FIREHOUSE®

Weekly Drill

Drill #137: BLEVE

Introduction

The boiling liquid expanding vapor explosion (BLEVE) is an impressive sight. I have seen them on the news and in training videos, but I have not personally experienced one – nor do I want to. In almost all incidents involving a BLEVE, the end results are generally catastrophic.

Let's dissect the BLEVE to get a better understanding of what is involved. First, liquid fuel has to vaporize in order for it to burn. Vaporization occurs when a liquid is converted to a gas or vapor. There are many different factors that will determine the rate of vaporization, but one thing that will accelerate the process is the addition of heat.

Another factor that we need to examine is the container in which that liquid fuel is being held in. If the product catches fire and leaves the container holding it, the flowing product will spread the fire to other objects and materials. These type (Class B) fires are a concern to the fire service as they don't mix with water, and in fact when water is applied the fire generally will spread faster and intensify. These type fires normally will require applying a fire fighting foam to suppress the vapors.

The problem, however, will magnify itself if the liquid fuel is contained in a closed vessel, like a holding tank, tank car, or some other similar container. When heat is added to the outside of one of these containers, the liquid fuel inside will increase in temperature. If this heat is allowed to continue heating the container, then the product inside will begin to boil and the vapors being released will begin building up pressure within the container. At some point, the pressure inside the container reaches such high pressures that the container will fail. Once one of these containers fails, the vapors and liquid being released, under pressure, causes a violent explosion, which we call a BLEVE.

Propane is one of the more common products that have caused violent container failures and BLEVEs that result in a massive fireball and are shortly followed by a shockwave. This shockwave has the potential to destroy everything that it comes in contact with for several blocks, depending on the size of the failed container. A large number of firefighters have been seriously injured or killed as a result of BLEVEs.

The vessels are equipped with a relief valve, giving the firefighters a false sense of security. In many incidents, the pressures inside the vessel are greater than what the relief valve can handle. Additionally, the container shell begins losing its integrity as this heat is being applied and the resulting increase in pressure and weakness of the container transmits into a BLEVE.

Let's examine a propane tank with fire impinging on it. The propane in the tank soon begins to boil, increasing the internal pressures. In time the relief valve will activate and release some of the propane, which is heavier than the air. This released propane then sinks and the vapors are ignited by the fire, which increases the fire and heat on the tank, increasing the internal pressure in the tank. Generally, the tank will start to discolor and the relief valve will increase in the noise it makes as it tries to relieve the internal pressures. If the fire is not extinguished, and the tank is not cooled, there will be a catastrophic failure of the tank and an ensuing BLEVE. Make sure you perform a risk/benefit assessment, as you might be too late to mitigate this situation. If so, evacuate the area immediately.

–Prepared by Russell Merrick