EMMETT GREEN ENGINEERING B.V.
Kanaalweg 4
2628 EB Delft
KVK 77003055
NL25 INGB 0008 0942 02
vanblijswijk@emmettgreen.nl
www.engineering.emmettgreen.nl

Technical Specifications - High voltage skids – and Design

Lageland 110kV

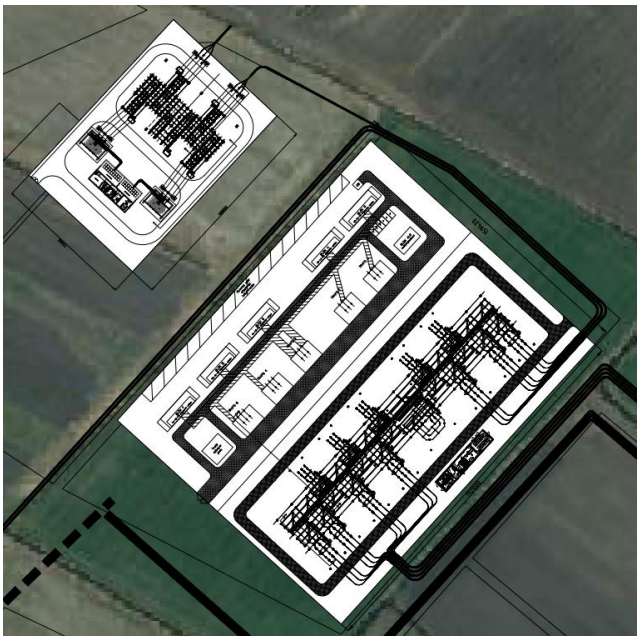
CUSTOMER NUMBER	0160
STATUS	Definitief
VERSION	V2.0
DATE	14-9-2026

	NAME	FUNCTION	SIGNATURE & DATE
AUTHOR	Evangelia Basdani	Project Engineer	Digitally signed by Evelina Basdani Date: 14-Sep-26
REVIEWER	Simon Sorgedrager	Lead Engineer	Digitally signed by S. Sorgedrager Date: 14-Sep-26
APPROVER	Ewout Hietkamp	Technisch manager	Digitaal ondertekend door Ewout Hietkamp Datum: 14.09.2026

Contents

1. Introduction

This working package describes the tender specifications for the High-Voltage SKIDS to be used on project Lageland. The Lageland project comprises the construction of a new 110/33 kV Air Insulated Substation (AIS) located in Meerstad Groningen, the Netherlands, commissioned by Energie Bedrijf Groningen. This substation is located next to a 110 kV substation of TenneT and will have a 110 kV cable connection to this substation. The Lageland substation will also have a 110 kV cable connection to a client, and two 110/33 kV power transformers. The switchyard for this station will comprise two cable bays, two transformer bays and one coupler bay. This working package covers the equipment associated with one cable bay, one transformer bay and one coupler bay.



This document defines the technical requirements of the public tender which entails the design, manufacturing, testing, documentation, delivery and commissioning of the interchangeable high-voltage skid assemblies and associated equipment required for the project. It establishes the minimum technical requirements to ensure a standardized, interchangeable and reliable skid solution that can be consistently evaluated by all suppliers.

The interchangeable skid assemblies are prefabricated modular units that support high-voltage equipment on a purpose-built foundation, simplifying transportation, installation and future maintenance.

The scope of supply includes CT-VS skids, disconnector skids, pantograph switch skids, pantograph earthing switch skids, field and rail gantries, and associated combination cabinets and all required mechanical, electrical and control interfaces necessary for a complete and operational installation. The equipment shall be suitable for outdoor installation in a 110 kV AIS substation and shall ensure safe, reliable and maintainable operation throughout the specified design life of the installation.

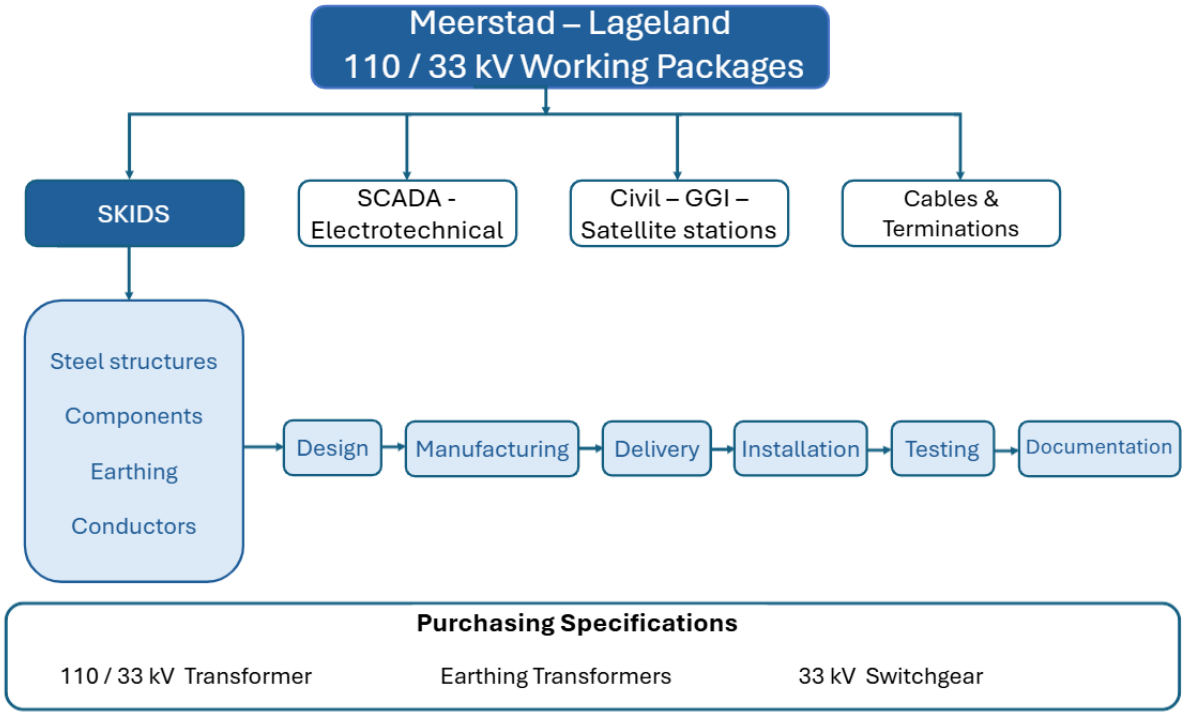
Unless otherwise specified, all equipment shall comply with the applicable IEC standards, project technical requirements and environmental conditions specified in this document.

Changes made within version 2 are colored orange.

1.1. Project scope overview

The realization of the project is divided into multiple disciplines, each of which will be appointed through a public tendering process.

The working packages describe a combination of designing, purchasing, interfacing, delivery, installation and testing of the different components within the scope. Bidders on these tenders are required to supply Energie Bedrijf Groningen (EBG) with the required designs, documentation, calculations, planning and realization plans to guarantee successful completion of the project. The purchasing specification documents describe the specifications which the components need to have. Interfaces between the different working packages and purchased electrical installations will be managed by EBG and Emmett Green Engineering (EGE).



1.2. Introduction

To facilitate the installation, maintenance and future replacement of high-voltage equipment, the substation is based on a modular skid concept. In this concept, the primary high-voltage equipment is mounted on steel support structures (skids) that can be removed from the switchyard as complete assemblies and transported for maintenance or replacement.

Each skid is installed on two reinforced concrete foundation rails located on either side of the bay and is securely fastened during normal operation. The skid is designed to be lifted from underneath by means of a dedicated transport cart (SPMT), allowing the complete assembly, including the mounted high-voltage equipment, to be safely removed and replaced with minimal interruption to the substation operation.

The Supplier shall prepare, if needed the required fabrication and installation drawings based on the Contract Design. Any deviation from the Contract Design shall require prior approval by EGE and EBG.

1.3. General Technical Specifications

Parameter	**Value**
Installation	Outdoor
Ambient Temperature	-25°C to 40°C
Relative Humidity	40%-100%
Ice Load	10mm
Wind Load	770 N/m^2
Altitude	≤1000m
Pollution Level	Class “e”
Air velocity	25m/s
Design Life	≥ 40 years
Grid Connection Voltage	110 kV
Maximum System Voltage HV	123 kV
Rated Frequency	50 Hz
Initial Symmetrical Short-Circuit Current	40 kA/1s
Peak Short-Circuit Current	100 kA
Lightning Impulse Withstand Voltage (LIWV)	550 kV
Power Frequency Withstand Voltage	230 kV

2. Scope of Supply

The Supplier's scope includes the Purchasing of components, assembly and/or production, testing and complete site installation of all SKIDS including primary connections and pulling rods, Field Gantries, Rail Gantries, busbar rails including Clamps, Secondary panels and cabling and associated equipment and connections. The Supplier shall coordinate these activities with the Station Contractor and shall comply with the applicable project Coordination Agreement, site planning, logistics and interface requirements.

The scope of supply includes the manufacture, testing, documentation, delivery and commissioning support of the following high-voltage equipment and associated accessories for the 110 kV AIS substation:

Skid Structures:

- CT-VS SKID
- Pantograph Earthing Switch SKID
- Pantograph Switch SKID
- Disconnector SKID

Steel Structures:

- Field Gantry
- Rail Gantry

Earthing Equipment:

- Earthing Rail
- Earthing Equipment

Primary equipment:

- CT-VS
- Pantograph
- Disconnector
- Circuit Breaker

Secondary Equipment:

- Combination Cabinet (Combikast)

Conductors and Connections:

- Conductors
- Clamps
- Rail
- Pulling rods

The supply of all primary high-voltage equipment identified in this specification and the Contract Design is mandatory and shall be fully included in the Tender Price. Omissions, exclusions or assumptions that such equipment will be supplied by the Employer shall be considered a non-compliant Tender unless explicitly accepted by the Employer.

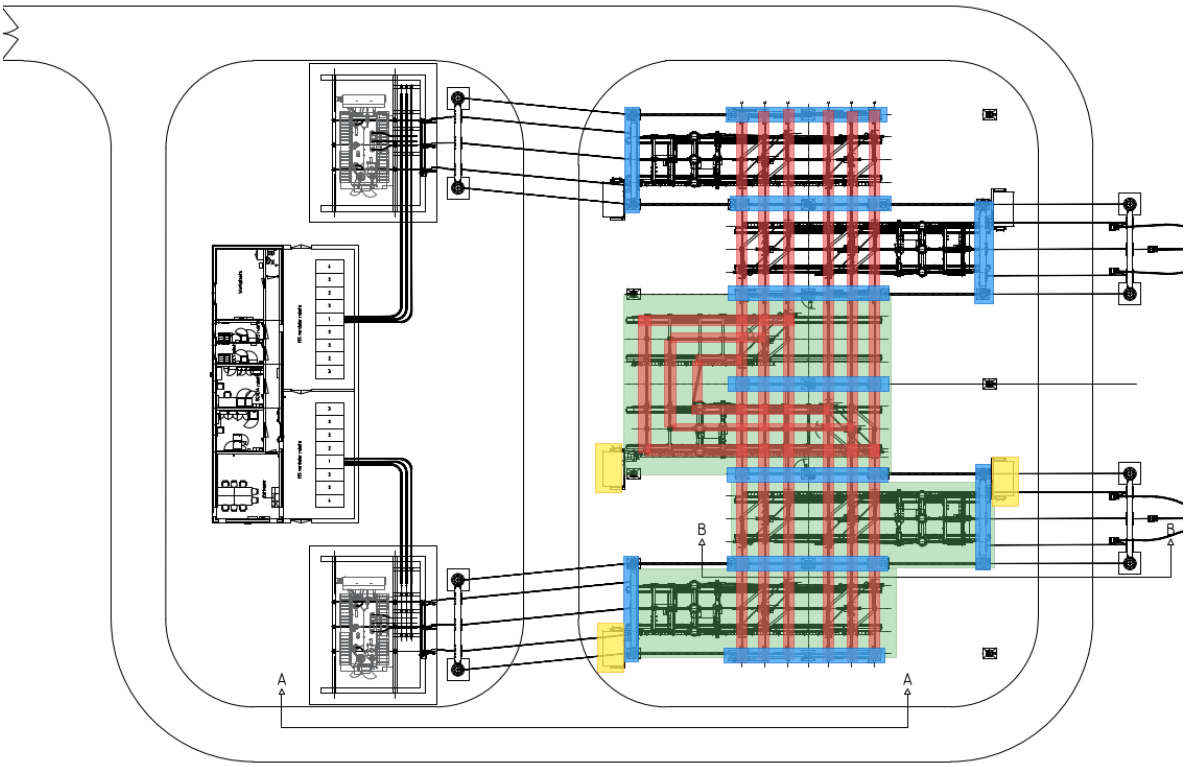


Figure 1 Indicative 110 kV AIS substation layout

Colour	Description
Green	Transformer, Cable and Coupler Bays
Red	Busbars/Rails
Blue	Field and Rail Gantries
Yellow	Combination Cabinets

The colour coding is for illustration purposes only and is used to clearly identify the scope of supply.

Figure 1 provides an indicative overview of the 110 kV AIS substation layout and highlights the equipment included within the scope of this working package.

The scope comprises one transformer bay, one cable bay and one coupler bay, together with the associated busbars, field and rail gantries, and combination cabinets, as highlighted in Figure 1.

The equipment associated with each bay type is summarized in the tables below. Quantities are specified per bay and are subsequently consolidated into the total equipment required within the scope of supply.

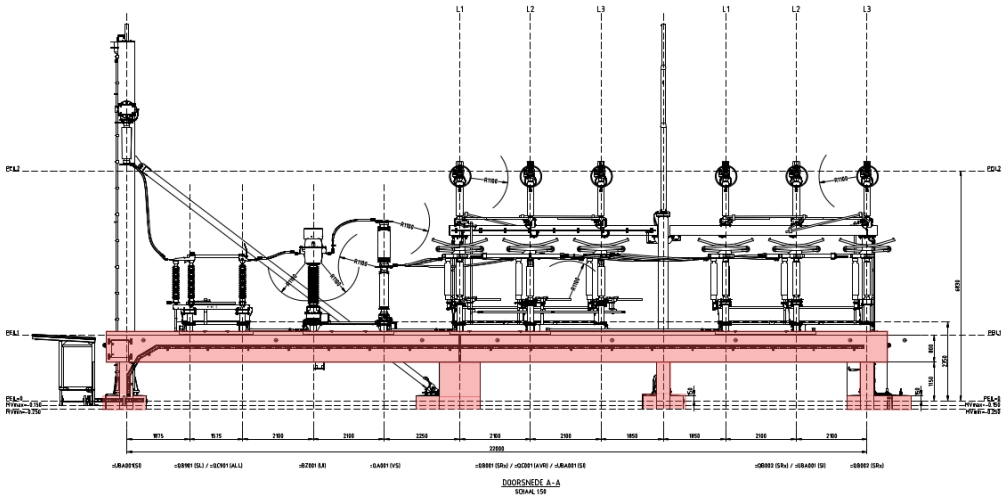


Figure 2. Overview of the High Voltage Components

Figure 2 provides an indicative side elevation of a typical bay arrangement. The equipment included within the scope of this working package is shown in its operational position, while the elements highlighted in red are provided for reference only and are outside the scope of supply. The figure is intended to illustrate the interfaces between the supplied equipment and the remaining substation infrastructure.

The 110 kV AIS substation consists of the following bays:

Bay Type	**Quantity**
Transformer Bay	1
Cable Bay	1
Coupler Bay	1

Each bay shall be equipped with the associated primary equipment, supporting steel structures, conductors, earthing provisions and control interfaces required for operation of the substation.

Equipment per Transformer Bay

Component	**Quantity**
CT-VS Skid	1
Pantograph Switch Skid incl. counter contact	1
Pantograph Earthing Switch Skid incl. counter contact	1
Disconnector Skid	1
Field Gantry	1
Combikast	1
Secondary cabling (set)	1
Primairy connections between SKIDs (set)	1
Puling rods (set)	1

Equipment per Cable Bay

Component	Quantity
CT-VS Skid	1
Pantograph Switch Skid incl. counter contact	1
Pantograph Earthing Switch Skid incl. counter contact	1
Disconnector Skid	1
Field Gantry	1
Combikast	1
Secondary cabling (set)	1
Primairy connections between SKIDs (set)	1
Puling rods (set)	1

Equipment per Coupler Bay

Component	Quantity
CT-VS Skid	1
Pantograph Switch Skid incl. counter contact	-
Pantograph Earthing Switch Skid incl. counter contact	2
Disconnector Skid	-
Field Gantry	-
Combikast	1
Secondary cabling (set)	1
Primairy connections between SKIDs (set)	1
Puling rods (set)	1

The supplier shall provide all equipment, interfaces, auxiliary components, mounting hardware, conductors, connections and accessories required for a complete and operational installation. Unless otherwise specified, all equipment shall be designed and supplied as an integrated system suitable for the specified electrical and environmental conditions.

3. Main components

Component	Description
CT-VS Skid	Complete skid assembly including current transformers, voltage transformers, support structure and accessories
Pantograph Switch Skid	Complete skid assembly including pantograph switch, support insulators, operating mechanism and steel support structure
Pantograph Earthing Switch Skid	Complete skid assembly including pantograph earthing switch, support insulators, operating mechanism and steel support structure
Disconnector Skid	Complete skid assembly including disconnectors, support insulators, operating mechanisms and steel support structure
Field Gantry	Complete steel gantry structure including columns, beams, connection hardware, grounding provisions and associated steelwork
Rail Gantry	Structural steel gantry supporting the rail conductor system, associated insulators and connection hardware.
Rail with Earther	Rail conductor assembly including earthing switch, support insulators, operating mechanism and associated connection hardware
Combination Cabinet	Local control cabinet
VT Panel	Secondary termination panel for the voltage transformer circuits

4. Standards

Unless otherwise specified in this document, all equipment shall comply with the requirements of the applicable IEC standards, relevant national and European standards, and project-specific technical specifications. The latest editions of all standards in force at the time of tendering or contract award shall apply.

As a minimum, the equipment shall comply with the following standards:

Standard	**Title**
IEC 60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V.
IEC 60815	Guide for the selection and dimensioning of high-voltage insulators for polluted conditions.
IEC 60168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 kV.
IEC 62271-1	High-voltage switchgear and controlgear – Common specifications.
IEC 62271-102	High-voltage switchgear and controlgear – Alternating current disconnectors and earthing switches.
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60068	Environmental testing
NEN 1010	Safety provisions for low-voltage electrical installations
IEC 61439	Low-voltage switchgear and controlgear assemblies
Project Specifications	Project-specific technical requirements and employer specifications

5. Requirements

5.1. Steel Requirements

The steel structures shall be designed, manufactured, tested, and delivered in accordance with the latest applicable European standards for structural steelwork, welding, corrosion protection, and quality assurance.

Materials

- Structural steel shall be minimum grade **S355**.
- Hollow sections shall be manufactured from structural steel suitable for load-bearing applications.
- Minimum plate thickness shall be **6 mm**.
- Minimum profile dimensions shall be **50 × 50 × 5 mm**.
- All materials shall be free from defects, laminations, cracks, and other imperfections.
- Material certificates according to **EN 10204 Type 3.1** shall be provided for all structural steel components.

Design and Construction

- The supplier shall be responsible for all detailed design calculations and fabrication drawings.
- Structural design shall account for all operational, environmental, transport, installation, and maintenance loads.
- Anchor bolts shall be minimum **M24** unless otherwise justified by design calculations.
- Structures shall be designed to prevent the accumulation of water and allow adequate drainage.
- All components shall be permanently marked to ensure traceability throughout fabrication, transport, installation, and operation.

Bolted Connections

- Minimum bolt diameter shall be **M12**.
- Bolts, nuts, and washers shall be suitable for structural applications and comply with the relevant European standards.
- Structural bolts shall be hot-dip galvanized and minimum property class **8.8**.
- Stainless steel fasteners shall be used for grounding and earthing connections.
- Bolted connections requiring preload shall be installed using controlled tightening procedures.

Welding

- Welding shall be carried out by qualified welders using approved welding procedures.
- Welding procedures and welder qualifications shall comply with applicable European standards.
- Welds shall be continuous, free from cracks, porosity, undercut, and other defects.
- Welded assemblies shall be designed and fabricated to facilitate corrosion protection and prevent moisture ingress.
- Non-destructive testing shall be performed where required to verify weld quality.

Fabrication

- Cutting, drilling, forming, and machining operations shall be carried out using controlled processes to avoid damage to the material.
- Burrs, sharp edges, and surface defects shall be removed.
- Dimensional tolerances shall comply with applicable European standards for structural steelwork.
- Fabricated structures shall be delivered free from distortion and with all interfaces correctly aligned.

Corrosion Protection

- All steelworks shall be **hot-dip galvanized** after fabrication.
- The galvanizing process shall comply with **EN ISO 1461**.
- The minimum local zinc coating thickness shall be **50 µm**, with an average coating thickness of at least **70 µm**.
- Where specified, a duplex coating system (galvanizing plus paint coating) shall be applied to provide enhanced corrosion protection.
- Damaged coating systems shall be repaired using approved repair methods.

Inspection and Quality Assurance

- The supplier shall maintain a documented quality management system covering design, procurement, fabrication, inspection, testing, and delivery.
- Full traceability of materials and components shall be maintained throughout the manufacturing process.
- Inspection and test records shall be available for review upon request.
- The purchaser reserves the right to witness inspections, audits, and acceptance tests.

5.2. Technical Requirements

All SKIDS, panels, primary equipment and IEDs shall be executed in accordance with the Contract Design. Alternative manufacturers or equipment types are only permitted following prior written technical approval by EBG. The Supplier shall provide full technical documentation, datasheets, type-test information, dimensions and interface data and shall demonstrate that the alternative has no adverse effect on selectivity, insulation coordination, mechanical interfaces, maintainability, spare-parts strategy or reliability.

Electrical Requirements

- All equipment shall be suitable for operation in a 110 kV AIS substation and shall comply with the technical data specified in Section 1.1.
- The equipment shall be designed for a maximum system voltage of 123 kV and a rated frequency of 50 Hz.
- The equipment shall withstand the specified short-circuit current of 40 kA for 1 second and a peak short-circuit current of 96.44 kA.
- The equipment shall comply with the specified insulation levels, including a Lightning Impulse Withstand Voltage (LIWV) of 550 kV and a Power Frequency Withstand Voltage of 230 kV.
- All electrical connections should ensure reliable operation under normal and fault-conditions.

Mechanical Requirements

- All equipment shall be designed to withstand mechanical loads occurring during transportation, installation, operation and maintenance.
- The equipment shall withstand wind loads, ice loads and temperature variations specified in Section 1.1.
- All structures and components shall maintain their mechanical integrity throughout the specified service life.
- Equipment should be designed to facilitate safe installation, inspection and maintenance.

Environmental Requirements

- All equipment shall be suitable for permanent outdoor installation.
- The equipment shall operate reliably under the ambient temperature, humidity, pollution level and altitude specified in Section 1.1.
- All metallic parts shall be protected against corrosion by means of hot-dip galvanization or an equivalent approved protection system.
- Earthing connections should ensure personnel safety and reliable operation of the installation.

Documentation Requirements

- The supplier shall provide all relevant documentation required for engineering, installation, operation and maintenance of the supplied equipment.
- Documentation shall include, where applicable, general arrangement drawings, datasheets, installation instructions, operating manuals, test certificates and inspection records.
- All drawings and documentation shall be submitted in English.

Quality Requirements

- All equipment shall be manufactured under a documented quality management system.
- Inspection and test records shall be available for review upon request.
- The purchaser reserves the right to witness inspections, audits and acceptance tests.

5.3. Earthing Requirements

All metallic structures, support frames, cabinets and equipment shall be connected to the substation earthing system. All earthing conductors shall be Aluminum and shall be provided by the supplier, together with all connections and interfaces required for the safe operation of the supplied equipment. The earthing system shall be designed to withstand the specified short-circuit current.

All metallic components shall be provided with suitable earthing connection points for connection to the substation earthing system. Each component shall be provided with at least one dedicated earthing point. Where required for reliability or accessibility, two earthing points shall be provided. The earthing connection surface shall remain free from paint or other non-conductive coating at the actual connection interface.

5.4. Conductors

Conductors are used for the electrical interconnection of the primary equipment within the 110 kV AIS substation. The conductor arrangement shall be based on the Contract Design. During the UO phase, the Supplier shall verify dimensions and complete the fabrication and installation details. Alternatives are only permitted following prior approval by EGE and EBG.

- Conductors shall be suitable for the system voltage and insulation levels specified in Section 1.1.
- Conductors shall be capable of carrying the specified continuous current and short-circuit current.
- Conductors and associated fittings shall be suitable for outdoor installation and environmental conditions specified in Section 1.1.
- All conductor connections shall provide reliable electrical and mechanical performance throughout the specified service life.
- All conductor connections and fittings shall be corrosion resistant and suitable for long-term outdoor operation.
- Suppliers of the conductors are free to offer different or alternative conductors, if they can present a good foundation for such choices.

5.5. Coating / Lifetime / Corrosion prevention

All exposed steel structures, supports, gantries and associated metallic components shall be protected against corrosion by means of a hot-dip galvanized coating system or an approved equivalent protection system.

Where a paint coating system is applied, all visible equipment shall be finished in a uniform RAL colour to be agreed during the detailed design phase.

The complete corrosion protection system shall be suitable for a corrosivity category C5 environment and shall provide a durability class VH (Very High) in accordance with ISO 12944.

The corrosion protection system shall be selected to support the specified design life of the installation and minimise maintenance requirements throughout lifetime operation of 40 years or more.

Component	**Required surface treatment**
Steel structures of all SKIDS	Hot-dip galvanised in accordance with EN ISO 1461
Field Gantries	Hot-dip galvanised in accordance with EN ISO 1461
Rail Gantries / Rail Gantries with Earther	Hot-dip galvanised in accordance with EN ISO 1461
Structural brackets, supports and associated carbon-steel parts	Hot-dip galvanised in accordance with EN ISO 1461
Structural bolts, nuts and washers	Hot-dip galvanised
Earthing and bonding fasteners	Stainless steel
Combination Cabinets (A200) and secondary cabinets	Coated, suitable for ISO 12944 corrosivity category C5 and durability class VH
Aluminium conductors, rails and clamps	No coating required; corrosion-resistant material suitable for outdoor use
Electrical and earthing contact surfaces	Free from paint or other non-conductive coatings

Hot-dip galvanised components shall comply with the coating thickness requirements specified in Section 5.1. Coated cabinets shall be suitable for corrosivity category C5 and durability class VH in accordance with ISO 12944. The final RAL colour shall be specified by EGE/EBG. Any deviation from the surface treatments specified above requires prior written approval by EGE and EBG.

5.6. Factory Acceptance Test (FAT)

The supplier shall perform Factory Acceptance Test (FAT) on the supplied equipment prior to delivery. The purpose of the FAT is to verify compliance with the requirements of this specification and to confirm that the equipment has been manufactured correctly.

The FAT scope shall include:

- Visual inspection
- Verification of dimensions and interfaces
- Verification of material certificates
- Verification of coating and corrosion protection systems
- Review of manufacturing and inspection records.
- Any routine tests required by the applicable IEC standards.
- Accepted FAT report of original equipment manufacturer (OEM).

FAT reports shall be submitted to the purchaser for review.

5.7. Site Acceptance Test (SAT)

Following installation, the supplied equipment shall be subject to a Site Acceptance Test (SAT). The purpose of the SAT is to verify correct installation, calibration and commissioning of the components.

The SAT shall include:

- Visual inspection of the installed equipment
- Verification of earthing and bonding connections
- Verifications of mechanical assembly and interfaces
- Verification of secondary wiring and cabinet interfaces where applicable.
- Verification of equipment identification labels
- Calibration of electrical components
- Functional checks of operating mechanisms and associated equipment.

SAT reports shall be submitted to the purchaser for acceptance.

6. Reference drawings

To support the understanding of the equipment specified in this document, a package of reference drawings is provided in Appendix B.

The reference drawings illustrate the general arrangement, principal interfaces and typical structural configuration of the interchangeable skid assemblies. They are intended to support the interpretation of this specification during the tendering and design stages.

The drawings package includes:

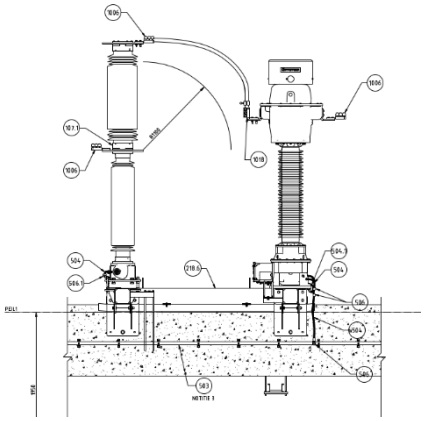
- Assembly drawings
- Steel drawings

The supplied drawings form the Contract Design shall be the basis for manufacture and installation. The UO phase is intended for verification, coordination and completion of fabrication and installation details only. Changes or optimisations to the Contract Design are only permitted following prior written approval by EBG.

7. The Skids

7.1. CT-VS Skid

A **CT-VS skid** is a modular assembly consisting of a steel support structure on which a circuit breaker and a combined current transformer/voltage sensor unit are mounted. Depending on the type of feeder bay such as a transformer bay, line/cable bay, or bus coupler bay different components may be installed on the skid. The skid shall be designed for modular removal and replacement and shall be delivered as a complete assembly with all conductors and associated components fully installed.



A **CT-VS skid** consists of a structural steel frame, grounding provisions, and the associated electrical and instrumentation components.

7.1.1. Steel

The steel drawings in Appendix B form the design basis. During the UO phase the Supplier shall complete the fabrication drawings based on this design. The steel structure shall comply with the requirements specified in Chapter 5 and shall provide the required support for the associated equipment.

All the CTVS skids, should have the same steel. Only the components per skid can be different.

7.1.2. Primary components.

The primary components for each bay type are provided in Appendix A. The manufacturer may propose equivalent components, provided they comply with the requirements of this specification. The proposed components, including the relevant technical documentation and datasheets, shall be submitted as part of the tender offer for evaluation and approval.

7.1.3. Earthing

The skid, its metallic frame, the panel and all exposed conductive parts shall be connected to the station earth grid. The earthing system shall be designed based on the short-circuit current specified in the introduction.

7.1.4. Secondary cabinets

The CT-VS Skid interfaces with the secondary system through dedicated Current Transformer (CT) and Voltage Transformer (VT) cabinets. These cabinets provide the termination and distribution of the secondary circuits from the instrument transformers and act as the interface between the primary equipment and the station protection, control and monitoring systems.

The required cabinet configuration depends on the functional requirements of the associated bay. Transformer and cable bays require both CT and VT cabinets, as both current and voltage measurements are required for protection, metering, supervision and control functions. The CT circuits provide the current signals required for protection relays, metering equipment and fault detection, while the VT circuits provide the voltage signals required for voltage measurement, synchronisation, protection schemes and station monitoring.

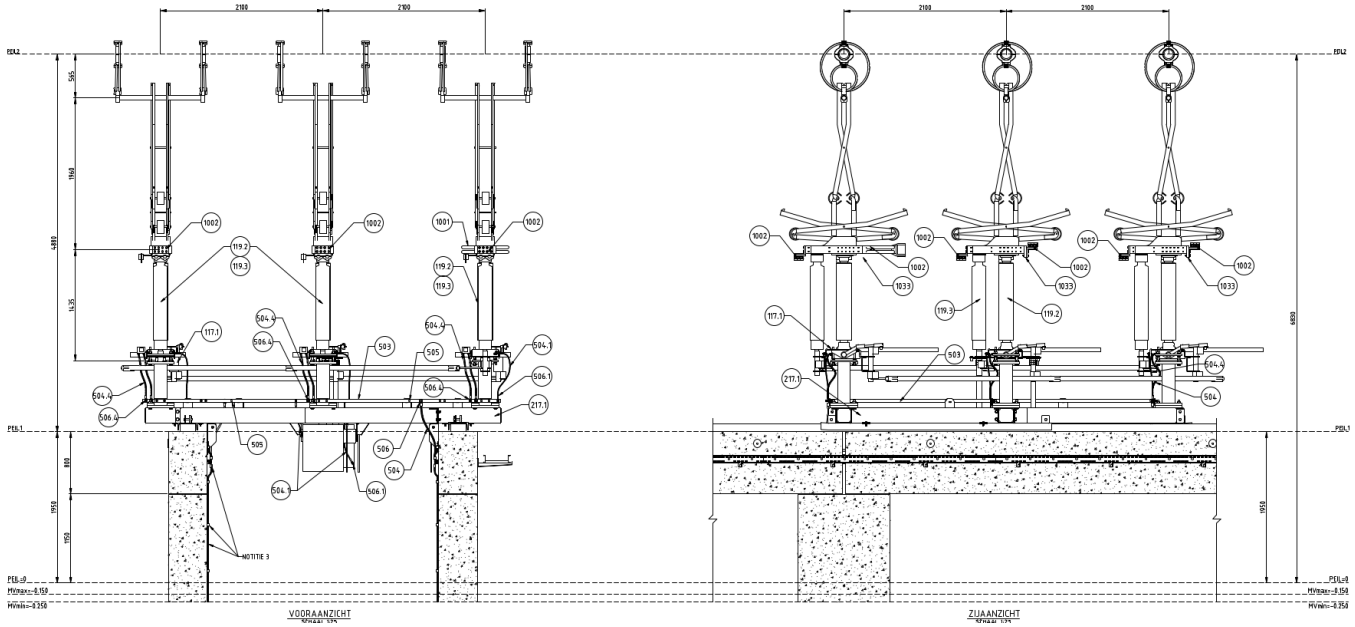
For coupler bay, only the CT cabinet is required. The CT cabinet provides the current transformer secondary circuits required for the protection, monitoring and operational functions of the bus coupler bay. The secondary cabinet arrangement shall therefore be implemented in accordance with the functional requirements of the associated bay.

The CT-VS skid shall be provided with dedicated CT and VT cabinets, as applicable to the bay configuration. The secondary circuits from these cabinets shall be connected to the Combination Cabinet (Combikast) by means of pluggable connectors. The pluggable connectors shall provide a standardized and reliable interface for all secondary circuits, allowing rapid installation, maintenance and replacement of the skid without the need for rewiring. The connectors shall be mechanically keyed or otherwise designed to prevent incorrect connections during installation and maintenance.

7.2. Pantograph Earthing Switch Skid

A **Pantograph earthing switch skid** is a modular assembly consisting of a steel support structure on which a disconnector (PS) and an earthing switch are mounted. Depending on the type of feeder bay, such as a transformer bay, line/cable bay, or bus coupler bay, different components may be installed on the skid. The skid shall be designed for modular removal and replacement and shall be delivered as a complete assembly with all conductors and associated components fully installed.

A **Pantograph earthing switch skid** consists of a structural steel frame, grounding provisions, primary switching equipment, and the associated electrical and instrumentation components.



7.2.1. Steel

Reference steel A steel drawing should be delivered and manufactured for this skid, the supplier is responsible for the delivery of the steel in combination with proper earthing and fitting of the components. The steel should meet the requirements mentioned in the steel requirements chapter.

All the Pantograph earthing switch skids should have the same steel. Only the components can be different per skid.

7.2.2. Primary components

The primary compononents for the Pantograph Earthing Switch Skid are listed in Appendix A.

7.2.3. Earthing

The skid & components should be earthed based on the short circuit current given in de introduction.

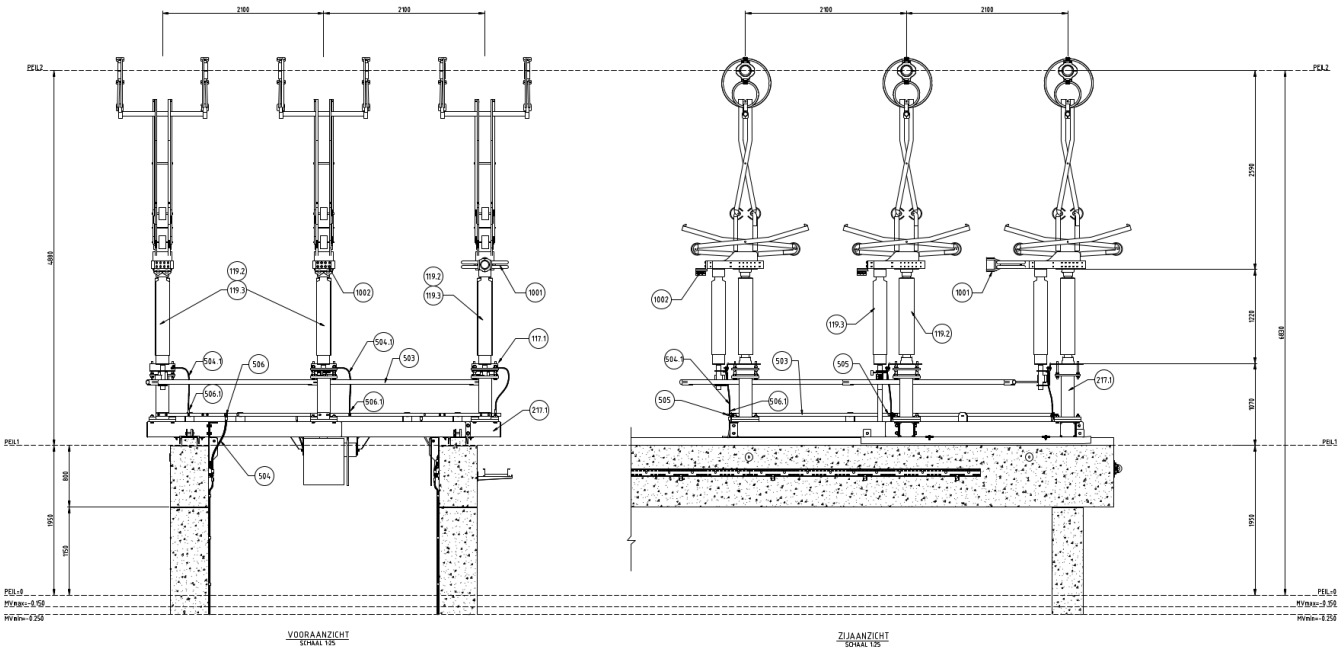
7.2.4. Secondary cabinet

The secondary circuits shall be connected to the Combination Cabinet by means of the standardised pluggable interface specified in Section 9.3.

7.3. Pantograph Switch Skid

A **Pantograph Switch** skid is a modular assembly consisting of a steel support structure on which a disconnector (PS) is mounted. Depending on the type of feeder bay, such as a transformer bay, line/cable bay, or bus coupler bay, different components may be installed on the skid. The skid shall be designed for modular removal and replacement and shall be delivered as a complete assembly with all conductors and associated components fully installed.

A **Pantograph Switch Skid** consists of a structural steel frame, grounding provisions, primary switching equipment, and the associated electrical and instrumentation components.



7.3.1. Steel

A steel drawing should be delivered and manufactured for this skid, the supplier is responsible for the delivery of the steel in combination with proper earthing and fitting of the components. The steel should meet the requirements of the mentioned in the other steel requirements chapter.

All the PS skids should have the same steel. Only the components per skid can be different.

7.3.2. Primary components

The primary compononents for the Pantograph Switch Skid are listed in Appendix A. Equivalent components may be proposed, provided they comply with the requirements of this specification.

7.3.3. Earthing

The skid & components should be earthed based on the short circuit current given in de introduction.

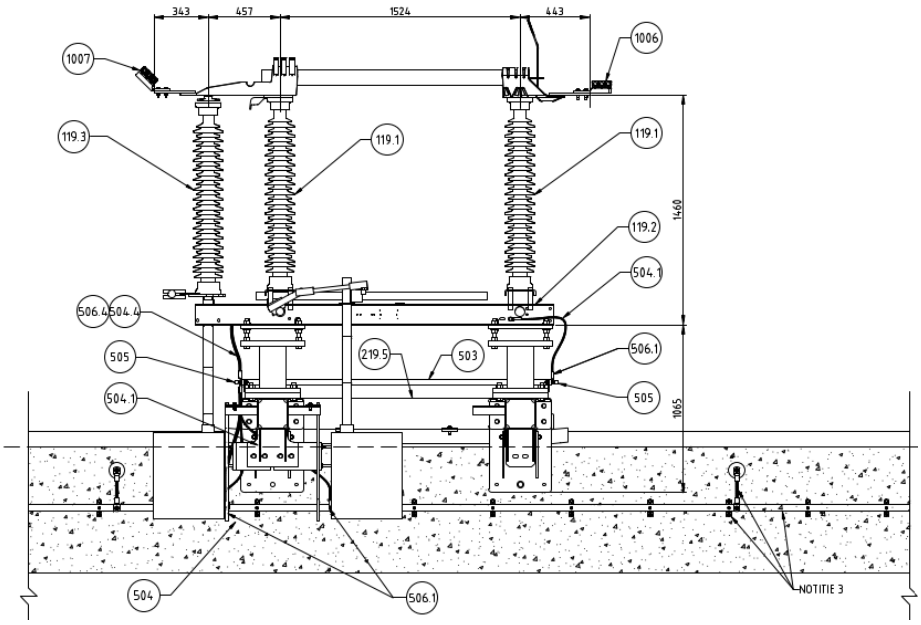
7.3.4. Secondary cabinet

The secondary cables should be connected with the Combination Cabinet by means of pluggable connectors.

7.4. Disconnector & Earthing Skid

Disconnectors shall be installed to provide visible isolation of lines, busbars and transformer bays during operational and maintenance activities. The disconnectors shall be suitable for outdoor installation in a 110 kV AIS substation and shall comply with IEC 62271-102.

The design shall ensure safe operation, reliable performance and full compatibility with the station protection, control, SCADA and interlocking philosophy throughout the design life of the substation.



7.4.1. Steel

A steel drawing should be delivered and manufactured for this skid, the supplier is responsible for the delivery of the steel in combination with proper earthing and fitting of the components. The steel should meet the requirements of the mentioned in the other steel requirements chapter.

All the Disconnector SKIDS should have the same steel. Only the components per skid can be different.

7.4.2. Primary Components

The primary compononents for the Disconnector are listed in Appendix A. Equivalent components may be proposed, provided they comply with the requirements of this specification.

7.4.3. Earthing

The skid & components should be earthed based on the short circuit current given in de introduction.

7.4.4. Secondary cabinet

The secondary circuits shall be connected to the Combination Cabinet by means of the standardised pluggable interface specified in Section 9.3.

8. Gantries

The different gantries on the substation provide structural support for the overhead conductors, busbar connections and the associated primary equipment. The gantries that support the conductors where they leave the switchyard, i.e. at the cable bay and the transformer bay, will thus have an interface with the other components and their supplier/designer. It is the responsibility of the supplier of these gantries to work out these interfaces together and demonstrate that they have been considered in the design. The supplier needs to supply an overview of these interfaces with the applied actions to mitigate unwanted consequences.

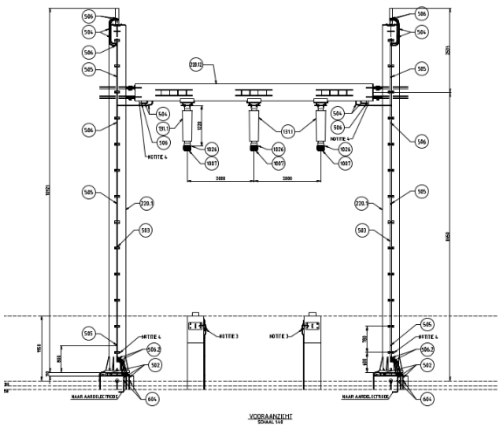
8.1. Busbar / Rail System

The 110 kV substation is equipped with a double busbar (rail) system providing the electrical interconnection between the individual bays. The busbars distribute electrical power between the transformer, cable and coupler bays and shall be designed to withstand the specified electrical, mechanical and environmental loads.

The busbars are supported by dedicated steel rail gantries and support insulators. The rail gantries provide the required mechanical strength, structural stability and electrical clearances while maintaining the correct positioning of the busbar system under all operating conditions, including wind, ice and short-circuit loading. The individual support structures are further specified in the following sections.

8.2. Field Gantry

A **Field Gantry** is a structural steel assembly designed to support overhead conductors, busbar connections, and associated primary equipment within a substation bay. The portal shall provide the required mechanical strength and electrical clearances for all operational and environmental loading conditions. The structure shall be designed for installation, maintenance, and future replacement of connected equipment where applicable.



A **Field Gantry** consists of a structural steel framework, foundations interfaces, conductor attachment points, grounding provisions, and all associated steelwork and connection hardware required for the intended bay configuration.

The field gantries shall be designed and positioned to provide sufficient clearance for the dedicated transport cart. Adequate space shall be maintained to allow the safe installation, removal and replacement of the interchangeable skid assemblies without interference with adjacent structures or equipment.

8.2.1. Steel

A steel drawing should be delivered and manufactured for this component, the supplier is responsible for the delivery of the steel in combination with proper earthing and fitting of the components. The steel should meet the requirements of the mentioned in the other steel requirements chapter.

All the field gantries should have the same steel. Only the components per skid can be different.

8.2.2. Primary components

The primary components shall be in accordance with the Contract Design and Appendix A. Alternatives are only permitted in accordance with Section 5.2.

8.2.3. Earthing

The components should be earthed based on the short circuit current given in de introduction.

8.3. Rail Gantry

A **Rail Gantry** is a structural steel assembly designed to support the main busbar conductors, associated insulators and connection points within the 110 kV AIS substation. The structure shall provide the required mechanical strength and electrical clearances for all operational and environmental loading conditions.

A **Rail Gantry** consists of a structural steel framework, support insulators, conductor attachment points, grounding provisions and all associated steelwork and connection hardware required for the intended substation configuration.

8.3.1. Steel

A steel drawing should be delivered and manufactured for this component, the supplier is responsible for the delivery of the steel in combination with proper earthing and fitting of the components. The steel should meet the requirements of the mentioned in the other steel requirements chapter.

All the field gantries should have the same steel. Only the components per skid can be different.

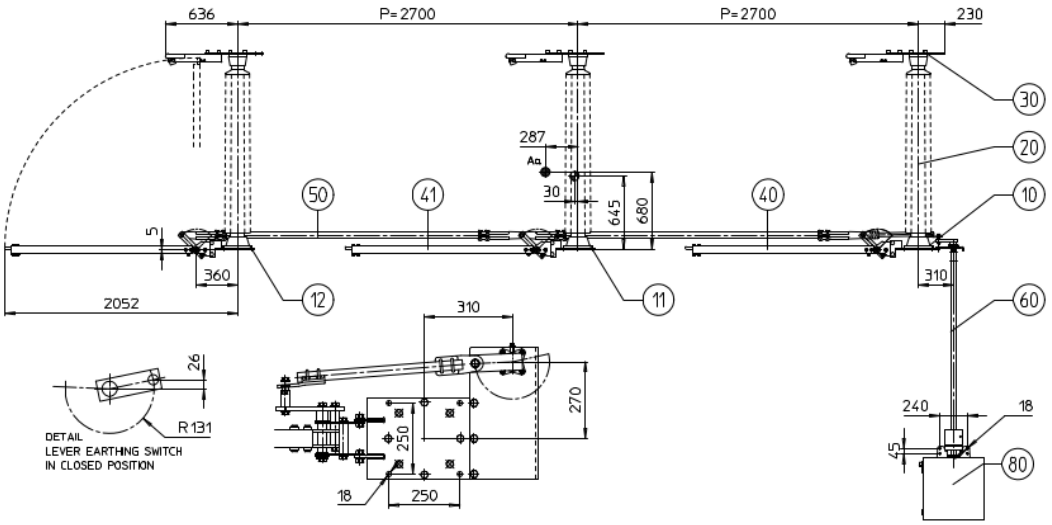
8.3.2. Earthing

The components should be earthed based on the short circuit current given in de introduction.

8.4. Rail Gantry with Earther

A **Rail gantry with Earther** is a busbar earthing assembly designed to provide a safe and reliable earthing connection for the main rail/busbar of the 110 kV AIS substation. The assembly is used to earth the rail during maintenance, inspection and operational activities, ensuring personnel safety and protection of equipment.

A **Rail with Earther** consists of support insulators, earthing switch equipment, conductors, operating mechanism, grounding connections and associated mounting hardware required for the intended rail configuration.



8.4.1. Steel

The steel structure shall comply with the requirements specified in Chapter 5 and shall provide the required support for the associated equipment.

All rail earther assemblies shall have the same steel structure. Only the installed components may differ where required.

8.4.2. Primary Components

The Rail with Earther shall include the required earthing switch, support insulators, conductors, operating mechanism and associated connection hardware.

8.4.3. Earthing

The rail earther and all associated metallic components shall be connected to the substation earthing system. The earthing design shall be suitable for the short-circuit current specified in the introduction.

8.4.4. Secondary Cabinet

The secondary circuits shall be connected to the Combination Cabinet by means of the standardised pluggable interface specified in Section 9.3.

9. Combination Cabinet (Combikast)

The **Combination Cabinet (Combikast)** is the local secondary cabinet that houses the equipment required for the control, protection and monitoring of the bay.

The Combikast is a metal-enclosed, free-standing cabinet consisting of multiple panels and a cable compartment, as illustrated in the relevant drawings. It includes the VBS (local control panel), protection and control devices, interface and terminal blocks, auxiliary components, and internal wiring. The front of the cabinet provides access to the VBS and control/indication elements, such as switches, pushbuttons, key selectors and status indications, while the interior off the Combikast contains the terminals, I/O modules and wiring for signal interconnection.

The Combikast receives secondary signals from the CT-VS skid (current and/or voltage transformer circuits) and other primary equipment, processes and distributes these signals to the protection IEDs and control circuits, and provides output signals for local and remote operation, interlocking, alarming and communication with the station automation system. The cabinet is designed for outdoor installation, with adequate protection against environmental conditions, and is configured according to the required bay type (e.g. line, transformer or coupler bay).

Drawings of the A200 cabinets for a similar project can be found attached in the appendix folder. This shows drawings of a 150 kV substation, that can be used for a price proposition.

9.1. Cabinet

The Combination Cabinet (Combikast) shall be manufactured, assembled and delivered as a complete unit for this application. The supplier shall be responsible for the design, manufacture, assembly, testing and integration of all cabinet components. The cabinet shall comply with the requirements specified in this document.

A200 secondary cabinet drawings are included in Appendix C for reference. These drawings illustrate the general cabinet arrangement and interfaces and shall not be considered as the final design. The supplier shall develop the final cabinet drawings during the UO (Detailed Design) phase in accordance with the requirements of this specification.

9.2. Main Components

Component	Description
VBS (Local Control Panel)	Local operation, status indication and bay control
Protection IEDs	Protection, control and monitoring functions
Terminal Blocks	Termination and marshalling of secondary circuits
Communication Equipment	Interface with the station automation and SCADA systems
I/O Modules	Acquisition and distribution of digital and analogue signals
Pluggable Connectors	Standardised pluggable interface between all applicable removable SKIDS and the Combination Cabinet.
Internal Wiring	Interconnection of all cabinet components
Auxiliary Equipment	Power supplies, fuses, miniature circuit breakers, switches and accessories
Cable Compartment	Cable entry, routing and segregation of incoming and outgoing cables

9.3. Interfaces

The Combination Cabinet shall provide the required interfaces for the associated CT-VS skids, disconnectors, pantograph switches, pantograph earthing switches, and RC-divider skids.

All secondary connections between removable SKIDS and the Combination Cabinet (A200) shall be made by means of standardised pluggable connectors. This requirement applies to the CT-VS Skid, Pantograph Switch Skid, Pantograph Earthing Switch Skid and Disconnector & Earthing Skid.

9.4. Secondary Cabling

The secondary cabling shall be connected to the Combination Cabinet and routed in accordance with the project requirements.

10. Conductors

Conductors provide the electrical interconnection between the primary equipment installed on the individual skid assemblies and the busbar system within the 110 kV AIS substation. The conductors form the current-carrying path between adjacent equipment and ensure the continuity of the primary circuit.

The conductor system consists of rigid aluminium conductors and the associated connection fittings. The conductors are used to interconnect adjacent skid assemblies, primary equipment and the busbar system. The clamp arrangement and selection shall be based on the Contract Design. Final fabrication and installation details shall be completed during the UO phase.

11. Clamps

Clamps are used to provide the mechanical fixation and electrical connection between the conductors and the associated primary equipment within the 110 kV AIS substation. They ensure a secure and reliable connection while maintaining the required electrical continuity and mechanical integrity.

The clamp arrangement and selection shall be based on the Contract Design. Final fabrication and installation details shall be completed during the UO phase.

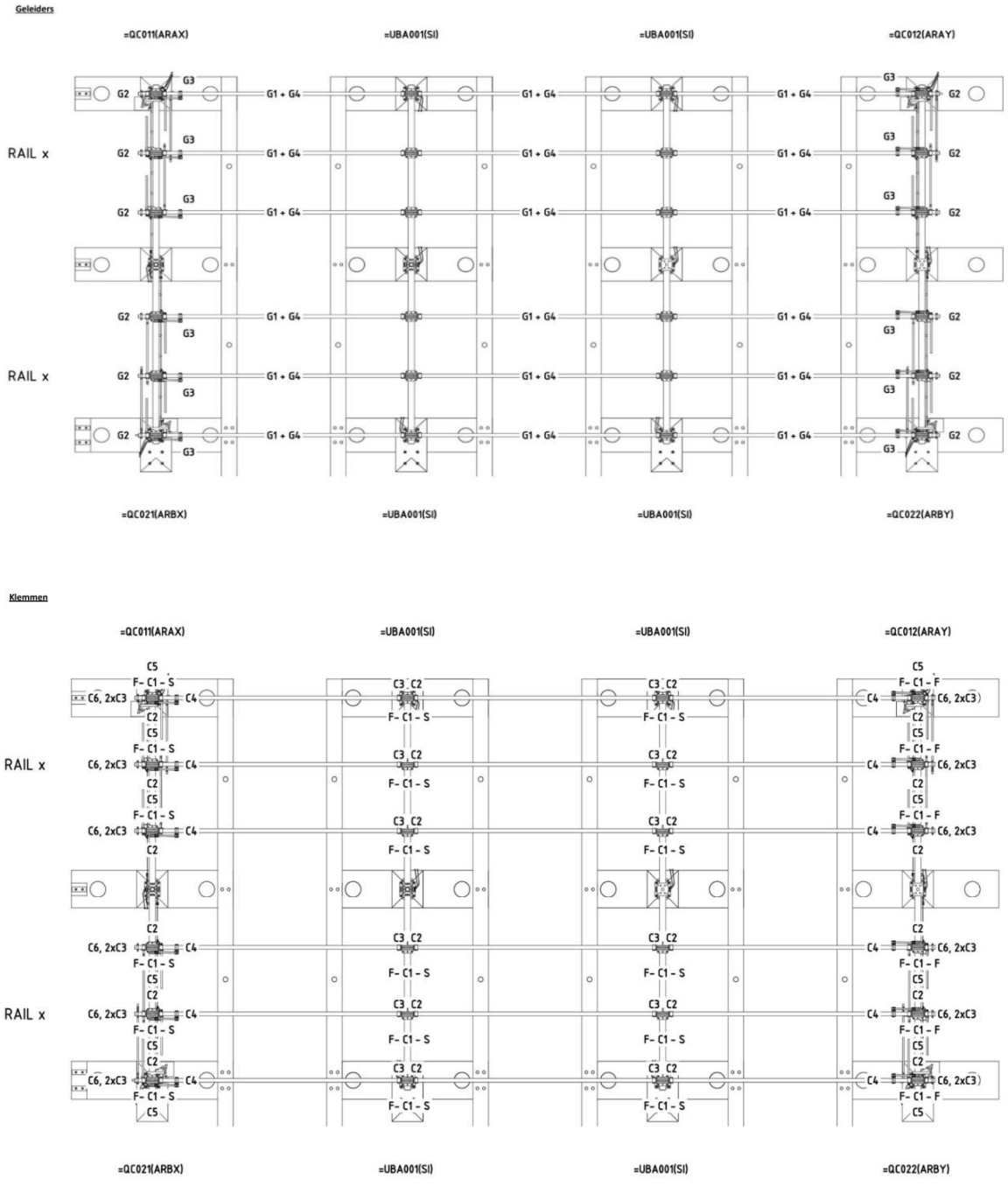
Indicative clamp arrangements for the different bay configurations are shown in the figures below. These drawings are provided for reference only and illustrate the general arrangement of the clamp assemblies.

Reference clamp arrangement drawings for the Cable Bay (LV), Transformer Bay (TV) and Coupler Bay (KV) are provided in the Appendix folder of the WP Skids tender documentation. The supplied drawings form the Contract Design and shall be the basis for manufacture and installation. The UO phase is intended for verification, coordination and completion of fabrication and installation details only.

12. Busbar Rails

The busbar rail system forms the main busbar arrangement of the 110 kV AIS substation and provides the electrical connection between the individual bays. The rails support the continuous transmission of electrical power while maintaining the required electrical clearances and mechanical stability. The substation is designed as a double-rail station which means that one rail can be disconnected from the power to enable maintenance work on one of the bays, while ensuring the other bays can remain in operation. The busbars are connected to the bays via the disconnectors.

The rail arrangement shall be based on the Contract Design. Final fabrication and installation details shall be completed during the UO phase.



Note: The reference numbers shown in the drawings correspond to the clamp and rail identification numbers provided in the Clamp and Rail Sheet.

13. Pulling rods

Pulling rods provide the mechanical linkage between the operating mechanism and the associated primary equipment within the 110 kV AIS substation. The pulling rods provide a mechanical linkage between the skids, which allows the skids to be slid along the foundation when a skid is being taken out of the field for maintenance or replacement. This linkage can be connected or disconnected and will save time during maintenance.

The pulling rod arrangement shall be based on the Contract Design. Final fabrication and installation details shall be completed during the UO phase.

Reference pulling rod drawings for the Cable Bay (LV), Transformer Bay (TV) and Coupler Bay (KV) are provided in the Appendix folder of the WP Skids tender documentation. These drawings are intended for reference only and illustrate the general pulling rod arrangement for each bay configuration.

Appendix A: Design Basis Equipment Configuration

This appendix provides an overview of the principal equipment configuration for the interchangeable skid assemblies included within the scope of supply.

Equipment	Manufacturer	Line Bay	Transformer Bay	Coupler Bay
CT-VS Skid	CT KONCAR	VAU_123 V.42h_50kV	VAU_123 V.42c_50kV	VAU_123 V.22h_50kV
	CT Pfiffner	V_42h_WP-84.967.04Ind00	V_42c_WP-83.796.04Ind02	V_22h_WP-84.967.02Ind00
	VS Hitachi	1HSBDG00011-893__ASM	1HSBDG00011-893__ASM	1HSBDG00011-893__ASM
Pantograph Earthing Switch Skid	HAPAM	GSSB 123kV	GSSB 123kV	GSSB 123kV
	PS + earthing GE	DIN-53983 A	DIN-53983 A	DIN-53983 A
Pantograph Switch Skid	PS GE	DIN-53984 B	DIN-53984 B	DIN-53984 B
Disconnector & Earthing Switch Skid	Disconnector GE	DIN-53986	DIN-53986	-
	HAPAM	SSBIII 123kV	SSBIII 123kV	-
Field Gantry	Insulators CERISOL	COL SUSP C10-550 3900 H21058	COL SUSP C10-550 3900 H21058	-

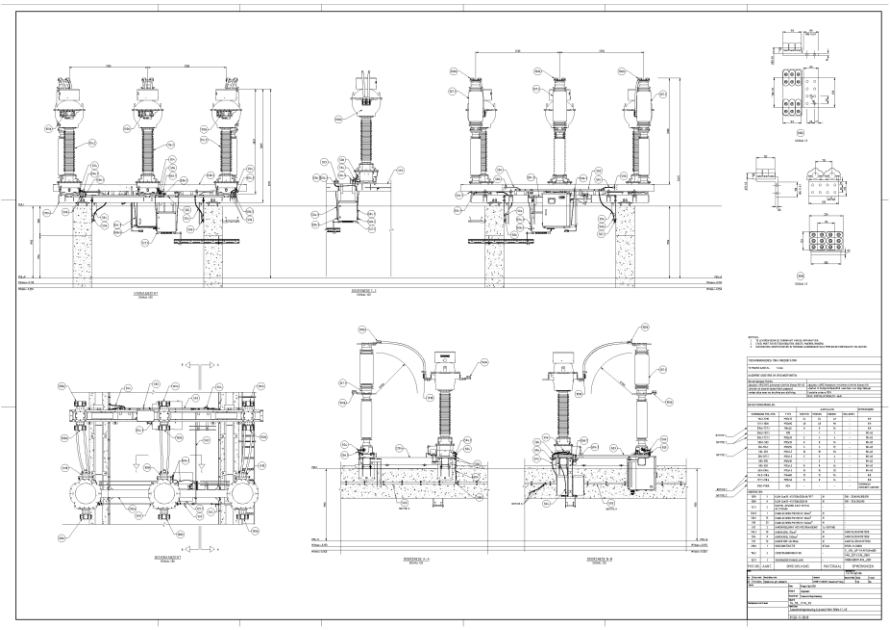
Appendix B: DO Drawings

This appendix contains the DO reference drawings referred to in Chapter 6.

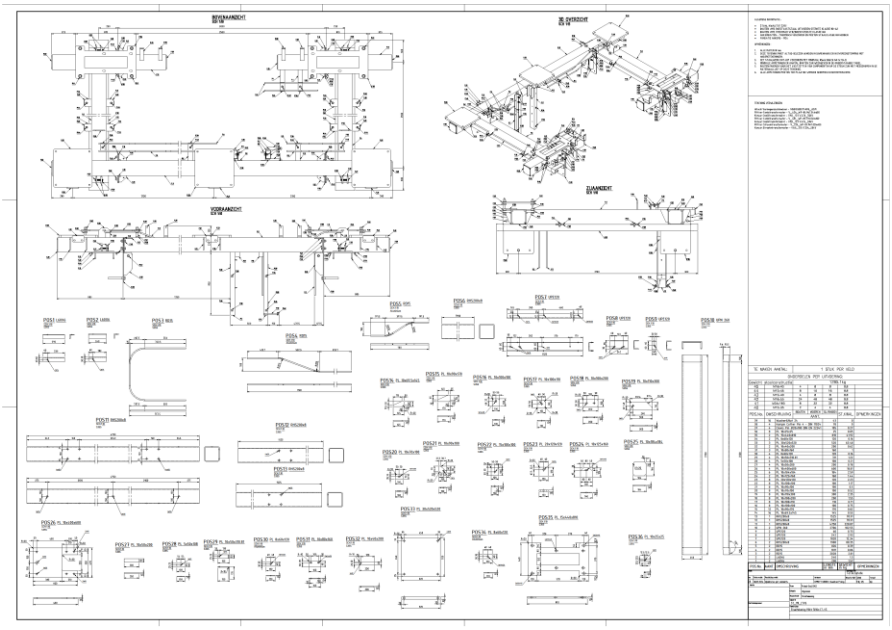
The drawings are embedded as PDF documents. They can be opened separately to view the complete drawings and all design details. The drawings will also be supplied as separate documents in the enclosed Appendix folder.

B.1. CT-VS Skid

Assembly Drawing

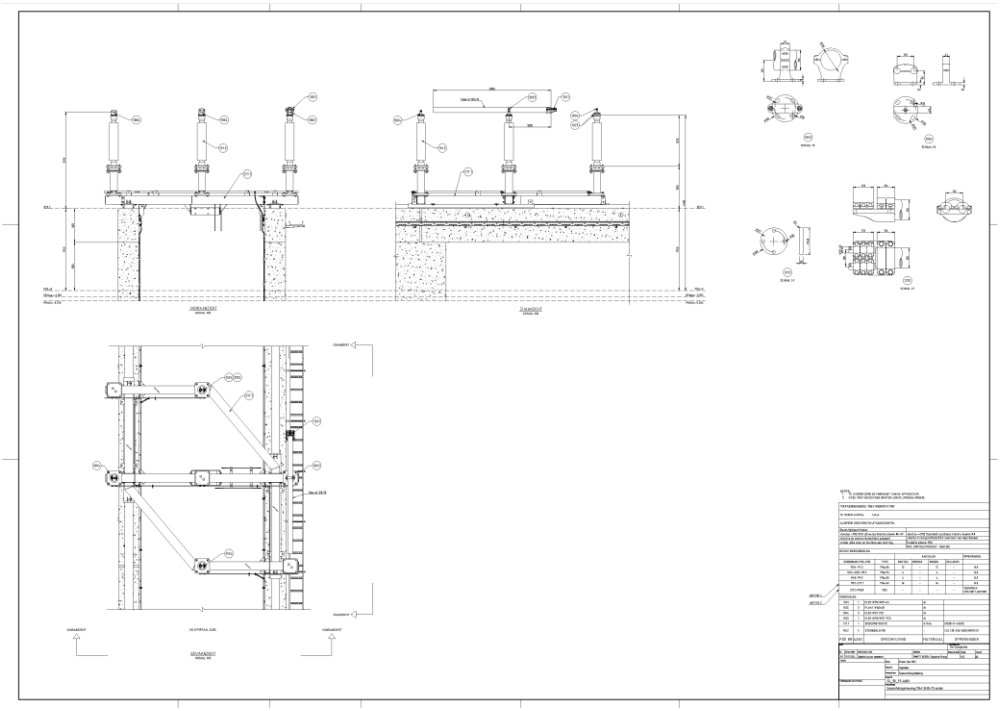


Steel Drawing

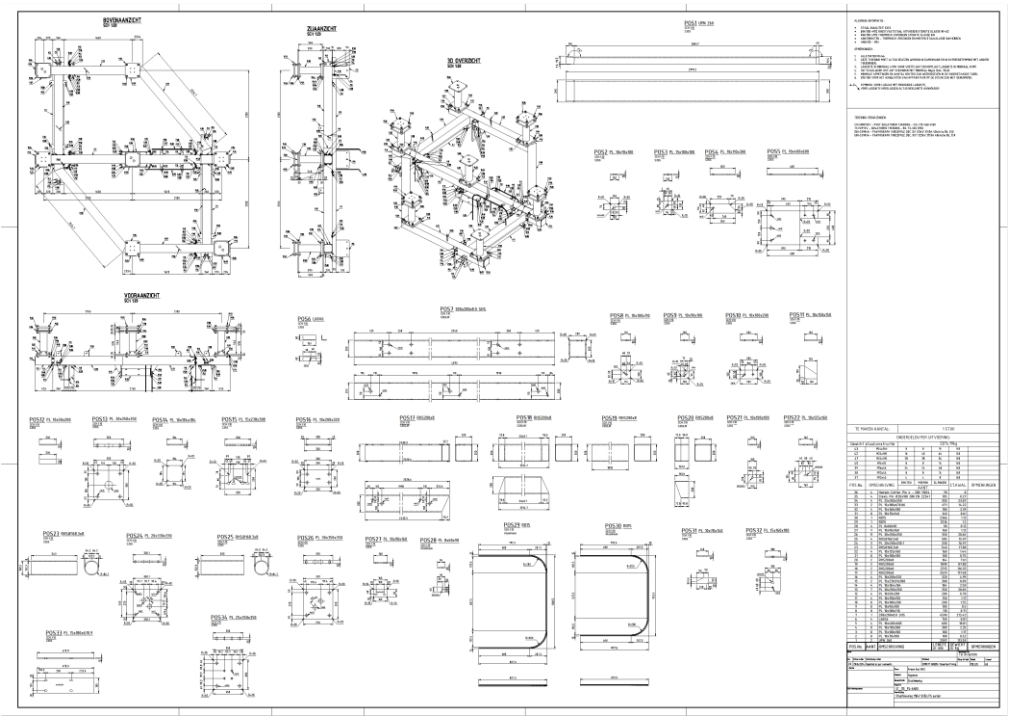


B.2. Pantograph Earthing Switch Skid

Assembly Drawing

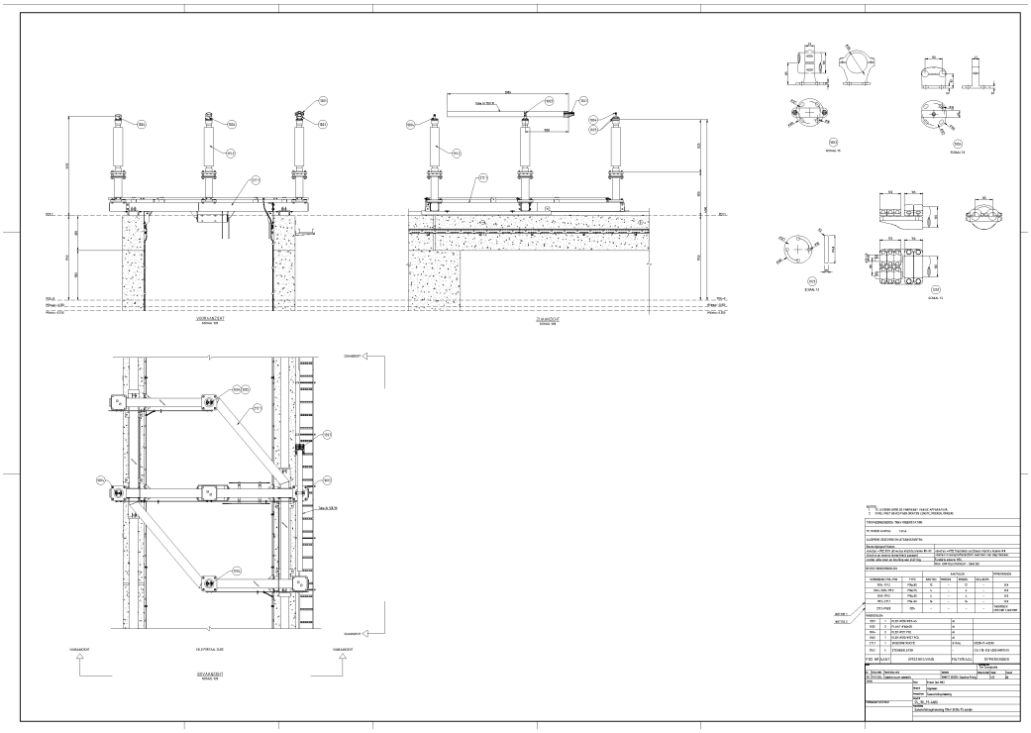


Steel Drawing

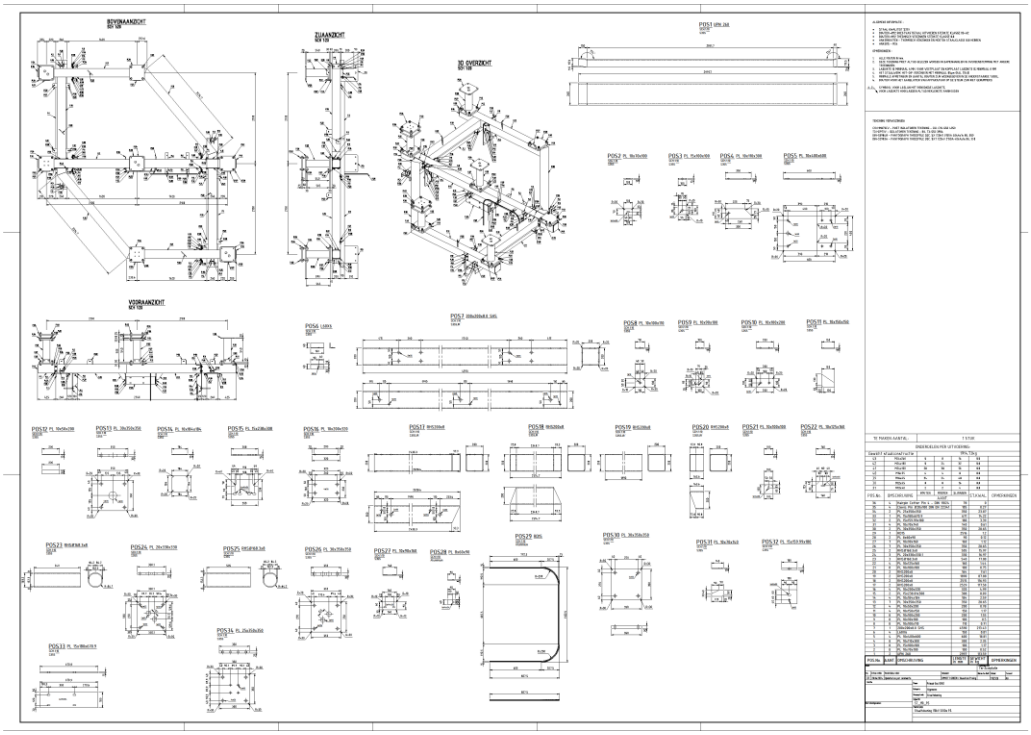


B.3. Pantograph Switch Skid

Assembly Drawing

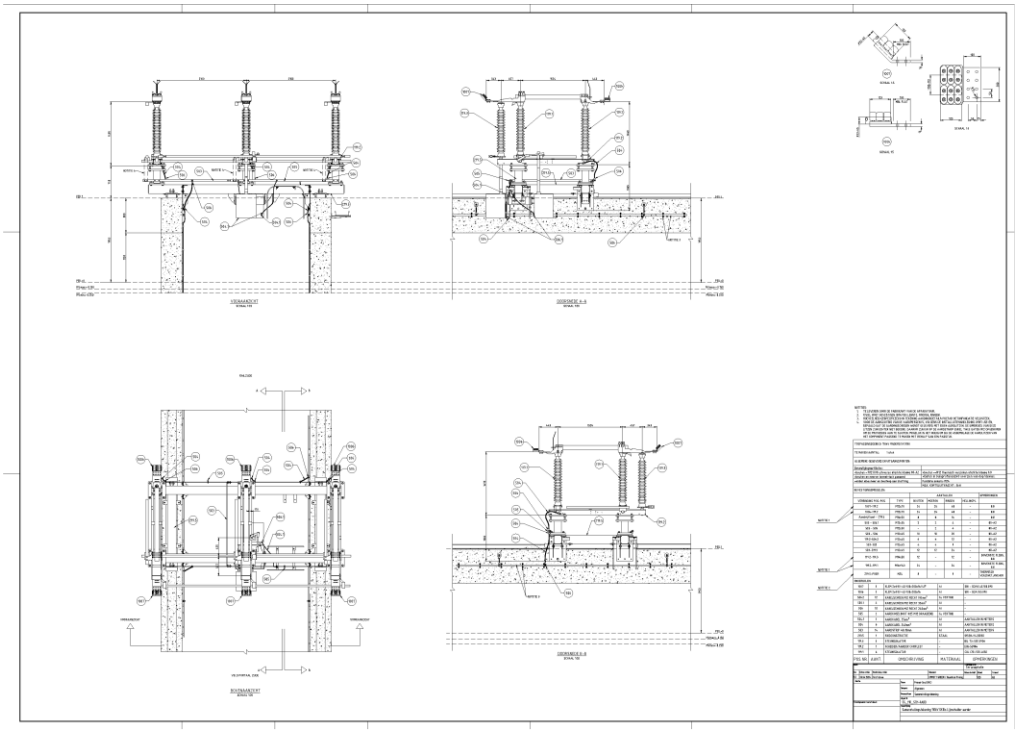


Steel Drawing

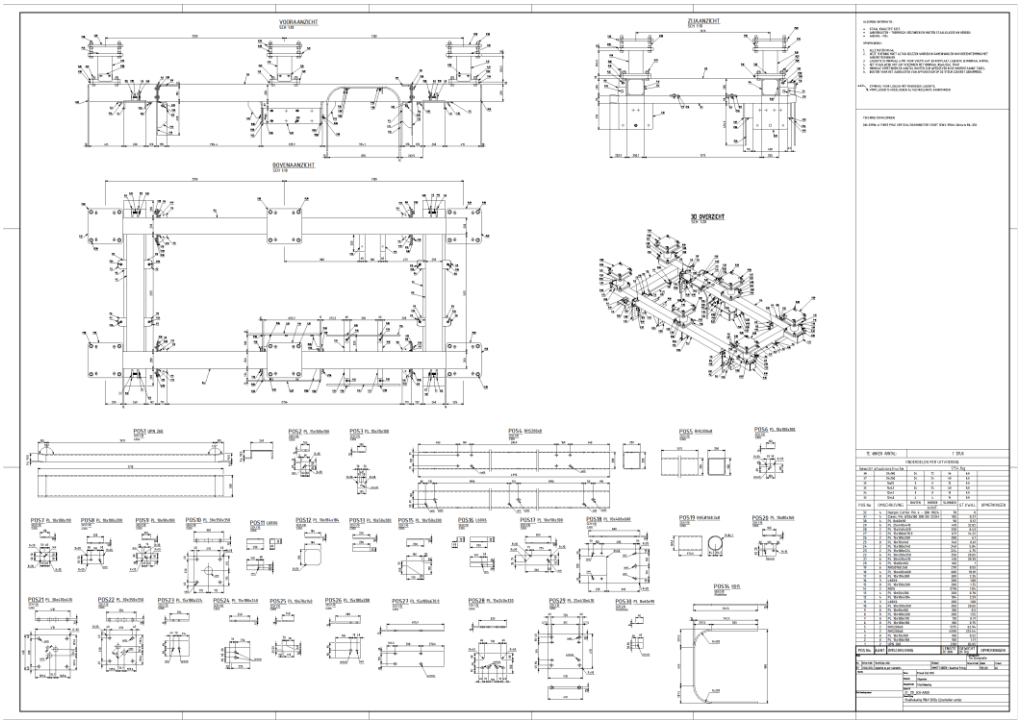


B.4. Disconnector

Assembly Drawing

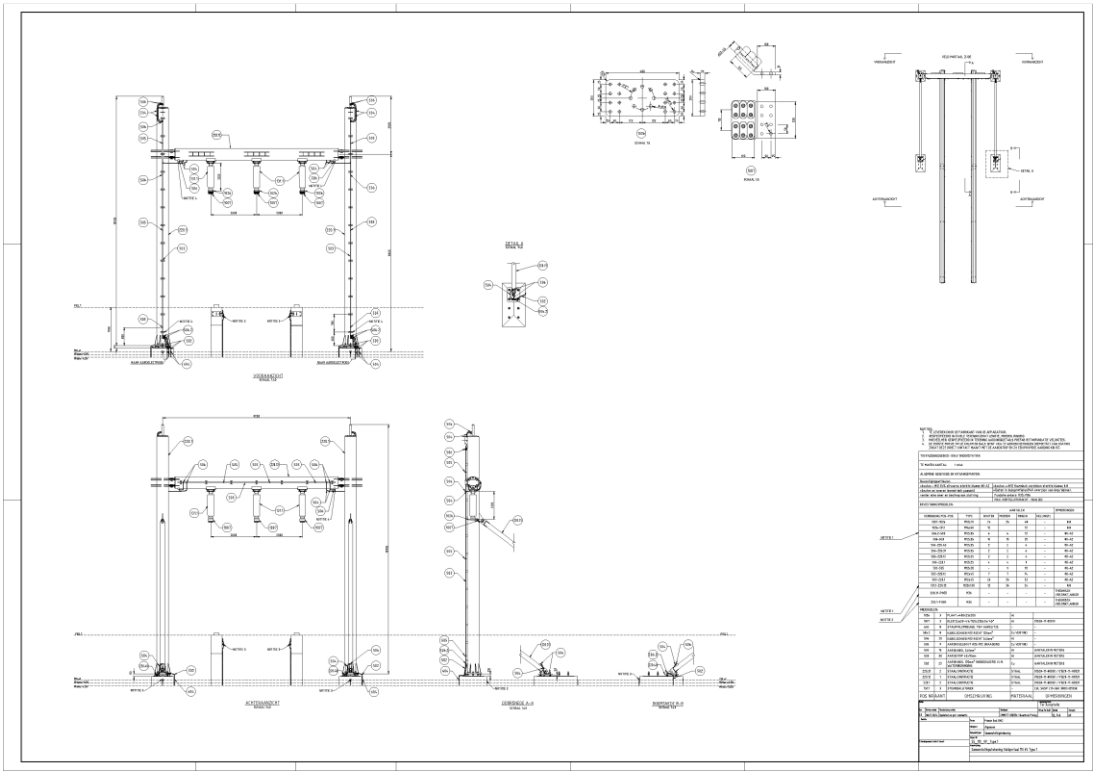


Steel Drawing

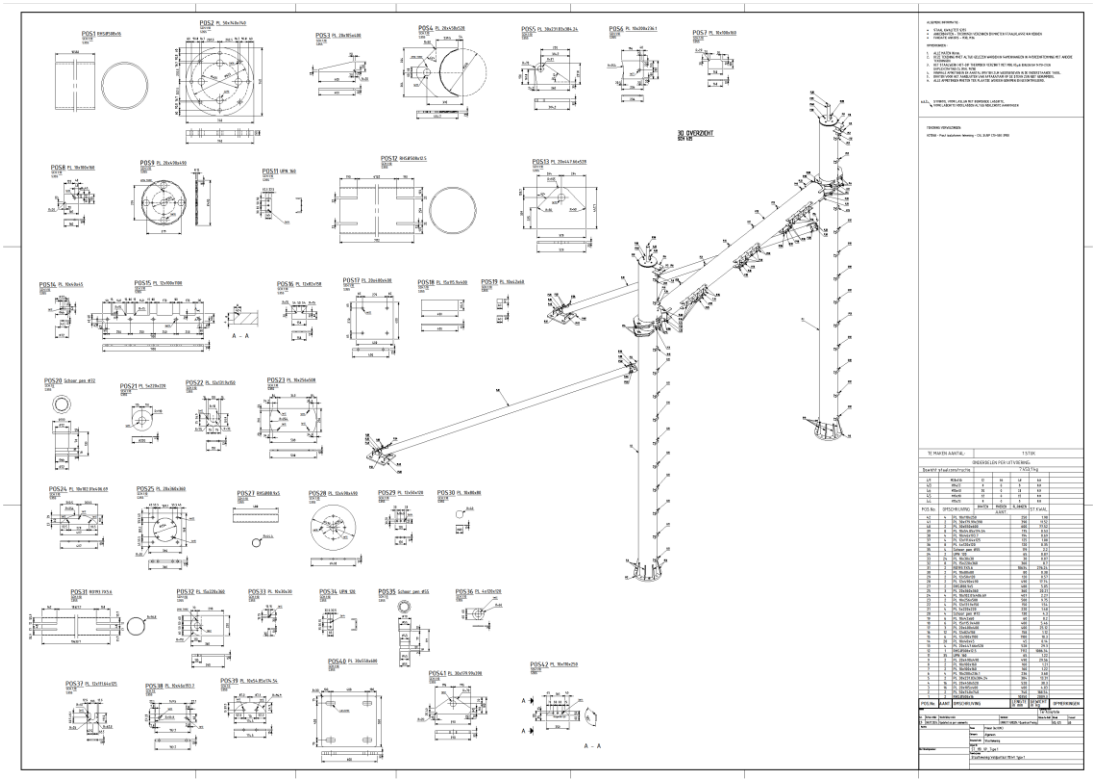


B.5. Field Gantry

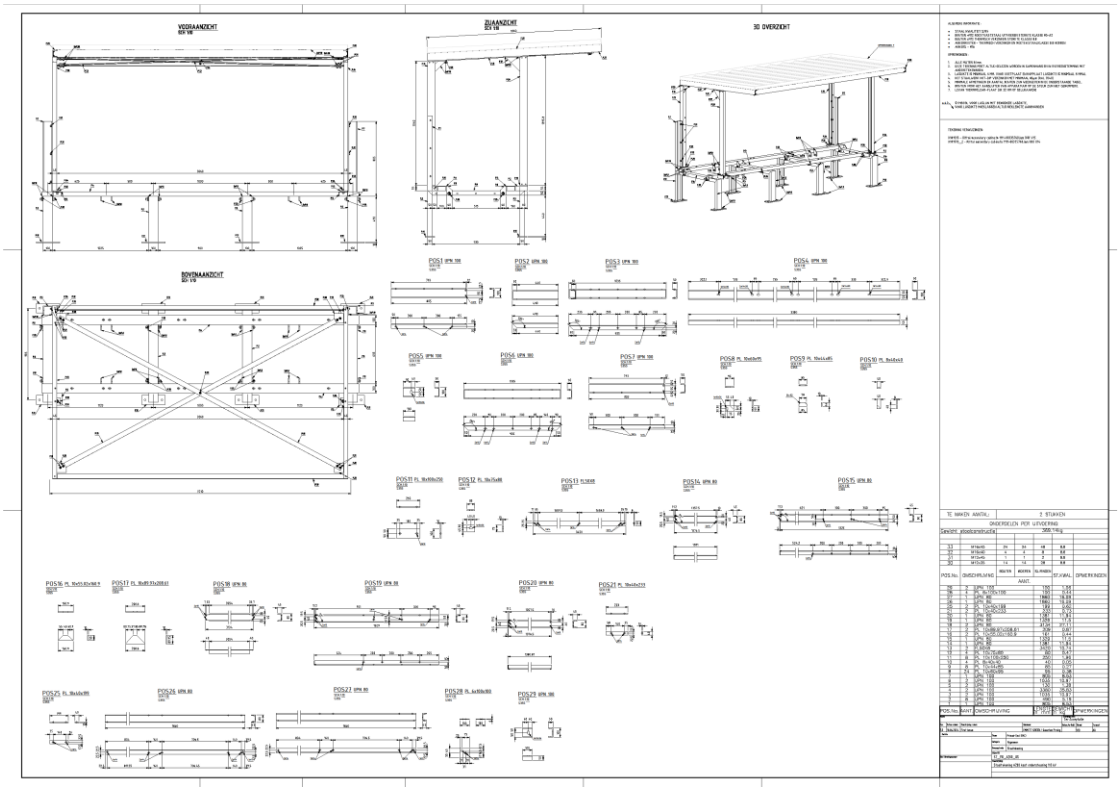
Assembly Drawing



Steel Drawing



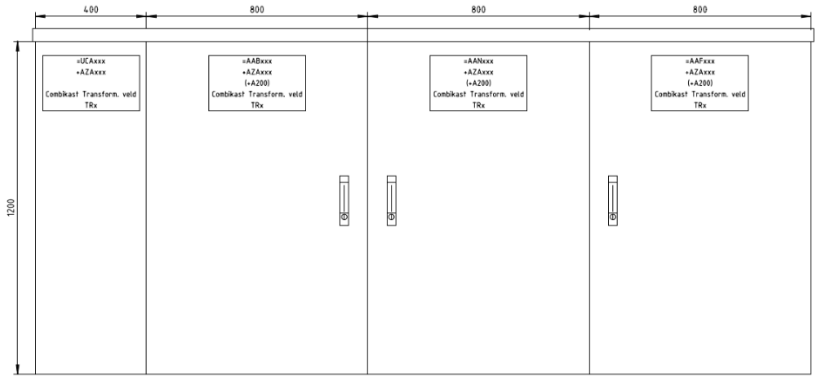
B.6. Combination Cabinet

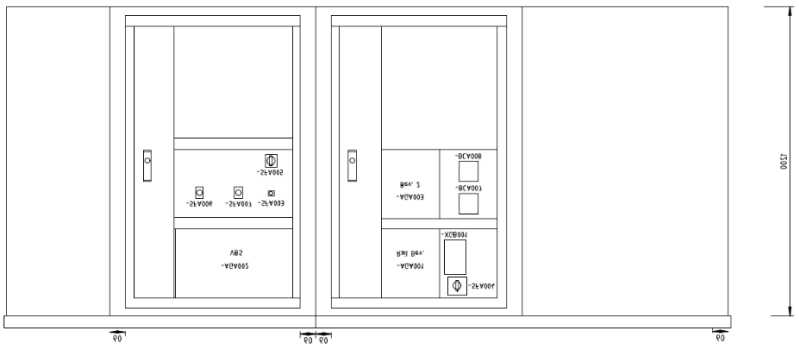


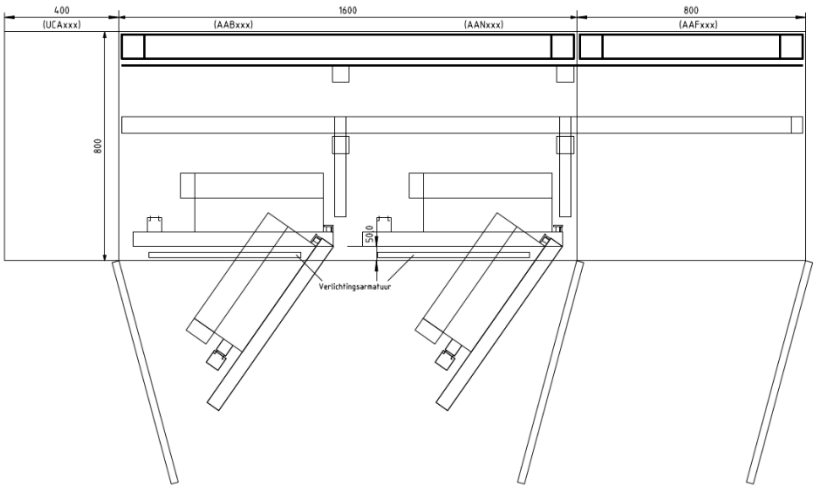
Appendix C: A200 Secondary Cabinet Drawings

This appendix contains A200 secondary drawings of the Combination Cabinet (Combikast) for the cable bay, transformer bay and coupler bay configurations. The drawings are provided for reference purposes only. The final A200 drawings shall be developed during the UO (Detailed Design) phase in accordance with the project requirements.

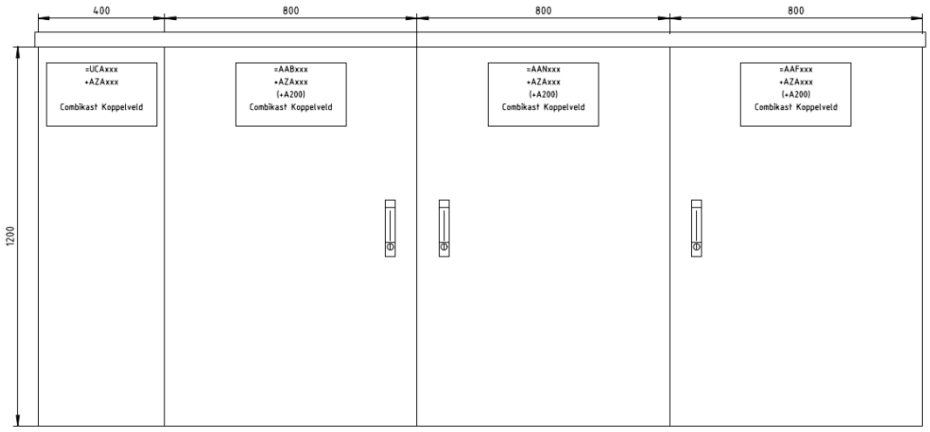
Transformer Bay Combikast

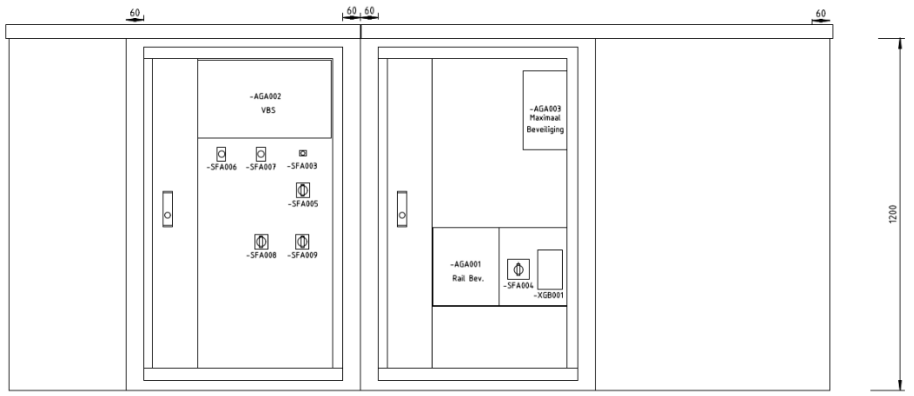


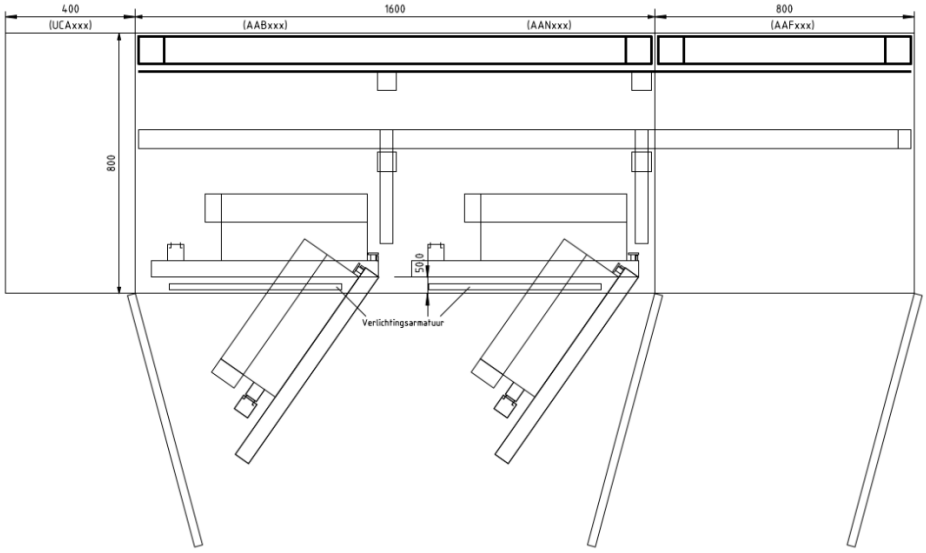




Coupler Bay Combikast







Cable Bay Combikast