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Proper risk assessments and effective regulation – is there ever acceptable risk?

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Synopsis

- Yes!
- 'Tolerable' not 'Acceptable'
- The cost of accidents
- Risk Assessment and Cost Benefit Analysis
- Valuing safety benefits in monetary terms
- Establishing a policy on safety spend
- References and further information

Tolerable Risk

- All life, and the activities we pursue, involve a chance of harm.
- Hazard and Risk must be managed down to a tolerable level
- What is Tolerable is situation dependent and usually set by Governments and Regulators (if at all!)
- But – Operators must have their own view

Tolerable Risk Example

Odds of being involved in a fatal accident

Odds of being on an airline flight which results in at least one fatality	Odds of being killed on a single airline flight
78 major world airlines 1 in 3.4 million	78 major world airlines 1 in 4.7 million
Top 39 airlines with the best accident rates 1 in 10.0 million	Top 39 airlines with the best accident rates 1 in 19.8 million
Bottom 39 with the worst accident rates 1 in 1.5 million	Bottom 39 with the worst accident rates 1 in 2.0 million

Source: OAG Aviation & PlaneCrashInfo.com accident database, 20 years of data (1993 - 2012)

- But I still decided to fly here to speak here today!!

The Cost of Accidents

DATE	PLANT TYPE	EVENT TYPE	LOCATION	COUNTRY	PROPERTY LOSS (US$ MILLIONS)
07/06/1988	UPSTREAM	EXPLOSION	NORTH SEA	UK	1,860
10/23/1989	PETROCHEMICALS	EXPLOSION	PASADENA, TEXAS	USA	1,440
04/01/2015	UPSTREAM	FIRE	BAY OF CAMPECHE	MEXICO	>1,000
06/04/2009	UPSTREAM	COLLISION	NORTH SEA	NORWAY	860
03/13/1989	UPSTREAM	EXPLOSION	GULF OF MEXICO	USA	850
01/15/2001	UPSTREAM	EXPLOSION	CAMPOS BASIN	BRAZIL	810
09/25/1998	GAS PROCESSING	EXPLOSION	LONGFORD, VICTORIA	AUSTRALIA	770
04/24/1988	UPSTREAM	BLOWOUT	CAMPOS BASIL	BRAZIL	720
09/21/2001	PETROCHEMICALS	EXPLOSION	TOULOUSE	FRANCE	690
06/25/2000	REFINERY	EXPLOSION	MINA AL-AHMADI	KUWAIT	680
05/04/1988	PETROCHEMICALS	EXPLOSION	HENDERSON, NEVADA	USA	660
01/19/2004	GAS PROCESSING	EXPLOSION	SKIKDA	ALGERIA	650
05/05/1988	REFINERY	EXPLOSION	NORCO, LOUISIANA	USA	630

Hidden Costs

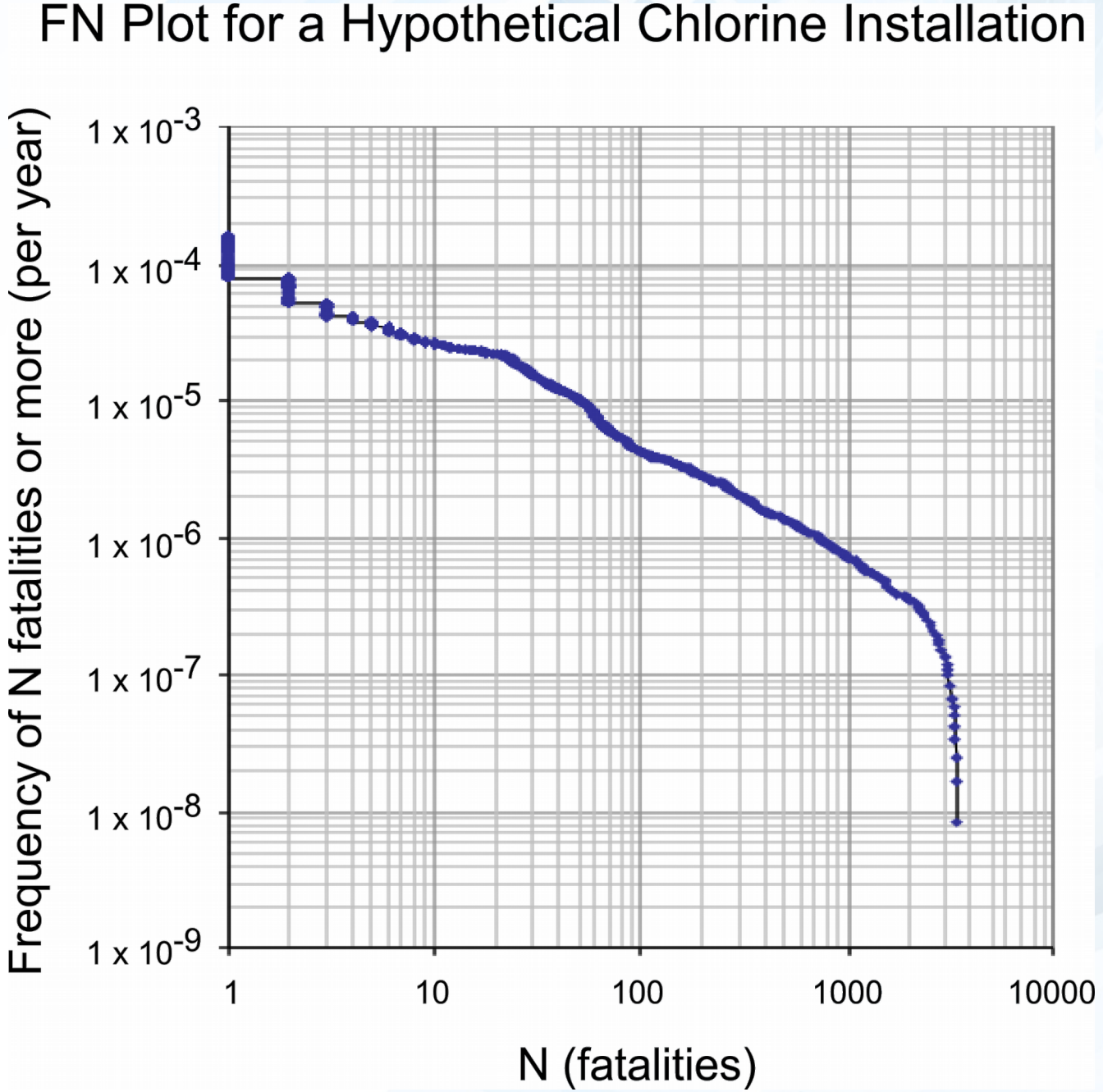
Risk Analysis/Assessment

- Risk Analysis
  The process of identifying sources of potential harm, assessing the likelihood that harm will occur and the consequences if harm does occur
- Risk Assessment
  The process of risk analysis together with the value judgements made concerning the significance of the results

  "Risk assessment data is like a captured spy. If you torture it long enough it will tell you anything you want to know"

  W M Ruckelshaus, Former Head of US EPA

Societal Risk
FN Curve



Valuing Harms (etc) Averted by Safety Measures

- Human harms (deaths, serious injuries, minor injuries etc)
- Harm to the Environment (natural and built)
- Avoidance of deployment of emergency services
- Avoidance of countermeasures such as evacuation
- Post accident decontamination
- Disruption to lives of others (during and after incident)
- Other harms, or costs falling on others, that might be required in different jurisdictions

Costs of Applying a Safety Measure

- Installation, operation, training
- Additional maintenance
- Business losses that would follow from any shutdown of the plant
- Ongoing production losses as a result of the measure
- Any savings as a result of the measure should be offset against the costs
- Other costs that might be allowable in different jurisdictions

Example

- Consider a plant with a process that if it were to explode could lead to:
  - 20 fatalities
  - 40 permanently injured
  - 100 seriously injured
  - 200 slightly injured
- The rate of this explosion happening has been analysed to be about 1×10^{-5} per year, which is 1 in 100,000 per year. The plant has an estimated lifetime of 25 years.
- How much could the company reasonably spend to eliminate (reduce to zero) the risk from the explosion

Example (Human Harms only)

		Values (2003 Q3) [1]
FATALITY		£1,336,800 (times 2 for cancer)
INJURY		
Permanently incapacitating injury	Moderate to severe pain for 1-4 weeks. Thereafter some pain gradually reducing but may recur when taking part in some activities. Some permanent restrictions to leisure and possibly some work activities.	£207,2000
Serious	Slight to moderate pain for 2-7 days. Thereafter some pain/discomfort for several weeks. Some restrictions to work and/or leisure activities for several weeks/months. After 3-4 monthsreturn to normal health with no permanent disability.	£20,500
Slight	Injury involving minor cuts and bruises with a quick and complete recovery.	£300
ILLNESS		
Permanently incapacitating illness	Same as for injury.	£193,100
Other cases of ill health	Over one week absence. No permanent health consequences.	£2,300 + £180 per day of absence
Minor	Up to one-week absence. No permanent health consequences.	£530

Example

Harm Type	Number	'Value of Averting'	Frequency	Plant Lifetime	'Overall Value of Averting'
Fatalities	20	£1,336,800	1×10^{-5} yr^{-1}	25 yr	£6,684
Permanent injuries	40	£207,200	1×10^{-5} yr^{-1}	25 yr	£2,072
Serious injuries	100	£20,500	1×10^{-5} yr^{-1}	25 yr	£512
Slight Injuries	200	£300	1×10^{-5} yr^{-1}	25 yr	£15
Total benefits					**£9,283**

Establishing a policy on safety spend

- Take account of particular requirements of the operating jurisdiction
- Set out a policy on benefits
- Set out a policy on costs
- Set out a policy in the discounting of future costs/benefits
- Consider other harms to be included e.g. reputational damage, share price, etc
- Consider whether to apply a bias in favour of safety
- Set out a policy on Sensitivity Analysis
- Document the policy

References

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- The Cost of Accidents at Work, HS(G)96, 2nd Edition, 1997, HSE Books
- The Cost to Britain of Workplace Accidents and Work-Related Ill Health in 1995/96, HS(G)101, 2nd Edition, 1999, HSE Books
- HSE - ALARP suite of guidance <www.hse.gov.uk/risk/expert.htm>
- Author's web site <www.alarp.plus.com>