Project Subjects

Evaluation of Damage to Electric Transmission Facilities Caused by Wind, Snow and Salt

Background and Objective

Severe snowstorms (called H18 GOUSETSU in Japanese) occurred on the coast of the Japan Sea in December 2005. These storms caused the failure of electrical insulators, or flash-over caused by sea salt contained in the snow, short circuit accidents in transmission lines caused by galloping*1, and the partial collapse of transmission towers caused by weight of heavily accreted snow. These have given us valuable knowledge and verification of the importance of effective countermeasures against the snow-related damage for a stable electricity supply.

In this project, in order to reduce these snow-related accidents, prediction methods of snow damage and technology of the countermeasures might be improved by observing both atmospheric conditions and physical processes to elucidate snow accretion mechanism.

Main results

1. Installation of field observation systems and consolidated data management

Cooperating with the electric power companies, the observation systems have been installed at five areas in Japan by Nov. 2009 (Fig. 1). The systems have made it possible both to remotely monitor the real-time site-situations and to manage the acquired data in uniform and centralized manners in our institute (CRIEPI). Since 2008's winter season, the measurement equipments (such as line tension load meter or conductivity sensor for accreted snow) have been continuously operating specific to the observation purpose at each site. Besides, we have been acquiring not only meteorological data such as local wind velocity and temperature, but also visual data obtained by network cameras. The large amplitude conductor vibration, identified as galloping, have been successfully observed once during the last two winter seasons, with obtaining synchronized data of weather conditions and line tension at the site. In this way, we have been accumulating valuable data that were hardly available in the previous studies. In the near future, based on the analysis of these observation data, the effectiveness of countermeasures and the phenomenal elucidation of snow-related damage in Japan might be verified furthermore.

2. Development of an experimental technique for elucidation of galloping phenomenon

An experimental technique to physically simulate the motion of actual transmission conductors has been newly developed [N09022]. In the technique, a sector model of four-conductor bundle is supported at both ends with multiple elastic cords. Such unique support allows to optionally and easily adjust vertical, horizontal and torsional vibration properties, and to simulate conductors' vibration with large amplitude at lower frequency (Fig. 2). In the near future, by applying this technique to wind tunnel tests, the effectiveness of vibration-suppression measures might be verified and also the vibration occurrence condition for transmission lines subject to wind might be elucidated.

3. Development of estimation method for wide area distribution of airborne sea salt

Estimation of wide area distribution of airborne sea salt is needed to cope with degradation of electric power facilities by sea salt pollution. A new numerical simulation method has been developed for estimation of cumulative airborne sea salt in a wide area over a radius of tens of kilometers (Fig. 3) [N09007]. This method allows us to make distribution maps of airborne sea salt regardless of the extent of maps reflecting the geographic effects of local terrain and land use such as flatlands, mountains and rivers. In the near future, we will proceed with accuracy estimations of this method by comparison with observation data and apply to estimations of salt damage of electric power facilities.

Other reports [N09006]

---

*1: One of the conductor vibration phenomena: Due to wind and accreted snow or ice, when torsion and lift force are generated, the phenomenon occurs as large-amplitude self-excited vibration of transmission lines. If the amplitude becomes large or the vibration continues, the phenomenon leads to short circuit or facility failure through fatigue.

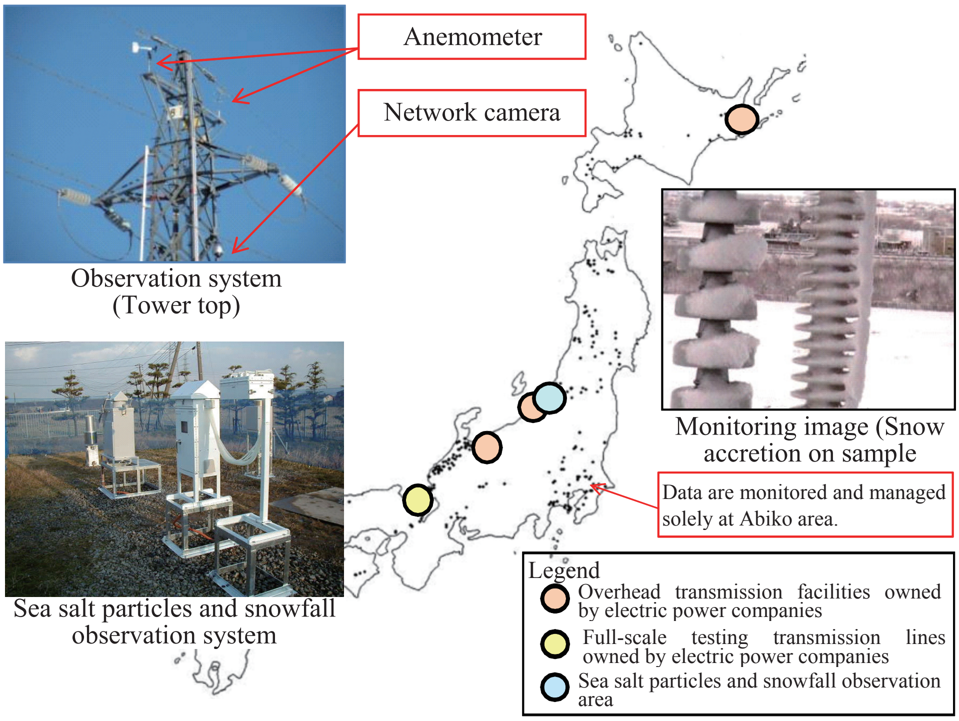

Fig. 1 Location and summary of the field observation systems

Data monitoring and recording are possible with the remote manipulation at Abiko area of CRIEPI. The observed data are managed in uniform and centralized manners, and are utilized in verification of countermeasure technology and in elucidation of phenomena of snow-related damage.

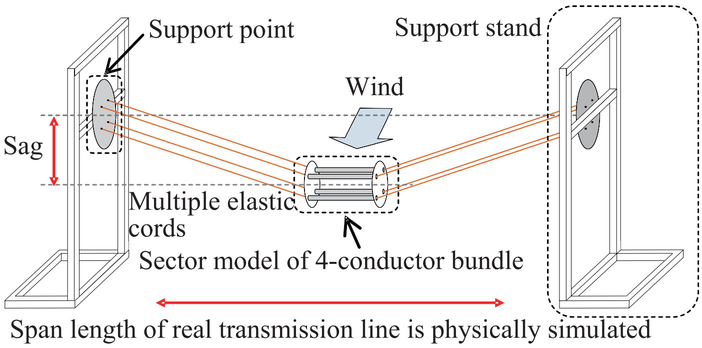

Fig. 2 A sector model and its supports simulating the vibration properties of real transmission lines

The use of multiple elastic cords in place of conductors enables the short model (10 – 15m) to simulate real scale (300 – 500m) vibration with large amplitude at low frequency.

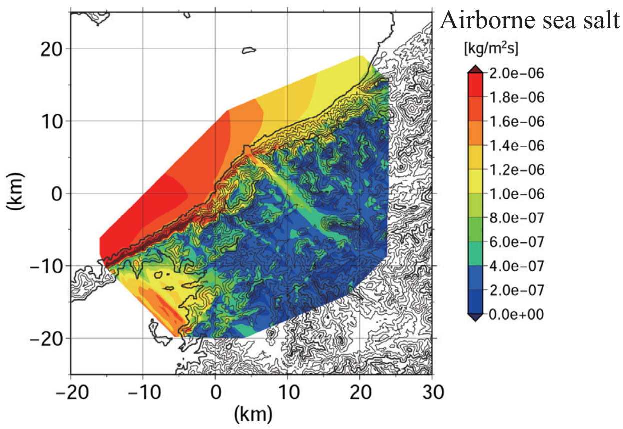

Fig. 3 Sample of yearly mean distribution maps of cumulated airborne sea salt

This method allowed us to make distribution maps of airborne sea salt in a wide area, reflecting geographic effects of local terrain and land use such as flatlands, mountains and rivers.