220 kV AC Substation

Outdoor AIS AC Substations
High-voltage Components
Inductive Voltage Transformers
ETS-50-06-11-D1
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1. Introduction
This standard specifies the minimum requirements for inductive voltage transformers for outdoor substations for the 220 kV voltage level.

2. Standards and regulations
Inductive voltage transformers shall comply with the following standards and regulations:

- Outdoor AIS AC substations common conditions and technical requirements for high voltage apparatus, ETS-50-00
- EN 60044-2: 'Instrument transformers - Part 2: Inductive voltage transformers’
- Other standards referred to in the above standards.

3. Functional requirements
For inductive voltage transformers the following apply:

- Shall be hermetically sealed.
- The voltage transformer must be able to thermically endure discharging of high voltage cables through the primary winding. As a minimum, the voltage transformer must be able to tolerate 4 subsequent dischargings of a fully charged 15 µF capacitance (charged to 200 kV). During the discharge the winding temperature must not rise to a level which causes permanent damage to the voltage transformer.

4. Technical requirements
The voltage transformer shall be fitted with two electrically separate windings on the secondary side:

- Winding 1. (measuring winding)
- Winding 2. (winding for relay protection)

Each winding shall be loadable up to the rated load, independently of the loading of the other winding.

The voltage transformer shall be protected from secondary short circuits by fuses in the secondary circuits. These fuses shall be of the type ‘DO1’, and mounted in fuse holders in the terminal box. There shall be one fuse in each secondary circuit, with an appropriate breaking current, i.e. 6 A. The manufacturer must ensure that the voltage transformer can deliver a sufficient short circuit current to break the fuse.

See Appendix 3 for an illustration of the requested type of fuse and holder.

4.1 Primary rating
The primary winding shall be based on:

\[ 220/\sqrt{3} \text{ kV} \]

Rated voltage factor = 1,5/30s

4.2 Secondary winding (winding 1, measuring winding)
Secondary winding 1 shall be selected on the basis of the following values:
### 4.3 Secondary winding (winding 2, for relay protection)
Secondary winding 2 shall be selected on the basis of the following values:

<table>
<thead>
<tr>
<th>Nominal voltage [kV]</th>
<th>Secondary voltage [V]</th>
<th>Class</th>
<th>Rated burden [VA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>220/√3</td>
<td>100/√3</td>
<td>0,2</td>
<td>25</td>
</tr>
</tbody>
</table>

### 4.4 Secondary winding (winding 3, for residual voltage)
Secondary winding 3 is intended to be connected in a broken delta, with the main purpose of suppressing ferro-resonances. An appropriate damping-coil or resistance must be included.
In some cases it may also be used for detection of earth-faults. It shall be selected on the basis of the following values:

<table>
<thead>
<tr>
<th>Nominal voltage [kV]</th>
<th>Secondary voltage [V]</th>
<th>Class</th>
<th>Rated burden [VA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>220/√3</td>
<td>100/√3</td>
<td>3P</td>
<td>25</td>
</tr>
</tbody>
</table>

### 4.5 Burden
If the burdens mentioned in 4.2-4.3 are not standard values, the nearest higher burden shall be offered for winding 1 while a smaller burden for winding 2 may be acceptable.

### 4.6 Test
The voltage transformer shall be tested in accordance with EN 60044-2, and a declaration of conformity concerning type conformity shall be available from the manufacturer. A test protocol for each voltage transformer shall also be available. The test protocol shall specify all test points in relation to EN 60044-2.

### 4.7 High-voltage terminals
Ø30 mm tap placed centrally on the equipment. See Appendix 1
Material: Aluminium, aluminium alloy or silver-plated copper.

### 4.8 Mechanical strength
The inductive voltage transformer shall be capable of withstanding static loads according to the requirements stated in IEC 60044-2.

### 5. Design requirements

#### 5.1 Interface for support
It shall be possible to install voltage transformers on a support using the footprint specified in Appendix 2.
5.2 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.

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

5.4 Earthing
Flexible earthing shall be designed to prevent corrosion, damage due to wear and tear etc. when in contact with other materials.

6. Documentation
The voltage transformer shall be delivered with the following documentation: Data sheets stating manufacture, type, description and drawings. This shall include:

- Measuring fault curve as a function of load and voltage
- Dynamic properties
- Verification of ferro-resonance properties
- Excitation curves and material data
- Mechanical core and winding dimensions
- Capacities
- Equipotential curves
- Equivalent diagram
- HF properties
- Detailed drawings
- Installation manuals
- Operating manuals
- Maintenance manuals
- Mechanical data, strength, deflection etc.
- Storage information
- Instructions for disposal
7. Appendices

7.1 Appendix 1 High-voltage terminals
High-voltage connection terminal for Inductive Voltage Transformer:

![Figure 1 Ø30 tap](image)

7.2 Appendix 2 Interface to support
Foot print for support of Inductive Voltage Transformer:

![Figure 2 Interface to support](image)
7.3 Appendix 3 Fuse and holder

Below is an example of the requested D01 fuseholder and fuse.

Figure 3 Fuse and holder