A Note on HSE's Use of Risk Integrals

Introduction

HSE uses two so-called risk integrals in its activities as regulator and advisor. They are known as the Approximate Risk Integral (ARI) and the Scaled Risk Integral (SRI). Despite their similar sounding names they have different derivations and uses. This note is intended to clarify their origin and use.

The Approximate Risk Integral (ARI)

The ARI is a single value intended to be representative of the overall risk that an onshore major hazard installation imposes on its surroundings. This type of risk is usually called *societal risk*[1] and, in particular, *local societal risk*. It is usually represented in the form of a two dimensional FN curve. The 'x' dimension is the magnitude of the various major accidents that might occur and the 'y' dimension is the frequency at which those major accidents might occur. The frequency is plotted on a cumulative basis so that the curve rises continuously from the more catastrophic major accidents to the lesser major accidents.

The FN curve, and data derived from it, are used in the regulation of safety at COMAH sites[2]. The effort required to produce an FN curve is substantial. HSE had a requirement for a less resource intensive assessment tool that could be used for ranking COMAH sites according to risk so that it could prioritise its regulatory activity.

The full detail is given elsewhere[3] but, in simple terms, ARI relies on the fact that most FN curves have a similar shape, and for each COMAH site, the overall curve can be approximated once the predicted magnitude and frequency of the worst possible major accident are known. This 'worst case' information is usually to be found in safety reports produced to comply with the COMAH legislation.

Care needs to be taken when considering the value of the ARI. It is a ranking tool and does not provide a regulatory target value. Once used for ranking and prioritisation, the ARI is set aside and the regulatory objective becomes that stated in the legislation, for example that ... *the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health;* … This involves the consideration of additional safety measures and whether they are cost beneficial.

The Scaled Risk Integral (SRI)

The SRI is a single numerical value intended to be representative of the risk that an onshore major hazard installation imposes on a specific area of land in the light of its existing or proposed use. It is also a type of *societal risk*, but to avoid confusion it is usually referred to as *case societal risk*.

The full detail is given elsewhere[4], but for a given site it takes account of the individual risk calculated by HSE (for the purpose of giving land use planning advice), the area of land involved, and the numbers of persons present, together with their pattern of occupancy. The value calculated increases with predicted risk and number of persons present and reduces with increasing area of the

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1 <http://www.hse.gov.uk/societalrisk/>

2 <http://www.hse.gov.uk/comah/index.htm>

3 Hirst, IL, Carter, DA, 2002, A worst case methodology for obtaining a rough but rapid indication of the societal risk from a major accident hazard installation, *Journal of Hazardous Materials*, *A92*, pp. 223-237.

4 Carter, D.A., (1995). The Scaled Risk Integral—A Simple Numerical Representation of Case Societal Risk for Land Use Planning in the Vicinity of Major Accident Hazards, Loss Prevention in the Process Industries (Elsevier, Amsterdam), pp. 219–224

land involved. It was originally intended to aid judgement when formulating advice to planners in Local Authorities in marginal cases which were referred to HSE headquarters for specialist advice. With the introduction of the PADHI and PADHI+ advisory systems[5] there is no need to utilise SRI in formulating that type of advice because all the decision boundaries are go/no-go and marginal cases are no longer defined for referral to HSE.

SRI remains as an aid to judgement when considering the location of new COMAH sites and the Hazardous Substances Consents that COMAH sites also require. It is also referenced in HSE's policy on 'calling in' planning applications where a Local Authority is minded to grant planning consent for a development against HSE advice[6].

It must be borne in mind that SRI can only be used in cases where HSE has carried an assessment of individual risk for the site in question. This is usually referred to as quantified risk assessment (QRA). Assessments using QRA are generally used for all toxic substances and some flammable substances where the hazardous effects, should there be loss of containment, are substantially directional. For most situations involving flammable substances, individual risk is not calculated and a system called the *protection concept* is used instead[7][8]. SRI cannot be used as an aid to judgement in such cases.

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5 <http://www.hse.gov.uk/landuseplanning/methodology.htm>

6 <http://www.hse.gov.uk/foi/internalops/hid/spc/spctg22.pdf>

7 Advisory Committee on Major Hazards - Third report, 1984, paragraphs 81-82 on page 20 <http://www.hse.gov.uk/landuseplanning/publications.htm>

8 A Review of HSE's Risk Analysis and Protection – Based Analysis Approaches for Land-Use Planning, Final Report, September 2004 , Page 54, <http://www.hse.gov.uk/landuseplanning/hseriskanalysis.pdf>