SVENSKA KRAFTNÄT

UNIT, BUSINESS AREA
NB, Grid expansion

OUR DESIGNATION
TR01-22

DATE
22 February 2018

CONSULTATION
AT, AU, NS, NL, NK, NT, IK, HM

TECHNICAL GUIDELINES

VERSION
4

APPROVED
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Technical building

Introduction

These guidelines deal with the technical requirements and preconditions for the supply of technical buildings with associated basic installation and basic equipment. Unless otherwise stated, Swedish regulations and standards must take precedence, followed by international standards.

Updates

Version	Note on amendments	Date
1	Original version (TR04-03)	30 March 2012
2	New TR number, extensive updates introduced after framework agreement procurement	19 August 2015
3	Appendix added on earthing and erection of technical building, previously TR10-02	24 March 2017
4	Minor adjustments to frame, alarms and signals, plus reference to BASTA criteria and BEST	22 February 2018

Contents

1 Specification of technical building

These technical guidelines are intended to form the basis for procurement, and describe how Svenska Kraftnät's technical buildings must be constructed and equipped.

In the choice of materials for components and equipment, the requirements in TR13-04-01 must be met, and building materials and products must comply with the BASTA criteria. If it is not possible to fulfil BASTA's criteria, building materials and products that fulfil BETA's criteria must be used.

1.1 References

The following technical guidelines must be followed in procurement:

- TR01-18 – Standby diesel power systems
- TR02-09-01 – DC system
- TR09-04 – Installation protection
- TR09-07 – Entry system
- TR13-04-01 – Requirements concerning environment and health

2 Building

2.1 General points

The technical building must have sufficient capacity to accommodate several stands or cabinets for communications equipment measuring 600 × 600 mm, as described below, together with rectifiers, batteries, ventilation etc. The ceiling height inside the technical building must be at least 2.50 m.

The technical building is designed in two sizes, as follows:

- One size suited to 4+3 stands (4 free, 1 for ODF, 1 for 48 V system and 1 for RTU/Lock etc.), with an inside size of at least 2.60 × 3.20 m (W × L). A suggested type drawing is shown in Figure 4.

- One size suited to 10+3 stands (10 free, 1 for ODF, 1 for 48 V system and 1 for RTU/Lock etc.), with an inside size of at least 2.60 × 5.00 m (W × L). A suggested type drawing is shown in Figure 5.
- The technical building must be suitable for road transportation without special authorisation.
- The technical building must be dimensioned and adapted for being lifted with a mobile crane, and fitted with lifting brackets.
- For operation and maintenance, and for orientation, the supplier of the technical building must carry out appropriate, coordinated and clear labelling of installations. All installations must be labelled in accordance with Swedish standards, in Swedish, and only established abbreviations may be used. Items of control equipment such as timers, thermostats and similar must be clearly labelled to indicate their function.

2.2 Frame

The following requirements apply to the frame of the building:

- The walls and floor of the technical building must be made of fully-welded steel sheeting.
- The building must fulfil SSF 200 'Regulations for mechanical intrusion protection' class 3.
- All surface treatments must fulfil corrosion class C4, high durability.
- The technical building must be equipped with a steel sheet gabled roof with a gradient of at least 14° and dimensioned for snow zone 5.5. The roof must be of a light colour in order to limit heating by the sun.
- Irrespective of the type of foundation, the cable entries must be protected from intrusion by a fully-welded steel plate frame.
- The inside walls and ceiling must be faced with 12 mm plywood and painted in a light colour.
- The floor covering must be made of hard-wearing, easy-to-clean vinyl, turned up against the walls.
- The floor must have a concentrated load of at least 200 kg/dm² and a distributed load of at least 500 kg/m².
- Two 19-inch stands must be fitted in the technical room. The cabinets must be lockable with padlocks, and one must have a 19-inch mounting stand, of the Elkapsling make (DC 220 60 60 with side panels and ventilated door) or equivalent. The stand must be positioned on the long wall immediately inside the build-

ing to the right for the assembly of RTU, entry system, communications equipment etc. The frame must be fitted with double 19-inch bars (at the front and rear edges) and an earth bar connected to the cabinet earth. The cabinet must be earthed with a 10 mm² cable to the nearest earth bar. The other stand, of the Elkapsling make (DCG 220 60 80 PD with double doors and side panel) or equivalent, must be installed next to the 48 V system for fibre ODF to be added, and earthed with a 10 mm² cable to the nearest earth bar.

- The foundations of the technical building must be made of a metal frame, concrete plinths, concrete sleepers or equivalent. The foundations must not consist of organic material.
- The technical building must be fitted with gutters and drainpipes.

2.3 Insulation

The insulation and environmental factors of the materials used in the technical building must meet the following requirements:

- The technical building must have insulation with an average heat transfer coefficient (U_m) of no more than 0.25 W/(m²K).
- Rated outdoor winter temperature –35°C.
- Ambient temperature: –50 to +35°C.
- Relative humidity 10 – 100 %.
- Precipitation rain: 100 mm/day with angles.
- Wind speed: 30 m/s.
- Height above sea level: 0 – 1,000 m

2.4 Entrance door

The entrance door must meet the requirements for doors in TR09-04.

The door must:

- Be positioned in the middle of a short wall, in order not to block stand positions - see Figure 4 and Figure 5.
- Size of 900 x 2,100 mm.
- Be equipped with a motor lock as in TR09-07 and have ducting in the door leaf and frame.
- Entry system: Svenska Kraftnät must be consulted concerning installation of Assa ARX UC (as in TR09-07).

- There must be an entry step (door width x 40 cm deep) under the door.

Svenska Kraftnät or Svenska Kraftnät's contractor must arrange ordering of a lock and key card system for the building as in TR09-07.

If fencing is put around the building, the lock system must comply with TR09-07.

2.5 Heating

The technical building must be equipped with:

- A 2 kW electric radiator or fan radiator, controllable from the ventilation system, to ensure that heating and cooling of the building do not take place simultaneously.

2.6 Ventilation

The ventilation must consist of:

- Free cooling with a cooling output of at least 5 kW at a temperature difference of 7°C.
- A fan which can conveniently be placed in the middle of a short wall for maximum exploitation of the stand places along the long wall. Air can be taken in through a wall or the floor. Alternative positioning is described with reference to air flow. If the air is taken in via a wall, the intake must be positioned at least 1 m above the ground to reduce the risk of it being covered by snow.
- The operating voltage of the fan must be 48 V DC.
- The fan must be equipped with a timer function for temporary shut-off.
- The fan must be mechanically protected against break-in from the outside, to the same class as the rest of the wall.
- Dampers for venting air from the technical building must be fitted diagonally to the fan and fitted with motor dampers to prevent downdraughts.
- The technical building must be equipped with a 3 kW cooling unit positioned on the short wall above the free cooling.
- The control unit coordinating the radiator, fan and cooling (including the fan's speed control) must be equipped with an Ethernet interface for monitoring alarms and parameters.

2.7 Fixed equipment

The technical building must be equipped with two cable ladders with widths of 320 mm and 100 mm of the wire type, at a height of 2,350 mm on all walls. The cable ladders must be electrically bonded from the incoming earth bar; the splice of the cable

ladders must be connected with the manuacturers' approved splices or with 6 mm² RQ cable.

The cable ladder with a width of 320 mm is used for electrical and signal cables.

The cable ladder with a width of 100 mm is used for fibre cables.

The cable ladder with a width of 320 mm is fitted closest to the wall.

3 Electrical power

All electrical installations and equipment must be enclosed and touch-protected.

3.1 Power supply

The technical building must, if necessary, be supplied via a circuit-separation transformer, following the guidelines in Appendix 1, which describes the requirements for locating a technical building adjacent to power lines or in a switchgear.

3.1.1 Cable cabinet

A cable cabinet with meter panel, fixed to the ground, which also functions as cable protection, must be positioned next to the circuit-separation transformer, against the side of the technical building or at the boundary of the site.

The cable cabinet must contain:

- Switch for at least 80 A.
- Fuse holder suitable for fuses up to 63 A.
- The meter panel must be fused with at the most 25 A before or in the meter panel.
- Overvoltage protection (rough/medium protection or rough/fine protection) which fulfils class I-IV in standard SS-EN 62305 and has variable alarm contact.

The cable cabinet must be obtained by the contractor if it is not supplied with the technical building.

3.1.2 Inside distribution box

The inside distribution box must be positioned such that a distance of 1.2 m in front of it is not blocked by cabinets placed there in the future.

The distribution box must be equipped with:

- Main switch for at least 80 A.

- Electricity meter installed in consultation with Svenska Kraftnät.
- The fuses needed for heating/cooling/48 V system, lighting and socket as in these guidelines.
- 2 extra 16 A 3-phase groups with alarm contacts.
- 4 extra 10 A 1-phase groups.
- The fuses that feed the heating/cooling and 48 V system must be fitted with alarm contacts.
- Only groups for lighting and sockets must be fitted with residual current circuit breaker, 30 mA.
- If necessary, outgoing groups must be fitted with overvoltage protection - apparatus protection. In such cases, this will be specified in the tender documents.

3.1.3 Backup power lead-in

For mobile backup power, a lead-in on the outside must be fitted, as specified in TR01-18 for technical buildings, with CEE lead-in inside with a manual change-over switch for backup power.

If the backup power feed-in is to be equipped with automatic change-over, this will be specified in the tender documentation.

3.2 Electrical installation 400/230 V

3.2.1 Lighting

The technical building must be equipped with:

- LED light fitting with movement monitor must be fitted externally above the door. The light must have > 10,000 hours operating time.
- Inside the technical building, LED light sources equivalent to at least 500 lux must be fitted to the ceiling to give adequate working light.

3.2.2 Emergency lighting

A torch with emergency lighting function or LED light connected to 48 V DC must be fitted inside the technical building, next to the door.

3.2.3 Sockets

The technical building must be fitted with at least:

- One socket positioned next to the switch for lighting next to the door.
- One socket for emergency lighting, positioned at floor level next to the door, unless there is LED emergency lighting.

- Two 2-way sockets for service purposes, positioned to be easily accessible, one on each short wall about 1 m above the floor.
- All sockets must be supplied via a 10 A fuse.

3.3 Power supply -48 V DC

It must be possible to equip the power supply equipment with rectifier modules for at least 5 kW, for connection to the technical equipment, and the power supply equipment must have an additional installed rectifier module to achieve an N+1 configuration.

The power supply equipment must be in a cabinet earthed against the earth bar with an earth cable of at least 16 mm^2, and must contain, inter alia:

- Rectifier (one rectifier system with N+1 configuration, for modular extension).
- The rectifier's monitoring unit must have potential-free alarm contacts.
- The rectifier must be equipped with an Ethernet interface for monitoring alarms and tests.
- The system must be positively earthed.
- Enclosed batteries of the valve-regulated type with at least two battery groups. To comply with TR13-01, batteries must not contain cadmium or mercury.
- The battery capacity must be chosen, in consultation with Svenska Kraftnät, so that the interruption time defined in TR02-09-01 is fulfilled at 1.5 kW load if there is fixed backup power or at 2.3 kW load if there is no fixed backup power.
- The 48 V distribution must contain 30 automatic fuses with slave terminal for buzzer alarm (= tripped fuse) as follows: 6 x 10 A, 18 x 25 A, 6 x 32 A.

3.4 Ducts for lead-in to the technical building

Ducts for lead-in of the electricity lines and telecommunications cables must be through the floor next to a wall, so that as large a wall area as possible remains free for the technical room's equipment. Effective sealing of all incoming ducts must be carried out when the building is assembled - see section 3.4.4. The lead-in can conveniently be combined with telecommunications cables, as in section 3.4.2.

3.4.1 Electricity line

The tube/hose for the service line must be sited outside the foundation frame and customised to the cable cabinet. The service cable must be laid at a depth of about 0.7 m.

3.4.2 Duct for telecommunications cables

The technical building must be equipped with a cable intake for at least 10 40/32 subhoses, gathered in a small area of the building so as not to take up unnecessary floor space - see Figure 4 and Figure 5. Roxtec model sealant or equivalent must be used. The technical building must be delivered with all the material needed for sealing the cable intake for 10 subhoses.

Ducts for communications cables must be laid about 1.5 m out from the foundation frame/cable protection at a depth of 0.7 m (Figure 2). The ducts must be positioned inside the foundation frame/cable protection and fixed in the frame/protection.

3.4.3 Ducts and foundation work

The following diagrams illustrate how the cables must be led in.

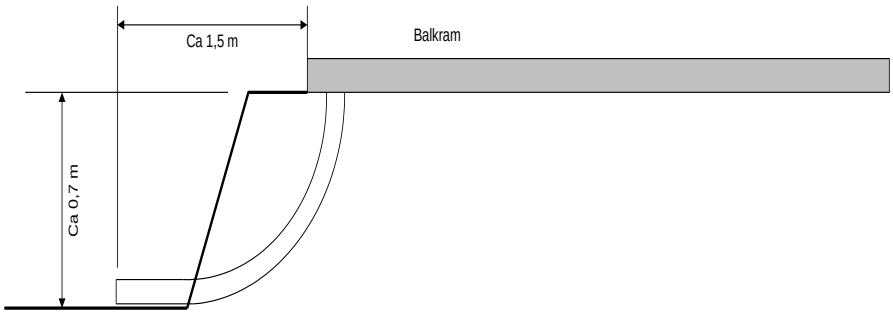
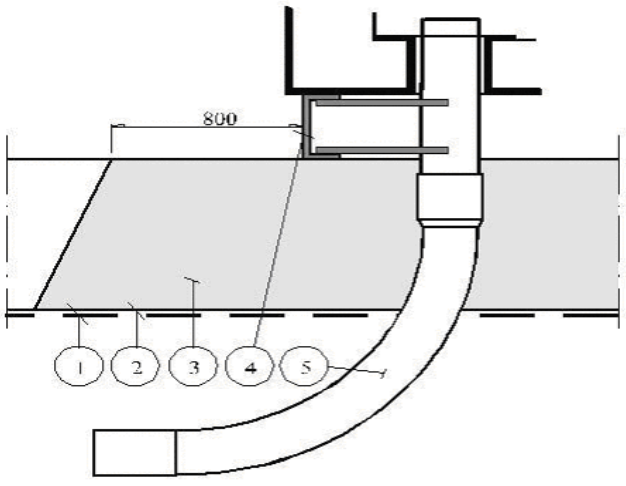


Figure 1 Foundation work



1 Shaft

2 Material-differentiating textile layer

3 Filling material

4 Foundation frame/cable protection or other foundation work

5 Duct

Figure 2 Duct connection to technical building

3.4.4 Sealant

Intake ducts with cables must be sealed with so-called 'Termosplugg', and only approved sealants may be used. Empty ducts must be fitted with a cover.

4 Earthing to the technical building

For technical buildings, account must be taken of the proximity of power lines, both Svenska Kraftnät's and those of other line owners. Appendix 1 'Earthing and erection of technical buildings' describes earthing principles in detail.

Usually, a ground conductor of the ring earth type is laid in the foundation. Read more about this below.

- The earth bar must be accessible in the technical building for connection of the earth to the technical equipment.
- Two additional earth bars must be installed in the middle of the long wall under the cable ladder for earth connection of stands to be placed there, and connected together with the main bar in the previous point.
- The earth bar must be connected to the PEN conductor in the distribution box.
- The earthing conductor, ground conductor and earth electrode must be positioned as in Figure 3 below.

- For technical buildings, a ground conductor of the ring earth type in the foundations must be connected directly to the PEN conductor fitted in the distribution box.

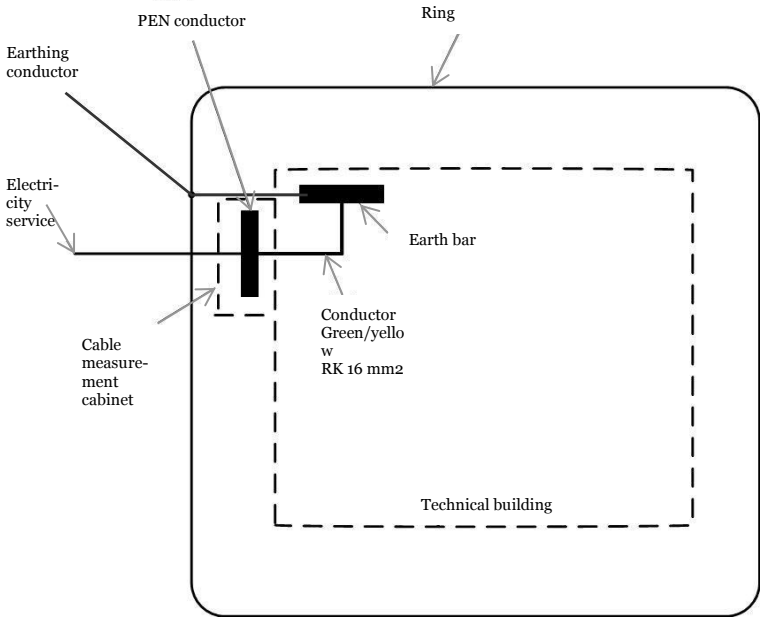


Figure 3 Earthing principles of technical building

5 Other equipment

The technical building must be equipped with the following equipment:

- Trolley with documentation cabinet
- Sheet metal step stool with wheels
- Double stepladder with 3 steps
- Wastepaper basket
- Carbon dioxide fire extinguisher, at least 6 kg
- Clothes hook
- Broom and shovel
- First aid kit
- Doormat

- Snow shovel
- Chair
- Openers for fibre well (supplied by contractor as shafts for fibre well). Where appropriate.
- Eye wash in bottle.
- Smoke detector with 24 V supply and neutral alarm contact
- Emergency alarm for working alone as in TR02-08-04, ABB E3717000 emergency stop with E3711625 safety collar or equivalent with manual reset and protection against unintentional alarm. Must be clearly labelled with a green sign and the text 'Emergency alarm'.

6 Alarms

The neutral contacts of the following equipment must be connected to RTU for alarm transmission to the operating centre:

- Fire alarm
- Burglar alarm (from entry system)
- Technical building staffed (from entry system)
- Emergency alarm
- Free cooling, all alarms.
- Cooling unit, all alarms.
- Rectifier, all alarms.
- Distribution box, tripped fuse.
- Lightning protection tripped.

Analogue signals: Temperature sensor for outdoor and indoor temperature.

Outdoor temperature sensor: KIMO TM110-POB Temp transmitter, supply 16-30 V DC output signal passive 4-20 mA (2-wire), display.

Outdoor, transmitter/PT100 sensor (suggested – but other 3-wire PT100 sensor OK). KIMO SF50-A-3-P-2-10-50, External, outdoor temperature 10 m.

Indoor, temperature sensor: KIMO TM110-POS Temp transmitter, Measurement range 0...+50°C, integrated room sensor, IP20, Supply 16-30 V DC output signal passive 4-20 mA (2-wire), display.

Choice of other equivalent temperature sensors is permissible if this is verified and approved by Svenska Kraftnät to guarantee function with overlying system.

To the above alarm contacts, cables laid on a 19-inch mounting stand - see section 2.2. The cables must be laid on the cable ladder and hung loosely on the stand, clearly labelled. Connection to the technical building's RTU (carried out by Svenska Kraftnät or Svenska Kraftnät's contractor).

Two supplies from the rectifier (48 V DC) must be pulled forwards to the mounting frame and hung loosely on the stand, fused with 10 A in 48 V distribution.

7 Communications equipment

Technical buildings must have equipment for remote control and communication. If this is not to be included in the delivery of the technical building, this must be specified in the tender document.

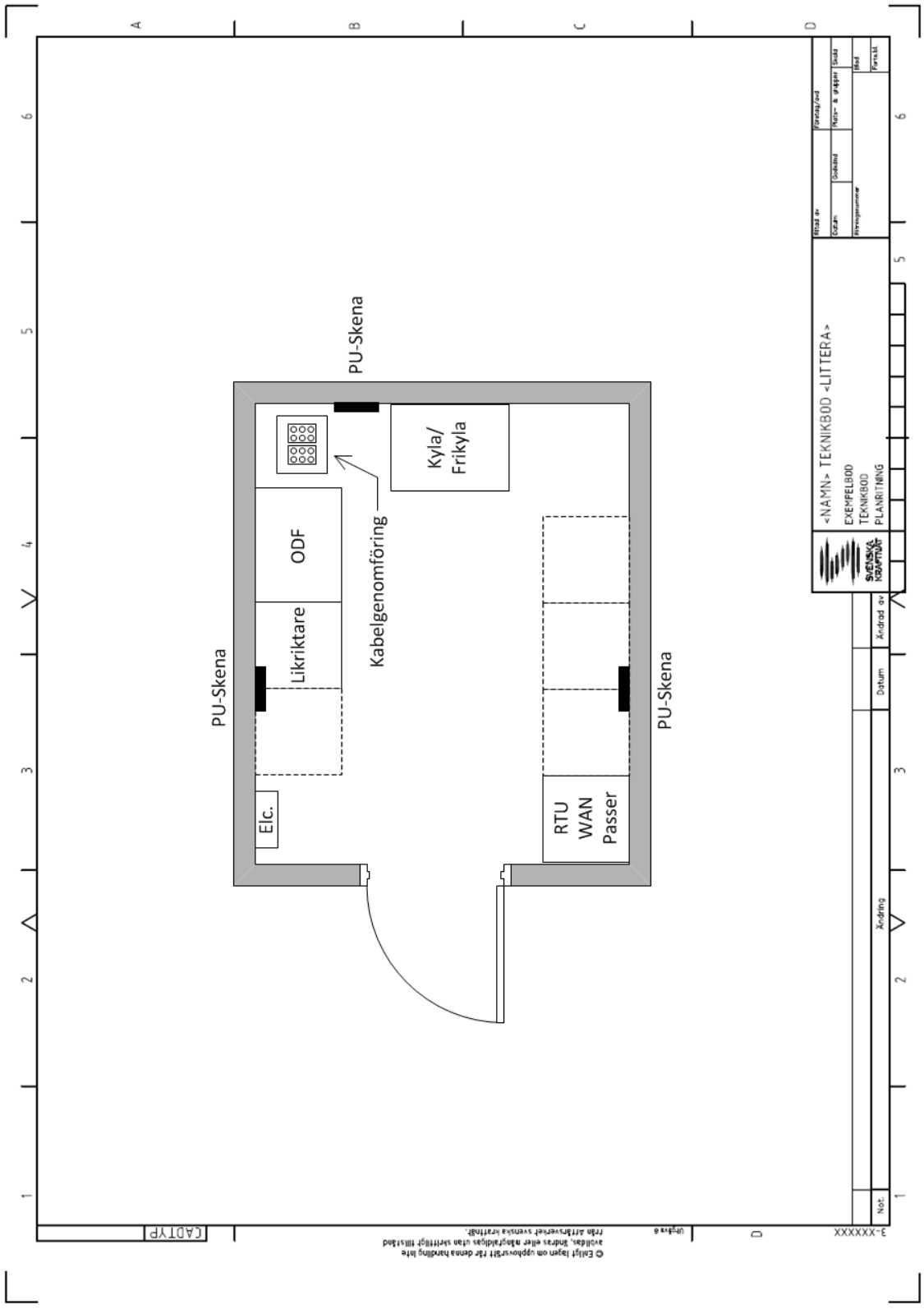


Figure 4 Type drawing for small technical building

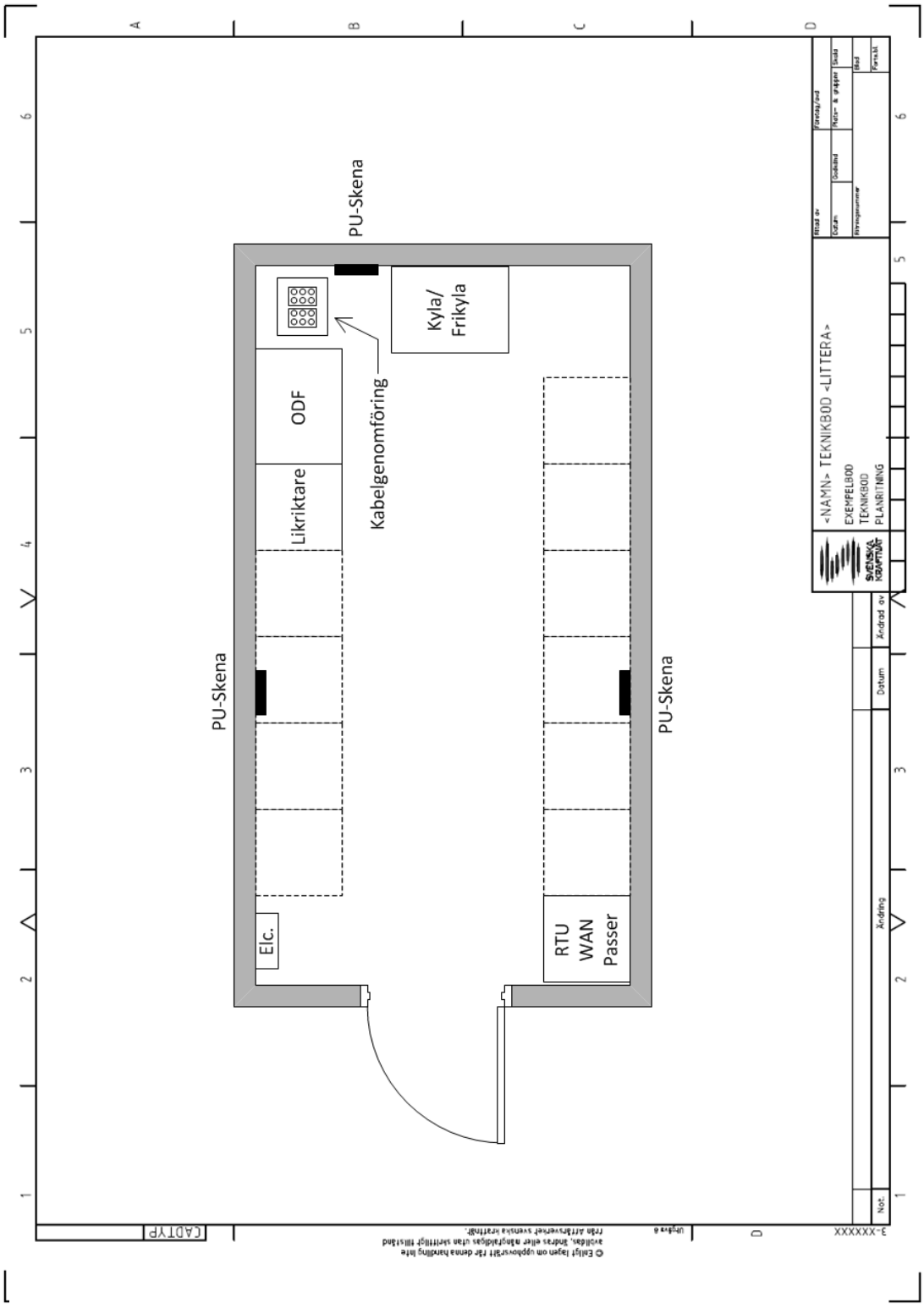


Figure 5 Type drawing for large technical building

Appendix 1: Earthing and erection of technical buildings

Summary

This Appendix 1, 'Earthing and erection of technical buildings', states the requirements for carrying out earthing of technical buildings.

The common factor is the proximity to pylons and the risk presented by co-earthing between power lines, technical building and low voltage network. Requirements for documentation etc. are given in Telestörningsnämnden's notifications.

In addition to following the *Starkströmsförordning* [High-voltage ordinance], ELSÄK-FS 2008:1 etc., the power supply to the technical building must be designed with particular attention. In an attempt to minimise the large number of possible solutions, a number of different applicable methods are described. The methods are described below.

Since there will often be a building for backup power on the same site, this must be included in the zone created.

Earthing principles

Local ground plane at technical building

This method can be used where insulating optofibres, without metallic bonding, lead up into the pylon. The method can also be used with backup diesel power. The method can also be used for an antenna mast next to the power line.

For an antenna positioned next to a power line, see Telestörningsnämnden's notification no. 23.

In this case, the technical building and associated earth lines must be erected at least 20 m from the power line and its earths. There must be no connection with the power line's earthing. The technical building must be earthed locally. The earthing resistance must not exceed 20 Ohm. Supply to the technical building must be via a circuit-separation transformer with at least 12 kV design voltage.

Insulated technical building without local earthing

This method can also be used where insulating optofibres, without metallic bonding, lead up into the pylon. The method can also be used with diesel backup power, on condition that this can also be erected insulated. The method can also be used for an antenna mast next to the power line. The technical building must be erected on a thick insulated base. The technical building can be supplied directly from low-voltage dis-

tribution without a circuit-separation transformer if there is good insulation from the surrounding ground.

Co-earthing between technical building and power line

This method must be used where metallic cables connect the technical building and pylon. This is the case, for example, if there are antennas in the pylons. The method must also always be used where the technical building is sited in a switchgear.

In this case, the technical building can be erected under the power line and must be connected to its earths. Supply to the technical building must be via a circuit-separation transformer with at least 24 kV design voltage. In addition, earthing measurement must be carried out, followed by a check calculation to ensure that the energising in the event of an earth fault is lower than the diverter's protection level (20-45 kV). With the aid of the high-tension method or similar, it can be ensured that contact tensions are within applicable limits. Energising current varies locally, according to the power lines, and must be monitored for each technical building individually. For antenna installations in pylons, see Telestörningsnämnden's notification no. 22 including appendix.

Directions

As mentioned above, Telestörningsnämnden's notifications 22 and 23 must be complied with. In addition, Telestörningsnämnden's notification no. 21 gives the minimum distance to telecommunications equipment and other infrastructure.

Technical buildings designed for antennas in pylons

The information in Telestörningsnämnden's notification no, 22 is applicable, with the following additions:

If the power line has a spark gap in the earthing conductor, this must normally be short-circuited, or disassembled after agreement with Svenska Kraftnät.

Svenska Kraftnät will supply measured values of pylon earthing and energising current. The resulting earth electrode (including the building's earthing) dimensions the diverter tension, and should not normally exceed 4-6 Ohm.

References to Telestörningsnämnden's notifications

Notification no. 20: Guidelines for the use of earth fault currents in the calculation of induced tensions and ground potentials.

Notification no. 21 with appendices: Distances between high-tension lines and low-tension and telecommunications installations etc.

Notification no. 22 with appendices: Antenna installations and technical buildings located in directly earthed high-tension installations.

Notification no. 23 with appendices: Antenna installations and technical buildings adjacent to directly earthed high-tension installations.