



**Gemeente
Amsterdam**

Schedule of Requirements

**Delivery and maintenance of
traction power components for
tram and metro traction power
substations**

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1 Introduction

1.1 Purpose

The Asset Management department of GVB Rail Services (GVB Infra B.V.) manages approximately 85 active traction power substations that supply power to the overhead lines of the tram and that supply power to the third rail of the metro.

These traction power substations convert 10 kV alternating current of the public power network into 750 V direct current for metro and 600 V direct current for tram. With the exception of four, the traction power substations for tram are suitable for future conversion to 750 V.

The technical service life of the traction power installations is between 30 and 40 years. In the coming ten years, several traction power substations have to be fitted with new traction power installations as a result of reaching the end of the technical service life. These installations will exhibit more interruptions and breakdowns in the coming years, which will result in interruptions of GVB's public transport and additional maintenance and hiring costs.

In addition, several expansions of the tram and metro network are anticipated for the coming years. Several traction power substations to be newly constructed are anticipated for the power supply of the expansions, which will require new traction power installations.

The purpose of the replacement is: the continuation of the power supply for tram and metro. The traction power installations are in use during GVB's public transport operation from 5:00 in the morning to 1:30 at night. 24-hour operation does not yet exist at this time. Studies are being conducted into the feasibility of possible 24-hour operation for metro. 24-hour operation in the future should therefore be taken into account.

This document comprises all requirements imposed by GVB with respect to traction power installations and the traction power components that are applied in the installations. This document also includes procedural requirements imposed with respect to project management, the design, delivery and commissioning. For this purpose, this document refers to several underlying documents. figure 1 represents the coherence and hierarchy of the various documents.

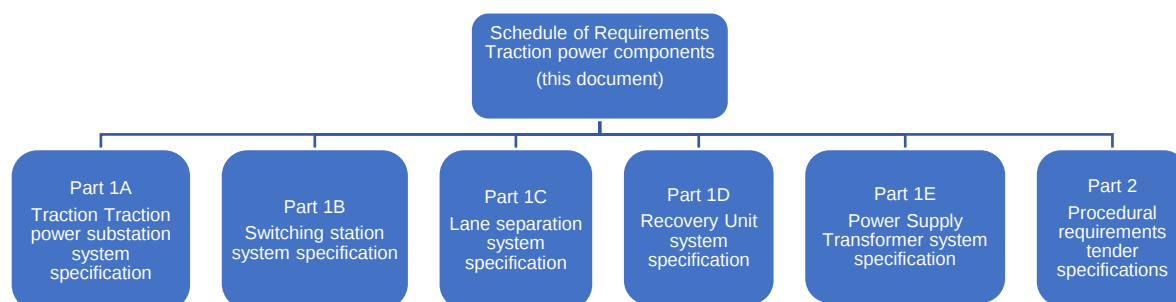


Figure 1 Hierarchy specification documents

1.2 Field of application

The traction power installations and the traction power components that make these installations must be suitable for providing tram and metro traction energy. It must be possible to deploy the traction power components in Amsterdam rail infrastructure area without any problems and they must be suitable for operation and reliable. They must satisfy all statutory requirements and standards and be safe for users and bystanders. In addition, the traction power components must satisfy the latest environmental requirements and rules, so that use results in the smallest possible environmental burden.

The traction power installations are used exclusively for the power supply of the regional area within the Vervoerregio Amsterdam. The traction power components must be or rendered suitable for this purpose.

1.3 Advisor

GVB Infra B.V. was advised by Arcadis Nederland B.V. when drawing up the technical specifications in this Schedule of Requirements. See for more information about the advisor: www.arcadis.nl

1.4 References

Reference	Description of the document	Version
1	Part 1A Traction Traction power substation system specification	8.1
2	Part 1B Switching Station system specification	5.1
3	Part 1C Track circuit breakers system specification	1.2
4	Part 1D Recovery Unit system specification	1.0
5	Part 1E Station Energy Supply Transformer system specification	1.0
6	Part 2 Procedural requirements tender specifications	1.0

1.5 Glossary

The abbreviations and terms used in this Schedule of Requirements have the following meaning:

Abbreviation or term	Meaning
BLVC	Accessibility, Livability, Safety and Communication
CAB	Central Remote Control
CBI	Central Control of installations
CO	Corrective Maintenance: for the purpose of remedying defects for example following the notification of a complaint, the discovery of an unauthorised person or a report of a breakdown by an installation that was generated automatically.

Abbreviation or term	Meaning
DD	Definitive Design
Requirement (E)	Requirement, the Contractor must demonstrate whether this wish is implemented.
Requirement with evidence (E-b)	Requirement with evidence, the Contractor must demonstrate whether the requirement is satisfied by means of the evidence requested
EN	European Standard
FAT	Factory Acceptance Test
FIT	Factory Integration Test
FD	Functional Design
GAO	Usage-dependent maintenance: preventative maintenance carried out on the basis of the use of an installation
GS	Traction power substation
HMI	Human Machine Interface
INS	Installer (The party contracted by the Client with ultimate responsibility for the construction of a traction power substation and/or assembly and commissioning of traction power components and/or traction power installation)
MTTF	Mean Time To Fail
MTTR	Mean Time To Repair
OG	The Client (GVB Infra B.V., Municipality of Amsterdam MET or Vervoerregio Amsterdam)
ON	The Contractor (Engineering and Components Supplier)
PO	Systematic Maintenance: for the purpose of preventing defects, performed in a structured manner over time based on a maintenance plan that was drawn up based on the use of the installation and adjusted regularly.
SA	Station Automation System
SAT	Site Acceptance Test
SCADA	Supervisory Control And Data Acquisition
SIT	Site Integration Test
TAO	State Dependent Maintenance

Abbreviation or term	Meaning
TI	For information purposes. This information or this document is provided for your information.
TO	Technical Design
UO	Implementation Design
VO	Preliminary Design

1.6 Tables of requirements

The requirements in this Schedule of Requirements are represented in accordance with the format in table 1.

ID Title of the requirement
Text of the requirement

Table 1 – Requirement format.

	:	Engineering and components supplier (is also indicated with the letter L in the requirement number).
	:	Delivery/Implementation Installer (also indicated with the letter I in the requirement number).
ID	:	Unique Requirement Number.
Title of the requirement	:	Brief description of the requirement with keywords.
Text of the requirement	:	Description of the requirement.

1.7 Unique requirement number

The unique Requirement Number consists of 9 characters, W-XX-YYY-ZZZ. The characters represent the following:

W	L or I	The requirement coding applies to the supplier (L) or the installer (I)
XX	M, T or MT	Coding requirement applies to M=Metro, T=Tram or MT=Metro and Tram
YYY	000-999	Coding for system group, see Table 2.
ZZZ	001-999	Coding of the requirement in the system group

Code system group YYY	Group name
000	General
001	Functionality
002	Test protocols
003	Single line diagram
004	Object Architecture
005	List of interfaces
006	Civil engineering Requirements/Designs
010	HVI
011	Metering
020	Traction Transformer
021	Own Company Transformer
022	Transformer power supply
030	Rectifier
031	Recovery Unit
040	GVI in general
041	GVI quick-switch
043	GVI Plus/minus separator
044	GVI Separator Recovery
045	Section switch installation (SSI)
046	Track separator
050	Low voltage general
051	Low-voltage switchgear
052	Low voltage UPS
060	Protection general
061	Protection HVI
062	Protection Traction Transformer
063	Protection EBI transformer
064	Protection Rectifier
065	Protection GVI
066	SSI locks
070	Cabling general

Code system group YYY	Group name
071	Cabling - cable ducts
072	Cabling - internal
073	Cabling - external
074	Cabling - fibreglass network
075	Cabling 61850
076	Connection CBI Metro
077	Connection CBI Tram
080	Control general
081	Control CBI Metro
082	Control CBI Tram
083	Operation HMI
084	Emergency outlet circuit
090	Building-related installations
091	Project management
092	Interface management
093	Design
094	Implementation
095	Testing
096	Verification/Validation
097	Delivery/Transfer
098	Training
099	Project control and Project support
100	Aftercare
101	Guarantee
102	Provision of parts
103	Service and maintenance

Table 2 – System group coding

2 Scope of the deliveries

2.1 Supply of components for traction power substations

L-MT-000-001 Scope delivery components traction power substations

The Contractor must be able to deliver at least the following components from table 3 of a traction power substation. The "Paragraph" column includes a reference to the paragraph in which the component in question is described in the document entitled Traction power substation System Specification [1]. The components must satisfy all requirements specified in the document entitled Traction power substation System Specification [1].

Description component	Paragraph
HVI (high-voltage distribution system)	4.3
Traction transformer	4.4
Traction Rectifier	4.5
Connection Recovery Unit	4.6
GVI (direct current switchgear system)	4.7
SSI (section switchgear)	4.8
Protection	4.9
Internal wiring	4.10
Control	4.11
Low-voltage power supply (including EBT (auxiliary transformer))	4.12
LVI (low-voltage distribution system)	4.13

Table 3 - Components of a traction power substation to be delivered

2.2 Delivery of components for traction power switchgear substations

L-MT-000-002 Scope delivery components traction power substations

The Contractor must be able to deliver at least the following components from table 4 of a traction power switchgear substation. The "Paragraph" column includes a reference to the paragraph in which the component in question is described in the document entitled Traction Power Switchgear Substation System Specification [2]. The components must satisfy all requirements specified in the document entitled Traction Power Switchgear Substation System Specification [2].

Description component	Paragraph
GVI (direct current switchgear system)	4.2
Protection	4.3
Internal wiring	4.4
Control	4.5
Low-voltage power supply	4.6
LVI (low-voltage distribution system)	4.7

Table 4 - Components of a switching station to be delivered

2.3 Deliveries of track circuit breakers

L-MT-000-003 Scope delivery track circuit breakers

The Contractor must be able to deliver track circuit breakers in accordance with the Track Circuit Breakers System Specification [3].

2.4 Deliveries of recovery units

L-MT-000-004 Scope delivery recovery units

The Contractor must be able to deliver recovery units in accordance with the Recovery Unit System Specification [4].

2.5 Delivery Station energy supply transformer

L-MT-000-005 Scope delivery Station energy supply transformer

The Contractor must be able to deliver transformers in accordance with the Station Energy Supply Transformer System Specification [5].

2.6 Delivery of a composition of components

L-MT-000-006 Scope delivery composition traction power substation

The Contractor must be able to deliver the components referred to in table 3 as a composition. When combining components, the Contractor guarantees the operation in accordance with the Traction power substation System Specification [1] in which connection the Client ensures that the following conditions are met:

1. The components are assembled, tested and commissioned by the Contractor in the prescribed manner;
2. The other components and parts of the traction power substation, which are not mentioned in table 3, exist or are delivered by third parties and satisfy the requirements of the Traction power substation System Specification [1].

L-MT-000-007 Scope delivery composition Traction Power Switchgear substation

The Contractor must be able to deliver the components referred to in table 4 as a composition. When combining components, the Contractor guarantees the operation in accordance with the Traction Power Switchgear Substation System Specification [2] in which connection the Client ensures that the following conditions are met:

1. The components are assembled, tested and commissioned by the Contractor in the prescribed manner;
2. The other components and parts of the traction power switchgear substation, which are not mentioned in table 4, exist or are delivered by third parties and satisfy the requirements of the Traction Power Switchgear Substation System Specification [2].

2.7 Variants of compositions of components

L-MT-000-008 Variants of compositions of components

Various types of traction power substations are in use in the metro and tram systems, these traction power substations differ as regards the number of traction groups (transformer-rectifier composition), the power per traction group, the number of high speed circuit breaker fields and the number of outbound sections. Differ variants will be constructed for the new traction power substations as well. The Contractor must be able to deliver all variants as a composition.

At this time, no traction power switchgear substations are applied for tram and metro. Switchgear Substations may be applied in the future. Switchgear substations only differ as regards the number of high speed circuit breaker fields. The Contractor must be able to deliver compositions for switchgear substations in which connection the number of high speed circuit breaker fields varies from 4 fields to 8 fields.

L-M-000-009 Variants of compositions of components metro

As regards metro, these are the variants referred to in table 5. If the HVI is not fitted with ring fields, the HVI must be prepared for the addition of ring fields in the future. The number of high speed circuit breaker fields and the number of outbound sections is flexible per variant. Each variant must be prepared for the connection and integration of a recovery unit and it must be possible to deliver them with and without a recovery unit.

Variant	Number of inbound 10 kV traction fields	Number 10 kV ring fields	Number of traction groups	Power per traction group (MVA)	Number of high speed circuit breaker fields	Number of outbound sections
1a	1	optional	1	2.5	4 up to and including 8	4 up to and including 12
1b	0	2	1	2.5	4 up to and including 8	4 up to and including 12
2a	1	optional	2	2.5	4 up to and including 8	4 up to and including 12
2b	0	2	2	2.5	4 up to and including 8	4 up to and including 12
3a	1	optional	3	2.5	4 up to and including 8	4 up to and including 12
3b	0	2	3	2.5	4 up to and including 8	4 up to and including 12
4a	1	optional	3	1.6	4 up to and including 8	4 up to and including 12
4b	0	2	3	1.6	4 up to and including 8	4 up to and including 12
5a	1	optional	1	3.15	4 up to and including 8	4 up to and including 12
5b	0	2	1	3.15	4 up to and including 8	4 up to and including 12
6	0	0	0	0	4 up to and including 8	4 up to and including 8

Table 5 - Variants of compositions of metro traction power substations

L-T-000-010 Variants of compositions of components tram

As regards tram, these are the variants referred to in table 6. The HVI of the tram traction power substations always have an inbound traction field from the network manager. No 10 kV ring fields are used for trams. The number of high speed circuit breaker fields is flexible, no section switches are used for trams.

Variant	Number of traction groups	Power per traction group (MVA)	Number of high speed circuit breaker fields
1	1	1.6	2 up to and including 5
2	1	2.0	2 up to and including 5
3	2	1.0	2 up to and including 5
4	2	2.0	2 up to and including 5

Table 6 - Variants of compositions of tram traction power substations

2.8 Design activities in case of delivery of individual components

L-MT-000-011 Design activities individual components

Design responsibility lies entirely with the Contractor in case of the delivery of individual components. The design, the design activities and the verification must satisfy the requirements from part 1 of the tender specifications [1], [2], [3], [4] and [5] as well as part 2 [6]. The selectivity study for protection (paragraph 3.1.8 of [1], paragraph 3.1.2 of [2]) does not have to be performed.

2.9 Design activities when delivering a composition of components

L-MT-000-012 Design activities composition of components

Design responsibility concerning the composition lies entirely with the Contractor in case of the delivery of a composition of components. The design, the design activities and the verification must satisfy the requirements from part 1 of the tender specifications [1], [2], [3], [4] and [5] as well as part 2 [6].

L-MT-000-013 Selectivity study

The selectivity study for protection (paragraph 4.9.1 of [1], paragraph 4.3.1 of [2]) has to be performed optionally by the Contractor. It must be specified separately in the price list.

L-MT-000-014 Dimensioning components outside the scope of the delivery

The dimensioning of components that are not part of the scope of the Contractor's delivery, but which do have an impact on the correct operation of the components that are part of the scope of the Contractor's delivery, is also part of the design. In the event additional requirements are imposed when compared to the tender specifications in respect of components that are not part of the scope of the Contractor's delivery, the Contractor will be obliged to indicate this. The Contract is required to substantiate these additional requirements with design documents and/or standards.

L-MT-000-015 Design control installation and the components to be connected out of scope

The dimensioning of the control installation must take account of both the components that are part of the scope of the Contractor as well as components that are not part of the Contractor's scope and that must be connected to the control installation. If this requires documentation concerning these components, the Contractor will be required to request this documentation from the supplier of the components in time. At the request of the Contractor, the Client will be obliged to deliver the contact details of the suppliers of these components.

2.10 Testing activities when delivering a composition of components

L-MT-000-016 Testing activities composition of components

Responsibility for testing the composition lies entirely with the Contractor in case of the delivery of a composition of components. The Contractor is obliged to draw up a test plan for all testing up to and including the FAT of the individual components. The components in table 7 must also be tested as a composition during the FAT.

The Contractor is required to indicate for the SAT, the SIT and the short-circuit tests which specific tests are required and what requirements are imposed in this respect. The SAT, the SIT and the short-circuit testing are carried out by the installer of the traction power substation. The Contractor will be allowed to attend these tests.

	HVI	Traction transformer	Traction Rectifier	Connection Recovery Unit	GVI	SSI	Protection	Internal wiring	Control	Low-voltage power supply	LVI	Recovery Unit
HVI												
Traction transformer			x									
Traction Rectifier		x										x
Connection Recovery Unit					x	x	x	x	x			
GVI				x		x	x	x	x			
SSI				x	x		x	x	x			
Protection				x	x	x		x	x			
Internal wiring				x	x	x	x		x			
Control				x	x	x	x	x				
Low-voltage power supply											x	
LVI										x		
Recovery Unit			x									

Table 7 - Components to be tested as a composition during the FAT

3 List of requirements

L-MT-000-001	Scope delivery components traction power substations	10
L-MT-000-002	Scope delivery components traction power substations	10
L-MT-000-003	Scope delivery track circuit breakers	11
L-MT-000-004	Scope delivery recovery units.....	11
L-MT-000-005	Scope delivery Station energy supply transformer	11
L-MT-000-006	Scope delivery composition traction power substation	11
L-MT-000-007	Scope delivery composition Traction Power Switchgear substation	12
L-MT-000-008	Variants of compositions of components.....	12
L-M-000-009	Variants of compositions of components metro.....	12
L-T-000-010	Variants of compositions of components tram	13
L-MT-000-011	Design activities individual components	14
L-MT-000-012	Design activities composition of components	14
L-MT-000-013	Selectivity study	14
L-MT-000-014	Dimensioning components outside the scope of the delivery	14
L-MT-000-015	Design control installation and the components to be connected out of scope 14	
L-MT-000-016	Testing activities composition of components	15