WINDBORNE DRUM MISSILES

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Accident analyses performed for nuclear facilities typically consider windborne missiles impacting drums and other storage containers. In contrast, the analysis presented here, which was performed at the request of the Defense Nuclear Facilities Safety Board, considers the converse problem, namely that of drums becoming missiles and rupturing on impact with a stationary object. This was of special interest for a new type of container, called the Pipe Overpack Container (POC), which consists of a heavy-gauge pipe component packed in a 55-gallon drum. The POC is used to package considerably more transuranic waste than the typical 55-gallon drum sent to the Waste Isolation Pilot Plant. It is shown in this report that for Rocky Flats Environmental Technology Site (RFETS), the credible wind speeds (straight line and tornado) are not great enough for this to be a significant issue. However, for DOE sites subject to severe tornadoes and hurricanes, this issue needs to be considered.

Symmetrical objects, such as 55-gallon drums, cannot be lifted by the horizontal component of the wind, except momentarily if the orientation of the drum relative to the wind is advantageous. Heavy drums can remain suspended in the air only if the vertical component of the wind is substantial. For a 450-lb drum, for example, the vertical component of the wind speed must be on the order of 200 mph for the air density at RFETS; at sea level, the vertical component of the wind would not have to be quite as great. The horizontal velocity of a windborne drum depends upon the horizontal wind speed and upon drum weight. A 200-lb drum, for example, could attain a speed of about 110-mph (at RFETS) for a horizontal wind speed of 350 mph. An 800-lb drum, on the other hand, couldn't attain a speed of 60 mph for such a wind.

The damage done to a windborne drum when it impacts a stationary object depends upon the kinetic energy of the drum, how the drum strikes the object, and how unyielding the object is. In the case of the POC, if it struck a building end-on or side-on it would not be breached even for wind speeds as high as 350 mph. However, it could be breached if it impacted side-on an unyielding object that was narrow, such as the horizontal timber of a rigid telephone pole; the wind speed would have to be on the order of 150 mph or greater for such a rupture of a POC. For other types of drums, the wind speed required for a rupture can be calculated if the energies to cause rupture for the various types of impact are known.

The occurrence probability of a rupture of a windborne drum missile depends on many factors. What is the probability of attaining the needed wind velocity (horizontal and vertical components)? If the drum is banded with others, what is the probability of the banding breaking? What is the probability of the drum being moved by the wind to an unshielded location so that it can be lofted? What is the probability of the drum striking a "sharp" object that is sufficiently unyielding to cause the rupture? What is the probability of the orientation of the drum being such that the impact causes a rupture (as opposed to a glancing impact)? In the

case of the POC, when all these factors are considered it is found that a rupture is less probable than 1E-6/yr, even using very conservative estimates of the factors entering the calculation. For other types of drums and other DOE sites, however, this may not be case.