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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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A Report on the

INTERNATIONAL SYMPOSIUM ON INDUSTRIALIZATION AND EMERGING HEALTH ISSUES - RISK ASSESSMENT AND RISK MANAGEMENT

C.R. Krishna Murti*
Madras Science Foundation
Madras - 600 020
India

Project No.: UC/RAS/88/258
Responsible Officer: Dr. S.P. Maltezou

Industrial Technology Promotion Division
Department for Industrial Promotion, Consultations and Technology
United Nations Industrial Development Organization
Vienna International Centre
A-1400 Vienna, Austria

INTERNATIONAL SYMPOSIUM ON INDUSTRIALIZATION AND EMERGING ENVIRONMENTAL HEALTH ISSUES- RISK ASSESSMENT AND RISK MANAGEMENT KITAKYUSHU, JAPAN OCTOBER 2-6, 1989

A REPORT

1. Introduction

The above International Symposium was held during October 2-6, 1989 at the University of Occupational and Environmental Health, Kitakyushu, Japan. The Symposium was cosponsored by the United Nations Industrial Development Organization. Besides two senior officers from the headquarters, UNIDO had arranged for the participation of a number of delegates from less developed countries. The main theme of the Symposium was highlighted in 42 invited papers presented in seven sessions under the following broad headings:

i) Global Environmental Problems

ii) Industrial Processes and Associated Health Issues

iii) Healthy Housing

iv) Risk Reduction Management for Industrial Hazardous Wastes, and

v) Risk Assessment and Risk Management.

A number of posters on the above sub-themes were also exhibited. A Panel Discussion was the concluding event of the symposium.

2. Global Environmental Problems

The following environmental problems were identified as of global significance:

- emerging problems associated with ozone and other photo oxidants increasingly generated due to anthropogenic activities.
- Outdoor and indoor air pollution
- Hazardous waste management, and
- Pollution of fresh water and sea water by the increased phase of industrialization anticipated from 1990 onwards.

2.1 The Ozone Problem:

The risks associated with ozone increases are two fold:

i. Health and environmental effects of increasing tropospheric ozone concentrating in urban air sheds and the effects at regional levels of long-range transport of air masses loaded with nitrogen oxides and volatile

organic compounds all acting as ozone precursors;

ii. Impacts on human health and the environment of stratospheric ozone depletion due to increased emission of trace gases such as chlorofluorocarbons and halons.

Human health effects of troposphoric ozone are mainly on the respiratory system manifest as decrease of the pulmonary function depending on the levels and periods of exposure to ozone. Exercise synergises the effects. Pathomorphological changes seen in lungs are the result of chronic long-term exposures. Although the depressive effect on pulmonary function is transient, long term effects of episodal massive exposures or periodic exposures to sub-lethal levels remain to be assessed. Extensive epidemiological studies have to be carried out to gain a more realistic understanding of chronic health problems.

Increased penetration to the earth of sunlight in the UV-B range resulting from stratospheric ozone depletion (eg. the ozone

holes) can give rise to increases in the incidence of cataracts and retinal dysfunction and skin cancer and the suppression of certain immune function components rendering people more susceptible to microbial and viral infections.

Of the environmental effects tropospheric ozone increase can adversely affect agricultural crops, forests and terrestrial ecosystems besides contributing to global warming. Green house effects emanating from tropospheric ozone concentration changes are likely to reduce rice production and adversely affect aquatic life.

2.2 Outdoor and indoor air pollution

With expanding industrial activity, power generation and automobile transport, outdoor exposure of humans to particulate and non-particulate air pollutants will show an upward trend. Of particular concern would be exposure to toxic polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzo furans (PCDFs) generated by incinerators and fossil fuel based thermal power generators. Exposure can be by direct outdoor inhalation of contaminated air or through the residues carried by food raised on contaminated

land. Admissible daily intakes (ADIs) for these toxic chemicals have been calculated from animal toxicity testing and not from human exposure assessments. There are many uncertainties in the validity of the underlying assumptions.

Gasoline is one of the largest volume products in global commerce today and its use is likely to increase as there is as yet very little evidence of a scientific/technological breakthrough in the development of environmentally less hazardous fuels. Even if methanol derived from natural gas based methane is a possible substitute, the goal of achieving formaldehyde-free or formaldehyde-low combustion systems is yet to be reached. Solar cell based or nuclear energy driven transport vehicles are still utopian dreams. Acute exposure to high levels of gasoline vapour produces adverse health effects. Recent evidence indicates long-term effects including cancer resulting from repeated exposures to low doses. Because of the presence of benzene and butadiene, International Agency for Research in Cancer has concluded that gasoline vapour is a "possible human carcinogen", although the United States Environment Protection Agency

on less firm ground would like to conclude that gasoline is a "probable human carcinogen". Analysis of the available data of epidemiological studies indicate that the carcinogenecity seen in rats and mice has so far no counterpart in human populations exposed in the course of manufacture, distribution or use of gasoline. There have been very few studies on the health impact of gasoline on human health in developing countries.

Indoor air quality is recognized today as an important factor in maintaining public health for it is accepted today that people spend 80-90% of their time indoors often in environments where pollutant concentrations are higher than those encountered outdoors. Sources of indoor pollutants are both natural and man-made. Radon originate from natural deposits of Uranium or from building materials such as granite, bricks made from materials containing radon sources or bricks made from the recycling of klin or cindar ash. Biological pollutant effects indoor are exacerbated by indoor human activity especially improper moisture controls. Tobacco smoke, elevated levels of carbon monoxide, oxides of nitrogen and numerous gas phase organic

compounds are examples of indoor contaminants originating from indoor activities including cooking and washing.

Large masses of human beings live in huge slums in many developing countries. Urban clusters with millions living in degraded environment are definitely on the increase. Assessment of the health effects of outdoor and indoor air pollutants on the people living in such crowded settlements poses many conceptual and methodological challenges. The adverse health effects can be synergised or exacerbated by under nutrition and the endemicity of coexistent infections and parasitic diseases.

2.3 Hazardous waste management

The generation of municipal and hazardous wastes and their disposal is of global concern today. The United States of America generate 10 billion metric tons of solid waste annually from industrial and municipal sources. In 1986 more than three fourths of all municipal solid waste in USA was deposited in the nation's 6000 municipal land fills. Characterization of the major sources of inorganics and organics in hazardous and municipal solid waste,

various technologies used in their management, impact on health and ecology of emissions from incinerators as fine ash containing heavy metals, polychlorinated dioxins, difurans, polyaromatic hydrocarbons and the export of hazardous wastes to Less Developed regions particularly islands are among the many challenges posed by this aspect of industrialization and development. Risk reduction can be achieved by improving technologies (Cleaner technologies) which will generate less and less of wastes or improve the current methods of recycling within the industry or outside.

2.4 Water Pollution

Arsenic, PCB's and tributyl tins are increasingly used in the maintenance of ships. These can bioaccumulate in marine organisms and through that affect human food resources. Increased location of industrial and commercial activities, crude petroleum unloading, refining in the proximity of ports can cause increased levels of pollution of coastal waters. Some of these problems have been studied in the past at the local level and various alert systems such as the mussel watch have been established. However, there

appears to be an ungent need for a more pragmatic evaluation of the possible impact of industrialization in developing countries with long coastal lines or nations comprised of small islands.

3. Industrial Processes and Associated Health Issues

Large quantities of toxic materials, ionizing and non-ionizing radiations and recirculation of "clean room" air are some of the sources of exposure leading to occupational illness likely to appear as the microelectronics industry expands in the coming years. The rate of occupational illness causing work loss among semiconductor workers in California is more than three times that among workers in general manufacturing industries. In a recent study in New Mexico, USA., semiconductor industry workers were found to have higher than expected rates of skin rashes, back problems, allergies, sinusitis, high blood pressure, psychiatric illness, bronchitis, kidney disease and cancer. Semiconductor processes involve the use of many metals, chemicals and toxic gases in a wide variety of combinations and different kinds of plant settings and the health risk associated with exposure to these agents requires investigations for taking steps to correct the problem at the source.

The number and quantity of carcinogenic chemicals produced are likely to show an increase in processing industries. The toxicity of these agents, their potential to induce cancer in workers and the general population, the possibility of synergistic effects of multiple exposures to industrial and non-industrial carcinogenic compounds are some of the areas which will require detailed studies. Bioassays are available for assessing the cancer inducing properties of fuels, benzene, aldehydes, intermediates of chemical industry, monomers of plastics, chlorinated solvents, propellents, pesticides, detergents, metals different types of asbestos and man made fibres. Nevertheless there appears to be need for further research on methodologies.

After Bhopal, policy issues related to cost, societal risk and benefit considerations related to the chemical industry have received greater attention. As a result steps have been taken by both government and industry to revamp and restructure existing installations and to introduce effective regulatory procedures for future control of hazards. The need for locating potential hazards in processing, storage, transport and waste disposal of highly reactive chemicals and anticipating emergencies has been

highlighted. The urgency for developing technologies using less reactive chemicals or less hazardous operations has been stressed. It is recognised now that wide gaps exist in our knowledge of the toxicity of highly reactive industrial chemicals and their degradation products. The most significant lesson of Bhopal has been the need for continuous vigilance, awareness of hazards in industrial installations and preparedness to face emergencies at local level by the orchestrated response of the local community, managers of industry, governmental and non-governmental agencies and the media.

Bhopal and other chemical accidents have also underscored the urgency of introducing and implementing a safety audit system both for the industry and the environment. Environmental audit has emerged as an effective tool for investigating whether industrial operations confined to installations have caused, are causing or are expected to cause serious environmental pollution.

4. Healthy Housing

It is now recognized that more than 80-90% of our time is spent indoors within built structures. Over the years building sciences have emphasized the cost, comfort and aesthetic aspects. In order to meet the

shelter needs of the burgeoning population of the world more and more housing and buildings for conducting occupations have to be built in the coming years. In developed societies up to 40 percent of variation in children's health status has been attributed to housing and environmental conditions. In poorer, less developed societies the housing factors could however account for more than 50% of variations of health status of children. The emerging knowledge about indoor pollutants and their health effects, have not been incorporated into building design, ventilation or building policies.

Asbestos is an important material for home and building construction particularly in the developing world. Its use in strengthening cement products is an important factor. Are the associated health risks sufficient to offset the social benefits?. With the possible exception of floor tiles, durable asbestos-containing products do not liberate significant numbers of respirable fibres under normal use. However, high concentrations in air can be attained from cutting and finishing and from building demolition. The risk of all asbestos related diseases directly reflects duration and concentration of exposure and the circumstances under which exposure takes place. There

is no assurance on the available evidence as to whether the commercial amphiboles can be used for cement or other building products without risk of mesothelioma. On the other side chrysotile if well controlled should carry no comparable risk.

5. Risk Assessment and Risk Management

The two step process of reducing risk to public health by appropriately developed policy decisions is based on a number of emerging scientific concepts: threshold effects, non-threshold effects and others. There is need for stimulating further research in methodologies for risk assessment. Currently the process of risk assessment of carcinogens relies heavily upon the availability and quality of information on the chemical originating from animal tests, mechanism of action, metabolism, pharmacokinetics and exposure assessment. Considerable degree of uncertainty characterizes the available information.

Epidemiology is an important though expensive tool for hazard identification and risk estimation of people exposed to toxic chemicals. There is an urgent need to improve and rationalize epidemiological methods and make available the relevant expertise for

industrializing countries.

USEPA has developed guidelines for risk assessment in five areas; Carcinogenicity, Mutagenicity, Developmental Toxicity, Chemical Mixtures and Exposure Assessment. Besides the scientific principles, these documents also give guidance on science policy. These guidelines are, being updated and supplemented with similar guidelines for Reproductive Effects and Neurotoxicity.

Agriculture based economies which are getting industrialized will have to bear the double burden of existing risks and risks newly introduced. There should be techniques to evaluate the overlaps of these risks and manage them.

The environmental crisis following the second world war led to considerable degradation and prompted many countries to establish central agencies for environmental control. However the approach hitherto has been to attack each medium, viz., air, water, soil etc. The need for paying more attention to Cross-media approach of controlling pollution has become inevitable.

Environmental regulation hitherto exercised minimal impact on encouraging non-polluting technology. End-of-pipe technologies or those related to production processes were developed in response to environmental laws. New demands for improving occupational and living environment will require cooperative efforts of industry, Government and R & D agencies.

In Japan, Risk Management has become effective by legislation such as the Pollution Related Health Damage Compensation Law which enables Government to pay compensation benefits and expenses of treatment to victims of air or water pollution related diseases. The Chemical Substances Control Law requires pre-market notification and testing of all chemicals. Ambient Air Quality standards are being prepared to afford further protection to public health.

In the United Statesof America, Comprehensive Environmental Responses, Compensation and Liability Act of 1980, and the Superfunds Amendments and Reauthorization Act of 1986 have paved the way for measures for the reduction of risk of damage to the environment and human health, Source Control, reuse and recycling, treatment and exposure minimization constitute the hierarchy of approaches used.

In the Netherlands, the National Environment Policy Plan became effective from 1989. Risk assessment is based on the principle that there is a level above which risk becomes unacceptable and a level below which the risk becomes negligible. The grey zone between these two limits is the area for risk/benefit consideration and management. The maximum permissible mortality risk to human beings from major accidents, exposure to toxic substances and radiation is the combined probability of mortality for each of these three hazards not exceeding 10^{-5}/year. The maximum permissible level has been fixed at 10^{-6}/year for each of these activities. The levels below which the risks to man and ecosystem can be neglected have been fixed as 10% of the maximum permissible values.

The role of Environmental Impact Assessment was emphasised as a tool for risk management and minimising damage by preventive action in projects being initiated in developing countries.

From a case study of selected industries in India, the trend of industrial accidents has been analysed for a ten year period. The results indicate that accidents of high risks to safety and life are

increasing, 60% of the mishaps are due to direct or indirect human failure, 27 percent due to design faults and 5 percent due to equipment failure. The bulk of information available on safety guidelines is not accessible to workers and supervisors.

6. Panel Discussion

A Panel discussion on future directions in policies and Risk Management Approaches was the concluding event. The discussion centred around

i) environmental priorities of industrializing countries,

ii) research areas in risk assessment and risk management,

iii) Policy directions and

iv) role of international agencies in preventing health problems associated with rapid industrialization.

7. Conclusion

There was general concern on the following broad issues that emerged out of the various presentations and the discussions following each session of the Symposium:

i) The fast pace of industrialization of many developing countries in Asia and the Pacific region highlights the need for a realistic appraisal of the pollution problems particularly in relation to human health.

ii) Population pressure in urban regions, location of industries in sensitive areas, industry versus human habitations and congestion due to heavy road transportation are part of the scenario of the industrialized world of tomorrow which one must keep in front to make risk assessments and to devise appropriate measures to reduce the risks.

iii) Hazards associated with the production, storage and transport over long distances of chemicals and chemical products have to be identified. Industrial safety has to be built into all plans of industrialization.

iv) Safety has to be maintained both within the industry and in the environment by instituting a broad system of safety audit. This calls for trained personnel with the

requisite expertise and experience.

v) Environmental improvement, accessibility to safe drinking water, provision of hygienic and reasonably cheap houses and mass immunization programmes will reduce the risks to health from poor environment. However in many developing countries industrialization has taken place before improvement has been effected in the general environment. Consequently the people of such countries may have to manage both the existing risks and the new risks introduced by industrialization.

vi) An important manifestation of industrial hazard is accidents with a potential to cause death, disability and long term health problems to the effected humanity. This underscores the need for appropriate contingency planning with emphasis on prevention but also preparedness to face accidents and respond to them with effective action to mitigate injury to public health and the environment.

vii) Another important manifestation of

industrialization is the problem of managing hazardous wastes. A related problem is the diffusion of this waste from highly industrialized countries to less developed countries where laws related to hazards control are not stringent.

viii) More than 90% of life is spent nowadays indoors either in the shelter of homes or in the work place. The design of homes and work place has become important from the point of view of reducing the risk associated with many indoor pollutants.

ix) With increased development and industrialization involving more power generation by burning fossil fuels and road and rail transportation using diesel and gasoline and diffusion of chemicals, there is greater need for environmental pollution control measures both by legislation as well as by improved technologies.

x) While the general scientific principles guiding health risk assessment are well known there is an urgent need to develop risk reduction procedures by research in safety evaluation of chemicals for their short term and long term effects and in epidemiological methodologies.