150 kV AC substation

Outdoor AIS AC Substations
High-voltage Components
Disconnectors/Earthing Switches

ETS-50-06-06-E1 Rev. 1
## REVISION VIEW

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<td>2013.06.17</td>
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<td>Minor editorial changes</td>
<td>JLY, JAS, BEJ, THO, EHN, EOM, CUM, BMP, HRH</td>
<td>JSO</td>
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1. **Introduction**

This standard specifies the minimum requirements for disconnectors and earthing switches for outdoor AIS substations for the 150 kV nominal voltage level.

2. **Standards and regulations**

The disconnector and earthing switch shall be in compliance with the following standards and regulations.

- Danish legislation
- Outdoor AIS AC substations common conditions and technical requirements for high voltage apparatus, ETS-50-00
- IEC/EN 62271 'High-voltage switchgear and control gear’ (Common specifications)
- IEC 60273:1990 (CENELEC HD 578 S1:1992) ‘Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V’
- IEC/EN 61000 ‘Electromagnetic compatibility (EMC)’
- Other standards referred to in the above standards.

3. **Functional requirements**

The disconnector/earthing shall comply with the following requirements:

- 3-pole operated if not specified otherwise.
- Centre break type if not specified otherwise.
- Motorized.
- Mounted on a rigid base frame.
- Installation of an earthing switch shall be possible on either side of the disconnector.
- Free-standing earthing switches shall include an insulator.
- The motor power supply and brake (if any) shall be galvanically separated from control circuits.
- The motor shall be protected by a protective motor switch which shall have a free alarm contact (break contact).
- An “open” command to an open disconnector/earthing switch or a “close” command to a closed disconnector/earthing switch shall not result in operation of the disconnector/earthing switch.
- It shall be possible to block the motor drive both mechanically and electrically.
- Manual operation shall be possible, but only when motorized operation is blocked.
- It shall be possible to control disconnectors and earthing switches independently of each other and no mechanical locking is required between a disconnector and a built-on earthing switch.
4. Technical requirements

Nominal voltage: 150 kV
Nominal current: 2500 A

If the specified nominal current, is not a standard value the nearest higher standard value may be used.

4.1 Mechanical forces

The static pull on the disconnector’s connection terminal(s) will not exceed 1500 N in any direction. Insulators shall have a flexural strength of minimum 4500 N.

4.2 Physical dimensions

The high-voltage terminals shall be placed 1.6-1.8 m above the support.

Center to center distance between phases is normally 3000 mm. But it may vary in the range 2500 mm – 4000 mm, and the exact distance is to be determined in each case.

Figure 3 in Appendix 1 shows the support structure used by Energinet.dk

4.3 High-voltage terminals

For disconnectors:
Plate terminals with 2x4 14 mm holes and a 50 mm hole centre spacing.
Material: Aluminium or aluminium alloy.
See Appendix 1 Figure 1.

Free-standing earthing switch:
One Ø30 mm tap placed centrally on the equipment. The tap diameter may be larger.
Material: Aluminium, copper or bronze.
See Appendix 1 Figure 2.

4.4 Auxiliary switches

Each pole shall have:

- 8 NO and 8 NC auxiliary contacts for position indication
- 1 adjustable early make and 1 adjustable late break contact

All auxiliary contacts shall be terminated in terminal blocks.

The contacts shall be designed for 220 V DC ± 15%, and the contacts shall be able to break a current In ≥ 2 A (L/R ≥ 20 ms.)

4.5 Supply voltage/motor control

Motor supply voltage and control voltage is 220 V DC ± 15%.

All circuits in the motor operation shall be designed for two-pole control.

The shortest impulse of the open/close commands is 100 ms.
4.6 Cabinets and motor drive
All cabinets shall have an IP55 protection rating and an integrated heating element. Heating elements shall be for 230 VAC.

The control cabinet and motor drive shall be accessible from the ground, meaning that no ladder or lift is needed in order to work or do maintenance in the control cabinet.

4.7 Test
Disconnectors and earthing switches shall be tested in accordance with IEC/EN 62271-102. The relevant test certificates and documentation shall be provided.

5. Design requirements
The delivery of disconnectors and earthing switches shall include all parts necessary for installing the components, including special tools, lubricants, contact grease, etc.

5.1 Corrosion protection
External parts shall be made of corrosion-resistant materials. Steel components shall be stainless or hot-dip galvanized. If surfaces are processed, they shall be protected in a permanent way. Combination of materials with different electrochemical potential shall be avoided, unless sufficiently protected from moisture.

5.2 Colours
All corrosion-protected surfaces that are given a paint finish shall be painted in the colour Grey RAL 7033.

The movable arm of the earthing switch shall be painted in yellow and black colours.

5.3 Earthing
Metal cabinets shall have protective earthing. Cabinets of insulating material shall have a common earthing terminal to which all internal separate metal parts shall be connected.

There shall be terminals for protective earthing of control cabling.

6. Documentation
Upon delivery, the following documentation shall accompany disconnectors and earthing switches: Datasheets for unit and equipment specifying the make, type, output data, preconditions, description, drawings which shall include:

- Electrical data
- Detailed drawings
- Operating manuals
- Maintenance manuals
- Mechanical data, strength, deflection, etc.
- Movement diagram, main contact, auxiliary contact, etc.
7. Appendix

7.1 Appendix 1

Figure 1 Plate terminals for disconnectors

Figure 2 Tap for Free-standing earthing switch

Figure 3 Stands used by Energinet.dk