

A method for defining wind turbine setback standards

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- **First published:** 4 April 2011 [Full publication history](#)

- **DOI:** 10.1002/we.468 [View/save citation](#)

- **Cited by:** 2 articles

Citation tools

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ABSTRACT

Setback distances established by regulatory authorities to minimize the probability of blade fragment impact with roads, structures and infrastructure can often have a significant impact on wind farm development. However, these minimum distance requirements typically rely on arbitrary rules of thumb and are not based on a physical or probabilistic analysis of blade throw. The work reported here uses a probabilistic approach to evaluate the effectiveness of current standards and to propose a new technique for determining setback distances. This is accomplished through the use of a dynamic model of wind turbine blade failure coupled with Monte Carlo simulation techniques applied to three different wind turbines. It is first shown that common setback standards based on turbine height and blade radius provide inconsistent and inadequate protection against blade throw. Then, using a simplified dynamic analysis of a thrown blade fragment, it is shown that the release velocity of the blade fragment is the critical factor in determining the maximum distance fragments are likely to travel. The importance of release velocity is further verified through simulation results. Finally, a new method for developing setback standards is proposed based on an acceptable level of risk. Given specific wind turbine operational parameters and a set of failure probabilities, the new method leverages realistic blade throw modeling to produce setback standards with a valid physical foundation. Copyright © 2011 John Wiley & Sons, Ltd.