ABSTRACTS:

UNEP's Integrated Approach to Disaster Management and Context to Industrial Disasters

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The production, storage and distribution of goods that are based on hazardous materials, posing the risk of occurrence of accidents that may incur into a wide range of adverse effects. These may result from incidents such as industrial fires, explosions, and large spills or releases of chemicals into the environment, affecting both businesses and the public. Additionally, it is very common for industrial companies to operate in densely settled urban areas and often near public water supplies. Furthermore, natural hazards pose an additional risk for industrial accidents as secondary effects of a natural disaster. An earthquake for example poses risks for industrial facilities or a tsunami poses risk for the tourism industry in coastal areas.

The United Nations Environment Programme is a leader on addressing these challenges and provides support to governments and the private sector on awareness, prevention, preparedness and management of industrial disasters. UNEP's contribution to these areas is in line with the International Strategy for Disaster Reduction and with the Strategic Approach for International Chemicals Management, and based on a number of tools and initiatives that provide an integrated approach to Industrial Disaster Management:

- Awareness and Preparedness for Emergencies at Local Level (APELL) process and programme: APELL is a modular, flexible methodological tool for preventing accidents and, failing this, to minimise their impacts.

- Flexible Framework Initiative. The initiative focuses on the development and implementation of a Flexible Framework for Chemical Accident Prevention. The Framework offers Guidance for national governments wanting to develop, improve, strengthen or review their industrial chemical accidents prevention and preparedness policies and programme.

- Responsible Production: the overall focus is on engaging business and the supply-chain in safer production, risk communication and emergency preparedness. It is aimed at SMEs who handle hazardous materials.

Within this framework UNEP's overall objective is to enhance the risk reduction of industrial accidents by strengthening the institutional capacity on chemical accident prevention and preparedness at national and local levels, including through legal frameworks.

Land-use Planning: A Technological Risk Minimization Tool for Industrial Areas

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Though land use planning is widely accepted as an important planning measure for minimizing risk, it is difficult to implement because of the various considerations involved with land use, especially so in developing countries where pressure on land resources tend to be high. Compared to many natural hazards, the location and time of occurrence for which is difficult to predict, considerable forward planning from the point of view of land use can be carried out for technological hazards through zoning approaches. However, such planning approaches have seldom been applied to industrial areas in India and many of them are faced with high vulnerability from technological hazards. The availability of information on the various aspects of the hazardous chemicals stored in such industries and the vulnerabilities present in the neighborhood is vital for undertaking any systematic land use planning exercise taking into accounts technological risks. As a part of the Environmental Risk Reporting and Information System (ERRIS) project, a comprehensive GIS based information system housing both spatial and related attribute data of the industries, hazardous chemical storages, buildings, transportation networks and existing prevailing land uses has been prepared for the Haldia region, one of the largest industrial hubs in eastern part of the country. Using this information, an effort has been made to prepare hazard and vulnerability maps to understand the spatial extent of potential hazard footprints in case of an accident using consequence analysis models as also the disposition of vulnerabilities through a multi-criteria rating and ranking method. These maps were subsequently combined into a composite risk map depicting potential risks on a mapping unit in the area. The same framework can be adopted for future land use planning exercises in other industrial areas to minimize risk levels, thereby helping to reduce the odds of another Bhopal like incident. **Key words:** Industrial Hazard, ERRIS, MCDA, Risk Zonation, Land Use Planning.

Disaster Management vis-a-vis DGFASLI'S Perspectives

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The disaster management is an old concept but industrial disaster management as assumed importance only in last few decades. The Directorate General Factory Advice Service and Labour Institutes (DGFASLI) Mumbai is a technical arm of Ministry of Labour & Employment, Government of India, advises the Government on the matters concerning occupational safety and health in industries and 12 Major Ports of the country. The department is also enforcing the safety & health related statutes in the major ports. The role of DGFASLI in respect of Disaster Control is primarily preventive in the sense that it can advise the Government for statutory changes to improve the safety and health conditions in the factories and carry out promotional activities through the Central Labour Institute Mumbai and Regional Labour Institutes at Chennai, Kanpur, Kolkata and Faridabad. The Department was instrumental in bringing the concept of management of major industrial accidents in the country in collaboration with ILO and Government of Federal Republic of Germany. The draft regulation developed during this innovation were the basis for framing of Control of Industrial Major Accident Hazard (CIMAH) Rules Under The Indian Factories Act 1948 and Manufacture, Storage & Import of Hazardous Chemicals Rules 1989 under the Environment Protection Act. The special provisions for Hazardous Process Industries introduced in the Factories Act through Factories (Amendment Act) 1987 were also promulgated by DGFASLI. The present ongoing statutory and promotional activities includes the enforcement of MSIHC Rules in Ports and Docks and promotional activities by development of human resources and creating awareness among various target groups by their training and advisory activities. The paper concludes with suggestion that special efforts are required to educate communities around the MAH installations and demonstration by the managements that all reasonably practical measure have been taken to prevent major accidents in identified installations.

NSC’s Experience in Developing Integrated Approach in Disaster Management

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This paper is an outcome of NSC’s experience in Industrial Disaster Management over a period of last 17 years, brain-storming among its senior officers & wide range of experts in the field through meetings, workshops/seminars, etc and commitment of its present Director General for providing necessary institutional support of NSC. Also, highlights the integration of Disaster Management in NSC services and its multi-hazard approach. This experience has been institutionalised and shared internationally by NSC and there is a consensus on the suggested strategies among the leading institutions at the national level. These strategies are recommended in the National Disaster Management Guidelines on Chemical (Industrial) Disasters issued by the National Disaster Management Authority (NDMA).

Industrial-Chemical Disaster Management Integration with Holistic Framework: Key Challenge for Implementation of National Action Plan

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Disaster management is gradually becoming a priority for scientific and political interventions for ensuring sustainability of human and economic developments. "Industry" and "chemicals" are inevitable in modern developmental system and human survival, *viz.* food, health, agriculture, energy, living, transport, etc. Major Accident Hazard (MAH) units as per MSIHC Rules 1989 account 1724. Release of hazardous and obnoxious chemical releases from natural origins, for example, pyrite bedrocks; gas release/explosions and fire in coal mines and storages; fire/explosion risk from historical waste sites; arsenic, fluoride contamination of mass water resources; and intentional or un-intentional sabotage of water or fuel supplies with hazardous/toxic substances, besides natural hazards triggering chemical/industrial mishaps, and chemical accidents during transport, conveyance, storages, etc. Un-organised sector industrial units and commercial/domestic or laboratory chemical accident can also result in major damages to life and property.

Bhopal disaster (1984) triggered worldwide awareness and new regulatory frame work and techno legal regime towards understanding environmental and disaster challenges within the framework of sustainable development. Legal framework for on-site and off-site emergency management, site-clearance, EIA, Risk-analysis, auditing, environmental status reporting, public liability insurance, environmental tribunal, life-cycle analysis, though conceptually evolved during 1970s, accelerated to practice and legal backing in post-Bhopal environmental drives. It also installed, the in principle, framework at national, state, district and local levels, during 1990s. The Environmental Protection Act 1986 and rules therein were significant in installing the framework to address environmental hazards through various tools and mechanisms including mitigation and emergency response indirectly on all natural hazards related to land, water, forests, coastal, climate-change besides direct intervention on chemical/industrial hazards. GIS and web-enabled system for emergency planning, vulnerability assessment and information system for industrial disasters has been worked out in certain districts/states. With the recommendations of a High Powered Committee on disaster management in India, that gave way to Disaster Management Act 2005, provided a holistic paradigm of multi-hazard disaster management framework, provision "disaster management plan" at national, state and district (and also local) levels. This has caused visible gaps in two parallel frameworks of disaster management and also distance from environmental risk management.

Similarly the major natural disasters in the recent times i.e. Latur Earthquake (1993), Bhuj Earthquake (2001), Orissa Super Cyclone (1999) and Tsunami 2004 has resulted in a paradigm shift in approach. The Disaster Management Act 2005' was enacted on 26 December 2005 with the objective of effective management of disasters at National, State and District levels. The Act seeks to institutionalize the mechanisms at the national, state and district levels to plan, prepare and ensure effective response to both natural calamities and manmade disasters/accidents. The Act mandates: (a) the formation of a national apex body, the National Disaster Management Authority (NDMA), with the Prime Minister of India as the Chairperson, (b) creation of State Disaster Management Authorities (SDMAs; also mandated to be formed in each State), and (c) District Disaster Management Authority at District level for the coordination and monitoring of the disaster management activities.

Integrated approaches in disaster management has been well advocated by United Nations Agencies, national governments, and stressed upon in Agenda-21 (Rio, 1992), IDNDR, WSSD (2002), Hyogo Framework and Millennium Development Goals, besides IPCC, IPCS, ISDR, ILO, WHO, etc. DM Act also stresses on holistic and proactive approach. As per the BMTPC's disaster vulnerability atlas (1997) of India identified 169 districts as multi-hazard prone and these districts were covered under the GOI-UNDP DRM programme (2002-08). Recently the altas has been revised and 241 districts are identifies as multi hazard prone. Reportedly there are 294 districts with MAH units. More than 100 districts with MAH units are multi-hazard districts. Noted lack of integration prevailed between the 'disaster management plan' and the 'off-site emergency plan' in many districts.

The gap exists in information and decision support systems, emergency communication plan, SRDN, IDRN etc., causing serious lapses on the claim of a holistic approach. A docile focus on preventive mitigation using risk management principles has been evident owing to deficiency of an organised framework of environmental management at district, state or regional levels, that otherwise may emphasise site assessment, land-use/landscape, cleaner production, hazardous waste, environmental health, etc. Integration is a key objective motivation in the development of national action plan as envisaged in the DM Act and National Guidelines on disaster management. In India, leadership is in creation of institutions, legislations and guidelines but the implementation is poor due to disintegration, duplicity, overlap and misunderstanding of mandates and accountabilities. Present paper carries a critical analysis of challenges, options, tools and strategies for integration at various levels for preparation and implementation of the national action plan for chemical disaster management.

GIS and Online Emergency Planning and Information Reporting System for Chemical Accidents in India

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The product GEPR is a tool developed for chemical emergency planning and response using the latest technology available so that emergency planners and responders can achieve farther improvement in this specialized area and public at large can be benefited to avoid incidences of the types of Bhopal Gas tragedy by adequate planning and tremendously improve the response to contain the damage if such incidences ever occur. GEPR comprises of digitized maps and that of the industrial clusters/surroundings comprising major chemical industries identified as MAH (Major Accident Hazard) units. This system incorporates data on first responders for chemical emergencies such as police, fire, medical and other emergency response agencies and services, resources available in the districts to combat such emergencies along with resources and location specific data. The product was developed for 42 districts covered under phase I and II. Web GIS for Emergency Planning & Response System (Phase III) is in continuation of the earlier work (GEPR phase 1 and II) to enhance the software capability with Web enabled technology, more powerful and accurate mapping.

It has been a concern for Ministry of Environment and Forests to get the timely information about these accidents from the concerned authorities as the authorities often either not send accident information or get it delayed. In order to overcome this time lag and allow on line monitoring and analysis it is envisaged to develop Chemical Accident Information and Reporting System (CAIRS).Chemical Accident Information and Reporting System(CAIRS) provides an online accident reporting and analysis mechanism where different authorities mentioned in schedule 5 of Manufacture, Storage, and Import of Hazardous Chemical Rule 1989 can Enter/Update chemical accident related information in the general format specified using two level password security features over web. This centralized web based system will store all the information related to chemical accident in the country. The system is capable of generating various online reports, charts as per the requirement of different stakeholders.

Efforts of TIMA-MARG & DISH for Chemical Disaster Management at Tarapur Industrial Complex

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M.I.D.C. Tarapur Industrial area is one of the prominent chemical zones of Maharashtra where in about 400 S.S.I. Chemical manufacturing units are located. The estate was established in middle seventies and slowly and steadily number of units increased and today there are about 1000 units mainly of chemicals textile & engineering categories.

As the chemical manufacturing activity gathered momentum problems related with safety came to forefront. Some accidents which resulted in huge losses called for urgent need to address the issued of industrial safety. At this stage Tarapur Industrial Manufacturers Association (TIMA) and Directorate of Industrial safety and health (DISH) jointly took up various programmers for creating awareness about industrial safety & occupational health. In addition, seminars and workshops were organized to enhance knowledge and train the manpower.

The TIMA-MARG (TIMA mutual aid response group) was formed in early nineties. Since then is has undergone same transformations but has very diligently served to the cause of industrial safety and occupational health at the industrial area of M.I.D.C. Tarapur. The activities of TIMA-MARG which are carried out in co-ordination of DISH Vasai Division have helped the S.S.I. units of area and accident rate has fallen significantly. **Key words**: TIMA MARG, DISH, chemical disasters, SSI units, Mutual aid and response group, MIDC Tarapur.

Identification and Strengthening of Key Provisions in Indian Regulations to Substantially Reduce the Risk in Hazardous Chemical Transportation by Road

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For a long time Hazardous Chemical Transportation by Road has been a relatively neglected area in Management of Chemical Disasters. The Static and Mobile Pressure Vessels Rules, The Gas Cylinder Rules, The Petroleum Rules and the Central Motor Vehicles Act and Rules to some extent pave way for the regulation of Hazardous Chemical Transportation. However, the implementation status of the key provision of these rules needs a re-look and strengthening.

This paper recognizes that in the Indian Context, the work of strengthening implementation of regulatory provisions must focus on a few select key provisions to start with. The select key provisions must be such that strengthening them alone causes a substantial impact on the base line improvement. How does one identify such few key provisions from a plethora of provisions enacted? The paper proposes a unique methodology for such analysis through a tried and tested example.

This paper investigates the provisions under various regulations by subjecting them to Risk Analysis method under FMEA (Failure Mode and Effects Analysis). The paper exhaustively enlists the existing rules pertaining to Hazardous Chemical Transportation. It then gives a Severity (S), Occurrence (O) and Detection (D) rating to the rules using a defined scale from 1 to 10. It then draws Risk Priority Number (RPN) for the regulatory provisions using the FMEA equation of RPN = S x O x D. The real time values are demonstrated using the data obtained on NH48 (Mangalore-Bangalore National Highway)

The significantly high priority rules are then thoroughly analysed. The causes of high priority number for certain rules are identified and practical recommendations are made to improve the implementation of these key rules. The paper analyses more than 100 rules and pin-points 6-7 rules which will have maximum impact on the risk of hazardous chemical transportation in India.

Natural Disasters Triggering Technological and Industrial (Chemical) Mishaps

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Disasters, often sudden and intense, result in considerable destruction, injuries and deaths, disrupting normal life as well as the process of development. Natural disasters are perceived to be on the increase in their magnitude, frequency, and economic impact. Economic impact can be seen in the form of emergency relief costs to individuals, care for evacuees and clean-up after flood or clearance after landslides or avalanches, and wages and sales lost due to business interruption. As a result, timely repair, replacement, and reconstruction divert the national resources. In India, the natural disasters eroded 2% of the GDP during 1996-2001 and consumed 12% of the Government revenue during the same period. The historical account of various natural disasters reveals several cases where chemical accidents and releases were triggered by natural events, example are earthquake – Bhuj, Japan, China, Super cyclone of Orissa etc.

The natural disaster triggered technological accidents refers mainly to the impact of a natural disaster (earthquakes, floods, landslides, hurricanes, storms and others) on industrial facilities housing hazardous materials, hazardous materials storage facilities, including port terminals, gas and oil pipelines, water supply systems, transportation of dangerous goods, and energy production systems. During natural disasters, technological malfunctions may release hazardous materials (e.g., release of toxic chemicals from a point source displaced by strong winds, seismic motion, or rapidly moving water). Natural disasters often lead to wide-ranging air pollution in large cities. Uncontrolled forest fires have caused widespread pollution over vast expanses of the world. Natural or manmade disasters resulting in massive structural collapse or dust clouds can cause the release of chemical or biologic contaminants (e.g., asbestos or arthrospores leading to coccidioidomycosis). Crude oil could be released into the environment during an emergency such as a hurricane and flood. In flood situations, some parts of the oil will float on water and can be seen as a film on the surface, and other parts will sink to the bottom. Other parts of the oil can become fumes in the air**.**

Flooding can cause the disruption of water purification and sewage disposal systems, overflowing of toxic waste sites, and dislodgement of chemicals previously stored above ground. Floodwaters also may be contaminated by agricultural or industrial chemicals or by hazardous agents present at flooded hazardous waste sites. On January 26, 2001 a devastating earthquake occurred in the Kachchh district of the state of Gujarat. Gujarat, being the second most industrialized state in the country, took heavy beating in terms of adverse socio-economic impacts. 26th December, 2004, a massive earthquake of Magnitude 9.0 hit Indonesia generating Tsunami waves in South-east Asia & eastern coast of India. Height of tsunami waves ranged from 3 – 10 m affecting a total coastal length of 2260 km in the States of Andhra Pradesh, Tamil Nadu, Kerala & UTs of Pondicherry, Andaman & Nicobar Islands. Tsunami waves traveled upto a depth of 3 km from the coast killing more than 10,000 people & affected more than lakh of houses leaving behind a huge trail of destruction.

The Gujarat Cyclone of 1998 with two landfalls and a wind velocity between 170-200 kmph ripped through the industrial heart of Gujarat and inflicted an economic loss of nearly Rs 2,500 crores. The corporate sector including Reliance Industries' Jamnagar oil refinery suffered losses amounting to Rs 100 crore and Gujarat State Fertilizer Corporation's output was disrupted to the tune of 2,000 tones per day. 29th October 1999, Super cyclone with winds 260-300 km/hour hit the 140 km coast of Orissa with a storm surge that created the Bay-of- Bengal water level 9 meters higher than normal. The violent cyclone inflicted a cumulative loss of nearly 1,000 crores on the industrial sector. The major industries like the Paradeep Port, Oswal Fertilizers and CESCO suffered heavy losses. Drought different from other natural disasters, do not cause any structural damages. Drought leads to substantial reduction in industrial production especially in the industries requiring considerable amount of water such as plastic, paper, textile and petroleum industries. The most recent, the drought of 2002, ranks fifth in terms of magnitude but is unique when examined in overall terms of magnitude, spacing, dispersion and duration. The impact of the drought spread over 56% of the land mass and threatened the livelihoods of 300 million people across 18 states The GDP in agriculture shrank by 3.1%. The estimated loss of agricultural income was around Rs 39,000 crore.

This paper discusses various technological, chemical/industrial mishaps arising out of natural disasters and tries to identify the lessons that can be learnt from the pro-active mitigation measures for the disaster prone areas. Paper also suggests the roles to be played by different stakeholders and sectors in minimizing these mishaps through adapting and enforcing strategic measures.

Waste Generation – Snowballing to a Man-made Environmental Disaster

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Waste has been generated even before the evolution of mankind. All waste generated was natural at that time and did not pollute the environment. With the rapid urbanization, industrialization and changed life style the quality and quantity of waste generation are also changed. This has degraded the urban and peri-urban environment in most of the developing countries, placing enormous strain on natural resources and generating huge quantities of waste undermining efficient and sustainable development. WHO defined 'waste' as: 'Every substance or object arising from human or animal activities that have to be discarded or unwanted' is waste.

Waste is generally classified based on the (i) Origin – Municipal Solid Waste (MSW), Agricultural Waste, Bio-Medical Waste, Construction Waste, Industrial Waste, E-Waste, Nuclear Waste, etc. (ii) Treatability – Biodegradable and Non-biodegradable Waste, (iii) Risk Potential – Hazardous and Non-hazardous Waste.

Piles of accumulated solid waste are a common sight in Indian urban localities. Waste accumulation becomes a menace, aggravated by the common belief that resources and disposal areas are infinite and materials not useful could be thrown away in open spaces. Waste pose a serious threat because the polluting materials remain in place for relatively longer period of time unless removed, burned or otherwise destroyed. Indifference of the industries and municipalities towards environmental safety and its protection, leads to the environmental pollution. A decade back, sanitary and land filling was though to be good option, but increase in the quantity of waste and space constraints forced us to search other scientific options for waste disposal viz. secured landfill, underground concrete chambers, effluent treatment plants, etc. The nutrition and fuel value of MSW could be utilized in the benefit of human population. Thus generation, storage, collection, transportation and disposal of waste are important to the mankind to avoid environmental degradation snowballing towards a man made disaster.

Chemical Disasters in Medium /Small Units, Unorganised Sectors, Education/Research Laboratories

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During the period January 1994 to July 2009, the chemical disasters are going on in medium/small units.It has been observed that fires and explosions have resulted in huge property/production loss whereas most of accidents have led to loss of human life. It has been also observed that almost all the casualties have taken place in accidents and have been due to inadequate knowledge of associated hazards, non usages of personal protective equipments and lack of supervision in medium/small unit. Workmen, including the contract personnel protective and hazards involved before commencement of the job. As Human Error has been a major cause for the disasters in Unrecognized organization. The major disasters reason are Non compliance of operation/maintenance procedure/Preventive and predictive maintenance of equipments, Non compliances of Work permit system, Safe operating procedures etc. ,Lack of supervision, Improper inspection of equipments, Lack of training. The following chemicals disasters took place in Maharashtra State and other state industrial area.

1. Major fire/explosion occured in Shree Rang Agrochemical industry in Tarapur .
2. Major fire /explosion/toxic gas releases took place in Avinash Srugs in Tarapur.
3. Major fire/explosion occured in Network Dye-chem in Tarapur.
4. Major fire/explosion occurred in drugs unit in Tarapur.
5. Major fire/explosion occurred in chemical industries in Vapi.
6. Major fire/explosion took place in Vishal Laboratories in Tarapur.
7. Major fire/explosion occurred in Sterling Auxiliaries in Tarapur.
8. Major fire/explosion occurred in Ramdev Chemicals in Tarapur.
9. Major fire took place in textile industry in Tarapur.
10. Explosion took place in small scale unit in Tarapur.
11. Major fire/explosion occurred in formulation unit in Palghar
12. Major fire/explosion occurred in formulation unit in Tarapur
13. Major fire occurred in textile unit in Tarapur
14. Fire took place in R&D lab in Tarapur.
15. Fire/explosion occurred in life line industries in Tarapur.
16. Fire occurred in Bajaj industries in Tarapur.
17. Fire occurred in Kalamboli godown.
18. Fire occurred in Kopran Mahad and Khapoli.

Disaster Control Plan for small/medium units /unauthorized sectors: Every Hazardous unit has to play Responsive Care role for protection of their personnel, surrounding community and Environment. Type of hazardous materials materials they deal with, Precautionary measures adopted for avoiding release, and control measure in place. On-site Disaster control management plan development is the responsibility of respective unit and approved by Directorate of

Industrial Safety and Health and District Authorities. Off-site control management plan covers multi units in pockets in districts and prepared by district authorities.

Inculcating Culture of Preparedness for Disaster Management in First Responders, Community & Schools - An Initiative by NDMA

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Disasters are not new to mankind but in recent times, their frequencies and intensities have increased manifold. Some of the reasons attributed to this, include population explosion, rapid and uncontrolled urbanization, unplanned land use, global warming, investigate and proactive media, rapid industrialization and menace of terrorism which has added new dimensions to manmade disasters.

Disaster Management Act, 2005 was a landmark legislation, institutionalizing DM framework in India. National Disaster Management Authority (NDMA) was constituted as single window apex body for coordination and management of disasters at the national level. Similar arrangements have been formulated at the State, District and local levels. NDMA has been tasked to lay down national policy and issue guidelines for various types of natural & manmade disasters and monitor & coordinate the implementation of the policies & plans. It is the latter role, under which NDMA has taken the initiative of conducting table top & mock exercises. The aim of this initiative is to inculcate a culture of preparedness in the first responders for the 'on site' & 'off site' emergencies in industrial units and in districts. Effective and determined role of community is being stressed. Mock Exercises have been conducted in various types of disasters, but almost 1/3 of them have been in chemical (industrial) disaster. This initiative has been taken to schools also, where mock exercises are being conducted to empower schools to manage effects of disasters before specialist response gets activated.

The mock exercises in industrial disasters are conducted in most accident hazardous units. They are conducted in four steps. In Step 1, sensitization of the participants takes place. The nuances of how the table top and mock exercises are conducted are delineated. In Step 2, during table top exercise, generally worst case scenarios are painted and responses of industrial units at operational, supervisory and management levels for 'on site' emergency and district authorities, like Collector/DC, Police, fire services, medial, municipal authorities, etc. are elicited through injects. In Step 3, the actual mock exercise takes place by mobilizing resources. For control & coordination of the disaster, incident command system is practised as a management tool. Step 4, involves, documentation and making of documentary films for learning purposes. The After Action Report made at NDMA is sent to the Chief Secretary of the State for follow up action. In schools, there are only two steps. The aim in school mock exercises is to empower them to face the disasters before specialist response gets activated. In Step 1, the school authorities are informed how to formulate DM Committee, DM Plan, school mitigation & response teams and trigger mechanism for response as per standard operating procedures. A documentary school mock exercise is also shown. In Step 2, which is after 10-15 days, the mock exercise is conducted to find gaps and the state of preparedness of the school.

A number of lessons, both positive and gaps related issues have been learnt from over 150 table top & mock exercises conducted so far. There has been a tremendous response from the states/districts/industries/schools. Positive lessons include overwhelming response, positive mind set, clarifying roles & responsibilities of stakeholders, introduction of ICS and concept of self reliance at various levels. Participation & special response of NDRF in exercises has been appreciated by the community, school children and district administration.

Some of the lessons learnt include need for sensitization of politicians, senior bureaucrats, MDs of industries & management and principals of schools. District Fire Services across India are deficient of upto 70% of their authorised strength, they are holding vintage equipment and very limited emergency response equipment. Police is not trained in DM tasks. Risk & vulnerability analysis of the district/industry/school against perceived disaster have not been carried out. First aid training is not adequate at the functional level. Medical response is inadequate. There is shortage of ambulances, stretchers and even antidote medicines for hazardous material produced/handled in the district. NGO are not skilled in specific DM tasks. The corporate sector has yet to gear up for corporate social responsibility during mitigation and preparedness phases. MAH units were not carrying out 'off site' mock exercises properly. Their efforts in this regard are at best eye wash. Early warning & alarm system need to be upgraded. DM plans are not properly made and community is not very interested in getting trained. Lastly, traditional practices are not given their due.

Initiative by NDMA has elicited overwhelming & positive response from all responders. Community has started feeling involved. India is among the very few countries conducting so many mock exercises on varied disasters at national level. In next few years, India may become disaster resilient, as a result of these crucial initiatives.

Chemical (Major Accident Hazard) Disaster Risk and their Management

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In this paper, Chemical Disaster Risk and Management in case of Major Accident Hazards is presented. Interrelationship of People, Equipment, Material and Environment (PEME) is an undesirable fact of life. To keep this relationship intact and holding, it is imperative to control and in some cases, eliminate the Hazards arising out of the manufacturing activities. However, there remains a finite possibility that certain hazard may occur beyond scales leading to a Disaster and give rise to human suffering and property damage. Hence it is imperative to formulate an effective Disaster Management System which would take cognizance of the Disaster in case of such eventuality so that losses are minimized.

Hence, the focus of the Major Accident hazard and risk management process is basically on the protection of the population and the environment from the consequences of major accidents occurring at industrial facilities handling toxic substances, processing or storing flammables and explosives. While few people are killed by disasters in Europe, the region suffers from disaster events on a scale comparable to that in Asia or Africa, the lower mortality figures reflecting a much lower human vulnerability to crisis. A clear example is the comparison of the human death tolls after the chemical accidents in Seveso (Italy) and in Bhopal (India)

Post Bhopal, considerable work has undoubtedly been carried out in India, for prevention of chemical accidents by Statutory Laws, Community awareness and emergency preparedness. More than half a dozen Central Acts and State Rules have been enacted and certain Acts Amended, Crisis groups have been formulated in the National, State, District and Local levels, Public Liability Insurance System has been formed in the country. But there are certain other key issues which are left still unattended.

As per the ILO code of Practice, the major hazard installations are most commonly associated with petrochemical works and refineries, chemical works and chemical production plants, LPG storage and terminals, stores and distribution centre for chemicals, large fertilizer stores, explosives factories and works in which chlorine is used in bulk quantities. These Major hazard installations have to be operated at a very high standard of safety. Successful Disaster Management involves addressing complex issues based on the hazard potential and vulnerability especially human population.

Hence, my paper is focused on key issues involving all the Stakeholders in Disaster Management (Chemical Disasters), which are still left unattended to. They are:

- Update the list of major hazard installations together with their respective threshold quantities and inventory levels in all the States and Union Territories
- Re-assess the Risk, based on the updated information and carry out the Hazard Analysis.

- Crisis Groups to be made as working groups by imparting adequate training, mock exercises and review conducted periodically.
- The Emergency response services are well equipped; staffs are trained to face any potential Disaster.
- Updated On-Site and Off-Site Emergency plans are in place. All the Districts in the country shall have a structured District Emergency Plan in force.
- Community near a hazardous installation to be aware of the warning it may receive in an emergency (e.g., a siren if there is a gas release) and the protective measures people should adopt (e.g., immediately go inside houses and close windows until advised to come out).
- Employers who play a key role in the organization and implementation of a major hazard control system also should be made accountable and responsible.
- Effective participation of the Workers, in respect of Disaster management and planning.
- Promote a “Safety Culture” that is known and accepted throughout the Major Hazard Installation.
- Practice of speedy and free flow of information to all stakeholders on chemical accidents regarding the lessons learnt

Disaster Management in Chemical Industries: A Case Study

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The consequences of floods especially on chemical industries are very severe, both in terms of financial losses and safety of employees & public. In view of the above, the disaster management due to flood incidents in hazardous chemical industries has become of significant importance. Apart from the disaster management plan for any industry, establishing liaison with government bodies like collector office, police authority, local hospitals etc. is of paramount importance both for pre-warning and post disaster management.

The paper highlights the consequences of floods and the precautions to be observed in case of flood emergency in a chemical industry with a case study of a flood incident at 'Heavy Water Plant (HWP), Hazira', Surat. HWP, Hazira faced the flood situation during August 2006, due to release of large quantity of water from the Ukai dam following heavy rains in the area & had to take a safe shutdown of the plant. The plant was under shutdown for nearly twenty days. Flood water level had risen to alarming level in a short span of time. There were no causalities in the plant and plant personnel had taken safe shutdown of the plants prior to rise in the water level. Certain pre flood actions taken by the plant management prevented any chemical mishap. The safety issues that surfaced from the incident were reviewed in detail at the Atomic Energy Regulatory Board (AERB). Appropriate measures to manage such flood incidents efficiently and effectively in future were recommended by AERB.

Handling a Disaster of Chlorine Release

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Chlorine is considered toxic beyond certain concentration. This chemical is heavily used in Power Plants for treatment of water for its bacteria killing capacity and cheap availability. However, an uncontrolled release of Chlorine can lead to disaster for surrounding inhabitants.

Toxic Chemicals : Chemicals having the following values of acute toxicity and which owing to their physical and chemical properties are capable of producing major accident hazards:

Sr. No.	Degree of Toxicity	Medium lethal dose by the oral route (oral toxicity) LD_{50} (mg/kg) body weight of test animals	Medium lethal dose by the dermal route (dermal toxicity) LD_{50} (mg/kg) body weight of test animals	Medium lethal concentration by inhalation route (four hours) LC_{50} (mg/l) inhalation on test animals
1.	Extremely toxic	>5	<40	<0.5
2.	Highly toxic	> 5 - 50	> 40 - 200	<0.5 - 2.0
3.	Toxic	>50 - 200	> 200 - 1000	> 2 - 10

Consequence analysis of Cl_2 release

The consequence results for chlorine (Cl_2) vapour cloud for various release scenarios under neutral stability class and wind speed of 4 m/s are shown in following Table . Chlorine is stored (in tonners) in three *indoor locations*: The Table shows the maximum downwind distances of chlorine cloud due to catastrophic rupture of a tonner (inventory = 900 kg). It is seen from the table that a Cl_2 vapour cloud with concentration level of 35 ppm can be felt within the maximum downwind distance of 248 m from release point when a catastrophic rupture of Cl_2 tonner occurs with the release of 900 kg.

Maximum affected downwind distances (in meter) for chlorine release from Tonner (Stability class: D and Wind speed = 4.0 m/s)

Maximum Inventory = 900 kg. Status: ***In-building storages***

Scenario	Maximum Downwind Distances (m) from location point within 30 minutes		
	LC_{50} = 35 ppm	IDLH =10 ppm	STEL = 3 ppm
Catastrophic Failure of Chlorine tonner	248	531	1079

Disruption of Power Generation due to Natural Disasters: Experience of 6 x 250 ME Nathpa Jhakri Hydro-Power Station

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Nathpa Jhakri Hydro Power Station (NJHPS) experienced exceptional flood in the river Satluj in August, 1997. The Paper describes devastation caused by the flood and measures taken to safeguard and mitigate the Project site which include Dam Site, Power House, etc. from the flooding consequences and preparedness in the aftermath of the flood. The Paper emphasizes how disaster management plan helped in taking timely action which resulted in no human loss, no damage to the major components of the Project. The unprecedented silt load which was not allowed to enter into the water conductor system and restoration of power generation in a shortest possible time.

Needs of Disaster Risk Management Program for Infrastructure Organizations

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Disaster management is the discipline of dealing with and mitigating the risks. In infrastructure project it involves preparing for disaster before it occurs as well as support, and re-arrange the condition after natural or human-made disasters have occurred. In general, any disaster management is the continuous process by which all individuals, groups, and communities manage hazards in an effort to avoid or reorganize the impact of disasters resulting from the hazards. Effective disaster management relies on thorough integration of emergency plans at all levels of government and institutions involvement. Activities at each level (individual, group, community) affect the other levels.

In infrastructure projects, disaster Management is focus on protecting civilians as well as persons involve in such condition. The nature of management depends on local economic and social conditions.

The Disaster Risk Management Program Project adopts an innovative approach, providing support primarily for disaster prevention and mitigation measures, including at the community level where vulnerability is often greatest, to reduce the impact of natural hazards on development process. The joint efforts of professional bodies and cultural heritage institutions have resulted in the development of a variety of different tools to assist in preparing disaster and recovery plans. The process of disaster management involves four phases: mitigation, preparedness, response, and recovery. In many cases, these are made available to external users. While each infrastructure will need to formulate plans and tools which meet their own specific needs.

Hazardous Waste, Electronic Waste, Biomedical/Radioactive Waste

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India's rapid industrialization has indiscriminately increased Hazardous Waste generation in India. Hazardous waste due to its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment. To manage Hazardous Waste (HW), not covered by the Water & Air Acts, MoEF notified the Hazardous Waste (Management & Handling) Rules in 1989 and further amended it in the year 2000 & 2003. Implementation of these rules is done through the SPCBs and Pollution Control Committees in respective States and UTs. Although in a broader sense, biomedical waste /electronic waste & radioactive waste also comes under the category of Hazardous Waste but separate legislation has been made for them for their effective management & disposal except for electronic waste. India being a Party to Basel Convention (signed in 1992) can prevent the import of hazardous waste or other waste if it believes that the waste in question will not be managed in an environmentally sound manner. In India, there are 36,165 no. of hazardous waste generating industries, generating 62,32,507 Metric Tonnes of hazardous wastes every year. Gujarat, Maharashtra and Andhra Pradesh are the top 3 HW generating States. Maharashtra and Gujarat putting together, are generating 62.87 % of country' total incinerable HW. Most of the hazardous wastes generated by small scale industries, is dumped directly into the environment. According to the National Productivity Council, there are more than 3 million small and medium scale industries, which generates HW. Severe pollution of land, surface and ground water may occur from such Hazardous Waste and its adverse impacts can lead to a Environmental Disasters. Moreover, the Treatment, Storage and Disposal Facility (TSDF) have been developed for the disposal of land disposable HW in 10 States only. Management of Electronic waste and other Household Hazardous Waste is still a new concept in India. Household Hazardous Waste consisting of tube lights, thermometers, vehicle batteries, used motor oil, electronic waste from TV, VCR, computers etc., is dumped openly with other garbage in most Indian cities as there is no specific methodology suggested / adopted for collection and disposal of household hazardous waste. Electronic waste too generated in a house, is sold to unauthorized dealers. Almost is the case for commercial sector. Toxic substances in electronic waste may include Lead, Mercury, and Cadmium and Carcinogenic PCBs. The nation wise data about quantity of electronic waste generated by Indian families in a year is lacking. The Trade in electronic waste is controlled by the Basel Convention. But still, large quantities of used electronics are typically sold to countries with very high repair capability, high raw material demand and without strong environmental laws.

Biomedical waste consisting of solids, liquids, sharps, and laboratory waste are potentially infectious and dangerous and must be properly managed to prevent an occupational hazard. For managment of bio-medical waste, Bio-Medical Waste (Management and Handling) Rules, 1998, came in 1998 which categorised Bio-medical waste in 10 categories. According to this Rule every hospital generating BMW needs to set up requisite BMW treatment facilities on site or ensure requisite treatment of waste at common treatment facility.

Radioactive waste is contains radioactive material which emits radioactive radiation. It is usually the product of a nuclear process however, industries also produce huge quantities of radioactive waste. Radioactive waste has been a contentious aspect of nuclear power programmes around the world. Radioactive waste, whether natural or artificial, is a potential threat to humans being & environment. Sufficiently high exposure can lead to cancer. In many industries, radiation exposure to the workers and general public can be as high as those from nuclear installations. The International Atomic Energy Agency (IAEA) is promoting acceptance of some basic tenets by all countries for radioactive waste management. Radiation protection have been among the major priorities in planning of India's nuclear energy programme. The Department of Atomic Energy with participation of the Indian industry has developed essential remote-handling gadgets required for operation and maintenance of waste management system.

Uranium Mining in Jadugoda - a Man-made Disaster

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Jadugoda is a nice locality in east Singbhum District of Jharkhand, India, covered with dense forest. The main inhabitants are tribal folk, including the Santhal, Oraon, Kol. Munda and several others. Since 1968 Uranium Corporation of India Limited (UCIL) started Uranium ore mining at Jadugoda. This study initiates with several reports published in different journals and periodicals since 1990 regarding different diseases frequently found among the people residing the mining area. Nutritional status of individuals suffering from different physical as well as congenital abnormalities is analyzed. Some international studies regarding radiation dose in the area are referred. Common people are raising voice against UCIL but they are not ready to leave their Disham (homeland) even after facing immense sufferings for uranium mining. Construction of different tailing ponds has uprooted a good number of tribal families, who are presently landless and jobless. People residing in the nearby villages are immensely sufferingfrom the cumulative effect of radiation. Increase of infertility rate specially among the mine-workers is alarming. At least one member of each family is suffering from at disease, which is directly or indirectly related to radiation. This study intends to shed light on these problems of the tribal inhabitants whose right to live is really at stake. This situatuon could easily be avoided if the suggestions given by different environmentalist were foil-wed. Reluctance of the UCIL authority has created a grave situation pointing out to the hazard of nuclear research. Peoples' right to live is at stake in Jadugoda and they are going to be the victims of a man-made disaster.

Chemical and Industrial Accident Hazards in India: An Evaluation of their Causes and Consequences and Mitigation Strategies

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There are cases of chemical and industrial accidents induced by a variety of technological and human factors. Damages due to chemical accidents are generally associated with explosion, fire, toxic release and nuclear accidents. Since the 1970s, the world has witnessed a number of serious industrial disasters. The world's worst industrial tragedy of Bhopal in 1984 and fire in a refinery in Visakhapatnam (1997) and several other incidents involving release of toxic and flammable gases in different parts of the country have raised considerable doubts about the safety and reliability of chemical process industry. Although there has been no tragedy on the scale of Bhopal in the last two decades, there have been innumerable gas leaks, explosions and accidents, e.g., Bhopal Ammonia leakage (transport accident, 1997), New Delhi fire at chemical store (1994), New Delhi explosion in warehouse (1992), Calcutta chlorine leakage from a pipeline (1991), Lucknow ammonia gas leakage in an ice factory (1990), etc.

Major industrialized countries have evolved effective mechanism for the management of chemical accidents. India has also made significant progress in evolving systems for tackling major chemical disasters after the Bhopal gas tragedy. In this paper, we discuss causes and consequences of various chemical and industrial accidents occurred in India during last two decades. We also enumerate various tools that have been adopted in India for the management of chemical accidents. The major tools available for the management of chemical accidents include the legal framework, the technoware, human elements, assessment of hazard and risk, planning for emergencies, response systems and safety management systems. We also evaluate the policy implications and mitigation strategies concerning major industrial and chemical accident hazards in Indian Context.

Role of Modeling in Risk Scenarios of Hazardous Atmospheric Chemical Effluents

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Abstract - Privatisation of power sector has an important role in liberalization of Indian economy. Power plants were setup at various locations particularly at coastal sites of Arabian sea coast and Bay of Bengal. Desem Dispersion Model (DDM) and Coastal Fumigation Model (CFM) are used to study short-term Ground Level Concentration (GLC) of SO; due to proposed or extension unit of power plant located at Dhuvaran. Kandla. Sikka. Hazira, Kutch and Mangalore sites of Arabian sea coast and Krishnapatnam and Madras at Bay of Bengal during winter and summer seasons. Hourly values of wind speed, wind direction, temperature, mixing height and cloud amount were monitored during winter and summer seasons and used as a input to the models. It is observed that max. 24-h GLC of SO: is 26.9 ug/m? and 28.2 u.g/mJ occurred at 3 Km and 2.3 Km southeast of the site due to existing units during winter and summer seasons at Mangalore. which is followed by lower values at other sites. However 24-h GLC of SO; is 22.8 ugW and 37.1 ug/m3 occurred at 4 Km southeast due proposed units during winter and summer seasons. GLC occurred during coastal fumigation is high. Short-term (<lhour). max. GLC predicted by CFM tor SO; is 716 ug/m3 occurred at 0.8 Km at Mangalore during winter at wind speed 3.8 Km/li under stability class B. which is followed by lower values of GLC at other sites. High values of predicted GLC of SOT may cause ill effect on health and hazards on socio-economic environment in periphery of site and at large extent.

Preventing Disasters Arising out of Tank Farms by Ensuring Their Safety

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The industrial growth in the last few decades has led to the large-scale production, use and storage of petroleum products and chemicals. The tank farms are utilized to store huge volumes of chemicals, which possess inherent hazards, such as fire, explosion and toxicity. There has been number of major fires and explosions in tank farms which led disasters, whose consequences on the neighbourhood and environment are well known. There are various codes, standards and statutory requirements for the tank farms to ensure their safety. In spite of the protective mechanisms and devices, accidents do occur with tank farms leading to disasters. The following are the two types of tank farms: Above ground and underground storage tanks. The above ground storage tanks are classified as atmospheric pressure tanks, low-pressure storage tanks at semi-refrigerated conditions and pressure storage tanks at ambient conditions. The under ground tanks are classified and grouped as atmospheric storage and pressure storage. The safety of these tanks is different from each other depending on the type of storage in addition to the hazard potential of stored chemicals. Hence, it is imperative on the part of the chemical industries to ensure safety of the tank farms to prevent and mitigate disasters arising out of them by adopting suitable strategies and procedures specific to each tank farm. Hence, This paper discusses on varies types of tank farms, hazards, safety measures and consequences of disasters, and strategies to prevent and mitigate disasters arising out of tank farms. Key Words: Disaster, Tank Farms and Safety

Needs of Disaster Risk Management Program for Infrastructure Organizations

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Disaster management is the discipline of dealing with and mitigating the risks. In infrastructure project, it involves preparing for disaster before it occurs as well as support, and re-arrange the condition after natural or human-made disasters have occurred. In general, any disaster management is the continuous process by which all individuals, groups, and communities manage hazards in an effort to avoid or reorganize the impact of disasters resulting from the hazards. Effective disaster management relies on thorough integration of emergency plans at all levels of government and institutions involvement. Activities at each level (individual, group, community) affect the other levels. In infrastructure projects, disaster Management is focus on protecting civilians as well as persons involve in such condition. The nature of management depends on local economic and social conditions. The Disaster Risk Management Program Project adopts an innovative approach, providing support primarily for disaster prevention and mitigation measures, including at the community level where vulnerability is often greatest, to reduce the impact of natural hazards on development process. The joint efforts of professional bodies and cultural heritage institutions have resulted in the development of a variety of different tools to assist in preparing disaster and recovery plans. The process of disaster management involves four phases: mitigation, preparedness, response, and recovery. In many cases, these are made available to external users. While each infrastructure will need to formulate plans and tools which meet their own specific needs.

Eco-introspection of Hazardous Waste Management in India - Disaster Manager's Perspective

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Hazardous Waste Management (HWM) is imperative in the sustainable industrial world. The adverse impacts caused due to the indiscriminate handling and disposal of Hazardous Wastes (HWs) are considered as one of the challenging Environmental Disasters. Wastes from mining and power sector sector containing hazardous constituents are also a serious and major threat to life, properties and environment. The proper treatment & disposal facilities and secured landfill facility to dispose of Hazardous Waste is lacking in India. A common waste treatment and disposal facility such as Treatment, Storage and Disposal Facility (TSDF) for management of HWs generated from industries is one of the useful suggested options.

Guidelines issued by Ministry of Environment and Forests under Hazardous Wastes (Management & Handling) Rules, 1989 defined as per Environment (Protection) Act, 1986 are available. The current status in India pertaining to generation of HW and the TSDF sites is addressed in the paper. Identification & quantification of HW and development & monitoring of TSDF are the important steps of HWM. This paper also looks into the basic steps involved in the Comprehensive HWM – risk assessment, inventorization, treatment, emergency planning, secure site geo-sensitivity and landfill design, recovery, role of GIS, etc. Management of Hazardous wastes during disasters, rescue/relief and post-disaster situations in context of natural disasters and industrial mishaps/ terrorist attacks, etc are also discussed.

Strategic Learning from Past Chemical (Industrial) Disasters

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India has an advanced commercial chemical industry, and produces the bulk of its own chemicals for domestic consumption. Industrial chemical disasters have resulted in casualties and also damages to nature and property. It may cause severe air poisoning or gradual high contamination of toxins in surface, water streams or underground aquifers resulting in instantaneous fatalities or slow casualties/deaths. On the other hand, Chemical Terrorism relates to acts of violence to achieve the professed aims using chemical agents. These chemical agents include poisonous gases, liquids or solids that have deleterious effects on people, animals, plants and environment. Facilities handling large amount of toxic industrial chemicals/materials like major accident hazard (MAH) units, storages and transportation of hazardous chemicals/materials (hazchem/hazmat) through ports, railroads and highways in large, unprotected quantities, are prone to sabotage by the terrorists leading to toxic spillages/ releases or during accidental emergencies. The examples of such accidental emergencies include Bhopal Gas Tragedy, Minimata Outbreak and Bichhari Leachates exhibit a variety of chemical (industrial) disasters. These events leave imprints of high state of demoralization and loss of confidence in the industry. The economic impact on employees and downstream associates is maximum leaving them devoid of means of livelihood.

The lessons drawn from the post-analysis of the chemical disasters provides wealth of information about the effective preventive and management aspects to improve the systems and other prevailing frameworks to the global standards. Bhopal Tragedy is a turning point to convert the legislative system of India and also in the other parts of world. It also saw a global death of UCC including loss of faith in numerous multi-nationals which were strategically using the developing and under-developed countries as a dumping ground for their obsolete technologies, outdated hardware without proper safeguards.

The major lessons learnt include a) restricting hazardous storages to lowest minimum; b) inventories corresponding to containment system' c) effective instrumentation; d) strengthening of inherent safety design and frequent auditing of documents and features created after HAZOP studies; e) transparent interactions with employees and community around including community awareness about the toxic chemicals; f) training and re-training of employees, off-site responders and community ; g) toning up of medical facilities; h) setting up of trauma centers and poison information centers (on scheme of things partly implemented and under progress) and; i) comprehensive overhaul of the legislative framework to encompass to every issue related to safety.

The main aim is to achieve continuous industrial growth in a sustainable manner without compromising safety and security aspects under any circumstances. Preparing the nation to address the threat of chemical disasters is a formidable challenge because of the devastating consequences of the harmful effects of chemical agents. Every country need to develop surveillance systems integrated with their intelligent agency as well with international agencies. Highest levels of preparedness including scientific expertise at local, state and national level need to be developed for management of chemical disasters. The infrastructure must be prepared to prevent, mitigate and manage the illness/injury caused by these chemical agents. FICCI is striving to educate, train, make industry and community aware of the menace of these disasters and how we can minimize their effects or eliminate them.