Project Subjects

Strategic Disaster Restoration Support Technology for Electric Power Distribution and Substation Equipment

Background and Objective

In order to effectively support the restoration activities for disaster damaged electric power distribution and substation equipment, their risk assessment and management technologies against disasters, which take into consideration the reliability and accuracy of obtained disaster information during the emergency restoration period, disaster force (hazard), and the diversity of the region and equipment, are requested.

The objective of this project is to develop a disaster restoration support system for their equipment against mainly earthquakes and typhoons, which includes earthquake and typhoon wind force evaluation systems, equipment damage assessment system, and emergency restoration process simulator in order to put it practical use in an actual target electric power supply area.

Main results

1. Application of a sequential update damage estimation system to actual electric power supply area

In order to improve the damage estimation accuracy of the proposed system (RAMP-Er) [N07027], an actual earthquake damage record of electric power distribution equipment was analyzed in detail. As a result, it was clarified that the damage rate of the distribution equipment was greatly influenced by not only seismic force but also the presence of specific earthquake countermeasures including distribution pole anchor (Fig. 1), micro-topography division of the surface ground conditions, land use conditions, and line connectivity types of distribution pole. It was also clarified that the damage ratio of service wires was correlated with the horizontal distance from residential houses. Furthermore, in order to solve a problem to underestimate the seismic force of the hypocenter neighborhood a hypocentral distance decision algorism for the seismic force evaluation system was improved (Fig. 2).

2. Collection, analysis and delivery of typhoon information

An existing weather disaster information system was expanded as a client-server information system, which communicates over the Internet. The server system distributes the typhoon information including wind direction and velocity, and precipitation of whole target area. On the other hand, the client system, which is called RAMP-T, receives the above information and estimates the equipment damage degree. The expanded client-server system enables us to visually, quantitatively and quickly forecast typhoon wind and equipment damage conditions (Fig. 3). Note that in order to provide the meteorological information from the expanded system to power companies, some restrictions associated with the Meteorological Service Law were considered.

3. Development of tsunami information system

After an earthquake occurs, the developed tsunami information system collects and accumulates the sea surface heights associated with tsunami collected by the 157 points tidal observatories in real time. The developed system enables us to divide the above collected the sea surface height into two elements; tsunami and tide elements and to display those elements for every target region on a map of Japan. Fig. 4 shows an example of analytical results of tsunami caused by the mega earthquake (Mw 8.8) occurred in Chile on February 27,2010 in real time (Fig. 4).

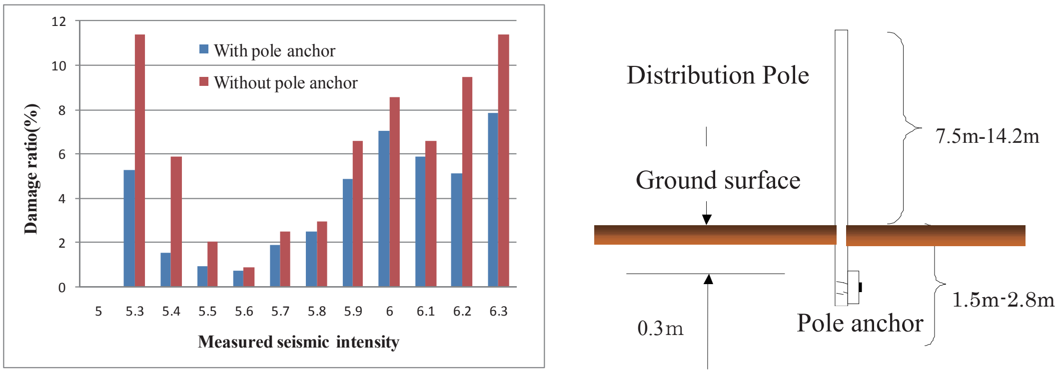


Fig. 1 Comparison between service wire damage rate and the presence of pole anchor for each measurement of seismic intensity

Fig.1 shows that the pole anchor effectively decreases the service wire damage.

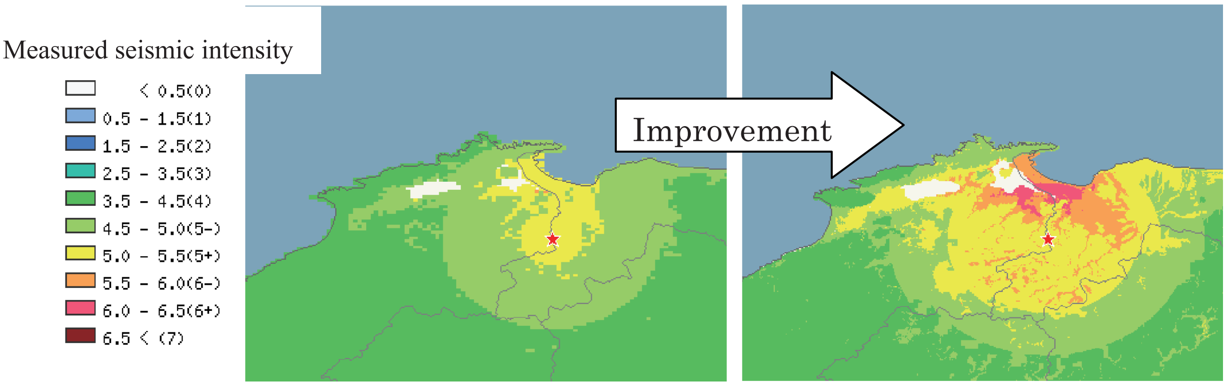


Fig. 2 Example of the distribution of surface ground motion intensities

The underestimation for the surface ground motion intensity near hypocenter is improved. And the spatial resolution was improved from 1km mesh size to 250m mesh size.

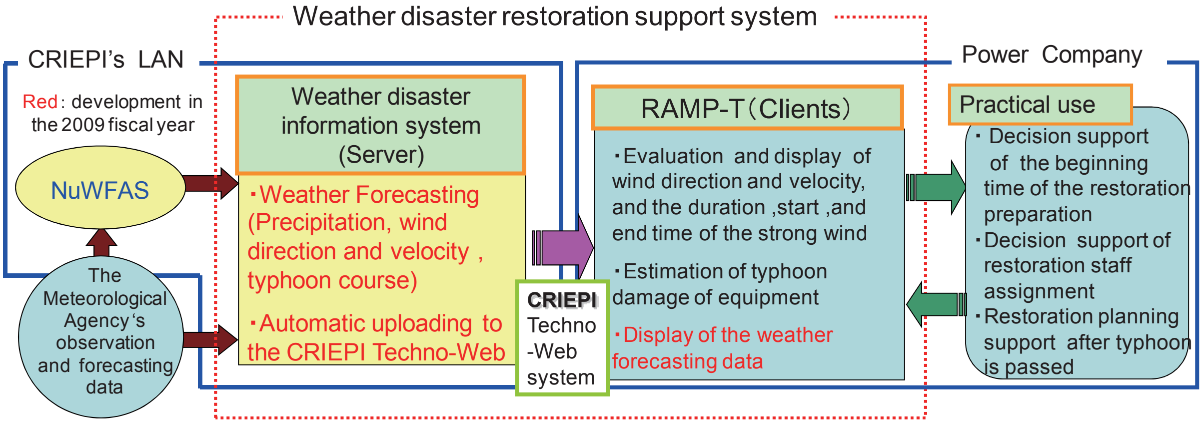
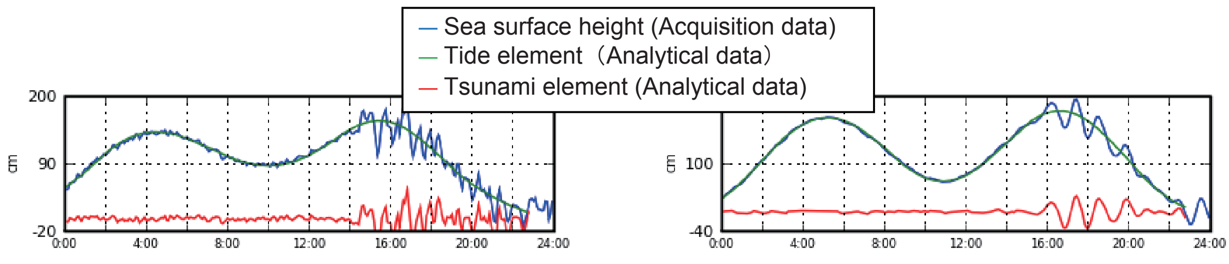


Fig. 3 Concept of Weather disaster restoration support system

RAMP-T receives the typhoon information from the weather disaster information system via the Internet.



(a) Chousi (b) Katsuura

Fig. 4 Change in water levels at Chose and Katsuura due to the 2010 Chili earthquake

The developed system enables us to extract the tsunami element from the collected water level.