

3.3 Ignition of a Flammable Cloud

Given a release of LNG and the formation of a flammable cloud, the hazardous outcomes analyzed in the QRA only occur if there is ignition of the flammable mixture. The timing of the ignition affects the consequence outcome because the flammable cloud stops growing after ignition since the flammable vapor will be burned. For example, immediate ignition of the release may result in a pool fire or jet fire (or both); delayed ignition may result in a pool fire, flash fire, or explosion. For each scenario modeled, PHAST Risk calculates the outcome due to both immediate ignition and delayed ignition for the range of outcomes in the event tree. The immediate and delayed ignition probabilities in PHAST Risk are consistent with the guidelines published in the Dutch Purple Book.^{28,29}

Exponent applied the default PHAST Risk ignition probability values for two release types:

- “Stationary” facility ignition probabilities were assigned for lifting operation incidents.
- “Tank wagon” (i.e., rail tank car) ignition probabilities were assigned for the train movement incidents.

An overview of PHAST Risk’s probability of ignition model is provided in the following sections.

3.3.1 Probability of Immediate Ignition

Methane is defined as a low reactivity material in the software, and the probability of immediate ignition has a fixed value depending upon the hole size. PHAST Risk also considers a catastrophic instantaneous release of the entire contents of the vessel and calls this an “instantaneous” release. The term “tank wagon” refers to rail tank cars and was used to represent LNG DOT-113s during train movement here. The “tank wagon” immediate ignition probability only depends on whether the release is continuous or instantaneous; the rate of release is not considered. Table 31 lists the probability of immediate ignition for the scenarios identified in the QRA (see also the flammable event trees in Figure 7 and Figure 8).

²⁸ PHAST Risk Technical Documentation, “MPACT Theory,” DNV Software, page 103 (2010).

²⁹ Chapter 4.7, Ignition, in *Guideline for Quantitative Risk Assessment* (Dutch Purple Book), Publication Series on Dangerous Substances, Ministerie van Verkeer en Waterstaat (2005).