

Lightning current simulators for tests of objects

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To carry out tests of objects exposed to lightning strokes or of objects through which lightning current (or its part) can flow one must have means to simulate lightning current. Recommendations of IEC (IEC 62305: Protection against lightning) give following parameters of test current impulses:

- impulse current $T_1/T_2=10/350 \mu s$ with amplitude up to 200 kA;
- impulse current $T_1/T_2=0.25/100 \mu s$ with amplitude up to 50 kA.

In the following presentation problems of lightning impulse currents simulation are considered.

To simulate the current impulse $10/350 \mu s$ a capacitor energy store supplied with "crowbar" switch can be used. To test low voltage (up to 1 kV) varistor type and gas discharge type surge arresters a generator of reserved energy up to 100 kJ has been developed (I.P. Kuzhekin and Z. Hribar. Impulse current generator for EMC tests of structures. IEEE Int. Symp. on EMC, 2003). In connection with the fact that gapped and non-linear surge arresters are suggested to be arranged directly on high-voltage overhead transmission lines, a problem of full-scale tests of such devices arises. To solve this problem calculations were carried out to determine required parameters of test devices.

Parameters of test installation intended for simulation of the current impulse of first kind ($10/350 \mu s$) that is used to test a non-linear surge arrester with residual voltage U_{RES} , are derived from the following equations:

$$U=U_{RES} \cdot \pi \cdot 2T_2/3T_1,$$

$$C=3T_1/\pi \cdot (I/U).$$

In these equations I is the amplitude of the test current, U – the output voltage of the capacitor energy store and C – the capacitance of the store.

Generation of the current impulse of the second kind ($0.25/100 \mu s$) using a traditional circuit has technical difficulties defined by high inductance of the tested object. In particular it is necessary to use a capacitor bank with output voltage of megavolt range. There is an opportunity to use the outside generator available in Russia with an impulse output voltage up to 9 MV for testing of large-sized objects. Generation of impulse current $0.25/100 \mu s$ can be done using the following steps:

- decreasing the discharge circuit inductance down to 20-40 μH ;
- using specially made low-inductance resistors in the discharge circuit;
- equipping the generator with shunting elements.

This last can be achieved by installation at each step of the generator automatically working shunting spark gaps.

The output voltage can be reduced by many times if an explosive wire is used. Parameters of such wire (its material, length, and diameter) are given.