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Technical specification Switchgear 0.5 kV

REVISION HISTORY

Revision	Date	Comment	Reviewed by
1.0	2023-12-14	Revision of TS from 2018-10-18. Integration with RTU added.	Nätkommittén

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1 GENERAL

Technical specifications and details for the delivery of indoor low voltage switchgear 0.5 kV to Ellevio.

In this specification, LV Type 1-7 are specified.

2 APPLICABLE STANDARDS AND REGULATIONS

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

1. The Swedish National Electrical Safety Board's Regulations (ELSÄK-FS)
2. This technical specification
3. Low-voltage switchgear and controlgear assemblies
 - Part 1: General rules, SS-EN IEC 61439-1
 - Part 2: Power switchgear and controlgear assemblies, SS- EN IEC 61439-2
 - Part 3: Distribution boards intended to be operated by ordinary persons (DBO), SS-EN 61439-3

Dimensions of low-voltage switchgear and controlgear - Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories, SS-EN 60715

Kontrollutrustningar - Lednings- och uttagsmärkning, SEK Handbok 423

4. Other applicable SS, EN and IEC standards

3 CONFIGURATIONS

LV Type 1

Fed from 1x800 kVA transformer and eight (8) outgoing fuse-switch-disconnector (400 A).

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

Single-line diagram, see attachment 1.

LV Type 2

Fed from 1x1000 kVA transformer and 11 outgoing fuse-switch-disconnector (400A).

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

Single-line diagram, see attachment 2

LV Type 3

Fed from 1x1000 kVA transformer and one outgoing bar.

Single-line diagram, see attachment 3.

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LV Type 4

Fed from 2x1000 kVA transformer and 27 outgoing fuse-switch-disconnector (400 A).

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

Single-line diagram, see attachment 4.

LV Type 5

Fed from 2x1000kVA transformer and 18 outgoing fuse-switch-disconnector (400A).

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

Single-line diagram, see attachment 5.

LV Type 6

Fed from 2x1600kVA transformer and 2x16 outgoing fuse-switch-disconnector (400A).

Space for mobile back-up power connection (2x2 fuse-switch-disconnector dual cable, 630A)

Single-line diagram, see attachment 6.

LV Type 7

Fed from 2x2000kVA transformer and 2x16 outgoing fuse-switch-disconnector (400A).

Space for mobile back-up power connection (2x2 fuse-switch-disconnector dual cable, 630A)

Single-line diagram, see attachment 7.

Options for all types

- Arc guard
- Transformer connection from below (normally connected from above)
- Fuse-switch-disconnector dual cable, 630A, for mobile back-up power connection.
- Extended switchgear for three (3) fuse-switch-disconnectors, 400A
- Extra Fuse-switch-disconnector, 400A

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4 MAIN TECHNICAL DATA

Main technical data that shall be fulfilled, table 1-3.

Table 1 General data for all types

General data for all types		
Nominal voltage	V	420
Rated insulation voltage	V	500
Test voltage versus effective voltage	V	2500
Rated frequency	Hz	50
Degree of protection in service (including top and bottom)		IP2X
Degree of protection in service (including top and bottom)		IP2X
Operation temperature	°C	-25 – 40

Table 2 Technical data LV Type 1-4

		LV Type 1	LV Type 2	LV Type 3	LV Type 4
Transformer	kVA	1x800	1x1000	1x1000	2x1000
Output (fuse-switch-disconnector, 400 A)		8	11	Bar	27
Space for mobile back-up power connection (fuse-switch-disconnector dual cable, 630 A)		2	2	0	2
Rated short-time withstand current, 1 s	kA	25	30	30	55
Rated peak withstand current	kA	50	65	65	115
Rated current, distribution busbar, phase conductor	A	1600	2000	2000	2500
Rated current, distribution busbar, PEN conductor	A	800	1000	1000	1250
Rated current, main busbar, phase conductor	A	1600	2000	2000	2000
Rated current, main busbar, PEN conductor	A	800	1000	1000	1000

Table 3 Technical data LV Type 5-7

		LV Type 5	LV Type 6	LV Type 7
Transformer	kVA	2x1000	2x1600	2x2000
Output (fuse-switch-disconnector, 400 A)		18	2x16	2x16
Space for mobile back-up power connection (fuse-switch-disconnector dual cable, 630 A)		2	2x2	2x2
Rated short-time withstand current, 1 s	kA	55	50	50
Rated peak withstand current	kA	115	105	105
Rated current, distribution busbar, phase conductor	A	2500	2500	2500
Rated current, distribution busbar, PEN conductor	A	1250	1250	1250
Rated current, main busbar, phase conductor	A	2000	2500	3000
Rated current, main busbar, PEN conductor	A	1000	1250	1500

5 DESIGN OF THE SWITCHGEAR

The general function of the switchgear shall be equivalent to the diagrams in attachment 1-7.

All devices shall be serviced and inspected from the front.

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The connection from transformers should be possible from the top with the option of connection from below according to the order form. Input with RK, cable or bar connection.

The phase sequence according to the order form. Palms for transformer connection are determined after contract signing.

All outgoing cables are connected from below and the standard area and cable type is 4x240 mm².

For connecting external wiring, two flange with size 21 should be on the top of the cabinet.

5.1 Installation of the switchgear

The switchgear will be installed inside a building but manage outdoor temperatures.

The switchgear will be installed on an installation floor with normal height of 650-800 mm.

The switchgear is normally placed directly to a wall. However, it shall be possible to place it stand-alone.

5.2 Cabinet

Main dimensions (length) for LV Type 1-7 shall be according to table 4.

Table 4 Main dimensions (maximum approximately)

		Connected from below	Connected from above
LV Type 1	mm	2500	2000
LV Type 2	mm	2500	2000
LV Type 3	mm	800	800
LV Type 4	mm	5500	4500
LV Type 5	mm	4500	3500
LV Type 6	mm	6000	5000
LV Type 7	mm	6000	5000

Table 5 General dimensions

Assembled height (max)	mm	2250
Transport height (max)	mm	2000
Longest transport width (max)	mm	2000

For practical reasons, the switchgear shall be delivered in parts that can easily be assembled on site. Transport length and height in table 5.

The switchgear parts shall be provided with lifting hooks on all top corners.

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

The lower front plate and beam shall be detachable.

Colour, sheet metal enclosing (all doors and panels)

Material / finish / colour, supporting structure - Galvanized sheet metal

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All cabinet doors shall be protective earthed.

5.3 Busbar

Main busbar - busbar to which one distribution busbars 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.

Following information shall be specified in de tender. The information shall be for all phases, PE+N and main current paths.

- Busbar material
- Dimensions for cross sectional area
- Distance between busbars
- Increase of temperature
- Method of temperature rise (calculated or measured)

The existing screw joint is fitted with tensioned washers according to DIN 6796 under both the screw head and the nut.

5.4 PEN busbar

Protective earth and neutral busbar (PEN) shall be suitable for a 240 mm² Al connection of outgoing cable screen and fourth conductor provided with contact pressed cable shoe for screw connection M12. Furthermore, the protective earth and neutral bar shall in both ends be prepared for connection of earth wire consisting of 120 mm² Cu wires fitted with contact pressed cable shoes for screw connection M12.

5.5 Earthing switch

The switchgear main busbar shall be fitted with earthing switches (not withdrawable configuration), mounted before the circuit breaker. Earthing switch technical data shall be according to table 6.

Table 6 Earthing switch, technical data

Type	Rated short-time current [kA/1s]	Closing capacity [kA]
LV Type 1	25	50
LV Type 2	30	65
LV Type 3	30	65
LV Type 4	55	115
LV Type 5	55	115
LV Type 6	50	105
LV Type 7	50	105

Earthing switches shall 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

Earthing with the earthing switch shall be possible to conduct with a closed cabinet door.

The cabinet door shall be possible to open after operating the earthing switch.

5.6 Circuit breaker

The switchgear shall be equipped with 3-pole manual circuit breaker with independent closing and opening, a withdrawable configuration and have specifications according to table 7:

Table 7 Circuit-breaker, technical data

Type		Rated current
LV Type 1	A	1600
LV Type 2	A	2000
LV Type 3	A	2000
LV Type 4	A	2000
LV Type 5	A	2000
LV Type 6	A	2500
LV Type 7	A	3000

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 table 8.

Table 8 Auxiliary contacts

In connected position		2 nc + 2 no
Rated current	A	10
Rated voltage	V	250
Rated frequency	Hz	50

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^2t 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

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

5.7 Outgoing units

Number of fuse switch disconnectors for outgoing cables according to table 9.

In addition to fuse switch disconnectors for outgoing cables, location for dual cable fuse switch disconnectors for mobile back-up power cables shall be reserved.

The fuse switch disconnectors for outgoing cables shall be rated 400 A and shall be delivered complete with cable connections for 4x240 mm².

The fuse switch disconnectors for mobile back-up power cables shall be rated 630 A and shall be delivered complete with dual cable connections for 2 x 4x240 mm².

The distributions busbars shall be mounted downwards L1, L2, L3, PEN.

Under the fuse switch disconnectors, for the cable installation, an anchor rail suitable for 4x240mm² type WIBE 24/40 or equivalent shall be placed.

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

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

Table 9 Incoming and outgoing units

	Transformer	Output (fuse-switch-disconnector, 400A)	Space for mobile back-up power connection (fuse-switch-disconnector dual cable, 630A)
	kVA		
LV Type 1	1x800	8	2
LV Type 2	1x1000	11	2
LV Type 3	1x1000	Bar	0
LV Type 4	2x1000	27	2
LV Type 5	2x1000	18	2
LV Type 6	2x1600	2x16	2x2
LV Type 7	2x2000	2x16	2x2

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5.8 Section switch-disconnector

LV Type 6 and 7 shall be equipped with sectioning switch-disconnector on the distribution busbar. See attachment 6-7 (T11/T12-0,4-LF). Technical data shall be according to table 10.

Table 10 Section switch-disconnector, technical data

Rated current	A	2500
Rated short-time withstand current, 1s	kA	50
Rated peak withstand current	kA	105

5.9 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 SS-EN 60715, Class B. Other terminal shall be configured as specified in SS-EN 60715, 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.

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.

All signals in attachment 9-11 shall be connected to terminal blocks.

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

Labelling shall be carried out as specified in SEK Handbok 423, Classes A and B; connection labelling, PARTEX sleeves or equivalent sleeves may be used.

The marking shall be carried out so that it is easy to read the two connection points of the cable in both ends.

Example of design/construction in attachment 14.

5.10 Ventilation control

The room, where the switchgear is installed, and the transformers is cooled by one or two fans (one fan per transformer).

The switchgear shall be equipped with auxiliary circuits to control the fans.

The fans are controlled by a 0-10 V signal.

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Terminals for connection of external thermometers, one for room temperature and one for transformer temperature per transformer. The signals should trigger a fan start.

Switches for one or two fans (Manuel – Off – Auto).

Two potentiometers for controlling 0-10 V signal to fan, different speeds depending on whether room temperature or transformer temperature trigger a start. The potentiometers shall be placed inside the cabinet.

The potentiometer shall have a graduated scale and it shall be possible to mark normal mode (adjust airflow).

Examples of design/construction are given in attachments 12-14.

5.11 Local power

Complete local power supply, as described in attachment 14.

Distribution board as specified in attachment 1-7, 3-pole groups, threaded II complete with hoods and gauge pieces (screw mounting, Swedish standard).

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

A residual-current device shall be installed for outlets.

One outlet for 3 phases + N + PE 32 A shall be mounted in the cabinet door.

LV Type 6 and 7 shall have automatic switchover functionality for local power.

5.12 Arc guard

Six detectors installed in the switchgear and two delivered separately (maximum 10 m). Exception for LV Type 3 which shall have two detectors installed and two delivered separately (maximum 10 m).

The arc guard, one per transformer, shall trigger all tripping coils (24 VDC) in the MV switchgear independent of manufacturer. The function shall be verified before delivery.

The switchgear shall be equipped with an arc guard with capacitors device.

5.13 Synchronizing equipment

Synchronizing equipment shall be included in LV Type 1-3 (single transformer switchgears). 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 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 is used to synchronize mobile back-up power and the grid.

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Synchronizing equipment shall be labelled “Synkroniseringsutrustning”.

5.14 Integration with Remote terminal unit (RTU)

The digital secondary substation play an important role in the Ellevio smartgrid. Measurements of voltages and currents on low voltage side give insights of loading levels and power quality. Alarms and/or control of local equipment such as fans, water pumps and fire dampers are also of interest to communicate. This is done thorough a RTU and northbound to control center or analysis platform.

The supplier shall be able to integrate 3rd party RTU components and sensors into the switchgears to make the delivery as complete as possible to minimize installation time on site.

Note: This requires the switchgear supplier to be actively involved in creating a good solution together with one or several RTU providers and Ellevio. This involves the physical form of housing but also decisions which supplier is best suited to deliver auxiliary products like current transformers, voltage transformers etc. The procedures for this are determined after contract signing.

The supplier of the LV switchgear is responsible for the final assembly and test/verification of signals from switchgear and auxiliary sensors to terminal before shipping to Ellevio.

Note: The signals needed for the different LV switchgear configurations can be found in attachment 14.

Position of circuit breakers shall be indicated with double point information and connected to terminal and onwards to RTU.

5.15 Labelling

All the warning signs shall be included in the delivery.

The switchgear shall be provided with a rating plate with the manufacturer's serial number and the customer's order number.

Marking of switchgear (e.g. switching devices) shall be performed according to order form. For example, earthing switch in Stockholm: “T11-0,4-JK”.

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 stud/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. The same marking of busbars shall be applied to the entire switchgear. Busbars shall be mounted and marked downwards L1, L2, L3, PEN.

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6 DOCUMENTATION

Type documentation (in PDF and drawings also in DWG format) for all configurations and options shall be delivered no later than three (3) months after contract signing. All updates shall also be delivered continuously.

Documentation for the ordered switchgear (in DWG format) needed for the construction shall be provided no later than four (4) weeks before delivery.

Documentation to be included with each delivery shall be sent to the person specified in the order form in three (3) copies in paper form and one (1) digital copy (in PDF format and drawings also in DWG format). Documentation to be sent with each delivery shall include:

- layout drawings
- single-line diagrams
- circuit diagrams
- list of apparatuses
- list of signs
- list of torques for screw connections
- instructions and manuals which is required for installation, commissioning, operation, inspection, troubleshooting, maintenance and repair
- type testing documentation carried out as specified by standards

All above documents shall be in Swedish.