Direct Lightning Hits to Wind Turbines in Winter Season – Lightning Observation Result for Wind Turbines at Nikaho Wind Park in 2005 Winter –

Background

Recently, a lot of wind turbines have been constructed in the Sea of Japan coastal region. However, damage by lightning occurs frequently in winter. Therefore lightning protection design for wind turbines has become an immediate problem. As the study of protection design, it is important to clear the aspect of lightning hit and lightning current waveform to wind turbines. However, the aspect of lightning current waveform flowing to wind turbines is unclear. Therefore lightning observation has been executed at Nikaho wind park since 2003 by CRIRPI and J-Power.

Objectives

The research aims to develop a device for observing lightning current waveform in a wide band, and to clarify the aspect of lightning hit and lightning current waveform to wind turbines in winter.

Principal Results

1. Development of rogowski coil with wide band

(1) To clear the aspect of lightning current hit to wind turbines, rogowski coil with wide band from 0.1Hz to 100kHz making up for lower region of cut-off frequency of former rogowski coil was developed in Fig.1. This device has an extremely wide band of six digits.

(2) It is clear that the former rogowski coil is not sufficient to observe winter lightning current in which serious damage is caused to wind turbines. As the observation of electric charge, rogowski coil with wide band is indispensable in Fig.2.

2. Lightning observation results in 2005 at Nikaho wind park

(1) Lightning currents hitting wind turbines can be classified into current with pulse element and current with continuous element. These classifications are similar to the observation results in Fukui thermal power plant and the feature is that current with continuous element has large charge amount as shown in Fig.3.

(2) 128 pictures of direct hits to 15 wind turbines in total were taken by six still cameras in 2005. Direct lightning hits to two or more wind turbines are 30 percent in Fig.4.

Future Developments

To conduct observation of lightning discharge using ALPS *1, in order to clarify the phenomena not interpretable in experiments, for example, aspect of lightning hits on wind turbine blades, in particular leader advance from the blade, etc.

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Reference

A. Asakawa et. al, “Development of Wide Frequency Band Rogowski Coil and Evaluation of Electric Charge in Winter Lightning. -Lightning Observation Result for Wind Turbines at Nikaho Wind Park in 2005 Winter.-”, CRIEPI Report H06010

*1 : ALPS: Automatic Lightning Discharge Progressing Feature Observation System.

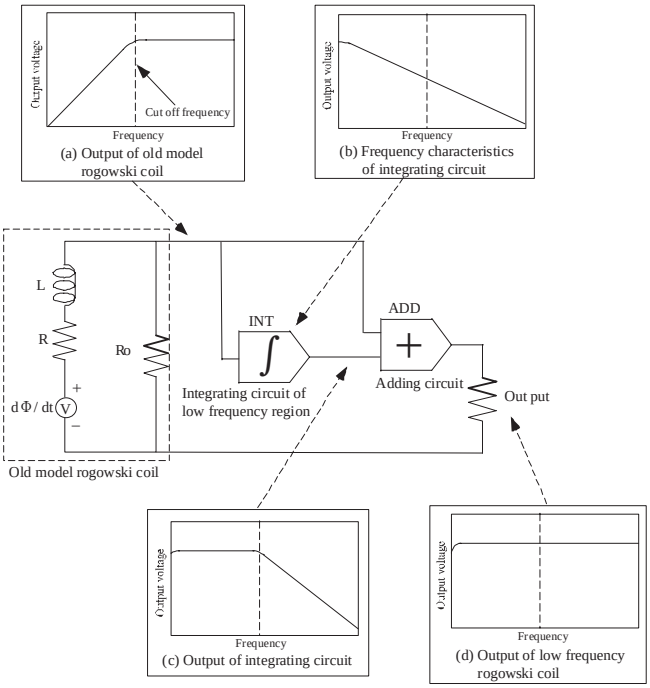
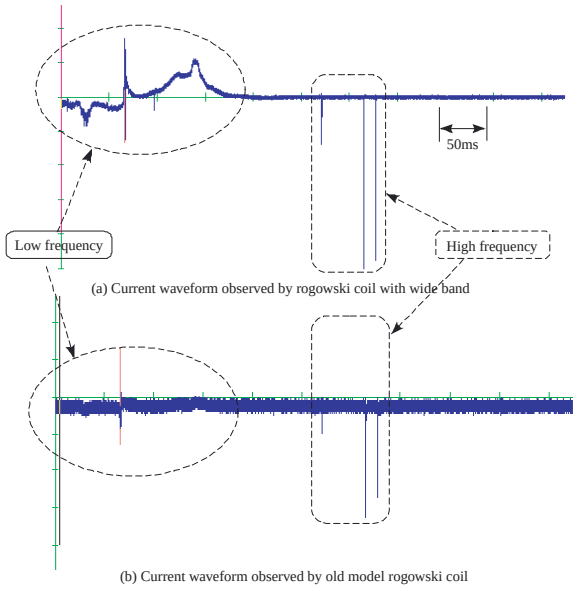
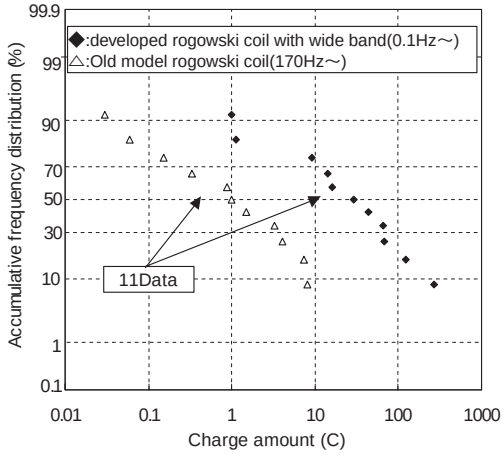


Fig.1 Composition of rogowski coil with wide band



(1) Example of current waveform



(2) Accumulative frequency of electric charge

Fig.2 Relation between electric charge and kind of rogowski coil.

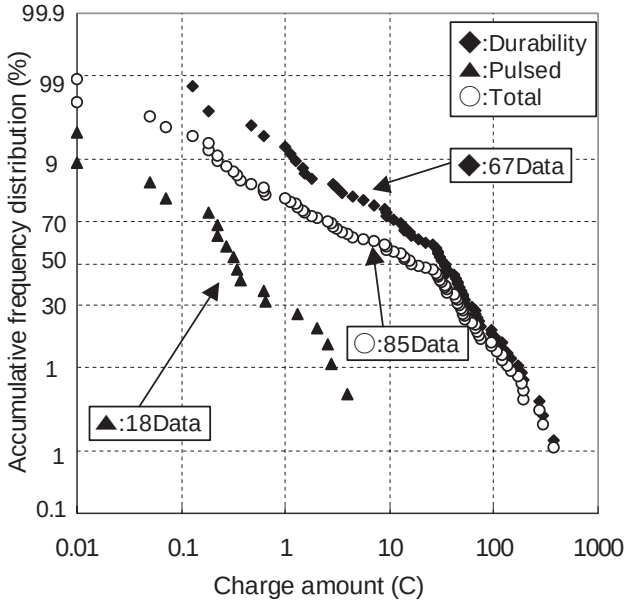


Fig.3 Cumulative frequency distribution of charge amount observed by rogowski coil with wide band.

Fig.4 Photograph taking by still camera