from 1971 to 2014.[35] The data set was filtered to include only UN1075 commodity accidents for the LPG tank car outflow frequencies. The data were then sorted and filtered by quantity released in order to estimate outflow frequencies. A histogram approach was taken, and spill volumes were ordered into logical groupings consistent with the intent of the QRA and the approach for LNG. Any spill less than 100 gallons was assumed as no release, spills between 100 and 1,000 gallons were a small spill (0.5-inch hole), spills between 1,000 and 30,000 gallons were a large spill (2-inch hole), and spills greater than 30,000 gallons were considered as a catastrophic release. A summary of the rail transport outflow frequency estimates versus spill size used in this study are provided in Table 16. The LOC probabilities for each spill volume range were remarkably similar to the statistics for all pressure cars.

Table 16. Rail transport outflow frequencies for LPG rail car accidents.

Quantity Released in gallons	Incident Count	Probability	Release Scenario
=< 100	2,293	0.945	No Release
100 < x =< 1,000	32	0.013	½-inch Leak
1,000 < x =< 30,000	84	0.035	2-inch Leak
> 30,000	17	0.007	Catastrophic

3.1.7 Multiple LNG ISO LOC Events

As the number of cars involved in an accident increases, the number of possible release scenarios grows exponentially. For example, an accident involving five cars, each with four possible outcomes, results in 4^5 (i.e. 1,024) possible combinations. PHAST Risk requires that each outcome be modeled as a single release; for example, a small release from one car combined with a large release from a second car would need to be combined into an equivalent release scenario. Within all of these combinations, several distinct outcomes are represented. As such, the combinatorial releases were grouped by discharge rates with aggregate probabilities of LOC. The outcomes were then refined by eliminating all potential LOC events with probabilities less than 1×10^{-7}; below this probability value, the risk was assumed to be insignificant.

None of the permutations were limited to only one ISO for all leak scenarios. Consolidated release rates ranged from 0 to approximately 100 kg/s depending upon the case. None of the permutations led to a catastrophic release of more than three LNG ISOs. The consolidated releases for accidents involving two through ten LNG ISOs are shown in Table 17 through Table 25.

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[35] Accessible via hazmatonline.phmsa.dot.gov/IncidentReportsSearch/search.aspx.