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EXTERNAL SAFETY POLICY IN THE NETHERLANDS: AN APPROACH TO RISK MANAGEMENT

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Summary

A description is given of the use of risk management by the Dutch government in their external safety policy. This risk management scheme comprises the following aspects: risk identification, risk quantification, risk assessment, risk reduction and risk control. For the process of risk assessment, quantitative criteria for both individual risk and group risk have been developed. Legislation emerging from this policy is completed or in preparation. As an example are the administrative orders emerging from the so-called "LPG-nota". The latter is a policy statement of the Dutch government based on a probabilistic risk assessment of the whole chain of LPG-handling activities, from import to retail trade.

Introduction

Catastrophic events like the explosions at the Flixborough works of Nypro, Great Britain, the DSM works at Beek or the large toxic release of dioxin at Seveso together with a growing public concern about potential hazards, led the Dutch government to initiate a policy of External Safety. The immediate goals of this policy can be summarized as:
- to protect individuals against undue risk levels, and
- to prevent catastrophic accidents.

The recent catastrophies in Mexico City, Bhopal and Chernobyl dramatize the urgent need for a systematic awareness of, and approach to major hazards due to these types of activities. It was therefore decided to embark on an extensive research program to obtain operational knowledge of the assessment and management of risks in order to integrate these in decision-making processes. Although the research program is still underway, an *external safety policy including quantitative risk criteria* has been developed. This external safety

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policy is imbedded in the environmental policy plan of the Dutch government, as described in a document called: "Environmental Program of the Netherlands, 1986–1990" [1]. In this environmental program a chapter has been devoted to risk-management as a tool for external safety policy. One of the backbones of this external safety policy will be the so-called Post-Seveso directive, a European directive soon to be implemented in the environmental legislation. This directive of the European Community makes it mandatory upon each member state to verify that the most appropriate measures for preventing serious accidents in connection with industrial activities are taken.

Risk management

In dealing with safety, one is confronted with a number of problems that can be summarized under the heading of *risk management*. That is, a decision-making process in which, on the basis of assessed risk and available means of risk reduction, a decision has to be made about the acceptability of risk exposure levels and the control of allowed risk levels. An integrated part of the decision should also be an agreement on the emergency measures in case of accidents, e.g. warning procedures, evacuation of population, etc. and the testing of these emergency measures.

A risk management scheme for fulfilling the above-mentioned tasks consists of the following steps:

HAZARD IDENTIFICATION
RISK QUANTIFICATION
RISK ASSESSMENT } RISK MANAGEMENT
RISK REDUCTION
RISK CONTROL

These steps will be applied not only sequentially but also cyclically. In other words this is a continuing process, and stops only after a license has been refused.

Hazard identification

The need for hazard identification is obvious and requires no further explanation.

Risk quantification

At the time of the policy's inception there existed little in the field of risk quantification models, apart from the Probabilistic Risk Assessments (PRA) in the nuclear industries.

Non-nuclear applications were limited to a few studies like the Canvey Island risk study [2] and the COVO study [3], which calculated the risk of 6 major industries in the Rhine delta. There was also the Public Vulnerability Model (PVM) of the U.S. Coast Guard [4] which dealt with the risk associated with the handling and transport of dangerous substances in sea harbours. It was therefore decided to design a risk quantification scheme along the lines set out in the PVM and adapt it to the special circumstances in the chemical industry in a densely populated country. A computer model is now operational. This code comprises generic failure data, dispersion models, meteorological data, population data and dose–consequence models for the effects of toxic, flammable and explosive materials [5].

Risk assessment

For the process of risk assessment, quantitative criteria have been developed. In setting up such criteria, the attitudes of the parties concerned had to be investigated. The results of these studies showed that these attitudes were strongly dependent on the – personal – material gain related to the activity concerned. Objective information alone could not change the irrationalities in the arguments pro and contra.

Accordingly the results of the attitude research have strengthened the argument for attempting to make the basis for policy decisions as objective as possible. One way of achieving this is to quantify risk as accurately and as scientifically as possible and compare the results with quantitative standards. The results of this comparison are clear, but will nevertheless lead to a debate in which all sorts of nonquantifiable arguments will be introduced. The *objective* arguments can then be weighed in whatever political system of decision-making happens to be in effect. The problem of standards remains, and for the time being the line of thinking of W.D. Rowe has been adopted [6]. He distinguishes three areas of risk: the normal risk level, where permissible activities lie, the excessive risk level, where the risks are unacceptable, and an intermediate range of risk, where the reduction of risk is desirable. This concept is applied to the two goals of the external safety policy, namely protecting the individual against undue mortality risks and the preventing of disasters which affect large segments of the population.

The definitions of individual risk in the literature vary considerably. A definition is chosen which is useful for risk management purposes and relatively free from ambiguity. Individual risk is defined here as the expected frequency with which a hypothetical person permanently located out-of-doors at a given distance from the hazardous source would be killed. Group risk is defined here as the probability that a single accident may cause more than a specified number of prompt fatalities.

The starting point for determining the limit of unacceptability for individual risk is the frequency of deaths from natural causes. Mortality per year is pres-

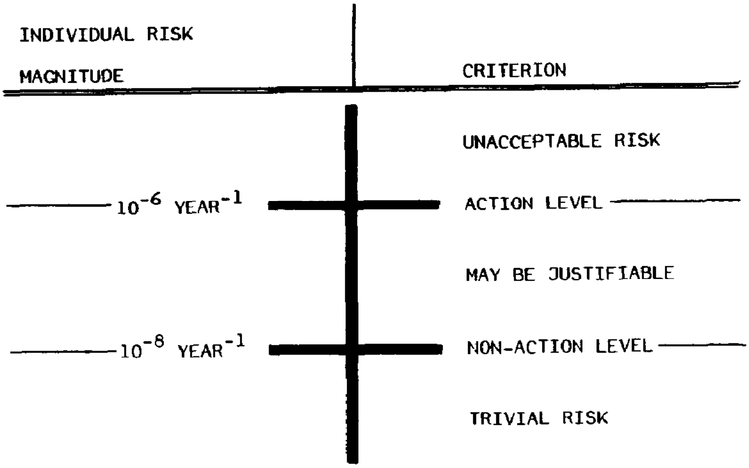

Fig. 1. Criterion for individual risk.

ently used as the evaluation criterion. It is the lowest for children between 10 and 15 years old, namely 10^{-4}/year. The policy adapted is that an industrial activity should not increase this background mortality risk by more than 1%. The upper bound of acceptable individual risk is thus 10^{-6}/year. An individual risk of 10^{-8}/year or lower is considered as negligible (see Fig. 1). In the area between these values (two decades wide) the ALARA (As Low As Reasonable Achievable) principle will be applied. This separation of two decades between the two levels is also very useful in dealing with uncertainties.

Apart from the risk criterion to protect the individual citizen, a criterion is developed to prevent, as much as possible, man-made hazards with a large societal impact. For these risk criteria two CCDFs (Complementary Cumulative Frequency Distribution) are chosen in the form of two straight lines on a log–log scale of the F–N plot (see Fig. 2). In order to deal with risk aversion a slope of -2 for these CCDFs is chosen. For example hazardous incidents in which 10 or more people (neighbours) are killed with a calculated frequency of 10^{-5}/year, are considered as unacceptable. Again below the lower CCDF the risk is considered as negligible (*de minimis* level).

These criteria only apply to persons in the vicinity of the installation and not to the employees on the site. The safety of the working environment of employees is assessed in a more qualitative way.

Risk reduction

Risk can be reduced in two ways: first in-situ, by means of the lay-out of plant activities, the application of additional safety devices and the use of less hazardous technology and the like; second, by means of zoning, i.e. keeping the public apart from the hazardous activity. Often a combination of both types of

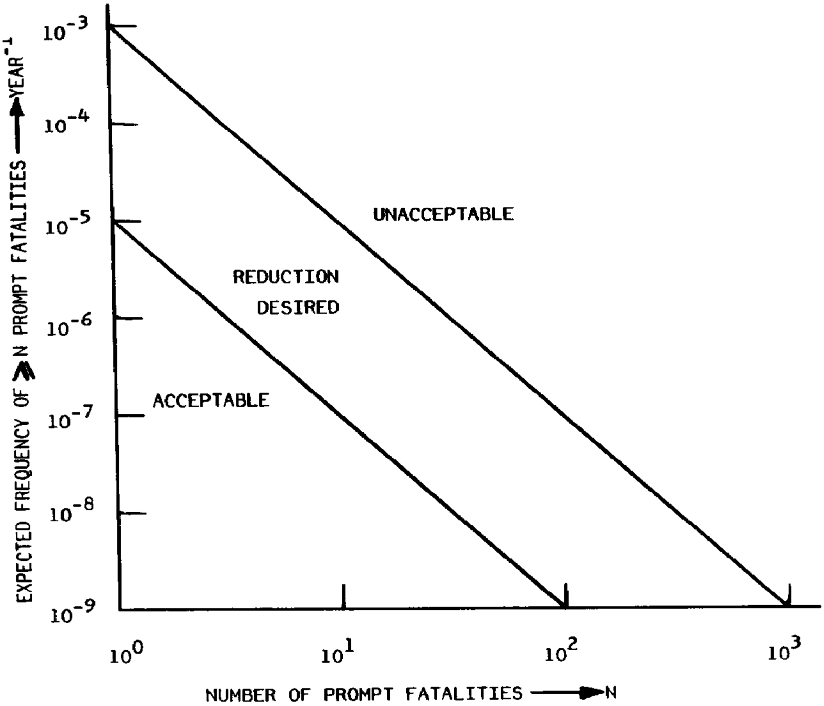

Fig. 2. Criterion for group risk in the form of a CCDF (prompt fatalities).

reduction is necessary. One of the major advantages of risk quantification is that it can provide information about the cost-effectiveness of different sets of risk reducing measures. On the basis of this information the licensing authority will be in a better position to judge what can be done at which costs. This of course is very important for his negotiations with the industries involved. This information is also very important for the licensing authorities in their presentation to the public; they are now able to demonstrate the measures which have been considered and the basis on which decisions regarding safety are made.

Risk control

When it has been decided what an acceptable level of risk is, decisions have to made and implemented to safequard this situation. The specific measures to be taken, will depend on the type and scale of activity involved.

Generally speaking the following actions will or may be required.

(a) For stationary sources the license under the Nuisance Act may specify the safety measures to be taken and the procedures to be followed to test these measures.

(b) The municipal authority is responsible for the implementation of the required zoning-measures. Where required distances between the installation and the public cannot be maintained, the removal of either the vulnerable dwellings or the hazardous installations may be enforced. The Dutch environmental and physical planning regulations provide for compensation funds for such rehabilitation measures.

(c) In case of risks associated with the transport of hazardous materials action may again be required to enhance the safety, either by improving the means of transport, or by routing and zoning, or both.

Uncertainties

Uncertainties associated with the results of hazard identification and risk quantification do exist. In particular the contributions of human factors, external hazards and inadvertent omissions of possible faults and accident sequences in the evaluation of the probability and consequences of severe accidents are extremely difficult to quantify and result in substantial uncertainties [7].

The decision-maker should be aware of the uncertainties involved and accomodate these uncertainties in his final decisions. In assessing the calculated risk the 50th percentile CCDF will be of major importance, although the size of the uncertainty intervals will be of interest as well. If no uncertainty analysis has been made the "best estimate" CCDF will fulfil the role of the 50th percentile CCDF. Uncertainties of the same or larger magnitude are present in deterministic decision-making. These uncertainties are not caused by the process of risk quantification, on the other hand this process might identify and reduce these uncertainties and provide an estimate of their cause and magnitude. There is clearly a need for expert judgement to deal with these uncertainties. To quote the former Minister Dr. P. Winsemius: "There is no substitute for thinking". The above-mentioned assessment process is not a simple "yes or no" decision but more a guideline for the decision-making process.

Applications

Implementation of the post-Seveso directive

This guideline, based on the EEC-Directive concerning major-accident hazards of certain industrial activities [8], will soon be implemented in the environmental legislation. Two administrative orders, embodied in the Nuisance Act and the Labour Conditions Act, will require the industries concerned to provide the competent authorities with a notification comprising a quantitative risk analysis. One administrative order is for existing industries, while the other deals with new activities.

LPG policy

The before-mentioned risk-management policy was also applied to the whole chain of activities concerning the import, transport, storage, distribution and retail trade of liquefied petroleum gas (LPG). Based on the expectation of a spectacular growth of the LPG-market, from 1 million tons a year to 10 million tons a year, the Dutch government commissioned a study of the possible risks which would accompany this growth [9].

The results of this study formed the basis for a policy statement of the Dutch government [10]. Legislation emerging from this policy statement is completed or in preparation.

The individual risk levels were translated into safety distances to make the results more applicable for legislation. For example LPG-selling petrol stations within city limits will be closed if dwellings are located within 15 m distance. Compensation funds are used for this purpose. For larger distances safety measures may be required.

Nuclear energy

Although the above-mentioned risk management scheme was not primarily developed for nuclear power plants, public hearings and questions raised in the parliament on nuclear safety in relation to the risk criteria triggered the demand for a PRA for the proposed nuclear power plants* within the framework of the existing licensing procedure and the associated environmental impact assessment procedure.

Future trends

Work is underway to formulate criteria for delayed health effects. The feasibility of extending these criteria to the domain of societal risk is being investigated. Also the integration of these criteria with the existing risk criteria is a point of interest.

The role of human factors in the concept of risk management is another area of development in the current safety policy. The main effort is to incorporate these influences in the domain of risk quantification and risk reduction.

Developments are to be expected for an enlarged role of risk perception in the decision-making process. How this can be done is very vague at this very moment. A lot of thinking is still needed on this subject.

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*Due to the Chernobyl disaster the decision to continue or to stop with the siting-procedure has been postponed until 1988.

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