SETTING MULTINATIONAL RISK TOLERANCE CRITERIA

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OVERVIEW

- Significance
- Nature
- Type and form
- Responsibility
- Challenges
- Bases for developing criteria
- Requirements for developing criteria
- Approach

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SIGNIFICANCE OF RISK TOLERANCE CRITERIA

- Decisions on process safety must be made with reference to risk tolerance criteria
- Codes, standards, and regulations around the world are moving towards the use of numerical criteria
- Risk tolerance criteria have been adopted in several places around the world, e.g.
  - United Kingdom
  - Netherlands
  - Hong Kong
  - Australia

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NATURE OF RISK TOLERANCE CRITERIA

- Express the level of risk that is tolerable to the stakeholders in a facility
  - Absolute safety cannot be guaranteed
- Express the tolerable frequency of harm to receptors such as:
  - People, property and the environment
- Regulatory bodies typically establish numerical criteria for risks to people
  - Focus of this paper

RISK TO PEOPLE

- Both risk to individuals and risk to groups of people from exposure to hazards are important
- *Individual risk*
  - Frequency at which an individual may experience a given level of harm
- *Group or societal risk*
  - Relationship between frequency and the number of people in a given population who may experience a given level of harm

TYPE AND FORM OF INDIVIDUAL RISK

- Can be determined at a location regardless of whether an individual is actually present there
  - *Geographic, location* or *hypothetical* risk
- Can also be determined for actual individuals
  - Preferred measure
- Can be determined for different levels of harm
  - Often, fatalities are used

EXAMPLE OF INDIVIDUAL RISK TOLERANCE CRITERIA

Maximum tolerable fatality risk per year per facility	
Workers	**Public**
1×10^{-3}	1×10^{-4}

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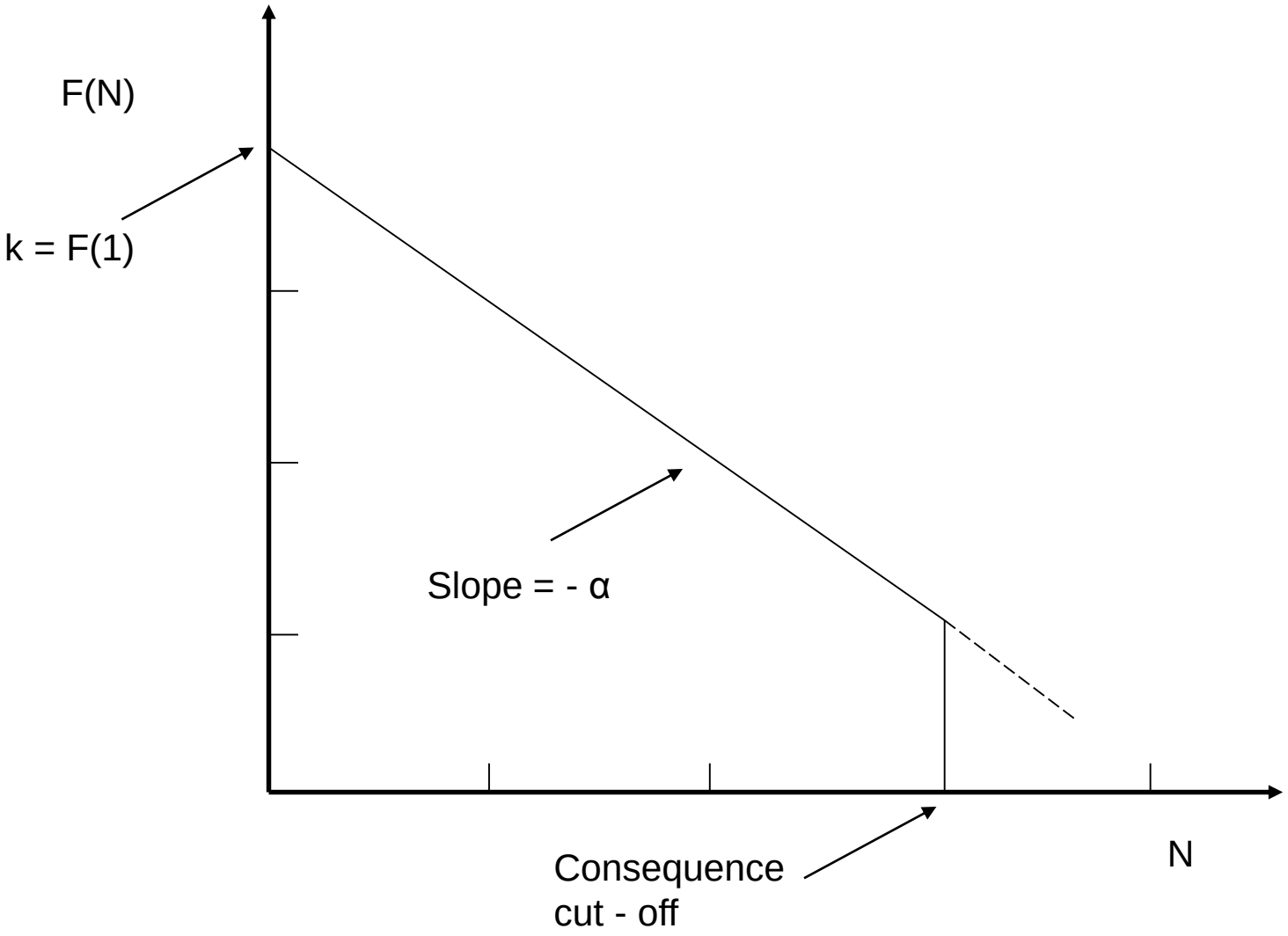
TYPE AND FORM OF GROUP RISK

- Often expressed as f-N or F-N curves
  - f-N curves display the frequencies of all events that result in N casualties
  - F-N curves display the cumulative frequencies of all events that lead to N or more casualties
- f-N or F-N curves used as risk tolerance criteria are called limit lines

EXAMPLE OF F-N LIMIT LINE



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RESPONSIBILITY FOR DEVELOPMENT OF CRITERIA

- A nation's government and institutions
  - Complexity of the decision-making process
  - Socio-political nature
  - Number and nature of stakeholders
- Many nations have not established risk tolerance criteria
  - E.g. United States of America
- Companies may be faced with the prospect of developing their own
  - Comply with industry practices and standards

CHALLENGES FACING MULTINATIONAL COMPANIES

- Requirements to comply with different established criteria in different nations
- Development of criteria for nations where regulatory criteria are absent

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COMPLYING WITH CRITERIA IN DIFFERENT NATIONS

- Legal or regulatory requirements provide a justification for their use
- Compliance can be challenging owing to variations in criteria from one nation to another:
  - Type and form
  - Values

VARIATIONS IN CRITERIA

- UK uses a hypothetical individual defined as a person who is in some fixed relation to the hazard
  - Netherlands uses geographic risk
- UK addresses risk to both workers and the public
  - Netherlands addresses risks only to the public
- UK has set the maximum tolerable individual fatality risk at 1×10^{-4} per year for the public
  - Hong Kong has set 1×10^{-5} per year

VARIATIONS IN CRITERIA (CONTD.)

- Different types and forms of risk tolerance criteria
  - Procedures for the calculation of risk estimates will vary
- Simpler if the same methods could be used in all cases
  - Not always likely to be possible
- Also, companies must have access to the means to evaluate process risk appropriately

DEVELOPMENT OF CRITERIA FOR NATIONS WHERE REGULATORY CRITERIA ARE ABSENT

- Views of local stakeholders on the tolerability of risks can vary significantly from one location to another
  - Actual risks that people currently tolerate can vary significantly depending on local factors
- Consistency of risk tolerance criteria across operations in various locations is important

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BASES FOR DEVELOPMENT OF CRITERIA

- Benchmarking with other companies
- Using prevailing risk levels from existing company facilities
- Comparing risks with other industries and everyday activities
- Accounting for prevailing societal views on risk

REQUIREMENTS FOR DEVELOPING CRITERIA

- Address nation-to-nation variations
- Use a defensible and justifiable method

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ADDRESS NATION-TO-NATION VARIATIONS

- Issue arises as to whether the same criteria should be used for all locations where none currently exist
  - Or, whether local variations should be considered
- Use of the same criteria for different nations may appear to be both equitable and the simplest approach

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ADDRESS NATION-TO-NATION VARIATIONS (CONTD.)

- However, people in different nations around the world accept different levels of risk
- People in an affluent society are likely to tolerate less risk than people who are disadvantaged economically
  - In the latter case, industrial risks are more readily accepted for the benefits offered

ADDRESS NATION-TO-NATION VARIATIONS (CONTD.)

- If the same criteria are used:
  - Company may experience difficulties in operating facilities in nations used to accepting higher risk levels
  - A facility of the same design could be located in two different nations but pose significantly different risks
    - Owing to differences in operations, maintenance, and management because of differences in culture, human factors, and land-use planning

ADDRESS NATION-TO-NATION VARIATIONS (CONTD.)

- If different criteria are used:
  - Company is open to criticism that it is taking advantage of people in those nations with higher criteria
  - Criticism may have significant impacts on the company
    - Adverse publicity may lead to a depressed stock price, boycotts of its products, and other difficulties

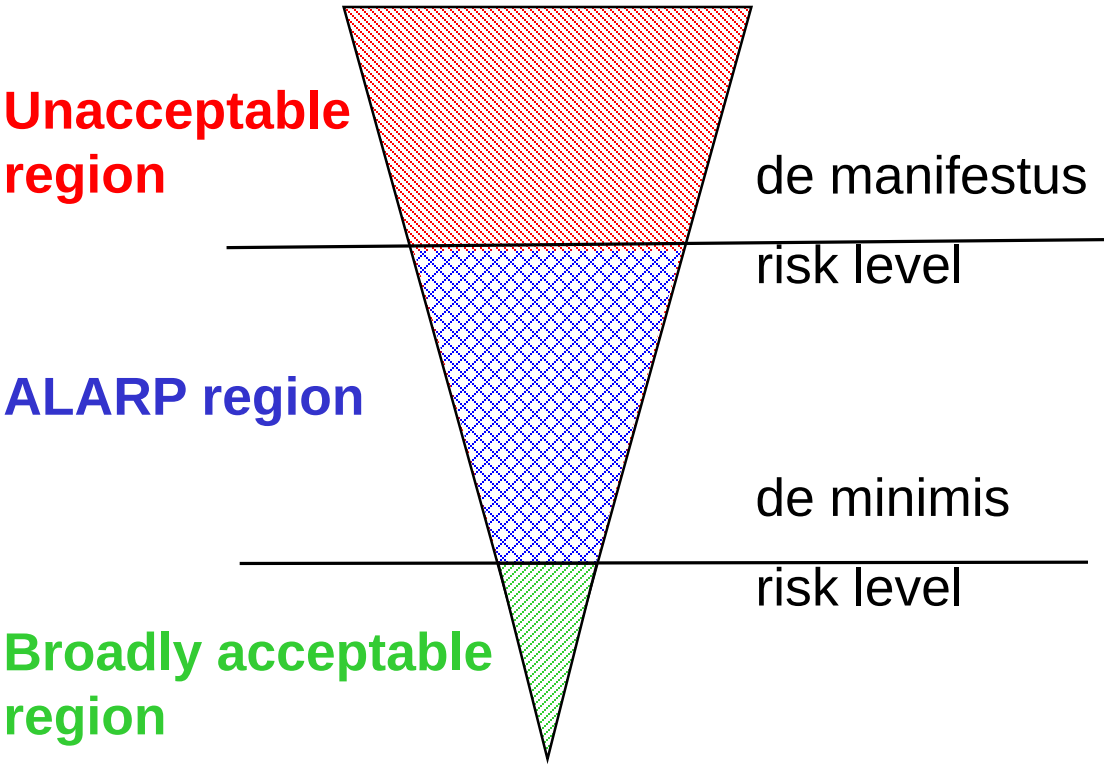
USE A DEFENSIBLE AND JUSTIFIABLE METHOD

- Employ United Kingdom Health and Safety Executive's (UK HSE's) tolerability of risk approach
- Developed over a number of years
- Subjected to extensive public consultation
- Benefitted from public inquiries into disasters and the funding of research projects on risk tolerance criteria
- Adopted as the basis for establishing criteria in other countries
- Provides a rational and logical basis for establishing criteria

UK HSE APPROACH

- Use the As Low As Reasonably Achievable Principle
- Base numerical values on comparison with levels of existing risk that are tolerated

ALARP PRINCIPLE



- Effort to reduce risk should continue until the incremental expenditure of resources is grossly disproportionate to the value of the incremental risk reduction achieved

UK HSE APPROACH – INDIVIDUAL RISK

- Risks to workers were surveyed in UK high-risk industries
  - Such as mineral extraction and construction
- Analysis resulted in the determination of the maximum individual fatality risk that was ordinarily accepted
- Used to establish a de manifestus value for individual fatality risk for a facility

UK HSE APPROACH – INDIVIDUAL RISK (CONTD.)

- UK HSE took the view that the de manifestus value for individual fatality risk for a member of the public should be at least 10 times lower than the value for workers
  - Equated to the average annual risk of dying in a traffic accident in the UK

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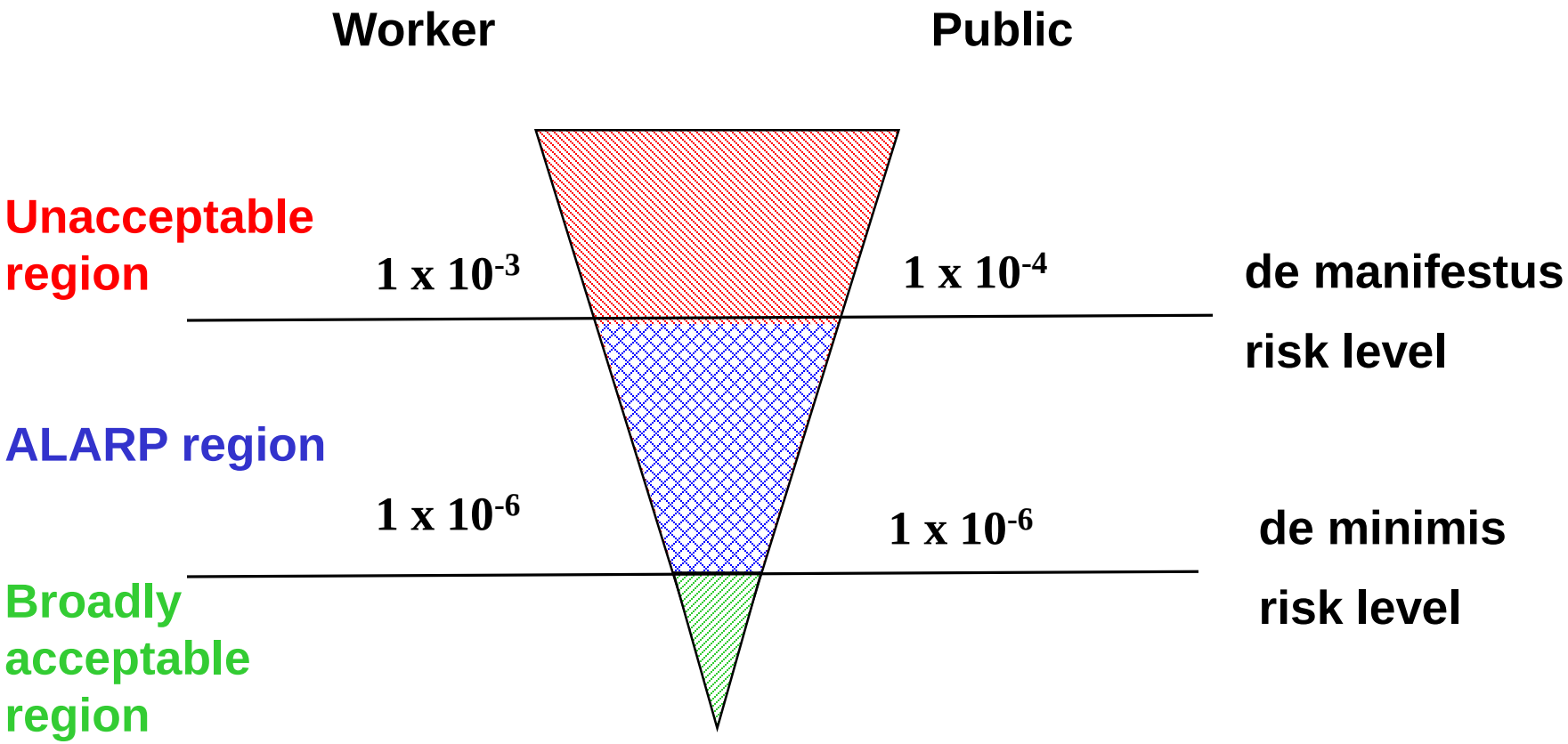
UK HSE APPROACH – INDIVIDUAL RISK (CONTD.)

- Same value was set for the de minimis individual fatality risk for both workers and the public
- Value was predicated on the very small addition it would make to the ordinary risks of life
  - Comparable to the risk of being electrocuted at home
- Viewed as a level of risk which does not cause worry or the alteration of ordinary behavior

UK HSE VALUES FOR INDIVIDUAL ANNUAL FATALITY RISK



Values are per person per facility per year for all hazards.

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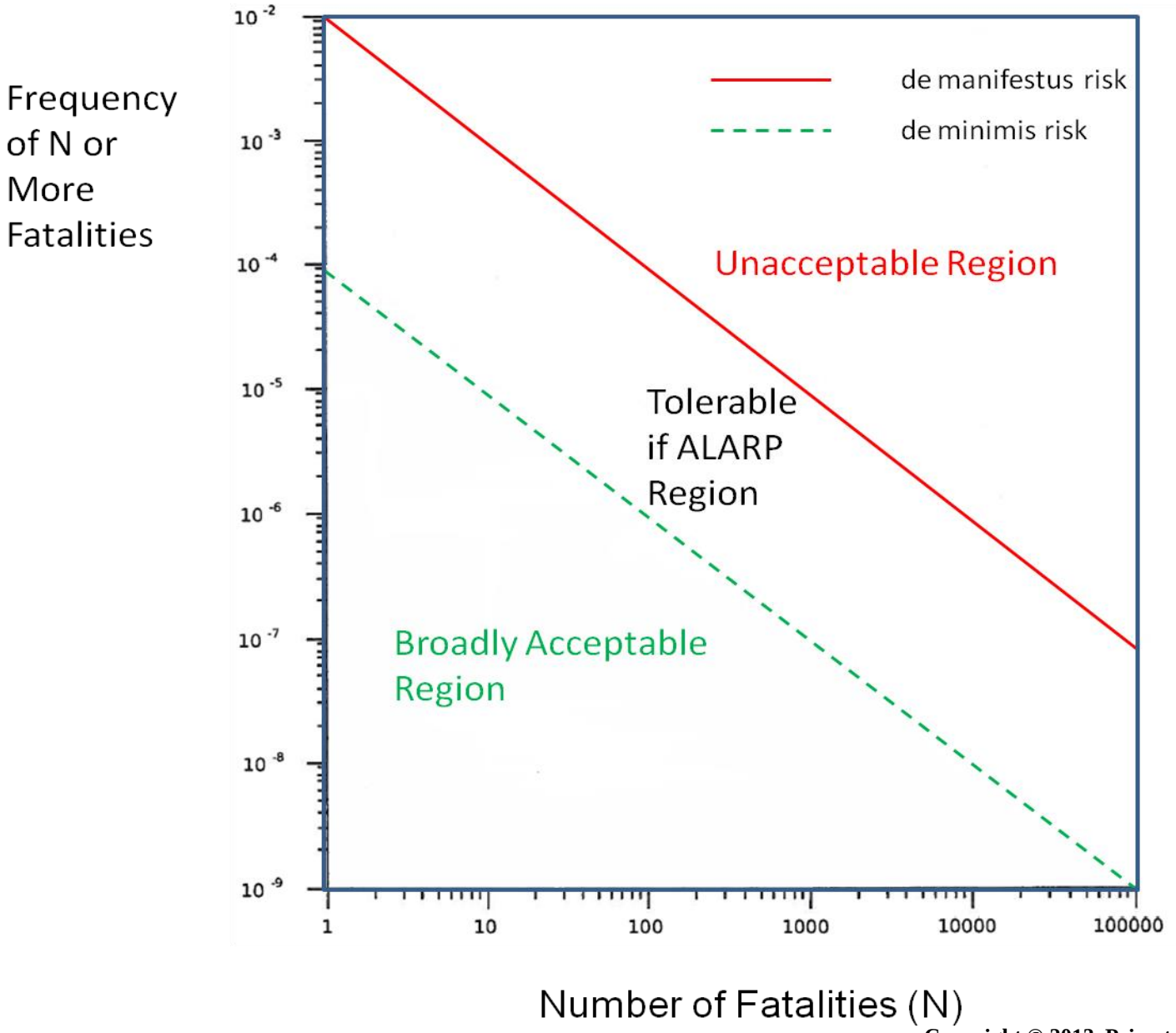
UK HSE APPROACH – GROUP RISK

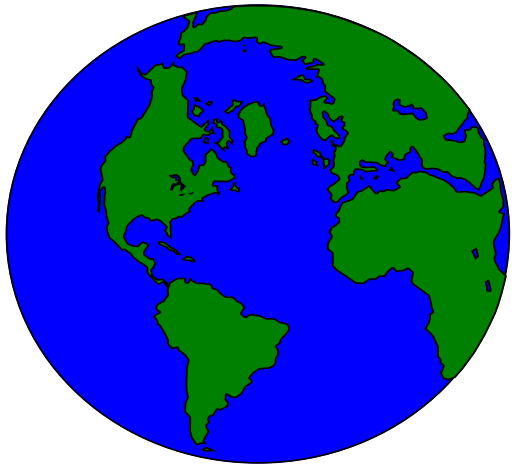
- Group criteria are more difficult to develop in the same way as individual criteria
  - Few actual F-N curves are available
  - Curves need to be scaled for a company's operations
- UK Hazardous Installations Directorate (HID) has defined limit lines

UK HID LIMIT LINES



DEVELOPMENT OF MULTINATIONAL CRITERIA

- Reasonable for companies to develop their own criteria using the above approach
  - Numerical values must be determined using nation-specific data on workplace and non-workplace casualties



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DEVELOPMENT OF MULTINATIONAL CRITERIA (CONTD.)

- Compromise approach that provides some uniformity to the criteria, but allows for local differences:
  - Use the ALARP framework
    - Set same de manifestus criteria for each location
    - Set de minimis criteria that are reflective of local conditions
- de manifestus values are set conservatively
- de minimis criteria can be lowered over time
- In the meantime, the ALARP principle will move actual risks lower
  - In a way that is feasible for each location

CONCLUSIONS

- Increasingly, companies need to use numerical risk tolerance criteria
- Many nations have not yet developed criteria and companies must develop their own criteria
- UK HSE approach provides a sound basis for developing criteria
  - With adjustments from nation to nation