Transportation Scenarios for Risk Analysis

PATRAM 2010

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Sandia National Laboratories

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Risk Triplet

- **What can happen (the scenario)?**
- **How likely is it (the probability)?**
- **What if it happens (the consequence)?**

Example: Transportation to the WIPP

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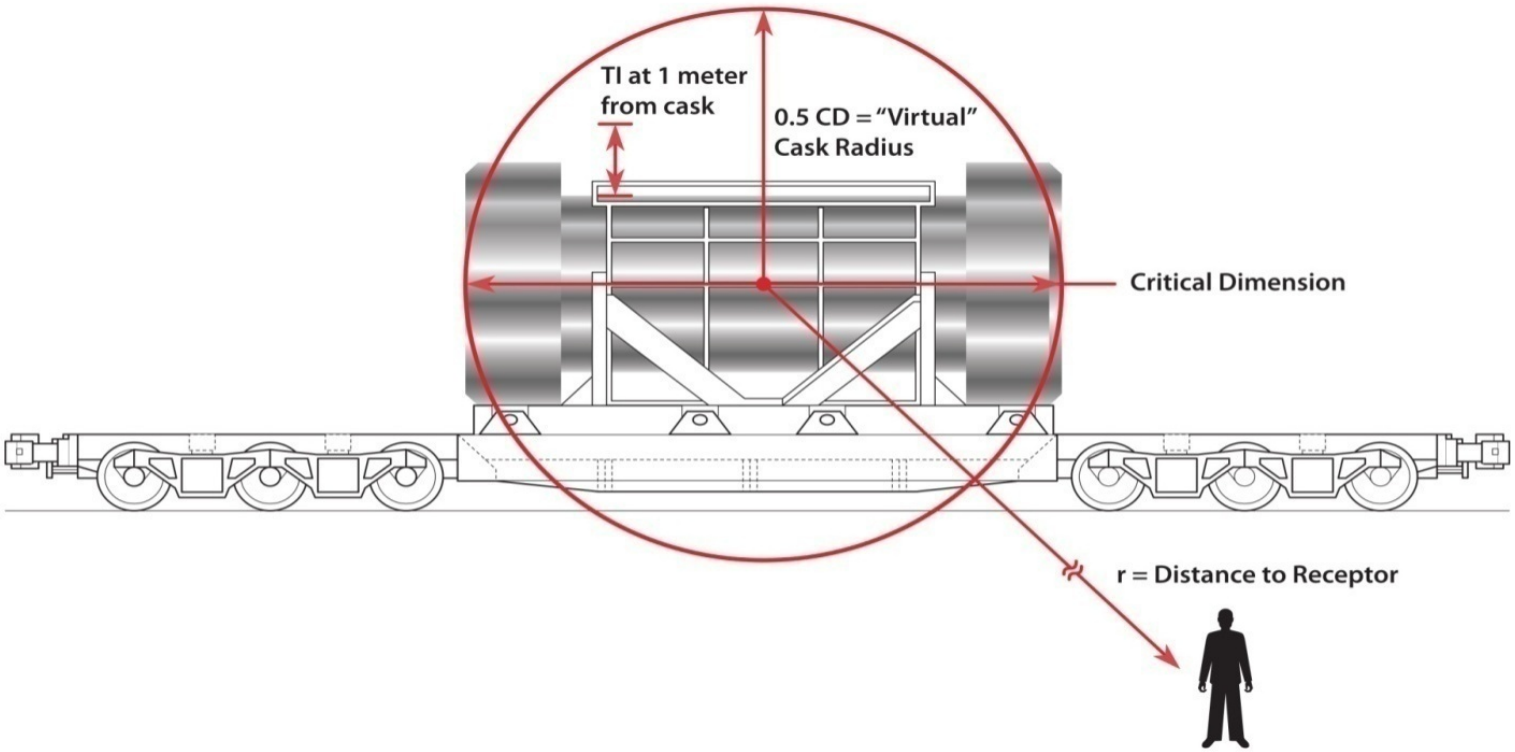
Scenario: Routine Transportation

Probability: essentially 100%

Consequence: very small external radiation dose

RADTRAN Model of Routine Transportation



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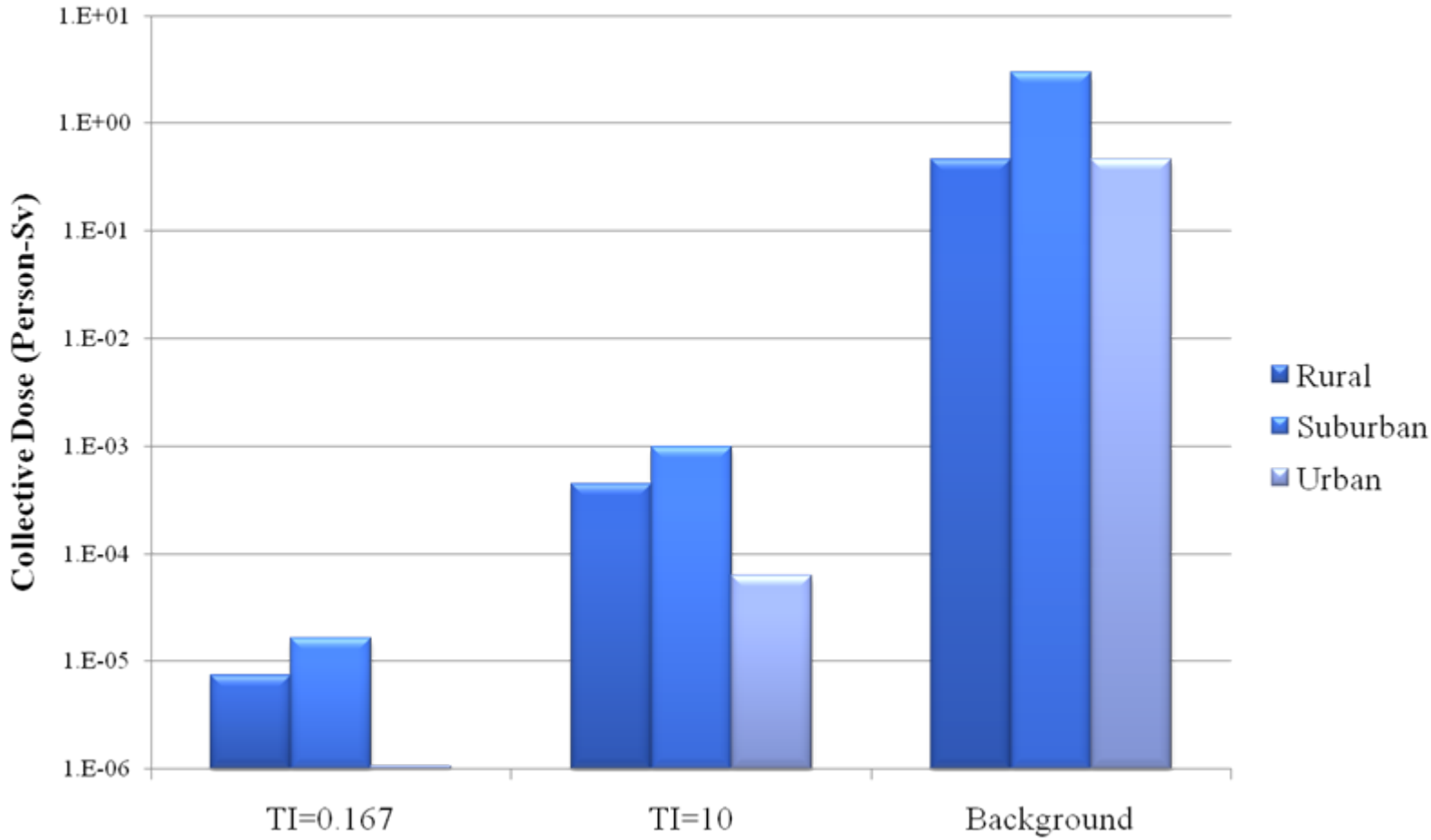
Effect of TI on Collective Doses from Routine Transportation to Public Along a Route



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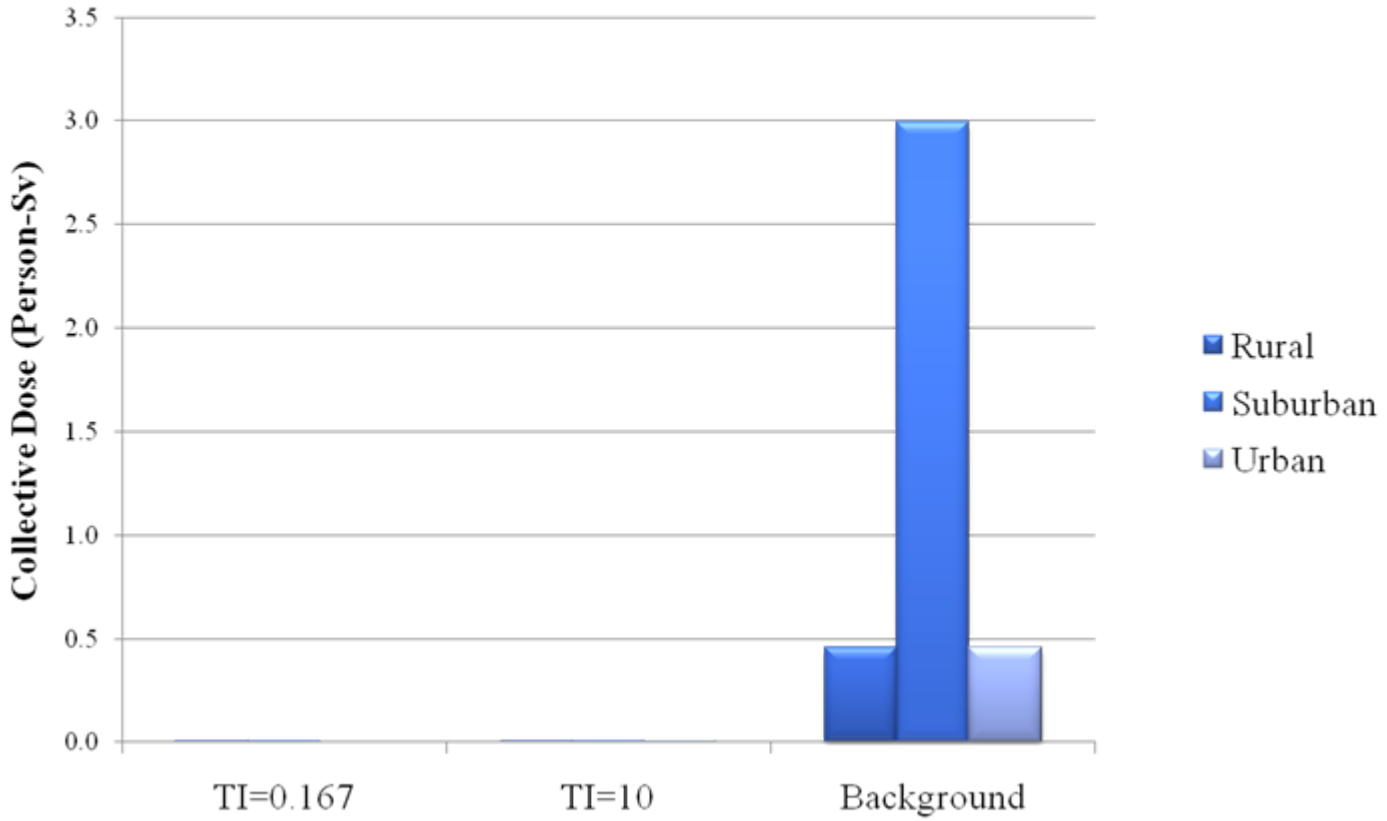

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Comparison of Collective Dose Risk to Background

The number of shipments from Brookhaven to the WIPP = 658.
TI= 0.167.
Radiation dose to the public from the shipments alone = 0.0165 person-Sv.
The WIPP receives at most five shipments a day.
Assume 10 shipments a day for a total of 65.8 days, for a total of 658 shipments.

Total collective background dose during the shipments = 65.8*3.9 = 256.6 person-Sv

Total collective dose from the 658 shipments = 0.0165 person-Sv

Total collective dose from background plus shipments = 256.6165 person-Sv.

Observations

The doses from routine shipments of radioactive materials are negligible when compared to background radiation exposure.

The difference between a shipment and no shipment is not the difference between the dose from a shipment and nothing, but the difference between the dose from the shipment plus background and the dose from background alone.

An increase in collective dose is not an increase in radiation exposure,
but an increase in the number of people exposed.

The practice of multiplying the dose to the public from a single shipment by the number of shipments is questionable.

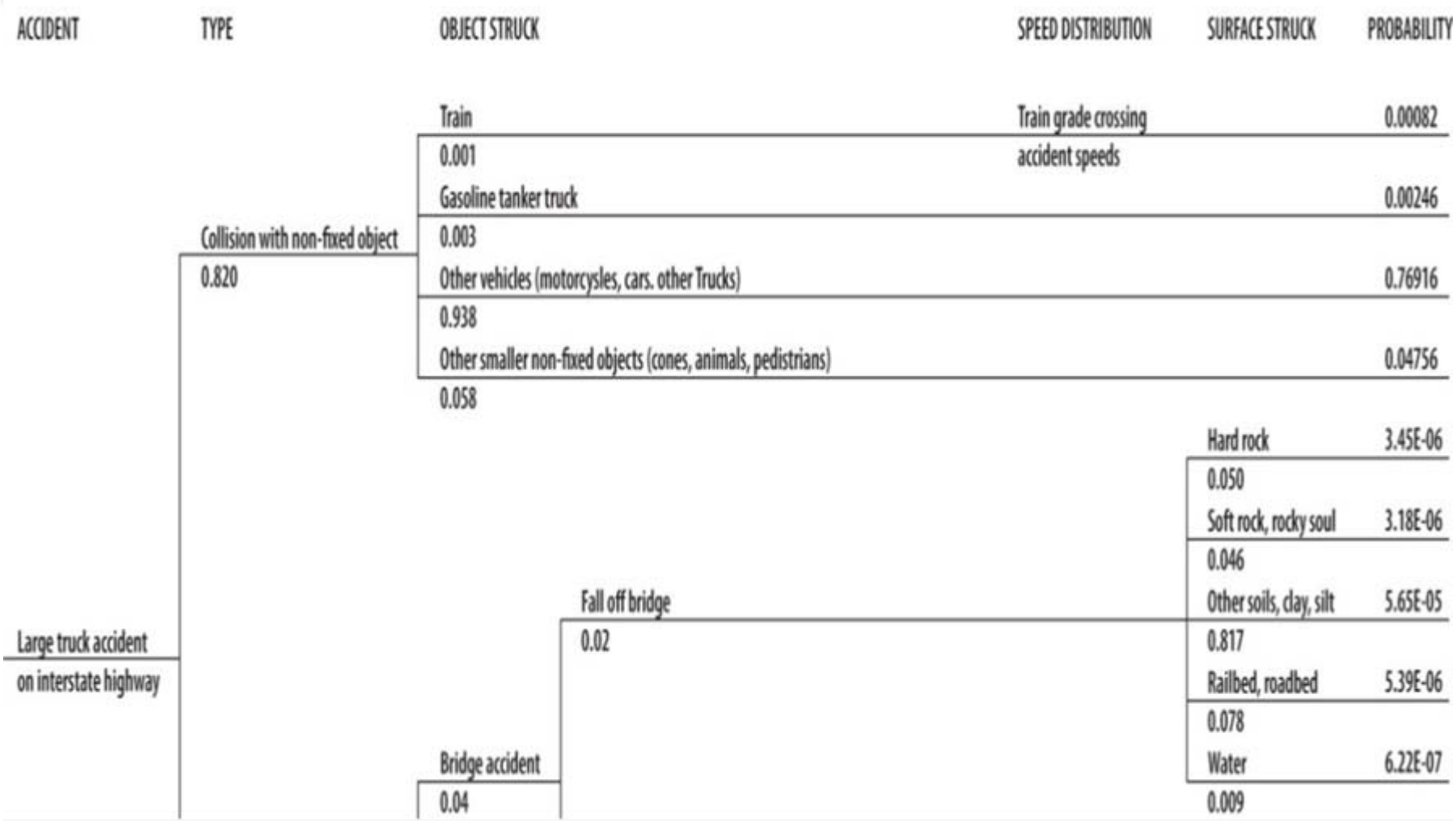
In effect, the dose delivered by 658 shipments made at the rate of one or two shipments per day has approximately the same effect as the dose from a single shipment.

Transportation Accidents

Two types of accidents:

- **Radioactive cargo is affected**
- **Radioactive cargo is not affected**
  - **Release of radioactive material**
  - **Loss of lead gamma shield**

Truck Event Tree – Part 1



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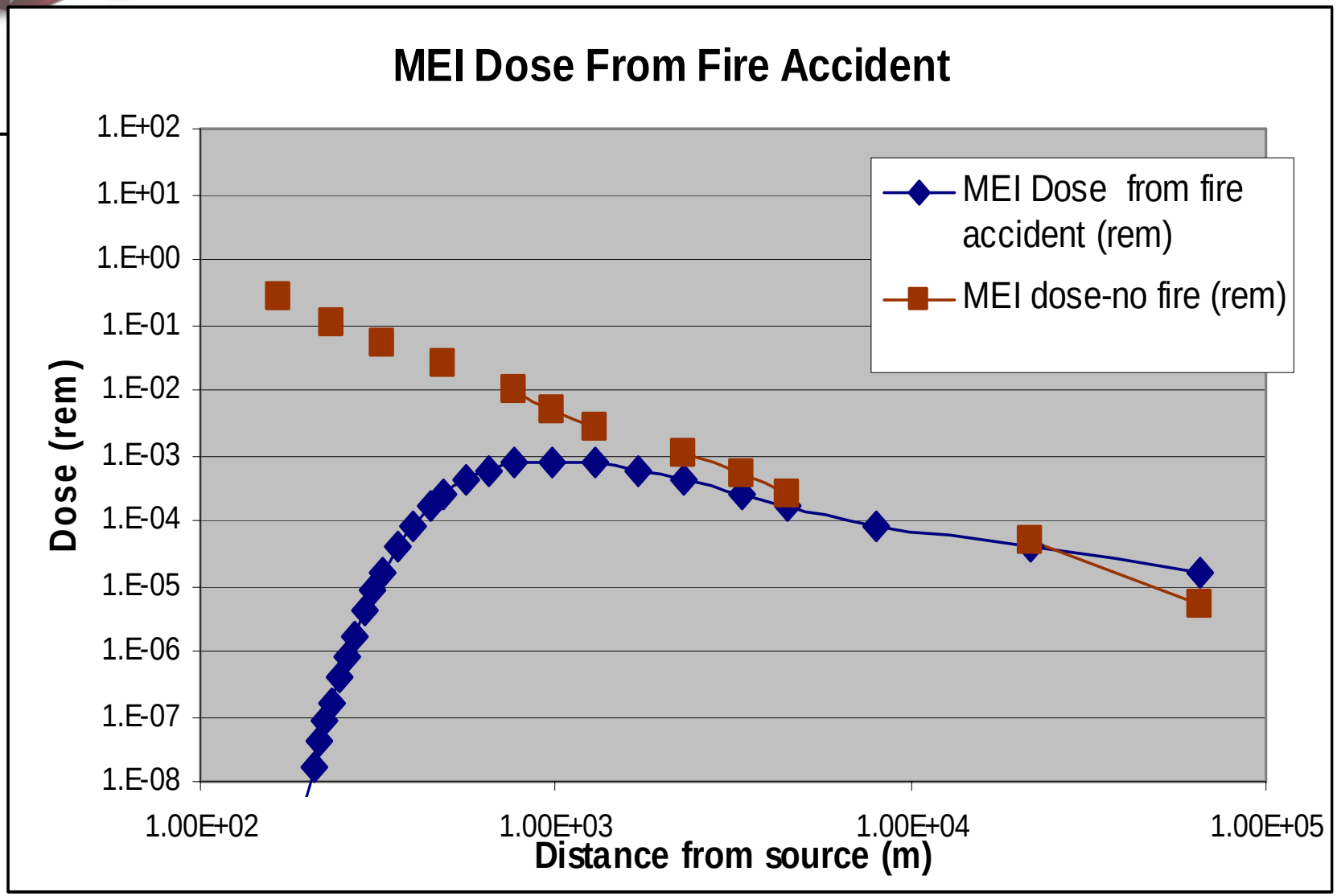
Example: Fire Damage to a Spent Fuel Cask

Probability of an accident in a 3000-km trip (From DOT) = 0.006

Probability of hitting a gasoline tanker truck (From DOT) = 2×10^{-4}
Probability of a subsequent fuel leak = 0.9
Probability of ignition = 1.0
Probability that the burning fuel engulfs the cask = 0.6
Probability that the resulting fire burns for 30 minutes or more = 0.6

Net conditional probability = 6.5×10^{-5}

Net probability = 3.9×10^{-7}



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Conclusions

The magnitude of a collective dose depends on the number of individuals exposed rather than on the intensity of radiation from the source.

Comparison of collective doses, e.g., for the same shipment on different routes, is a comparison of populations, not of radiation exposure.

Release in a fire can result in an elevated radioactive plume. The dose to the public from an elevated plume is less than from a ground level release, though the number of people under the plume may be larger.

Dose to the MEI is a better indicator of radiological effect than collective dose.