Topic No. 6

Performance of class I arresters under multiple lightning.

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Multiple lightning can be observed in negative cloud to ground flashes. Since 90 % of all flashes are negative cloud to ground discharges there is an impact of multiple lightning impulse currents to all components of lightning protection.
Lightning protection components are tested with an 10/350µs impulse according to IEC 61024.
But what is the impact of multiple lightning on the performance of spark gaps arresters ? Do they trigger under multiple lightning impulses reliable?

The parameter of multiple lightning currents are defined in standards. The peak currents are lower than the peak current of the first stroke but the steepness is about 40 times higher in case of multiple lightning currents. The simulation of multiple current in laboratory is very difficult as far as the high steepness of 200 kA/µs is concerned.
In order to check the performance of equipment e.g. spark gap arresters under multiple lightning a multiple hybrid generator for 1,2/50µs open circuit voltage and 8/20µs short circuit current was build in our laboratory.

Fig. 1 shows the circuit of the generator. Fig 2 shows the set up. Fig. 3 shows the output.
10 stages are connected in parallel. The first spark gap triggers and some ionised air remains in that spark gap. When the next is triggered immediately after the first gap, the second capacitor will discharge into the first gap. Therefore a certain time for recovery of the upper gaps was realised using pressurised air. With this method the recovery time could be resduced to 5ms.
Each capacitor can be charged to an individual value. The time between two pulses can be varied from some 50 ns up to 10 s.

A series of lightning current arresters of different technology was tested under multiple lightning currents and the observed data were compared. The tests were focussing on the spark-over voltage. In case of closed spark gaps during the first current application a pressure can be build up in the gap. When the second voltage impulse comes soon, there might be an increase of spark-over voltage. In the tests the time between the impulses was varied in a wide range in order to identify critical conditions.
Arresters with sealed chambers show a little variation of the spark-over voltage, an example is shown in fig. 4.

In the final paper we will present the results. The increase of spark over voltage will be normalised to the nominal spark over voltage at 1,2/50µs impulses.
Also the different technologies of spark gap arresters will be compared.
As parameters will be varied the time between the multiple impulses as well as the open circuit voltage.

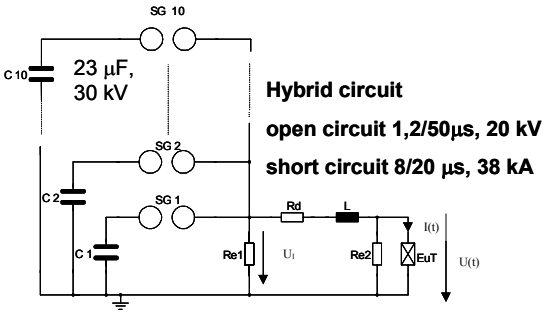

Fig. 1 basic circuit of a multiple lightning impulse current generator.

Fig. 2a: Construction of the generator One stage of 2 is shown.

Fig 2b View of the spark gaps.

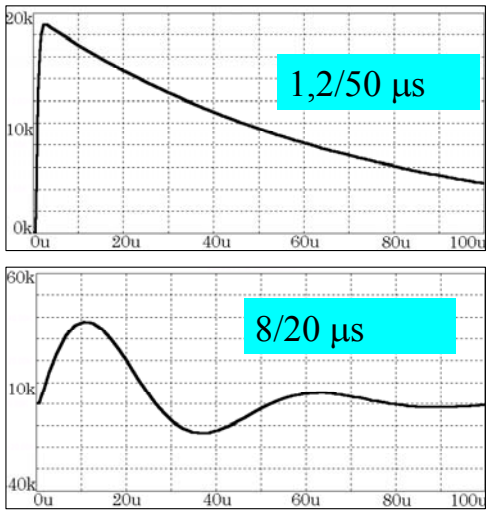

Fig. 3 Wave shape of the open circuit and short circuit.

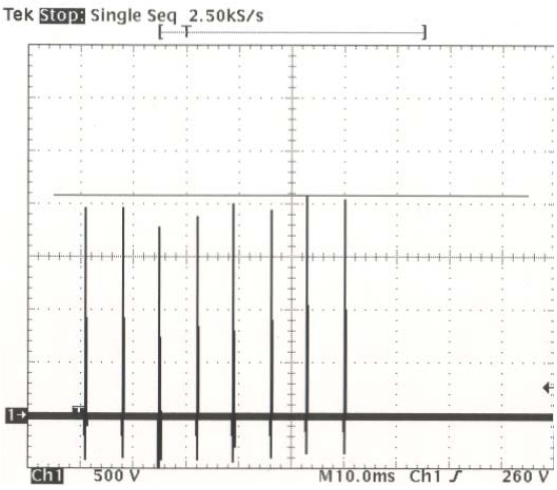

Fig. 4 Response of a 9 stage spark gap after 8 multiple impulses with hybrid generator 1,2/50µs/ 8/20µs, open circuit voltage : 10 kV