

Assessing Risks from Hazmat Transportation on Rail

by

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DISCLAIMER

- **All references to companies, their names, addresses and other attributes indicated in this presentation are for example purposes ONLY and should NOT be construed as facilities in any FRA action plan.**
- **Any data used for illustrating the details of Risk Assessment or results shown are to be considered as fictitious and are NOT attributed to any specific institution.**

What is in this presentation?

- General discussion on what constitutes “Risk.”
- Usefulness of risk assessment; why should an FRA inspector care?
- Voluntary and Involuntary Risks
- Individual Risk and Societal Risk.
- Elements to be considered in risk evaluations
- Description of an approach
- Example results and how to interpret the results.

Common experiences of Risk

- Our own activities such as (i) driving at high speed on a highway, (ii) going to a beach and swimming in the sea, (iii) flying, etc.
- “Risk” by dictionary definition is “A situation involving exposure to danger.”
- “Risk” for technical evaluations is “Occurrence likelihood of a defined hazard when a person is exposed to adverse conditions.”
- Risk is not just a magnitude of a harm but also how likely such a harm can come to a person, over a period.
- An exposure may result in many types of harms, both immediate and long term.
- The totality of harms and their likelihoods constitute the total risk.

Why should we (FRA) care about risk or its assessment?

- FRA mission is to ensure and improve safety to public and RR workers (without adversely impacting nation's economic activity).
- This can be done only when we have a bench mark for current levels of safety. A Risk analysis considers all types of hazards, how they originate and circumstances that impact safety.
- Alternative routes of hazmat shipments (if exists) can be analyzed and the one that poses least risk can be chosen.
- Risk or performance based, data driven, regulations are becoming the new norm; we need to be able to understand how regulations based on risk concepts can be enforced.

Risk Categories

- “Acute” risk is the one that arises from immediate harm circumstances (such as from a rail accident).
- “Chronic” risk is where the exposure to the harm is continuous over a period of time (months to years) and the effect is not realized, gradually, over a long time period.
- “Voluntary” risk arises from one’s activity by choice, for real or perceived immediate benefit.
- “Involuntary” risk arises when the potential harm is imposed by a third party with or without the knowledge of the person(s) exposed.
- In general, involuntary risk may not provide tangible and direct benefits to the person(s) exposed to harm.

Definition of Risk for Hazmat Transportation

What is risk?

Risk is the likelihood an event will occur and cause a consequence e.g. Injury or fatality



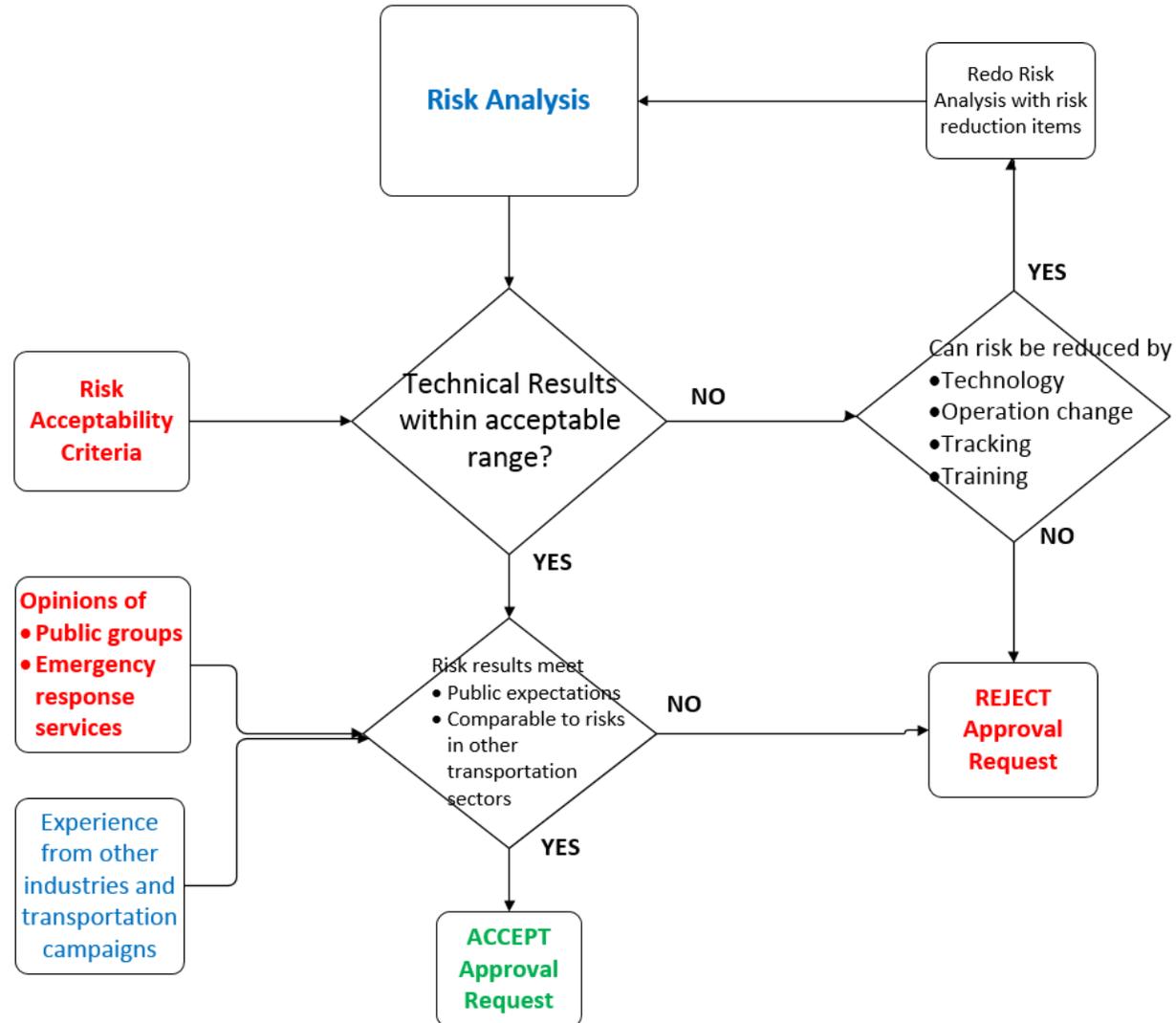
$$\text{Risk (Numerically)} = \{ \text{Likelihood of an event} \times \text{Consequence of the event} \}$$

[Summed over all possible events that can occur]

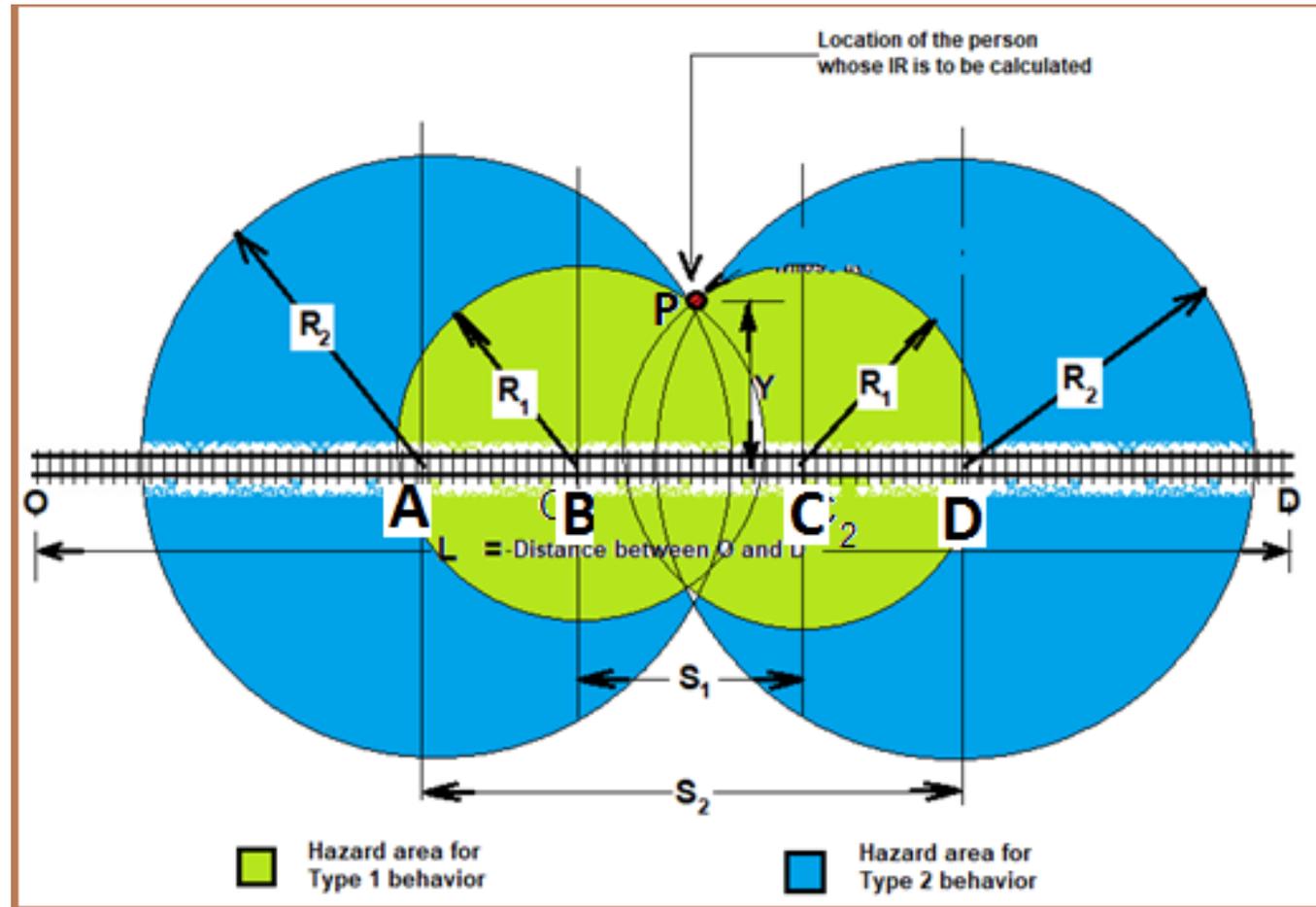
Types of Risks Evaluated

- Only involuntary, acute risks to the public are evaluated, in FRA assessments.
- “Individual Risk” determines the risk as a quantitative expression of “potential harm” to an individual
[Probability that an average unprotected person, permanently present at a certain location, is killed due to an accident resulting from a hazardous activity].
- “Societal Risk” measures the impact of harm to the population set affected by the activity.
“It is the relationship between frequency and the number of people suffering from a specified level of harm in a given population from the realization of specified hazards”.

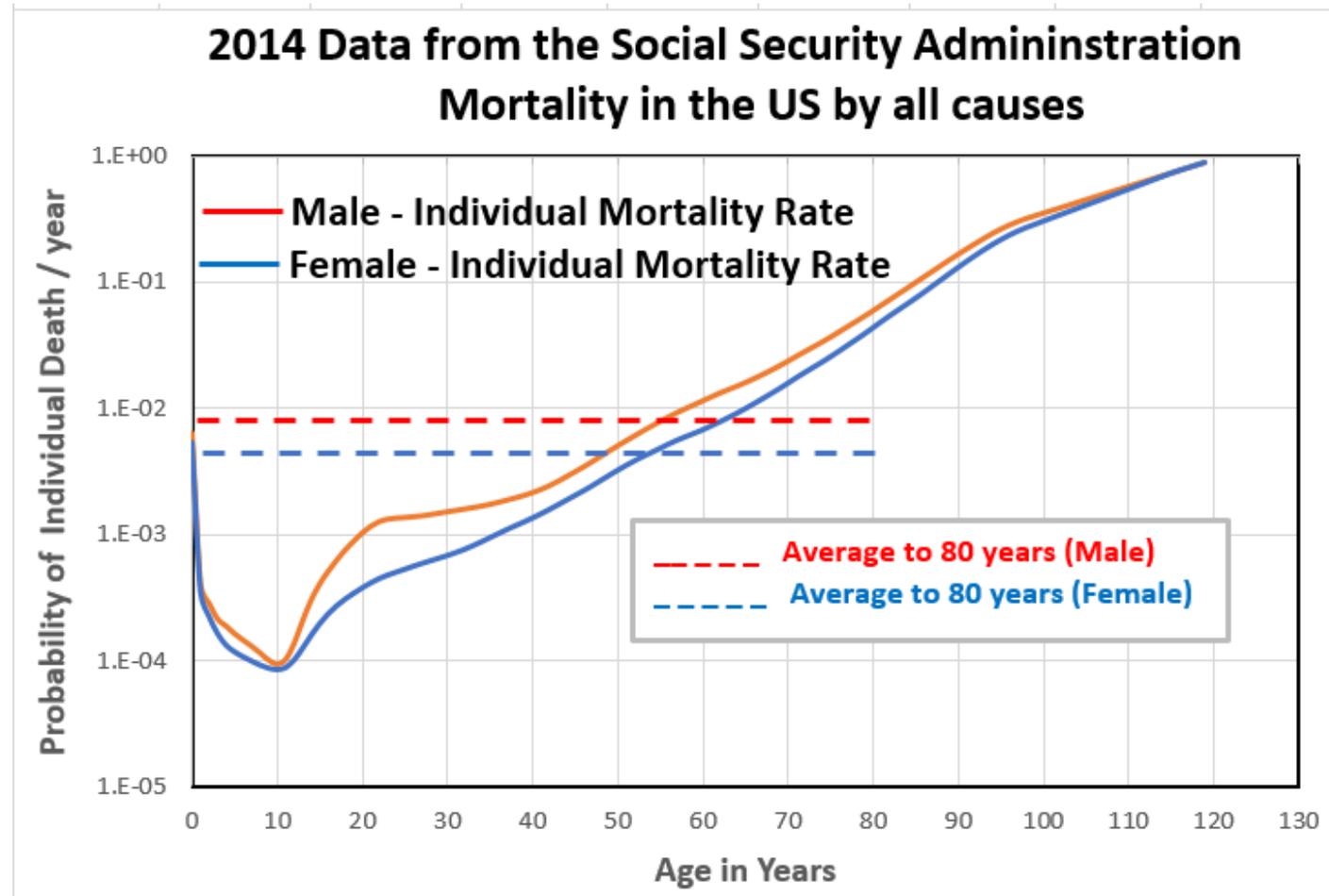
Risk Analysis Process



Individual Risk Calculation



Mortality Rate in US due to Natural Causes



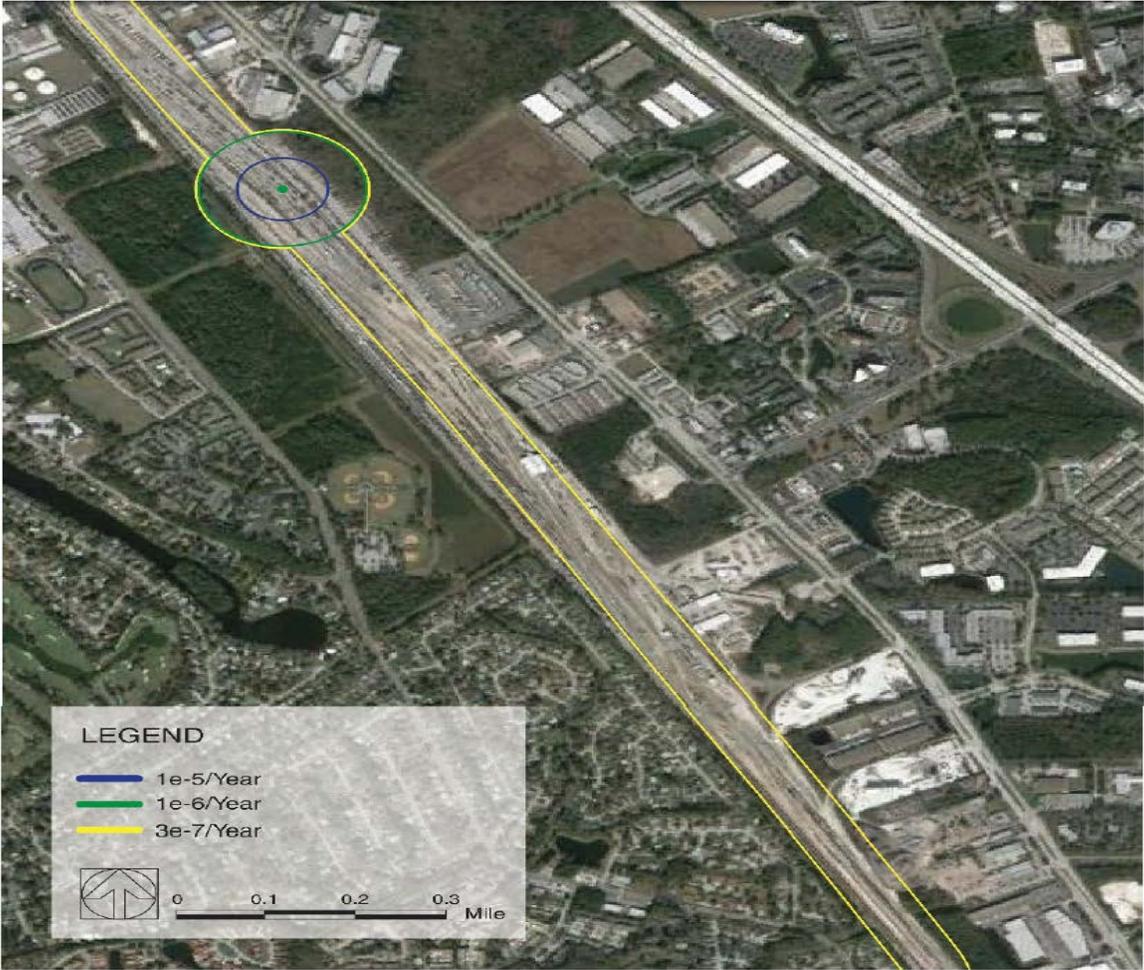
Individual Risk Acceptability Criteria [from an ANSI Standard]

Criteria for Tolerability of Individual Risk (IR) from Injury Due to Exposure to Dangerous Dose or Higher

Criterion Annual Frequency	Remarks
Zone 1 $IR > 10^{-5}$	Not permitted: Residential, office, and retail Permitted: Occasionally occupied developments (e.g., pump houses, transformer stations)
Zone 2 $10^{-6} \leq IR \leq 10^{-5}$	Not permitted: Shopping centers, large-scale retail outlets, restaurants, etc. Permitted: Work places, retail and ancillary services, residences in areas of 28 to 90 persons/hectare density
Zone 3 $3 \times 10^{-7} \leq IR \leq 10^{-6}$	Not permitted: Churches, schools, hospitals, major public assembly areas, and other sensitive establishments Permitted: All other structures and activities

Source: NFPA [2016]

Illustration of the IR Results on a Map



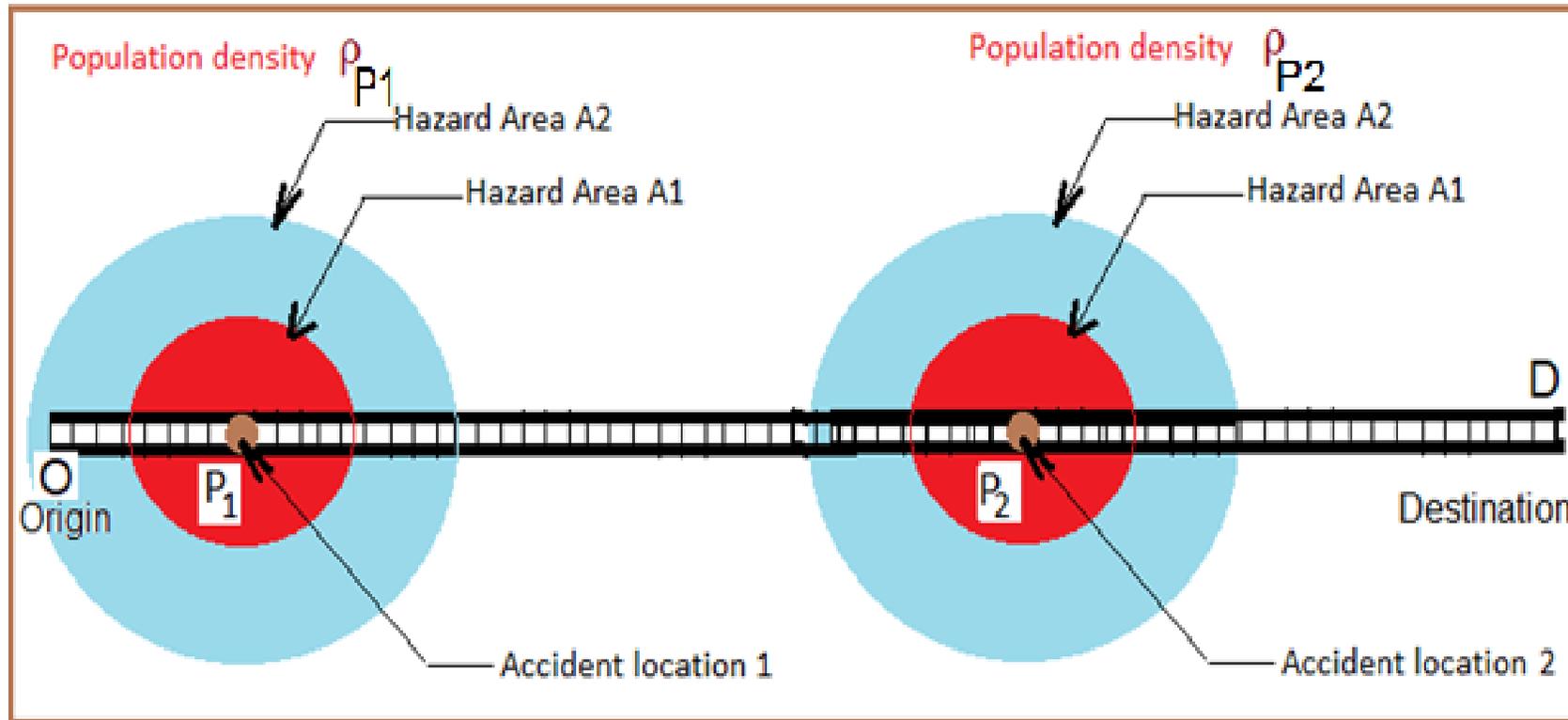
The cumulative IR contours for the Bowden Yard for baseline train configuration C-1. North is up.

Examples [FECR] Individual Risk Results Rail Shipment of LNG in Portable Tanks

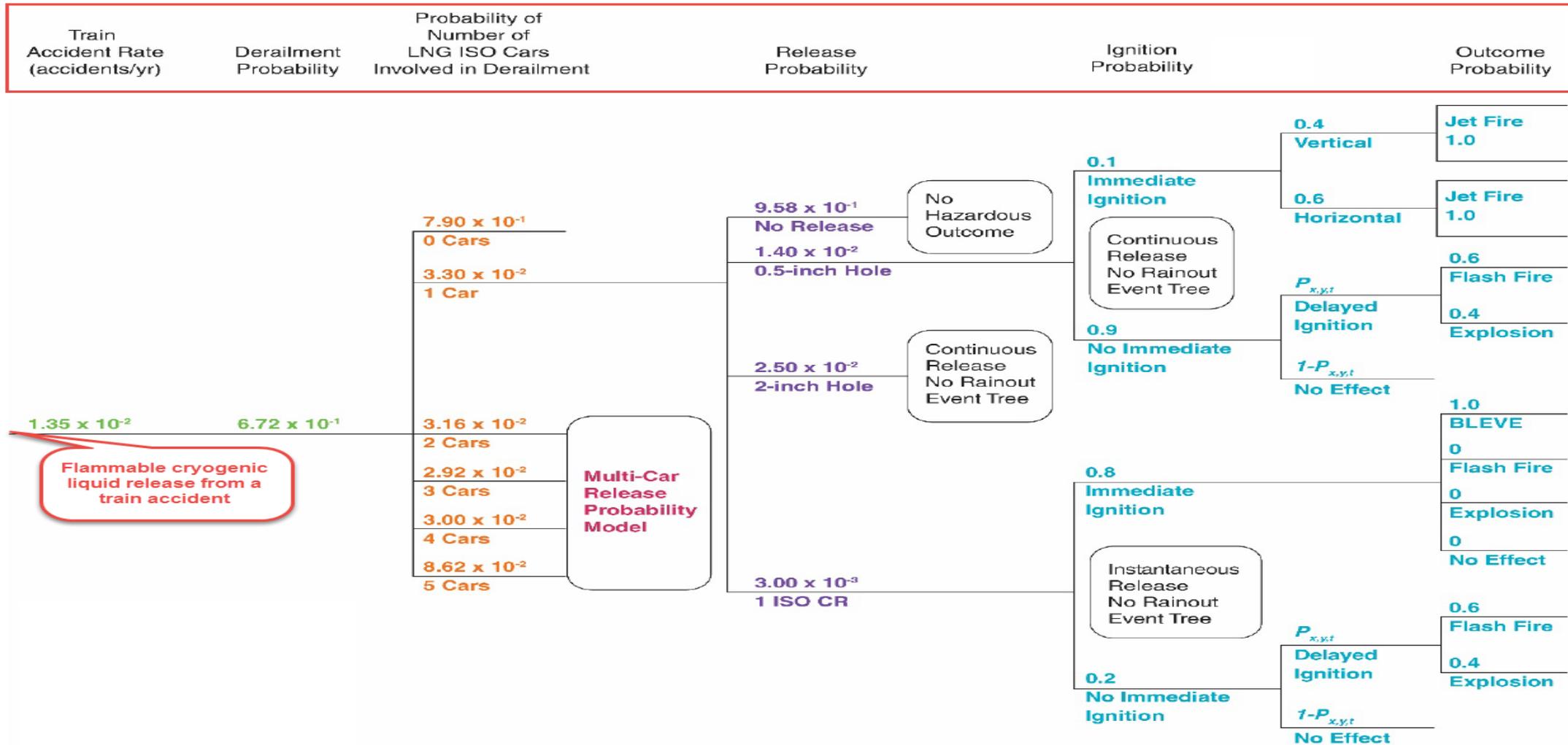
Table 57. Sensitive Targets Results –Route 1 & 2 Overlap from Hialeah to Little River (FEC MP 360.90)

Establishment Name	Category	Sub-Category	Yard or Mainline?	Max Track Speed	Distance to Railway	Distance to 3×10^{-7} /yr	Distance to 1×10^{-6} /yr
Miami Springs Montessori	School	Private preschool, kindergarten, elementary	Hialeah Yard	Rule 67	320 ft	205	DNE
iMater Elementary Charter School	School	Public Charter School	Mainline	35 mph	487 ft	200	DNE
iMater Academy Charter School	School	Public Charter School	Mainline	35 mph	161 ft	200	DNE
New Bethel AME Church	Church	Self-standing church	Mainline	35 mph	318 ft	200	DNE
New Mount Zion Missionary Baptist Church	Church	Self-standing church	Mainline	35 mph	348 ft	200	DNE
Templo de Alabanza Asambleas	Church	In strip mall	Mainline	35 mph	238 ft	200	DNE
Liberty City Elementary	School	Public Elementary School	Mainline	35 mph	319 ft	200	DNE
Martin Luther King Elementary	School	Public Elementary School	Mainline	35 mph	360 ft	200	DNE
New Vision Emmanuel Baptist Church	Church	Self-standing church	Mainline	35 mph	110 ft	200	DNE

Societal Risk Calculation

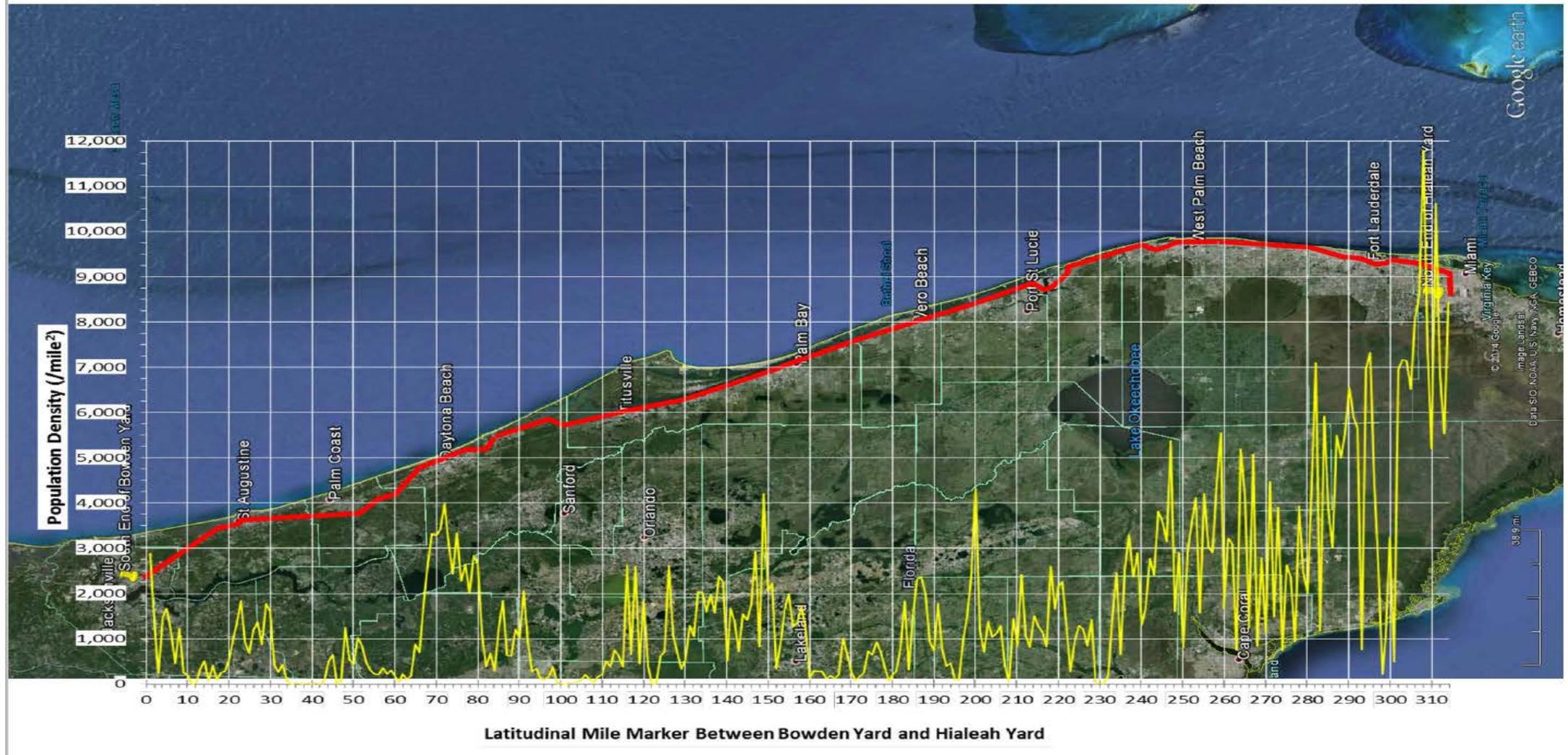


Flow Chart of Event Probability Evaluation

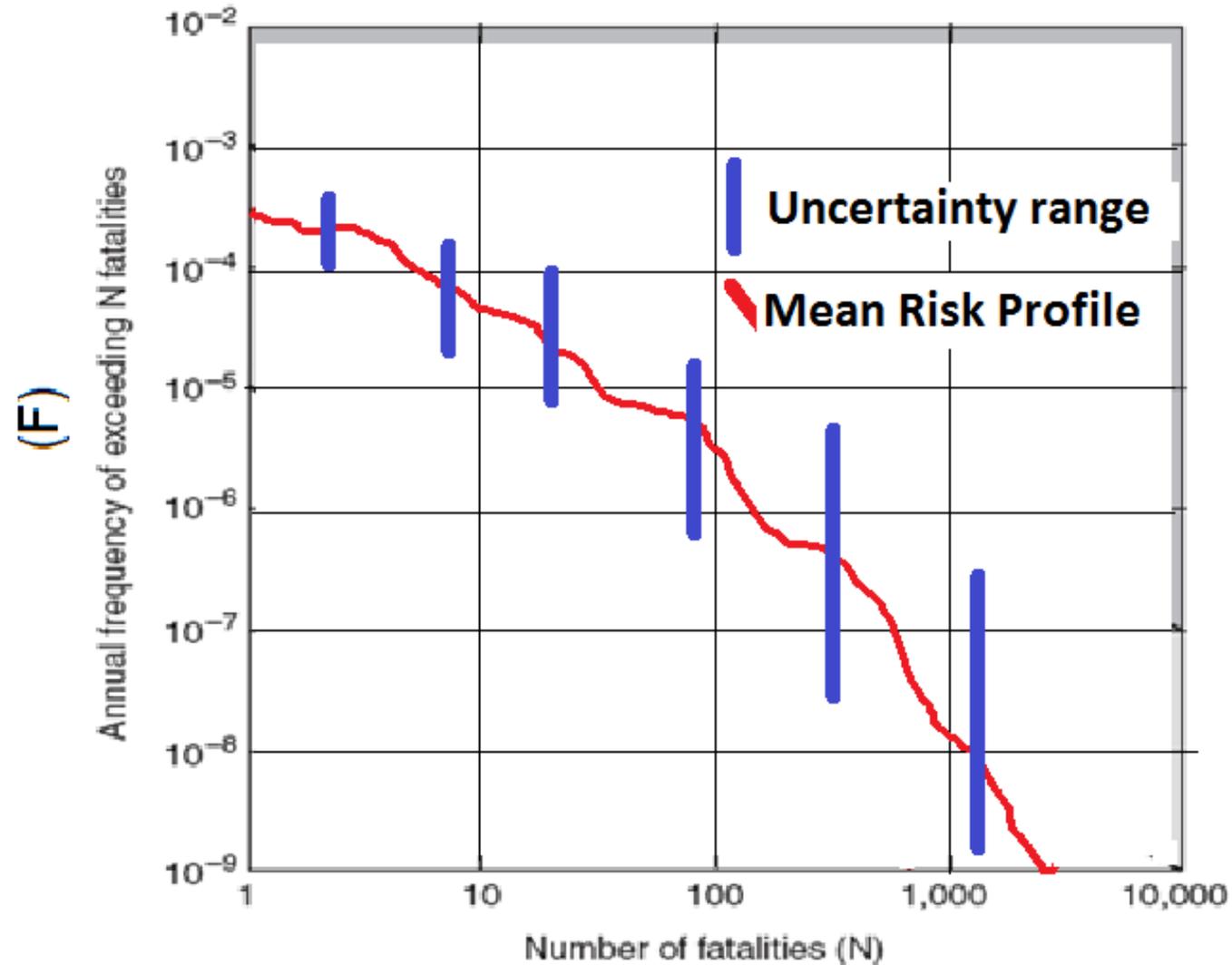


Representative event tree illustrating the relationship between the frequency of train accident and conditional probabilities of subsequent events in the analysis.

Enumeration of Population Density on a Route

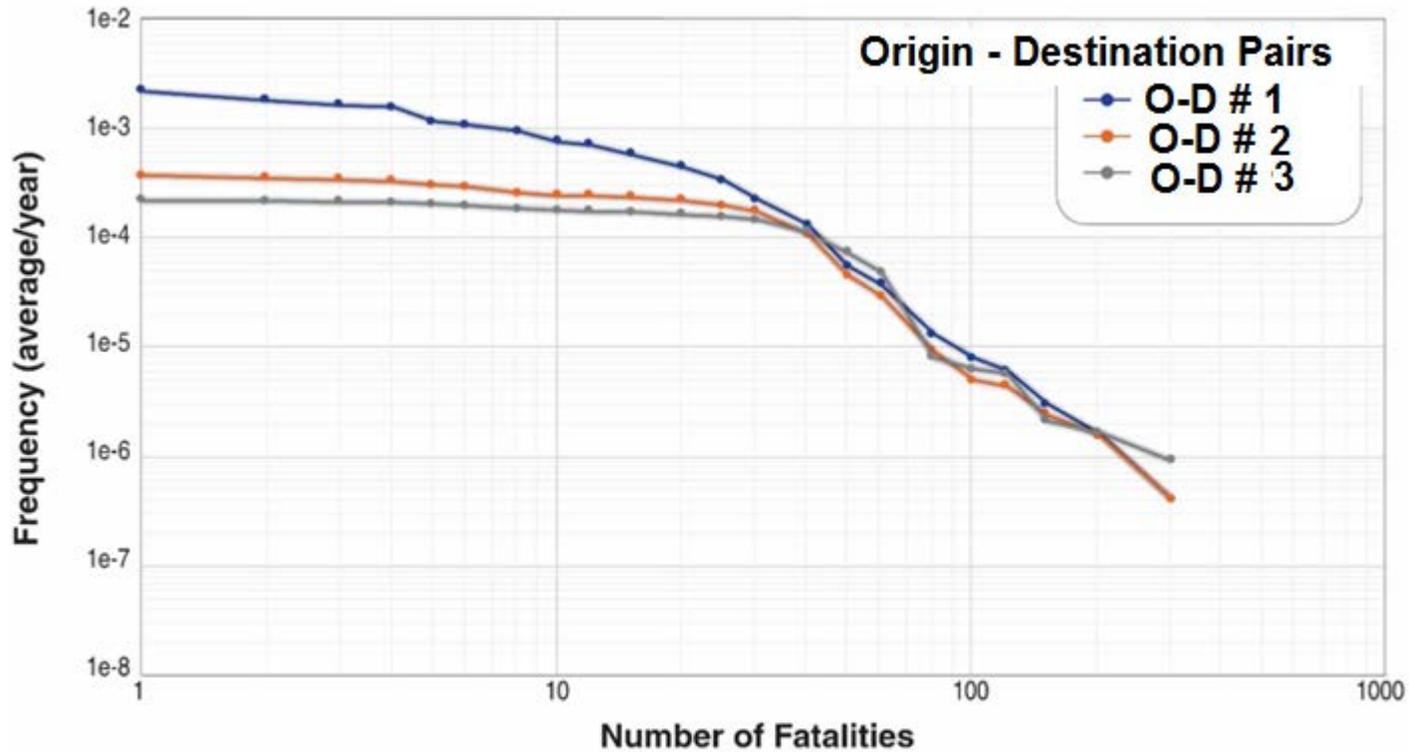


Final Results of Societal Risk Calculations



Examples Societal Risk Results

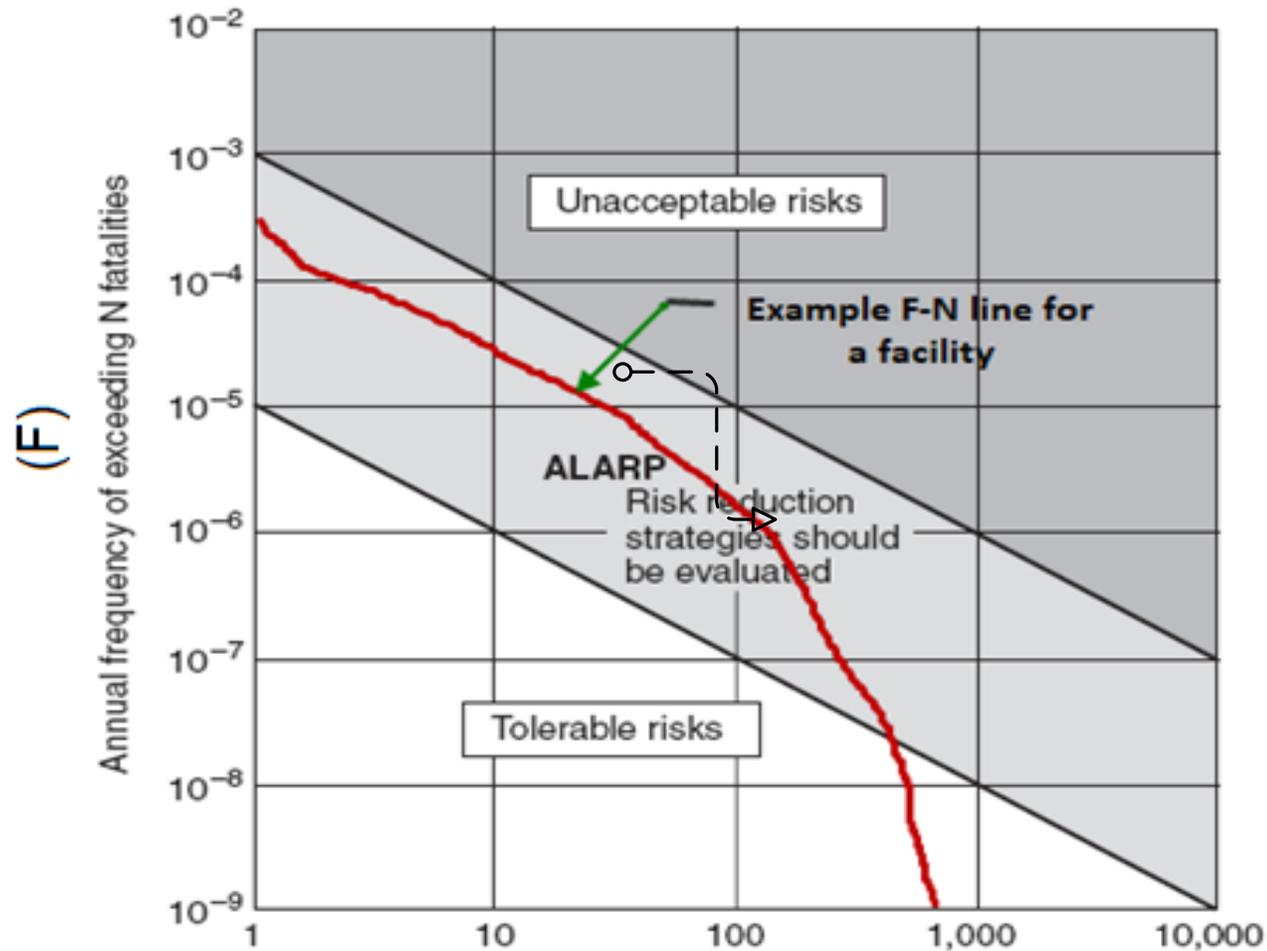
Rail Shipment of LNG in Portable Tanks



FN curve of the aggregate SR for the baseline train configuration C-1 mainline train movement for train speeds between 25 mph and 60 mph along the three proposed routes.

Societal Risk Acceptability Criteria

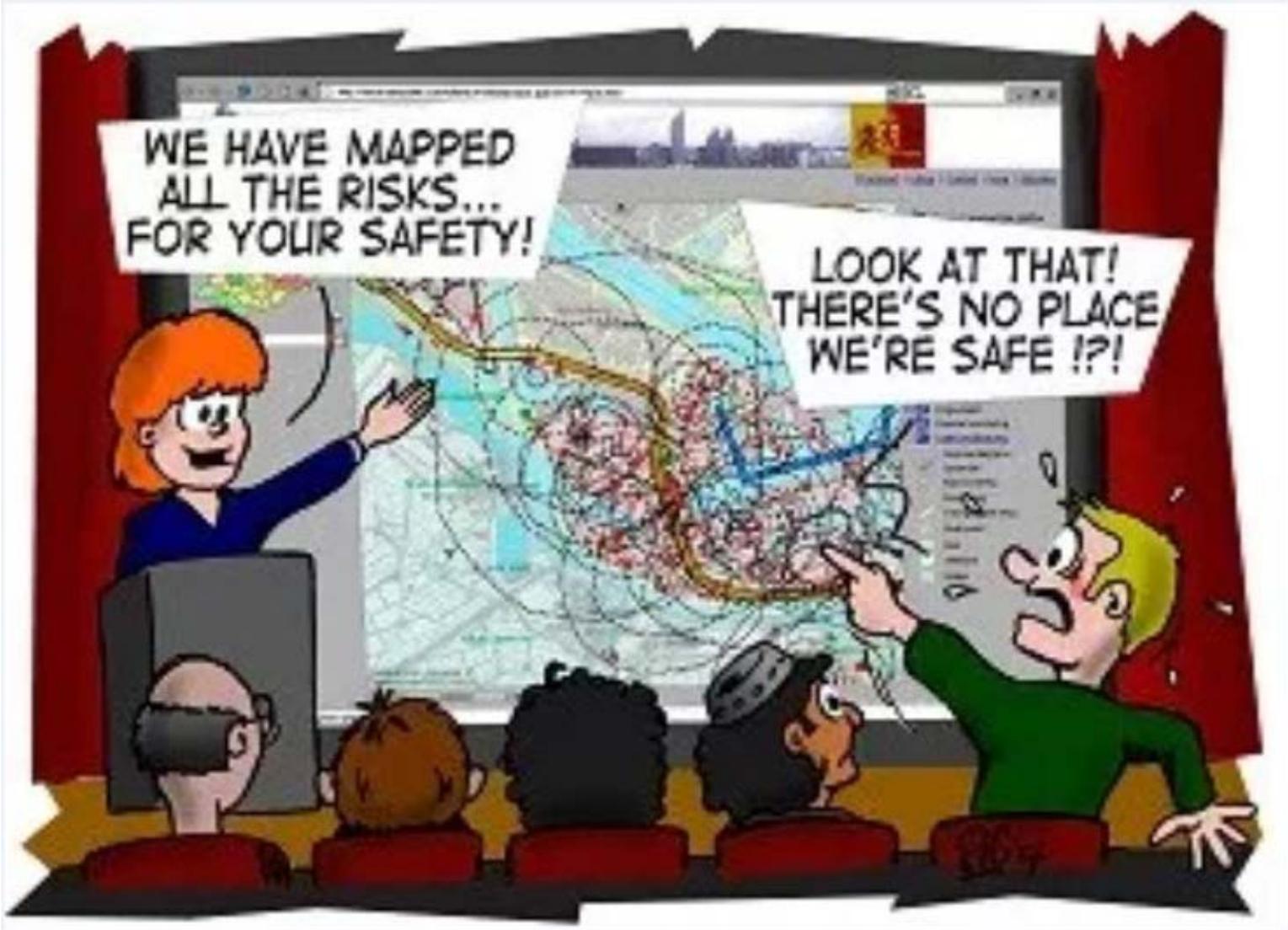
[from an ANSI Standard]



Source: Chapter 15, NFPA 59A [2016] – for acceptable Societal Risk Regions



"Well he certainly does a very thorough risk analysis."



WE HAVE MAPPED
ALL THE RISKS...
FOR YOUR SAFETY!

LOOK AT THAT!
THERE'S NO PLACE
WE'RE SAFE !?!

Thank you
Any questions?