The effect of ignition modeling on prediction of explosion risk

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Abstract
Explosion risk assessments for petrochemical facilities and offshore platforms is a complex interaction of many factors, which include: location, size, direction and frequency of a given leak; ventilation conditions such as wind speed and direction; accumulation of gas clouds and associate frequency of ignition for flammable clouds; explosion consequence such as overpressure and drag forces for ignited flammable clouds. One of the most common methods for calculating explosion risk is Probabilistic Explosion Risk Assessment, which apply frequency arguments to risk calculations. While ignition models can have a large impact on the explosion risk level and the risk driver; they are the single largest source of uncertainty in risk modeling. Ignition sources can include electric sparks and arcs (from electrical circuits, motors, etc.), mechanical sparks, static electric discharges, lightning, open flames, and hot surfaces. There are two widely accepted ignition models that attempt to account for contribution of ignition sources:

1. UKOOA – ignition frequency related to leak rates (indirectly cloud sizes), non-transient ignition
2. TDIIM Model – ignition frequency related to time dependent cloud size, whereby continuous and discrete (intermittent) ignition sources considered

This paper will evaluate the concept of “intermittent” ignition sources. Presumably the concept of intermittent ignition sources is motivated by historical data that suggests ignition occurs after an area is exposed to flammable gas and hence this is not consistent with a continuous ignition source, which theoretically would ignite a flammable cloud upon initial exposure. However, it seems unlikely that explosion-proof equipment would “fail” in such an intermittent manner, and a more likely explanation is that the conditions leading to a successful ignition were intermittent. For example, a large release in an enclosed area can quickly “smother” a continuous ignition source by removing the necessary oxygen for ignition; however, when the leak slows or stops (ESD or emptying the inventory) the gas concentration can dilute back within the flammable range and the cloud can ignite. The idea that discrete ignition is due to intermittent ignition conditions, rather than intermittent ignition sources, is also supported by experimental data. This
paper will explore alternate mechanisms that can more accurately describe the concept of “intermittent” ignition, and the potential effect of risk level and drivers.