1.1 Understanding Risk

Risk, simply defined, is the potential to lose something of value. Risk is evaluated by taking the product of event likelihood with the event outcome severity, and then comparing the product to some benchmark risk which is considered by the stakeholders as being acceptable.

The likelihood of an event can be estimated using experience relating to given equipment in similar service, industry data, or engineering approximations. A challenge of quantifying risk, or affixing a number to a particular risk level, is determining how to quantify the event outcome portion of the equation. For quantifying risk at industrial facilities and operations, the outcome of an event is typically evaluated as the potential for a fatality or multiple fatalities.

In evaluating the potential for fatality, two metrics are utilized to yield the risk: (1) Individual Risk (IR) and (2) Societal Risk (SR). Individual Risk is the frequency (yr^{-1}) where an individual with continuous potential exposure may be expected to sustain a serious or fatal injury.

Given that the LNG DOT-113 tank cars will be transported along long routes (e.g., hundreds of miles), release scenarios were modeled along the rail line on a per-route mile basis. IR contours cannot be succinctly represented for long routes such as this, but they are related to the population level along the line.[2] Thus, the highest risk along the mainline will occur at the portion of the track exposed to the highest populations.

Societal Risk (SR) is another method for evaluating the risk of a given process or operation. Unlike IR, the SR calculation considers the relationship between the cumulative number of potential fatalities (N) versus likelihood (F) from a series of potential events. The outcome of a SR analysis is a FN graph depicting annual frequency F on the y-axis and N fatalities on the x-axis, where F is the cumulative frequency for all scenarios having N potential fatalities. Whereas the IR calculation gives insight into the probability of having a fatality, the SR calculation gives the likelihood of a number of potential fatalities. This is especially important for evaluating scenarios with a large potential impact for loss of life, such as train derailments of flammable materials.

1.1.1 Developing Quantitative Risk Criteria

After quantifying risk and presenting the calculations as IR and SR for a given operation or process, the results are evaluated for tolerability (or acceptability). Typically, stakeholders (e.g., government agencies, investors, communities) have a threshold risk level that is deemed acceptable—known as quantitative risk criteria. Currently, the U.S. Department of Transportation (DOT) Federal Railroad Administration (FRA) has not codified quantitative risk

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[2] IR is a weak function of population due to the population density effect on the likelihood of ignition model.