

Anomalous Counts of a Lightning Flash Counter with Vertical Antenna

垂直アンテナ式雷放電カウンタにおける異常カウント

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1. Introduction

The lightning flash counter (LFC) is a device to register the number of lightning flashes over an area and the most widely used is the CIGRE type⁽¹⁾ which operates by detecting positive field changes. In recent years, the LFC with a compact vertical antenna has been investigated actively⁽²⁾⁽³⁾ as a substitute to the conventional CIGRE type with a large horizontal antenna. Especially in Japan, from the viewpoint of ground space, it will be appreciated if the LFC with a compact antenna is shown to have the same property with the conventional LFC.

The authors have developed a new LFC with a vertical antenna and have been observing lightning flashes since 1974 to prove the equality to the CIGRE type. Up to now, the registration of the new LFC over a long period agrees well with the one of the conventional LFC. However, there existed some cases in which only the new LFC spontaneously gave continuous registration within a few minutes, which we call anomalous counts⁽⁴⁾. This phenomenon is discussed in this investigation.

2. Observation and Results

The new LFC under test is equipped with a vertical antenna of 40mm in diameter and 3m long, the top of which is cylindrically shaped. The antenna capacitance and effective height are about 50pF and 2.3 m respectively. The frequency characteristic of the filter circuit is the same as that of the CIGRE type having a peak at 500 Hz and being 4.6 ± 1 dB down at 100 and 2500 Hz. The observation has been done at the experiment station of the institute in Chiba on the Pacific side

of the Honshu Island, and at Sakata on the Japan Sea side of the same island. The registration was compared with the nearby CIGRE type LFC.

The both results obtained in 1974 at Chiba showed in good agreement and the difference of the registered counts over the summer period was 13%, being the one of the new LFC higher. However, most of the excessive counts of the new LFC seemed to be due to the anomalous counts which will be discussed later. In the observation in 1975, a field mill and another new LFC with a vertical antenna with a sphere of 100mm in diameter on the top were added.

Two samples of the observation are shown in Figs. 1 and 2. Fig. 1 shows the fairly good agreement between the two LFCs, and the maximum static field strength over this period was +2.6 kV/m. Fig. 2 clearly shows a sample of anomalous counts. It is seen around 16^h 00^m that the registration of the LFC with a vertical antenna without a sphere quickly increased whereas the one of the CIGRE type showed no such abnormal registration, and at the same time the static field strength was exceeding +6 kV/m.

In this year 1975 also the difference of registered counts between the new type and the CIGRE type LFC was about 10% and it reduced to 1% after the anomalous counts were subtracted from the registration of the new type LFC.

3. Discussion

The anomalous counts were registered only when the static field was positive (downward) and intense, the lowest being +2.6 kV/m. Small direct current that flows the antenna was simultaneously recorded by a 1Hz DC recorder and it was proved that this current corresponded to the record of the static

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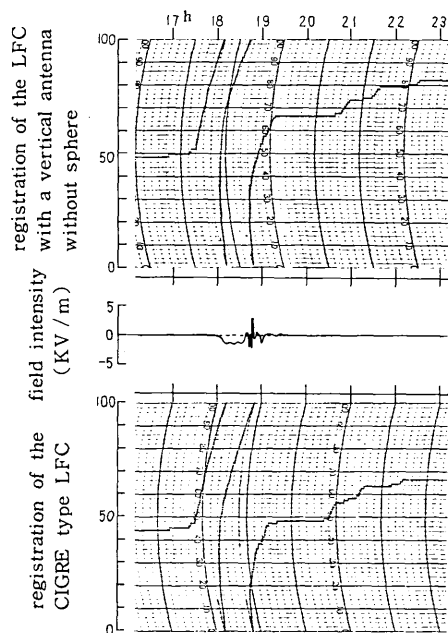


Fig. 1. A sample of the observation
(Aug. 6, 1975 at Chiba)

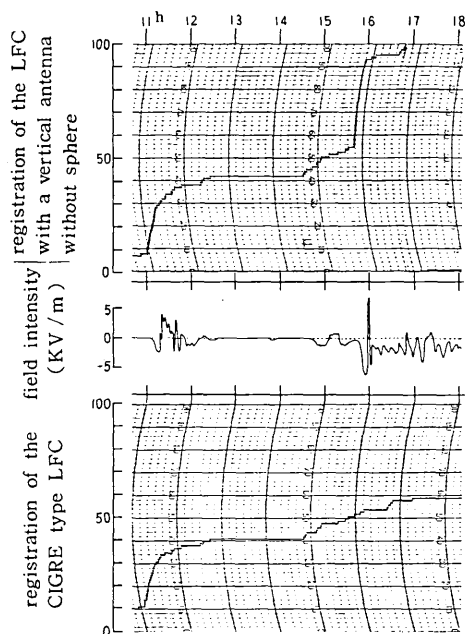


Fig. 2. Another sample of the observation
(Oct. 5, 1975 at Chiba; anomalous counts
are included)

field. So that it is clear that the point discharge current⁽⁵⁾ also exists for this vertical antenna. The newly located LFC with a vertical antenna having

a sphere on its top to suppress the point discharge current registered much less anomalous counts.

From these results, it appears that the point discharge current has close relation to the anomalous counts. The reason is thought to be due to the smaller effective height and higher antenna impedance of a vertical antenna requiring the higher sensitivity at the input end compared with the CIGRE type. The polarity effect of the anomalous counts corresponds to the fact that the CIGRE type LFC registers mainly positive - going signals. However, the cause of the anomalous counts is not simple. They did not always appear at intense positive field exceeding the lower limit, but seemed to be related also with heavy rain.

The influence of the existence of anomalous counts to the performance of the LFC with a vertical antenna is thought to be as follows.

When only the sum of the counts through a long period is discussed, the registration due to anomalous counts will be around 10% of the total under subtropical climate where lightning in summer prevails. However we cannot disregard this phenomenon in areas like the Japan Sea side of the Honshu Isl. where lightning in winter prevails and intense field appears more frequently.

Mounting a sphere on the top of the antenna is effective though it has not been possible to completely eliminate the anomalous counts. When the counting rate is concerned as seen in a thunderstorm warning system⁽⁶⁾, it is quite important to suppress the anomalous counts. Moreover, there exists a request to solve the problems in locating the LFC for a thunderstorm warning system on the top of a building where more intense field than on the ground is expected. In such cases, other countermeasures are necessary since this phenomenon is not caused simply by the electric field only.

The mechanism of this phenomenon and the improvement of the LFC with a vertical antenna are now under investigation and will be reported later.

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