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SafeBuild: Risk-Based Analysis of Overhead Electric Distribution Facilities

In 2011, winds toppled 248 SCE poles, causing an outage to 440,000 customers in California. In 2018, a component on a PG&E tower broke during windy conditions, igniting the Camp Fire, which destroyed 18,804 buildings and killed 86 civilians. These incidents occurred because utility companies' faulty software prevents them from predicting how much wind their infrastructure, e.g. poles and conductors, can withstand before breaking and igniting a fire.

Existing pole design programs rely on an outdated methodology that does not account for material strength variability. As a result, existing programs lack the mathematical ability to calculate a probability of failure for a component due to a given wind gust.

A finite-element based structural engineering program called SafeBuild was created that employs a risk-based methodology for designing poles and conductors. SafeBuild calculates the stress on poles and conductors using large deflection finite element analysis. Subsequently, SafeBuild calculates the probability of failure of any component using z-scores based on material median strengths and coefficients of variation. SafeBuild also models other forms of failure that don't involve wind. For example, SafeBuild models the thermal and electromagnetic properties of conductors to determine if they will melt under abnormal fault currents.

SafeBuild fits into the bigger picture of utility safety and wildfire prevention by allowing users to design poles and conductors to withstand external conditions to any desired confidence level. Future work includes displaying 3D graphics of the forces acting on the structures and linking an SQLite database to store calculations.