Modeling the Power Outage After Hurricane Ike

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Abstract: In this study, the influence of trees, distributions of population, wind speed and distance from Ike route on the electrical power outage was investigated. Data from total of 24 zip codes in the City of Houston were used for this investigation to develop a nonlinear damaged model (DM-THC) after the hurricane Ike. Of the parameters investigated, population and trees had a greater influence on the power outage than the other factors investigated.

1. Introduction

On September 13th, 2008, Hurricane Ike made its landfall in Galveston, Texas and passed across the City of Houston. The wind speed was around 80 mph and hurricane Ike was category 1(74-95 mph). With this wind speed, it was mainly tree damages so that this hurricane could be described as a "Category Tree" hurricane. Trees falling down caused damages to electrical poles, blocked traffic and damaged residential structures (Figures 1 and 2). Based on the information provided by the power utilities, about 2.9 million customers lost power during the hurricane. The number was larger compared to the power outage after Hurricane Rita 2005 (719,000 out of 1.9 million) and Hurricane Alicia 1983 (750,000 out of 1 million). Center-Point spent 16 days to restore the power and replaced 0.82% of distribution poles, 6,400 out of more than 1 million wood distribution poles, and wooden transmission infrastructures. There was no replacement of steel and concrete transmission infrastructures (Center-Point Energy).

2. Objectives

The objective was to investigate the factors that influenced the power outage in the Houston area and develop a model to represent observed trends.

3. Data Analyses

The data for this study was collected from number sources (1-3). Information on the distribution of trees (T) in various zip codes was obtained from the City of Houston GIMS website; Information on the power outage was obtained from Center-Point website. The population (P) information was obtained from census web site. (http://www.zip-codes.com/) Based on the analyses of data following nonlinear relationship is proposed:

Power outage (PO)/area (A) =a x(number of trees (T)/area)^b x (population (P)/area)^c x (wind speed (V))^d x (Distance to Ike route(D))^e

$$[PO/A] = a\,[T/A]^b \times [P/A]^c \times [V]^d \times [D]^e \qquad (1)$$

4. Conclusion

It was found that there are strong correlations between the number of outages and populations and between the number of outages and the number of trees of which diameters are larger than 20 inches. After carefully study the tree species, the most popular trees in each zip code are oaks which can generally grow to the height of 40-70 feet. According to the Center-Point Energy's requirements on trees (Figure 2), those trees should be plant farther away from transmission lines. In other words, if they are close to

Figure 1. Falling Down Trees Caused Damages to Electrical Poles (Center-Point Energy)

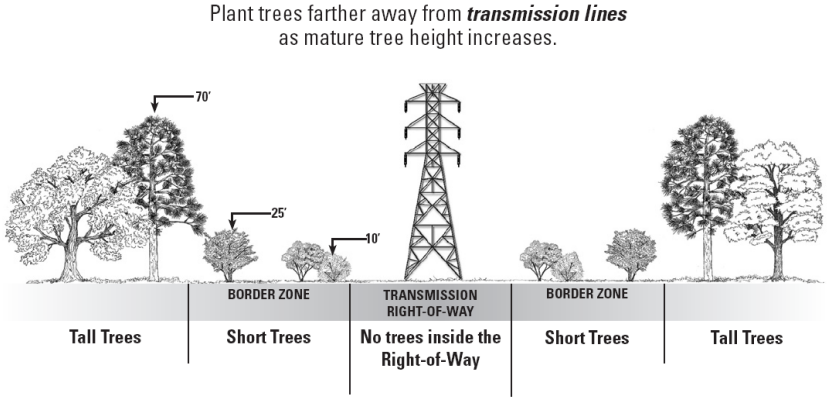

Figure 2 Requirement on Trees (Center-Point Energy)

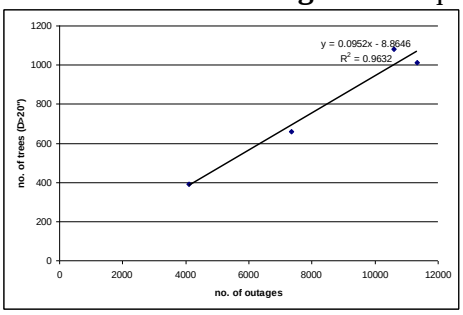

Figure 3. Relationship between power and no. of trees (D>20 inches).

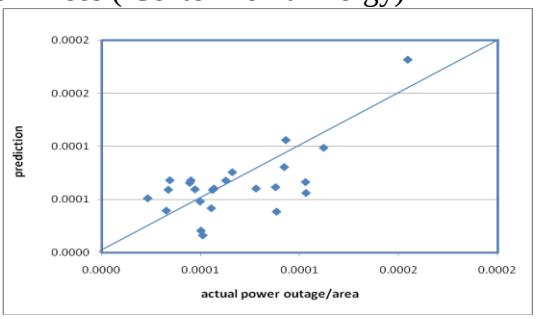

Figure 4. Comparison of Prediction model outage

the distribution poles, especially wood poles, they could be problems during the hurricane. Therefore we study the number of trees with outages in different population groups. In each group, the number of trees is proportional to the number of outages. (Figure 3) We developed the model to predict the power outages parameters a, b, c, d and e are 0.002, 0.069, 1.032, 0.121 and 0.08 respectively.

6. Acknowledgements

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7. References

1. Center-Point Energy, http://www.centerpointenergy.com/home
2. City of Houston GIMS website
3. US population by zip codes, http://www.zip-codes.com