



Failure analysis and risk management of a collapsed large wind turbine tower

Jui-Sheng Chou^{*}, Wan-Ting Tu

Department of Construction Engineering, National Taiwan University of Science and Technology (Taiwan Tech), 43 Sec. 4, Keelung Rd., Taipei 106, Taiwan

ARTICLE INFO

Article history:

Received 7 April 2010

Accepted 10 September 2010

Available online 19 September 2010

Keywords:

Failure analysis

Wind turbine

Natural disaster

Structural failure

Risk management

ABSTRACT

Developing renewable energy is crucial as nations face the twin threats of global warming and a reduction in energy supplies. Wind turbines are one of the most promising sources of renewable energy in Taiwan. However, on September 28, 2008, Typhoon Jangmi struck Taiwan, bringing strong winds and heavy rainfall that collapsed a wind turbine tower located on the shore of Taichung Harbor. This study provides significant insights into, and lessons learned from, post-disaster inspection into the causes of tower failure during this typhoon. This event represented the first time that a wind turbine in Taiwan that had to be reconstructed after collapsing. To prevent similar accidents, the likely causal mechanisms are examined from the risk management perspective. Data for case analysis are collected from original tower design reports, the tower design code, construction records and documents, historical wind-speed data, structural tower analysis, and intact and fractured bolt material tests. Furthermore, similar accidents in other countries and their causes are reviewed to identify potential risk factors affecting the lifecycle of wind turbines.

© 2010 Elsevier Ltd. All rights reserved.

1. Background information

1.1. Background to accident

On September 28, 2008, Typhoon Jangmi struck Taiwan and collapsed wind turbine No. 2 located on the shore in Taichung Harbor. The tower was bent and broken into three sections; the lower two parts buckled and snapped during the typhoon. Due to the strong winds, the middle part snapped and deformed when it hit the ground. The nacelle and shaft collapsed and were destroyed. The wind turbine owner contacted the insurance company for a site inspection. The insurance company then employed an adjuster and surveyor company to conduct an independent investigation and estimate loss. The Taiwan Tech research team was requested as an independent party to conduct a site investigation on October 17, 2008. This accident was first of its type in Taiwan. Consequently, forensic engineering findings will prove extremely valuable [1]. To identify failure causes and mechanisms, the researchers explored all possibilities. The hope was that by conducting a causal analysis and systematic investigation [2], future damage to wind turbines can be prevented or minimized.

1.2. Background of wind turbine failure

In 2003, a company from Holland successfully bid for this wind turbine; however, due to operational problems, this contract was turned over to a Japanese company in 2005 (Hara Kosan Co.). The Japanese company transferred this work to

^{*} Corresponding author. Tel.: +886 2 2737 6321; fax: +886 2 2737 6606.

E-mail addresses: jschou@mail.ntust.edu.tw (J.-S. Chou), m9705113@mail.ntust.edu.tw (W.-T. Tu).