Managing Safety – A Success Story

presented by:

Gene K. Lee, Ph.D.

GLee@BakerRisk.com

KOSEE/KIG Joint Spring Symposium, 2006

BAKERRISK BAKER ENGINEERING AND RISK CONSULTANTS, INC.

BAKERRISK

Disclaimer

Opinions expressed here are author's own.
His employers, past and present, are free
from any liabilities.

Hazards and Risks

Thank you for having taken the risks from various hazards to come here to listen to my talk!

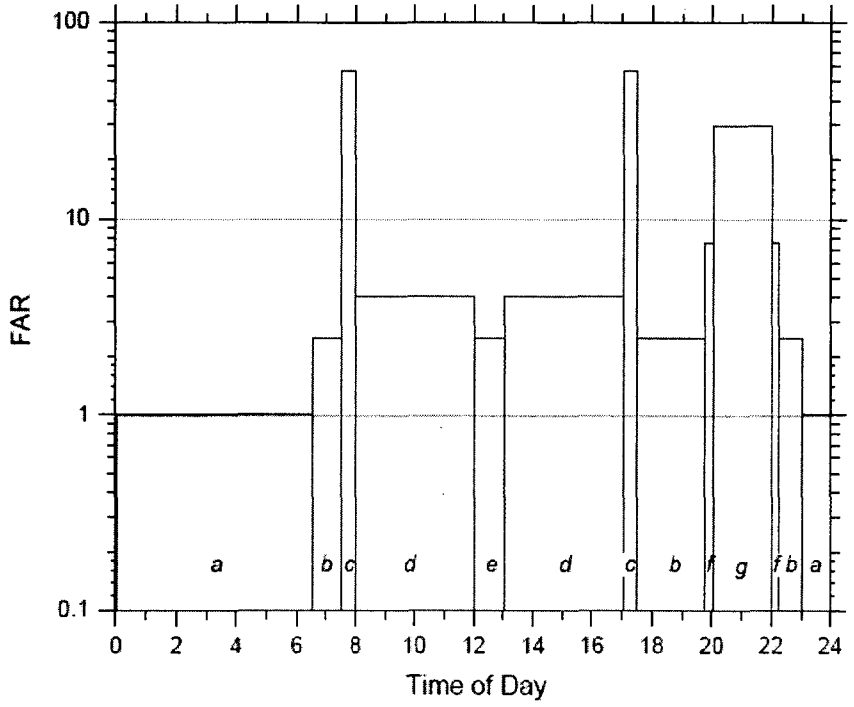
Measuring Risks - Example

Driving in the US: According to a statistics, there is a yearly total of 40,000 fatalities in the US of a population of 200 million people.

- Number of drivers = 200,000,000 persons
- Hours driven = 1 hour per person per day = 365 hrs. per person per year
- Number of fatalities = 40,000 per year
- Fatal Accident Rate (FAR) = (40,000) / (200,000,000 $\times$ 365) = 55 per 100,000,000 driver hours

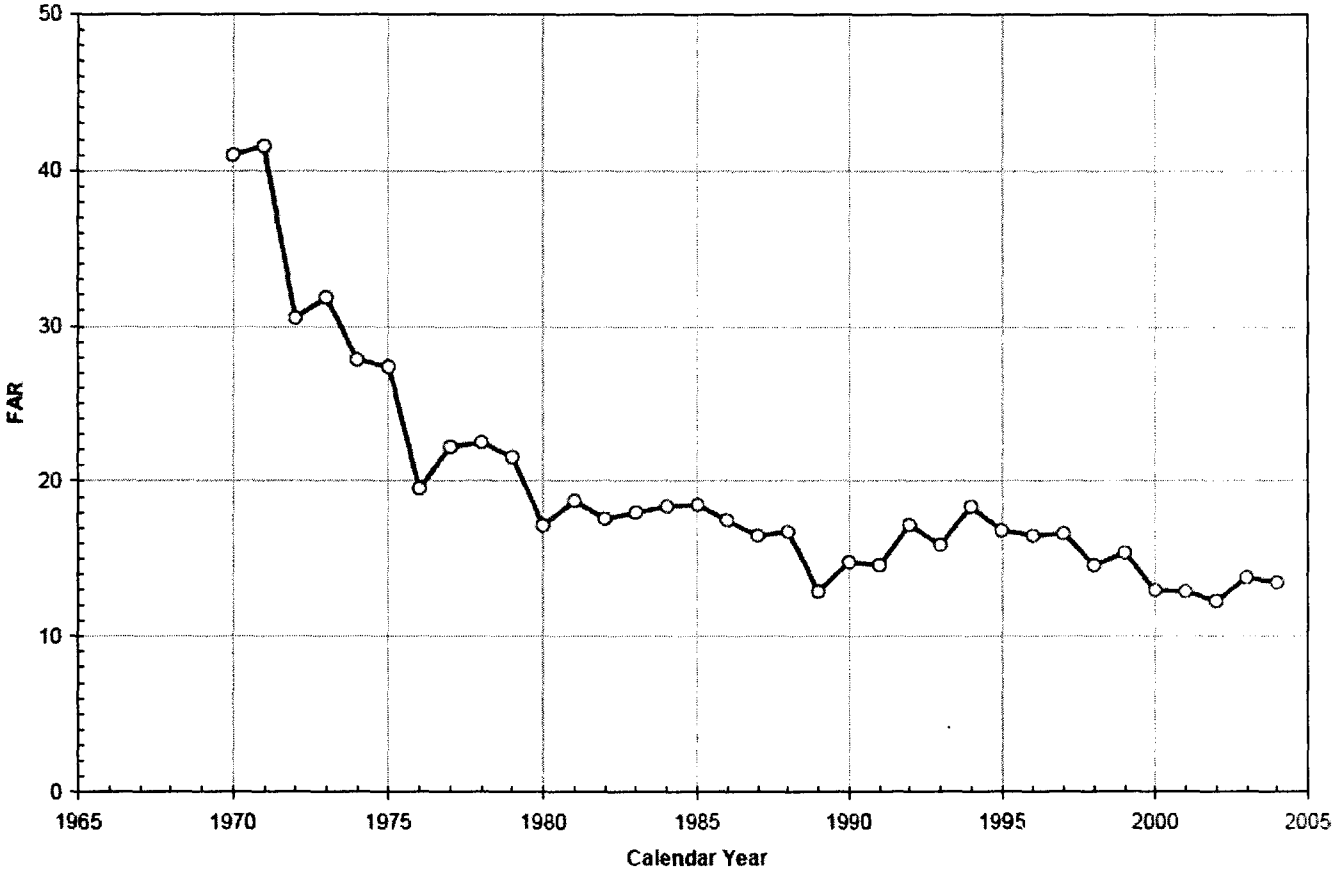
FAR is the number of fatalities per 100,000,000 exposed (or working) hours. Therefore in the US, the FAR for driving is 55.

Daily Hazards and Risks

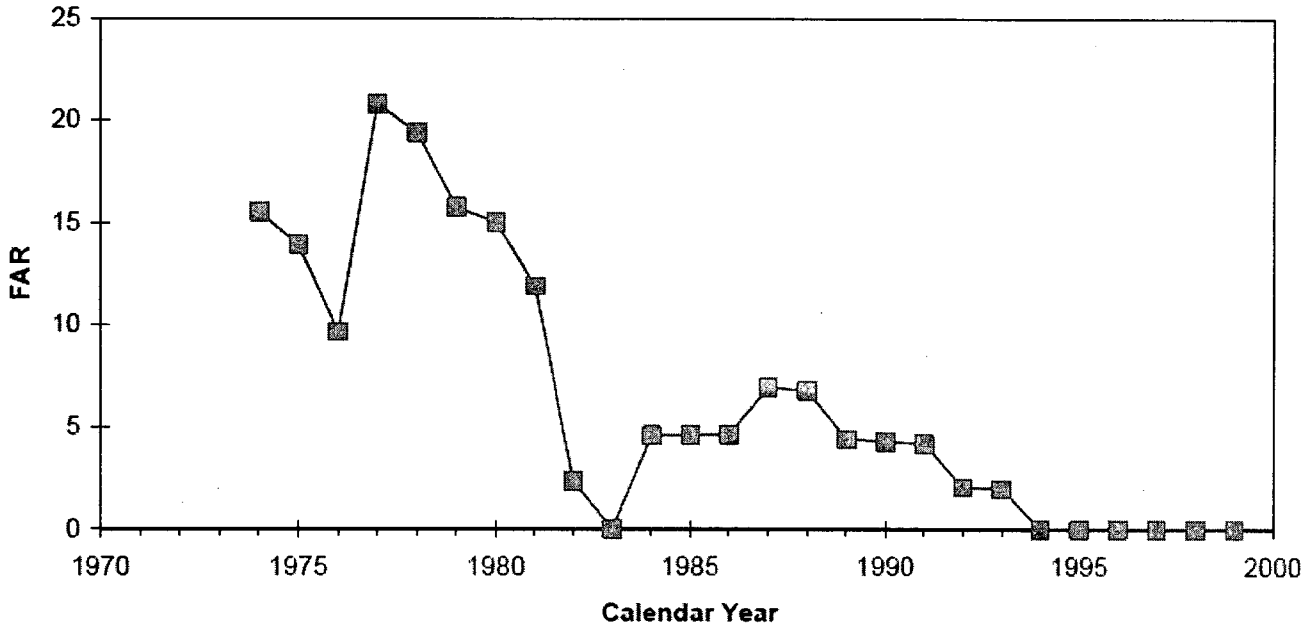


a	sleeping
b	Eating, washing, dressing, etc. at home
c	Driving to or from work by car
d	The day's work
e	The lunch break
f	To or from the Center City by bus
g	Community activity at the Center City

FAR Trends – KOSHA Data (Yearly Average)



FAR Trends – Process Safet (5-Year Average)



What a success! So let's learn from it.

BAKERRISK

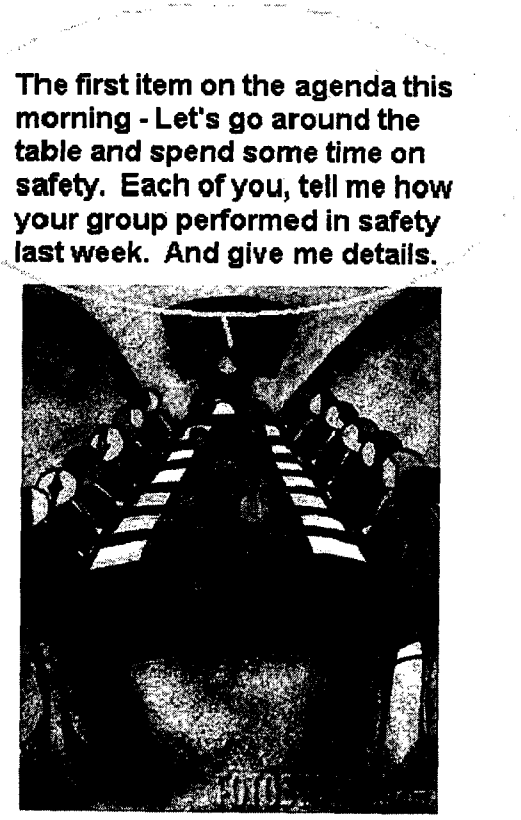
All accidents are preventable, and safety can be managed. Managing safety requires molding corporate culture as well as developing superior technology. It requires building proper attitudes and safety awareness as well as conducting hazard review and safety audits. A total safety program is required to prevent falls from ladders and runaway reactors, cuts and burns and explosions and toxic releases. The leadership must come from the Chief Executive Officer. He must take safety his top coporate priority.

Dr. P. L. T. Brian
Vice President - Engineering
Air Products and Chemicals, Inc.

Managing Safety – From the Top down though the Line

- Managing safety is just like managing sales, profits, productivity, or costs.
- Safety is a responsibility of line management... and it can be managed.
- The initiative must come from the very top – the Chief Executive Officer.

CEO Showing Initiative



- Safety – the first item on the agenda of his management meetings
- Serious incident to be reported promptly
- Senior line officer to present on
  - what happened
  - why it happened
  - what is his plan of corrective actions
- Review safety statistics – create peer pressure

CEO's Message – Loud and Clear

Management commitment and attention to safety –

- Nothing is more important than Safety. . . not production, not sales, not profits
- Safety is a responsibility of line management. . . and it can be managed.

Remolding the Corporate Culture

With the management commitment and attention to safety, no more of . . .

- "I told him to work safely but he did not do it"
- "Where does it say that I have to do this"
- "Our safety records are not as good as theirs because . . ."

Developing Safety Programs – Rules, Tools & Practices

Line management must accept the responsibility for safety. Staff safety professionals must support line management by developing strong safety programs –

- Institute the rules relating to process safety standards and practices
- Make available the tools that are needed to evaluate process safety with maximum speed and productivity
- Ensure that the work practice is consistent throughout the company
- Ensure proper training and independent auditing

Instituting Rules

The risk can never be reduced to zero, but it can usually be reduced further, inevitably with the expenditure of more money. So we ask ...

- How safe is safe enough?
- When to stop?

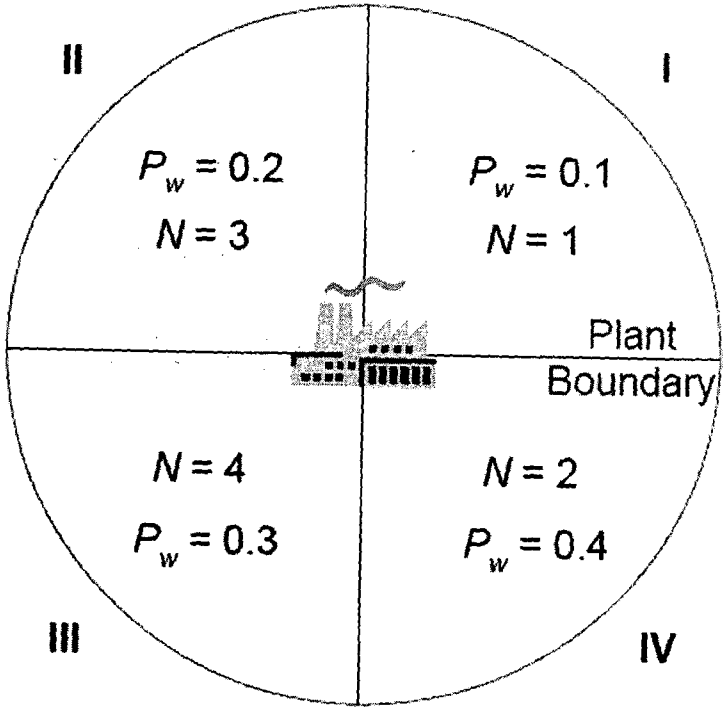
Making these decisions is based upon the comparison of the risk in question with other yardstick risks or risk targets.

Adopting T. Kletz's Philosophy

- Risk targets – You have to have them, more than one
- Compare risks to make a target (No $ involved)
- Use finite resources to reduce the highest risk

Quantifying Individual Risks – Deadly Plant in Island

Assume a release of "deadly" gas every 10^3 years.



- Always consider the risk to the most exposed employee, *i.e.*, the person at highest risk,
- He is in Quadrant IV. His FAR is

$$\frac{1}{10^3} \times 0.4 \times \frac{10^8}{8760} = 4.57$$

Risk to Employees (Onsite Risk) – Rule #1

"Yardstick" risk –

- All employees should leave work the way they came to work
- Safer at work than at home

Example Rule #1

- The company's target for an individual FAR from process related hazards is one-tenth his FAR at home.
- If all hazards cannot be analyzed, the target FAR will be one-hundredth his FAR at home.

Risks to the Public (Offsite Risk)

Two separate risks to consider:

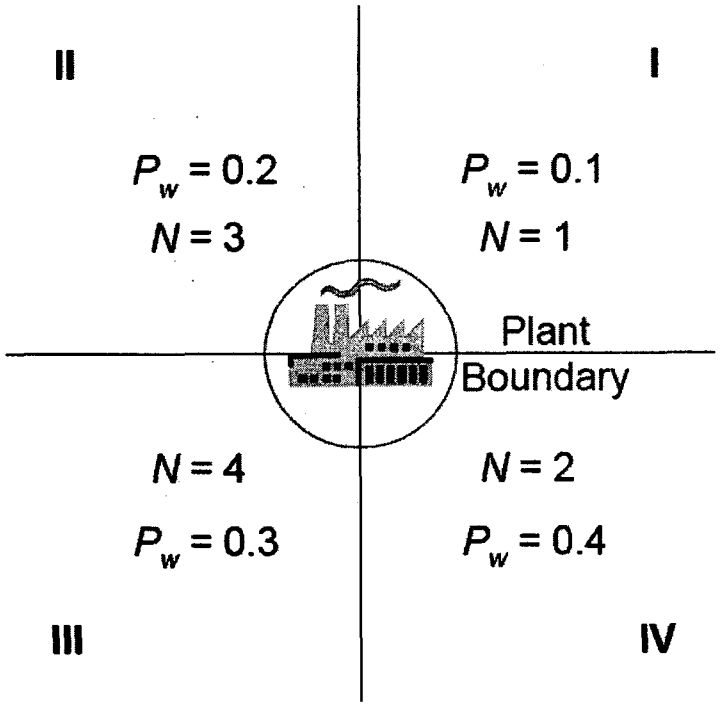
- Individual Risks
  - Risks to members of the public at greatest risk (mostly the nearest neighbors)
  - "I am concerned that I might be killed . . ."
- Societal Risks
  - Probability that 10, 100, 1000, or 10000 people may be killed
  - Impacts on society, the disruption, the fuss, *etc.*
  - "We are concerned that these many people might be killed at once"

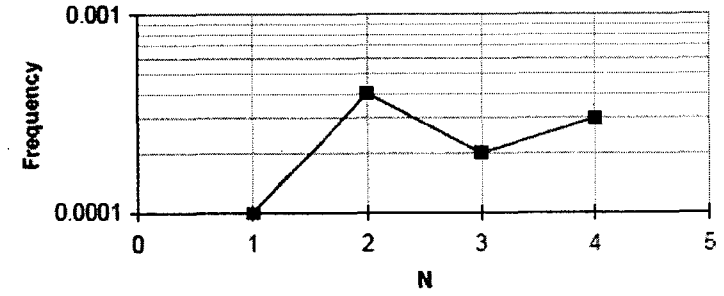
Risks to members of the Public

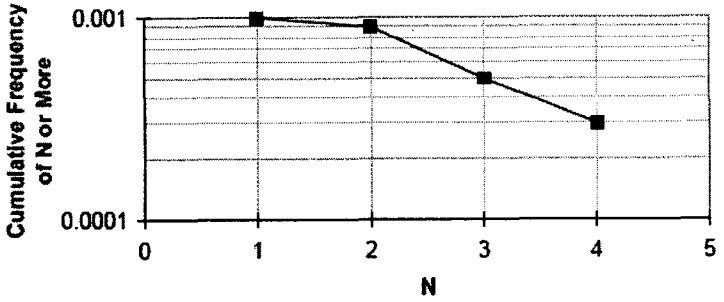
"Yardstick" risk for individual risks (to a member of the public)

- Risk to the most exposed neighbor should be less than that to a worker
- NIMBY - Not in my back yard!
- Risks posed by human activity should be smaller than those posed by nature
  - The risk of being killed by lightening is 10^{-7}/year

Quantifying Societal Risks – Deadly Plant in Island





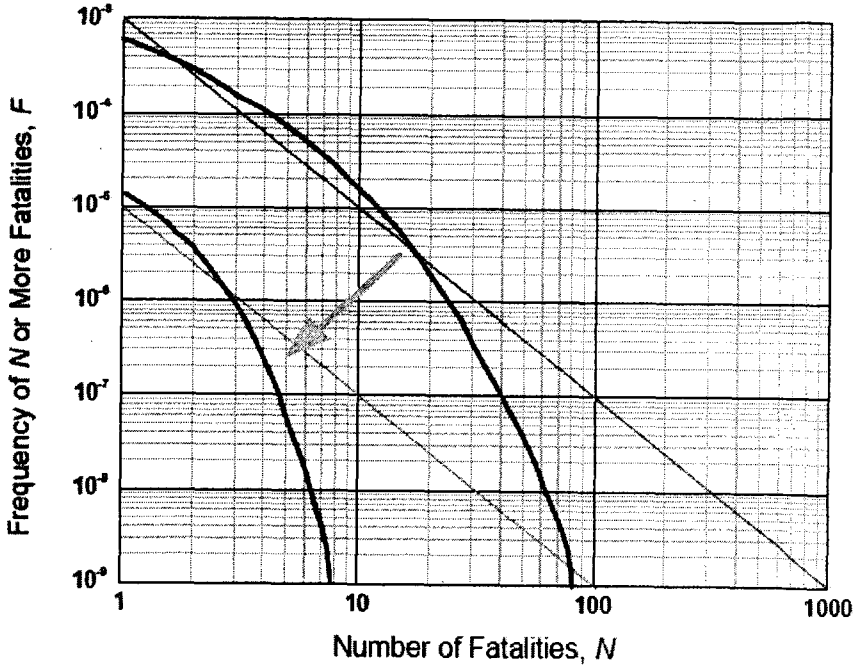


Societal Risk – FN Curve

Which is worse - one person killed every year for 100 years or 100 people killed once in 100 years?

"Yardstick" risk for the public

- Standards or Guidelines
- "Bread-and-butter" business (BBB)
- Previous decisions



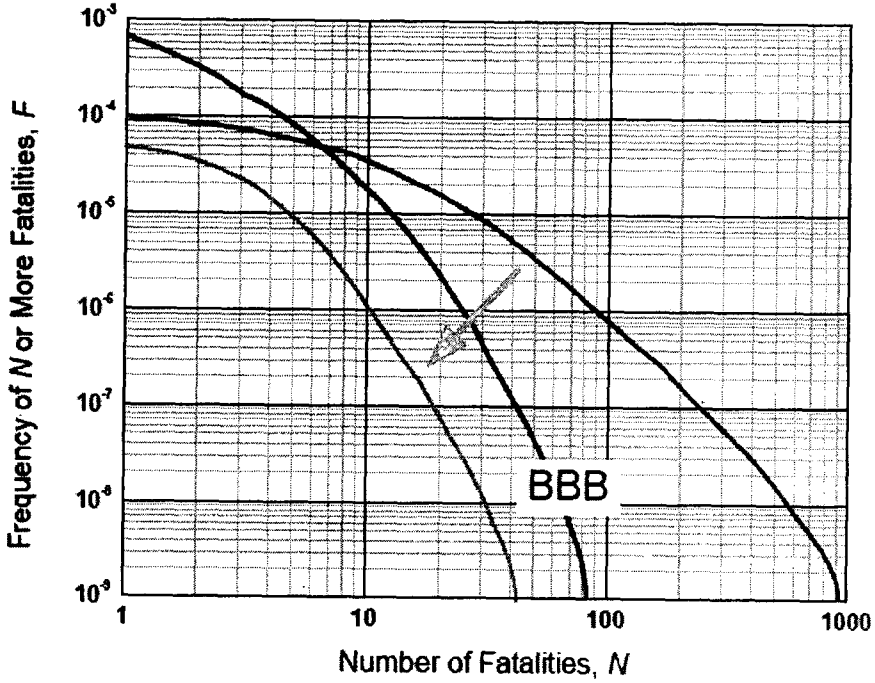
Societal Risk

FN curve may imply . . .

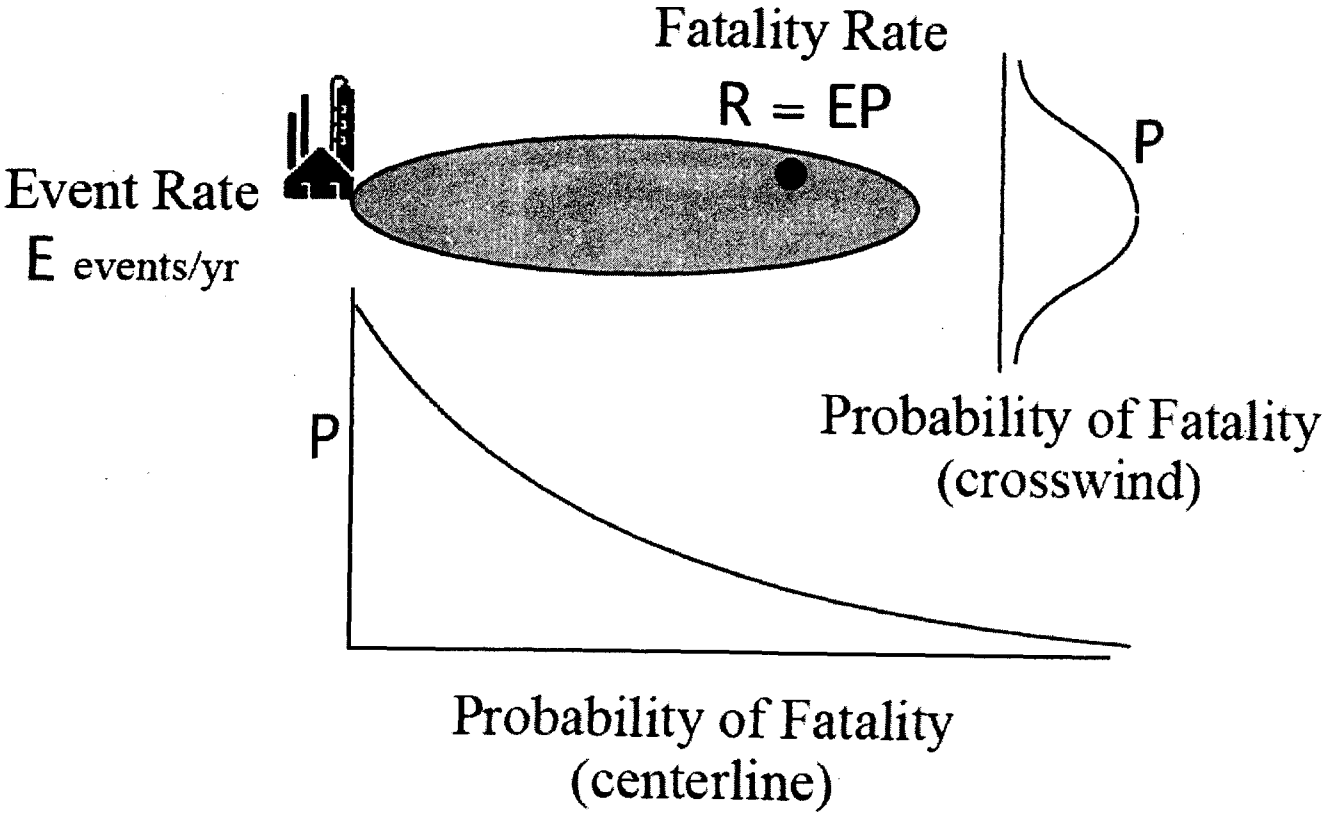
- F determines the frequncy of trips to the court
- N determines the survival of a corporation

Leave the case-by-case decision to the "Top" management.

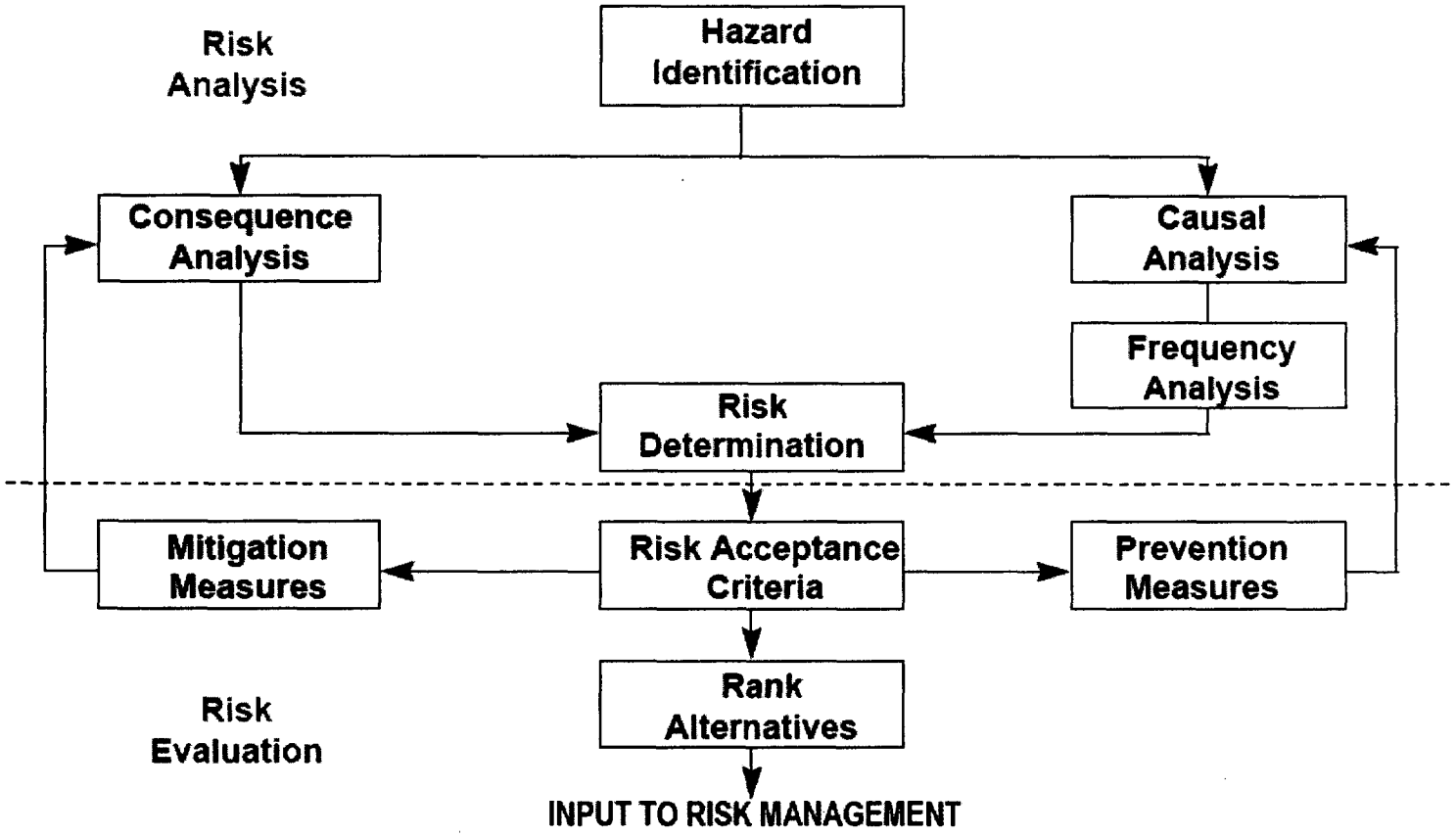
- He has all other risk profiles
- Risks to the nearest neighbors



Developing Tools for Risk and Consequence Analysis



Quantitative Risk Analysis (QRA)

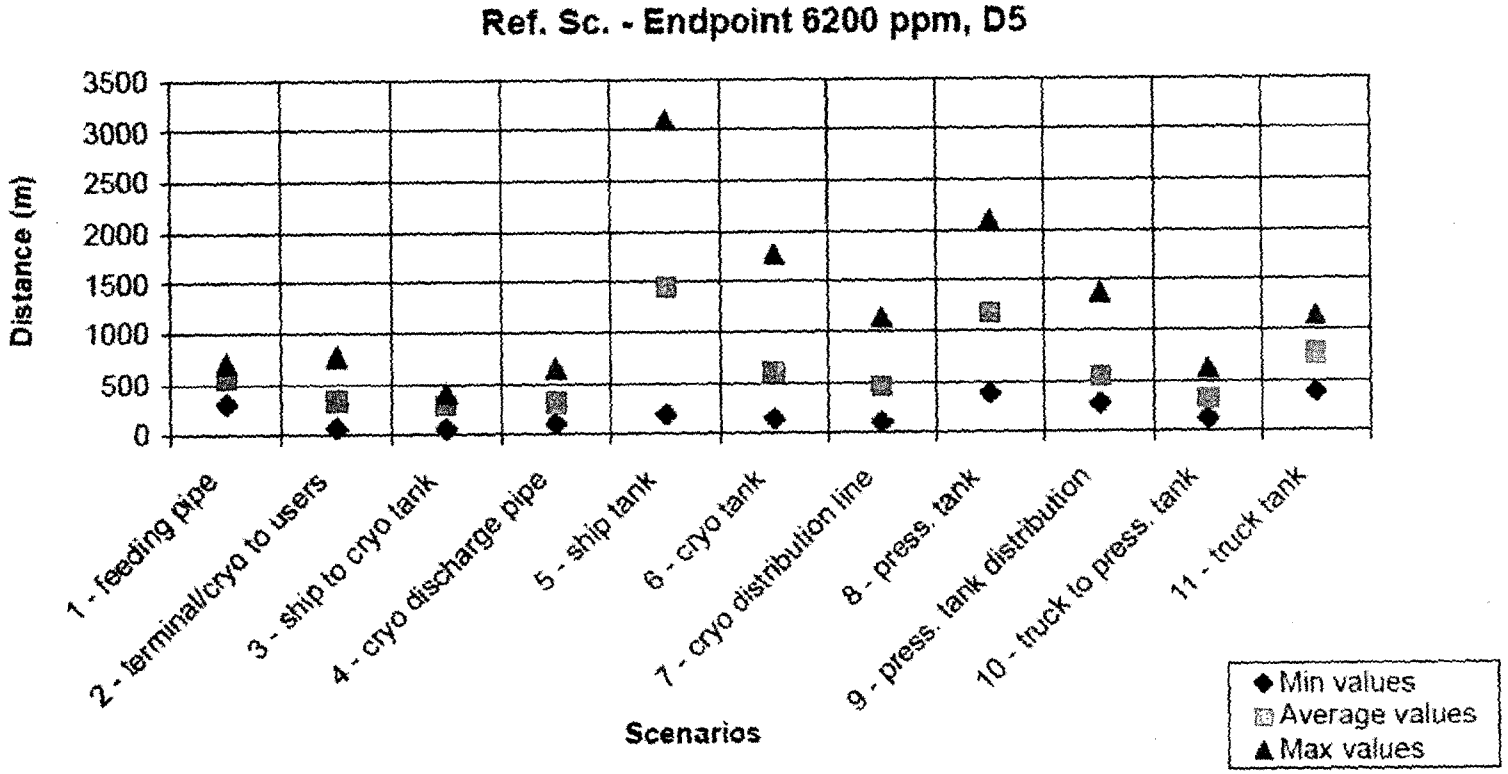


Uncertainties in QRA – ASSURANCE Project

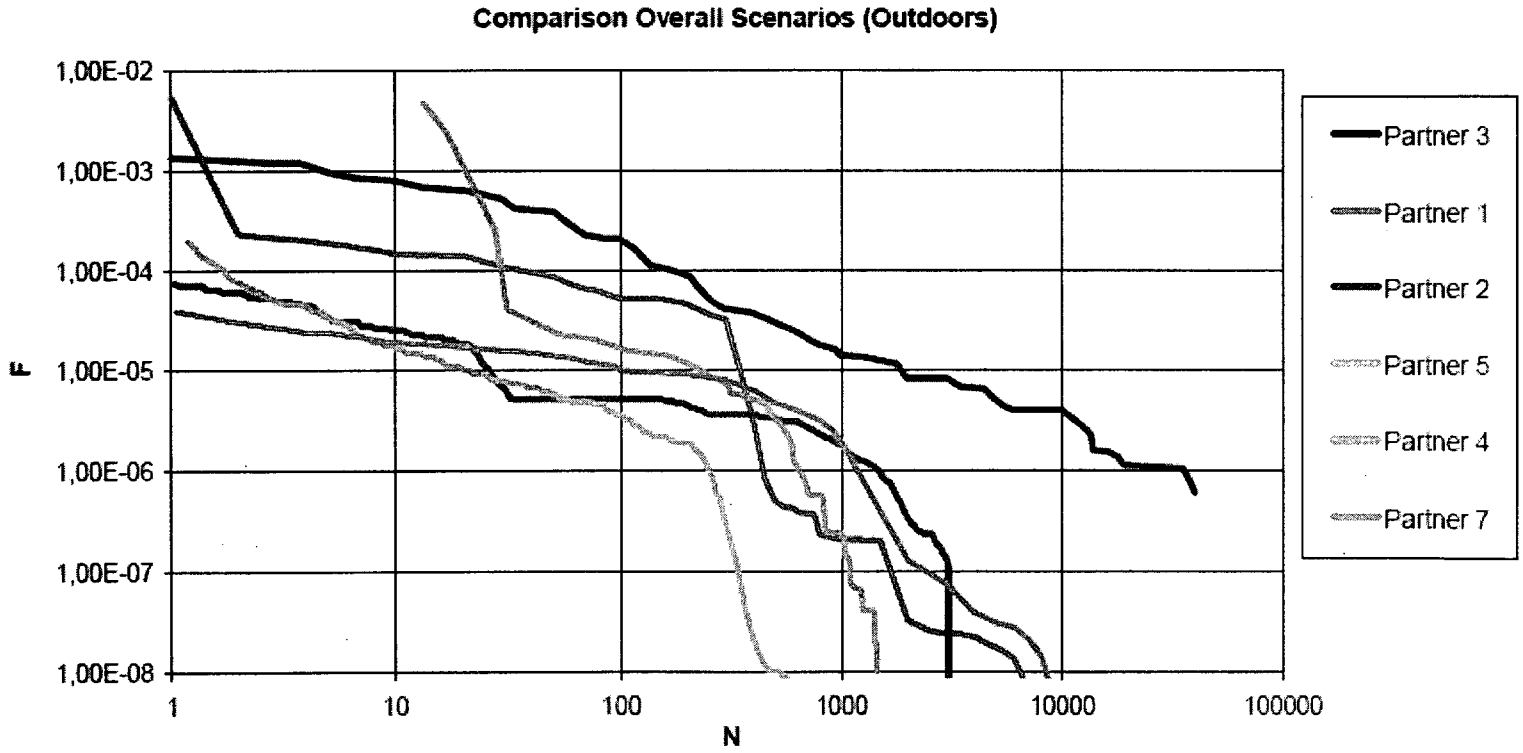
Assessment of Uncertainties in Risk Analysis of Chemical Establishments –

- Year 1998-2001
- 7 teams – DNV, UKHSE, TNO, VTT, INERIS, ...
- Risk analysis on an ammonia storage facility
- 11 reference scenarios

Uncertainties in QRA – ASSURANCE Project



Uncertainties in QRA – ASSURANCE Project



Quantitative Risk Analysis (QRA)

- Must always be applied with good judgement
- Should be viewed as a supplement to, not a substitute for, standards, best practices, and a safe design based on long experience
- Not for everyone
  - Numbers, numbers, numbers, ...
  - Uncertainties - No infinite confidence in data and methods
  - Demands attention to details
- Extremely useful in
  - Uncovering risks that are far greater than have been perceived
  - Identifying the most effective ways to reduce risks

Ensuring Proper Training

- Hazard Review
- Fault Tree Analysis
- Consequence Analysis (Level I and II)
- Risk Analysis
- Hazard Review for Managers

Be a learning organization.

Ensuring Consistent Practices

- Designs are reviewed and checked
- Operations are documented, reviewed and checked
- People are trained and retrained and motivated
- Safety audits are vigorously pursued
- Accidents are thoroughly investigated and taken care of

Don't normalize abnormalities!

Safety Training and Motivation Involves ...

- Heightening the safety awareness of everyone in the corporation
  - Safety is a management responsibility... and safety can be managed
  - Safety is an individual responsibility... and a condition of employment
- Modifying attitudes and always putting safety first
  - All accidents and injuries are preventable, they are not inevitable
  - Safety is a way of life... around the clock
    - in the plant and in the office,
    - in the control room and on the highway,
    - at work and also at home

Safety First – Affordable?

Benefits far exceed the costs

- ⇓ Worker injury rates
- ⇓ Workers compensation insurance
- ⇓ Damage to plant and equipment
- ⇓ Lost production
- ⇓ Liability claims

- ⇑ Worker morale
- ⇑ Productivity
- ⇑ Workmanship quality

A first-class safety management system is a necessay ingredient in a quality management system.

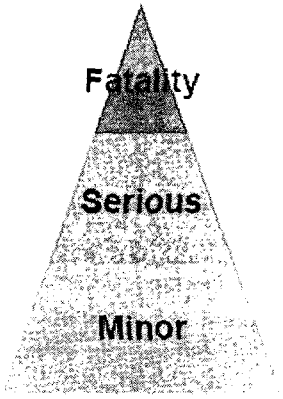
Safety First means ...

People cannot turn on the proper safety attitude

- when they come to work and then tum it off when they leave for home
- when maintaining the pump but tum it off when securing the ladder
- when operating the reactor but turn it off when driving the truck

Safety is a way of life. . . around the clock

Remolding the Corporate Safety Culture – Lessons Learned



It should not take others to have a fatal accident to learn the lessons we did . . . This was a preventable incident, . . . It should be seen as a process failure, a cultural failure and a management failure . . . The need to capture the right metrics that indicate process safety trends; do not get seduced by personal accident measures, they have their place but do not warn of incidents such as this one . . . Our task now is to transform the refinery's safety culture.

John Mogford
BP Senior Group Vice President, Safety & Operations
On the March 23, 2005 BP Texas City Refinery Explosion