World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:11, No:05, 2017

A Damage Level Assessment Model for Extra High Voltage Transmission Towers

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Abstract : Power failure resulting from tower collapse due to violent seismic events might bring enormous and inestimable losses. The Chi-Chi earthquake, for example, strongly struck Taiwan and caused huge damage to the power system on September 21, 1999. Nearly 10% of extra high voltage (EHV) transmission towers were damaged in the earthquake. Therefore, seismic hazards of EHV transmission towers should be monitored and evaluated. The ultimate goal of this study is to establish a damage level assessment model for EHV transmission towers. The data of earthquakes provided by Taiwan Central Weather Bureau serve as a reference and then lay the foundation for earthquake simulations and analyses afterward. Some parameters related to the damage level of each point of an EHV tower are simulated and analyzed by the data from monitoring stations once an earthquake occurs. Through the Fourier transform, the seismic wave is then analyzed and transformed into different wave frequencies, and the data would be shown through a response spectrum. With this method, the seismic frequency which damages EHV towers the most is clearly identified. An estimation model is built to determine the damage level caused by a future seismic event. Finally, instead of relying on visual observation done by inspectors, the proposed model can provide a power company with the damage information of a transmission tower. Using the model, manpower required by visual observation can be reduced, and the accuracy of the damage level estimation can be substantially improved. Such a model is greatly useful for health and construction monitoring because of the advantages of long-term evaluation of structural characteristics and long-term damage detection.

Keywords : damage level monitoring, drift ratio, fragility curve, smart grid, transmission tower
Conference Title : ICEPDS 2017 : International Conference on Electric Power Delivery Systems
Conference Location : London, United Kingdom
Conference Dates : May 25-26, 2017

Open Science Index, Energy and Power Engineering Vol:11, No:05, 2017 publications.waset.org/abstracts/63746.pdf