MANUAL OF INDUSTRIAL HAZARD ASSESSMENT TECHNIQUES

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BIBLIOTECA
FOREWORD:

As an integral part of the appraisal and supervision function for industrial development, the World Bank and International Finance Corporation (IFC) are required to evaluate the adequacy and effectiveness of the measures to control major hazard accidents affecting people and the environment outside the plant boundary. For this purpose, the Office of Environmental and Scientific Affairs has drawn up "The World Bank Guidelines for Identifying, Analysing and Controlling Major Hazard Installations in Developing Countries."

In order to implement these guidelines, it is necessary to carry out a hazard analysis of the proposed installation to determine the potential damage of accidental releases of toxic, flammable or explosive materials from the proposed installation. From the results of this hazard analysis, potential causes and sources of major hazards are identified and ranked according to the degree of severity. For those failures that would cause major damage of loss of life on or off the plant site, the first objective is to reduce the magnitude of the potential damage through the introduction of alternative processes or process changes, the reduction in hazardous inventories, the provision of robust secondary containment systems, the modification of site layouts, the identification of alternative sites and the optimisation of control and management techniques.

If it is not possible to reduce the magnitude of the hazards by these methods, a risk analysis may be required to determine if the probability of the hazardous event can be reduced through process changes, additional or improved safety systems, improved training or testing and maintenance procedures and so forth. In the final analysis, it may be shown that the particular process, storage requirements, or site that has to be selected for the plant are incompatible and that a new site has to be selected. These hazard and risk assessment methodologies can be applied also to existing operations as well as to rehabilitation or expansion projects.
This manual provides as far as possible the latest simplified techniques used in the chemical industry to assess the consequences of major hazard accidents releasing toxic, flammable and explosive materials into the atmosphere. A spreadsheet methodology has been devised to simplify hand calculations on scientific calculators where access to computers may not be available to the user of this manual. The spreadsheet methodology also simplifies computer applications of the manual, but more complex modeling procedures may be prepared for programming on micro computers.

While this manual has been prepared primarily for application to World Bank and IFC projects, the methodologies which are presented have wide application in the chemical industry and its use by others is welcomed and encouraged. Further information concerning the environmental and health and safety activities of the World Bank are available by writing to:

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Chapter 1

Introduction
1. **INTRODUCTION**

The chemical and energy industries throughout the world utilise a wide variety of manufacturing, storage and control processes. These processes may involve many different types of raw materials or intermediate chemicals as part of the production of products required by both industrialised and developing countries alike. Some of the materials used may be potentially harmful if released into the environment due to inherent toxic, flammable or explosive properties. In the technical processes involved in the modern chemical industries and energy, these materials may also be subject to elevated temperatures and/or pressures; similarly, in order to facilitate storage active refrigeration of condensable gases may also be employed.

Under these circumstances it is essential that high standards of plant design, management and integrity can be achieved and maintained. Indeed, in the context of the large quantities of the potentially hazardous materials which are now handled on a routine basis, it is clear that effective methods have been developed to ensure adequate controls and safeguards in the facilities using such materials. Nonetheless, accidents do occur and these may have very serious consequences upon the employees, among the public and to property. It is therefore a high priority that potential hazards are properly identified and accounted for in the assessment of design and development proposals for such plant.

In order to conduct a sensible analysis of the potential hazards associated with accidental releases of toxic, flammable or explosive material, it is important to follow a structured approach applying methods of calculation for the estimation of such matters as discharge rate, dispersion and effect distances which will be straightforward to use and of adequate reliability. In the initial stages of an hazard assessment, it is appropriate to apply simplified techniques which may assist in the ordering and ranking of potential impacts; subsequently, if necessary, more refined calculations may be conducted to assist in plant optimisation.
This manual has been prepared with the aim of providing the framework necessary for the structured identification of major hazards. The manual employs simplified formulae useful in guiding the calculation of potential effect distances or damage ranges; it is intended to provide the minimum basis for any initial assessment utilising tested techniques which have been found to be effective when applied to a variety of petrochemical and process plant.

The procedures described in these manual are intended for use by the hazard analyst in conjunction with such other methods of safety assessment as may be appropriate for the plant under examination. These include such techniques as Hazard and Operability (HAZOP) studies and Failure Mode and Effective Analysis (FEMA). In addition, other methods of hazard ranking based upon the development of indices of potential hazard may also be useful, such as the application of the Dow Index and/or the ICI Mond Index. These latter techniques have provided an important role in the establishment of safety in the chemical industries, but detailed descriptions of the methods involved are not included here. The interested reader is referred to the various references given elsewhere in this manual.