



Explosives Risk Management

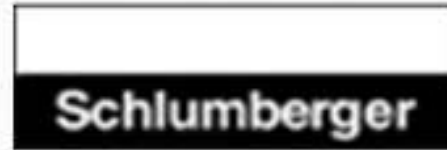
Institute of Makers of Explosives Safety Analysis for Risk

IMESA FR



*Vet's
Explosives*

TREAD
CORPORATION



W. A. MURPHY, INC.
Explosives Distributors



SUMMA INSURANCE MANAGERS



Baker Atlas



ExploTrack™

Safety Consulting Engineers, Inc.

R&R
Trucking, Inc.



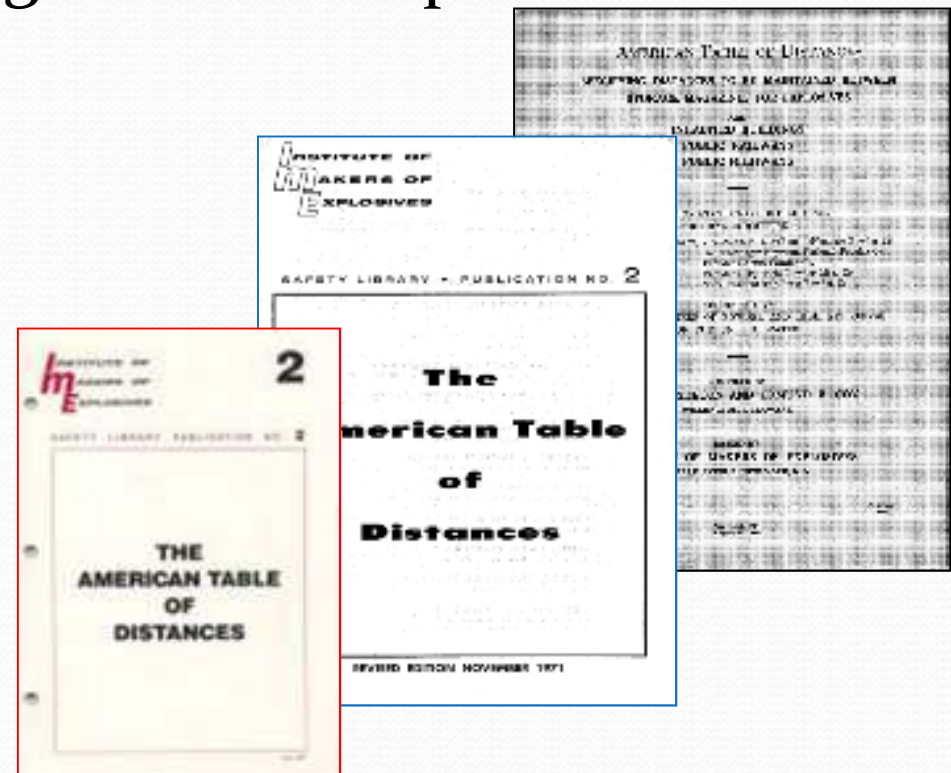
NOBEL
INSURANCE
SERVICES

MP ASSOCIATES, INC.



American Table of Distances (Q/D)

- Published in 1914
- Based on Classic Risk Management Principals
- Limits Building Damage
- Modified in 1971
- Today the Law of the Land
- Limited Application



As Operational Complexities Increased



We needed an additional tool to help manage risk in a consistent manner

- A Methodology where Q/D
 - Does not apply
 - Is impractical
 - Too liberal
- 3,000 Regulating Entities
 - Compliance
 - Fill gaps
 - Consistent methodology

Quantitative Risk Analysis (QRA)

- Mathematical Calculation Determines Risk
- Compare Risk to a Standard or ALARP
- Advantages
 - Objective, Quantifiable, Comparable , Powerful and Flexible
- Disadvantages
 - Complex

QRA for Explosives Operations

- Extensive use in Military Operations
- Considered by Civil Authorities
 - Europe
 - Canada



North Atlantic Treaty Organisation



General Comparison of Q/D to QRA

- Q/D is conservative except:
 - High frequency of event activities
 - Large numbers of people exposed beyond IBD
 - Excessive glass & debris hazard, weak construction, etc.
- QRA considers a wide range of actual risk
 - From infinitesimal to the probability of the event happening

Department of Defense SAFER Model (Safety Assessment for Explosive Risk)



- Risk based approach to military explosives operations
- Quantifiable, comparable, powerful and flexible



(IME Safety Analysis for Risk)

- Built on DOD “SAFER” foundation
- Models commercial operations
- Reflects potential explosive sites
- Considers wide variety of activities
- Fill gaps where standards don’t exist
- Consensus of Government and Industry

Technical Working Group

- IME
- ATF
- DDESB
- DOT
- ISEE
- MSHA
- OSHA
- NRCan
- APT



Natural Resources
Canada



The Fundamental Math

Risk = Probability x Consequences

Probability = Probability of Event

Consequences = Physical Effects x Exposure

Probability of Event $P(e)$

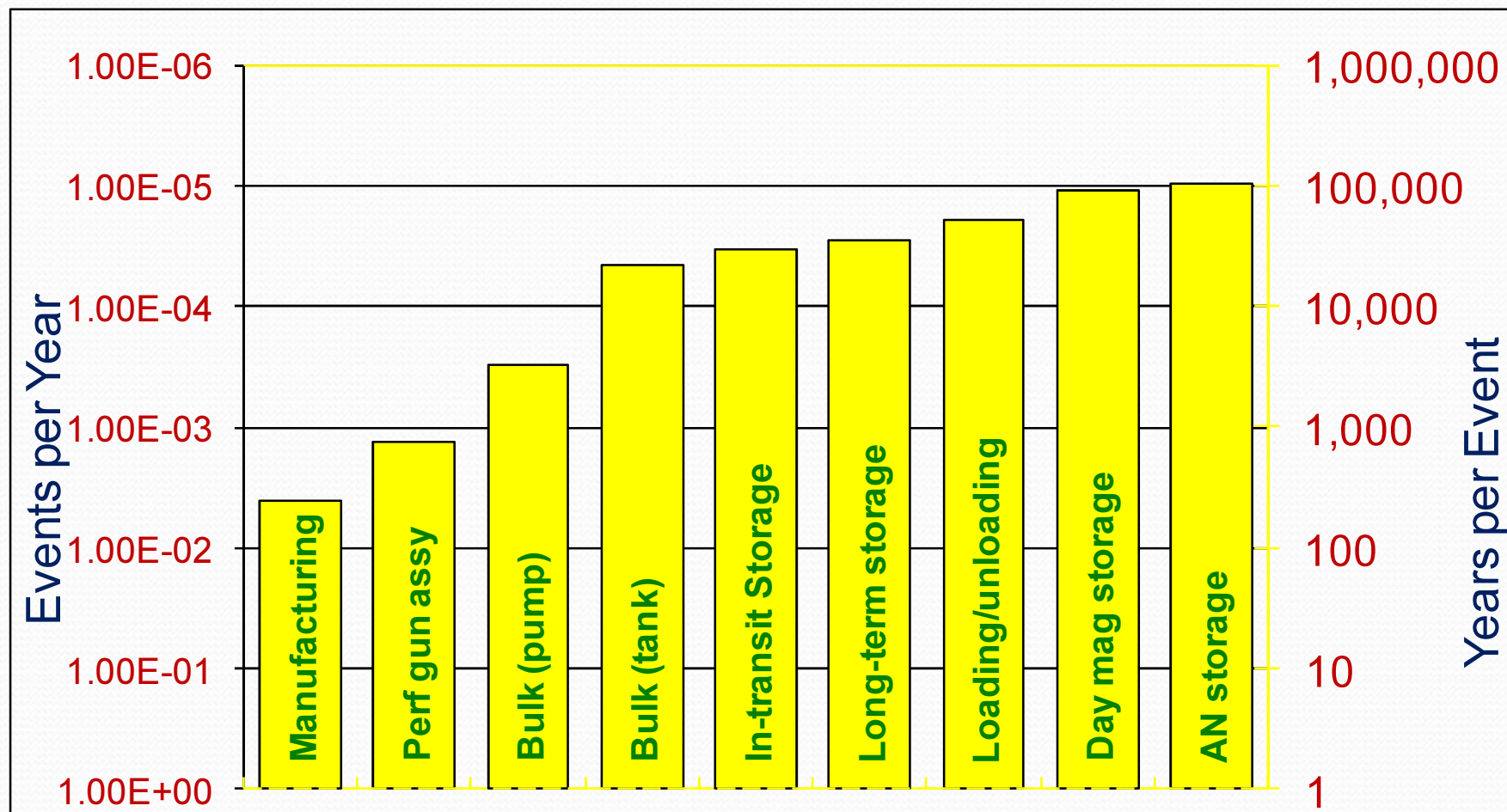
Accidental Initiation During a Defined Activity

Based on:

- Actual experience in last 20 years
 - Manufacturing
 - Perforating Gun Assembly
 - Long-term Storage
- Extrapolated from Basepoint
 - Ammonium Nitrate Storage
 - Bulk Loading and Unloading
- DOD experience
 - Assembly, demilitarization, disposal, inspection, lab, in-transit storage, day magazine storage, temporary storage and loading/unloading

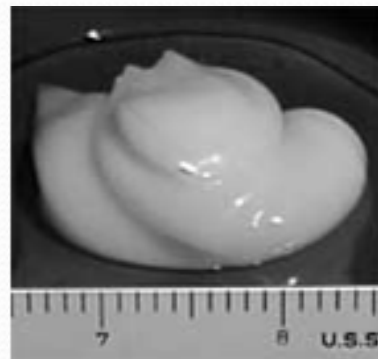


Selected P(e)



P(e) Adjusted by Environmental Factors

- Hazard Division (10x or 30x)
- Adverse Operating Conditions (2-3x or 10x)
- Heightened Security (3x or 10x)
- Water-based Explosives Only (0.3x)
- Blasting Agents Only (0.1x)
- Auger, No Pump (0.1x)

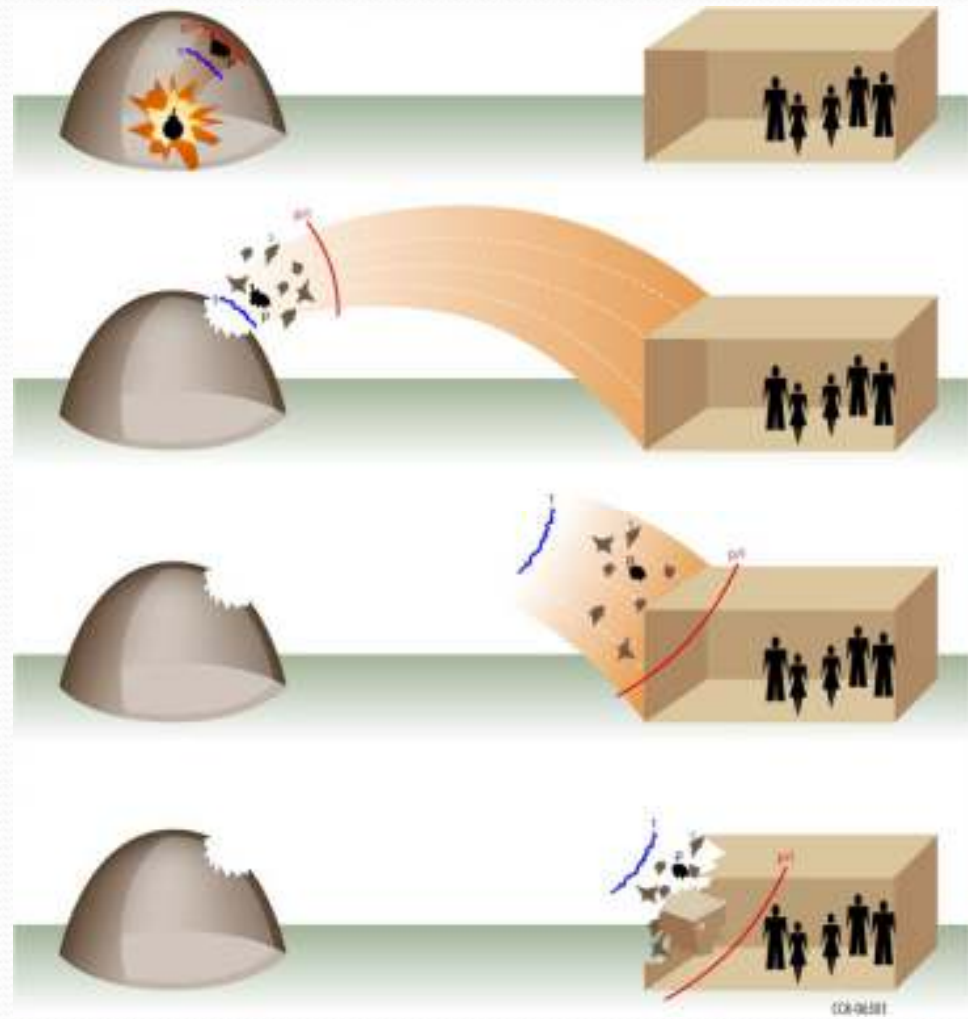


Physical Effects

- Explosives
 - Overpressure
 - Primary fragments
- Potential Explosion Site (PES)
 - Secondary fragments
 - Screens overpressure and primary fragments
- Exposed Site (ES)
 - Responds to overpressure and debris
 - Protects from overpressure and debris

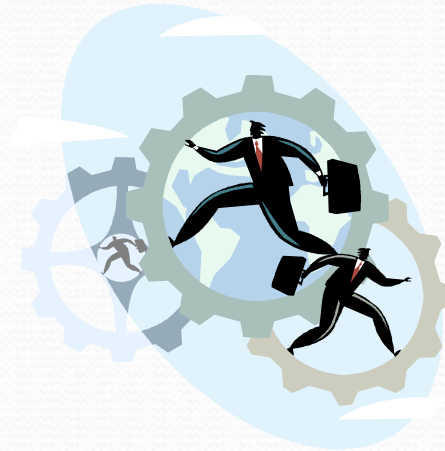
Potential Explosion Site (PES) Variables

- Quantity
- Distance
- Type of explosive
- Type of ground
- Barricade
- Air blast attenuation
- Debris containment
- Debris creation
- Response to air blast
- Debris protection



Exposed Site (ES) Variables

- Hours of Operation at PES
- People Exposure Hours
- Number of People Exposed
- Structure Specifics
- Correlations



Outputs

- Risk Measurements
 - Fatalities/yr.
 - Major Injuries/yr.
 - Minor Injuries/yr.
- Scenarios
 - Worst Case
 - Expected
 - Confidence Interval
- Groups
 - Public
 - Workers



What's Acceptable?

- DOD Criteria:
 - 1×10^{-6} one public individual
 - 1×10^{-5} all public individuals combined
 - 1×10^{-2} $P(f|e)$ criteria for projectiles
- Compared to Societal Expectations:
 - 1×10^{-2} All Causes
 - 2×10^{-3} Cancer
 - 1×10^{-4} Homicide
 - 1×10^{-5} Choking
 - 1×10^{-6} Hunger, Thirst or Neglect
 - 2×10^{-7} Bees, Wasps or Hornets
 - 1×10^{-8} Snakes, Lizards or Spiders



Potential Applications in Regulated Situations

- MSHA –
 - Storage and Other Activities
- OSHA
 - Process Safety Management (PSM/JSA)
 - Blasting Agent Manufacturing
- ATF
 - Variance Requests
 - DoD/ATF Incompatibility
- DOT –
 - In-transit Storage
- USCG
 - Permit Apps.
- EPA
 - OB/OD and CAA 112(r) RMP
- DHS
 - Elevated Threats
- Multi-Jurisdictional
 - Day use storage
 - AN storage
 - Bulk Loading/Unloading

Future Development

- Gain Experience with QRA
- Work with Regulators
- Collaborate with APT on Upgrades
- Expand Risk Criteria
 - Individual
 - Group
 - Worker
 - Catastrophic



Additional Reading

Paper presented by Lon Santis at ISEE 2008:

“Managing Commercial Explosives Operations Using QRA”

www.isee.org

Compliments to Andy Begg for Risk Assessment Workshop