Feasibility Study on Establishing Disaster Warning System and Applying RTK Assessment

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(1) Introduction

In the past few years, extreme climate has been affecting the stability of power supply, for the instance of slop sliding of tower foundation. This study not only applies slope monitoring instruments, such as fixed slope inclinometer, along with real-time dynamic positioning system, but also imports the Optic Fiber Composite Overhead Ground Wire(OPGW), the first time in Taiwan, for the purpose of disaster prevention information transfer. We selected five towers respectively from 345 kV East-West Line # A,# B , # C, and 161 kV East Area # E, # F as our research targets. The sensing system comprises four major systems, namely (1)the dynamic positioning system, (2)the structure monitoring system, (3)the tower foundation monitoring system and (4)the environmental monitoring system; additionally, a management system to provide early warning and real time data for maintenance personnel to monitor the tower status.

Fig. 1 Location of Tower # 68

(2) Research content

The tower foundation dynamic monitoring system comprises four components, respectively (1)power, (2)sensing, (3)communication, and (4)data analysis management. The system composition is shown in Figure 2. What worth mentioning, the sensing system is composed of the following systems: (1)dynamic positioning system, (2)structural monitoring system, (3)tower foundation monitoring system and (4)environmental monitoring system. The functions of the above systems are summarized as follows:

1. **The dynamic positioning system:** based on high-precision 3D positioning data obtained by one GPS station and two GPS fixed stations around the tower to monitor the long-term trend of the tower sites.
2. **The tower structure monitoring system:** to help understand the tower structure behaviors and rigidity through the acceleration gauges, strain gauges, and inclinometers installed on the tower foundations.
3. **The tower foundation monitoring system:** based on the inclinometers to measure the change of the tower foundation and the sliding deformation of the stratum, and evaluate its safety.
4. **The environmental monitoring system:** to apply rain gauges, water pressure gauges, and anemometers to help understand the rainfall, wind speed, and wind direction, and to monitor the

changes of groundwater level. The system is used as early warning for slope disasters.

The monitoring data afterwards will be transferred to the management platform through the communication system. As a whole, this study not only adopts communication technologies capable to transmit data from one monitored tower to the connected towers (the tower with the OPGW Joint Box), such as LoRa, 4G, etc., but also builds a corresponding communication system along with photoelectric conversion communication test.

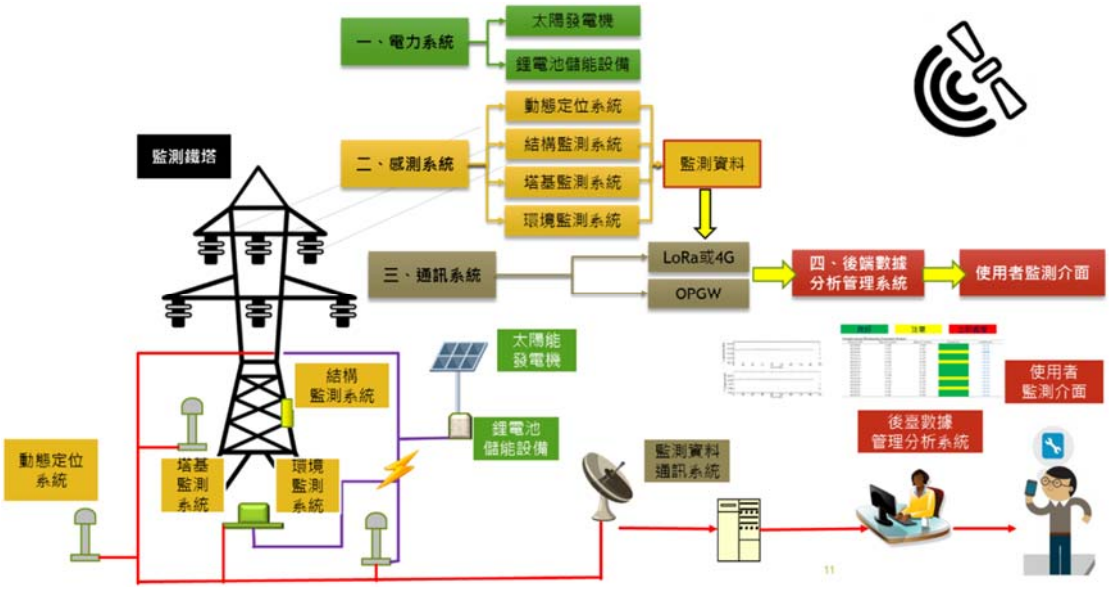

Fig. 2 Diagram of the tower foundation dynamic monitoring system

(3) Monitoring management system and the results

In this study, automatic monitoring equipment had been installed on five towers (# 76, # 77, # 163, # 52, # 68), and two transmission technologies(LoRa and 4G) used in two different communication protocols to transfer various monitoring data to the server to be recorded in the database.

The instruments adopted in this study, regarding different monitoring needs and purposes, include fixed-type inclinometers, water pressure gauges, landslide warning, electronic inclinometers, real-time dynamic positioning (GPS), accelerometers, wind speed & direction indicators, etc. The data transferring diagram and system screen are respectively shown in Figure 3 and Figure 4. Figure 5 is the returned monitoring results of # 77 fixed type inclinometer. As far as we can see, the system is effective for tower monitoring and early warning for towers confronting with slope hazards. The results of this study may serve as a reference for the towers in the same situation.

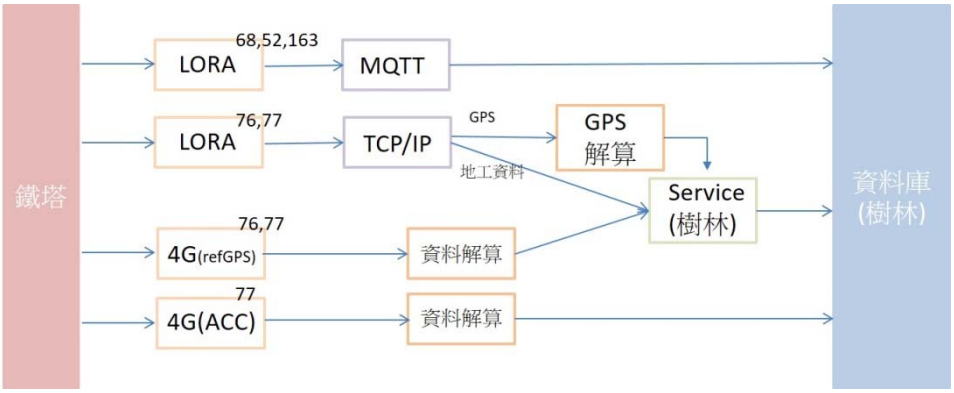

Fig. 3 Schematic diagram of data transmission

Fig. 4 system home page (map page)