of the documentation included within the table below. The documentation shall be held by the Infraco in electronic format with hard and soft copies being made available as required.

Risk Documentation shall be submitted to **tie**, in paper copy and electronically, for their approval in accordance with the Review Procedure and the required dates and frequencies are included in the table below.

Required Action from the Infraco	Timing/Frequency applicable to the Infraco
The Infraco shall provide assurance that they shall manage design and construction risk to the satisfaction of **tie** and in order to fulfil the objectives described in12.11.1. As part of this obligation the Infraco shall be responsible for the production, development and maintenance of a Infraco Risk Management Plan ("IRMP") for the management of all risk aspects of the Edinburgh Tram Network throughout the Term. The IRMP shall focus on the risk factors related to the Infraco managed activities related to the Infraco Works for the delivery of the Edinburgh Tram Network including the risk deliverables noted below. The IRMP shall identify individuals and their responsibility in relation to risk.	Agree format and delivery date for the IRMP with **tie**'s designated risk manager within one month of the Commencement Date. The Infraco shall update and maintain the IRMP throughout the Term. The Infraco shall issue an update to the IRMP at least bi-annually throughout the Term.

Required Action from the Infraco	Timing/Frequency applicable to the Infraco
The Infraco shall be responsible for the development and maintenance of an Infraco Risk Register ("IRR"), to best present all capex, opex, lifecycle, programme and quality risks to the Edinburgh Tram Network. The IRR shall also detail the proposed and completed mitigation of such risks. The platform used shall include the ability to generate reports, highlight risks to **tie**, key programme and cost impacts. The Infraco shall be responsible for the identification of commercial risks associated with all interfaces related to the works and shall facilitate and coordinate the inputs from stakeholders and other parties requested by **tie** from time to time. The IRR shall include analysis of each risk in terms of 'likelihood' and 'impact' providing detail on the inherent risk significance and current residual risk significance. Each risk shall have a designated responsible owner and the Infraco shall provide dashboard type graphical summaries of the risk profile and management actions being taken to mitigate. The risks to be addressed should include technical, operational, infrastructure, interface, economic, legal and regulatory, organisational and environmental risks. The Infraco should review the IRR on a four weekly basis to ensure that it is current. The Infraco shall meet with **tie** on a four weekly basis in line with the tram period calendar to discuss the control of key risks by the Infraco.	Agree format assessment criteria, platform and delivery date with **tie**'s designated risk manager within one month of the Commencement Date. The Infraco shall update and maintain the IRR as required on a four weekly basis and shall distribute the IRR to **tie** on a four weekly basis throughout the Term. Assessment criteria must be compatible with **tie**'s own risk register and assessment criteria.

Required Action from the Infraco	Timing/Frequency applicable to the Infraco
It is recognised that the identification, monitoring and progress of risk shall be discussed at regular workshops. The Infraco shall provide to **tie** a schedule of and undertake workshops, regarding risk matters to assist **tie** in ensuring the effective management of risk in relation to the Edinburgh Tram Network, **tie**, the Operator and/or relevant suppliers should receive timely notification of these in order to be able to attend. It is noted that **tie** may routinely request to attend workshops in order to be able to evaluate Infraco's approach to and performance in relation to risk. Infraco shall also attend meetings and workshops with **tie**'s project and risk management team and other ETN suppliers, the Operator and service providers as instructed by **tie** to take part in update of existing project risk and identification of new risks. The representatives attending such workshops shall be qualified and shall have sufficient knowledge of the ETN project to be able to contribute pertinent information within these workshops.	Provide and agree workshop schedule for the coming 6 months within the risk progress report to **tie**'s designated risk manager within 2 months of the Commencement Date.

Required Action from the Infraco	Timing/Frequency applicable to the Infraco
The Infraco shall be responsible for the preparation and maintenance of a Commissioning Risk Control Report which shall detail the plans for mitigating risks associated with the commissioning of the Edinburgh Tram Network. This should cover commissioning, operational and design risks, but not limited to the trams, the tracks, the power supply and the tram depot. The Commissioning Risk Control Report shall concentrate primarily on the (commercial risk) associated with the commissioning process, but shall also refer to ongoing issues which also affect the construction and/or operation or part operation of the Edinburgh Tram Network .	Agree format of the Commissioning Risk Control Report to **tie**'s designated risk manager (as notified to the Infraco from time to time) within 6 month of the Commencement Date. Final report to be delivered at least 3-months prior to start of the Testing and Commissioning. The Infraco shall update the Commissioning Risk Control Report as required until the Service Commencement Date..
The Infraco shall be responsible for the preparation and maintenance of a Residual Risk Control Report ("RRCR") that will detail the plans for mitigating the risks arising from the construction and commissioning of the Edinburgh Tram Network, which are still of ongoing importance. The RRCR should clearly detail the areas of importance that could affect the ETN after the Service Commencement Date until the end of the Term. These areas could be associated with design, operational and defects factors. Risks to be noted in the RRCR may include, but shall not be limited to commercial risk associated with, snagging, claims, specification defects and other commercial concerns.	Agree format of RRCR with **tie**'s designated risk manager (as notified to the Infraco from time to time) within 12 months of the Commencement Date. Final report to be delivered at least three months prior to the Service Commencement Date. The Infraco shall update the RRCR as required throughout the Term.

Required Action from the Infraco	Timing/Frequency applicable to the Infraco
The Infraco shall prepare and maintain an Operational and Maintenance Risk Register ("OMRR") that will detail the identified risks associated with provision of the Maintenance Services in relation to the Edinburgh Tram Network and management actions being taken to mitigate. The Infraco shall liaise with its Sub-Contractors and the Operator and any other relevant party as required in relation to the creation, development and updating of the OMR	Agree format and assessment criteria of the OMRR with **tie**'s designated risk manager (as notified to the Infraco from time to time) within 12 months of the Commencement Date. First formal report to be delivered at least three months prior to the Service Commencement Date. The Infraco shall update the OMRR in line with the four weekly tram period calendar

Table 27 - Table showing required actions from the Infraco

12.12 Traffic Management / Temporary Traffic Regulation Orders (TTROs)

The Infraco shall be responsible for the preparation of a Traffic Management Plan (TMP) and Work Site Staging Plan (WSSP). The TMP and WSSP shall comply with instructions issued by **tie** and shall be drafted in consultation with **tie** and CEC. The Infraco shall be responsible for the preparation of a Traffic Management Plan (TMP) and Work Site Staging Plan (WSSP). The plans shall apply to all work required in connection with the Infraco and including wider area traffic management measures associated with the construction of the main works. The TMP and WSSP shall comply with instructions issued by **tie** and shall be drafted in consultation with **tie** and CEC.

The TMP and WSSP shall identify and account for interfaces with parallel works, including the MUDFA Works.

The TMP and WSSP shall also include all necessary survey work, temporary traffic diversion modelling, assessment and design which will take account of the works, network constraints and the traffic control requirements.

The design shall identify the required alterations to road layouts, regulatory changes to be enacted through TTRO, altered/additional traffic signal equipment, new traffic signal installations and advance/local road signage.

The design shall also determine the locations of temporary bus stops and taxi ranks, alterations to parking and access/servicing arrangements for residents and businesses in works areas.

The TMP and WSSP shall be submitted within four weeks of the Commencement Date by the Infraco to **tie** and CEC for approval in accordance with the Review Procedure and as detailed in the current CEC-**tie** Interface Protocol relating to TTROs (Protocol Ref: TECH – 01).

The TMP and WSSP submission packages shall be as described in the Protocol and the plans shall include temporary works method statements, and shall identify general traffic, bus and pedestrian diversionary routes, access routes for emergency vehicles, and alternative arrangements for bus stops, parking and loading. The plans shall also include assumptions registers, issues logs and any other means to ensure prompt resolution of issues which could affect the progress and economic execution of the Infraco Works.

Leaflets and other approved publicity material shall be prepared for the information of the public/stakeholders/media showing temporary traffic management arrangements and traffic diversions and how these will operate.

Prior to implementation the TMP and WSSP shall be presented for review and approval to the **tie**/CEC/ Police/TEL Traffic Management Review Panel (TMRP) in-line with the agreed protocols and timescales which include procedures to give stakeholders advanced notification of the proposed arrangements to be implemented during the works.

The TMP and WSSP shall also include all necessary drawings, diagrams and supporting information to show the mobilisation, erection and dismantling of Temporary Works, traffic and pedestrian management during any pre-diversion works and the Infraco Works, access to properties, details of fencing and security measures.

The Infraco shall update the TMP and WSSP every two weeks throughout the duration of the Infraco Works for review at fortnightly design meetings and every four weeks at stakeholder and third part meetings.

The Infraco shall be responsible for the preparation of draft TTROs which shall be submitted to CEC, in its capacity as Roads Authority, for approval, again as described in the current CEC-**tie** Interface Protocol relating to TTROs (Protocol Ref: TECH – 01). The submission packages shall be as described in the Protocol.

TTRO submissions will adhere to the programme detailed in the Protocol.

The Infraco shall also attend meetings in relation to the TTROs, as required by **tie**, including representations to the **tie** / CEC Roads Working Group Committee, which convenes quarterly.

The Infraco shall develop a set of requirements in relation to TTROs and traffic management, which shall be based on information supplied to the Infraco by **tie** and/or **tie** ("TTRO Obligations and Traffic Management Plan") and shall take account of the interface on traffic management that will be required in relation to the MUDFA Works.

The Infraco shall prepare and develop project-specific procedures for complying with the TTRO Obligations and Traffic Management Plan, and these procedures shall be submitted for approval by **tie** and CEC in sufficient time to avoid disruption to the Programme.

By appropriate induction, the Infraco shall ensure all site-based personnel, management staff, operatives and visitors are fully aware of and understand the procedures contained within these Employer's Requirements.

The designated project or site manager appointed by the Infraco shall be accountable for the implementation and compliance with these requirements and procedures.

The Infraco shall ensure that the overriding considerations expressed in these procedures and requirements shall be the safety of road users, minimising disruption caused by the Infraco Works, pedestrian management and ensuring that traffic and pedestrian disruption is kept to a minimum.

This shall include taking such measures as CEC, in its capacity as roads authority, may reasonably require.

The Infraco shall ensure that reasonable access to all business, residential premises and properties along the route of the Edinburgh Tram Network is maintained at all times.

12.13 Stakeholder Management

12.13.1 General

A Stakeholder and Communications Management Plan has been developed by **tie**. The Infraco shall comply with the requirements of this document.

The Infraco shall be, jointly with **tie**, accountable for minimising any possible adverse impact of the implementation of the Edinburgh Tram Network on stakeholders (both statutory and non statutory), local businesses and the general public.

12.13.2 Design

The Infraco shall incorporate the following requirements into the design in addition to any other requirements as defined:

- Securing, implementing and incorporating into the design all necessary Network Rail, BAA and other third party agreements;
- Assisting by providing all technical details relevant to the compulsory purchase order process and land acquisition process (including wayleaves and servitudes); including integration with **tie**'s stakeholder and GIS systems.
- Liaising with CEC, Scottish Executive, Historic Scotland, World Heritage Trust, Scottish Natural Heritage and others as required by **tie** in relation to the performance of the Infraco Works.

12.13.3 Liaison and Public Information

The Infraco shall appoint a liaison officer to manage all public relations, information and press related matters relating to the Infraco Works, who shall along with the necessary technical, commercial and other Infraco resource, liaise with **tie**, and if so requested by **tie**, with CEC, other statutory bodies, members of the public, local businesses, the press and the media as may be necessary on all matters relating to the Infraco Works. Except where expressly stated in the Agreement, the Infraco shall not make any publicity or media statements or make any other formal disclosure of information regarding the Infraco Works without the prior approval of **tie**.

The liaison obligation referred to in the above paragraph shall include, but shall not be limited to the following matters:

- From time to time as directed by **tie**, Infraco shall be required to participate in business, stakeholder and community liaison groups, public meetings and consultation meetings as the progress of the Infraco Works dictate.

- From time to time as directed by **tie**, Infraco shall be required to provide proactive input, information and comment into information initiatives organised by or on behalf of **tie** and attending as requested by **tie** at any relevant consultation meetings

- As directed by **tie Infraco** will assist with the development and maintenance of, and adherence to, a communications protocol for dealing with all stakeholders, businesses and members of the public affected by the Infraco Works. In particular this will require strict adherence to timescales determined by **tie**.

- Assisting with the development and maintenance of procedures developed by **tie** in relation to stakeholder management by way of the provision of information relating to the Infraco Works

- Provision of weekly updates to **tie** on the progress of the Infraco Works and all planned Infraco Works in a form reasonably requested by **tie**.

- Depending upon the type of communication, Infraco shall give **tie** a minimum of two weeks notice in advance of all plans for any formal communication with stakeholders, businesses and members of the public (e.g. for major customer works governed by the Customer Interaction Cycle far more weeks would be required). The form and content of such formal communication shall be subject to **tie**'s prior approval

- Provision to **tie** of all information reasonably requested by **tie** in respect of the Infraco Works planned in a form prescribed by **tie** and timescales and frequency agreed with **tie**.

- **tie** and Infraco will be jointly involved in the appointment of appropriately qualified "Tram Helpers". They will be directly managed by **tie,** but integrated into Infraco work areas and teams through joint induction and briefing; appropriate cross training; "Tram Helper" visibility in Infraco work areas; "Tram Helper" involvement in the direct management of stakeholder issues on site; direct engagement by "Tram Helpers" or appropriate Infraco management and staff to assist in the resolution of on site issues; provision of appropriate Infraco uniform and equipment, etc.

"Tram helpers" are to be recruited and in place four weeks prior to commencement of notification.

- Provision and use of approved branding materials, PPE kit and signage at all operational Work Sections. No such materials, kit or signage shall be erected at any Work Section without the prior approval of **tie**.

- The provision and distribution of traffic routing maps which conform to the terms of the TTROs for all areas affected by the Infraco Works in advance of the Infraco Works starting in any particular location as may be requested by **tie**. In the event that **tie** requires that such material is for public issue, public issue shall not occur before the form and content has been approved by **tie**. Infraco shall ensure that all public statements (including by way of media referred to in the sections below (customer care centre, website, weekly newsletter, monthly newsletter, call centre and communication log) in relation to the Infraco Works are consistent with (**tie**'s) Communications Strategy and integrated with **tie**'s systems and procedures.

12.13.4 Information Centre

The Infraco shall provide all information and documentation regarding the Infraco Works as may be reasonably required by **tie** in respect of the mobile and fixed information centres being operated jointly by **tie** and Infraco in relation to the Edinburgh Tram Network. The frequency of update and version control of information shall be subject to a process agreed with **tie**.

12.13.5 Website

The Infraco shall provide all information regarding the Infraco Works, reasonably requested by **tie**, in order to populate the website, which shall be maintained and operated by **tie** throughout the progress of the Infraco Works, in respect of the Edinburgh Tram Network. The frequency of update and version control of information shall be subject to a process agreed with **tie**.

12.13.6 Weekly Newsletter

The Infraco shall produce and publish weekly newsletters every Wednesday, detailing the Infraco Works to be undertaken in the forthcoming week and outlining, with appropriate maps, drawings and diagrams, the impact on the general public, businesses and in particular any alterations to road traffic circulation patterns required by the coming week's Infraco Works.

Each newsletter, the contents and format of which shall have the prior approval of **tie**, will also be issued, if requested by **tie**, by fax and email to: local and national newspapers and other news media, CEC, Lothian and Borders Police, the emergency services, to any party or parties requested by **tie** and to any other persons or organisations that have requested receipt of the newsletters.

The newsletters shall also be distributed door to door by the Infraco in affected locations and the Infraco shall advise **tie** when such distribution is occurring.

The Infraco shall monitor and record the distribution of newsletters, recording who is carrying out such distribution, the intended recipients etc, so as to enable **tie** to carry out its own audit and monitoring of such distribution. Infraco to ensure, by regular surveys that circulation data is accurate and up to date.

Sufficient free distribution take-away hard copies of these newsletters shall be delivered to and placed in the information centre by the Infraco before 08:00 every Thursday morning.

The Infraco is required to submit a draft of each issue of the newsletters to **tie** no later than midday on the Monday immediately preceding the proposed issue of the newsletters on the Wednesday. **tie** shall respond before 17.00 hours the same day.

12.13.7 tie Monthly Newsletter

The Infraco shall provide all information and assistance reasonably requested by **tie** in relation to the publication by **tie**, of a monthly newsletter in relation to the progress of and future plans for the Edinburgh Tram Network.

12.13.8 Customer Contact Centre

The telephone number, fax number and e-mail address of the call centre to be operated jointly by **tie** and Infraco in relation to the Edinburgh Tram Network (the "hotline") shall be publicised through the press and the weekly newsletter and clearly displayed on all appropriate PPE kit, site signage, hoardings and at other suitable locations within and throughout the vicinity of the Infraco Works. All letters, e-mails, customer queries shall be answered by Infraco within timescales, to be agreed in advance with **tie**.

12.13.9 Communication Log

All contacts, communications, complaints, comments and queries howsoever received by the Infraco shall be registered in a suitable electronic log (the "communication log").

The Communications Log shall be developed and maintained by Infraco in a manner that allows it to be fully integrated with **tie**'s Stakeholder Database and GIS systems. The communication log shall set out each contact under the type (e.g. General, Traffic, Safety, Vibration, Noise, Dirt, Disruption, Injury, Parking, Access, RTA, publicity, suggestions etc).

The method of approach shall also be logged (e.g. phone, direct, letter, email, etc.) as well as the time and date.

The log shall be so constructed such that statistical analysis of the different communications can be presented as part of the data to be provided to **tie**. It shall be a requirement that the Infraco shall deliver an "above average" customer satisfaction level, with criteria, frequency and method of assessment to be agreed by **tie**. In order to demonstrate this, there shall be a requirement for the Infraco (and as required **tie**) to undertake internal (and external) audits of the overall engagements with the stakeholders. All this information shall be summarised by the Infraco in its monthly progress report.

Infraco shall take such steps as are required to address any such contact, communication, complaint, comment or query in accordance with the response requirements set out in Table 28 - Notification Hierarchy and in line with the agreed enquiry management process.

To the extent that a stricter response requirement is otherwise required under the Agreement, the stricter response requirement shall apply.

To the extent that Table [26] provides for the recovery of any amount by **tie** from the Infraco, such amount may be deducted from any monies due to or to become due to the Infraco or, alternatively, may be recovered from the Infraco as a debt.

A record of all remedial actions taken shall be maintained.

In the event of the Infraco receiving a complaint, a follow up letter or electronic communication shall be passed to the complainant by the Infraco within 24 hours of their receipt of the complaint, outlining the complaint and details and timing of the remedial action being undertaken by the Infraco.

An up to date copy of the communications log shall be compiled daily by the Infraco, together with a report on the progress of any actions.

The communications log shall be inspected and signed daily by a nominated senior representative of the Infraco and shall be counter signed by the Infraco's Representative at least once per week.

The Infraco's Representative shall write a report to **tie** and/or the Nominated City Officer of CEC (as notified by **tie** from time to time) at a frequency determined by **tie** (at least once per month) containing a list of any breaches of the requirements as defined within this section and also Schedule 3 (Code of Construction Practice and Code of Maintenance Contract) occurring within the previous month, setting out:

- the nature of the breach;
- the duration of the breach;
- the action taken by the Infraco to mitigate the breach; and
- the steps taken to minimise the likelihood of a subsequent occurrence of the breach.

Subject to the Infraco obtaining **tie**'s prior approval, a copy of each week's communication log shall be placed every Friday in the information centres, where it will remain until completion of the Infraco Works.

Any person, including representatives of **tie** and CEC's nominated representatives may freely inspect all deposited copies of the communications log during the normal opening hours of the information centres.

The version of communications log on public display should not breach any data protection legislation or other Law.

Copies of the communication log shall be forwarded to **tie**'s Representative and/or and CEC's Nominated City Officer once per week.

The master communication log shall be available for **tie**'s Representative and CEC's Nominated City Officer to inspect at any other time during normal working hours.

Level of Urgency	Category of Notification	Required Response Time
1	**High urgency** Involves an immediate threat to persons or property or the circumstances otherwise require immediate rectification.	Immediate action required. If response not completed by the Infraco within 4 hours, **tie** may procure that the relevant work is carried out and the costs of so doing shall be recovered from the Infraco.
2	**Medium urgency** No immediate threat to persons or property, but circumstances require rectification within 24 hours.	Remedial action requires to be completed within 24 hours. If the Infraco does not complete the required response within 24 hours, **tie** may procure that the relevant work is carried out and the costs of so doing shall be recovered from the Infraco.
3	**Issue requires rectification** but no immediate threat to persons or property and the circumstances do not otherwise require immediate rectification.	Timescales for rectification to be agreed between the Infraco and **tie**. In the event that the Infraco does not comply with the agreed timescales, **tie** may procure that the relevant work is carried out and the costs of so doing shall be recovered from the Infraco.

Table 28 - Notification Hierarchy

13 Permits / Approvals [xx] – SF check with code of construction practice

The Infraco shall obtain all necessary permits and approvals prior to undertaking investigations or works on Site, in accordance with paragraph 3 of the Code of Construction Practice.

13.1 Method Statements

The Infraco shall prepare method statements in respect of all investigation and work activities, as detailed in this Section and paragraph 3.2 of the Code of Construction Practice and submit these in accordance with paragraph 3.3 of the Code of Construction Practice.

The Infraco shall produce a method statement entitled "Procedures for dealing with Unidentified Apparatus or Unrecorded Artificial Obstructions", which shall be submitted by Infraco in accordance with paragraph 3.3 of the Code of Construction Practice. This method statement shall contain procedures which shall confirm the processes for dealing with unforeseeable events or circumstances, the discovery of unidentified apparatus (including live services) or unrecorded artificial obstructions. The final version of the method statement and procedures shall be agreed with the relevant key third parties, Approval Bodies, the Utilities and the emergency services The method statement shall be updated and a final version produced which shall be finalised by the Infraco in accordance with paragraph 3.3 of the Code of Construction Practice.

13.2 Existing Structures Which May Affect Progress and relationship with Third Parties

The Infraco shall undertake works to address the condition of existing structures where such condition may affect the progress of the Infraco Works. Where such work is completed the Infraco shall take appropriate photographs to fully demonstrate the quality of the reinstatement works.

The Infraco shall undertake survey inspections associated with buildings and structures which may be at risk of physical damage as a result of the Infraco Works.

For such structures and buildings the Infraco shall compile an appropriate schedule of such buildings / structures, and produce surveys / records similar to those described under paragraph 18.2.1 of Schedule 3(Code of Construction and Code of Maintenance Practice).

During the Infraco Works, the Infraco must comply with Third Party Obligations and work with the third party to resolve any outstanding issues. Furthermore, early warning must be given to **tie** where any third party is, or is likely to start, acting unreasonably. In these situations, **tie** will seek to resolve any issues with the third party to assist Infraco.

13.3 Network Rail

The Infraco shall ensure that the requirements of the Network Rail GRIP process are implemented on the works for which they are responsible whilst working in accordance with all relevant Network Rail Group Standards.

The contract requirements for Network Rail with regard to health and safety are included within the Network Rail document NR/SP/OHS/008. The project specific requirements are identified within the Safety Clause Menu against the requirements of Network Rail document NR/SP/OHS/008 and indicated with 'ticks' in the contractor column sections 51 to 59 inclusive of the safety clause menu and any other requirements that the Infraco is proposing by virtue of his method of undertaking the Infraco Works. The safety clause menu shall be signed off by the Infraco to confirm its proposals.

The Infraco Works shall be undertaken as Third Party Works as identified within the Network Rail document (RT/LS/P/043).

14 Human Factors

The Infraco shall provide systems and working practices that are:

- As easy to use as possible;
- Unlikely to cause annoyance or stress to users of the Edinburgh Tram Network, whether members of the public, operators, or maintainers; and
- Likely to promote safety to all.

The Infraco shall systematically and comprehensively:

- identify all the human factors issues associated with the engineering of the Edinburgh Tram Network, using task analysis;
- determine which of these human factors issues pose the most significant risk to the efficiency, productivity, safety and health of the Edinburgh Tram Network; and
- describe the organisational arrangements and processes the Infraco intends to put in place to manage these significant human factors issues as part of the engineering of the Edinburgh Tram Network

The Infraco shall produce and maintain in accordance with the submittals schedule a human factors management plan, covering the requirements summarised above, and where appropriate, shall undertake human factors studies to recommend solutions.

Areas of particular concern are:

- The human computer interfaces in the Control Centre;
- The layout of the driver's cabs;
- The facilities to enable maintenance of equipment:
  - In the workshop and Depot;
  - At trackside;

- In substations;
- At the Tramstops; and
- In the Control Centre.

The Infraco shall adopt all applicable best practice and guidelines for human factors. In designing the environment in the Control Centre, the Infraco shall comply with BS EN 50126 and ISO 11064 "Ergonomic Design of Control Centres.

15 Reliability, Availability and Maintainability

15.1 Reliability and Availability

The Edinburgh Tram Network is made up of many different subsystems, most of which may affect the reliability of operation of the ETN as a whole. In respect of achieving and maintaining reliability, the Infraco shall design, construct and maintain the Edinburgh Tram Network in accordance with Good Industry Practice, subject to the reasonable constraints of cost. Where necessary, the ETN should be made resilient to single point equipment and cable failure by employing suitable levels of equipment/cable redundancy and duplication.

On equipment or cable failure, subsystems shall be designed in a fail-safe manner, with graceful degradation. Limited back-up facilities shall be provided to maintain services under specified partial failure conditions.

Defined below are the requirements for availability of individual subsystems (each of which is given a definition), and also the availability of individual components of the subsystems.

In addition to the above, the overall availability of the Edinburgh Tram Network and its subsystems must support the tram punctuality requirement that is set out in these Employer's Requirements. Consequently it may be necessary to increase the minimum requirements that are set out below, especially as the consequences of the actions that third parties may take, including delays caused by other road users, need to be included in the punctuality analysis for the Edinburgh Tram Network.

For all components and subsystems, assume a Mean Time to Repair (MTTR) of 4 hours.

Any downtime required for planned maintenance can be discounted from the determination of availability, provided that such maintenance can be reasonably undertaken at a time when the maintenance has no impact on the operation of the ETN. This will often be during overnight shut downs.

15.2 Traction Power System

Component or Subsystem	Minimum Availability
AC circuit breaker, where its availability is defined as the probability that it either fails to conduct electricity when commended to be closed.	99.99%
Transformer / rectifier where its availability is defined as the probability that it either fails to provide the nominal 750VDC when energised.	99.99%
DC circuit breakers and busbars, where its availability is defined as the probability that traction power is not available from the DCCB when commanded to be closed, provided that 750 VDC is available at from the rectifier	99.99%
Transformer / rectifier where its availability is defined as the probability that it fails to provide the nominal 750VDC when energised by the HV input.	99.99%
Substation battery and charger, where its availability is defined as the probability that control voltage is not available from the battery at any time during its normal operation, regardless of the state of the incoming LV supply	99.99%
Substation, where its availability is defined as the probability that 750VDC voltage is not available for the OLE when the substation is commanded to provide 750VDC	99.75%

Table 29 - Substation Equipment

Component or Subsystem	Minimum Availability
OLE System, where its availability is defined as the probability that in any linear km of the OLE system, trams are not able to operate at the normal operational speed due to defects in the OLE. This is based on an 8 hour incident once every 3 years, 20hr/day operation and (20 route-km plus depot, about 50 track-km)	99.99925% for each km

Table 30 – Overhead Line Equipment

15.3 Supervisory and Communications Systems.

Component or Subsystem	Minimum Availability
ODN node	99.99%
Fibre Optic Cabling	99.99%
Patch Panels and Connectors	99.99%
ODN network, where its availability is defined as the probability that any message from a given input to a node reaches its intended destination node correctly and could be transmitted onwards by that node.	99.99%

Table 31 - Operational Data Network

Component or Subsystem	Minimum Availability
Transponder (if used)	99.9%
Loop Detector	99.9%
TPDS Trackside Controller	99.9%
TPDS subsystem, where its availability is defined as the probability that any given tram has its position detected and passed to the signal controller and to Control Centre operators correctly, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional	99.75%

Table 32 - Tram Position and Detection System

Component or Subsystem	Minimum Availability
Passenger Information Display	99.9%
Local Controller (if required)	99.9%
PID subsystem, where its availability is defined as the probability that the appropriate message is displayed correctly at a given PID, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional	99.75%

Table 33 – Passenger Information Display

Component or Subsystem	Minimum Availability
Telephone Handset	99.9%
PABX	99.99%
Telephone network, where its availability is defined as the probability that any 30 second conversation between a given telephone and another given telephone is heard clearly and completely by the caller and the intended recipient, assuming that the ODN is fully functional.	99.75%

Table 34 – Telephone Network

Component or Subsystem	Minimum Availability
PA speaker	99.9%
PA controller	99.9%
Microphone and speaker	99.9%
PA subsystem, where its availability is defined as the probability that an operator can make an intended announcement clearly at a given platform, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional.	99.75%

Table 35 - Public Address System

Component or Subsystem	Minimum Availability
Base Station	99.95%
Mobile Handset (Tram, Vehicle, or Hand Held)	99.7%
Central Switch	99.99%
Operational Radio subsystem, where its availability is defined as the probability that a 10 second call (voice) or short data message can be received clearly by the intended recipient, assuming that the ODN is fully functional and that the hardware component of the Control Centre workstations is fully functional	99.75%

Table 36 - Operational Radio System

Component or Subsystem	Minimum Availability
Help / Emergency Help Point	99.9%
Help Point subsystem, where its availability is defined as the probability that a member of the public can contact the Control Centre operator and can carry out a Help Point conversation lasting 20 seconds, clearly and without interruption, assuming that the ODN is fully functional and that the PABX is fully functional	99.75%

Table 37 - Passenger Help / Passenger Emergency Help System

Component or Subsystem	Minimum Availability
CCTV camera	99.95%
Digital Video Recorder	99.95%
CCTV Matrix	99.95%
CCTV subsystem, where its availability is defined as the probability that an image is displayed correctly and in the specified sequence at the Control Centre, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional	99.9%
Recording and replay subsystem, where its availability is defined as the probability that an image is displayed from any given time in the past (within the recorded period) can be retrieved and displayed correctly, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional	99.9%

Table 38 - CCTV System

Component or Subsystem	Minimum Availability
SCADA RTU (including I/O cards and interface cards)	99.95%
SCADA subsystem, where its availability is defined as the probability is the lesser of (a) that an indicator is read correctly at the RTU, transmitted to the SCADA Master Station in the Control Centre, and displayed correctly on any SCADA display that is in use within four seconds: and (b) that a control is effectively transmitted to an outstation within two seconds, assuming that the ODN is fully functional and that the hardware component of the Control Centre servers and workstations is fully functional	99.75%

Table 39 - SCADA System

Component or Subsystem	Minimum Availability
Servers (if necessary, by use of hardware and software redundancy)	99.99%
Workstations	99.9%
Printers	99.5%
CCTV Matrix Controller	99.9%
LAN Switches, Routers and Hubs	99.99%

Table 40 - Central Control Equipment

15.4 Maintainability

The ETN and its components shall be designed with maintainability in mind. To this end, the following shall be observed:

- Important equipment shall be in a redundant configuration, so that a component may be replaced while standby equipment takes over its duty;
- Equipment shall be replaceable, if possible, as field replaceable units, so that defective components can be replaced without the need to power down the overall piece of equipment; and
- Equipment, particularly at trackside and on Tramstops, shall be positioned so that where possible it is accessible for maintenance or replacement without the necessity to halt tramway traffic or to close the Tramstop and without the need to use access equipment such as steps.

15.5 Supportability

The equipment selected for use on the Edinburgh Tram Network shall be selected so that:

- It has a long design life, as specified in section 6 of these Employer's Requirements.
- It shall be based on standard Commercial Off-the Shelf (COTS) equipment as far as appropriate, so that replacement parts may be easily obtained and integrated into the ETN without the necessity of resorting to the original subsystem or equipment suppliers.

16 Electromagnetic Compatibility

16.1 EMC Directive

On 20th July 2007 a new EMC Directive came into force in the European Union. Statutory Instrument 2006 No.3418 implements the new EMC Directive 2004/108/EC in UK law. The rules for the new EMC Directive have changed significantly from the old Directive (89/336/EEC). After 19th July 2009 declarations made will require appropriate "Technical Documentation". This means that the Declaration of Conformity made using the old conformance mechanisms will have to be updated to use "Technical Documentation". The Infraco must be aware of the relevance of the 19th July 2009 date and insist that suppliers provide documentation accordingly.

16.2 Essential Protection Requirements

The purpose of the EMC Directive is to ensure that electrical/electronic equipment does not cause or be susceptible to electromagnetic disturbance. The protection requirements required of all electrical/electronic equipment/systems/installations are as follows:

- the electromagnetic disturbance generated shall not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended; and

- they shall have a level of immunity to the electromagnetic disturbance to be expected in their intended use which allows them to operate without unacceptable degradation of that intended use.

The Infraco must produce an Edinburgh Tram Network specific EMC strategy document in accordance with the Submittal Programme that clearly defines its strategy for achieving compliance with these essential protection requirements and shall submit it to **tie** for its approval.

17 Health, Safety, Quality and Environment

17.1 Quality Management

The Infraco shall undertake the Infraco Works fully in compliance with quality management processes and procedures referenced in ISO 9001 and ISO 9004.

The Infraco shall develop a Quality Plan to meet the requirements of ISO 10005 - 1995, and which fully defines all quality aspects of the Infraco Works. The Quality Plan shall be submitted in accordance with the Review Procedure. The Quality Plan shall demonstrate an integrated quality management system relating to the design, construction, testing, commissioning and maintenance of the Edinburgh Tram Network and shall show how Infraco and its Sub-Contractors shall comply with the requirements of the Quality Plan.

The Infraco shall have all associated documentation readily available for internal review and review by **tie**. Regular internal audits shall be undertaken by the Infraco to ensure full compliance with ISO 9001 and ISO 9004 in accordance with paragraph 5.1 of the Code of Construction Practice. The Infraco shall prepare and submit in accordance with the Review Procedure a "Schedule of Internal Audits" for agreement with **tie**. This shall define the planned nature and timing of the internal audits. Furthermore **tie** reserves the right to undertake external audits in accordance with paragraph 5.2 of the Code of Construction Practice.

The Infraco shall ensure that its management system for the Infraco Works is developed to ensure that it aligns with the requirements of the Tram Project Quality Policy Statement (DEL.HSQE.103).

Quality control including materials and works on Site shall also be undertaken by the Infraco in accordance with the requirements of paragraph 3.2 of the Code of Construction Practice and the Project Safety and Quality Interface Document. The Infraco shall be required to comply with the requirements of this document including the completion of forms and other systems in order to assist **tie** in complying with **tie's** own safety and quality management systems.

17.2 Health & Safety

17.2.1 Safety Management Plan

The Infraco shall submit a safety management plan that is over-arching with regard to safety and defines the management procedures that shall be put in place to ensure health and safety for the design, construction, testing, commissioning and maintenance of the Edinburgh Tram Network. This document shall be stand alone and separate from other safety deliverables such as health and safety plan, system safety management plan, case for safety development etc. The Safety Management Plan shall address all issues relating to the safety of the Infraco Works, staff and third parties, however specific details relating to the items below are required and shall be submitted by the Infraco in accordance with the Submittal Programme:

- The plan shall detail the approach and all management procedures relating to health and safety for the Edinburgh Tram Network;
- The plan shall show how the Infraco will ensure that its Sub-Contractors apply all relevant health and safety policies and procedures to all Sub-Contractors;
- Details of all interfaces associated with safety and the procedures of how these shall be managed. Interfaces shall include Roads Authorities, Health and Safety Executive; any other relevant statutory authorities, HMRI; Competent Person (ROGS); Network Rail; Police; Fire and Rescue Services; Ambulance Service; and all applicable Law;
- Proposed Safety Initiatives;
- How the Infraco proposes that a safety culture shall be cascaded and enforced throughout the team including with Sub-Contractors;
- Infraco proposals for how safety shall be incentivised throughout the team, including with Sub-Contractors;
- The emergency procedures which the Infraco propose to implement;
- Details of how the Infraco shall implement accident and incident reporting and promotion of an open culture;
- The Infraco's safety inspection & safety tour regime;

- An outline of the Infraco's procedures relating to safety for compliance with **tie**'s Drugs & Alcohol Policy and procedures and details of the Infraco's own similar policy and procedures;
- Details of any particular safety issues the Infraco considers would be significant and initial mitigation measures the Infraco considers necessary;
- Commissioning of the Edinburgh Tram Network;
- Driver Training on the Edinburgh Tram Network;
- Maintenance of the Edinburgh Tram Network.

17.2.2 Occupational Health & Safety Management System

The Infraco shall adopt an occupational health & safety management system consisting of the implementation and use of those processes and procedures referenced in BS 8800, OHSAS 18001-2007 and/or HSG 65 (Successful H&S Management).

17.2.3 Project Health & Safety Plan and Health & Safety File

The Infraco shall develop a construction phase plan and supply all necessary information for the Project Health & Safety File in accordance with the Construction (Design and Management) Regulations 2007 and L144 Managing Health and Safety in Construction and as described in the pre-construction information. The construction phase plan shall require to be submitted in accordance with the Review Procedure.

17.2.4 Interface with tie's Safety Systems

The Infraco shall ensure that the management system for the Infraco Works is developed to ensure that it aligns with the requirements of the Tram Project Safety Policy Statement (DEL.HSQE.105). Section 32 of the Agreement contains the Project Safety (and Quality) Interface Document. The Infraco shall be required to comply with the requirements of this document including the completion of forms and other systems in order to assist **tie** in complying with **tie**'s own safety and quality management systems.

17.2.5 System Safety Management Plan (SSMP)

The Infraco shall be responsible for the development of the SSMP.

The SSMP shall define the engineering process that shall ensure, and provide a record of, assurance that the tramway has achieved an acceptable level of performance. This is achieved through a staged "case for safety" submission (refer below) process to signify that safety has been engineered into the design of the Edinburgh Tram Network. The SSMP shall define the process, activities and requirements for the preparation for a "case for safety" at the relevant design stage. The SSMP shall also define the system safety management organisation and the strategy to achieve the individual hazard system safety targets. The SSMP is concerned with only with those hazards that could give rise to an increased level of risk to passengers, staff and the general public from the operating system. (All health and safety hazards related to the risk to workers, staff and the general public from the construction activities should be covered under the safety management plan.)

17.2.6 The Railways and Other Guided Transport Systems (Safety) Regulations 2006

The Edinburgh Tram Network shall be delivered in accordance with The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS).

The Infraco shall design and execute the Infraco Works using safety management and procedures to demonstrate that the Edinburgh Tram Network is safe to introduce into service as defined by the Safety Management System under ROGS. This shall also include the development of the Case for Safety to the satisfaction of the Competent Person and the Project Safety Certification Committee. These aspects form an integral part of the design of the Edinburgh Tram Network and are detailed in this section of these Employer's Requirements.

The Infraco shall undertake all Infraco Works in accordance with the written safety verification scheme requirements prepared by **tie**. Safety verification will be undertaken by **tie**. The Competent Person shall assure the process and its outputs. The Infraco shall allow **tie** and the Competent Person access to undertake safety verification activities, such as system safety audits. The Infraco shall develop a safety management system for when the Edinburgh Tram Network is operational which complies with the requirements of ROGS and other relevant legislation to the satisfaction of the Competent Person and **tie/TEL**.

Whilst there is no requirement in ROGS for projects such as the ETN to be notified to or given prior consent or approval by HMRI, HMRI have been involved in the development of the Edinburgh Tram

Network scheme to date and it is **tie**'s intention to continue this involvement. The Infraco shall assist **tie** in any liaison with the HMRI when requested to do so.

17.2.7 Health and Safety Management

The health and safety responsibilities and CDM/ROGs application are defined in the matrix below for each phase of the project.

Table 41 – Matrix showing Contractual Responsibilities – Health & Safety Management

			Infraco				Revenue services	
RESPONSIBILITIES	**MUDFA**	**Pre Novation Design**	**Post Novation Design**	**Construction / Installation**	**Commissioning / Test running ***	**Shadow running**	**Operation**	**Maintenance.**
tie Ltd.	CDM Client.	CDM Client. **ROGS duty holder.**	CDM Client. **ROGS duty holder.**	CDM Client. **ROGS duty holder.**	CDM Client. **ROGS duty holder. ****	- **ROGS duty holder. **	-	-
Transdev.		Adviser to **tie**.	Adviser to **tie**.	Adviser to **tie**.	Driver training. Inputting into hazard log.	Operator of tram system. Inputting into hazard log.	Operator of tram system.	-
SDS	Designer.	Designer. Managing hazard log.	Designer. Inputting into hazard log.	-	-	-	-	-
MUDFA contractor.	Principal contractor	-	-	-	-	-	-	-
Infraco.	-	-	Design manager. Managing hazard log.	Principal contractor. Managing hazard log.	Principal contractor. Managing hazard log.	-	-	Contractor/Principal contractor. Maintainer–infrastructure.
Tramco.	-	-	Designer. Inputting into hazard log.	Contractor. Inputting into hazard log.	Contractor. Inputting into hazard log.	-	-	Maintainer–vehicles.
TEL.	-	-	-	-	-	-	**ROGS duty holder.**	CDM Client.
CEC.	-	-	-	-	-	-	-	-Maintainer - roads
REGULATIONS								
CDM Regs	Yes – Construction Phase Plan, Residual Risk Register. Health & safety file initiated.	Yes – Pre-construction information, Residual Risk Register. Health & safety file progressed.	Yes – Pre-construction information, Residual Risk Register. Health & safety file progressed.	Yes – Construction Phase Plan. Health & safety file progressed.	Yes – Construction Phase Plan. Health & safety file completed & handed over to TEL.	No – no longer construction work.	No.	Yes – where maintenance works are "construction works". (Notifiable works last more than 30 days or 500 man days).
ROGS Regs	No.	Yes – Safety Verification Scheme. Appointment of Independent Competent	Yes – Safety Verification Scheme. NoNOs from ICP.	Yes – Safety Verification Scheme. NoNOs from ICP.	Yes – Safety Verification Scheme + Safety Management System. NoNOs from ICP.	Yes – Safety Verification Scheme + Safety Management System. Final NoNO from ICP.	Yes – Safety Management System.	Yes – Safety Management System.

		Person (ICP).						
SAFETY MANAGEMENT SYSTEMS								
Safety Management Systems	AMIS SMS – construction. SDS SMS – design.	**tie** SMS – safety verification. SDS SMS - design.	**tie** SMS – safety verification. Infraco SMS – design management. SDS SMS – design. Tramco SMS – design.	**tie** SMS – safety verification. Infraco SMS – construction/installation Tramco SMS – manufacture/installation.	**tie** SMS – safety verification. Infraco SMS – installation/operation. Tramco SMS – installation. Transdev SMS – operation.	**tie** SMS – safety verification. Infraco SMS - operation. Transdev SMS – operation.	TEL SMS. Transdev SMS - operation.	TEL SMS. Infraco SMS – maintenance. Tramco SMS – maintenance.

* The project moves into this stage in phases once key milestones have been achieved e.g. the energisation of the OLE within the depot.

** This is flexible. TEL may assume the role of **ROGS duty holder** during this phase.

KEY

Responsibilities under the CDM Regulations

Responsibilities under the ROGS Regulations

17.3 Environmental Management

17.3.1 Environmental Management System

The Infraco shall adopt an environmental management system consisting of the implementation and use of those processes and procedures referenced in ISO 14001.

Documentation developed to meet the requirements of the environmental management system shall be submitted in accordance with the Review Procedure.

The Infraco shall ensure that the management system for the Infraco Works is developed to ensure that it aligns with the requirements of the Tram Project Environmental & Sustainability Policy Statement (DEL.HSQE.101).

17.3.2 Environmental and Sustainability Action Plan

The Infraco shall submit and maintain an Environmental & Sustainability Action Plan (EAP). This shall be based on SDS Environmental Mangement Plan and shall cover environmental issues for the duration of the Infraco Works, including design and construction stages. It shall describe the management process, procedures and interface requirements associated with meeting the Infraco's environmental responsibilities.

It shall then develop in detail the potential impacts on environmental resource, mitigation measures and responsibilities associated with all stages of the Infraco Works.

The EAP shall be prepared using the following sources of information.

- the Environmental Statements;
- The Design Manual;
- The Noise and Vibration Policy as contained within the Code of Maintenance Practice;
- The Code of Construction Practice;
- The Landscape and Habitat Management Plan for the Roseburn Corridor;
- The Badger Mitigation Plan for the Roseburn Corridor;
- Agreements made with statutory bodies; and

- Parliamentary agreements.

The EAP shall be amended by the Infraco to reflect any changes to the tramway design or engineering solutions and the results of surveys..

17.3.3 Construction Environmental Management Plan (CEMP)

The Infraco shall prepare a construction environmental management plan (CEMP) including method statements, as necessary, to convey the required level of information during the construction stage of the Infraco Works.

Site specific EMPs shall be prepared for each geographical section and intermediate geographical section as appropriate. These plans shall be produced by the Infraco prior to any works commencing on Site and must be reviewed by **tie** before work starts. The site specific EMPs must separately address the following sites and/or issues:

- Site accommodation, compound and offices and storage areas;
- Site clearance;
- Geographical sections and intermediate geographical sections of the Tram route;
- The Depot;
- Structures, such as sub-stations not already included in the above; and
- Road, cycleway and footway works, including drainage, signage and lighting.
- A series of site specific and topic related EMPs shall also be produced by the Infraco that shall address all the environmental issues, landscape, ecology etc. These shall cover the general control and protection measures for each topic as it relates to each of the site specific sections in the plan area. The Infraco shall have responsibility for the production, content and implementation of the Site Specific EMPs.
- The Infraco shall submit to **tie** the site specific EMPs 8 weeks prior to the commencement of the relevant section of the Infraco Works.

- **tie** shall comment on the plan(s) submitted, in accordance with the Review Procedure and agree the final plans prior to the commencement of any work on the relevant section or activity.

17.3.4 Requirement of Site Specific EMPs

The Infraco shall develop the site specific EMPs to include the following details:

- **A description of the works to be undertaken**
- List of all separate work activities that fall within the scope of the works.
- **A detailed programme of the construction activities**
- Proposed dates and sequence of the works (showing how environmental impacts are affected by potential changes to the Programme);
- Details of proposed normal working hours and intended start up and close down times; and
- Outline of any works which may require construction activities outside of normal working hours.
- **Location of the works, including a site plan, showing construction site boundaries**
- This shall show the position of plant and position of any sensitive receptors e.g. watercourses, local residents, etc.
- **Personnel access routes/points**
- Location plan of each access route/point;
- List of activities for which each access point is to be used
- **Vehicular access routes/points**
- Location plan of each access route/point;
- List of activities for which each access point is to be used
- **Equipment and plant to be used (including type, make and expected number)**
- **Method of delivery/removal of materials and plant**

- **Details of proposed site accommodation**
- **Details of how public right of way and access to property will be retained and managed**
- A list of Consents/permissions obtained or to be obtained for the works
- **External Consultation**
- A list of those notified of the works and the date notified
- A list of proposed notifications and dates
- **Significant environmental impacts relating to each activity.**
- (This should draw upon the definitions of significant impacts used in the Environmental Statement).
- **Significant environmental risks relating to each activity.**
- **Receptors which are likely to be affected by the works.**
- **On-site mitigating measures for each impact and risk.**

These will be transferred onto site management statements which will briefly state the key risks and mitigating measures which have been agreed. The site management statement will be attached to the construction method statement for the works to ensure that it is brought to the attention of all site staff. The Site Management Statement will be briefed out to all site based staff as a toolbox talk.

- **Monitoring proposals that shall include:**
- The receptors for which monitoring will be undertaken;
- Frequency of monitoring;
- Factors against which the monitoring results will be analysed;
- Threshold levels;

- Timescales within which results will be analysed;
- List of organisations/individuals to whom results will be distributed; and
- Actions to be taken in the event that thresholds are breached.

17.3.5 Permits to Work

Prior to being granted access to commence construction works, the Infraco shall complete and submit to **tie** for its autorisation, the required Permits to Work.

This permit shall identify and confirm that the necessary licenses, third party approvals and notifications have been obtained / granted and that the Infraco has identified any specific control measures and permits that will require to be implemented within the Infraco's safety management system.

Further details of the Permits to Work process are included within the Code of Construction Practice, the Project Safety & Quality Interface Document and Section 39 of the Employer's Requirements. [XX SF to check]

18 Cabling and Ducting

This Section 18 sets out the requirements with the Infraco must comply with in relation to cabling and ducting.

18.1 Cabling

All cables must be mechanically protected such that they cannot be accessed by the public without using tools to remove separate mechanical protection.

Cables and associated supports must be rated such that neither the cables nor the supports degrade due to thermal or mechanical stress during their design life.

Cables must operate satisfactorily under all foreseeable fault, and loading conditions.

Cables must operate satisfactorily under all foreseeable environmental conditions. This must include the effects of sunlight, dampness, temperature, and exposure to water. Cables must be selected to recognise risk that they may be submerged in water.

Cables must be designed to last for the durations that are set out in *Table 22 - Equipment Design Life.*

Cable terminations must not impose any stress on the cables, and sufficient spare length must be provided in all cables to permit foreseeable maintenance and repair work.

Cables must be identified in accordance with requirements agreed with **tie**.

Where joints in cables are required, and cannot be reasonably avoided, they must be located in draw pits and identified on the as-built drawings. Joints in draw pits must be both suitably supported and accessible. This may require draw pits that are larger than normal size to be used to contain cable joints.

All cables in all draw pits will be identified with a suitable label.

18.2 Ducts

Spare ducts shall be provided on all duct routes as follows:

Number of ducts in cable route	Minimum number of spare (unused) ducts	Minimum size of spare duct
2	0	N/A
3 or more	20% of the number of ducts	Maximum size of used ducts

Table 42 – Ducts

All ducts, and all individual ducts in banks of ducts, must contain draw ropes of sufficient mechanical integrity to enable additional new or replacement cables to be pulled through the duct.

All ducts, including ducts that are installed but not used for cables, must be free from debris and free from obstructions.

All installed ducts, including ducts that are installed but not used for cables, must not be crushed. All internal dimensions of the duct as built must never less than 90% of duct's nominal dimensions.

Ducts must be provided with drainage that is integrated with the specification of the cables used such that there is no foreseeable risk of degradation from any water that may be in the ducting system.

Ducts must be of sufficient mechanical integrity to protect both themselves and the cables contained in the ducts from all foreseeable damage, degradation and vandalism.

The bending radii of ducts must be integrated with the requirements of the cables to be installed such that the cables can be installed, replaced and terminated without damage.

Ducts must be provided in sufficient number and size to ensure that there is no degradation in the cables due to thermal effects or chafing of cables. It shall be possible to remove and replace any individual cable in the ducting system without the need to remove or significantly disturb any other cables from the system.

Cable ducts shall be installed with appropriate warning arrangement to anyone who may be undertaking excavation work that may damage the ducts. This may be achieved by the installation of plastic warning tape in the ground above the ducts.

Where cables are installed in segregated parts of the tramway, they shall not be installed in cable troughs unless specifically agreed by **tie**. Any proposals for the use of cable troughs must include:

- Locked lids or equivalent to minimise the risk of vandalism and/or theft;
- Where cable troughs form part of the walkway along the tram route, a proven design of locked lids that will eliminate any rocking of the lids must be used; and
- Troughs must be secured against any lateral movement.

For the avoidance of doubt, where cable troughs form part of a structure, the above requirements still apply.

Where ducts are used on the off street tramway, these are preferred to be placed under the walkway with draw pit covers forming part of the walkway.

Any slipping and/or tripping hazards associated with draw pits that are located in a walkway must be eliminated.

Some cables terminate in equipment on ballasted track. These include:

- traction return bonding connected to the rails;
- connections to loops; and
- possibly some connections to some Point Position Indicators.

These cables are to be installed such that the risk of damage to the cables due the activities of track maintenance equipment, vandalism and people walking on the track is minimised.

18.3 Duct Chambers and Draw pits

Duct chambers must be structurally sound and built to the requirements of the cabling network as specified in this section 18.

The design of the location of draw pits must such that they can be safely accessed without stopping the operation of the tramway or requiring a road closure, unless specifically agreed by **tie**.

The integration of draw pit covers into the surfacing in the surrounding area shall be included in the design. This will include the orientation and the surfacing of the cover.

Draw pit covers will be of a family, such that the number of different keys needed to lift draw pit covers is minimised.

The Infraco shall provide sufficient draw pit keys and access equipment to adequately operate and maintain the system.

18.4 Cable separation

Sufficient separation between cables must be provided in order to:

- ensure that any risk of damage to the insulation of the cables that could cause potential risks of energising other circuits is minimised. All cables carrying +750V dc must not be in physical contact with any other cables unless the cables are permanently bonded together,
- ensure that electromagnetic compatibility between cables is provided, and
- permit access to cables and any essential cable joints for maintenance purposes

18.5 Other requirements

Where cables are installed inside conducting items that are not earthed, such as OLE poles, the insulation and the mechanical protection of the cables must be sufficient to mitigate any associated hazards.

As built drawings will accurately identify:

- the cables that are contained in each duct, to aid cable location and fault finding; and
- the location of all draw pits and all duct runs.

19 Cabinets

This Section 19 sets out the requirements which the Infraco must comply with in relation to cabinets and the environmental conditions as defined in Section 3.6.4.

Cabinets, cubicles and equipment housings will be required in the following instances as a minimum:

- To house communications equipments at the Tramstops;
- To house SCADA equipment within substations;
- To house radio equipment at base stations; and
- To house points control, points indicator control, points heaters and Tram control equipment at rail junctions.

All cabinets that are located externally shall meet the following requirements:

- They shall provide an ingress protection rating of 55 (Specification for Degrees of Protection Provided by Enclosures) [XX AS] as a minimum;
- They shall be coated with materials that inhibit graffiti and assist with its removal;
- Equipment housing, enclosures, cable routes etc. shall allow for an increase of temperature caused by the equipment, whereby the housing itself shall not cause any harm to the functionality of the equipment or the temperature reached at the surface of the enclosure
- All cabinets shall provide an entry for cabling, with no cables visible or accessible without opening the cabinet;
- All cabinets are provided with a robust lock, satisfying the **tie** lock suiting requirements set out in these Employer's Requirements;
- The cabinet doors shall be equipped with a multi point locking mechanism that complies with the Edinburgh Tram Network security locking policy;
- In the event of the equipment cabinets being opened, an alarm shall be transmitted to the Supervisory Control and Data Acquisition system so that staff in the Control Centre can be alerted;

- The equipment contained within the cabinets shall be of a modular construction that shall allow rapid replacement should that become necessary;
- When the cabinet doors are open, they do not obstruct tramway operation, road vehicles, passengers or other members of the public; and
- Work can be carried out safely on the contents without affecting tramway operations or requiring temporary traffic management.

In addition, those cabinets located at Tramstops shall be designed to integrate visually with the Tramstop furniture. The external colour and appearance of the cabinets, shall match and complement the architectural finishes and materials of the structures of the Tramstop where the cabinet is to be mounted.

20 Advanced Works

The scope of the Advanced Works has been developed by **tie** and has been separately communicated to the Infraco. The final scope of the Advanced Works will be integrated with the Infraco Works during Infraco Contract period.

21 Utilities / MUDFA

The philosophy adopted for the MUDFA Works is to clear the ground of utilities such that the track can be installed in ground that has no live utilities within it. The MUDFA Works considers utilities that lie below the area of land that is described by the tram's DKE. It is assumed that the width of ground needed for the construction of the track slab is no more than the width of the tram's DKE.

Where utilities lie below 1200mm from the surface, they are left in-situ.

Where utilities occupy ground that is within 600mm of the existing road surface, they are removed and replaced.

Where utilities lie between these two limits, they are considered on a case by case basis. Generally, utilities that cross the tramway are protected (sleeved for example) and left in position. Where utilities run along the tramway, they are diverted and placed outside the tram's DKE.

Special arrangements are made for major utilities such as the HV cables and the service tunnel along Leith Walk.

Infraco shall undertake all utilities diversion, relocation or protective works necessary to deliver the Edinburgh Tram Network that have not been undertaken or are due to be undertaken by the MUDFA Contractor. This will be because they are either outside the swept path, or it is impracticable for the MUDFA Contractor to move them or they have been erroneously installed by a third party between the MUDFA Contractor finishing their works and Infraco starting their work at that work site.

Schedule [46] details specific locations and utility types which shall be either left in situ or be diverted by Infraco. Where utilities' scope decisions and responsibilities fall outside this schedule Infraco and tie shall jointly agree the most appropriate party (either MUDFA or Infraco) to undertake the diversion works.

The generic allocation of responsibility for relocating utilities is set out in Section [21] of these Employers Requirements.

Tie will obtain designs for all utility diversion works and issue them to Infraco.

Infraco shall deliver the utilities diversion works instructed in accordance with designs provided.

Infraco shall ensure that the Programme contains adequate allowance for these utility diversion works.

Infraco responsibilities in respect of utilities diversions shall also include:

1. Where diversion works are to be delivered by Statutory Utilities (SUs) supporting tie in the development and agreement of utilities diversions works package agreements with the SUCs. Such support mean supporting tie and providing all necessary information to enable tie to negotiate contracts for diversion works with SUCs, assembling and checking work package agreements, defining detailed scope, providing constructability advice and agreeing programme of works with SUC's and co coordinating such so that impact on programme for delivery of the Infraco Works is minimised, agreeing construction and delivery methodologies with SUCs, finalising the scope of Utilities diversion works and the boundary of responsibility between work to be delivered by Infraco and that of SUCs.
2. Providing all enabling, traffic management requirements, ancillary building, civil engineering, electrical and mechanical works in connection and all attendances required to enable SUCs to carry out and complete their works.
3. Coordinate the works of SUCs with each other and with that of the Infraco.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
Water	Connections	Connections to new mains will be required before old main can be decommissioned. This is part of the advance diversion scope of MUDFA.	If any connections are missed by MUDFA and subsequently identified by Infraco, they must be carried out at the time of Infraco. However, this risk is small as missed connections would usually lead to immediate customer complaints when the old service was decommissioned.	Note that this is not intended to be the primary mitigation of this risk: site investigation and planning should ensure that connections are identified and dealt with by MUDFA.
	Diversion (other than 800mm at Depot)	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, the diversion must be carried out by (or at the same time as) Infraco. Extensive site investigation has been carried out to reduce this risk, but it cannot practically be eliminated.	
	Diversion of 800mm at Gogar Depot.	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, the diversion must be carried out by (or at the same time as) Infraco.	There is little, if any, risk of encountering any other water service in the Gogar Depot area that has not been dealt with by MUDFA.
	External Protection	Part of the advance diversion scope of MUDFA.		Long longitudinal protection would not be acceptable for water mains

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	Insurance Pipes	Part of the advance diversion scope of MUDFA.		

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
Waste water	Diversions and manhole construction	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, or where the designs of works have been unable to be sufficiently progressed prior to MUDFA vacating the Work Sections, the diversions must be carried out by (or at the same time as) Infraco. Extensive site investigation has been / will be carried out to reduce this risk, but it cannot practically be eliminated.	Sewer design and agreement with SUC (Scottish Water) regarding treatment required to existing sewers is not currently complete and the programmed completion of the telecoms cabling works is such that existing services cannot be abandoned to allow the manhole and sewer construction works to be undertaken for significant periods of time after all the ducts and other utility diversions are complete. This may result in sewer diversion works to be undertaken after all other MUDFA programmed works in Work Sections are complete. Works may be undertaken by either MUDFA or Infraco.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	Internal Refurbishment	Part of the advance diversion scope of MUDFA.		
	External protection	Where crossing or short longitudinal - part of the advance diversion scope of MUDFA.	Where long longitudinal: would be relatively easy to incorporate into Infraco - for a section, excavation would be deeper with (e.g.) concrete placed - this would avoid double excavation by MUDFA and Infraco.	
	Connections to new sewers	Connections to new mains will be required before old main can be decommissioned. This is part of the advance diversion scope of MUDFA.	If any connections are missed by MUDFA and subsequently identified by Infraco, they must be carried out at the time of Infraco. However, this risk is small as missed connections would usually lead to immediate customer complaints or evidence of flooding when the old service was decommissioned.	This is not intended to be the primary mitigation of this risk: site investigation and planning should ensure that connections are identified and dealt with by MUDFA.
	Existing connections	An existing connection to an existing (and left in place) sewer may have to be repositioned. This would be part of the advance diversion scope of MUDFA.	A connection may not be identified at the time of MUDFA, and uncovered by Infraco. The connection must be repositioned at the time of Infraco.	

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	Manhole access level change (eg raise height of access cover)	St Andrews Square and North & South St Davids Street will be undertaken by MUDFA as part of the road realignment and construction works required to accommodate the proposed Traffic Regulation Order (TRO).	Manhole access level changes must be adjusted at the time of Infraco. Manhole lids to be flush with the finished road surface.	It will also mean that new manholes installed by MUDFA may have to be modified by Infraco.
	New Gully connections	St Andrews Square and North & South St Davids Street will be undertaken by MUDFA as part of the road realignment and construction works required to accommodate the proposed Traffic Regulation Order (TRO).	Infraco shall install road gulleys. These will have to be installed at the same time as the road construction is carried out.	If a new road gully is required at a place where the road level is not to be changed, MUDFA could install it. However this situation is unlikely, and for consistency and avoidance of confusion Infraco should probably do all of this.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
Telecoms	Protect	Where crossing or short longitudinal - part of the advance diversion scope of MUDFA. Where long longitudinal: would be part of the advance diversion scope of MUDFA allowing Infraco a "clear run". However would necessitate double - excavation of a long length of the tram foundation area.		Where long longitudinal: would be relatively easy to incorporate into Infraco - for a section, excavation would be deeper with (e.g.) concrete placed - this would avoid double excavation by MUDFA and Infraco*.
	Slew/Lower	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, the diversion must be carried out as Infraco Works. Extensive site investigation has been carried out to reduce this risk, but it cannot practically be eliminated.	

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	Divert (inc manhole construction)	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, the diversion must be carried out as Infraco Works. Extensive site investigation has been carried out to reduce this risk, but it cannot practically be eliminated.	
	Insurance Ducts	Part of the advance diversion scope of MUDFA.		
	Manhole access level change (eg raise height of access cover)	St Andrews Square and North & South St Davids Street will be undertaken by MUDFA as part of the road realignment and construction works required to accommodate the proposed Traffic Regulation Order (TRO).	Manhole access level changes must be adjusted at the time of Infraco. Manhole lids to be flush with the finished road surface.	This will also mean that new manholes installed by MUDFA may have to be modified by Infraco.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
Gas	Divert	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, the diversion must be carried out as Infraco Works. Extensive site investigation has been carried out to reduce this risk, but it cannot practically be eliminated.	
	Protect	Part of the advance diversion scope of MUDFA.		Long longitudinal protection would not be acceptable for gas mains
	Insurance Pipes	Part of the advance diversion scope of MUDFA.		
	Connections	Connections to new mains will be required before old main can be decommissioned. This is part of the primary scope of MUDFA.	If any connections are missed by MUDFA and subsequently identified by Infraco, they must be carried out as part of Infraco Works. However, this risk is small as missed connections would usually lead to immediate customer complaints when the old service was decommissioned.	This is not intended to be the primary mitigation of this risk: site investigation and planning should ensure that connections are identified and dealt with by MUDFA.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
Electricity	Divert	Part of the advance diversion scope of MUDFA.	If any apparatus is discovered by Infraco that was not identified at the time of the utility advance diversion works, the diversion must be carried out as part of Infraco Works. Extensive site investigation has been / will be carried out to reduce this risk, but it cannot practically be eliminated.	
	Protect	Where crossing or short longitudinal - part of the advance diversion scope of MUDFA.	Where long longitudinal: would be relatively easy to incorporate into Infraco - for a section, excavation would be deeper with (e.g.) concrete placed - this would avoid double excavation by MUDFA and Infraco.	Where long longitudinal: would be part of the advance diversion scope of MUDFA allowing Infraco a "clear run". However would necessitate double - excavation of a long length of the tram foundation area.
	Insurance ducts	Part of the advance diversion scope of MUDFA.		

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	Domestic + Business connections	Connections to new cables will be required before old cable can be decommissioned. This is part of the primary scope of MUDFA.	If any connections are missed by MUDFA and subsequently identified by Infraco, they must be carried out as part of Infraco Works. However, this risk is small as missed connections would usually lead to immediate customer complaints when the old service was decommissioned.	This is not intended to be the primary mitigation of this risk: site investigation and planning should ensure that connections are identified and dealt with by MUDFA.
Street Furniture (eg street lighting, traffic lights, lighted bollards, bus stops, etc)	Existing power & telecoms Divert	St Andrews Square and North & South St Davids Street will be undertaken by MUDFA as part of the road realignment and construction works required to accommodate the proposed Traffic Regulation Order (TRO).	All existing power and telecoms diversions required must be carried out by (or at the same time as) Infraco. Depth of cover and the final road infrastructure alignment and construction to be finalised by and carried out by Infraco.	Extensive site investigation has been / will be carried out to reduce this risk, but it cannot practically be eliminated.
	Protect	St Andrews Square and North & South St Davids Street will be undertaken by MUDFA as part of the road realignment and construction works required to accommodate the proposed Traffic Regulation Order (TRO).	All existing power and telecoms diversions required must be carried out by (or at the same time as) Infraco. Depth of cover and the final road infrastructure alignment and construction to be finalised by and carried out by Infraco.	.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	New connections	For future street furniture, appropriate ducting would be installed by MUDFA where (1) design details are available sufficiently in advance, (2) the road/tram alignment is formally finalised and (3) the future ground levels are such that new ducts can be buried beneath the existing ground level, without either excessively deep excavation or inadequate (or no) cover.	Where design is not available in time for MUDFA, or where future road levels do not facilitate advance installation, duct installation work must be carried out as part of Infraco Works.	
Other	SP transmission cables	If the design agreed with Scottish Power requires external protection beyond that provided by the track slab in that area, and if the design is available in good time, then MUDFA could undertake these works if required.	Infrastructure design will have to take account of the specific requirements to avoid diverting these cables. This will include special track slab construction (for Leith Walk) and careful bridge abutment/pier design (for 3 other areas). Should this design be impossible, the diversion work would be carried out by Scottish Power directly.	This would not be possible before 2008 (at the time of writing; lead time requires a notification before October in one year for work in the summer of the following year). Consultation between utilities and infrastructure design teams should facilitate this design.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	BT cables at A8 by Gogar		Infrastructure designs shall take account of the specific requirements to avoid diverting these cables.	This may include a deeper excavation for the tunnel under the A8 than had previously been envisaged, plus provision of temporary support for the cables during the construction of the tunnel. Should this design be impossible, the diversion work would be carried out under MUDFA terms and conditions. Consultation between utilities and infrastructure design teams should facilitate this design. Trial holes have been undertaken on behalf of BT to confirm the depth of the existing cables – the initial, informal, impression from BT is the cables are higher than anticipated which indicates the cables may not require diversion but incorporation into the infrastructure design.

Service	Description	MUDFA SCOPE	INFRACO SCOPE	NOTES
	BT cables at Roseburn street		Infrastructure design will have to take account of the specific requirements to accommodate these cables. Infraco shall consider the design solution for cabling installation as part of the Infraco Works.	This will include careful bridge abutment/pier design. The cabling element of this work is to be carried out by BT following diversion works, and may impact on the Infraco programme. Consultation between utilities and infrastructure design teams should facilitate this design. Note: a design solution for the cables as part of the Infraco works has been agreed with BT.
	Utility work dependent on prior structures work, eg cables in bridge decks		Will require structures work to be completed before utility work can be started. Infraco shall complete any and all utility diversions, utility protections works etc. including design (by SDS) following (or at the same time as) the Structures are completed.	

Table 45 – Table showing the responsibility for diversion/protection work on the utilities for the Edinburgh Tram project

22 Locks and Key Suiting

22.1 General

The Edinburgh Tram Network will have many locks installed to provide a suitable level of secure access to equipment and rooms. The locks and keys used shall be integrated into appropriate key suiting families. The philosophy is to strike an appropriate balance between the following two extremes:

- A single fully integrated key suiting arrangement for the whole of the Edinburgh Tram Network;
- No suiting, with every lock needing a different key;

The Infraco shall propose key suiting arrangements that are subject to approval by **tie**. In developing the proposals, Infraco shall consider:

- The need for staff to be able to undertake their duties without having to carry large numbers of keys with then to access the places that their duties require;
- Future expansion of the Edinburgh Tram Network;
- Changes to the key suiting that are likely to be needed as the system matures, and any key suiting must bear be sufficiently flexible to enable such changes to be made; and
- The ongoing costs of providing keys to staff during the life of the Edinburgh Tram Network;

22.2 Key Suiting System

A key suiting system that is based by the Infraco on the following is likely to be acceptable to **tie**.

A stand alone suite of keys, hierarchically structured to provide access to equipment such as:

The suiting documentation will list all locks to be installed on the Edinburgh Tram Network, including any locks that are not proposed to be included in the suites. There should be 4 completely separate suiting systems, as set out below:

22.2.1 Tram

- The Infraco shall procure all keys that are required for operating each tram. It is anticipated that each tram driver will need to carry no more than two keys for each Tram in order to undertake their duties. One key would permit access onto the tram, into the cab, and enable the Tram to be driven. The second key would open any panels that the driver may need to access and may also provide for such tasks as locking doors out of use;

- A different key would permit staff such as cleaners to access the inside of the Tram and the Tram cabs, but would not enable the Tram to be driven;

- Tram Maintenance staff may also need additional keys to access sensitive or potentially dangerous equipment.

22.2.2 Substations and Power

A stand alone suite of keys, hierarchically structured to provide access to equipment such as:

- Isolator cabinets, to check the position of isolators and to fit isolation padlocks;

- Substation LV areas;

- Substation HV areas in substations;

- Isolators, to permit hand operation;

- Equipment within the substations may also have a multitude of locks that may be suited, depending on the Infraco maintenance philosophy.

Separate individual locks with a single key will be used for securing isolations. There will be no suiting whatsoever for these.

22.2.3 Depot and buildings

A stand alone suite of keys, hierarchically structured to provide access at doors in the Depot building and other buildings in the Depot area such as the Depot plant building. A low level key in this structure could be used for any trackside gates that are required along the alignment.

22.2.4 Signalling and Communication Equipment

A stand alone suite of keys, hierarchically structured, to provide access to all trackside cabinets, including:

- Points control;
- Points heating;
- Signalling and;
- Tramstop.

Isolator cabinets are substations are excluded from this suite because they are included in the substations and power suite of keys.

23 Testing and Commissioning

23.1 Systems Acceptance

23.1.1 Scope

This section of the Employer's Requirements is to define the systems acceptance requirements applicable to the Edinburgh Tram Network (ETN) which the Infraco must comply with.

23.1.2 General Description and Principles

The process for acceptance of the Edinburgh Tram Network set out in this document is designed to ensure that the ETN is delivered in an acceptably safe, compliant, and efficient manner. The objectives of the process are to ensure that system performance, integrity, reliability, availability, and safety are rigorously tested and that throughout all stages of the delivery process the many sub-systems and the overall System are validated and verified against **tie**'s requirements and applicable standards. The detailed sequence and scope of infrastructure testing and commissioning prior to System Acceptance Testing shall be programmed out and proposed by the Infraco.

The acceptance process is heavily dependent on the delivery of the planned service timetables, the Operational Timetable (see 2.8 of these Employer's Requirements) and the Enhanced Timetable (see 2.8 of these Employer's Requirements). Details regarding the tram service frequency, number of trams and the phased opening of the Edinburgh Tram Network are contained in 2.8 of these Employer's Requirements.

Pre-system acceptance testing includes both Factory Acceptance Tests (FATs), Site Acceptance Tests (SATs), Sub-system Integration Tests (SITs) and System Commissioning Tests (SCTs).

Once a Section of the ETN is physically completed and the System Integration Tests are satisfactorily completed then the formal acceptance process requires the Infraco to carry out and pass a series of System Acceptance Tests (SATS) in order to achieve Sectional Completion. These tests are:

Table 43 - Description of the Acceptance Tests

Test	Test Name	Test Description	Programme
T1	Post Commissioning Test	The test shall demonstrate and prove that each Section of the ETN in sequence is able to perform in an acceptably safe manner and deliver the required run times. Please refer to **Error! Reference source not found.Error! Reference source not found.** for details. This is the gateway test to driver training.	Post Commissioning Test will immediately follow the successful commissioning of the nominated section and is a requirement for progressing into the Driver Training.
T2	Performance Test 1	After Section D has passed Test T1 then this test shall demonstrate and prove that Phase 1a of the ETN is able to perform satisfactorily to move into the three-month Shadow Running period. Please refer to **Error! Reference source not found.Error! Reference source not found.** for details. This is the gateway test to shadow running.	Performance Test 1 will immediately preceed the Shadow Running period and is a requirement for progressing to this phase of the programme.
T3	Pre-operations Test	The test shall cover a seven day period during the latter part of the Shadow Running phase of the programme. The Test is the operation of the initial entry into service timetable and includes infrastructure, trams, and operations systems – please refer to **Error! Reference source not found.Error! Reference source not found.** for details	Pre-operations Test shall immediately precede the Service Commencement Date.
T4	Network Performance	The Test shall be carried out over a 28 day period in Passenger Service to	To be completed within twelve months of the Service

	Test	establish that the ETN can reliably operate the Operational Timetable – please refer to **Error! Reference source not found.Error! Reference source not found.** for details	Commencement Date.
T5	Network Reliability Test	Reliability Testing of certain sub-systems in Passenger Service – please refer to **Error! Reference source not found.Error! Reference source not found.** for details	To be completed within twelve months of the Service Commencement Date.

The Post Commissioning Test (T1), Performance Test 1 (T2) and Pre-operations Test (T3) have to be passed before the Edinburgh Tram Network (or Sections thereof) can open for passenger carrying service and are therefore to be scheduled during the test running and driver training and shadow running phases.

The Post Commissioning Tests (T1) can be undertaken in isolation for each Section.

Performance Test 1 (T2) and the Pre-operations Test (T3) can only be undertaken for that/those section(s) that are to be opened for passenger carrying service immediately thereafter.

The Network Performance (T4) and Network Reliability Test (T5) shall not be carried out until Passenger carrying Service has commenced on the whole Edinburgh Tram Network.

The figure on the next page shows the structure of the tests.

Figure 10 - Edinburgh Tram Network: Extract from System Life Cycle Model

Stage Flow Chart	Tests	Description
Network Performance (T4) and Reliability Test (T5)		The date upon which the Edinburgh Tram Network starts in public service
		PASSENGER SERVICE COMMENCEMENT
Pre-Operations Test (T3)		The period of Tram operations that simulates full public service operation including running to published timetable and calling / dwelling at Tramstops before the ETN enters public service
Performance Test 1 (T2)		**ENERGISATION OF COMPLETED PHASE OF THE ETN**
Test Running & Driver Familiarisation		The period post-ETN commissioning used to complete driver and control room staff training and gain confidence to enter Shadow Running Phase
Post-Commissioning Test (T1)		
System Integration Test		All subsystems, including the tram, are fully-integrated to form the ETN and are tested to demonstrate that they work together successfully and meet the Employer's Requirements
		ENERGISATION OF SECTION OF THE ETN
Site Tests		The point at which subsystems have been installed and then tested to prove they meet their requirements with both Type tests and Site Acceptance tests
		LIMITED ENERGISATION OF PART OF THE ETN
Installation / Construction		Once the subsystem has successfully passed Factory Acceptance Tests installation / construction at site will take place and as appropriate a delivery test undertaken.
FAT		Thorough demonstrable testing of the subsystem at Infraco's premises
Build / Manufacture		Manufacture and assembly of the System by the Infraco
Design		The scope of the works designed through Approval in Principle and Approved for Construction & Manufacturing Drawings; with associated verification and validation test and integration plans complete

23.2 Test Planning

The efficient programming of the tests is vital to the success of the system acceptance test process. Infraco shall, therefore, consider and incorporate, in a coordinated manner at each stage of the implementation of this process, the relevant documentation, the required tram availability and commissioning site availability and staff (from all concerned parties), into the overall Infraco test plan.

The Infraco shall prepare and present the Infraco test plan for review no later than six months after the Effective Date. The Infraco test plan shall describe how the Factory Acceptance Testing, Site Testing and Commissioning, Test Running and Driver Training and Shadow Running, as well as the Network Performance and Network Reliability tests are to be undertaken. The definition of these tests is shown in Figure 10. The programming of the tests shall be in accordance with the Programme as described in Section 39 of these Employer's Requirements. Infraco shall ensure that the PSCC and the Independent Competent Person (or the appropriate approval regime in force) are satisfied that the testing process is robust, comprehensive and satisfies all of the safety issues legislated and mandated for the system.

As the project evolves the Infraco Test Plan/Risk Register/Hazard Log shall be maintained by the Infraco. Infraco shall demonstrate that the issues raised in this log have been mitigated or that the tests have demonstrated the risk has been resolved. It is therefore important that the testing procedures and results are correlated with the Project Risk Register and Hazard Log.

23.3 Pre-Systems Acceptance Testing (before starting the systems acceptance process)

The following should be noted with regards to any tests to be undertaken:

- The individual test documentation / specifications shall be submitted to **tie** for acceptance in accordance with Schedule 14 (Review Procedure) and **tie**'s approval obtained before the test can take place;
- A notice period of at least seven working days shall be given to **tie** prior to any test in order that **tie**, and/or its representative(s), can arrange, at their option, to witness the test. The Operator's staff shall also be invited to witness all testing activities;
- Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT) test results shall be submitted to **tie** for review;

- **tie** reserves the right to be present during any of the tests to be undertaken; and
- Any such review will be undertaken in accordance with Schedule 14 (Review Procedure).

The following tests shall be carried out in advance of the systems acceptance testing sequence.

23.4 Factory Acceptance Tests (FAT)

23.4.1 Overview

Factory Acceptance Tests consist of a series of progressive activities all of which are undertaken at the sub-system manufacturer's premises.

Initial testing at the component manufacturer's premises of components to be used as part of a sub-system shall be undertaken to verify that the components behave as predicted in the design and satisfies the Employer's Requirements for that component.

Initial testing undertaken at the manufacturer's premises shall be undertaken to verify that the sub-system **or** component behaves as predicted in the design and meets the requirements of the design specification and provides correct functionality.

Once sub-systems or components have been successfully tested they shall be incrementally integrated and tested to verify that the sub-systems behave as predicted in the design and meet the requirements of the design specification and provide correct functionality.

Part of the FATs are first article inspections or type tests. These shall be undertaken on the first production item. This inspection shall verify that the Quality and functionality of the product is acceptable and that the manufacturers' quality control processes and procedures have been implemented.

The test specification(s) shall be produced by Infraco and shall be subject to acceptance in accordance with the Review Procedure. **tie** agreement to all proposed component, sub-system and Factory Acceptance Test specifications is required at least ten business days prior to the date of the component, sub-system and FAT tests identified above and any additional tests required by Infraco.

23.4.2 Pass Criteria

FAT testing shall demonstrate that the individual sub-systems or components and equipment fully meet the requirements and are suitable for the subsequent release from the factory environment, delivery to site and installation.

FATs demonstrate the integration of the modules and sub-systems under factory conditions and their reliable operation under cyclical testing.

As far as applicable the FAT will demonstrate that the sub-system or components has been successfully exercised through simulation, including a demonstration on how the alarm handling manages the worst case alarm flood. This test will be subject to **tie** approval.

23.5 Site Tests

23.5.1 Overview

The site tests shall demonstrate that:

(a) Construction/installation activities have been completed correctly by demonstrating that the design specification and functionality of these Employer's Requirements have been achieved;

(b) The sub-systems, in isolation and before passengers are carried, function and behave at site as designed and tested in the FAT;

(c) The infrastructure sub-systems and the tram will then be integrated with each other insofar as is possible to prove that they collectively function and behave at Site as designed and tested in the FAT; and

(d) The ETN functions and behaves at Site as designed and tested in the FAT. This is defined as system commissioning tests and involves the integration of the infrastructure sub-systems and the tram.

The Independent Competent Person as defined under the ROGS Regulations, other regulatory bodies and the PSCC shall need to be satisfied that the ETN is safe to operate before commencement of system commissioning activities. In order to verify this it shall be necessary for the Infraco to address the issues raised by the Independent Competent Person, PSCC, HMRI (or the appropriate approval regime in force) and Approval Bodies. This may necessitate defining specific tests or incorporating additional Network Performance Test details into the suite of verification commissioning tests. Often the areas of interest to these bodies do not become clear until the majority of issues on the risk register and hazard log have been closed out. Typically these may include items such as:

- pedestrian collision, and the risk of a person being "run over " by a tram;
- gauging and possible entrapment of people in pedestrian areas;
- failed tram recovery;
- control room operational procedures; and
- Recovery from derailments, including rerailing a tram.

It is assumed that **tie** shall procure all electrical power and that a supply is available for the complete on site test procedures until commencement of passenger service.

23.6 Sub-system Integration Tests (SIT)

23.6.1 Overview

Sub-system Integration Tests cover items 23.5.1 of these Employer's Requirements **Error! Reference source not found.Error! Reference source not found.**, and **Error! Reference source not found.Error! Reference source not found.** as defined in **Error! Reference source not found.Error! Reference source not found.**. They shall be undertaken on Sections.

The Infraco shall produce the suite of SIT testing specifications for acceptance by **tie** no later than three months prior to the commencement of the tests through the Review Procedure.

23.6.2 Pass Criteria

The tests are passed when:

- Each sub-system, module or component of the system functions in isolation as designed and does not deviate from FAT results.

- All sub-systems for the given section of tramway are demonstrated to collectively perform in accordance with the operations and performance, and all of these Employer's Requirements.

23.7 System Commissioning and Integration Tests (SCT)

23.7.1 Overview

System Commissioning and Integration Tests shall be undertaken on Sections.

Such activities include the running of tram(s) over section(s) of the Edinburgh Tram Network for which Sub-system Integration Tests have been successfully completed. This will verify that the ETN behaves as predicted and as demonstrated as far as was practical in previous tests.

Infraco shall liaise with both **tie** and the Operator to ensure that sufficient competent operational personnel are available to conduct the required activities, including tram drivers and control room staff.

23.7.2 Pass Criteria

The tests are passed when:

- Each sub-system, module or component of the system functions collectively as designed and do not deviate from FAT results.

All sub-systems for the given section of tramway are demonstrated to collectively perform in accordance with the operations and performance, and all of the Employer's Requirements for a representative number of consecutive passes of a tram in each direction over the given section of the network.

- The integration testing shall include demonstrating that the control room systems and control centre equipment connected to a representative sample of the substation SCADA and other equipment required for Tramstops can be effectively exercised under a robust simulation of trams progressing around the ETN.

23.8 System Acceptance Activities and System Acceptance Tests

The Infraco shall produce the suite of System Commissioning Test specifications for review by **tie** no later than three months before commencement of the tests. These will be reviewed in accordance with the Review Procedure

23.9 Operations and Maintenance Staff Training

The object of this series of activities is to complete driver, control room and maintenance staff training and provide said staff with greater system familiarisation, demonstrating competence to enter Shadow Running phase upon the passing both of the Post Commissioning and Performance Test 1 (T1 and T2). It therefore forms an integral part of the driver-route familiarisation and training programme.

Staff Training shall achieve the following objectives:

- Enables control room staff to gain experience running a tramway without passenger pressures;
- Allow operational staff to fulfil their duties; and
- Enables the drivers to gain route knowledge and familiarity with the trams and procedures without passenger pressures.

The activities undertaken during this phase are designed to demonstrate confidence in the system performance and system safety by means of passing the post commissioning test and performance test T1, and to gain approval of the Independent Competent Person, PSCC and HMRI. (or the appropriate approval regime in force) to progress to Shadow Running.

Infraco shall liaise with the Operator to undertake careful integration of the operational training programme and testing needs in order to avoid conflicts between operational requirements and the technical validation/verification. These comprise items 4, 5 and 6 of the system commissioning model in Figure 10 – Edinburgh Tram Network –Extract From System Lifecycle Model.

23.10 Shadow Running

The Shadow Running phase will last three months and shall:

- Build and validate the operating pattern up to the Service Commencement Date;
- Carry out any further emergency exercises;
- Demonstrate that the ETN can be safely operated in a routine manner and can recover from emergency situations and emerging perturbations;
- Resolve any issues in respect of operating practices;
- Demonstrate that reliability growth is being monitored and corrective action taken as necessary;
- Allow mileage accumulation to be carried out on the trams;
- Permit infrastructure and tram maintenance staff to familiarise themselves with the procedures, practices and operations regimes and to demonstrate competence development;
- Ensure experience is gained in the gathering and evaluation of the performance monitoring regime data in accordance with Schedule 7 of this Agreement; and
- Allow minor adjustments and tuning of systems.

This comprises item 7 of the system commissioning Model in Figure 10 – Edinburgh Tram Network –Extract From System Lifecycle Model.

The evaluation of Shadow Running is the pre-operations test (T3), the passing of which is the gateway to moving into operation, provided all necessary HMRI (or the appropriate approval regime in force) consents are obtained.

23.11 Final System Acceptance Tests in the Operations and Maintenance Phase

Within twelve months of opening the ETN to passenger service Infraco shall undertake and pass the Network Performance (T4) and Network Reliability Test (T5) (as described in Sections 23.16 and 23.17).

23.12 Emergency Exercises

The Infraco and the Operator shall prepare a plan for review by tie and the Competent Person and following approval of the plan, the Operator shall perform with support from the Infraco a series of exercises with the emergency services and other stakeholders such as Network Rail and BAA. The planning for these exercises will require close liaison by the Infraco and the Operator with the various emergency services. They will be planned to take place in the commissioning period, test running or in the shadow running phase. The nature of the exercises will require detailed planning with Fire, Police, and Ambulance services but are likely to include, as a minimum:

- A simulated road traffic accident at a major road junction;
- A major tram collision/derailment including emergency isolations; and
- A rescue of persons trapped underneath a tram.

23.13 Post Commissioning Test Specification – T1

This sub-section sets out the Performance Test assumptions applicable to all Performance Tests. Should the Infraco be able to prove to the reasonable satisfaction of **tie**'s Representative that any of the Performance Test pass criteria have been exceeded by reason of a Performance exclusion then the test results will be amended to discount the effects of such Performance Test exclusions.

The following exclusions shall apply:

- Operator staff in the Control Room causing or significantly contributing to delays in the operation of the System;
- Failure to provide the correct number of trained Tram Drivers as defined in the DPOFA save where the failure is as a result of the Infraco's own failure in respect of its own obligations in the Agreement;
- Failure of the Tram Drivers to consistently drive the Trams to good industry practice;
- Failure to procure all electrical power that is required for the operation of the System. Periods when the electrical supply is not available will be discounted from the Test and the test period shall be extended by an equivalent period;

- A failure by the Operator to comply with the relevant parts of the Operations and Maintenance Manuals; and
- Damage caused by the Operator.

However, in no event shall any allowances or relief or Network Performance Test exclusion be granted to the Infraco where any delays or failure to pass the Network Performance Test has been caused or contributed by:

(a) Any default, breach or omission by the Infraco or its subcontractors;

(b) Infraco Defects or Snagging;

(c) Equipment undergoing modification or rectification by the Infraco and;

(d) TRAMCO's failure pursuant to the Tram Maintenance Contract.

The burden of proof shall be on the Infraco to show that such failures of the Operator were caused by reasons for which the Infraco was not responsible and for which the Operator should be properly accountable for by reason of the Operator's default, omission, negligence or breach of statutory duty. The Infraco shall develop and agree audit procedures with **tie**, and the Operator in respect of the Network Performance Test exclusions set out in this paragraph.

Dwell times at Tramstops shall be regulated; as set out in the Employer's Requirements.

23.13.1 Overview of Post Commissioning Test

This section describes the requirements for the Post Commissioning Tests, their execution, monitoring and completion. Post Commissioning Tests form part of the requirements for the final system acceptance.

23.13.2 Test Objectives

This Post Commissioning Test seeks to achieve the following objectives:

Prove that the system is capable of controlling an 'off-street' section of Edinburgh Tram Network in an acceptably safe manner; and

Prove that the system is capable of controlling an 'on-street' section of Edinburgh Tram Network in an acceptably safe manner.

23.13.3 Network Performance Test Description

The Post Commissioning Test is a multi part test, with each part of the test required to be passed in sequence before the entirety of the Post Commissioning Test can be passed. It cannot be conducted until Phase 1a of the Edinburgh Tram Network has been successfully commissioned.

23.13.4 Features

The Infraco shall demonstrate that Gogar Depot and Phase 1a of the Edinburgh Tram Network can be monitored and controlled in accordance with the Case for Safety.

Tests shall provide for:

- Demonstration of the run times as defined below.
- Forty end-to-end tram movements on the nominated section of which twenty are in each direction; and
- Trams will dwell at each Tramstop, and will exercise opening and closing of the doors at each Tramstop, the minimum period of doors being fully opened at each Tramstop will be 13 seconds.

The undertaking of the test shall essentially be an operational function led by Infraco but in conjunction with the Operator. Infraco shall manage the preparation for the tests with technical and maintenance support and monitoring by Infraco (along with representatives from **tie)**.

For the demonstration of run time, the following conditions shall apply:

- Targets of the run time demonstrations shall be developed in accordance with Section 2.12 of the Employers Requirements and agreed between the parties from the agreed maximum journey times and associated assumptions detailed in Section 2.11 of the Employers Requirements during the design phase, as further details of tram performance and traffic lights are available;
- For avoiding of influences due to public traffic, run time demonstrations shall take place during night times only;
- tie will be responsible for the communication with local authorities like CEC, UTC or police;
- run time demonstration to be performed in both directions and shall include the following two demonstrations:
  - run allowing tram priority at each traffic junction along the route
  - run following the regulations and phasing of traffic lights under regular conditions
- Sufficient runs shall be carried out in both directions to provide a level of confidence that the target runtimes have been achieved as agreed in accordance with Section 2.12 of the Employers Requirements.
- Infraco shall undertake and pass the Post Commissioning Test (T1) before proceeding to the Performance Test 1 (T2).

tie shall be given thirty working days advance notice of the finalisation of the Post Commissioning Test plan and seven working days written notice of the Test commencement date.

23.13.5 Pass Criteria

Subject to the exclusions defined in23.13 above, the following shall define the pass criteria for the T1 test.

- All test results from previous tram and system and sub-system tests are to be available and signed off as accepted by **tie**, including all the closed out Snagging Rectification Certificates.
- The test shall have been successfully completed when:
  - At least 95% of the end-to-end tram movements are within the agreed target runtime; and
  - Acceptance of the Case for Safety and test results by the Independent Competent Person and where appropriate Her Majesty's Railway Inspectorate (or the appropriate approval regime in force) and approval or "No Objection to Proceed" respectively for full driver training has been obtained.

23.13.6 Monitoring and Reporting of Test Performance

Appropriate levels of observation by Infraco shall be conducted to satisfy **tie** that the auto-generation of reports from the systems is accurate.

23.14 Performance Test 1 Specification – T2

23.14.1 Overview

This section describes the requirements of Performance Test 1 and the proposals for its execution monitoring and completion. Performance Test 1 forms part of the requirements for the final System Acceptance.

23.14.2 Test Objectives

Performance Test 1 seeks to achieve the following objectives:

- Demonstrate that the Edinburgh Tram Network (or sections thereof) can be operated in an acceptably safe manner;

- Demonstrate that the completed Operator training programme has achieved an adequate competency to proceed in Shadow Running; and

- Demonstrate the mobilisation and competency of the maintenance teams provided by the Infraco.

23.14.3 Network Performance Test Description

Performance Test 1 builds upon Post Commissioning Test and cannot be undertaken until Post Commissioning Test has been passed.

23.14.4 Features

The Infraco shall demonstrate that the Edinburgh Tram Network can start Shadow Running and can be monitored and controlled in accordance with the Case for Safety.

Performance Test 1 shall provide for:

- Operation from 07:00 to 20:00 hrs on three consecutive days (none of which are Saturday, Sunday or Bank Holidays);
- The System will run to the Operational Timetable with headways extended by no more than 50%. For the avoidance of doubt, the trips scheduled for this test are the same as in the Operational Timetable as set out in Sections 2.11 and 2.12 of these Employer's Requirements; and
- Trams shall dwell at each Tramstop and shall exercise opening and closing of the doors at each Tramstop. The minimum period of doors being fully opened shall be 13 seconds at each Tramstop.
- The undertaking of the test shall be an operational function led by Infraco but in conjunction with the Operator. Infraco shall manage the preparation for the Tests with technical and maintenance support and monitoring by Infraco (along with representatives from **tie**).
- Infraco shall undertake and pass Test T2 before proceeding to the Shadow Running phase.
- **tie** shall be given twenty working days advance notice of the Performance Test 1 plan and seven working days written notice of the Test commencement date.

23.14.5 Pass Criteria

The following define the pass criteria for the T2 test.

All test results from previous tram and system and sub-system tests are to be available and signed off as accepted by **tie**. Any Defect Correction lists shall be available and agreed as being programmed to be remedied.

The test shall have been successfully completed when:

- At least 95% of the end-to-end tram movements meet the requirements of the Performance Regime in terms of Punctuality Service Element as defined in 2.16.

- Acceptance of the Case for Safety and test results by the PSCC , the Independent Competent Person and where appropriate Her Majesty's Railway Inspectorate (or relevant approval body) and their approval or 'Letter of No Objection to proceed" into Shadow Running.

23.14.6 Monitoring and Reporting of Test Performance

The primary data used to evaluate the test shall be automatically generated from the Supervisory Control & Communications performance monitoring sub system and validated independently.

23.15 Pre-Operations Test Specification – T3

23.15.1 Overview

This section describes the requirements of the Pre-Operations Test and the proposals for its execution monitoring and completion. The Pre-operations Test shall be conducted during the Shadow Running phase of the project and forms part of the requirements for the final System Acceptance.

23.15.2 Test Objectives

The Pre-operations Test seeks to prove that the Edinburgh Tram Network, or section thereof, in the event of sectional opening operates to a sustained level of performance determined by the Opening Timetable and the performance regime such that:

- The Operator can safely commence passenger carrying revenue earning service;
- The Infrastructure and Tram Maintainers can commence the Planned Maintenance proposed for passenger carrying revenue earning service; and
- The Edinburgh Tram Network passes the ride quality criteria in Tables 62 & 63 of the Employers Requirements.

23.15.3 Network Performance Test Description

Pre-operations Test is a four-part test upon successful completion of all parts of which the Edinburgh Tram Network or section(s) thereof can be opened to public service. The Pre-Operations test cannot be undertaken ahead of the successful completion and passing of the respective Performance Test 1.

23.15.4 Features

The Infraco shall demonstrate that the entire Edinburgh Tram Network or section(s) thereof can be operated to the defined levels of performance, reliability and availability and in accordance with the operational Case for Safety.

The Part 1 test shall comprise:

- Five consecutive days (none of which are Saturday, Sunday or Bank Holidays) of testing in accordance with the Operational Timetable. This test is to be undertaken no sooner than two weeks after commencement of the Shadow Running phase;

The Part 2 test shall comprise:

- Five consecutive days (none of which are Saturday, Sunday or Bank Holidays) of testing in accordance with the Enhanced Timetable, which cannot commence until two weeks from successful completion of the Part 1 test, and must be completed at least two weeks prior to the end of the Shadow Running phase, unless agreed otherwise by **tie**.

For both the Part 1 and Part 2 tests, trams shall dwell at each non-terminus Tramstop for a nominal 25 seconds and the doors shall normally remain closed.

The Part 3 test (which can be undertaken at any time during shadow running) shall comprise:

- One of the fleet of trams shall be selected by **tie** to be instrumented and monitored. The selected tram shall provide results for 100 journeys of the selected tram consecutively over all sections of the ETN;

- Measurement of lateral, longitudinal and vertical accelerations to be taken on the floor of the trailing cab of the tram.

- All tram journeys during the test period that provide data for this test ~~must~~ **shall** be completed within a tolerance of plus or minus 10% of the journey times that are setout in the Operational Timetable;

- Analysis to be performed as follows:

- For each journey between Tramstops a root mean square average of the combined lateral, longitudinal and vertical accelerations (RSS addition) is to be determined in accordance with ISO 2631.

The Part 4 test shall comprise:

- One tram from the fleet will be loaded to AW0
- Measurement of lateral, longitudinal and vertical accelerations to be taken on the floor of the trailing cab of the tram
- Entire Edinburgh Tram Network to be covered within 10% of the journey times that are setout in the Operational Timetable
- Load the tram to AW2 and repeat steps above; and
- Analysis to be performed as follows:
  - Select the greater of the results (AW0 or AW2) for each of the journeys to be used as a benchmark for each individual tram for any particular journey.

The undertaking of the test shall essentially be an operational function led by Infraco but in conjunction with the Operator. Infraco shall manage the preparation for the Tests with technical and maintenance support and monitoring by Infraco (along with representatives from **tie**).

Infraco shall undertake and pass Pre-operations Test before proceeding to the Service Commencement Date.

tie must be given thirty working days advance notice of the Performance Test 1 plan and seven working days written notice of the Test commencement date.

23.15.5 Pass Criteria

The following define the pass criteria for the T3 test.

All test results from previous tram and system and sub-system tests shall be available and signed off as accepted by **tie** including the clearance of all Defect Correction lists unless dispensation has been proposed by Infraco and agreed by tie acting reasonably.

23.15.6 Part 1 and 2 Pass Criteria

Each Pre-operations Test can only be successfully completed:

- As soon as 99% Punctuality Service Element as defined in chapter 2.16 has been achieved in accordance with the Infraco and Tram Maintainer performance regimes.

For the avoidance of doubt any delays caused by road traffic shall not be included in the delay measurement.

23.15.7 Part 3 and 4 Pass Criteria

Part 3 test can be deemed to be passed when none of the 100 journeys have an rms of the combined lateral, longitudinal and vertical accelerations exceeding 30mg.

Part 4 test can be deemed to have been passed when the instrumented tram from the fleet has attained a Ride Index equal to or less than as shown in the tables below in accordance with ISO 2631:

Speed	Wz Vertical	Wz Lateral
40 km/h	2,32	1,58
70 km/h	2,96	2,36

Table 44 - Ride Index in the Drivers Cab

Speed	Wz Vertical	Wz Lateral
40 km/h	2,24	1,64
70 km/h	2,82	2,28

Table 45 - Ride Index in the Passenger Compartment

23.15.8 Consents

This is in addition to passing the above tests.

All consents to achieve full passenger service must have been obtained and evidenced as part of Test T3.

23.15.9 Monitoring and Reporting of Test Performance

The primary data used to evaluate Parts 1 and 2 of this test shall be automatically generated from the Supervisory Control & Communications performance monitoring sub system and validated independently.

During the Pre-operations Test monitoring period Infraco will undertake audits, to the satisfaction of **tie**, of the collection and communication of fault and tram punctuality data against each of the performance indicators.

23.16 Network Performance Test Specification – T4

23.16.1 Overview

This section describes the requirements of Network Performance Test (T4) and the proposals for its execution monitoring and completion. Network Performance Test forms part of the requirements for the final System Acceptance.

The Test shall cover a 28 day consecutive period, which shall be undertaken after the Edinburgh Tram Network has entered Public Service until the Test is satisfactorily passed or, unless otherwise agreed by **tie**.

The Test is the operation of the complete ETN to the Operational Timetable each day for the duration of the test. The timetable used for the test shall be agreed with **tie**.

The undertaking of the test will be an operational function carried out by the Operator. Infraco shall manage the preparation for the Tests with technical and maintenance support and monitoring by Infraco (along with representatives from **tie**).

Infraco shall undertake and pass the Network Performance Test within twelve months after the Service Commencement Date of the whole Edinburgh Tram Network.

tie shall be given thirty working days advance notice of the Network Performance Test plan and seven working days written notice of the Pre-operations Test commencement date.

23.16.2 Pass Criteria

The test will measure the Punctuality Service Element over twenty-eight days.

The test shall be passed once the criteria stated in the Employer's Requirements Operational and Performance Section (Section 2) have been demonstrated to be met.

The Infraco may discount any one day from the calculation but shall not be a day on which a Special Demonstration shall be planned.

For the avoidance of doubt the exclusions in Section [ ] shall apply.

23.16.3 Special Demonstrations

During the Network Performance Test a number of demonstrations will be performed, these are described in the following two sub-sections.

23.16.4 Substation and UPS Demonstrations

Infraco shall demonstrate that the system can operate with two of the traction supplies from a substation taken out of use, one at a time, for a period of two hours during the peak service. The substations concerned and the times for their disconnection will be selected by **tie**.

The disconnection of the substations and placing them into bypass will be undertaken in accordance with the Operator's normal procedures for such switching.

Operation of the Uninterruptible Power Supplies (UPS) at two tram stops for four hours shall also be demonstrated. During this period the electrical supply to the chosen tram stop UPS's shall be disconnected. The tram stop UPS's concerned and the time for their disconnection shall be chosen by **tie**.

The Infraco shall prepare a plan detailing the programme for the above events and include this in the test arrangements that will be submitted to **tie** in accordance with the review procedure.

23.16.5 Tram Change Over

The Infraco shall demonstrate, during peak hours, a Tram changeover by which a Tram in service shall be substituted with the "hot spare".

tie will give Infraco thirty minutes notice of this test. For the avoidance of doubt the Operator

23.16.6 Monitoring and Reporting of Test Performance

The Punctuality Service Element shall be obtained. The results for the previous day shall be ratified in accordance with the Performance Regime in Schedule 7 of this Agreement and the Operator Performance Regime under the DPOFA Agreement.

A meeting will take place daily where the performance up to that date is reviewed and any investigations concluded and data accepted. The meeting will be recorded and minutes distributed to each party by the meeting secretary within three working days.

During the Network Performance Test monitoring period **tie** may undertake audits of the collection and communication of fault data against each of the performance indicators.

23.16.7 Network Performance Test Timetable

The Enhanced Timetable delivering the ultimate capacity of the ETN as contracted shall be prepared by the Operator as that which shall be the ultimate timetable to be used in Passenger Service, proposed by the Infraco, and agreed by **tie**.

23.17 Network Reliability Test Specification – T5

23.17.1 Overview

This sub-section describes the requirements of Network Reliability Test and the proposals for execution, monitoring and achievement of System Acceptance.

Network Reliability Test is a set of sub-system reliability tests each measured over a twenty-eight day period. Each specified sub-system has its own specified target detailed within [23.17.2]. The tests may start on the same date as T4 (on or after Service Commencement Date) and as each subsystem is individually demonstrated to meet its contractual target that subsystem reliability test is then considered completed. Network Reliability Test is only passed when all the sub-systems meet their targets.

The undertaking of the test will essentially be a maintenance function carried out by the Infraco. However, it requires Infraco management of the preparation for the Tests with technical support and monitoring by Infraco, (along with representatives from **tie** during the Test).

Infraco shall undertake and pass Network Reliability Test within twelve months after the Service Commencement Date of the whole Edinburgh Tram Network to pass Network Reliability Test.

If any part of the works or part of the ETN fails to pass Network Reliability Test then rectification, repair, modification or reinstatement of that part shall be undertaken. The defect correction period on that part of the system or any sub-system which fails the test shall be extended a further twelve months beyond the time of rectification, repair or modification. Infraco will propose and undertake the necessary remedial action and retest to achieve acceptance.

tie must be given 20 working days advance notice of the Network Reliability Test plan and fourteen working days written notice of the test commencement date.

23.17.2 Sub-Systems Subject to Network Reliability Test and Reliability targets

Table 46 - Network Reliability Test

TEST	TARGET VALUE
Tram Reliability	Please refer to Tram Supply Agreement.
Passenger Information Display System	As set out in the Employer's Requirements 99.75% availability over six consecutive Periods.
Passenger Help/Emergency Help Point System	As set out in the Employer's Requirements 99.75% availability over six consecutive Periods.
On Street Track & Formation	Achieves 99.995% availability over six consecutive Periods.
Off Street Track & Formation	Achieves 99.995% availability over six consecutive Periods.
Point Machines	Achieves 99.995% availability over two consecutive Periods.
Traction Switchgear	Achieves 99.99% availability over two consecutive Periods.
OLE Equipment	Achieves 99.999% availability over two consecutive Periods.
Earthing & Bonding	No reported stray current instances, or rail to earth voltages that exceed 60 volts as defined in the EN50122/1, for four consecutive Periods
Operational Radio	Achieves 99.75% availability over two consecutive Periods.
Operational Data Network	Achieves 99.99% availability over two consecutive Periods.
UTC Interface	Achieves 99.75% availability over four consecutive Periods.
Wheel/Rail Interface	No proven instances of Noise and Vibration exceedence have occurred in a six month periods
CCTV System	Achieves 99.9% availability over two consecutive Periods.
Tram Position Detection System	Achieves 99.9% availability over two consecutive Periods.
Traction SCADA System	Achieves 99.75% availability over two consecutive Periods.
Tramstop Lighting	Achieves 98.5% availability over two consecutive Periods.

23.17.3

23.17.4 Assumptions and Exclusions

General Exclusions and Assumptions

Should the Infraco be able to prove to the satisfaction of **tie** that any of the reliability tests would have been exceeded by means of one or more of the following exclusions then, in consultation with **tie**, the test results shall be amended to discount the effects of such proven Network Reliability Test exclusions.

The Network Reliability Test exclusions and Network Reliability Test assumptions set out in this section relate only to the Network Reliability Test and shall not be used or relied upon in any circumstances in any connection with any other test.

Influences of tie, the operator or third parties having impacts on the tram operation and its service shall neither be qualified to interrupt the started test process nor result in a non- acceptance or any other disadvantage for Infraco.

Operator Influences

Defects caused by the Operator's failure to:

Provide properly trained staff as defined in the DPOFA, exercising a reasonable duty of care to good industry practice.

Exclusions

The Infraco must demonstrate by reasoned argument that failures or loss of availability resulting from Operator actions were caused by reasons for which the Infraco was not responsible (eg Operating Manuals and supplier training). The Infraco shall develop and agree audit procedures with **tie** and the Operator in respect of the Network Reliability Test exclusions set out in this paragraph.

However, in no event shall any allowances or relief or Reliability Network Reliability Test exclusion be granted to the Infraco where any delays or failure to pass Network Reliability Test has been caused or contributed to by:

- Any default, breach or omission of the Infraco;

- Infraco defects; and
- Equipment undergoing repair, modification or rectification by the Infraco.

Realistic long term response times to repair defects shall be provided by Infraco during the period of the test.

It is assumed that **tie** shall procure all electrical power and that a supply is available for the tests.

Any failures resulting from inappropriate actions or omissions by the Operator or his contracted staff shall be discounted. as set out in the DPOFA .

For the avoidance of doubt, the impact of third party vandalism shall be excluded.

23.17.5 Monitoring & Reporting of Test Performance

The scoring of faults should be achieved by first reviewing the fault logs and performance reports using them as a filter to establish which faults need to go forward into the review. The review meeting will then be used to discuss and allocate the responsibility of faults under the performance regime.

The review meeting will take place daily where the performance of each system will be reviewed for the previous day. Representatives of Infraco, Tramco, **tie** and the Operator will attend this meeting. Each sub-system will be reviewed and agreement reached on all failures. The meeting will be recorded and the resulting daily report distributed to each party within 3 Business Days.

23.17.6 Audit Procedures

During the Network Reliability Test monitoring period, **tie** may undertake audits of the collection and communication of fault data against each of the sub-system tests and also audit the response times to rectification of notified faults.

23.17.7 Services in Connection with the Operator

The Operator shall be appointed separately by **tie** to provide various services in conjunction with the construction, commissioning and operation of the Edinburgh Tram Network. The Operator's Scope of Supply shall include the following:

Provision of representatives during the Construction, Commissioning and Operation stages to provide the Operator's Services, including liaison with the Infraco.

Observing and reporting on the acceptability of the proposed design and the quality of infrastructure, trams and equipment;

Supporting obtaining the necessary consents for commissioning and Public Operation;

Assisting Infraco in development of a Testing & Commissioning Plan (in conjunction with Infraco)

Appointment and training of staff in support of any commissioning process.

Notwithstanding the Operator's responsibilities described above, the Infraco responsibilities (associated with the interface with the Operator) shall include, but not be limited to, the following:

- providing support to obtain operational approvals and consents in respect of the Edinburgh Tram Network;
- providing technical support on systems integration
- providing technical support on the development of operational plans and management systems; and
- provide technical support with regard to operational interfaces with CEC traffic management systems. This shall include phasing sequence drawings of key junctions
- Preparing and submitting plans for driver training and the training of other operational staff. Undertaking training of the Operator's trainers (8-10 trainers) and control room staff (18-21 staff)
- Prepare and submit plans for maintenance and operations manuals
- Provide support required for System Acceptance, including the development of a Testing and Commissioning Plan;
- Work to mitigate any delays to the system construction and commissioning howsoever caused.

Comm. Model Ref	Infraco	Operator
Refer to Section 23.5.2 - Figure 11.	The following table represents a guide of the key responsibilities associated with the Infraco and the Operator during the various phases of the Life Cycle Model. Further details are provided within these Employer's Requirements and the DPOFA. The Infraco Contract (refer to the Code of Construction Practice) allows for the potential for Sectional Completion. Accordingly, where Sectional Completion was to apply, then it would follow that the (System Commissioning Model) stages for each Sectional Completion would apply at different times in the programme (e.g. possible to have "Shadow Running" ongoing for Section A, whilst "Commissioning" for Section B on-going). The listed responsibilities would equally apply to each Sectional stage. Items are listed under the most appropriate stage, but this does not exclude the associated activity from being required during other stages	
	GENERAL OBLIGATIONS	
	The general provision of all the technical and management services as defined within these Employer's Requirements. This shall include design, programming, installation, testing, system acceptance, training and maintenance. The Infraco shall be required to work closely with the Operator to successfully deliver the project.	Liaising and working closely (and timely) in partnership with the Infraco to meet the requirements of the Project associated with design, installation, system acceptance, delivery into service and maintenance, taking account of the Infraco's Scope of Supply. The Operator shall also be responsible for Operator Maintenance.

	Management and implementation of a liaison process, with the assistance of the Operator, to ensure that all parties are fully informed and resources arranged adequately.	Provision of staff resources during the Commissioning, Construction and Operation stages to provide the Operator's Services, including liaison with the Infraco. Provide and keep updated the training and recruitment plan describing the roles of each member of the Operations staff with specific instructions for the proper performance of their duties and training requirements.
		Ensuring that all relevant operational and maintenance subcontracts are in place and that appropriate subcontractor staff training programmes are implemented.
	Responsibility for adherence to the programme	Monitoring Progress
	Responsibility for complying with the functional and non-functional requirements as defined within these Employers Requirements.	Observing and commenting on the acceptability of the design and installation.
	Production of risk deliverables and register in accordance with these Employer's Requirements.	Provision of risk advice (from the Operator's viewpoint) to Infraco and commenting / liaising on risk documentation produced by Infraco.
	Under the CDM Regulations, the Infraco shall be responsible as Principal Contractor and shall comply with all associated CDM Responsibilities relating to the design and construction activities until Services Commencement Date (and beyond, where appropriate). Beyond the Services Commencement Date, the Infraco may be required to undertake certain elements of work (including maintenance) which fall within the remit of CDM Regulations. In such a scenario the Infraco would be responsible as Principal Contractor for the duration of such works.	As with any party working on a "CDM site", the Operator shall be responsible for complying with CDM Regulations and the Principal Contractors Safe Systems of working (e.g. permit to work system). Notwithstanding the Infraco's over-arching responsibility as Principal Contractor up to Services Commencement Date, once the network is energised (and trams begin to operate) the Operator shall have a key role in managing the "operational end" of systems (e.g. the Operator would be responsible for developing and managing a permit to isolate systems within the context of the over-arching Infraco's systems).

	There shall be a requirement for the Infraco to comply where appropriate with the Operators Systems and procedures associated with the Operator's responsibility to manage operational safety.	The Operator shall be responsible for Operational Safety. This shall include developing Operational Plans, timetables and Management Systems and Operating Procedures for the Operational Phase. Operational safety responsibilities shall, by definition, occur once any part of the system is energised (anticipated to be between Stages 4 and 5, "Set to Work Tests" and "Commissioning", respectively.
DD	**DETAILED DESIGN STAGE**	
	Completing the full design and meeting all the deliverables as defined within the SDS Providers Agreement with **tie**, which is being novated and which is included in Volume 7 of the Infraco ITN.	Observing and reporting on the acceptability of proposed designs against the Design Manual and the Employers Requirements and the ability of the proposals to meet operational objectives
	Obtaining all approvals and consents in respect of the Edinburgh Tram Network;	Supporting the obtaining of necessary consents for Commissioning and Public Operation (and any consents which are relevant to the Operator).
	Managing and undertaking all interfaces with CEC traffic management systems.	Assisting Infraco with the interfaces with CEC, which are relevant to the Operator.
	Developing and updating a Testing and Commissioning Plan (TCP) for each element of the System including programmes and procedures with controls and acceptance criteria.	Providing input to a Testing and Commissioning Plan (TCP) for each element of the System including programmes and procedures with controls and acceptance criteria.

	Assisting the Operator with the development of a process for the handover for Operational purposes of the infrastructure and equipment from Infraco.	Developing a process for the handover for Operational purposes of the infrastructure and equipment from Infraco.
	Scheduling, and coordinating with the Operator, driver training, and the training of other operational and maintenance staff. The scope of the training shall cover all aspects of maintenance (as defined within these Employer's Requirements) and all operations. The Infraco shall be responsible for developing coordinated Training Plans in accordance with section 40 (Maintenance) of these Employer's Requirements.	Assisting the Infraco in the development of coordinated Training Plans and the specification of training documentation requirements from Infraco and Sub-suppliers.
	Complying with, and undertaking internal audits, associated with the Code of Construction Practice	Reviewing Infraco's compliance with the Code of Construction Practice, associated with any operator related issues.
1	**BUILD / MANUFACTURE**	
	Managing and implementing the manufacture and assembly of the System in accordance with the general provision of all the technical and management services as defined within these Employer's Requirements	Observing and reporting on the quality and functionality of Infrastructure and Equipment provision / manufacture and its compliance with Specifications where it affects the operational objectives.
	Liaising with the Operator to address any associated issues, and where necessary rectifying any works.	
2	**FACTORY ACCEPTANCE TESTS**	
	Managing and implementing the Testing process in accordance with the TCP. FAT tests (initial tests and integrated testing) shall be undertaken to verify that the components / system behave as planned in the design, meet the requirements of the design specification and provides correct functionality.	Assisting and providing advice to Infraco to manage the Testing process in accordance with the TCP.
		Observation if necessary and appropriate of any factory acceptance tests on equipment to be provided.

3	**INSTALLATION / CONSTRUCTION**	
	Managing and implementing the installation and construction at the Site in accordance with the general provision of all the technical and management services as defined within these Employer's Requirements.	Observing and reporting on the quality and functionality of Infrastructure and Equipment provision and installation, and its compliance with Specifications where it affects the operational objectives
	Liaising with the Operator to address any associated issues, and where necessary rectifying any works.	
4	**SET TO WORK TESTS**	
	Managing and implementing the Testing process in accordance with the TCP. These site tests (System Integration Tests) in accordance with section 6 of Part 1c – Tram Testing and Commissioning of the Employer's Requirements shall be undertaken to demonstrate that the construction / installation has been undertaken satisfactorily and that the systems behave as intended in the design.	Assisting and providing advice to Infraco to manage the Testing process in accordance with the TCP
		In accordance with the TCP; witnessing and reporting on the implementation tests
		Attending Tests
		Managing the Operational Safety of the Testing and Commissioning process in support of Infraco once the system is energised and trams begin to operate. Develop a system of management of safety during testing and commissioning (including the training of staff and contingency provisions)
	Obtaining Consents and Approvals required to allow the system to be energised and trams to operate.	Supporting the obtaining of Consents and Approvals for the system to be energised and trams to operate.
	Reviewing and commenting on the proposed Commissioning Phase Operating Procedures.	Developing Commissioning Phase Operating Procedures.

5	**COMMISSIONING**	
	Managing and implementing the Testing and Commissioning process in accordance with the TCP. This includes the site commissioning testing as defined within this Section at **Error! Reference source not found.Error! Reference source not found.**.	Assisting and providing advice to Infraco to manage the Testing and Commissioning process in accordance with the TCP
		In accordance with the TCP; witnessing and reporting on the implementation tests
		Attending Tests
		Managing the Operational Safety of the Testing and Commissioning process in support of Infraco once the system is energised. Develop a system of management of safety during testing and commissioning (including the training of staff and contingency provisions)
	Providing technical support on the development of operational plans, timetables and management systems and Operating Procedures; and	Developing Operational Plans, timetables and Management Systems and Operating Procedures for Operational Phase
	preparing and submitting plans, manuals & procedures for maintenance and operations in accordance with these Employer's Requirements, in time for System Energisation.	Reviewing and commenting on the acceptability of plans, manuals & procedures for maintenance and operations.
6	**TEST RUNNING AND DRIVER FAMILIARISATION**	
	Scheduling, and coordinating with the Operator, driver training and the training of other operational staff as part of the Commissioning activities prior to the start of Shadow Running. Implementing training plans including the undertaking of training of the Operator's trainers (8-10 trainers) and control room staff (18-21 staff).	Appointing and training of Operator staff and Operational rules and procedures training for Infraco. The Operator shall be responsible for training the drivers (utilising the training plans / information developed by Infraco and the Operator Trainers, who shall have been assessed as competent by Infraco on the operation of their systems and equipment).

	Demonstrating that the completed Operator training programme has produced a level of adequate competency to proceed to shadow running.	Assisting Infraco to demonstrate that the completed Operator training programme has produced a level of adequate competency to proceed to shadow running.
T1	The implementation of the T1 Post Commissioning Test: follows successful commissioning of the nominated section, test to demonstrate and prove the system is able to perform in a safe manner and delivers the required end to end run times (these may be up to 5% greater than target runtimes).	Assisting and providing advice to Infraco to manage the Testing and Commissioning process in accordance with the TCP
T2	The implementation of the T2 Performance Test: precedes Shadow Running: test to demonstrate and prove the system is able to perform satisfactorily to move into the 3 month Shadow Running Period (The T2 Performance Test is performed over 3 days and 95% of runtimes must be within target runtime; whilst service headways may be increased by up to 50% of those of the operating timetable).	
		In accordance with the TCP; witnessing and reporting on the tests
		Attending Tests
		Managing the Operational Safety of the Testing and Commissioning process. Develop a system of management of safety during testing and commissioning (including the training of staff and contingency provisions)
	Infraco to review to prepare Go Live timetable to be tested during shadow running.	Operator to prepare the Opertional Timetable to be tested during shadow running.
	Obtaining Consents and Approvals required to allow the system to start shadow running.	Supporting the obtaining of Consents and Approvals for the system to commence shadow running.

7	**SHADOW RUNNING**	
	Implementing the Shadow Running Phase to cover the requirements as defined within this Section at **Error! Reference source not found.Error! Reference source not found.**.	
T3	Implementing the T3 Pre-Operations Test: precedes Service Commencement, the test is undertaken during the Shadow Running Period, the test is the operation of the initial entry into service timetable and includes infrastructure, trams and operations systems (T3 is over 2 x 5 days and 99% performance must be achieved).	In accordance with the TCP; witnessing and reporting on the tests
		Attending Tests
		Managing the Operational Safety of the Testing and Commissioning process
		Developing a system of management of safety during shadow running and public operation (including the training of staff and contingency provisions)
	Obtaining the necessary Consents and Approvals for Public Operation.	Supporting the obtaining necessary consents for Public Operation
8	**SERVICE COMMENCEMENT DATE**	
	Infraco shall support the preparation for the T4 Network Performance Test with technical and maintenance support and monitoring. (T4 is over a 28 consecutive day period on a rolling basis in passenger service with the ultimate timetable in operation. 1 day in the period may be discounted. The test is to show that reliable operation is achieved.)	The Operator shall manage the preparation for the T4 Network Performance Test with technical and maintenance support and monitoring by the Infraco. The implementation of the T4 Network Performance Test.

	Demonstrations during the Network Performance Test e.g. sub-stations / UPS – demonstration of operation where a sub-station can be taken out of service for 2 hours during peak service.	
	Review, comment and provide support in preparation of the Test and Ultimate Timetables.	Preparation of an agreed Network Performance Test Operational Timetable and Enhanced Timetable as that which shall be the ultimate timetable to be used in Passenger Service.
	Infraco management for the preparation of the T5 Network Reliability Test with technical support and monitoring by Infraco.	The implementation of the T5 Network Reliability Test: the reliability testing of certain sub-systems in Passenger Service (within 12 months of opening).
	In accordance with the TCP; witness and report on the tests	Managing the Operational Safety of the Testing and Commissioning process. Develop a system of management of safety during testing and commissioning (including the training of staff and contingency provisions)

Table 47 - Table showing a guide of the key responsibilities associated with the Infraco and the Operator during the various phases of the Life Cycle Model

23.18 Tram Testing and Commissioning

23.18.1 Document Scope

The scope of this section of the document is to define the Tram Testing & Commissioning requirements that are applicable to all elements of the Edinburgh Tram Network (ETN).

23.18.2 General Requirements

This document defines the process for the testing and commissioning of the ETN that shall be carried out by the Tram Supplier together with the requirements of the Tram Tests that must be carried out to meet the Employer's Requirements and all relevant regulatory bodies as to the quality, performance and compliance of the Trams. It also identifies the tests to be carried out to meet the requirements for System Acceptance testing (involving Trams) of the completed Edinburgh Tram Network.

For certain of the type tests it may be acceptable to reference relevant tests previously undertaken on similar systems. The Tram Supplier will justify to the Tram Inspector all instances where this approach is applicable. This approach will only be possible in areas where there has not been anything other than very minor design changes. Where this approach is proposed, the final test reports and supporting data must be provided to allow the information to be assessed and accepted or rejected. It will be the Tram Supplier's responsibility to obtain any necessary permissions for the use of the test results and data concerned.

23.18.3 Test Plan

The Tram Supplier shall create and adhere to a Test Plan, which will comply with the requirements of EN50215 and encompass a logical build up of testing that leads to acceptance of the vehicles. The Test Plan shall include sufficient testing to demonstrate that all the Employer's Requirements have been met and to ensure that all relevant consents for passenger operation can be achieved from all relevant bodies. It must also be created in such a way as to maximise off-site testing.

The Tram Supplier shall carry out the Tram tests in accordance with this document, the Test Plan and the Tram commissioning and delivery programme. The Tram Supplier shall submit the Test Plan for agreement by the Infraco. Detailed Test Specifications for all tests shall also be submitted for agreement as part of the design scrutiny process and not less than eight weeks prior to the commencement of the tests.

The Test Plan shall be provided in Microsoft Project, together with any commentary, specifications and all results following completion of the Tram tests, in Microsoft Word/Excel format. The relevant supplied drawings shall be provided in electronic format and as hard copy. Test reports for each Tram Test shall be submitted, within two weeks following the completion of the Tram Test.

23.18.4 Tram Test Categories

The Tram Tests shall be divided into five discrete stages:

- Factory Acceptance Tests ("FAT")
- Delivery Acceptance Tests ("DAT")
- Site Commissioning Tests ("SCT")
- System Integration Tests ("SIT")
- System Acceptance Tests ("SAT")

With the exception of the Factory Acceptance Tests, which shall be carried out at the Tram Supplier's Factory, all other tests are to be carried out after the Trams are delivered to the Depot. All the tests are to be carried out by the Tram Supplier, except for the System Integration and System Acceptance Tests, which will be managed by Infraco.

Each category of Tram test can comprise two sub-categories:

- Type tests shall be performed to demonstrate that the vehicle design complies with the **Error! Reference source not found.Error! Reference source not found.** section of these Employer's Requirements and all relevant Legislation and regulations;
- Routine tests shall be carried out on each vehicle prior to delivery/handover. The routine tests shall include the agreed measurements and checks to confirm the compliance of each Tram.

The Tram Supplier shall provide all necessary support to the Infraco during the testing and commissioning activities in Edinburgh, from the delivery of the first Tram and until the completion of the System Acceptance Tests. This will include input to the development of the necessary specifications and procedures. The support for the Tram tests to be undertaken in Edinburgh shall include, but be not be limited to, a testing manager and technicians (who will be based in Edinburgh throughout the delivery and testing of the trams), full logistics support for the despatch of urgent and

routine spares during the testing process, documentation authors and administrative support for the production and control of test specifications, reports, and supporting documentation.

23.18.5 Test Certificates

Upon the successful completion of each of the Tram tests the Tram Inspector will issue the following test certification:

- Factory Acceptance Type Test Certificate;
- Factory Acceptance Routine Test Certificate;
- Certificate of Tram Delivery; and
- Site Commissioning Type Test Certificate.

Upon successful completion of all the tests for any individual Tram the Tram Inspector will issue the following test certification:

- Certificate of Tram Commissioning.

23.19 Factory Acceptance Tests (FAT)

Factory Acceptance Tests– This group of tests shall be undertaken at the Tram Supplier's Factory and upon successful completion the Tram Supplier will be issued with a Factory Acceptance Type Test Certificate and/or Factory Acceptance Routine Test Certificate by the Tram Inspector. The Factory Acceptance Tests shall be conducted in accordance with the Tram Manufacturing, Delivery Programme and the Test Plan. The FAT will be broken down into Factory Acceptance Type Tests and a series of Factory Acceptance Routine Tests and will comprise both static inspections and dynamic tests. The Factory Acceptance Type Tests shall be undertaken on a single Tram. This shall be the first Tram unless agreed otherwise in writing by the Tram Inspector.

Static inspections and tests shall be conducted at the Tram Supplier's Factory or at the sub-suppliers' premises during normal working hours during which the Tram Inspector will be entitled to inspect, examine and witness testing of all major systems, sections, apparatus, equipment, components, internal seating, fixtures and fittings and devices, including all structural, electrical, hydraulic and other major components and assemblies (except where the items concerned have been previously tested to the Tram Inspector's satisfaction and the appropriate test certificate issued).

Dynamic tests shall be conducted on the test track at the Tram Supplier's Factory or an alternative location subject to the Tram Inspectors agreement.

The Tram Inspector shall be given adequate prior notice of all tests. **tie** may, at its sole discretion, waive its right to attend or witness any test.

Whether or not the Tram Inspector is in attendance the Tram Supplier shall keep, and make available to the Tram Inspector on request, true and accurate records of the tests, the performance of the Tram during such tests, and any faults which developed or became apparent during the course of such tests.

The Tram Inspector may require evidence that the Tram has operated an agreed number of kilometres/hours in order to fulfil the requirements of the Test and Commissioning Plan under the agreed test track conditions without major faults or breakdown and has met the performance standards set out in this section throughout such period before issuing the Factory Acceptance Routine Test Certificate and/or Factory Acceptance Type Test Certificate. The distance travelled during the dynamic test on the test track will be limited and the main objective will be to check functions and performances not endurance, hence the distance travelled will relate to an agreed schedule to prove these functions.

The Factory Acceptance Routine Tests and the Factory Acceptance Type Tests referred to in the following tables shall include such examinations and tests as the Tram Inspector may reasonably require to satisfy himself that the Trams qualify or do not qualify for a Factory Acceptance Routine Test Certificate and/or and a Factory Acceptance Type Test Certificate. This will include but not be limited to; the checking of individual manufacturing and inspection records, module and sub-assembly tests including as-built dimensional checks where appropriate, for major items such as but not limited to bogie frames, wheel sets, traction and brake equipment.

The Tram Supplier shall make available to the Tram Inspector throughout the Factory Acceptance Routine Tests and/or Factory Acceptance Type Tests qualified staff and, where appropriate, its major sub-contractors to conduct, supervise and record the results of all such inspections, tests and examinations as are referred to in this document and to respond to all enquiries about the condition or performance of the Trams or its major sub-systems.

Table 48 - Factory Acceptance Tests: Static Type Tests

TEST	LOCATION	EN 50215 Reference	COMMENTS
Overall dimensional checks	Static test, at the Tram Supplier's Factory	8.1	To include external static envelope, internal dimensions, door widths and openings.
General examination and security check.	Static test, at the Tram Supplier's Factory		To establish accuracy and security of fixing of fixtures and fittings,
Coefficient of flexibility	Static test, at the Tram Supplier's Factory	8.2	Static test with a maximum cant of 100mm simulated. Horizontal and vertical flexibility.
Lifting ability	Static test, at the Tram Supplier's Factory	8.3	Body Lifting and major component removal. Bogie handling.
Tram weight	Static test, at the Tram Supplier's Factory	8.4	Tram and axle weights, including individual wheel and axle loading. Load testing of the complete vehicle and the checking of critical dimensions and clearances under a range of loading conditions. Suspension deflections and door entrance height measurement.
Sealing	Static test, at the Tram Supplier's Factory	8.5	Resistance of body structure to water ingress, humidity and snow.
Electrical insulation	Static test, at the Tram Supplier's Factory	8.6	High voltage insulation tests. Withstand and impedance of all cabling.
Bonding & return circuits	Static test, at the Tram Supplier's Factory	8.7	Continuity and integrity of all safety earth bonds and return current circuits.
Hydraulic system	Static test, at the Tram Supplier's Factory	8.9	Pumps and pipe-work. Pressure tests and leakage.
Braking System	Static test, at the Tram Supplier's Factory	8.10	Friction brake system

TEST	LOCATION	EN 50215 Reference	COMMENTS
Parking brake	Static test, at the Tram Supplier's Factory	8.11	Clamping force measurement
Auxiliary Power Supply	Static test, at the Tram Supplier's Factory	8.12	Power supplies and associated equipment.
Battery charging system	Static test, at the Tram Supplier's Factory	8.13.1	Batteries, battery chargers and associated equipment. Battery capacity for emergency working.
Auxiliary and control system	Static test, at the Tram Supplier's Factory	8.14	Vehicle control and management system. Software validation. Drivers' controls and instruments.
Doors	Static test, at the Tram Supplier's Factory	8.14.3	Passenger Doors, driver's doors. Emergency access and egress. Operation and timing.
Heating, ventilation & air-conditioning	Static test, at the Tram Supplier's Factory	8.14.4	System operation and effectiveness at the ambient conditions of the test location Thermostats, air flows. Hot/cold areas.
Lighting	Static test, at the Tram Supplier's Factory	8.14.5	Interior and exterior lighting.
Monitoring equipment	Static test, at the Tram Supplier's Factory	8.14.7	CCTV System, cameras and displays.
Event recorder	Static test, at the Tram Supplier's Factory	8.14.7	OTMR, (as far as practicable at the test location).
Communications and passenger information systems	Static test, at the Tram Supplier's Factory	8.14.7	Radios, PA, emergency communications (as far as practicable at the test location). Warning tones. Passenger information system. Passenger Emergency Help Points.
Configuration control	Static test, at the Tram Supplier's Factory	8.14.8	Determination of defined software and firmware status for all sub-systems. Modification status for all major and critical components and others as appropriate.

TEST	LOCATION	EN 50215 Reference	COMMENTS
Traction system	Static test, at the Tram Supplier's Factory	8.16	Motors, gearboxes, control equipment, power supplies and current collection.
Tram control system	Static test, at the Tram Supplier's Factory	8.16	Tram central control system and interfaces, fault monitoring and diagnostics.
Operability and maintainability	Static test, at the Tram Supplier's Factory	8.17	Verification of conformity with the proposed and agreed design. Operator and maintainer access to all appropriate areas.
Safety systems	Static test, at the Tram Supplier's Factory	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman system, door safety loop. Emergency pushbutton, Track brakes. Horns/warning devices.
Windscreen washers, wipers and demisters	Static test, at the Tram Supplier's Factory	9.18	System operation and effectiveness, demisters.
Pantograph	Static test, at the Tram Supplier's Factory	9.12	Operation. Contact forces.
Sanding system	Static test, at the Tram Supplier's Factory		System operation. Sand delivery rate. Coherence between VTCU output and the correct sanding unit.
Flange lubrication system.	Static test, at the Tram Supplier's Factory	9.11	Set-up of equipment.
Visual examination of all client defined features	Static test, at the Tram Supplier's Factory	HMRI, RVAR	Interior layout, seating, livery and signage.
Emergency coupler	Static test, at the Tram Supplier's Factory		Check of mountings / space envelope. manual operation.

Table 49 - Factory Acceptance Tests: Dynamic Type Tests

TEST	LOCATION	EN50215 Reference	COMMENTS
Traction system performance	Dynamic test, at the Tram Supplier's Factory test track	9.1	Dynamic performance, acceleration and braking rates. Jerk rates. Current collection. Degraded modes. Speed attainment. Power consumption. Wheelslip correction and sanding. Simulated locked axle detection
Braking system	Dynamic test, at the Tram Supplier's Factory test track	9.3	Friction brake system, service and emergency deceleration rates and stopping distances. Dynamic brake operation and blending with friction brake, jerk rates. Wheelslide correction and sanding. Track brake operation.
Thermal capacity	Dynamic test, at the Tram Supplier's Factory test track	9.4	Temperature rise monitoring of traction, braking & auxiliary equipment during repeated duty cycles. Including degraded modes and emergency duty.
Motion resistance	Dynamic test, at the Tram Supplier's Factory test track	9.5	Demonstration/derivation of Tram resistance to motion.
Coupling test	Dynamic test, at the Tram Supplier's Factory test track	9.8	Coupled Tram operation with emergency couplers, as far as practical and subject to availability of two Trams.
Ride quality	Dynamic test, at the Tram Supplier's Factory test track	9.9	Assessment of Tram ride quality, (providing that the test is meaningful at this location).
Flange lubrication system.	Dynamic test, at the Tram Supplier's Factory test track	9.11	System operation.
Pantograph	Dynamic test, at the Tram Supplier's Factory test track	9.12	Operation, Functional check.

TEST	LOCATION	EN50215 Reference	COMMENTS
Electromagnetic compatibility	Dynamic test, at the Tram Supplier's Factory test track	9.14	Electromagnetic radiation and susceptibility of vehicle systems. See also EN 50121, within the constraints of the test track.
Voltage interruption and jump	Dynamic test, at the Tram Supplier's Factory test track	9.15	Reaction of traction/dynamic brake/auxiliary power systems to supply voltage interruptions jumps. Operation over the full-specified voltage range covered by the type test certificate of the traction and auxiliary equipment (as far as practicable at the test location).
Windscreen washers, wipers and demisters	Dynamic test, at the Tram Supplier's Factory test track	9.18	System operation and effectiveness, including demisters.
Tram control system	Dynamic test, at the Tram Supplier's Factory test track	9.19	Interfaces between traction, braking, auxiliary, control and safety systems. Tram management systems, displays and diagnostics.
Monitoring equipment	Dynamic test, at the Tram Supplier's Factory test track	9.19	CCTV System, cameras and displays.
Event recorder	Dynamic test, at the Tram Supplier's Factory test track	9.19	OTMR, (as far as practicable at the test location).
Communications & passenger information systems	Dynamic test, at the Tram Supplier's Factory test track	9.19	Radios, PA, emergency communications. Warning tones. Passenger information system as far as practicable at the test location.
Safety systems	Dynamic test, at the Tram Supplier's Factory test track	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman system, door safety loop and speed inhibit. Emergency pushbutton, Track brakes. Horns/warning devices. Speedometer calibration.

TEST	LOCATION	EN50215 Reference	COMMENTS
Operability & maintainability	Dynamic test, at the Tram Supplier's Factory test track	8.17	Demonstration of degraded modes
Parking brake	Dynamic test, at the Tram Supplier's Factory test track	8.11	System operation and pull away test
Noise and vibration	Dynamic test, at the Tram Supplier's Factory test track	9.16	Noise and vibration measurements, as far as practicable at the test location.

Table 50 - Factory Acceptance Tests: Static Routine Tests

TEST	LOCATION	EN 50215 Reference	COMMENTS
Overall dimensional checks	Static test, at the Tram Supplier's Factory	8.1.2	Reduced overall dimension check.
General examination and security check.	Static test, at the Tram Supplier's Factory		To establish accuracy and security of fixing of fixtures and fittings.
Tram weight	Static test, at the Tram Supplier's Factory	8.4.3	Tram, and axle, weights.
Sealing	Static test, at the Tram Supplier's Factory	8.5.2	Resistance of body structure to water ingress
Electrical insulation	Static test, at the Tram Supplier's Factory	8.6	High voltage insulation tests. Withstand and impedance of all cabling.
Bonding and return circuits	Static test, at the Tram Supplier's Factory	8.7	Continuity & integrity of all safety earth bonds and return current circuits.
Hydraulic system	Static test, at the	8.9	Pumps and pipe-work. Pressure tests. Leakage.

TEST	LOCATION	EN 50215 Reference	COMMENTS
	Tram Supplier's Factory		
Braking System	Static test, at the Tram Supplier's Factory	8.10.2	Friction brake system functional test including parking brake
Auxiliary power supply	Static test, at the Tram Supplier's Factory	8.12.2	Power supplies and associated equipment.
Battery charging system	Static test, at the Tram Supplier's Factory	8.13.2	Batteries, battery chargers and associated equipment.
Auxiliary and control system	Static test at the Tram Supplier's Factory	8.14.1	Tram control and management system. Drivers' controls and instruments.
Doors	Static test, at the Tram Supplier's Factory	8.14.3	Passenger doors, driver's doors. Emergency access and egress. Operation & timing
Heating, ventilation and air-conditioning	Static test, at the Tram Supplier's Factory	8.14.4	System operation and effectiveness. Thermostats, air flows. Hot/cold areas. Duct sealing. Functional check
Lighting	Static test, at the Tram Supplier's Factory	8.14.5	Interior and exterior lighting. Functional check.
Monitoring equipment	Static test,at the Tram Supplier's Factory	8.14.7	CCTV System, cameras and displays.
Event recorder	Static test, at the Tram Supplier's Factory	8.14.7	OTMR, (as far as practicable at the test location).
Communications and passenger information systems	Static test, at the Tram Supplier's Factory	8.14.7	Radio, PA, emergency communications (as far as practicable). Warning tones. Passenger information system.
Configuration control	Static test, at the Tram Supplier's Factory	8.14.8	Verification of defined software and firmware status for all sub-systems. Modification status for all major and critical components and others as appropriate.

TEST	LOCATION	EN 50215 Reference	COMMENTS
Traction system	Static test, at the Tram Supplier's Factory	8.16	Motors, gearboxes, control equipment, power supplies and current collection.
Tram control system	Static test, at the Tram Supplier's Factory	8.16	Tram central control system and interfaces, fault monitoring and diagnostics.
Operability and maintainability	Static test, at the Tram Supplier's Factory	8.17	Fault handling, diagnostics and indications. Safety isolations.
Safety systems	Static test, at the Tram Supplier's Factory	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman system, door safety loop. Emergency pushbutton, Track brakes. Horns/warning devices.
Windscreen washers, wipers and demisters	Static test, at the Tram Supplier's Factory	9.18	Functional check including demisters.
Pantograph	Static test, at the Tram Supplier's Factory	9.12	Operation. Contact forces
Sanding system	Static test, at the Tram Supplier's Factory		System operation. Sand delivery rate.
Flange lubrication system.	Static test, at the Tram Supplier's Factory	9.11	Set-up of equipment.
Visual examination of all client defined features	Static test, at the Tram Supplier's Factory		Interior layout, seating, livery and signage.

Table 51 - Factory Acceptance Tests: Dynamic Routine Tests

TEST	LOCATION	EN 50215 Reference	Comments
Traction system performance	Dynamic test, at the Tram Supplier's Factory test track	9.1.2	Dynamic performance, acceleration and braking rates. Current collection. Speed attainment. Wheelslip correction and sanding.
Braking system	Dynamic test, at the Tram Supplier's Factory test track	9.3.2	Friction brake system, service and emergency deceleration rates and stopping distances. Dynamic brake operation and blending with friction brake, Wheelslide correction and sanding. Track brake operation.
Flange lubrication system.	Dynamic test, at the Tram Supplier's Factory test track	9.11	System operation, as far as practicable.
Tram control system	Dynamic test, at the Tram Supplier's Factory test track	9.19	Interfaces between traction, braking, auxiliary, control and safety systems. Tram management systems, displays and diagnostics.
Monitoring equipment	Dynamic test, at the Tram Supplier's Factory test track	9.19	CCTV System, cameras and displays.
Event recorder	Dynamic test, at the Tram Supplier's Factory test track	9.19	OTMR, (as far as practicable at the test location).
Communications and passenger information systems	Dynamic test, at the Tram Supplier's Factory test track	9.19	PA, emergency communications. Warning tones. Passenger information system (as far as practicable at the test location).
Safety systems	Dynamic test, at the Tram Supplier's Factory test track	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman system, door safety loop and speed inhibit. Emergency pushbutton, Track brakes. Horns/warning devices. Speedometer calibration.

23.20 Delivery Acceptance Tests (DAT)

These tests shall be carried out by the Tram Supplier upon the delivery of each Tram. They shall establish that the Tram has not been damaged or affected in any way by the delivery process and that it remains in the condition in which it was inspected prior to despatch from the Tram Supplier's factory. On satisfactory completion of the DAT the Tram Inspector will issue a Certificate of Tram Delivery.

TEST	LOCATION	EN 50215 Reference	Comments
Overall dimensional checks	Static test, at the Depot		Reduced to any parts or components which will been adjusted/removed during the transport.
General examination and security check.	Static test, at the Depot		To establish accuracy and security of fixing of all fixtures and fittings, transit damage. Visual inspection
Hydraulic system	Static test, at the Depot	8.9	Pumps and pipe-work. Visual inspection and checks for leakage.
Tram weight	Static test, at the Depot		Measurement of as-delivered tare weight, plus sand and fluids.

Table 52 – Table showing Delivery Acceptance Tests

23.20.1 Site Commissioning Tests

The Site Commissioning Type Tests shall be undertaken on the Tram(s) as appropriate, when they are delivered to the Depot and following the completion of the DAT. Upon successful completion the Tram Supplier will be issued with a Site Commissioning Type Test Certificate by the Tram Inspector. The tests shall comprises Static and Dynamic tests and will include, but not be limited to, the tests referred to in the tables on the following page.

For the avoidance of doubt the Tram Inspector shall not issue a Type Test Certificate even if by a lack or fault of the system infrastructure a test is failing or cannot be executed.

Table 53 – Site Commissioning Tests: Static Type Tests

TEST	LOCATION	EN 50215 Reference	Comments
Monitoring equipment	Static test, at the Depot	8.14.7	CCTV System, cameras and displays.
Tram location and detection system	Static test, at the Depot	8.14.7	Tram location and detection system.
Event recorder	Static test, at the Depot	8.14.7	OTMR
Communications and passenger information systems	Static test, at the Depot	8.14.7	Radios, PA, emergency communications. Warning tones. Passenger information system.
Noise.	Static test, at the Depot	8.18	Noise (outstanding from factory), internal & external. At same time as dynamic and performed on specified track section.
Safety systems	Static test, at the Depot	8.19	Brake control systems, emergency brake, passenger emergency. Driver's Deadman system, door safety loop. Emergency pushbutton, Track brakes. Horns/warning devices. Speedometer
Pantograph	Static test, at the Depot	9.12	Operation. Contact forces.
Electromagnetic compatibility	Static test, at the Depot	9.14	Electromagnetic radiation and susceptibility of Tram systems. Completion of the Tram FAT type test.

Table 54 – Site Commissioning Tests: Dynamic Type Tests

TEST	LOCATION	EN 50215 Reference	Comments
Traction system performance	Dynamic test, at designated test site	9.1.1	Dynamic performance, acceleration & braking rates. Jerk rates. Acceleration and control on gradients. Roll-back protection. Current collection. Speed attainment. Power consumption. Wheelslip correction and sanding. Emergency duty.
Braking system	Dynamic test, at designated test site	9.3.1	Friction brake system, service and emergency deceleration rates and stopping distances. Dynamic brake operation and blending with friction brake, jerk rates. Wheelslide correction and sanding. Track brake operation.
Thermal capacity	Dynamic test, at designated test site	9.4	Temperature rise monitoring of traction, braking and auxiliary equipment during repeated duty cycles. Including degraded modes and emergency duty.
Tram/track interaction	Dynamic test, at designated test site	9.8	Wheel rail interaction. Load testing of the complete vehicle and the checking of critical dimensions and clearances under a range of loading conditions. Suspension deflections and inter-vehicle clearances. Safety against derailment. Coupled Tram operation
Ride quality	Dynamic test, at designated test site	9.9	Assessment of Tram ride quality.
Kinematic gauging	Dynamic test, at designated test site	9.10	Dynamic performance, kinematics and gauging. Load testing of the complete vehicle and the checking of critical dimensions, swept path and clearances under load conditions. Suspension deflections. Pantograph sway,

TEST	LOCATION	EN 50215 Reference	Comments
Flange lubrication system.	Dynamic test, at designated test site	9.11	System operation.
Pantograph	Dynamic test, at designated test site	9.12	Included in Kinematic gauging
Electromagnetic compatibility	Dynamic test, at designated test site	9.14	Electromagnetic radiation and susceptibility of Tram systems.
Noise and vibration	Dynamic test, at designated test site	9.16	Noise and vibration tests performed on the specified section of track.
Safety Systems	Dynamic test, at designated test site	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman system, door safety loop and speed inhibit. Emergency pushbutton, Track brakes. Horns/warning devices. Speedometer. Event Recorder (OTMR).
Tram location and detection system	Dynamic test, at designated test site	8.14.7	Tram location and detection system.
Operability and maintainability	Dynamic test, at designated test site	8.17	Coupling test and recovery.
Parking brake	Dynamic test, at steepest gradient	8.11	System operation, effectiveness on steepest available gradient.

The Site Commissioning Routine Tests shall be performed on each Tram and comprise static and dynamic tests. This shall comprise of a full functional test, both statically and dynamically, of the Tram, including inspection, examination or testing of all major systems, sections, apparatus, equipment, components, internal seating, fixtures and fittings and devices (including testing the same whilst in operation); with the further inclusion of electrical, hydraulic and other major components and assemblies, as far as practical, at the test location.

The Site Commissioning Routine Test will be designed to establish that each individual tram functions in accordance with the design. It is not intended that the routine test should be a full re-working of the either the type test or the factory tests merely confirmation through carefully targeted testing that the build was correct., It will confirm that it is in a suitable condition to operate safely on the system. Upon successful completion of the Routine Tests the Tram Supplier will be issued with a Certificate of Tram Commissioning by the Tram Inspector.

Whether or not the Tram Inspector is in attendance at a Site Commissioning Test, the Tram Supplier shall keep and make available to the Tram Inspector on request true and accurate records of the Site Commissioning Test conducted, the performance of the Tram during such tests and any faults which developed or became apparent during the course of such tests.

23.20.2 Re-Testing

The Tram Supplier shall, if requested by the Tram Inspector, undertake such further examinations and tests as the Tram Inspector may reasonably require to satisfy himself that a Tram and/or the Trams qualify for a Certificate of Tram Commissioning

23.20.3 Testing Support

The Operator shall make the following available where required by the Testing and Commissioning Plan, (and agreed by Infraco):

- Depot and workshop facilities at the Depot;
- Reasonable assistance from its drivers, maintenance and other staff; and
- Track, power supplies and other facilities, as agreed, to meet the needs of the Tram Testing and Commissioning Plan.

All parties involved and their respective representatives and staff shall:

- Observe such reasonable requirements as may be notified in writing by the Operator or to preserve health and safety, protect the Trams against damage and avoid unnecessary disruption to the Operator's operations.
- Use all reasonable endeavours to avoid risks to health and safety, damage to the Trams or unnecessary disruption to the Operator's operations.
- The Tram Supplier shall make available throughout the Tram Commissioning Tests qualified staff from the Tram Supplier's organisation and, where appropriate, its major sub-contractors to:
  - Conduct, supervise and record the results of all such inspections, tests and examinations as are referred to in this document; and
- Respond to all reasonable enquiries about the condition or performance of the Trams or the major systems, sections, apparatus, equipment, components, internal seating, fixtures and fittings and devices, including all structural, electrical, hydraulic and other major components and assemblies and to rectify any failures of the same.

Table 55 – Site Commissioning Tests: Static Routine Tests

TEST	LOCATION	EN 50215 Reference	Comments
Braking system	Static test, at the Depot	8.10.2	Friction brake system, including parking brake
Monitoring equipment	Static test, at the Depot	8.14.7	CCTV System, cameras and displays.
Event recorder	Static test, at the Depot	8.14.7	OTMR,
Tram location and detection system	Static test, at the Depot	8.14.7	Tram Location and Detection equipment.
Communications and passenger information	Static test, at the Depot	8.14.7	Radios, PA, emergency communications. Warning tones. Passenger information system.

TEST	LOCATION	EN 50215 Reference	Comments
systems			
Configuration control	Static test, at the Depot	8.14.8	Verification of defined software and firmware status for all sub-systems. Modification status for all major and critical components and others as appropriate.
Traction system	Static test, at the Depot	8.16	Motors, gearboxes, control equipment, power supplies and current collection.
Safety systems	Static test, at the Depot	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman system, door safety loop. Emergency pushbutton, Track brakes. Horns/warning devices. Speedometer.
Windscreen washers, wipers and demisters	Static test, at the Depot	9.18	System function
Pantograph	Static test at the Depot		Contact forces and operation.
Sanding system	Static test, at the Depot		System function.
Doors	Static test at the Depot		Cycle times.
Heating, ventilation and air-conditioning	Static test, at the Depot	8.14.4	Functional check

Table 56 – Site Commissioning Tests: Dynamic Routine Tests

TEST	LOCATION	EN 50215 Reference	Comments
Traction system performance	Dynamic test, at designated test site	9.1.2	Dynamic performance, acceleration & braking rates. Speed attainment. Operation through supply interruptions and at varying line voltages.
Braking system	Dynamic test, at designated test site	9.3.2	Friction brake system, service and emergency deceleration rates and stopping distances. Dynamic brake operation and blending with friction brake, sanding. Track brake operation.
Ride quality	Dynamic test, at designated test site	9.9.2	Subjective ride test to discern any obvious ride irregularity.
Flange lubrication system.	Dynamic test, at designated test site	9.11	System function.
Noise and vibration	Dynamic test, at designated test site	9.16.2	Subjective noise and vibration assessment to discern any obvious irregularity.
Tram control system	Dynamic test, at designated test site	9.19	Interfaces between traction, braking, auxiliary, control and safety systems. Tram management systems, displays and diagnostics.
Monitoring equipment	Dynamic test, at designated test site	9.19	CCTV System, cameras and displays.
Event recorder	Dynamic test, at designated test site	9.19	OTMR
Tram location and	Dynamic	9.19	Tram location equipment

TEST	LOCATION	EN 50215 Reference	Comments
detection system	test, at designated test site		
Communications and passenger information systems	Dynamic test, at designated test site	9.19	Radios, PA, emergency communications. Warning tones. Passenger information system (as appropriate).
Safety systems	Dynamic test, at designated test site	8.19	Brake control systems, emergency brake, passenger emergency. Driver's deadman's system, door safety loop and speed inhibit. Emergency pushbutton, Track brakes. Horns/warning devices. Speedometer calibration.
Parking brake	Dynamic test, at designated test site	8.11	System function Part of braking test

23.21 System Integration Tests (SIT)

The System Integration Tests consist of tests carried out to prove that the ETN as a whole can function as intended. All infrastructure, operation and control systems shall be exercised during these tests. The Tram Supplier will provide reasonable input to the development of the SAT specifications as well as participation in, and support to, the tests whenever reasonable technical support is needed in reference to the Trams.

The System Integration Tests will include, but will not be limited to, the following:

- Comprehensive gauging and dimensional checks under a range of loading conditions;
- Run time tests;
- Interface checks to all items of workshop plant and equipment including the wheel lathe, Tram washing machine, sanding plant, cranes and hoists;
- Access and handling checks for all major items of equipment, sub-assemblies and major capital spares items;
- Validation of the radio communication system; and
- Validation of the tram position detector system.

The System Integration Tests will involve carrying out gauging runs over all parts of the ETN in order to establish that the Trams (when operating individually or in conjunction with other Trams) accord with the Tram Section and the agreed detailed interface arrangements in terms of the alignment geometry, clearances, loads, pantograph dynamics, wheel rail interface, traction power system, communications and route setting equipment, compliance with operational procedures and Tram performance values. In particular it shall be demonstrated that there is sufficient clearance between passing Trams on the Network and between Trams and other Network equipment and installations to ensure that the Trams can be operated safely and without damage to themselves and to the other parts of the System.

There shall be static and dynamic tests to verify that the pantograph conforms to the requirements of the Employer's Requirements.

There shall be a series of tests to demonstrate the ability of one Tram to recover another failed Tram, including on the most severe gradient on the ETN and potentially in a degraded mode.

The testing of the systems, including but not limited to; power supplies, overhead line, Depot equipment, and EMC tests will require the use of a number of Trams running at the same time.

Table 57 – System Integration Tests: Static Type Tests

TEST	LOCATION	EN 50215 Reference	Comments
Lifting ability	Static test, at the Depot	8.3	Body Lifting and major component removal. Bogie handling.
Battery charging system	Static test, at the Depot	8.13	Battery access for maintenance and topping up. Operation and suitability of external battery chargers.
Monitoring equipment	Static test, at the Depot	8.14.7	CCTV System, Interface with the Depot systems.
Event recorder	Static test, at the Depot	8.14.7	OTMR, Interface with the Depot systems.
Tram location and detection system	Static test, at the Depot	8.14.7	Tram location equipment.
Communications and passenger information systems	Static test, at the Depot	8.14.7	Radios, PA, emergency communications. Warning tones. Passenger information system. Interface with the Depot systems.
Traction system	Static test, at the Depot	8.16	Power supply interaction.
Operability and maintainability	Static test, at the Depot	8.17	Review and demonstration of accessibility and removal of components. Fault handling, diagnostics and indications. Safety issues.
Noise and vibration.	Static test, at the Depot	8.18	Noise and vibration levels, internal and external.
Pantograph	Static test, at	9.12	Operation. Contact forces.

TEST	LOCATION	EN 50215 Reference	Comments
	the Depot		
Sanding system	Static test, at the Depot		Refilling system. Verification that the fill level can be observed from inside the tram.
Flange lubrication system.	Static test, at the Depot	9.11	Refilling.
Visual examination of all client defined features	Static test, at the Depot	HMRI, RVAR	Interior layout, seating, livery and signage
Electromagnetic compatibility	Static test, at the Depot	9.14	Electromagnetic radiation and susceptibility of vehicle systems.

Table 58 – System Integration Tests: Dynamic Tests

TEST	LOCATION	EN 50215 Reference	Comments
Tram/track interaction	Dynamic test, at designated test site	9.8	Wheel rail interaction. Load testing of the complete vehicle and the checking of critical dimensions and clearances under a range of loading conditions. Suspension deflections and inter-vehicle clearances.
Kinematic gauging	Dynamic test, at designated test site	9.10	Dynamic performance, kinematics and gauging. Load testing of the complete vehicle and the checking of critical dimensions, swept path and clearances under a range of loading conditions. Suspension deflections. RVAR and HMRI requirements.
Platform gauging	Dynamic test, at designated test site	9.10	Platform stepping distance and heights, tare and loaded conditions. RVAR requirements.
Flange lubrication system.	Dynamic test, at designated test site	9.11	Effectiveness.
Pantograph	Dynamic test, at designated test site	9.12	Operation, contact forces, sway. OLE deflection.
Electromagnetic compatibility	Dynamic test, at designated test site	9.14	Electromagnetic radiation and susceptibility of vehicle systems.
Voltage interruption and jump	Dynamic test, at designated test site	9.15	Reaction of traction/dynamic brake/auxiliary power systems to supply voltage interruptions, jumps and short circuits. Operation over full-specified voltage range.
Noise and vibration.	Dynamic test, at designated test site	9.16	Noise and vibration levels.
Monitoring equipment	Dynamic test, at designated	9.19	CCTV System, cameras and displays.

TEST	LOCATION	EN 50215 Reference	Comments
	test site		
Tram location and detection system	Dynamic test, at designated test site	9.19	Tram location equipment, throughout the available route. Road junction and point motor control.
Communications and passenger information systems	Dynamic test, at designated test site	9.19	Radios, PA, emergency communications. Reception and effective communication with the Depot throughout the available route. Warning tones. Passenger information system
Operability and maintainability	Dynamic test, at designated test site	8.17	Review of all systems as required. Demonstration of degraded modes and recovery practices. Coupling test
Traction supply	Dynamic test, at designated test site		Sub-station load tests, sub-station outages. Regeneration. Overload protection, touch voltage and stray current tests.
Section run times	Dynamic test, throughout the System		Proving of the System infrastructure in stages as it becomes available to operate.

23.21.1 System Acceptance Testing

Tram testing will be undertaken in support of the system acceptance testing set out in these Employer's Requirements.

24 Trams

24.1 Scope

This section defines the requirements for Trams that are applicable to the Edinburgh Tram Network and with which the Infraco must comply.

24.2 General Technical Specification

The Trams shall be of a high quality in design and construction and comply with the following general design criteria:

- High safety standards including, but not limited to:
  - Compliance with Railway Safety Publication 2 - Guidance on Tramways, issued by the Office of the Rail Regulator;
  - Compliance with Rail Vehicle Accessibility Regulations, 1998;
- High reliability, minimum maintenance requirement and ease of repair;
- Proven design and technology;
- Low floor access;
- Easy to clean;
- Modern and attractive appearance;
- Low weight;
- Low environmental impact;
- Meets access requirements for the disabled;
- Minimum use of energy;
- The Trams will be required to have a minimum operating capability of at least 100,000 km per year; and

The Trams shall be designed to have a minimum service life in accordance with Section 6 of these Employer's Requirements.

The Trams shall be articulated in order to negotiate the track alignment. They will be fully bi-directional and capable of being driven from either end and shall have passenger doors on both sides. They will be capable of being operated by one person.

Normal service Trams shall comprise one vehicle, but shall be capable of running coupled together for the purpose of one Tram recovering another failed Tram from any point on the system.

The Tram should be designed and constructed in accordance with a Quality Plan (as prescribed under ISO9001), which should also include a delivery plan and a Test Plan.

A full-scale Tram mock-up shall be provided to demonstrate areas critical to operation and access as part of the formal design process and for use in public consultation. The mock-up shall include the entire cab and a representative portion of one saloon, including a vestibule with at least one operational pair of bi-parting doors and space reserved for wheelchair use. The mock-up shall show the exterior form and livery. The mock-up shall be weatherproof and shall be delivered to a location in Edinburgh designated by **tie.**

24.3 Wheel / Rail Interface

The Trams shall have a wheel profile and suspension characteristic that is compatible with the rail profiles used throughout the System in terms of risk of derailment, noise, wear and vibration. The wheel profile shall allow for flange running at crossings. The Tram will be designed to operate in conjunction with a track gauge of 1,435mm and a flange back-to-back dimension consistent with the rail types to be used on the Edinburgh Tram Network.

24.4 Tramway Path

Trams shall be compatible with the System track alignment and the geometric constraints as outlined in Section 26 of these Employer's Requirements, which gives the alignment criteria and the assumed Tram characteristics. From this the developed kinematic envelope ("DKE") calculations and any other information, to show compatibility with the alignment, shall be provided by the Infraco. The Trams shall negotiate the minimum radius horizontal and vertical curves, and maintain acceptable wheel flange wear.

Minimum clearances to existing structures, Tramstops, overhead line equipment structures and all other road furniture shall be maintained in accordance with the agreed DKE and it shall always be possible for one Tram to pass another, at any point on the system. The Infraco shall ensure that the Tram Supplier shall provide supporting information to enable a reduced DKE to be developed for use in locations where restricted speeds are or may require to be applied.

24.5 Supervisory, Control & Communications Systems

The Trams shall be fitted with equipment to automatically indicate their position to, and communicate with, a central control centre.

Additionally, a bus tracker box will be fitted.

A voice radio system will be permanently available between the driver and the central control centre. This equipment will be supplied by Infraco and will be free-issue to the Tram Supplier, to be installed and tested as part of the Tram manufacturing process.

The supply and integration of the free-issue equipment will be controlled through a system interface register, to be developed from Schedule 22 of the TSA and managed by Infraco.

All on-board systems with real-time clocks shall be updated and synchronised from a common source, throughout the working life of the Tram.

24.6 Depot Facilities

The Trams shall be maintained at the Depot and a system interface register shall be used to ensure that the Trams and the equipment provided for their routine maintenance and operation are compatible.

The Trams shall be compatible with a mechanised sand filling system at the Depot (see Section 29 of these Employer's Requirements), enabling the sand system on the Trams to be replenished within five minutes and by one driver alone. The Infraco shall ensure that the Tram Supplier shall provide a specification for the sand, and contact details for a UK-based commercial supplier of this sand.

The Trams shall have a key suiting system that provides a logical hierarchy of access to cleaners, inspectors, drivers and maintenance staff. It shall not be part of the same suite as detailed in 22 of these Employer's Requirements.

The Trams shall be supplied with a nominal 24VDC shore supply, socket compatible with battery charging equipment in the depot.

24.7 Electro-Magnetic Compatibility

The Trams and their sub-systems shall not generate excessive, nor be susceptible to, electro-magnetic interference and shall comply with EN 55013, EN 50121 and EN 50122 as appropriate.the requirements of the specification as detailed in 16 of these Employer's Requirements.

24.8 Climate and Environment

The Trams shall operate normally in all climatic and environmental conditions found in the Edinburgh area on the proposed route, including operation in a marine environment having a saline atmosphere and being subject to fine wind-blown sand. This shall also include conditions where ice forms on the overhead line and wind speeds of up to 120km/h.

The Trams shall function, without deterioration in performance and for their whole design working life, within the weather conditions anticipated within the Edinburgh area as described elsewhere in 3.6.4 of these Employer's Requirements - taking into account the previously quoted wind speed. All equipment housings/enclosures that contain electronic equipment shall be so equipped to avoid the occurrence of condensation. The Trams shall be capable of being started up normally under the range of weather conditions as outlined above after no less than 72 hours of being left in the open in a shutdown condition.

24.9 Interface Management

The Infraco shall procure that the Tram Supplier participates in the interface engineering process. The Tram interfaces are identified in the TSA. The management of the interfaces will be carried out by Infraco using the system interface register.

24.10 Systems Assurance

The Infraco shall ensure that the Tram Supplier shall implement a System Assurance engineering process in accordance with the requirements of the Edinburgh Tram Network. This process shall cover all aspects of design, manufacture, integration, testing and commissioning of the Tram, and all interfaces with the system, to demonstrate compliance with the reliability, availability, maintainability and safety requirements of **tie**.

The Infraco shall ensure that the Tram Supplier shall follow the approach of BS EN 50126:1999 "Railway Applications – The specification and demonstration of RAMS".

The Infraco shall ensure that the Tram Supplier shall implement a reliability, availability and maintainability management process and will detail it in a Reliability, Availability and Maintainability Plan (RAMP).

The Infraco shall ensure that the Tram Supplier shall implement a System Safety Management Plan (SSMP), which shall define the process, activities and requirements for the preparation of a 'Case for Safety' during the design and handover stages of the project. The plan shall also define the system safety management organisation and the strategy to achieve the individual hazard system safety targets.

All foreseeable system safety hazards are to be identified, evaluated and recorded in a Hazard Log that will be managed and maintained throughout the project lifecycle. The Infraco shall ensure that the Tram Supplier shall implement a hazard management process to identify hazards through hazard analysis and the means to mitigate these hazards.

24.11 Noise and Vibration

Trams shall at all times meet the requirements of the **tie** Noise and Vibration Policy (NVP/001/V1.01). Trams shall operate as quietly as is reasonably possible. The proposed design shall incorporate wheel damping, side skirts with sound-deadening linings and resilient mounting of electrical equipment likely to generate noise. The Infraco shall ensure that the Tram Supplier shall provide the anticipated noise levels of the proposed Tram. Noise tests shall be carried out in Edinburgh to determine the frequency peaks generated, in particular by the wheels. The results of these tests shall be used to determine the type and extent of any tuned vibration dampers that should be fitted to the wheels.

24.12 Specific Technical Requirements

The Tram body shall be a nominal width of 2.65m externally. Note that external door sills may be required in order to comply with Rail Vehicle Accessibility Regulations.

The total Tram length shall be a nominal value of up to 44m.

The following loading conditions shall apply in this document:

- AW0 = Tram tare weight (empty car)
- AW1 = AW0 + full load of seated passengers
- AW2 = AW1 + weight of standing passengers at 4 persons/m^2

- AW3 = AW1 + weight of standing passengers at 5 persons/m_2
- AW4 = AW1 + weight of standing passengers at 6 persons/m_2
- AW5 = AW1 + weight of standing passengers at 8 persons/m^2

Where the mean passenger weight is taken to be 70.5kg.

The passenger capacity of the tram shall be at least 230 persons, of which a minimum of 80 shall be seated, on fixed seats. There shall in addition be provision for wheelchairs in accordance with Rail Vehicle Accessibility Regulations. There shall also be provision for luggage racks.

At least 66% of the floor area available for standing must be low-floor, with a height above rail level of between 300mm and 400mm. High floor areas shall be minimised. All doorways shall allow level boarding access at a height between 300-350mm above the top of the rail. The slope of the floor at the entrance shall be in accordance with disabled access regulations. Suitable means of adjustment shall be provided to compensate for wheel wear in order to remain within these limits.

The Tram shall have a maximum operating speed of up to 70km/h. However, a speed of 80km/h must be achievable, though not sustainable for a prolonged period.

The Tram structure will incorporate a strong and stiff underframe capable of supporting a buffing load in compliance with EN 12663 category V without permanent deformation. The structure shall not deform, crack, fracture, corrode or suffer loosening of rivets or bonding during the normal service life of the vehicle. It shall be, and remain, watertight against rain, passing through standing water and passing through the washing plant throughout its working life.

The tram structure shall be designed and tested to accommodate a passenger loading of AW5 as defined earlier in this clause.

All cavities in the floor structure, body sides and ceiling will be well drained and constructed in such a way that water does not collect and corrosion does not occur. Insulation material will fill all void spaces to minimise noise, vibration and heat loss.

The articulated joints will provide a wide gangway and resistance to vehicle climbing in the event of a collision. The articulation will require minimum maintenance and be capable of being dismantled to separate the Tram bodies with a minimum of equipment.

Where different metals are in contact, due regard shall be given to preventing the effects of dissimilar metal corrosion. All metal surfaces shall be treated to resist corrosion. All body panels will be interchangeable between vehicles and all exterior panels will be lined with water resistant, sound absorbing and heat insulating materials to minimise the possibility of resonance.

Easily replaceable energy absorption devices shall be provided at both ends of the Tram such that frontal and rearward collisions, at speeds up to 5 km/hr shall be fully absorbed without causing permanent deformation of the body structure. The front skirts and lower body side panels shall be mechanically fastened so as to allow easy replacement and shall be interchangeable between Trams. Each panel must be able to be replaced by one person in ten minutes.

The Trams shall be designed to be resistant to fire in accordance with the standard BS6853 Category 2, or the equivalent European Standard.

The maximum axle load at AW4 loading, and including all consumables, shall be 11.5 tonnes.

The windscreen shall be compliant to the equivalent International Regulation ECE 43 (Uniform Provisions Concerning the Approval of Safety Glazing and Glazing Materials (Rev1 08.1990). The windscreen and cab side windows shall consist of laminated glass panes made of safety glass. There should be no diffraction effects or colour distortions in the cab windows. Any glass screens dividing the driver's cab from the saloon shall be treated to minimise reflections. All internal glazing shall be made from safety glass.

The side windows (including the door windows) will be made from heat reflecting safety glass. The glazed area shall be maximised within the limits set by structural integrity, solar gain and passenger modesty. Passengers must have a clear view to the exterior whether seated or standing. Tinted windows shall be used to minimise dazzling.

The windows shall allow permeability for radio waves with frequencies for Global System for Mobile telecommunications, and other public-domain transmissions.

All windows, (including the driver's windscreen) shall be easily replaceable using standard methods and tooling available in the Depot. All glass surfaces must be replaceable within two hours and should be secured so as to be watertight and draught-proof. Bonded glass is not preferred, unless it can be demonstrated that the bonded glazed units can be easily interchanged in less than two hours. Bonding to a mechanically-fixed window frame, or securing using a rubber section, is preferred.

If the windows used are bonded, they should have a black, printed ceramic silk screen print to cover the bonding zone and protect the bonding material from ultra violet transmission, on which the ultra violet -Transmission should be less than 0,1% at 400-600 nm.

Opening hopper windows will be fitted throughout the passenger compartment. All interior glass surfaces in the Tram passenger compartments shall be fitted with Ultra Violet light reducing and shatter resisting film on the inside surface, which shall be easily replaceable as a maintenance task when required yet give good visibility when in place. This film shall also provide effective protection against damage to the glass by 'etching'-type graffiti.

24.13 Driver's Cab

The driver's cab shall be arranged so that at least 95% of adult persons can comfortably access the cab desk and all the controls located within the cab, whilst retaining the appropriate field of view out of the cab. The design of the cab shall be undertaken to good human factors practice.

The driver's cabs shall be air-conditioned and the temperature shall be thermostatically controllable by the driver. Air conditioning in both cabs shall be switched on or off from either cab. Temperature selection shall be only available from the cab in use.

An effective windscreen demisting system shall be fitted, suitable for the climatic conditions encountered in Edinburgh. The demisting system shall be able to clear the windows of condensation within ninety seconds of a cab being made operational.

The cab may extend to the full width of the Tram, and be separated from the passenger area by a glazed partition providing good passenger visibility through the cab windscreen. A mirror providing the driver with a view into the saloon (when sat at the controls) shall be provided.

An internal cab to saloon door is required, which must be lockable from the saloon side and cab side but capable of being opened at any time from inside the cab. The door must latch automatically when closed.

An inward opening, hinged and lockable external cab door may be provided. It shall be capable of being locked and unlocked from both inside and outside the cab.

The cab lighting level shall be 250-300 LUX at 1.0m above floor level. The driver shall have the control of switching this lighting on or off.

A generally translucent mesh fabric sunblind shall be provided, with an opaque strip extending 150mm up from the bottom edge. The blind must be able to be deployed by the driver whilst in the driving position. It need only be retractable at stops.

Cab windscreens and cab windows shall maximise the degree of all round vision available to the driver. A clear unobstructed view of the road/track ahead shall be provided with clear and unrestricted sight lines, particularly low down in front of the cab.

The partition between the Cab and Saloon and other glazing surfaces shall minimise the incidence of reflections at all times and in all expected environmental conditions. Blinds or curtains shall be provided to screen the saloon lighting from the cab at night.

The following features that relate to instruction of Tram drivers shall be provided:

- A Tram driver can be under instruction when a Tram is in passenger service, consequently it must be possible for an instructor and a driver to be inside the cab with the cab/saloon door closed, and the instructor must be comfortably and safely located in the cab.
- The instructor must be able to apply the Tram security brakes quickly.
- The instructor must be seated and secure in the cab to the extent that he can apply the brakes even when the Tram is performing unpredictably.
- The instructor's seat may be a portable item,supplied with the Tram.

The driver's seat, unless purpose-designed for a Tram, shall be a seat specifically designed for bus applications rather than for other vehicles such as heavy rail or heavy goods vehicles, as it must be capable of being adjusted frequently without any damage. The seat must be of ergonomic design, easy to clean and easily removable from the cab. The seat cushions shall be easily removable for cleaning.

The driver's seat must be easily adjustable so that 95% of adult persons may be seated comfortably with effective reach to the drivers' controls, and maintain unrestricted lines of sight through the windscreen.

Both cabs on each Tram shall provide stowage for:

- A points handle, typically a steel bar about 1m long (supplied by others). This must be placed so the driver can easily take it with him when leaving the cab, and so it must be stowed and un-

stowed without risk of damage to the cab finishes or equipment. When not in use it must be secured so as to prevent becoming a hazard in the event of an emergency stop or a collision.

- A first-aid box (supplied by others)
- A fire extinguisher to be supplied with the Tram.
- A place to hang a driver's coat, where it will not interrupt the view in any direction.
- A place to hold two A5 ring binders of timetables, information and procedures.
- A place to clip an A5 sheet of paper, which can be conveniently referred to by the driver (whilst at a Tram stop), and which does not obscure any controls or gauges.
- A hand lamp (supplied by others)

Provision shall be made within each cab to allow two operational personnel to separately and securely store personal effects

There shall be provision in each cab for a secure cash box (supplied by others). The dimensions of this are to be provided by **tie**.

There shall be charging points in each cab for a portable radio and a hand-held ticket machine.

The tram shall be fitted with holders in each cab for a destination board, for the purpose of indicating additional destinations of public interest. This board is to be placed in position by the driver so as to be seen from in front of the tram. The dimensions of the board are to be provided by **tie**.

24.14 Tram Controls

The layout of controls, switches and instrumentation shall be agreed with **tie** on the mock-up, by use of design submittals and the use of the mock-up. The desk panels shall be made of material that is wear resistant and free from reflections.

It shall be possible to drive the Tram from each cab. Insertion of the driver's key and the operation of one switch in either cab shall switch on all of the equipment needed to enable the Tram to be driven from that cab. Essential sub-systems shall not be separately switched.

The Tram acceleration and braking shall be controlled from a combined controller handle, incorporating a dead man safety device. This shall normally be locked out of use until released by the driver's key, which shall remain captive in the controller until the controller is placed in the off

position. It shall not be possible to operate the Tram with more than one controller in use at any one time.

The controller shall include a slow speed mode, for driving through the Tram washing plant.

The following controls shall be conveniently placed for the driver's free hand when the Tram is in motion:

First priority

- Audible warnings (bell, horn);
- Track brake (in addition to the emergency brake on the driver's controller);
- Indicators;
- Pantograph emergency drop.

Second priority

- Manual sand (in addition to the automatic sanding system);
- Windscreen washer and wiper controls;
- Headlamp dip/main beam;
- Panic Alarm;
- Tram punctuality display against timetable or headway.

The following controls shall be conveniently placed for use when the Tram is at a Tram stop:

- Door controls;
- Rear-view normal mode push-button;
- Tram Ready To Start (junction calling when at a Tramstop close to the junction);
- Hazard and marker lights;

- Air-conditioning and temperature controls;
- Saloon heating control;
- Fault reset push-button;
- Public Address controls;
- Radio controls;
- Cab light switch;
- Saloon lighting;
- Pantograph control;
- Windscreen demister.

At least one cab shall display an odometer calibrated in km. Both cabs shall display a speedometer calibrated in km/h and mph.

Windscreen wiper control shall be by means of a multi-position switch having intermittent, continuous slow and continuous fast positions. Wipers shall be self-parking to a position close to and parallel with the edge of the windscreen.

There shall also be a separate push button, which operates wipers and windscreen washers for as long as it is held down, and provides one additional sweep of the wipers after it is released.

Each cab shall be equipped with an indicator to inform the driver whether the Tram is running early or late, and by how much.

24.15 Rear View Equipment

Rear-views shall be provided by close circuit television equipment which shall function as follows:

The 'normal' view, displayed whenever the Tram is in motion, shall have two screens in the cab integrated into the desk: one on the left side of the desk and one its right. The images in them shall be the same as would be seen in mirrors.

The 'Tram stop' view shall be displayed in the time between the doors being enabled at a stop and all doors being proved closed. In this view, the monitor on the platform side (the side on which the doors are enabled) shall show the same as in normal view. The other monitor shall display the image from the rear camera on the platform side, to enable the driver to view passengers disembarking and embarking and to ensure that doors are clear before they are closed.

Note that the images of views back from the cab will be laterally inverted and those forward from the rear of the Tram will not.

A separate push button conveniently located on the cab desk shall provide the driver with a changeover facility from 'Tram stop' to 'normal mode' for as long as it is held down, to allow a driver to check that nothing is overtaking the Tram at an on-street stop whilst the doors are closing.

Closed circuit television images must remain clear enough to see a cyclist overtaking the Tram before the Tram sets off from an in-street Tram stop, even whilst it is raining, dark, under street lighting and there are car headlamps shining towards the cameras. The tram supplier will be required to demonstrate that the CCTV coverage allows drivers to effectively see all passengers boarding and alighting, as well as being sufficient for the needs of driving the tram on street.

The images from the cameras shall be displayed in the cab to the driver on colour flat-screens with manually adjustable brightness. Images on these screens shall be viewable by the driver under all ambient lighting and weather conditions and at as wide an angle as possible. Care shall be taken to ensure that 'flaring' of the image from brightly lit, wet, road surfaces is avoided. Special consideration shall be given to the use of this equipment in wet weather and poor lighting conditions, when it may be necessary to remove rain droplets or prevent them from forming on the camera lens.

Rain affects closed circuit television both by creating additional reflections from wet road surfaces and by settling on the camera housings themselves. The system must cope adequately with both.

24.16 Interior

Care and attention shall be given to provide a safe passenger environment. Passenger movement within the Tram shall be made as safe as practicable, and able-bodied passengers shall be able to move along the entire length of the passenger saloon of the Tram.

The free and safe movement and loading of passengers shall be facilitated by the incorporation of handrails, grab-poles and an interior free of tripping hazards and sharp corners throughout the Tram. The gangway width between seats shall be not less than 650mm. Hand-holds will be provided to maximise the use of standing space, particularly in vestibules and articulations.

Steps may be included to permit the movement of passenger's to or from areas where there is a difference in the height of the floor of the Tram. Steps shall not exceed 200mm in height and the quantity should be as few as possible. There shall be a minimum of 16 seats accessible to passengers without using steps.

All seats shall be at least 450mm wide, ergonomically designed, resistant to damage and soiling and have easily replaceable covers. The seats shall as far as possible not be placed on pedestals, i.e. shall not require a step up for passengers when taking a seat. Wherever practicable seats should be cantilevered from the vehicle side so as to leave a clear floor area to facilitate cleaning. Seat rows shall be pitched no closer than 752mm.

The non-slip, easy clean floor covering shall also continue up the vehicle sides and seat pedestals so that there are no corners that can act as dirt traps. The floor covering shall be hardwearing with minimal openings and continuous welded or seamless glued joints. The edges of the floor covering shall be sealed to prevent water penetration to the structure of the Tram.

The floor covering shall be highly resistant to staining from any source.

The actual floor area available for standing passengers shall be clearly identified. From this the total standing capacity shall be calculated, respecting Rail Vehicle Accessibility Regulations and the limitations of standing room in areas such as articulations. Seating shall generally be arranged transversely with minimum longitudinal seating.

The tram shall be fitted with luggage racks, distributed evenly about the vehicle and situated as close as practicable to the vestibules. The luggage racks shall occupy a floor space of up to $10m^2$ and extend the full height of the interior and have two intermediate shelves. At floor level a horizontal bar shall extend across the opening into the saloon to prevent objects rolling out of the luggage space. Luggage shall be effectively prevented from excessive movement out of the racks, either under high rates of braking or lateral acceleration. The luggage racks should be easily replaced by seating (or standing areas if appropriate) should **tie** require to do so.

The tram is to be provided with information screens so as to be visible from within most parts of the saloon. The screen should be able to display video information for events and places of public interest, and should also be able to display selected views from the closed-circuit television system. All passenger areas of Trams shall be provided with windows in all sidewalls to maximise visibility for passengers. This requirement shall also apply to draught screens and separation walls to the driver's cabs.

The Tram shall provide data on the number of passengers boarding and disembarking at each Tramstop. This data shall be easily downloaded each day when the tram returns to the Depot. Software to allow analysis of the data shall be provided.

The passenger counting facility shall be incorporated on 6 of the trams in the fleet only. It shall be possible, with minimum disruption to wiring looms, body panels and major equipment, to retro-fit passenger counting equipment should this be required after the vehicles have been delivered.

Passenger stop request buttons shall be provided in the saloon area in accordance with Rail Vehicle Accessibility Regulations.

Interior saloon lighting shall provide glare free, uniformly distributed illumination in passenger areas, to a level of between 280-350 lux. The lighting diffusers shall be easily cleanable.

Emergency internal lights must function after disconnection from the overhead power supply (at all operating temperatures) in accordance with the battery back-up and load-shedding requirements below. Emergency internal lighting shall provide a minimum illumination of 30 lux at floor level and shall be evenly distributed in each passenger area of the Tram. The operation shall be independent from the overhead line power supply. Uniformity of illumination shall not be less than a factor of 0.4 Headroom throughout the seating areas shall be at least 2.1m to ceiling.

There shall be litter bins provided at each vestibule on both sides of the tram, each being able to be filled with typical soft drink cans. The litter bins shall be easily emptied.

All passenger areas of Trams shall be provided with a heating and ventilation system that maintains a constant acceptable ambient temperature during transit between Tram stops and during boarding and alighting at Tram stops when operating in all prevailing climatic and environmental conditions on the proposed route.

The arrangement of heating devices shall prevent excessive draughts caused by high airflow rates, due to the even warm air distribution inside the Tram. With the appropriate arrangement of the

vents, the air inside the Tram shall be heated and distributed over a large area through natural convection. Pockets of hot and cold air shall be avoided.

The interior of each Tram shall be fitted with reserved spaces for on-board advertising and passenger information notices. These spaces shall allow cardboard panels, 210mm deep, to fit snugly into retaining grooves. A clear smooth surface at least 160mm deep shall be available between the grooves to allow for the fixing of vinyls. There shall be a route map above the inside of every passenger doorway. The Infraco shall ensure that the Tram Supplier shall produce and fix all notices required by law or the Safety Management System, and fix free-issue logos, route maps and other notices, using appropriate materials and attachment methods, against a schedule which shall be agreed by **tie** on the mock-up.

Trams shall be fitted with racks close to the vestibule areas for holding information leaflets and newspapers. The arrangement and design of these racks is to be agreed by **tie** on the mock-up.

Two night partitions shall be provided which are fully retractable and can be securely stowed when not in use. These partitions shall be located adjacent to the articulations on either side of the wheelchair area towards the centre of the tram.

This night partition should be included in the mock-up.

The function of these partitions shall be to enable the rearmost portion of the tram to be securely locked out of use by the on-board inspector in order to enable him to more closely supervise the passengers in the forward portion of the tram whilst retaining the wheelchair facilities, as required by RVAR.

The partitions themselves shall be simple to operate by one person in the range of 5th percentile female to 95th percentile male. It shall be possible to lock the partitions in either the stowed or fully deployed position using a key which is carried by the on-board inspector as part of his normal duties. It shall be possible to deploy and stow the partition within 2 minutes. When deployed or stowed the partition shall be robust enough to withstand a person falling against it without sustaining damage.

A key operated control, located such that it may be conveniently operated by the on-board inspector with the partition deployed, from either side of the partition, shall cause the lights in the rearmost (isolated) portion of the tram to be reduced to emergency lighting levels, and disable the external door pushbuttons in order to prevent passengers accessing this portion of the tram. Under all circumstances the crew entry functionality at the single end doors shall remain operable and it shall be possible to operate the emergency door release throughout the tram. Additionally the Passenger

Emergency Communication Units shall remain active in all parts of the tram. The activation of the key operated control shall be indicated in the active driving cab but shall not cause a fault alarm.

In order to assist with the design the following information gives the anticipated normal method of operation.

At a terminus where the partition is to be put in place:

- The passenger doors will be opened in the normal way to allow passengers to exit and enter the tram (at this point they may board at any point in the tram);
- The driver will close and remove the enable command from all doors before closing down the cab and walk to the other cab;
- The on-board inspector will move any passengers in the area to be closed off to the portion of the tram forward of the partition;
- The inspector will then secure the partition in place and operate the key switch to deactivate the rearmost door controls and dim the lights;
- The driver will activate the forward cab and enable the doors for passenger boarding in the normal manner prior to departing.

Consideration should be given to providing an indication on the side passenger information displays to indicate to intending passengers that boarding is at the forward end of the tram only.

Tram loading will be uneven when the partition is deployed. The implications on load compensation in traction and braking control of the tram shall be considered and should continue to function appropriately when this condition is in force.

Interior ceiling and coving panels should be securely retained, so that they do not fall onto the maintainer when the catch is released. All interior panels should be small enough to be handled and lifted by one person unaided.

The interior livery shall be developed as part of the system identity and branding package and is to incorporate the features set out in the Design Guidelines. Typically this shall include the following factors:

- Paint finishes should use the same colours as for the exterior;
- GRP interior panels / door interiors / lower finisher trim for bonded glazing shall be Blue RAL 5005;
- Roof / coves / sides laminates shall be the same colour as Perstorp PP5650U Cezanne;
- Seats and wheelchair backrests shall be covered in Holdsworth Edinburgh Tartan – W218ET (including priority moquette);
- Driver's seat covering shall be Black hide material;
- Floor colours shall be as per Taraflex Luna NT Lewis (Taraflex Red BEF 53/01) and Taraflex Polaris NT Arran (Taraflex Blue BEF 33/01);
- Floor covering weld cord – Yellow;
- Seat backs shall be in Lothian Blue; and
- Hand rails and stanchions shall be in Red RAL 3020.

Passenger seats shall be of a similar style to the Grammar Pratico 2845 Low backrest, as currently deployed on Lothian Buses.

24.17 Bogies

The vehicle will have a minimum of 66% adhesive weight on motored axles.

The bogies shall be of proven design and have been used successfully in another Tram project.
The bogies will incorporate suspension systems to give a high-quality ride characteristic. The suspension system will be self-adjusting or adjustable for wheel wear so that ride heights can be closely maintained.

The ground clearance (from top of rail) fully laden with worn wheels shall not be less than 50mm to any part of the bogie structure except a track guard.

Each axle on the motor bogies will have a spring-applied friction brake. It shall be possible to release the spring-applied brake manually in the event of failure of the actuation system. Under normal operation the parking brake will release and apply automatically when the driver's controller is activated.

Each bogie shall have two electro-magnetic track-brakes, one suspended over each rail between the wheels.

The wheels shall incorporate resilience and damping in order to minimise noise and vibration. Tuned vibration absorbers will be fitted after carrying out tests to determine their most effective parameters.
Effective under-run protection arrangements shall be provided. The end bogies will carry adjustable track guards on their outer ends, to conform to Railway Safety Publication 2 – Guidance on Tramways, issued by the Office of the Rail Regulator requirements for under-run protection. The motor bogies will be interchangeable with each other.

Removal of components such as brake actuators, suspension units, etc. will be facilitated to allow on-site repair and replacement of major items such as motors or wheels to take place with the minimum of Tram down-time.

The ride comfort levels measured according to the ISO 2631 Standard on a ballasted straight and level track in good condition shall be no worse than:

Speed	Wz vertical	Wz lateral
40 km/h	2,32	1,58
70 km/h	2,96	2,36

Table 59 - Ride Comfort in the Driver's Cab

Speed	Wz vertical	Wz lateral
40 km/h	2,24	1,64
70 km/h	2,82	2,28

Table 60 - Ride Comfort in Passenger Compartment

At least two wheelsets of the Tram shall be equipped with flange lubrication equipment on all wheels. Both sides of the flange shall be lubricated. It shall be capable of being programmed to operate on the basis of either location, or of a time interval, or a combination of these.

24.18 Re-Railing

The Trams shall be capable of being returned to the running track in case of derailment with the minimum amount of equipment and in the shortest possible time. The Infraco ensure that the Tram Supplier shall indicate the best methods for re-railing and the equipment required, for all track forms used on the system.

If the Tram design includes suspended body sections, then articulation locks shall be procured by the Infraco from the Tram Supplier.

24.19 Propulsion Equipment

The Tram shall not export additional risk onto Network Rail infrastructure. In particular, the harmonic generation from the propulsion and control equipment shall not interfere with train-borne or trackside systems or other third party systems and infrastructure.

The traction equipment shall detect and automatically manage wheel slip and wheel slide, so as to maintain performance and stopping distances in all track conditions and without damage to the wheel treads. When slip or slide is detected sand will automatically be applied to the rails in front of the leading axle. Sanding must not take place due to spurious wheelslip/slide detected at flange running crossings, pointwork or sharply curved or transitional track. The traction equipment shall tolerate variations in wheel diameter.

The Trams will have the following performance when motoring, on straight and level track and with a nominal line voltage of 750V dc:

Speed (km/h)	Load	Performance	Notes
0 -> 30	Up to AW4	1.2 m/s^2	Instantaneous
0 -> 70	Up to AW4	0.8 m/s^2	Average

Table 61 - Tram Performance Levels

The effect of variation of the line voltage (within the prescribed system limits) on the Tram performance, shall be provided by the Tram Supplier on behalf of the Infraco. The maximum line current, and the conditions when it shall be demanded by the Tram, shall also be provided by the Tram Supplier on behalf of the Infraco.

The Trams shall provide safe operation on all gradients under degraded performance modes as imposed by the traction equipment. In particular, the Trams shall be able to complete any journey on the System with one complete traction drive unit isolated.

The traction and braking control system shall be optimised to provide smooth and low jerk values in starting from rest, acceleration, braking and stopping, on level track and on all gradients that are encountered, under all loading and environmental conditions, while protecting against unintended downhill movement.

The Tram may be fitted with a short-time rated emergency mode, with a higher tractive effort, to assist in recovering other Trams.

24.20 Braking Equipment

The Tram Braking Equipment shall be designed to comply with BS EN 13452 Part 1 except where stated below.

The service brake application shall be capable of retardation at an acceptable rate (as defined in Tables 3 and 4 of BS EN 13452 Part 1) at all specified laden conditions and the jerk rate shall be limited so as to not cause discomfort to standing passengers. The service brake shall normally consist of a regenerative electro-dynamic brake, (that as far as is practicable shall return the braking energy to the overhead line) and a friction brake. The electro-dynamic brake shall normally take precedence over the friction brake.

The regenerated voltage shall not exceed 900V. Should the overhead line become unreceptive, the braking energy shall be dissipated in naturally cooled resistors. Transition between regenerative and rheostatic modes shall be automatic, instantaneous and free from jerk. Braking distances and deceleration rates shall be unaffected by transitions during braking.

The brake resistors shall be protected from overheating. Malfunction of the dynamic brake system must be detected and recorded by the fault monitoring system.

Electro-dynamic and friction brakes shall be blended. In normal operation the friction brake will take over from the electric brake at a low speed. In addition, sand will be applied automatically during braking when triggered by the wheel slip/slide control system. Should the electro-dynamic brake be unavailable on any particular traction drive then the friction brake will be automatically applied to compensate, without jerk or loss of performance.

For emergency braking applications the jerk rate shall be limited without compromising emergency braking performance. The friction braking system should be capable of repeated full service or emergency brake applications.

The Tram parking brake shall be of sufficient performance for a Tram (whether laden or unladen) to hold without movement and for an indefinite period another unladen Tram without brakes on the steepest gradient on the Edinburgh Tram Network under all adhesion conditions.

The braking function and performance of the Tram shall be in accordance with Tables 3 and 4 of BS EN 13452 Part 1. The definitions of the braking modes given in these tables are as defined at Section 3.2 of the Standard.

When the Emergency brake is applied, the track brakes should be released immediately before the Tram comes to rest in order to minimise jerk to passengers.

All braking and jerk rates shall comply with the requirements defined in Standard EN 13452.

24.21 Run Time

The Trams will be capable of being operated continuously for twenty hours in each day.

A runtime simulation will be carried out by the Infraco to demonstrate the required end-to-end journey times. The Trams shall have sufficient performance and ratings to meet the requirements for these run times and end to end journey times. The inputs to the simulation shall be based on theoretical Tram performance validated by type test measurements with similar Trams in service elsewhere. The infrastructure and operational assumptions for the runtime shall include, but not be limited to:

- Alignment information, including speed restrictions due to geometry and sighting restrictions;
- Location of Tram stops and assumed dwell times;

- Speed restrictions due to the presence of pointwork;
- Service brake rates including agreed allowances for driver variation and technique, and varying adhesion conditions;
- Jerk rate and acceleration compliant with the requirements;
- Assumed delays due to operation in mixed traffic, which may be in the form of assumed speeds or time delays;
- Assumed delays due to the operation of the traffic-signal-controlled junctions, which may be in the form of assumed speeds or time delays;
- Tram loading;
- Wheel wear; and
- Traction system supply voltage.

24.22 High-Voltage Equipment

All Tram-borne high voltage equipment shall be adequately rated for operation at the line voltage. All high voltage equipment other than the pantograph will be securely enclosed in rigid, metal and earthed equipment cases.

The high-voltage sub-systems will be protected by high-speed circuit-breakers or fuses, which shall be enclosed so that their operation does not cause alarm or danger to persons standing near to the Tram. The length of electrically unprotected cabling between the pantograph and the protection devices shall be minimised.

Wherever feasible, there will be duplication of primary assemblies in order to minimise the potential for single-point failures. There will be a minimum of two self-contained traction groups, so that failure of a traction drive on one bogie does not immobilise the Tram.

24.23 Auxiliary Power Supply Systems

The auxiliary supply converter(s) shall start when fed from the overhead line, irrespective of the state of charge of the batteries.

The converter outputs for auxiliary supplies and battery charging derived from the overhead supply shall be isolated from the overhead supply to prevent any possibility of excessive voltages appearing on the low-voltage circuits.

The saloon heating units (if mounted in the saloon area) shall be provided with appropriate protection and insulation for the heating elements and their terminal connections.

The charging system for the batteries will be appropriate to the type and size of battery provided.

A suitable socket for connecting a 24V battery charging supply shall be provided.

The batteries shall be of a low maintenance type suitable for traction applications and enclosed in electrolyte-proof containers to contain environmental pollution in case of damage. There shall be absolutely no possibility of spillage from the batteries entering the passenger saloon or the cab. The battery enclosure shall be vented to prevent the build-up of gases.

In the event of loss of the 750V overhead supply, the batteries will allow all essential systems to operate for a minimum of thirty minutes. Certain critical functions will continue to operate for up to one hour from battery supply:

After ten minutes:

- The saloon lighting system shall revert to emergency lighting only.

For up to thirty minutes, the following systems shall remain in operation:

- Brake system;
- Public Address system ;
- Emergency lighting; and
- Door system.

For up to one hour the following systems shall remain operational:

- Pantograph;
- Minimum exterior lighting; and
- Radio communication system.

24.24 Faults and Diagnostic System

The Trams will have a condition and fault monitoring system integral with the vehicle control system, to give indication to the driver of the status of equipment and to allow control of degraded modes. Failures or events requiring maintenance intervention shall be recorded by an on-board system that shall retain all pertinent details after the Tram has been shut down, for downloading and analysis by maintenance staff. This system will have sufficient capacity to store such information at least for the interval between scheduled maintenance examinations, on a first-in, first-out basis. There shall be a visible indication that at least one day's worth of recording remains available.

The downloading of data shall be accomplished using a commonly available lap-top computer or related portable device. Any software or special equipment or licences required to download or analyse the data from the Trams shall be provided by the Tram Supplier.

The display for the driver shall also provide unambiguous information of the status of the Tram, and the severity of any faults present. In particular, the system shall continuously indicate one of the following fault states according to the condition of the Tram:

- Tram OK;
- Minor fault, report to control and continue;
- Major fault, report to control and continue in degraded mode;
- Major fault, Tram must be immediately taken out of service; and
- Major fault, Tram inoperative.

The Tram shall perform a self-check automatically whenever it is started up from a shut-down condition.

24.25 Sanding System

The Tram shall be equipped with a system, which deposits sand immediately ahead of the driven wheels in the direction of travel to rectify any poor adhesion conditions at the wheel/rail interface. The system shall be activated both automatically whenever wheelslip or wheelslide is detected, and manually when under control of the driver. Sand will also be automatically applied whenever the emergency or security brakes are used.

Sand shall be deposited on at least two locations on each rail per direction of travel. The rate of sand deposition shall be no more than that required to correct the poor adhesion. The automatic sanding system shall be inhibited when the Tram is stationary, unless activated manually. The sanding unit response time shall be effectively instantaneous.

The Tram-mounted sand boxes shall have sufficient capacity for a full day's service under all conditions of weather and loading.

The sand filler covers shall have seals to keep the sand content dry under all weather conditions, and when the vehicle is being washed.

A means of ascertaining the sand level in the sandboxes shall be provided, visible from within the Tram.

The Tram sandboxes shall be filled from outside of the Tram using a sand dispensing plant at the Depot. The sandbox arrangement will be compatible with the sand dispensing plant such that it is possible for the driver of the Tram to completely fill all the sandboxes in five minutes. In the event of failure of the plant, it shall also be possible to fill the sandboxes manually, and if any special equipment is required for this, the Infraco shall ensure that the Tram Supplier shall provide it.

24.26 Passenger Doors

The Tram will be equipped with at least four pairs of bi-parting sliding-plug doors, plus two single doors, on each side of the vehicle for the passenger saloon and one internal cab door per cab with a clear opening of not less than 610mm. The doors shall be equipped so that rainwater does not drip onto passengers when the doors are opened.

The passenger saloon doors shall be fitted on both sides of the vehicle in the low-floor area. The doors will be of the following characteristics:

- The double door clearance width shall not be less than: 1300 mm
- The double door clearance height shall not be less than: 2025 mm
- The closing force shall be: <200N
- The opening force shall be: <250N

The doors will be opened and closed by the driver or simply released by the driver so that the passengers will be able to open the doors themselves using door push buttons. The push buttons will be illuminated when they are activated. The doors shall stay open for a fixed time before closing automatically. A warning tone shall be sounded when the doors are released and a different tone shall sound to give warning of door closure.

Devices will be incorporated into the individual door control mechanisms, or in the leading edge of the door, to detect and protect against door obstruction. Slow or defective door mechanisms will be indicated to the driver by the vehicle fault management system. The driver shall be able to isolate any door by using the driver's key to operate an isolation switch local to each door. Such a door shall be secured from all forms of operation other than emergency release.

It shall be possible to open each door manually in case of emergency (including any door that has been isolated). An internal emergency handle will be provided at each door entrance. Operation of the handle shall cause an immediate application of the emergency brake and unlock the door such that it can then be moved open by hand after the vehicle is stationary. The emergency handle will only be able to be reset using the driver's key.

The door edges shall be fitted with weather-proof seals that are soft enough to allow a person's fingers to be withdrawn after the doors have closed. The seals shall be effective against all likely weather conditions and in the Tram washing plant and shall not offer a hand-hold to allow persons to ride on the outside of the Tram.

The Tram shall accept a door enable command from the driver when the Tram speed is below 10km/h, but the doors shall not become enabled until the Tram is at a standstill. If, having been enabled, the Tram speed then rises above 10km/h, the enable command shall automatically be cancelled.

The time from the Tram coming to rest to doors being fully open in response to a prompt passenger demand, plus the time from the driver pressing the door close button to the Tram moving off, shall be less than 12 seconds. This time shall include all necessary delays for RVAR-required tones. The doors themselves shall move from closed to fully open or vice versa in 3.5 seconds or less.

The door guidance mechanism shall not be a swing plug mechanism nor a folding door.

The following controls shall be fitted in each cab for driver control of the doors:

- Separate door-enable controls for the left and right sides. It must be possible to enable both sides simultaneously. The 'enable' buttons of the Tram should each be located on the appropriate side of the cab desk.
- One door 'open' button, which will open any doors previously enabled, but not opened by passengers, provided the Tram is at a stand still.
- One door 'close' button, which will close all doors that are open. This will be the normal mode of door closing at Tram stops other than termini.

- To prevent the doors being enabled on the wrong side, the door enable shall be interlocked and programmed with the correct side for the platform at each Tram stop along the route. This feature shall be capable of being over-ridden by the driver (for example, if the Tram uses an unusual platform at a terminus), but such over-ride shall require the driver to press at least one additional button, which shall not be located adjacent to the other door controls in the cab. It shall be possible to open all the doors when the Tram is in the Depot.

The door enabled indicator lights at the doors shall illuminate and the door enabled tone start, simultaneously with the door actually becoming available.

A door shall re-close automatically, with warning tone, if no obstacle is detected for twenty seconds (configurable). This will be the normal mode of door closing at termini.

When all doors are closed and traction is available, an audible signal, distinct from all other tones and quieter and less offensive than any alarm tone, shall sound in the cab in use. This is preferred to a lamp or other visual signal as the driver already has to view the platform and check ahead before moving off.

Unless a separate external cab door is provided, the door nearest each cab on each side (four doors in total) of the Tram shall be provided with local internal and external 'door open' and 'door close' switches operated by the driver's key. These shall be spring-loaded centre-off, turned one way to open and the other to close. Any door opened using a local switch shall be capable of being closed either using the appropriate local switch or the 'door close' button in any active cab. The purpose of these switches is to allow local control of the door by a driver who needs to leave and re-enter a passenger-carrying Tram, for example to operate points, at a place which is not a Tramstop. In addition, unless a separate cab door is provided, a separate control shall be provided in the cab to allow the Tram driver to open and close the nearside front passenger door separately from the cab. This is to allow the driver to open and close this door separately at the crew change halt at the Depot. An exterior emergency door release shall be incorporated to comply with the requirments of Railway Safety Publication 2,

The door-enabled tone required by Rail Vehicle Accessibility Regulations 1998 (as amended) shall be audible from both inside the Tram and on the platform. This may require an additional external sounder if, in order to be heard outside, the internal one is uncomfortably loud for passengers on the Tram.