

Title	Research Report 283: Development of an intermediate societal risk methodology
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Executive Summary	<ol style="list-style-type: none"> 1. Environmental Resources Management (ERM) was commissioned by the Operational Policy Unit (OPU) of the Health and Safety Executive (HSE) to investigate the development of an Intermediate Societal Risk Methodology. The investigation was undertaken between May and October 2003, and revised in July/August 2004. 2. The objective of the investigation was to identify the requirements of a 'rapid' societal risk tool that could provide improved 'resolution' compared to ARI_{COMAH}, and would be less resource intensive than the calculation of 'full' FN curves. 3. Essentially, ARI_{COMAH} is a simple formula that produces a score that can be compared against set criteria. Although 'coarse', the use of ARI_{COMAH} requires only the frequency of the 'worst case' scenario and the maximum number of persons harmed. By comparison, an FN curve is a plot of the cumulative frequency of harming a specified number of persons or more (i.e. the 'y-axis' represents frequency and the 'x-axis' represents the number harmed). Calculation of 'full' FN curves can be time consuming, not least because data must be collated from, for example, drawings and documentation, and sometimes via a physical inspection of plant and equipment. 4. The investigation focused on six 'idealised' installations: two bulk chlorine facilities; a chlorine drum facility; a hydrogen fluoride installation; a liquefied flammable gas processing plant; and a liquefied petroleum gas (LPG) distribution depot. For each of these, 'full' FN curves for a number of representative populations were calculated assuming release scenarios, frequencies and consequences typically used by HSE. As expected, it was found that the FN curves differed between cases. It was decided that the results from the most 'accurate' population representations would be used for each installation's base case. 5. Each base case was modified by removing scenarios to form a number of test cases. The resulting FN curves were then compared with the appropriate base case. 6. At the 'right-hand' side of the FN curve (i.e. in the region where the number harmed (N) was greater than 10% of the maximum (N_{max})), it was found that a close approximation to the base case was possible for a significant reduction in scenarios. Furthermore, a good approximation to the whole FN curve was possible assuming a line of gradient -1 (minus one on a log-log scale) for the 'left-hand' side (i.e. from the point where the number harmed (N) was assumed to be 10% of the maximum (N_{max})). 7. The reduction in scenarios was found to be greater for the toxic installations. For example, the bulk chlorine installation base case scenarios of 44 and 51 reduced to 5, whereas, the flammable and LPG base case scenarios of 13 and 24 reduced to 9 and 14. The reduction in scenarios also resulted in the reduction of hazard sources (i.e. equipment). For example, the bulk chlorine and the hydrogen fluoride base cases included 7 and 21 hazards compared to 1 and 5 in the representative test cases. For the flammable and LPG installations the reduction in hazard sources was less marked; 5 and 8 included in the base cases and 3 and 4 in the representative test cases. 8. In conclusion, without much loss in 'accuracy', development of an Intermediate Societal Risk Methodology (or rapid societal risk tool) would require the inclusion of significantly fewer scenarios and hazard sources than required for the calculation of 'full' FN curves (for the types of installations investigated). This could greatly reduce the time and effort needed to determine the societal risks from an installation.

	9. Further work is recommended to: test variations in extrapolating the FN curve; investigate the assumed position of the ‘right hand’ part of the curve for cases with relatively low N_{max} (i.e. as per the LPG installations); and, determine if similar results would be calculated for other types of installations (e.g. ammonia installations, etc.).	
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