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Thomas Saubach, 2022-05-09**TECHNICAL SPECIFICATIONS PREFABRICATED SECONDARY
SUBSTATION TYPE O06 800 kVA for 12/0.42 kV and 24/0.42 kV****REVISION HISTORY**

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ATTACHMENT 1 SINGLE-LINE DIAGRAM EXAMPLE**ATTACHMENT 2 SIGNALS TO SIGNAL BOARD****ATTACHMENT 3 CONTROL CABLE BOX****ATTACHMENT 4 TECHNICAL SPECIFICATIONS OIL-IMMERSED DISTRIBUTION TRANSFORMERS**

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1 GENERAL

In this document specifications and technical requirements for the delivery of low-profile, outdoor service prefabricated substation are defined.

Type O06 (the designation used by Ellevio) is for, 12 and 24 kV, 800 kVA for Stockholm, Sweden.

The general design of the substation shall be functionally equivalent to the single-line diagram in Attachment 1.

The external appearance of the construction is to be designed according to the design of the supplier such that it satisfies in the most optimal manner the other points in these specifications.

The secondary substation will be ordered with either an advanced (Option 1) or a traditional (Option 2) solution. All other options can be ordered regardless of the chosen solution (i.e. Option 1 or Option 2).

The advanced solution (Option 1) consists of parts marked with Part of Option 1. These can be found in section 8.2 The RTU with modem and firewall, all installed in a cabinet, are supplied by the purchaser. The RTU shall be completely installed and tested with all accessories included.

The traditional solution (Option 2) consists of parts marked with Part of Option 2. These can be found in section 7.10 Measuring instrument, 7.11 Signal board and 8.1 Control cable box.

The transformer is supplied by the purchaser. The transformer shall be lifted off the lorry and installed by the supplier at the factory. All cables, cable terminations and other equipment for the connection of the transformer to MV and LV switchgears are part of the supplier scope.

The equipment shall be contained in a sheet steel building with a maximum weight allowing the substation to be transported to the site fully equipped, including transformer.

The secondary substation shall be able to operate and store in an ambient temperature range of -25°C to +40°C.

2 APPLICABLE STANDARDS AND REGULATIONS

The substation and all components shall be designed and tested according to the following list of priorities:

- Elsäkerhetsverkets föreskrifter ELSÄK-FS (The Swedish National Electrical Safety Board's Regulations)
- This specification
- SS-EN 62271-202
- Substations 12-24/0.4 kV (EBR KJ 59:19)

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- Other applicable SS and EN standards
- Applicable IEC standards

3 CONSTRUCTION

3.1 Structure and foundation

The building shall be made of sheet steel and have a disposition allowing for easy access to all ingoing components through doors and a removable roof. One side shall be free of doors. The walls and roof of the substation are to be aluzinc coated, hot dip galvanized or an equivalent.

A secondary substation will be selected in consultation with the City Planning Administration (Stadsbyggnadskontoret).

The foundation of the substation is to be designed such that incoming cables can be easily connected to the switchgear.

The secondary substation shall have a prefabricated concrete base to prevent structure bending changes and prevent corrosion.

Lifting hooks or similar shall be fitted for removing the roof if applicable.

It shall be possible to lift the complete construction, including the foundation and the 800 kVA transformer, as a single unit. For this purpose, the requisite lifting system shall be cast into the concrete foundation. All attachment fittings shall be stainless steel or hot-galvanized steel. HALFEN lifting anchor system shall be used.

There shall be a floor panel in the HV-area to cover free areas.

The substation shall be designed to minimize internal condensation.

3.2 Transformer space

Under the oil transformer there shall be arranged a water- and oil-tight trough for the collection of oil. The minimum volume for the trough shall be 0.6 m³.

The spaces for the transformer shall be separated from other spaces in the substation with a metal mesh or similar, with a protection class of at least IP2X.

The space for the transformer shall be provided with natural ventilation that results in the achievement of protection class 15 (as specified by SS EN 62271-202) with respect to losses from the low voltage switchgear and the transformer.

3.3 Doors

The doors shall be built with minimum two point closing and be possible to lock in open position.

Doors shall be equipped with pockets, for documentation, that is securely fastened.

Doors shall be hinged at the side. Due to the size of the door leaves, they shall be reinforced. The door design shall be such that there will be no risk of sagging. It shall be easy to remove the doors and any posts.

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The locks on the doors shall be of the ASSA brand, the lock body on the inside shall be ASSA Bolts 280 H with outer handle 664, or equivalent. Espagnolette rods shall be of square steel, > 13x13 mm or similar, for all doors.

Lock cylinders of type CLIQ, manufactured by ASSA, are to be paid for by the supplier. The lock cylinders are to be requisitioned from Ellevio AB. Fitting of lock cylinders and adaptation of locks and lock bodies are to be included in the supplier's undertaking.

The secondary substation shall be delivered with all doors locked.

The supplier will sign out keys from the purchaser.

Door brakes for all doors shall be of the brand FIX, type 533/2, or equivalent.

Under the switchgear doors, the prefabricated concrete foundation shall be equipped with easily removable sheet metal sections of stainless steel, t=3 mm, to facilitate the connection of high voltage and low voltage cables.

3.4 Service connection

There shall be two hatches (300 x 300 mm or similar), one at each switchgear door (but not in it), that can only be opened from the inside, for the connection of measurement cables to the medium voltage switchgear and for back-up power cables to the low voltage switchgear. Moreover there shall exist one hole (diameter 75 mm) to the low voltage switchgear, only to be open from the inside for future use of temporary power to e.g. a construction site. It shall be possible to close the doors once the cables have been connected.

3.5 Surface treatment

The exterior of the substation shall be phosphated and then painted with Duasolid undercoat 40 µm and Duasolid topcoat, minimum thickness 40 µm, or equivalent, and with graffiti protection AGS 3502 or equivalent sacrificial coating. The supplier shall describe what standards are followed for painting and for corrosion protection.

The colour shall be according to NCS colour system and will vary and be determined no later than when ordering. It may be that the roof and the walls are painted in two different colours.

4 TECHNICAL DATA

Type O06

Medium voltage switchgear

Nominal voltage	11	22	kV
Rated voltage	12	24	kV
Rated insulation level	75/28	125/50	kV
Rated frequency	50	50	Hz
Rated short-time withstand current 1 s	20	16	kA
Rated peak withstand current	50	40	kA
Rated continuous current main busbar	630	400	A
Rated current switching devices	400	400	A

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Rated current circuit breaker (transformer bay)	200	200	A
Breaking capacity circuit breaker (transformer bay)	20	16	kA
Making capacity switch-disconnector	50	40	kA
Making capacity earthing switch	50	40	kA
Protection class of enclosure	IP3X	IP3X	
Low voltage switchgear			
Rated voltage	420	420	V
Rated insulation voltage	500	500	V
Rated frequency	50	50	Hz
Rated short-term withstand current 1 s	25	25	kA
Rated peak withstand current	50	50	kA
Protection class of enclosure (including on top)	IP2X	IP2X	
Degree of protection inside cabinet (open cabinet doors)	IP2X	IP2X	
Rated current, busbars, phase conductor	1600	1600	A
Rated current, busbars, PEN conductor	800	800	A
Making capacity earthing switch (if used)	50	50	kA
Earthing of busbar with ball studs 25 mm (if used)	Yes	Yes	
Building			
Saddle roof elevation (approximately)	15	15	degrees
Outdoor operated	Yes	Yes	
Corrosion protection	Yes	Yes	
Graffiti protection (sacrificial coating)	Yes	Yes	
Removable sheet metal sections of stainless steel, t=3 mm, under the switchgear doors	Yes	Yes	
Concrete foundation	Yes	Yes	
Delivery check and installation of transformer in factory (includes transportation and installation material)	Yes	Yes	
Two hatches (300 mm x 300 mm or similar), one for temporary connection of emergency power etc.	Yes	Yes	
One hole (diameter 75 mm) to the low voltage switchgear for use of temporary power	Yes	Yes	
Designed for max transformer size	800	800	kVA
Degree of protection	IP23D	IP23D	

5 MEDIUM VOLTAGE SWITCHGEAR

The normal configuration of the switchgear will be: 2 feeder bays (3 feeder bays may be necessary) distributed between one or two cable systems, 1 transformer bay (2 transformer bays may be necessary). Total number of feeder bays plus transformer bays will never exceed 4. It may be necessary to interconnect the systems under certain operating conditions. In summary, the configurations are these: CTC, CTCC, and CTCT, where C represents cable bay and T represents transformer bay. Example of configuration CTC, see Attachment 1.

The switchgear shall be of an approved design such that internal arcing cannot arise, or such that any arcing is extinguished so rapidly that dangerous excess pressure or dangerous gases are not emitted from the switchgear.

The switchgear may be air-insulated, or single-phase encapsulated in insulating composite material. Switchgear containing SF6 gas is not accepted.

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Mechanical switch position indication of all switching devices shall be on the front of the switchgear.

Earthing switches shall be available for all bays. All earthing switches shall be equipped with hand-operated preloaded spring units for closing and opening. They shall have a lock mechanism.

If door blocking is used it shall be possible to bypass it independent of switching position.

Option 12: Additional cost for voltage level 24/0.42 kV.

5.1 Transformer bays

The transformer bays shall be provided with circuit breakers including relay protection and earthing switches.

Breakers that have oil as extinguishing medium shall not be used.

The breakers shall be provided with magnetic release and trip-free release for 230 VAC. Auxiliary contacts 2NO + 2NC to indicate circuit breaker position. The circuit breakers shall have a lock mechanism.

The relay protection function shall be constituted by reconnectable over-current protection characteristics that can be reconnected between NI, VI, EI (as specified by SS-EN 60255-151) and an instantaneous function. Setting of lower current start, tripping characteristic, and instantaneous function shall be independent of each other. It shall be possible to carry out relay testing without interruption in service. Indication of function shall be included. An external auxiliary voltage shall not be required.

Option 6: Additional transformer bay, configuration CTCT.

5.2 Feeder bays

Feeder bays shall be equipped with switch disconnectors and earthing switches, or equivalent.

Option 3: Motor operated switching device to enable remote control. Operating voltage 24 VDC. Auxiliary contacts enabling double-point information for operating mode.

Option 5: Additional feeder bay, configuration CTCC.

5.3 Cable bushings

Switchgear connections shall be made by cable bushings, which shall be designed according to SS-EN 60137 and SS-EN 50181 that permit plug-in connection. Feeder bays and transformer bays shall be designed for bolt connection interface C (630 A, series 400).

5.4 Cable installation

Connection may take place using three core cables (3x240/50 Al), installed with component screening after attachment at an anchor bar. Single core cables

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(3x1x240/25 Al) may also be used. One anchor bar or its equivalent for connection shall be placed at a suitable level. It shall be possible to secure three core cable to the anchor bar so that shear forces from ground displacement that occurs in the Nordic region can be absorbed. A test installation with three core cable 3x240/50 Al shall be performed at factory to decide the location of the anchor bar.

It shall be possible to carry out the cable assembly in a work environmentally sound manner. E.g. no cable assembly in transverse direction.

5.5 Accessories

Auxiliary equipment for the medium voltage switchgear. The following items shall be included in the delivery of the switchgear:

- Tools required for operation and overhaul. With a device for hanging up the tools.
- Operating handles, insulated and of each type required.
- Capacitive outlets for connecting voltage presence indicator system (or fixed) and phase sequence detector in the transformer bays and feeder bays. One voltage presence indicator system per bay shall be included.
- **Option 4:** Short-circuit and earth fault sensors in feeder bays of type Cabletroll 2320, manufactured by Nortroll, including auxiliary equipment required such as batteries and indicators, etc., or equivalent. This equipment shall be placed such that it can be checked visually. Earth fault element shall be delivered with extension core up to 650 mm circumference. Everything except the sensors shall be installed, including the cables for the sensors.
- Indicators for visual checks of insulator durability at gas-insulated switchgear, e.g. manometers.
- It shall be possible to disconnect all terminal blocks, and they shall have test terminals.
- Earthing connection through M12 bolts in both ends of PEN bar.
- Each encapsulation for feeder bays shall be equipped with one flat plastic component with the dimensions height x width = 80 mm x 130 mm, for the purchaser's cable address signs.

6 TRANSFORMER

Transformer 800 kVA is supplied by the purchaser. The supplier of the secondary substation shall install the transformer in the factory. The substation shall be possible to equip with one three-phase ONAN distribution transformer.

For technical specification for the supplied transformer, see Attachment 4.

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Distribution transformer ONAN		
Rated power	Voltage ratio	Connections and clock hour figure
800 kVA	11000 V $\pm 2 \times 2.5\%$ / 420 V	Dyn11
800 kVA	22000 V $\pm 2 \times 2.5\%$ / 420 V	Dyn11

The low voltage connection is to be made using cable or flexible busbars, depending on the transformer. It may be necessary to adjust the selected dimensioning following type testing of the substation.

6.1 Other installations (transformer)

The high voltage connection shall be designed for 20 kA (11 kV), or for 16 kA (22 kV) 0.5 s, at the transformer breaker.

Initial earthing of the high voltage side of the transformer shall be accomplished with an earthing switch that is suitably located in the medium voltage switchgear.

- Taped connections shall not be used.
- To be connected to the transformer by crimped or threaded cable lugs.
- To be connected to the switchgear with suitable connectors.
- Screening shall only be connected in the medium voltage switchgear.

Connection between the transformer taps and the medium voltage switchgear will be specified when ordering. The following alternatives may be employed:

A connected to phase L3	A connected to L1
B connected to phase L2	B connected to L2
C connected to phase L1	C connected to L3

The low voltage connections shall be made using cables or flexible bars, depending on the transformer. Only one connection per bolt shall be used between transformer connection palm and low voltage connection. It may be necessary to adjust the selected dimensioning following type-testing of the substation.

Connection between the transformer taps and low voltage switchgear will be specified when ordering. The following alternatives may be employed:

a connected to phase L3	a connected to L1
b connected to phase L2	b connected to L2
c connected to phase L1	c connected to L3

6.1.1 Synchronizing equipment

Synchronizing equipment shall be included. Equipment shall have double isolated installation (double isolated RK and installed in separate hoses) without fuses and panel mounted sockets for test probes. The sockets shall not be mounted on the cabinet door or other moving part. The sockets shall be placed so they are safe to use during operation.

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The safety sockets shall be according to this:

- L1 red (SKS Kontakttechnik GmbH art. no 972 356-101, or equivalent)
- L2 white (SKS Kontakttechnik GmbH art. no 972 356-107, or equivalent)
- L3 green (SKS Kontakttechnik GmbH art. no 972 356-104, or equivalent)

The equipment are used to synchronize mobile back-up power and the grid. Synchronizing equipment shall be labelled “Synkroniseringsutrustning”.

7 LOW VOLTAGE SWITCHGEAR

7.1 General

The secondary substation shall include a low voltage switchgear that shall be built and equipped as in the following sections.

The equipment shall be dimensioned to fulfil the technical data in section 4.

7.2 Configuration and design

The switchgear is fed from one (1) 800 kVA transformer and have eight (8) outgoing fuse-switch-disconnectors (400 A) (with side connection).

Space for mobile back-up power connection (two (2) fuse-switch-disconnectors dual cable, 630 A).

The general function of the switchgear shall be equivalent to the single-line diagram in Attachment 1.

Connection of the low voltage switchgear, see section 6.1.

All devices shall be serviced and inspected from the front.

All outgoing cables are to be connected from beneath. The bottom frame's front base shall be removable, so that the cables can be drawn in at their respective connection locations. The standard area and cable type is N1XE-AS 4x240 mm².

All cable connections are to consist of separate bolted connections, i.e. parallel cables are to be fitted with separate bolted connections at both ends.

7.3 Cabinet

The switchgear shall be enclosed in sheet metal, also on the top and the back.

The lower front plate and beam shall be detachable.

At the switchgear's outer end, there shall be an empty switchgear cabinet with interior dimensions of at least $w = 700$, $h = 500$ and $d = 200$ mm. For connecting conductors, at least one size-21 bushing opening shall be located at the top of the cabinet.

All cabinet doors shall be protective earthed.

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7.4 Busbar

Main busbar - busbar to which one distribution busbar and incoming units can be connected (before and after circuit breaker).

Distribution busbar - connected to the main busbar and from which outgoing fuse-switch-disconnectors are connected.

The distribution busbar for mounting the fuse-switch-disconnectors shall be IP2X.

The distribution busbar shall be mounted downwards L1, L2, L3, PEN.

The protective earth and neutral (PEN) bar shall by the supplier be configured with 10 cable clips (240 mm²) for PEN conductor.

The protective earth bar (PEN) shall be prepared at both ends for connection to operative earthing consisting of 95 mm² Cu conductors equipped with crimped cable lugs for M12 screw connection.

The protective earth and neutral (PEN) busbar are to be suitable for the connection of 240 mm² Al/Cu.

Screw joint shall be fitted with tensioned washers according to DIN 6796 under both the screw head and the nut.

Following information shall be specified in the tender. The information shall be for all phases and PEN in the main current paths.

- Busbar material.
- Dimensions for cross sectional area.
- Positioning of the sections (vertical or horizontal).
- Distance between busbars.
- Temperature rise in K for the conditions specified above.
- Method for temperature rise determination (calculated or measured).

7.5 Ball studs or earthing switch

The input feeds to the switchgear shall be equipped with ball studs, alternatively earthing switch, fitted before the circuit breakers.

If the switchgear is equipped with ball studs they shall have a diameter of 25 mm and shall be able to withstand a rated short-time current of 25 kA/1s. When using ball studs, the wing nut shall be of the Stålskog brand, or equivalent.

If the switchgear is equipped with an earthing switch instead of ball studs the earthing switch shall have a making capacity of 50 kA and a rated short-time current of 25 kA/1s.

Earthing switches are to be equipped with:

- Manual spring unit for closing and opening.

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- Locking mechanism for closed position.
- Clear mechanical indication of position, visible from the front of the cabinet.

The earthing switch shall be possible to have in an earthed position behind a closed substation door.

7.6 Circuit-breaker

The switchgear shall be equipped with one 3-pole manual circuit breaker with independent closing and opening, a withdrawable configuration and having the following specifications:

Rated current, 1600 A

Manual, withdrawable, 3-pole air circuit breaker (ACB) equipped with:

Shunt trip, 250 V/50 Hz MX

and contacts for indication of:

Connected position CE

Auxiliary contacts connected to terminal for easy access according to the table below.

In connected position	2 NC + 2 NO	
Rated current	10	A
Rated voltage	250	V
Rated frequency	50	Hz

The circuit breaker shall be equipped with a trip block with the following basic functions:

Long-time tripping, adjustable up to the rated current I_n and with adjustable inverse time delay.

Short-time tripping with I_{ct} selector (CLOSED/OPEN) adjustable from $1.5 \times I_n$ with delay up to 0.3 s.

In other respects, the circuit breaker shall be equipped with:

- Operating mechanism for operation with closed cabinet door.
- Multiple-pole, non-reversible, contact device for control cables.

The following interlocks shall be fitted:

- The circuit breaker unit shall not be possible to withdraw from the connected (operating) position nor be moved in from the disconnected (test) position when the circuit breaker is closed.
- The circuit breaker shall not be possible to close when the breaking component is between the connected and disconnected positions.

The withdrawable unit shall, when applicable, be effectively earthed, with the unit designed in accordance with primary data for the respective types, for 0.5 s in the

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connected position, disconnected position and between these positions. Mechanical indication shall indicate tensioned springs and the circuit breaker's CLOSED and OPEN positions.

7.7 Outgoing units

The switchgear shall have eight (8) outgoing fuse-switch-disconnectors with side connection installed.

The fuse-switch-disconnectors for outgoing cables shall be rated 400 A and shall be delivered complete for connections of cable type N1XE-AS 4x240 mm².

The switchgear shall have space reserved for mobile back-up power connection. Two (2) fuse-switch-disconnectors dual cable with side connection, rated 630 A.

Option 7: The fuse-switch-disconnectors for mobile back-up power cables shall be rated 630 A, with side connection and shall be delivered complete with dual cable connections for 2 x N1XE-AS 4x240 mm².

The fuse-switch-disconnectors shall have voltage test holes.

Under the fuse-switch-disconnectors, for the cable installation, an anchor rail suitable for N1XE-AS 4x240 mm² type WIBE 24/40 or equivalent shall be placed.

After the cable installation, the use of a clamp current meter on all phases on all cables shall be possible.

A test assembly shall be performed by the supplier with a N1XE-AS 4x240 mm² cable to determine the location of the anchor rail.

Only 4-conductor cable will be connected with 240 mm² Al.

It shall be possible to equip output fuse-switch-disconnectors with permanently attached current transformers in phase L1. The current transformers may not be of a model that can be separated.

7.8 Auxiliary circuits

Auxiliary conductors shall have an area of 2.5 mm² for current transformer circuits and an area of 1.5 mm² for other circuits. These conductors shall be run so that they are well protected from any internal faults that arise with arcing inside the switchgear.

It shall be possible to test and disconnect terminal blocks for auxiliary current as specified by SEN 36 03 13, Class B. Other terminal shall be configured as specified in SEN 36 03 13, Class A.

Terminal blocks shall have minimum protection class IP2X.

Solid conductors connected to the same terminal on a terminal block shall have the same area.

Multiple-stranded conductor and solid conductors shall not be connected to the same terminal on a terminal block.

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A maximum of two internal connection conductors may be connected to a terminal block.

Auxiliary relays shall be mounted in sockets and be standard model.

The terminal rail shall have approximately 10% free space for later use.

7.9 Local power

One complete local power supply, 63 A, complete with fuses with function as specified in Attachment 1. The 63 A fuses shall withstand the same short circuit current as for the low voltage switchgear specified in section 4.

One distribution board with at least six (6) 3-pole groups, threaded II complete with hoods and gauge pieces (screw mounting, Swedish standard).

The distribution board shall have free space for connection of PE and cable shield to be able to use all groups.

A residual current device shall be installed to protect wall sockets and the 3-phase outlet, as described in section 8.3.

7.10 Measuring instrument

The installation shall include three (3) current transformers (1500 / 5A), shall be Class 0.2S.

Double bolts for short-circuiting the current transformers when changing the measuring instrument during operation.

Part of Option 2:

A multifunction instrument shall be installed in the cabinet door visible from the front.

The instrument shall be Megacon EMS96-ETH-WEB or equivalent.

EMS96-ETH-WEB shall be delivered completely installed, programmed and connected.

On the cabinet door, a serial output (DB9 female) shall be placed to enable the instrument to be connected to a computer. The DB9 shall be connected to the EMS96-ETH-WEB according to the table below.

Signal	DB9, pin
TX	2
RX	3
GND	5

7.11 Signal board

Part of Option 2:

One panel-mounted signal board with ten channels for closing contacts 230 V / 5 A and closing contacts 230 V / 5 A for external joint signal as specified in Attachment 2

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Brand Osterbrant and model PILOT B10 MX-AR.K1 with UPS, or equivalent. All signals in Attachment 2 shall be connected to the signal board.

Functions for all measured values and contacts shall always be ensured, even in the event of a power outage at the substation.

One switch to turn off (Offline/In operation) the external joint signal (control cable), specified in Attachment 2. A light on the cabinet’s door shall indicate when the signal is offline-mode.

8 OTHER INSTALLATIONS

8.1 Control cable box

Part of Option 2: A complete and ready-mounted enclosure is to be installed at a suitable location within the high voltage section as specified in the diagram of circuit principles of signal circuits, Attachment 2, and for the subsequent connection by the purchaser of control cables. The enclosure is described in Attachment 3. The manufacturer shall be specified in the bid.

8.2 RTU

Part of Option 1:

The RTU with modem and firewall, all installed in a cabinet, are supplied by the purchaser. The antenna and the antenna cable is supplied and installed by the purchaser. The Pt100 sensor for the transformer temperature is supplied by the purchaser and installed by the supplier of the secondary substation.

Maximum dimensions for the RTU cabinet W x H x D = 600 mm x 800 mm x 300 mm shall be possible to install. The RTU cabinet includes a UPS.

Components shall have auxiliary contacts or equivalent that enables connection to a remote terminal unit (RTU) for monitoring of the secondary substation and remote control of the feeder bays according to table below.

Component to monitor	Type of information
Position of circuit breakers in transformer bays:	
Medium voltage	Double-point information
Low voltage	Double-point information
Position of switch disconnectors in feeder bays	Double-point information
Position of earthing switch feeder bays and transformer bays	Double-point information
Feeder bays remote not ready (if applicable)	Single-point information
Remote control switch disconnectors in feeder bays	Double command
Fault indicators in feeder bays:	
Over current	Single-point information

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Earth fault	Single-point information
Fault indicator reset (combined for all feeder bays)	Single command
High temperature	
T11	Single-point information
Pt100	Analog value
Low voltage measurement	Analog value

The RTU cabinet shall be installed at a suitable location within the secondary substation.

A secured placement for the antenna shall be prepared. Antenna cable routing and antenna placement shall be safe from vandalising. The solution shall be specified in the tender.

8.3 Lights and outlets

Lighting shall be arranged at all places using fixed lighting devices. These shall be located such that light bulbs can be replaced without risk during operation.

Easily accessible wall sockets with two-way 10 A and earth attachments shall be installed in the high voltage section and the low voltage section. These shall be protected by a residual current device.

One outlet for 3 phases + N + PE 32 A is to be mounted in the low voltage section, protected in the group unit with 25 AT, at a location such that it is easy to connect to the outlet with an electrical plug.

9 EARTHING

One earth terminal block, Cu 50x6 mm, is to be located on the wall within the high voltage section, equipped with ten (10) through-holes, d = 13 mm, cc min. 35 mm. In each hole there is to be a bolt 12 mm with screw nut.

To the block, 95 mm² Cu earth conductors are to be connected for medium voltage switchgear, for low voltage switchgear, for the transformer chassis and for earthing exposed parts. The remaining terminals are intended for the earth lines, earth plate conductors and reserves associated with the cables. The conductors are to be labelled in a suitable manner.

The main earth conductor is to be installed in the substation in the form of a ring with clamp-on units. Objects connected to this earth conductor ring are not allowed to be a part of the ring itself.

In addition to the above, all earth conductors from the terminal block to the transformer chassis, and the PEN bar in low voltage switchgear, shall consist of Cu 2x95 mm².

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10 TESTING

Each component shall be tested as described in this document and in accordance with the respective applicable norms or standards for the component. Type testing and routine testing of the substation shall be as specified by SS EN 62271-202, with the addition of the temperature rise test being completed with 125% load for two hours.

Installed relay protection for both medium voltage and low voltage shall be function tested at the factory. Documentation of the function test shall be included in the delivery of the substation.

The supplier of the substation shall before the first delivery specify at which distance in meter from the substation where the sound pressure level (LpA) is 40 dB(A) at a height of 1.5 m above the ground. This applies to all four sides of the substation.

The purchaser shall be given the opportunity to be present during testing.

Type testing documentation for a similar substation can be appended to the bid. Regardless of the type testing documentation appended, the bid shall still include an option for type testing, with the supplier agreeing to conduct an approved type test prior to the initial delivery. The purchaser is to determine whether appended type test documentation shall be regarded as equivalent, or if the option is to be ordered. The purchaser also reserves the right to independently arrange type testing. In this case as well, all type testing shall be approved prior to the initial delivery.

If type testing is not approved, the purchaser is entitled to demand new type testing within 14 days at the expense of the supplier.

Type testing shall be conducted, alternatively have been conducted, by a member of SATS (Scandinavian Association for Testing of Electric Power Equipment) or by another equivalent laboratory outside of the Nordic region that has been approved by the purchaser.

Part of Option 1: All signals and manoeuvres shall be tested from component to the RTU according to agreed test protocol.

Option 10: Type testing b), c), d) and e) according to SS EN 62271-202.

Option 11: Type testing i) according to SS EN 62271-202. Performed at the same time as the tests in Option 10.

11 LABELING

All requisite signs, excluding address sign, are to be included in the delivery.

The signs to be delivered include the following:

- Warning signs (both internal and external)
- Signs for the group unit
- Signs for the earth terminal block

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- Signs for the medium voltage switchgear and low voltage switchgear to the extent required for their operation and connection
- Three signs in Swedish "Får ej manövreras. Arbete pågår."

Phase conductors in the high voltage section shall be labelled L1, L2 and L3.

Conductors within the low voltage section shall be labelled L1, L2 and L3. The common protective earth and neutral conductor is to be labelled PEN.

Labelling of medium voltage switchgear, see section 5 and Attachment 1.

Labelling of main current circuits shall be carried out on the switchgear's input feeds, on busbars, on both sides of the bars for the circuit breaker and the ball studs/earthing switch, on bars (where relevant) both before and after the 3-pole group unit in the output bay. The same labelling of conductors is to be applied to all switchgear. Input bars have the following phase sequence, from left to right when the switchgear is viewed from the front: PEN, L3, L2 and L1. Busbars shall be installed and labelled downwards, L1, L2, L3 and PEN.

Labelling of auxiliary circuits shall be carried out as specified in SEN 36 03 11 and SEK Handbok 423, Classes A and B; connection labelling, PARTEX sleeves or equivalent sleeves shall be used.

All internal cabling in the substation is to be labelled in both ends with a label sleeve. The marking shall be carried out so that it is easy to read the two connection points of the cable in both ends.

Labelling may change depending on the order form.

External signs shall be resistant to UV radiation.

A sign shall be installed at a suitable location giving the supplier's manufacturing number (serial number) and the order number of the purchaser.

All signs shall be in the Swedish language.

12 DOCUMENTATION

An excavation drawing for the foundation of the substation shall be sent to the purchaser six weeks prior to the first delivery.

Three (3) copies of the type documentation in binders shall be sent to the purchaser with the first delivery. A digital copy (pdf-files) of the type documentation shall be sent to the purchaser. This documentation is to include descriptions and instructions for use, etc. in the Swedish language, together with other relevant drawings for the substation that are required for its commissioning, inspection, troubleshooting and repair. Sound test protocol (see section 10) shall be included. A list of torques for any M10 or larger screw/bolt connections that occur, and all type testing documentation carried out as specified by standards (thermal testing, etc.) shall be included.

Documentation to be sent with each delivery (one copy in paper form accompanying the substation and one electronic copy to the person specified in the purchase order):

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- building layout drawing, including the documents required for building permits.
- single line diagram. One laminated diagram shall be put up inside the substation.
- circuit diagrams
- list of apparatuses
- list of cables
- list of connections
- **Part of Option 1:** signal list (signal to plinth and input in RTU)
- list of signs
- installation instructions (mounting, connection and taking into service, lifting)
- list of all suitable (brand and type) connectors 630 A, type C
- operation and maintenance instructions (fault tracing, repair etc.)
- function test of relay protection

All above documents shall be in Swedish.

13 TRANSPORT, LIFTING AND INSTALLATION

The purchaser is to prepare a drained bed as specified in instructions from the supplier, and ensure that a permitted, accessible path to the installation site is available. The purchaser also provides personnel for control when lowering the substation. The supplier is responsible for transport to and lifting at the installation site. Transport shall be conducted with regard to the traffic regulations of the relevant municipality. Traffic permits and similar, when necessary, are to be obtained and funded by the supplier.

The supplier is responsible for removing packaging, materials for safe transport and similar materials.

Option 8: Unloading of substation at site. Lifting distance c/c 0 - 10 m

Option 9: Unloading of substation at site. Lifting distance c/c 10 - 15 m

14 TRAINING

Option 13:

The supplier shall provide skilled personnel to demonstrate all normal inspection, maintenance and service routines for the equipment supplied. This training shall take place in the Stockholm area and in Swedish no later than four weeks after placement of the order of the training by the purchaser.

Training shall be priced separately in the bid. Estimated duration of training: one day.