Analysis of Propane Sphere BLEVE After the Earthquake in Japan

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ABSTRACT

After huge earthquakes, several chemical and oil complexes faced to the Pacific Ocean were badly damaged. In Chiba, a refinery operated by Cosmo Oil Co., Ltd., 17 LPG storage tanks (Volumes of the tanks were 1000 to 5000 m³, and fuel in the tanks at the earthquakes was estimated to about 400 to 5000 m³ for each tank) were totally burnt or heavily damaged in the refinery. Five BLEVEs (Boiling liquid expanding vapor explosions) of LPG occurred, resulting in fire balls measuring 400 meters in diameter.

The boiling liquid expanding vapor explosion, or BLEVE, is defined as the explosive release of expanding vapor and boiling liquid when a container holding a pressure-liquefied gas fails catastrophically. Here, catastrophic failure means that the tank is fully opened to release its contents nearly instantaneously. If the pressure-liquefied vapor is flammable, the BLEVE leads to a fireball.

The objectives of this research are to determine the conditions in the five LPG tanks would be at the time of the BLEVE. To this end the following conditions were calculated:

- Duration of tank failure, Time to BLEVE
- Mass fraction in tank with time
- Temperature distribution in the liquid and vapor region
- Pressure within the tank – initial pressure; internal high-speed transient pressure during failure

The hazards form the sphere BLEVE, such as the expected fireball diameter and duration and the expected blast overpressure produced by the BLEVE failures is also a subject of active research. Data suggests that the shock produced by a BLEVE is due to the energy in the vapour space. The liquid phase change process may be too slow to produce a shock. However, it is essential to know if this is true for very large scales such as spheres. Here the blast using the methods of PHAST were calculated.