Table 21. Probability of immediate ignition for methane in PHAST Risk

Hole Size	Rail Tank Car
0.5-inch	0.1
2-inch	0.1
Instantaneous	0.8

3.3.2 Probability of Delayed Ignition

The probability of delayed ignition is dependent upon many characteristics of the release scenario, including the growth of an un-ignited vapor cloud with time and the presence of potential ignition sources at some distance from the point of release. Thus, the probability of delayed ignition is not a fixed value; it is calculated as a function of space and time for the duration of the event. The model domain space is split into grid cells, and the size of the cells is an integer value dependent on the size of the model domain. PHAST Risk performs calculations for each grid cell and sums the probability of ignition for all cells at a given time step as a function of the flammable cloud growth and passage through the model domain. The domain is the maximum spatial extent of the consequence (e.g., maximum flammable cloud size), and PHAST Risk uses up to 40,000 grid cells for analyzing the domain.

For each step forward in time after the start of the release, every grid cell that overlaps with a portion of the flammable cloud will have a probability of delayed ignition. The delayed ignition probability for a given grid cell is calculated from the equation,

$$P_{x,y,t} = f_{x,y}(1 - e^{-n\omega_{x,t}t})$$

where $P_{x,y,t}$ is the probability of delayed ignition in the grid cell located at (x,y). The variable $f_{x,y}$ is the proportion of time that the ignition source is present and active in the grid cell located at (x,y), $\omega_{x,y}$ is the ignition effectiveness factor for that grid cell, n is the number of people in the grid cell, and t is the time step. No fixed location ignition sources were defined in the QRA analysis presented here (e.g., a stationary flare), thus the PHAST Risk delayed ignition probability model considers only the potential for ignition due to the surrounding population. The default PHAST Risk ω for ignition due to population used in this analysis was 1.68×10^{-4}/person (for outdoor populations only). Thus, the ignition effectiveness factor, ω, in the QRA is dependent only on the population specified in each grid cell in the domain. The probability of delayed ignition in a given grid cell at a given time step increases with increasing population (holding all other variables constant). Since the risk within a given grid cell is directly related to the probability of ignition through all time steps, the risk will increase with an increase in the probability of ignition.