representative unit length (which is typically on a per route kilometer basis).[14,15,16] Although many international groups and agencies also increase the stationary facility quantitative risk criteria by an order-of-magnitude when applied to transportation routes, this approach was not taken here in order to use conservative risk criteria (although increasing the thresholds by an order of magnitude may ultimately be decided as being appropriate by the stakeholders for this project). Thus, the NFPA 59A stationary facility quantitative risk criteria were used as a basis for evaluating the transportation risk results on a per track mile basis. The SR has also been calculated on a per mile basis using customary measure of distance in the U.S. for the rail routes, which is also more conservative than using a per kilometer basis (i.e., the per mile risk is approximately twice the value as a per kilometer basis). Thus, Exponent's approach was to analyze the SR for shipping LNG on a per track mile basis and use the NFPA 59A stationary facility quantitative risk criteria in order to provide conservative risk results relative to the recommended approaches relied upon by international governments and agencies.

The SR quantitative risk criteria lines, as depicted in Figure 1, will be used in this report on a per track mile basis[17] for line of road operations. The FN curves for the yards and intermodal facilities will not be normalized per mile of track length since these operations more closely resemble stationary facilities and, therefore, will include the switching areas of the yards and the intermodal loading facilities.

The SR for alternative train configurations was also evaluated by examining the SR integral, or the area under the FN curve. This allows for the FN curves between multiple scenarios to be easily compared to one another by representing the FN curves as a single number. To compare against the values reported for the specific scenarios, the SR integral for the upper risk criterion (labeled "unacceptable" in NFPA 59A) is 6.91×10^{-3} when integrated from 1 to 1,000 (or $4.61\text{x}10^{-3}$ when integrated from 1 to 100).

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[14] Chapter 3.3.5 Detailed QRA, Railways, Calculation and presentation of results, p. 3.15 in *Guideline for Quantitative Risk Assessment, Part Two: Transport* (Dutch Purple Book), Publication Series on Dangerous Substances, Ministerie van Verkeer en Waterstaat (2005).

[15] Section 5.4, p. 23 in Ham JM, M Struckl, AM Heikkila, E Krausmann, C DiMauro, M Christou, JP Nordvik, "Comparison of Risk Analysis Methods and Development of a Template for Risk Characterisation," Institute for the Protection and Security of the Citizen, European Commission, Directorate-General Joint Research Center (2006).

[16] Schork JM, EM Lutostansky, and SR Auvil, "Societal Risk Criteria and Pipelines," Pipeline & Gas Journal, 239(10), October 2012.

[17] Two types of mile units are used in this report: train miles and track miles. Train miles represent the distance traveled by a train, typically as an average value of miles traveled per year. Track miles represent the length or position along a fixed route along the rail line.