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Towards a disaster free India

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RESOURCE BOOK ON
CHEMICAL (INDUSTRIAL) DISASTER MANAGEMENT

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CHEMICAL (INDUSTRIAL) DISASTER MANAGEMENT

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Disaster Management Concepts and National Disaster Management Framework of India

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Introduction

India is one of the most disaster prone countries of the world. It has had some of the world's most severe droughts, famines, cyclones, earthquakes, chemical disasters, mid-air head-on air collisions, rail accidents, and road accidents. India is also one of the most terrorist prone countries. India was, until recently, reactive and only responded to disasters and provided relief from calamity. It was a relief driven disaster management system. India also has world's oldest famine relief codes. In recent times, there has been a paradigm shift and India has become or is becoming more proactive with emphasis on disaster prevention, mitigation and preparedness.

This chapter cover the basic concepts and terminologies used in Disaster Management, hazards, vulnerability, history of disasters in India, development of disaster policy, organization of disaster management, challenges and opportunities.

Disaster Terminology

Hazard

Potentially damaging physical event, phenomenon or human activity that may cause loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards are classified on the based on the orgin i.e. Natural (geological, hydro-meteorological and biological),human induces process (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity, frequency and probability

Disaster

A catastrophe, mishap, calamity in any area, arising from natural or man made causes, which results in substantial loss of life or human suffering, damage destruction of, property, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area. Imapacts of Disasters are

- Loss of lives
- Loss to Property and infrastructure
- Damage to livelihood
- Economic Losses
- Environmental Damage- Flora & Fauna
- Sociological & Psychological after effects
- Civil Strife

RISK

Probability of harmful consequences or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interaction between natural or human-induced hazards and vulnerable conditions

$$\text{Risk} \sim \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Capacity}}$$

Vulnerability

The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. Vulnerability can be due to the following factors

- Geographic and Environmental
- Physical
- Social
- Economic
- Systemic

Disaster Management

Disaster Management is a continuous and integrated process of planning, organising coordinating, and implementing measures which are necessary for Prevention of danger or threat of any disaster Mitigation or reduction of risk, Capacity Building, Preparedness

Prompt Response, Severity or Magnitude assessment, Evacuation, Rescue, Relief, Rehabilitation & Reconstruction

Disaster management Cycle



Prevention

Prevention means activities to avoid the adverse impact of hazards and means to check from turning into disasters. Examples: avoiding construction in seismically active areas, landslide prone areas and flood planes

Mitigation

Mitigation means various structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.

Preparedness

Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations

Response

Specific actions taken immediately after a disaster to provide support to those affected These activities are immediately initiated by the community itself and then by the district, state, national or up to international levels. These are actions and functions undertaken to face the disaster when it occurs. These include warning to vulnerable population, evacuation to avoid further damages, search and rescue, restoration of key infrastructure etc. A quick and effective response requires adequate planning and preparedness.

Relief

An act of helping or alleviating the conditions of persons who are suffering from the effects of disaster/calamity .A relief plan provides provisions of assistance or intervention during / immediately after a disaster to meet the basic needs of affected people.

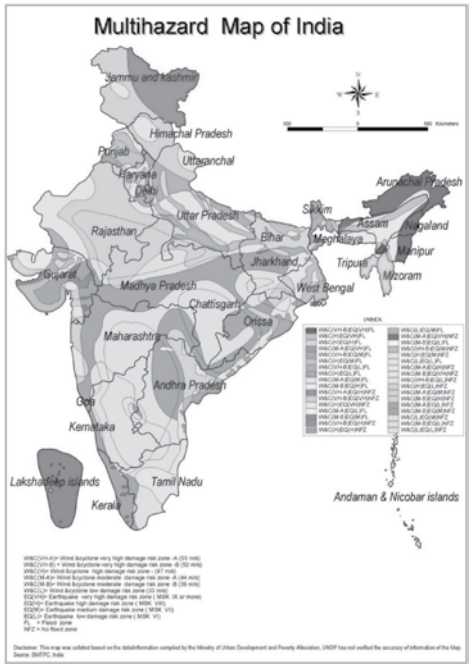
Reconstruction

These include long term measures e.g. houses, livelihoods, infrastructures etc.capital intensive and needs careful planning and community participation also provides good opportunity to plan developmental activities which are more robust and disaster resilient.

Vulnerability of India

Vulnerability is the susceptibility of being harmed. Scholars have debated on the concepts of hazards and vulnerability. Two of the explanations for these concepts can be found in McEntire (2004 and 2005). A disaster occurs when hazard interacts with vulnerability. For example, if an earthquake (hazard) occurs, a structurally safe building will withstand the shock (resistant), but a hutment (vulnerable) may collapse; creating a disaster for the hutment dwellers. Vulnerability could be due to the human related factors or natural features. The human related factors that increase vulnerability of India could be intended or unintended, and include apathy, poverty, corruption, illiteracy, land use pattern, technological misuse, and terrorism. Poor land use planning and inconsistent emergency management systems leads to vulnerability to floods, drought, cyclones, earthquake, heat and cold waves, and landslides.

As mentioned, India has a highly diversified range of natural features. Its unique geo-climatic conditions make the country among the most vulnerable to natural disasters in the world. Disasters occur with very high frequency in India and while the society at large has adapted itself to these regular occurrences, the economic and social costs continue to mount year after year. It is highly vulnerable to floods, drought, cyclones, earthquakes, landslides etc. Almost all parts of India experience one or more of these events.



Many regions in India are highly vulnerable to natural and other disasters on account of geological conditions. About 59 % of the total area of the country is vulnerable to seismic damage of buildings in varying degrees. The most vulnerable areas, according to the present seismic zone map of India, are located in the Himalayan and sub-Himalayan regions. Kutch and the Andaman and Nicobar Islands, which are particularly earthquake hazard prone. Over 8% Indian area of 40 million hectares is prone to floods, and the average area affected by floods annually is about 8 million hectares. Of the nearly 7,500 kilometers long coastline, approximately 5,700 kilometers is prone to cyclones, and 68% area is susceptible to drought. Disasters are no longer limited to natural catastrophes. Man-made emergencies also cause disasters in terms of fatalities and economic losses.

Disasters have been categorized into 33 types by the High Power Committee (HPC) set-up by the Government of India, in the August, 1999 and submitted Report in October, 2001, later added tsunami after 2004 experience.

Vulnerability Atlas of India 1997 shows that there are 169 Districts prone to Multi hazards considering only Floods, Earthquake and Cyclone. As per the revised atlas 2006 there are 241 district covering 20 states are prone to multiple hazards.

Earthquake Vulnerability

59% of India are prone to Earthquake

Zone	Area	Parts of the State
V	11%	N.E States, J&K, H.P, Gujurat, Bihar, Uttaranchal, part of Gujurat, A&N
IV	18%	J&K, HP, Uttaranchal, Bihar, Delhi, W. Bengal, Gujurat, Punjab, Sikkim, Gujurat, maharashtra, Lakshdweep
III	30%	Punjab, Haryana, Uttaranchal, Bihar, W. Bengal, Gujurat, Rajasthan, M.P, Odisha, A.P, Geo, Kerala, Tamil Nadu, maharashtra

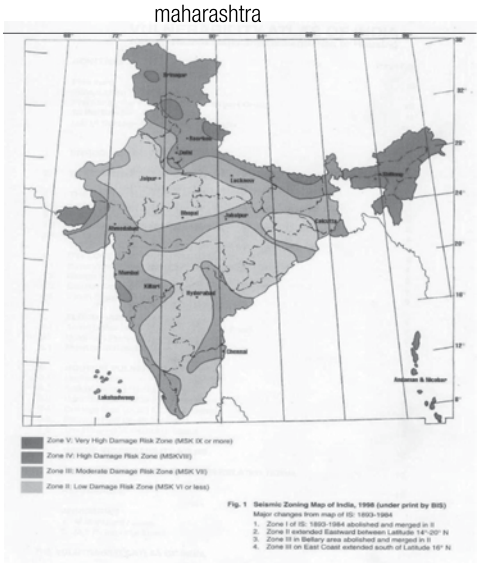
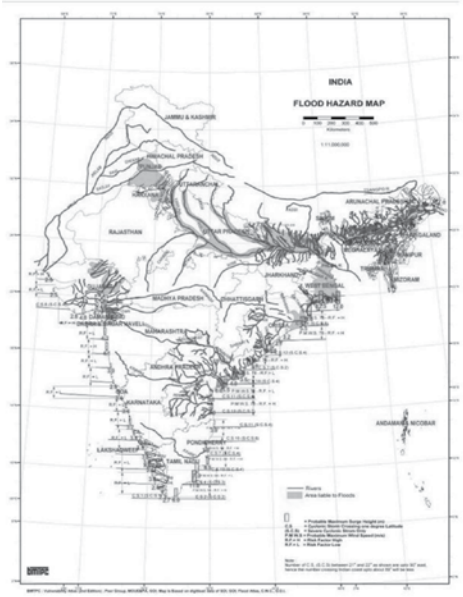


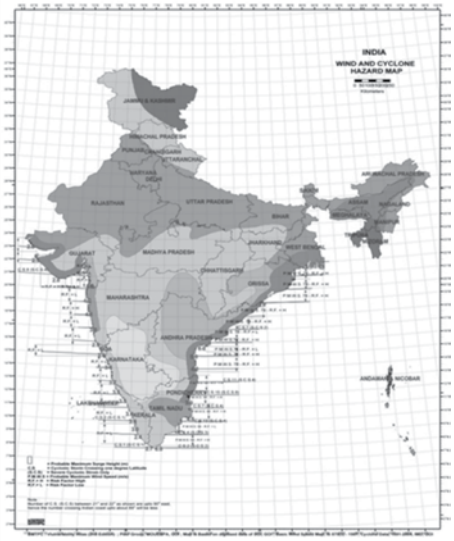
Fig. 1 Seismic Zoning Map of India, 1998 (under print by BIS)
Major changes from map of IS: 1893-1984
1. Zone I of IS: 1893-1984 abolished and merged in II
2. Zone II extended Eastward between Latitude 14°-20° N
3. Zone III in Bellary area abolished and merged in II
4. Zone III on East Coast extended south of Latitude 16° N

Flood Vulnerability

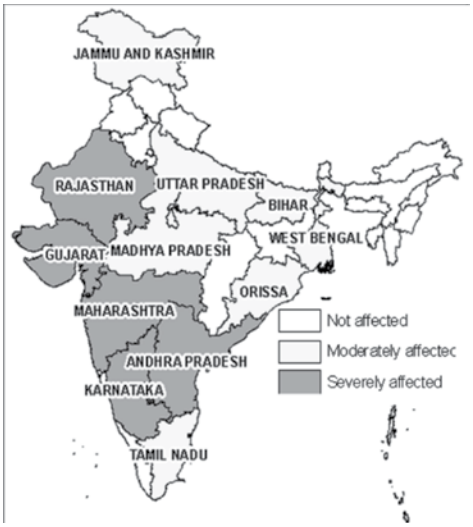


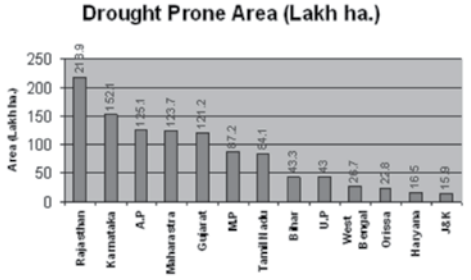
- *40 million hectres are prone to flood*
- *8 milion hectres affected by flood every year*
- *Brahmaputra and Gangetic Basin are most flood prone areas*
- *North-west region of west flowing rivers-Krishna, Cavery river and Mahanadi -are other flood prone areas*

Cyclone – Wind Hazard Map



- *Long coastline of 8000 kms*
- *Pre-monsoon (May – June) and post-monsoon (May-June) cyclones*
- *Costal districts of Orissa, Andra Pradesh and gujurat most prone to cyclone*
- *Most casualties caused by costal inundation due to tidal waves, storm surges and torrential rains*





- **68% of the net area sown in the country is prone to drought**
- **Out of this 33% is chronically drought prone, receiving rainfall less than 750mm per annum**
- **35% drought prone that receive rainfall between 750-1125mm per annum**
- **2002 and 2009 were major drought years**

Landslide Hazard Map



- *About 25% of the total geographical area of india is prone to landslides.*
- *Entire Himalayas, North eastern region, Western Ghats are perennially affected by landslides*

Organization of Disaster Management

India has a federal system with Government of India at the federal level. For the administrative purpose, India has been divided into 35 jurisdictions known as states and union territories. The union territories consist of six jurisdictions that are centrally or federally administered. These are Andaman and Nicobar Islands, Lakshadweep, Chandigarh, Puducherry, Dadra and Nagar Haveli, and Daman and Diu. The remaining twenty nine states have their own duly elected state governments.

Disaster management is the responsibility of local administration, under the supervision of the State Government, facilitated by the Government of India. The 35 states and union territories are divided into 615 districts. Each district is administrated by a Collector and District Magistrate (same person performs both the duties). Although there is a separate judicial system in India, certain judicial powers are given to the administrators, like Collectors. Collector of the district is the administrative head for all matters within the district. The Collector is an Indian Administrative Service cadre official. Under the Disaster Management Act, 2005 each district is supposed to have a disaster management plan, district disaster management committee, district EOC, training and drills, and do disaster prevention, preparedness, and mitigation activities.

The Building Materials Promotion and Technology Council have prepared a Vulnerability Atlas of India giving details of different types of vulnerabilities of each state and district. On the basis of the Vulnerability Atlas, Ministry of Home Affairs of the Government of India, and UNDP, identified 169 multi-hazard prone districts in the country in different states. UNDP and Government of India launched a comprehensive disaster management program focusing on all multi-hazard prone districts in select States, which are extremely vulnerable to natural hazards such as Gujarat, Orissa, Bihar, Tamil Nadu, West Bengal, Maharashtra, Delhi, Uttar Pradesh, Uttaranchal, Assam, Meghalaya and Sikkim for disaster risk management. In this program, a multi-pronged strategy is adopted for ensuring administrative, institutional, financial, and legal mechanisms for disaster risk management. The first phase of the program was during 2002 to 2007. Lot of good work has been done under this program and now it is in its second phase (Disaster Risk Management Programme) with a wider focus.

Even before the enactment of the Disaster Management Act, 2005 the National Disaster Management Authority was set up in July 2005 by an executive order with the Prime Minister of India as the Chairperson of NDMA. former Chief of Army staff is the Vice Chairperson and ex-officio CEO of the NDMA, with the status of a Cabinet Minister. There are seven other Members of the NDMA

with the rank of the State Minister (in India, there are three levels of ministers in descending rank as Minister, State Minister, and Deputy Minister). The NDMA is responsible and has the authority for laying down the policies, plans, and guidelines to be followed by Ministries and Departments of the Central Government for disaster management. The NDMA is to coordinate the enforcement and implementation of the policies and plans for disaster management and arrange for, and oversee the provision of funds for mitigation measures, preparedness and response. The NDMA is to frame guidelines for the minimum standards of relief to be provided to persons affected by disaster, and give directions regarding relief in loan repayment or grant fresh loans on such confessional terms as may be deemed appropriate. The NDMA can take such measures for prevention of disaster, of mitigation of its effects, or for preparedness and capacity building for dealing with a threatening disaster situation or disaster.

The Government of India decided to make the Ministry of Home Affairs as the nodal ministry. The government issued an order on October 16, 2003 upgrading the NCDM and establishing the National Institute of Disaster Management (NIDM). NIDM is a premier national organization working for human resource development at national level in the area of disaster mitigation and management. The NIDM is gearing up the national, state and district level administration to tackle disasters and also in coordinating research projects, training programs and building a database on disasters with case studies. NIDM's vision is to be the leading center of excellence in the field of disaster risk mitigation and management in India and the region.Each state has a Disaster Management Cell, located generally in the State Administrative Training Institutes. Major funding for the faculties of the Disaster Management Cell comes from the Central Government (Central Sector Scheme). Each cell is supposed to carry training in disaster management and prepare plans and documents.

A multi-disciplinary, multi-skilled, high-tech National Disaster Response Force (NDRF) of eight battalions has been set up for dealing with all types of disasters capable of insertion by air, sea and land. This is a military related response force. All the battalions are to be equipped and trained for all natural disasters including four battalions in combating nuclear, biological and chemical disasters. Each battalion will provide 18 self-contained specialist search and rescue teams of 45 personnel each including engineers, technicians, electricians, dog squads and medical/ paramedics. The total strength of each battalion will be approximately 1,158. These NDRF battalions are located at nine different locations in the country based on the vulnerability profile to cut down the response time for their deployment. During the preparedness period/in a threatening disaster situation, proactive deployment of these forces will be carried out by the NDMA in consultation with state authorities.

Legal and Policy Framework

Indian disaster policy is geared to make a paradigm change from response and calamity relief to disaster prevention, preparation and mitigation. Another significant change is to move from disaster management largely from government to public private partnership, and community disaster management. In this regard, significant changes have been made, but the authoritarian attitude of the government officials is the main stumbling block.

The Great Famine of 1876-1878 lead to constitution of the Famine Commission of 1880 and eventual adoption of Famine Relief Code. India probably has the world's oldest disaster relief code which started in1880. This relief code provides details of the relief to be given by the government to the affected people.

The India Disaster Report (Parsuraman and Unikrishnan 2000) provides the nature of disaster response by the government of India. It identifies key issues with respect to the availability of

and access to disaster-related information and its quality, the absence of coherent disaster preparedness and response policy, and urgent actions and interventions needed. It shows that significant advances in health and social and economic development have been repeatedly interrupted and reversed by disasters.

The recurrent occurrences of different types of disasters compelled Government of India to establish many different committee and commissions to suggest dealing with the problem. The most recent and the important was the establishment of High Power Committee on Disaster Management (HPC) in 1999 for making recommendations on the preparation of Disaster Management plans and suggestions for effective mitigation mechanisms. The High Power Committee gave its recommendations in October 2001 including a draft of the disaster management act, a National Response Plan, move from disaster response to disaster preparedness, and establishment of National Disaster Management Authority. Following one of the HPC recommendations, the disaster management function was transferred from Ministry of Agriculture to Ministry of Home Affairs.

India has been following five year national plans (Planning Commission). The earlier five year plans did not mention disaster management. The Tenth Five-Year Plan 2002-2007 for the first time had a detailed chapter entitled Disaster Management: The Development Perspective. The plan emphasized the fact that development cannot be sustainable without mitigation being built into the development process. Disaster mitigation and prevention were adopted as essential component of the development strategy.

The Eleventh Five Year Plan 2007-2012 (Planning Commission 2008) states,

"The development process needs to be sensitive towards disaster prevention, preparedness and mitigation. Disaster management has therefore emerged as a high priority for the country. Going beyond the historical focus on relief and rehabilitation after the event, there is a need to look ahead and plan for disaster preparedness and mitigation in order to ensure that periodic shocks to our development efforts are minimized."

Disaster management has emerged as a high priority for the country. The Eleventh Five Year Plan aims at consolidating the process by giving impetus to projects and programs that develop and nurture the culture of safety and the integration of disaster prevention and mitigation into the development process. The guidance and direction to achieve this paradigm shift will need to flow from National Disaster Management Authority (NDMA), and in the true spirit of the Disaster Management Act, 2005 to all stakeholders including State Governments and Union Territories, right up to the Panchyat Raj (local administration by five locally elected citizens) Institutions. Communities at large will need to be mobilized to achieve this common objective as they are the first responders (and not the usually thought fire, ambulance, and police). Even the best of isolated efforts will not bear fruit unless they are part of an overall, well-considered approach, and responsibilities of all stakeholders are clearly spelt out and accountability and sustainability factored in.

NDMA has prepared a disaster management policy framework in October 2009. The themes underpinning this policy are:

(i) Community-based disaster management, including integration of the policy, plans and execution at the grass root level. (ii) Capacity development in all related areas (iii) Consolidation of past initiatives and best practices. (iii) Cooperation with agencies at national, regional and international levels (iv) Compliance and coordination to generate a multi-sectoral synergy.

- The objectives guiding the policy formulation have evolved to include:
- Promoting a culture of prevention and preparedness – by centre-staging disaster management (DM) as an overriding priority at all levels and at all times.

- Encouraging mitigation measures based on state-of-the-art technology and environmental sustainability.
- Mainstreaming DM concerns into the development planning process.
- Putting in place a streamlined institutional techno-legal framework in order to create and preserve the integrity of an enabling regulatory environment and a compliance regime.
- Developing contemporary forecasting and early warning systems backed by responsive and fail-safe communications and Information Technology (IT) support.
- Promoting a productive partnership with the Media, NGOs and the Corporate Sector in the areas of awareness generation and capacity development.
- Ensuring efficient response and relief with a caring humane approach towards the vulnerable sections of the society.
- Making reconstruction an opportunity to build back better and construct disaster-resilient structures and habitats .

Thirteenth Finance Commission has observed that effective disaster response requires trained manpower to deal with complex situations where effective and speedy handling

reduces the impact of a disaster on human life and property. Therefore it is necessary to continuously undertake measures to build capacity amongst those responsible for disaster response and augmenting public awareness. Accordingly, FC-XIII has recommended a grant of Rs. 525 crore for building capacity within the administrative machinery for better handling of disaster response and for preparation of district and state level disaster management plans as envisaged under the Disaster Management Act of 2005 (DM Act). Besides FC-XIII has provided financial allocation for State Disaster Response fund.

Conclusion

There is paradigm shift in India from reactive approach of responding and calamity relief after the disaster to proactive approach of disaster prevention, preparedness, and mitigation. The enactment of Disaster Management Act, 2005, establishment of National Disaster Management Authority with the Prime Minister as its Chairperson, and disaster management training by the National Institute of Disaster Management along with the Disaster Management Cells of the state Administrative Training Institutes will help in India becoming disaster resilient. India has also shown the path to the world for starting disaster management education from middle and high school. This generation of middle and high school students will make probably near revolution in community based disaster management, which is the only proven method of disaster management; and it is hoped that India would be world leader in disaster management. Although disaster led displacement seems to be a post-disaster issue of concern, but its effective management has to be taken into consideration within the overall disaster management planning framework in the pre-disaster and preparedness phase itself. The objective has to minimize the impact of development or a disaster in form of displacement – temporary or permanent, and to adapt measures for early rehabilitation and recovery in case when displacement is imperative. The concept of 'risk sensitive land-use planning' for urban and rural areas is being promoted in India as well to facilitate preventive approach for managing the challenges of disaster-led displacements by reducing vulnerability and exposure.

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Industrial and Chemical Disasters

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Industrial disaster

Industrial disasters are disasters caused by chemical, mechanical, civil, electrical or other process failures due to accident, negligence or incompetence, in an industrial plant which may spill over to the areas outside the plant or with in causing damage to life , property and environment."

Chemical Disaster

Chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity (handling) , storage or transportation or due to natural events leading to serious effects inside or outside the installation likely to cause loss of life and property including adverse effects on the environment.

A "chemical accident or emergency" refers to an event which results in the release of a substance or substances hazardous to human health and/or the environment in the short or long term. These events can cause illness, injury, disability or death to human beings, often in large numbers, and can result in extensive damage to the environment with considerable human and economic costs (OECD/ UNEP).

Chemical and industrial emergencies may arise in a number of ways :

- disaster/explosion in a plant handling or producing toxic substances
- accidents in storage facilities handling large and various quantities of chemicals
- accidents during the transportation of chemicals from one site to another
- misuse of chemicals, resulting in contamination of food stocks or the environment, overdosing of agrochemicals
- improper waste management such as uncontrolled dumping of toxic
- chemicals, failure in waste management systems or accidents in wastewater treatment plants
- technological system failures
- failures of plant safety design or plant components
- natural hazards such as fire, earthquakes, landslides
- arson and sabotage
- human error

Characteristics

Chemical accidents may be classified by the chemicals involved, the sources of the release, the extent of the contaminated area, the number of people exposed, the routes of exposure an the health and medical consequences. Chemical releases may result from human or natural activities. Human sources include manufacture, storage, handling, transport (rail, water and pipeline) use and disposal. Natural origins include volcanic and other geological activity, toxins of animal, plant and microbial origin, natural fires and minerals. The four main routes of exposure are inhalation, eye exposure, skin contact and ingestion. Health effects are described in terms of the system or organ affected and may include cancer, immune system dis-functions, nerve or skin or liver disorders, or deformations.

Chemicals may be grouped as :

- Dangerous substances such as explosives, flammable liquids or solids, oxidizing agents, toxic substances and corrosives
- Additives, contaminants or adulterants, for example in drinking water, food and beverages, medicines and consumer goods
- Radioactive products.

Special characteristics of chemical accidents may include the following:

- Knowledge of the effects of some chemicals is not complete or widespread.
- Not all victims will have the same effects from exposure.
- There may be a toxic zone, that may inc1ude treatment facilities, which can only be entered by specially clothed personnel.
- Exposed persons may contaminate unexposed persons.

Predictability

Emergencies involving hazardous substances are becoming more common with increasing uses, sources, means of transporting and disposing of chemicals. Past histories of chemical and industrial accidents are not necessarily good predictors of future incidents mainly because many incidents are not reported and near-accidents/misses are usually not reported at all. Industrial development and expansion occurring in geographic areas prone to other disasters adds to the probability of greater human and economic losses caused by natural disasters.

The OECD Hazard Assessment Programme, in conjunction with other agencies worldwide, is developing hazard/risk assessment as a basis for regulation of the use of chemicals and pesticides. The process is based on a tiered assessment, which allows the effects to be progressively defined starting from the initial exposure. The basic elements of the assessment include:

- identification of the substance, its physical and chemical properties, and toxicity to animals and plants
- evaluation of the likely distribution of the agent and whether it will be toxic
- effects of possible exposure on organisms through selection of testing methods.

The hazard/risk assessment procedures will allow greater predictability of the effects of chemical hazards. Other methods being developed include use of environmental monitoring data, and modeling for Predicted Environmental Concentrations.

Although accidents may be anticipated in any industry, their causes and consequences are not always understood or predictable. Plans, therefore, must be made for any possible emergency to protect lives and property. The extent of loss (human casualties) by chemical releases from plants, trucks, ships or rail accidents depends largely on the first responders to the emergency.

Factors contributing to vulnerability

The elements most at risk to an it industrial disaster include the plant or vehicle and its employees or crew, passengers or residents of nearby settlements; adjacent buildings and the occupants; livestock and crops in the vicinity of the plant (up to hundreds of kilometers in the case of large scale releases of airborne pollutants and radioactive materials); regional water supply and hydrology; and flora and fauna.

Vulnerability is further increased by plants and operations which are poorly maintained or use antiquated equipment. Of great concern are transport vehicles and railway lines which may encounter hazardous conditions while in motion. Residents are more vulnerable if they do not know of the possible dangers and have no escape plan.

Typical adverse effects

Explosions may cause destruction of buildings and infrastructure. Trans¬portation accidents damage vehicles and other objects on impact, with possible loss of hazardous materials into the environment. Industrial fires may reach very high temperatures and affect large areas.

Many people may be killed and numerous injured may require emergency medical treatment. Hazardous substances released into the water or the air may travel long distances and case contamination of air, water supply, land, crops and livestock, making affected areas uninhabitable for humans. Wildlife may be destroyed and ecological systems disrupted. Large scale disasters may even threaten the stability of global ecology.

Possible risk reduction measures

The United Nations Environment Programme (UNEP) has developed a handbook describing the APELL (Awareness and Preparedness for Emergencies at the Local Level) method of planning for chemical accidents. It is not meant to replace national disaster plans but rather to augment them. The goal is to assist decision makers and technical personnel to improve community awareness of hazardous installations and aid them in preparing response plans should a disaster happen. A brief description follows.

Identification of APELL partners

National level- The initial response to an incident is normally provided locally and affects the overall outcome and magnitude of the incident. Responsibilities of national government include:

- Providing guidelines to encourage industries to initiate emergency response plans at the local level.
- Disseminating information on the APELL process and sponsoring workshops and training courses.
- Providing adequate resources for local communities to respond effectively if an emergency occurs.
- Follow up and assistance with the APELL process. Industrial facilities owners and managers - The APELL process relies on the full commitment of both state and privately owned industries to ensure that plant managers devise, and test accident prevention and emergency preparedness plans inside the land boundaries. Responsibilities include:
- Developing outreach programs to inform the community regarding emergency response to lessen fears.
- Establishing good working relationships with local emergency response agencies.
- Establishing close links with local leader and officials and informing them about plant safety measures.
- Being the catalyst in formation of the coordinating group.

Local Authorities - Local governments' playa critical role in first response to a crisis, mediating the roles of different interest groups and gathering necessary planning data. Responsibilities include:

- Raising public awareness and mobilizing public support for the APELL process.
- Coordinating emergency and other group participation.
- Training personnel in emergency response. Community leaders - The leaders represent the concerns or view of their constituents in the community. Responsibilities include:
- Communicating with local authorities and industry leaders regarding issues of concern in the community.
- Communicating with their constituency on programs to protect public health and the environment.
- Providing leadership through community-based organizations to train the public.

Community preparedness

Although attention to accident control is increasing within industry, preparedness in the community is often much lower. The local community has a right to be informed and to participate in the response planning.

Furthermore, fears may be eased when people understand the workings of a plant and the safety measures being used. In general, a better scientific understanding of the hazard is desirable for all local emergency responders, such as police, fire and medical services as well as the media.

Based on data collected in regard to potential hazards and the resources available in the community to combat any disaster, the planning should proceed as follows:

1. Identify the emergency response participants (such as the fire department, military, Red Cross) and establish their roles, resources and concerns.
2. Evaluate the risks and hazards that may result in emergency situations in the community.

3. Have participants review and comment on their own emergency plans.
4. Identify the required response tasks not covered by existing plans.
5. Match these tasks to the resources available from identified participants.
6. Make the changes necessary to improve existing plans, integrate them into an overall community plan and reach overall agreement.
7. Commit the integrated community plan to writing and obtain approval from local governments.
8. Educate participating groups about the integrated plan and ensure that all emergency responders are trained.
9. Establish procedures for periodic testing, review and updating.
10. Educate the general community about the integrated plan.

Land use planning

Although hazardous facilities will seldom be wanted by _e local population, desires for economic growth by business and governments often take precedence. This has resulted in long term problems such as the need to clean up toxic waste sites in many countries. Land use zoning should separate densely populated residential areas from hazardous industrial activities and associated transportation routes, possibly through creation of buffer zones. Due to the increasing potential for dangerous incidents, better planning is required for hazardous installation, particularly for large sites and for substances which may travel over long distances. This requires a sense of responsibility on the part of governments and developers and sensitivity to the dangers for local residents.

Transportation accidents

A study of technological disasters of the past 40 years reveals a preponderance of transportation accidents, which pose daily threats to communities and usually occur without warning. Although most spills and releases are relatively small, some events, especially maritime spills, may be extremely large. In some cases ocean going tanker spills have been known to affect large areas sometimes crossing international borders.

Another special problem presented by transportation accidents is the mobility of the hazard. Unlike landslides, volcanoes, and even flooding which may be locally targeted for mitigation and preparedness measures, transportation accidents often happen in areas unprepared and ill-equipped to deal with the hazard. Local populations may be wholly unaware of the substances passing near or through their communities on route to distant factories and plants. Due to the extreme unpredictably of their occurrence and location, these accidents require a special approach for mitigation and preparedness.

In the United States, CHEMTREC (Chemical Transportation Emergency Center) established by the Chemical Manufacturers Association (CMA) provides around the clock guidance for hazardous materials accidents. The National Response Center, operated by the U.S. Coast Guard, works with CHEMTREC to assist emergency responders, carriers, shippers and all others handling hazardous materials. Some features of the program are:

- Communication and coordination with emergency response specialists and information regarding 10,000 hazardous materials shippers and 500 carriers
- Database containing over a million material safety data sheets provided by manufacturers
- Access to information from the major railroads on contents of rail cars.
- Access to special materials for isolating spilled products
- Participation by response teams in drills in communities throughout the country and providing training to prevent human loss and environmental damage.

Specific preparedness measures

Hazard mapping

Inventories and maps of storage locations of toxic or hazardous substances with descriptions of their

physical appearance (i.e. gas, liquid, powder, etc.) should be prepared and should include the chemical characteristics (such as: may produce fumes, or may explode) and possible effects on human beings (i.e. may cause blindness, burns the skin, etc.). Common transportation routes for dangerous substances through communities should also be mapped.

An important feature of hazard mapping is determination of a possible zone of contamination and possible intensity of contamination. This requires knowledge of the nature of the chemicals themselves and may include review of historical records of accidents. The European community (EC) requires that premises storing specified quantities of very hazardous substances are designated "major hazard sites". The operators of such sites must prepare emergency plans and communicate the dangers to the public. The EC's Major Accident Reporting System (MARS) keeps a database on chemical accidents.

Hazardous materials identification

All chemical containers should be labeled including storage boxes and barrels, vehicles, ships, and aircraft. Label information may include the name of the chemical, its toxic effects, the name of an antidote, instructions for treatment or cleanup, and where to call for further information. In the United States, pilots of crop spraying aircraft are encouraged to wear labels on their safety helmets with information about the pesticide being used.

Other preparations

- Chemical plants and storage facilities should be inspected for safety and any needed improvements should be made immediately. If possible, storage capacities of dangerous or flammable chemicals should be limited.
- Toxic waste disposal procedures should be monitored and toxic waste dumps should be documented on a hazard map with information about the chemicals they contain.
- Fire fighting capacity both at plants and in the surrounding communities should be improved and practice drills conducted.
- Civil defense forces should be prepared to assist.
- Community members should monitor pollution levels and report any adverse effects.
- Individual citizens and communities should prepare and practice evacuation plans.
- Testing of warning sirens at plants and in the communities should be routine.
- Hazardous materials incident response training

Insurance and compensation - Requirements of insurance for industries handling hazardous chemicals will help to define the risks associated with vulnerable locations and operations. Compensation schemes should be encouraged which are able to provide large sums immediately to help victims.

Typical post-disaster needs

In the event of a chemical disaster, medical and emergency teams should remove all injured persons from the scene of the emergency. All persons should leave the area unless protected by special equipment. They should then stay away until safe return to the area has been determined and announced to the public. In the case of water contamination alternate sources would have to be provided.

Clean-up of the effects of the disaster may require more resources than are locally available. In this case the required resources would have to be sought from other sources, such as international emergency assistance agencies. The affected area should be monitored continually following the disaster. Thorough investigation and documentation of the emergency must follow.

CASE STUDY, *Bhopal, India*

At around one o'clock on a December morning of 1984, a thick, white cloud of gas seeped out of a ruptured valve from a pesticide factory near Bhopal, India. Winds blew the fumes over a 50 kilometer area and cool temperatures kept the gas cloud low where it engulfed the houses. Citizens awoke coughing and many died in their beds. Thousands who escaped death were cared for in

makeshift medical centers. Many were temporarily or permanently blinded. There were no adequate warning or evacuation plans and no understanding of the nature of the chemicals among the local population.

The official death toll reached 3,598 in 1989 but it is believed that actual numbers are much higher. A further, 50,000 were seriously affected and another 150,000 suffered from after effects. The seeping gas was highly toxic methylisocyanate. Within 45 minutes of the rupture, the leak had been repaired, but a lethal dose had already escaped. It is noteworthy that none of the workers at the plant were killed. Many claims against the company for compensation to the victims have not been settled.

Source : UNDRO News, "Bhopal Tragedy", Nov/ Dec., 1984, p.4.

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3

Hazard Identification and Risk Assessment

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OCCURRENCE OF AN ACCIDENT / DISASTER



HAZARD

Anything Capable of producing adverse effect on Health & Safety.

RISK

The probability of an event occurring and the consequence if it occurs.

ACCIDENT

A sequence of events resulting in injury / illness / property damage or with potential to do so.

MAJOR HAZARD CONTROL SYSTEM

A. Identification of Hazard

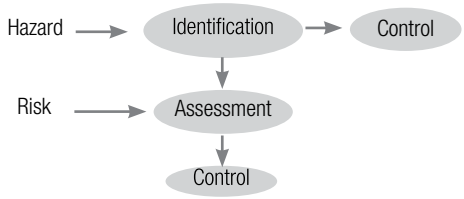
B. B. Setting Priorities

- Establishment of a group of experts
- On-Site Emergency Planning
- Off-Site Emergency Planning
- Sitting criteria / policy
- Preparation of check list
- Inspection by Inspectorate
- Inspection by Specialists
- Evaluation of major hazard
- Actions arising from evaluation
- Information to public

ROLE OF MANAGEMENT

- Provide the information required to identify major hazard installation.
- Carryout the hazard assessment.
- Report to the Authorities on the results of hazard assessment.
- Set up an emergency plan.
- Take measures to improve plant safety.

RISK MANAGEMENT SYSTEM



RISK ASSESSMENT PROCESS



ASSESSMENT METHODS

- ➢ Preliminary hazard analysis (PHA)
- ➢ Hazard and Operability studies (HAZOP)
- ➢ Fault Tree Analysis (FTA)
- ➢ Consequence Analysis (CA)

Working methods for hazard assessment

Method	Purpose	Aim	Working principle
1. Preliminary Hazard analysis 2. Matrix diagrams of interactions 3. Use of check lists 4. Failure effect analysis 5. Hazard and operability study	1. Identification of hazards	1. Completeness of safety concept	1. Use of "thinking aids" 2. Use of "searching aids" and schematic a documentation
6. Accident sequence analysis (inductive) 7. Fault tree analysis (deductive)	2. Assessment of hazards according to their occurrence frequency	2. Optimisation of reliability and availability of safety systems	3. Graphic description of failure sequences and mathematical calculation of probabilities.
8. Accident consequence analysis	3. Assessment of accident consequence	3. Mitigation of consequences and development of optimum emergency plans	4. Mathematical modeling of l physica and chemical processes

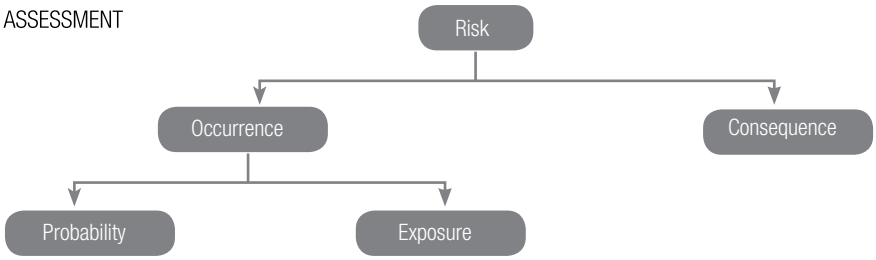
PRELIMINARY HAZARD ANALYSIS IN AN LPG STORAGE PLANT

Accident	System	Hazard	Safety-relevant component
Vapour explosion	Storage vessel	Formation of an explosive atmosphere outside storage vessel due to : - Faulty safety valve - Corroded vessel - Overpressure	Safety valve vessel, corrosion protection Pressure gauge, temperature gauge, Sprinkler system, Safety valve

CAUSES OF MAJOR INDUSTRIAL ACCIDENTS

- Component failure
- Deviations from normal operating conditions
- Human and organizational errors
- Outside accidental interferences
- Natural forces
- Acts of mischief or sabotage
- Additional failures

RISK ASSESSMENT



Risk Score = Consequence x Exposure x Probability

RISK SCORE CALCULATION

	Consequence	Mark
1	Numerous Fatalities	100
2	Multiple Fatalities	50
3	Fatality	25
4	Serious Injury	15
5	Casualty Treatment	05
6	F. Aid Treatment	01

	Exposure	Mark
1	Continuous	10
2	Frequent	06
3	Occasional	03
4	Infrequent	02
5	Rare	01
6	Very	0.5

	Probability	Mark
1	Almost Certain	10
2	Quite Possible	06
3	Unusual But Possible	03
4	Remotely Possible	01
5	Very Unlikely	0.5
6	Practically Impossible	0.1

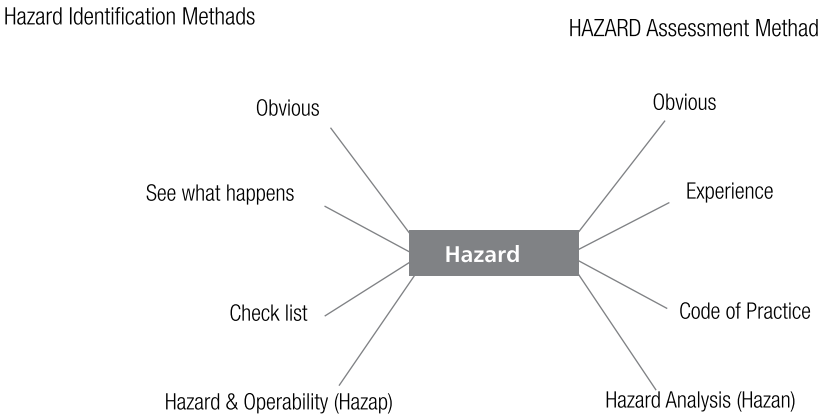
	Risk Score	Mark
1	Very High Risk	Above-400
2	High Risk	200-400
3	Substantial Risk	80-200
4	Moderate Risk	20-80
5	Probably Acceptable	Below 20

FIXING PRIORITY

	Bigh Risk	Low Risk
Easy to Fix	Priority-1	Priority-3
Hard to Fix	Priority-2	Priority-4

SYSTEM OF HAZARD STUDIES

Project Phase	**Pre-sanction**		**Sanction Obtained**		**Post-sanction**		
Stage	Project Exploration	Preliminary Project Assessment	Project Definition	Design and Procurement	Construction and Safety check	Commissioning	Normal Operation
Hazard Study No.	I		II	III	IV	V	VI



HAZARD ANALYSIS (HAZAN) TECHNIQUES

- What if? Analysis
- Event Tree and Fault Tree Analysis
- Preliminary Hazard Analysis
- Coarse Hazard Studies (HAZCHECK)
- Hazard and Operability Studies
- Failure Modes Effects and Criticality Analysis
- Sneak Analysis
- Human Error Analysis
- Hazard Warning Analysis

SEQUENCES OF EVENTS IN A RISK ASSESSMENT

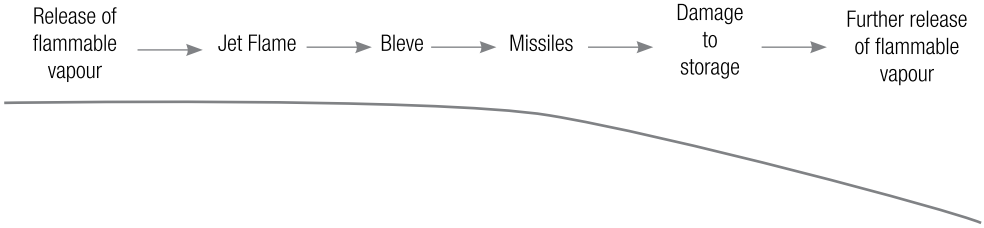
A. FLAMMABLE RELEASE

Emission
Vaporization (if liquid)
Air entrainment
Gas dispersion
Ignition
Flash fire or vapour cloud explosion

B. TOXIC RELEASE

Emission
Vaporization (if liquid)
Air entrainment
Gas dispersion

A CONSEQUENCE CHAIN



4
RECENT INDUSTRIAL DISASTERS IN INDIA

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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. Despite the setting up of pollution control boards and monitoring agencies, the lack of will to impose punitive measures on industry means that industry continues to violate safety norms. There is also a vast unorganized sector that continues to endanger not just the lives and health of its workers but also the community at large. Exploitation and violation of safety norms often go hand in hand, with poor and vulnerable sections of society bearing the brunt.

2014

June 07 : Gas leaked at SAIL's Bhilai Steel Plant, Chhatisgarh, 7 died and 30 injured.

2013

November 13 : An Explosion took place in the new blast furnace of Bhushan Steel and Power Company, Meramundali, Dhenkanal, Odisha, 3 died and 15 injured.

2012

June 13 : The worst-ever accident in the history of Visakhapatnam Steel Plant (VSP), happened at 8.45 PM on 13 June 2012. Nineteen persons including senior officers were burnt alive following a huge explosion in the recently commissioned oxygen plant in the steel melting in unit III. About 20 workers were injured seriously. The explosion occurred when the officials were conducting a trial run of the oxygen plant.

2010

June 14 : Nearly 103 persons fell sick after inhaling chlorine gas leaking from a cylinder stored in Bombay Port Trust (BPT) premises at Sewri

2009

October 29 : The Jaipur oil depot fire broke out on October 29, 2009 at 7:30 PM (IST) at the Indian Oil Corporation (IOC) oil depot's giant tank holding 8,000 kilolitres of oil, in Sitapura Industrial Area on the outskirts of Jaipur, Rajasthan, killing 12 people and injuring over 200. The blaze continued to rage out of control for over a week after it started and during the period half a million people were evacuated from the area. The incident occurred when petrol was being transferred from the Indian Oil Corporation's oil depot to a pipeline. There were at least 40 IOC employees at the terminal, situated close to the Sanganer Airport (Jaipur Airport) when it caught fire with an explosion. Crude oil worth 500 Crore (1 crore = 10 million) was burned. Besides huge damage to Environment was caused

2008

June 6 : Explosion in the Indian Petrochemicals Corporation Limited (IPCL, Nagothane, Maharashtra, 4 died and 46 injured. The explosion occurred due to a fire in the plant where around 205 maintenance workers were present. Contact of hydrocarbon and welding gas in the plant caused the accident

2007

March 5 : A major fire broke out in the Indian Oil Corporation's Guwahati refinery's crude distilling unit . The fire, caused due to a leakage in unit 1 of the refinery

2006

October 25 : Reliance Industries Refinery, Jamnagar, Gujarat, Leaked hot vaccum gas oil catches fire in air, 2 died

September 19 : Ravi Organics Ltd., Muzzaffarnagar, UP, Gas release 1 died

18 July: Anjana Explosives Ltd., Peddakaparthi Nalgonda District, Andhra Pradesh,Spillage of haz chem, 5 died

29 March : Kanoria Chemicals and Industries Ltd. Renukoot, Sonebhadra, Uttar Pradesh,Chlorine release, 6 died 23 injured

2005

December : Mathura Refinery, Mathura, Uttar Pradesh, Fire,1 died

28 November : Aurobindo Pharma Ltd., Unit-V, IDA Pashamylaram Medak Dist., Andhra Pradesh, Indian Oil Corporation, Explosion while drying cloxaciline sodium 1 died 4 Injured

October 4 : Gulf Oil Corporation Ltd., Sanathnagarn, Hyderabad, Andhra Pradesh Explosion/fire, 2 died , 2 Injured

November 3 : Orchid Chemicals and Pharmaceuticals Ltd., Alathur, Kancheepuram District, Tamil Nadu Explosion with fire, 2 died 4 Injured

15 June : Gujarat Refinery, Fire

5 March : Matrix Laboratory Ltd. Unit 1, Kazipally, Medak District, Andhra Pradesh, Sodium Hydride, 8 died

2004

October 30 : Ranbaxy Laboratories Ltd., Mohali, Punjab, Fire in dryer room,1 died 2 Injured

October 29 : Gujarat Refinery, Vadodara, Gujarat, Explosion in slurry settler, 2 died 13 Injured

September 30 : Explosion kills 10 people at Bhushan Steel's factory in Sahibabad, Uttar Pradesh, when bombs contained in scrap originating in Iraq exploded. Indian law prohibits the import of scrap from war-zones.

July 29: Two matador trucks carrying cartons of date-expired drugs and pesticides were dumped and set ablaze by officials of Hindustan Antibiotics Ltd in Sankheri village, near Bhopal. Villagers residing within 200 metres of the site complained of breathing problems, stomach ache, diarrhoea, nausea and vomiting. Four people belonging to the family of a farm labourer living nearby fell unconscious and were hospitalised.

July 18 : A chlorine leak at 6 pm from Chemplast Sanmar's chlorine plant in Mettur Dam, Tamil Nadu, sent 23 people, including a 22-day-old child, to hospital. More than 50 people are reported to have fainted after inhaling the chlorine fumes. The state regulatory authorities, police and district officials cooperated with the company to hush the matter. No criminal proceedings have been initiated against Chemplast.

July 13 : Bombay High Court appoints retired judge D R Dhanuka commissioner to investigate possible toxic exposure among employees working or having worked for Monsanto India Ltd at its Lonavla and Silvassa plants.

July 6 : A fire at Hindustan Insecticides Ltd's Toluene fire, endosulfan plant in Eloor, Kerala, guts the plant. More than 250 people exposed to toxic fumes from the fire. The company had no onsite or offsite emergency plan, and the fire hydrant was not working. The company dismissed the fire as a major accident averted. No systematic medical monitoring or aid was offered for victims.

May 31 : Chemical Factory, Dombivilli, Maharashtra, Hexane release—fire, 1 died and 8 Injured

April 28 : Anil Enterprises, Zakhira, Rohtak, Haryana, Fire in LPG fired oven, 6 died and 2 Injures

April 17 : Three employees at the Waste Immunisation Plant in Tarapur, Maharashtra, exposed to radiation from a small bottle of diluted but highly radioactive waste.

April 6 : One person killed and 29 affected following a toxic gas leak at the Jaipur Golden Transport Company's godown on Roshanara Road, north Delhi. Toxic gas is released after water was used to douse a fire mixes with aluminium phosphide stored inside the godown. The police find that the firm does not have a valid licence to handle toxic chemicals. Three managers arrested.

February 24 : Explosion at ammonium perchlorate facility in the SHAR complex, Sriharikota, kills 36 people. SHAR is India's premier space research station.

January 5 : Residents of Gawanpada township in Chembur, a Mumbai suburb, complain of breathlessness after a whitish powder is emitted from the Hindustan Petro Chemicals Ltd plant. HPCL's general manager visits the township and sends sweepers in to clean up the powder. A representative from the public relations company hired by HPCL claims the silica powder is harmless.

2002

December 20 : IPCL, Gandhar, Gujarat, 18 workers & 300 villagers, in Jageshwar affected.

December 24 : Three workers at a distillery at the Chittur Cooperative Sugar Mills in Palakkad, Kerala, die after inhaling carbon dioxide while repairing a pipeline. Workers allege absence of safety measures and medical facilities at the factory premises.

November 8 : Three killed, two hurt in an explosion at Parakh Food Products at Kurkumbh Industrial Estate near Daund in Maharashtra. The fire starts when welders, repairing a pipeline connecting edible oil tanks, cause the oil to overheat. Workers are flung high into the air with the impact of the explosion.

Septermber 5 : GACL, Vadodara, Gujarat, Chlorine gas explosion,4 died and 20 injured

September 22 : Six young women, aged between 17 and 20, die and 54 suffer serious burns when a fire breaks out at a match factory in Mudukkumeidanpatti, near Kovilpatti in Tamil Nadu.

July 30 : One person killed and 12 hospitalised following a gas leak at RPG Life Sciences Ltd's Pimpri facility located in the premises of Hindustan Antibiotics Limited, Pimpri, Maharashtra. The company claims the gas, emitted during manufacture of the drug Spirunolactone, is not poisonous.

2001

August 26 : Five women employed at the Gujarat Clay Mills in Kurla, Mumbai, hospitalised after inhaling fumes caused by grinding a 'blackish' material. The dean of Sion Hospital, where the women were admitted, said they were suffering from methhaemoglobinia. Workers say there was no proper ventilation at the mill.

August 17 : Twenty-two killed in a blast at the Tamil Nadu Industrial Explosive Ltd plant near Katpadi in Vellore. The accident occurred during the crimping process for making detonators used in quarries. 35,000 detonators were stored in the building at the time of the explosion. Two people had earlier died at the unit.

May 31: Twenty-two young labourers, mainly from Bengal, die after a gas cylinder bursts at a gold-processing unit in Mumbai's crowded Bhuleshwar area. The gas cylinder had been illegally procured and was fake. The labourers were unable to escape the raging fire as the owner had locked them in the room at night.

2000

December 8 : West Bengal government orders the closure of the Frigerio Conserva Allana meat-processing factory in Mourigram, Howrah, two days after angry residents storm the plant. The residents claim toxic emissions on October 28 caused the death of one worker and affected four others.

November 21 : death of two labourers at an effluent treatment plant at Naroda Enviro Projects Ltd. The workers died on July 28 when they fell into toxic liquid at the treatment chamber.

June 7 : One worker dies in a fire mishap at Oswal Chemicals & Fertilisers in Paradip, Orissa. The government had earlier registered three cases

against the company for not adhering to safety norms.

April 18 : Thirty-one people, including several children, hospitalised in northeast Delhi following a chlorine gas leak from a water treatment plant of the Delhi Jal Board.

1999

October 16 : Three persons killed and 17 badly affected after inhaling hydrogen sulphide gas from a storage tank at a unit near Kalyan, Maharashtra. Though there were 124 industrial units handling chemicals in the area, staff at the civic Rukminibai Hospital say they are not equipped to handle chemical asphyxiation and lack basic equipment like ventilators.

October 8 : Thirty-seven women employees of Ravi Frozen Foods at Wagle Estate, Thane, faint when a hosepipe bursts in the cooling hall, releasing ammonia gas. The director, engineer, foreman and two others arrested on charges of gross negligence; later released on bail.

May 6 : Five people killed in a flash fire at the hydro cracker unit of Indian Oil Corporation's Panipat refinery.

1998

July 10 : Heavy rains in Bajwa, Gujarat, cause the sliding of a mountain of waste gypsum dumped by Gujarat State Fertilisers & Chemicals. The radioactive waste flows into the town affecting several residential areas. The government distributes food and water packets in response to protests by residents.

April 21: Four killed and 60 injured after several barrels containing chemicals catch fire at the Dasnagar Industrial Estate near Howrah. Three days later, residents near the site are forced to flee as the resultant aniline gas causes asphyxiation. Police blame the authorities for stockpiling chemicals without adequate supervision.

April 2 : Five workers killed at the Nutra Plus factory at Boisar Industrial Estate, Gujarat. A faulty safety valve rendered the cooling apparatus ineffective. The ceiling collapsed. Factory workers allege that two chemical engineers meant to be operating the reactor were busy watching a televised cricket match.

1997

September 14 : Vapour cloud explosion in the Hindustan Petroleum Corporation Limited Refinery (HPCL), Vishakhapatnam, 80 died and 50 injured. Most victims were casual labourers employed on a contract basis. Environmental scientists at the Tata Energy Research Institute and the Indian Institute of Technology Delhi express fears that the blaze may have damaged crops and triggered respiratory diseases among the town's population. The A B Sathe Committee looking into the incident holds staff responsible for failing to close the valves of the sphere in the storage tanks, resulting in the blast.

May 22 : Nine persons die in an explosion at a factory in Faridabad, Haryana. The chemical factory stored drums of methyl elkyl ketone peroxide.

March 13 : Twenty people die at a gelatin godown in Sangamnagar in Satara town.

1996

September 26 : 64 miners drown in the Gasiltand mines of Bharat Coking Coal in Katra, near Dhanbad, Bihar, after torrential rains breach a river embankment and water gushes into the mine. Miners stranded in a lift that stopped working rang the alarm bell repeatedly but BCCL management personnel had fled. No rescue efforts were undertaken until too late. Fourteen officials charged with culpable homicide not amounting to murder.

September 14 : Eighteen children hospitalised in Narkheldanga, West Bengal, after inhaling poisonous fumes emitted at a paper and cardboard godown. It is believed the fumes spread when

boxes that once had chemicals spread on top of them were being cleaned.

1995

August 7 : Six people, including a supervisor, die after inhaling poisonous gas while cleaning a tank at the Marico edible oil plant in Jalgaon, Nashik. Among the workers is a 16-year-old boy.

July 10 : Thirty people fall ill after a gas leak at the Hindustan Lever prawn-processing unit near Kolkata, West Bengal.

March 15 : Two workers die after inhaling poisonous gas at the Mukund Iron plant in Kalwa, Thane, near Mumbai.

1994

November 13 : Hundreds affected by a toxic cloud formed after a fire breaks out at a chemical store in Delhi.

January 25 : Fifty-three miners die when a fire breaks out in a mine in Asansol, West Bengal.

1993

March 17 : Nine residents of Chhota Shahad village in Ulhasnagar, Thane district, near Mumbai, die after being affected by hydrogen sulphide released by the Century Rayon factory into a nallah. About 140 villagers were affected. Four Century Rayon employees arrested. A Maharashtra Pollution Control Board (MPCB) report implicates Century Rayon for violating safety norms in the treatment of effluents. On MPCB orders, closure operations begin on April 16 amid protests by the workers union. On April 24, the MPCB and Maharashtra government allow the company to reopen its plant provided it complies with MPCB orders

1990

Explosion in the Indian Petrochemicals Corporation Limited (IPCL) Gas Cracker Complex, Nagothane, Maharashtra,(1990).

5

INDUSTRIAL DISASTER MANAGEMENT

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DEFINITIONS

- "A disaster can be defined as any occurrence that cause damage, ecological disruption, loss of human life, deterioration of health and health services on a scale, sufficient to warrant an extraordinary response from outside the affected community or area". (W.H.O.)
- "A disaster can be defined as an occurrence either nature or man made that causes human suffering and creates human needs that victims cannot alleviate without assistance". American Red Cross (ARC)

What is a disaster ?

- A disaster is a result of a vast ecological breakdown in the relation between humans and their environment, a serious and sudden event (or slow, as in a drought) on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid. (from Noji, Gunn and Lechat)
- Disaster Management can be defined as "The range of activities designed to maintain control over disaster and emergency situations and to provide a framework for helping at risk persons avoid or recover from the impact of a disaster" (Cuny)
- **DISASTER NURSING**

It can be defined as the adaptation of professional nursing skills in recognizing and meeting the nursing, physical and emotional needs resulting from a disaster.

TYPES OF DISASTER

- **Natural Disasters -**
  - ✔ Meteorological
  - ✔ Topographical
  - ✔ Environmental
- **Man-made Disaster –**
  - ✔ Technological
  - ✔ Industrial accidents
  - ✔ Security related

CHARACTERISTIC OF DISASTER

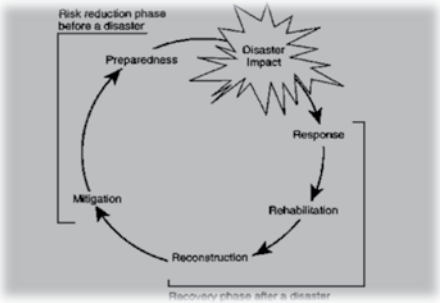
- Predictability
- Controllability
- Speed of onset
- Length of forewarning
- Duration of impact
- Scope and intensity of impact

PRINCIPLES OF DISASTER MANAGEMENT

- Disaster management is the responsibility of all spheres of government
- Disaster management should use resources that exist for a day-to-day purpose.
- Organizations should function as an extension of their core business
- Individuals are responsible for their own safety.
- Disaster management planning should focus on large-scale events.
- Disaster management planning should recognize the difference between incidents and disasters.
- Disaster management operational arrangements are additional to and do not replace incident management operational arrangements

- Disaster management planning must take account of the type of physical environment and the structure of the population.
- Disaster management arrangements must recognise the involvement and potential role of non- government agencies.

DISASTER MANAGEMENT CYCLE



DISASTER DRILL

- A disaster drill is an exercise in which people simulate the circumstances of a disaster so that they have an opportunity to practice their responses.

DISASTER IMPACT

- Search, rescue and first aid
- Field care
- Triage
- Tagging
- Identification of dead

Factors Contributing to Disaster Impact and Severity

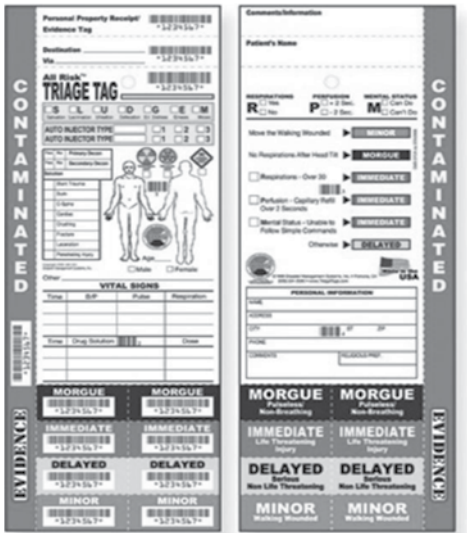
- Human vulnerability
- Phenomenon (hazard) characteristics
- Impact (sudden vs gradual)
- Manageability
- Risk

Triage

- Golden hour
- Immediate or high priority:
- Delayed or medium priority:
- Minor or minimal or ambulatory patients:
- Expectant or least priority:
- Colour code:



Manual Triage Tag



Disaster-Effects

- Deaths
- Disability
- Increase in communicable disease
- Psychological problems
- Food shortage
- Socioeconomic losses
- Shortage of drugs and medical supplies.
- Environmental disruption

ROLE OF NURSE IN DISASTER MANAGEMENT DISASTER PREPAREDNESS

- To facilitate preparation with community
- To provide updated record of vulnerable populations within community
- Nurse leads a preparedness effort
- Nurse play multiroles in community
- Nurse should have understanding of community resources
- Disaster Nurse must be involved in community organization

DISASTER RESPONSE

- Nurse must involve in community assessment
- Once rescue workers begin to arrive at the scene, immediate plans for triage should begin
- Nurse work a member of assessment team
- To be involved in ongoing surveillance

DISASTER RECOVERY

- Successful Recovery Preparation
- Be vigilant in Health teaching
- Psychological support
- Referrals to hospital as needed
- Remain alert for environmental health
- Nurse must be attentive to the danger

THE BASICS OF DISASTER RESPONSE

DISASTER RESPONSE- ESF- Emergency Support Functions (ESF)

1. Transportation
2. Communications
3. Public Works and Engineering
4. Fire fighting
5. Emergency Management
6. Mass care, Housing and Human Services
7. Resource Support
8. Public Health and Medical Services
9. Urban Search and Rescue
10. Hazardous Materials
11. Agriculture and Natural Resources
12. Energy
13. Public Safety and Security
14. Long-Term Recovery
15. Public Affairs

Concepts in Evaluating Disasters

- Phenomenon: Disaster type and intensity
- Vulnerability: Predisposition and capacity of local response
- Impact: Effect on population

Vulnerability vs. Manageability

- Vulnerability: Factors that increase risk
  - Number of people exposed by the hazard
  - Area covered by the hazard
  - Dose or intensity of power of the hazard
  - Time duration
  - Frequency
- Manageability: Factors that reduce risk
  - Affluence of population, coping mechanisms
  - Knowledge and practices of population
  - Technology available to the population

Emergency Response

Phase

- Search and rescue
- Emergency medical services
- Immediate health service mobilization
- Preliminary needs assessment

Disaster Medical Response Phases

- Notification (recognition)
- Search and rescue
- Triage
- Medical care of disaster victims
- Disaster communications
- Record keeping
- Transportation and evacuation
- Debriefing/CISD
- Recovery

Disaster Response

The benefits and drawbacks of:

- Internal (Local) Response
- External (National or International) Response

Internal Response Management

Strengths

- Rapid response
- Socially and culturally appropriate
- Family and community support
- Assists in immediate recovery
- Reduces dependency
- Builds upon local response mechanisms
- Develops internal capacity

Limitations

- Limited capacity
- Limited experience and planning
- Lack of large scale sectoral ability
- Lack of coordination on large scale
- Lack of large scale funding
- Lack of monitoring
- Limited ability to address prevention and preparedness

External Response Management

Strengths

- Large scale assistance
- Expertise in disaster response
- Dedicated disaster funding
- Sector specific support
- On site organization and coordination

Limitations

- Duplication of services
- Draws from local capacity building
- Non-sustained funding and dependency
- Culturally and socially problematic
- Lack of standardization of NGO response
- Difficult to coordinate and monitor
- Unrealistic expectations of donor assistance
- Local partners overloaded
- Program is poorly conceptualized

What happen in a Disaster ?

Chemical Hazard Profile-

- Out of 602 districts in India, 263 districts have MAH units.
- 170 districts have clusters of more than 05 MAH units (hazardous/industrial pockets).
- There are 1666 MAH units in India.

Sources of Chemical Disasters-

- Manufacturing and Formulation Facility
- Material Handling and Storage
  - Bulk Storages : Manufacturing and isolated storages (including in Ports & Docks)
  - Storages of Small Containers : In manufacturing facilities, in isolated warehouses and godowns, and
  - Storage of Fuels (LPG Depots etc.)
  - Pipelines, and Transportation (road-, rail-, air- & waterways)

Causes of Chemical Disasters-

Chemical Disasters in general, result from –

- Fire
- Explosion
- Toxic release
- Poisoning, or
- Combination of the above
  - Reactive
  - Radioactive
  - Corrosive

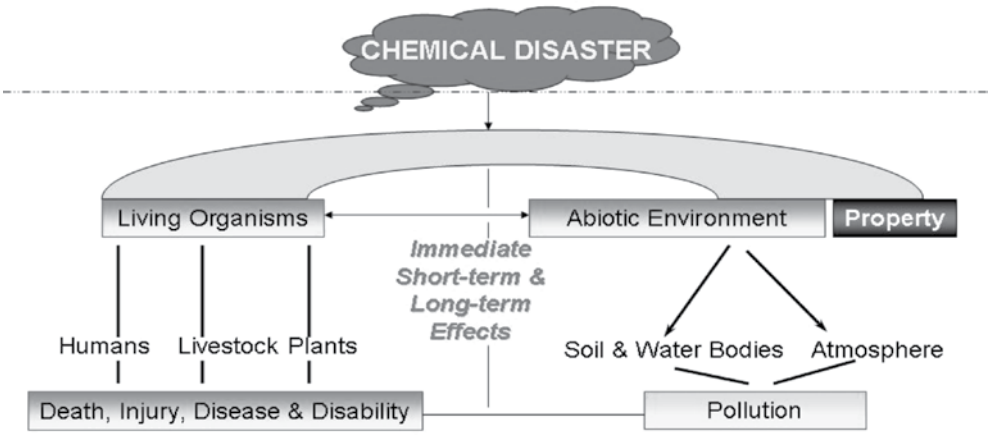
Bhopal Gas Tragedy-

- Worst industrial disaster in history
- 2,000 people died on immediate aftermath
- Another 13,000 died in next fifteen years

- 10-15 persons dying every month
- 520,000 diagnosed chemicals in blood causing different health complications
- 120,000 people still suffering from
  - Cancer
  - Tuberculosis
  - Partial or complete blindness,
  - Post traumatic stress disorders,
  - Menstrual irregularities
- Rise in spontaneous abortion and stillbirth



Effects of a chemical disaster on life and environmental factors-



Immediate impact-

- Morbidity and mortality
  - Including of health care staff
- Disruption of water supplies
- Disruption of sanitation
- Destruction of infrastructure, including health facilities
- Displacement of large numbers of people
- Social and psychological distress

What effects skin and soft tissue infections?-

- Post-traumatic Care
  - Hypoxia from pulmonary contusion, ARDS, VAP
  - Coagulopathy
  - Renal failure
  - DVT/PE
  - Ulcer disease
  - Soft tissue infections
- Cellulitis
- Necrotizing fascitis
- Post op wound infection
- Burn care

CELLULITIS

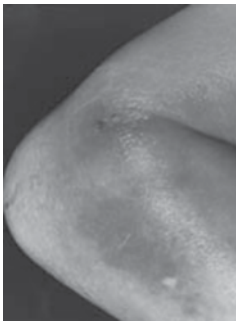
- Skin infection involving the subcutaneous tissue
- Predisposing factors
- Lymphatic compromise
- Site of entry
- Obesity

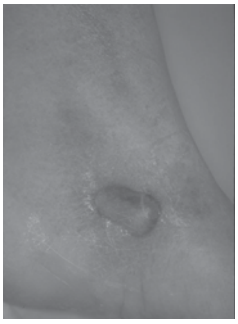
- Dirty/contaminated wound
- Cellulitis- Microbiology-
- Streptococcus
- Staphylococcus (MRSA)
  - Worse in shelters
- Special circumstances
  - Water exposure
- Aeromonas (MMWR 2005 Sept;54(38):961 and Clin Infect Dis 2005 Nov;41(10):93)
- Vibrio vulnificus (MMWR 2005 Sept; 54(38): 961)
- Ecoli, Klebsiella, Pseudomonas (Lakartidningen 2005 Nov; 102(48):3660)
- Myroides, Bergeyella, Sphingomonas
- Mucormycosis (Ann Acad Med Singapore 2005)











NECROTIZING FASCIITIS

- Fulminant destruction of tissue
- Systemic toxicity
- Very high mortality
- Much larger bacterial load than cellulitis
- Travels through fascial plain
- Much less inflammation from necrosis, vessel thrombosis, and bacterial factors



TOXIN DISEASES

Tetnus

- Rare due to vaccination
- 1 Million die per year in developing world
- 4 clinical patterns
  - Generalized
  - Local
  - Cephalic
  - Neonatal
- Spores of C. tetani enter the tissue
- Produce metalloprotease, tetanospasmin
- Retrograde movement into CNS
- Blocks neurotransmission by cleaving protein responsible for neuroexocytosis
- Disinhibition of motor cortex
- Extensive spasm

- Needs the right factors to produce-
  - Penetrating injury with spore delivery
  - Co-infection with other bacteria
  - Devitalized tissue
  - Localized ischemia
  - Can have water contamination as part of entry (Ann Acad Med Singapore 2005;34(9):582

Myths and Disaster Realities



1) Myth : Foreign medical volunteers with any kind of medical background are needed.

Reality :

- The local population almost always covers immediate lifesaving needs.
- Only skills that are not available in the affected country may be needed.
- Few survivors owe their lives to outside teams

2) Myth : Any kind of assistance is needed, and it's needed now!

Reality:

- A hasty response not based on impartial evaluation only contributes to chaos
- Un-requested goods are inappropriate, burdensome, divert scarce resources, and more often burned than separated and inventoried
- Not wanted, seldom needed
  – used clothing, OTC, prescription drugs, or blood products; medical teams or field hospitals.

POLICY : PREPAREDNESS AND RESPONSE

- Development of fully trained and equipped specialist response teams.
- Strengthening of civil defence set up to supplement local response and relief efforts.
- Development of Standard Operating Procedures by all relevant Ministries/ Departments at Central, State and District levels.

POLICY : RELIEF AND REHABILITATION

- State Government will be advised to establish per-contract and pre-agreement arrangements for immediate mobilization f resources.
- Central Government will also facilitate mobilization of resources when requested by the State Governments.

POLICY: HUMAN RESOURCE DEVELOPMENT

- Establishment of National centers of excellence for human resource development in areas of disaster mitigation, preparedness and response.
- Promotion of research and envelopment for early warning systems and prevention and mitigation of sudden onset disasters.
- Involvement of community civil defence volunteers, NGOs, ex-servicemen and youth organizations in all aspects of DM.
- Promotion of self-reliance in the community.

FINANCE

- National, State, District Mitigation Fund
- National, State, District Response Fund
- Ministry or Department to make provision for fund in annual budget for disaster management activities as set out in disaster management plan
- During any threatening disaster situation, disaster National/State/District authority if satisfied that immediate procurement of provision or materials are necessary. Inviting tenders shall be waived.

NATIONAL DISASTER RESPONSE AND MITIGATION FUND

- National Disaster Response Fund will be constituted and funded by the Central Government, and grants may be made by any person/institution.
- National Disaster Mitigation Fund started for mitigation projects.
- The State Government shall establish Disaster Response Fund and Disaster Mitigation Fund at State and District Levels.
- Every Ministry/Department of Central and State shall make provision in budget for activities in DM plan.

6

ASSESSMENT OF CHEMICAL DISASTERS-RISKS, TOOLS & TECHNIQUES

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The decade 1914 to 1984 saw large number of industrial accident. Flixborough explosion. The seveso disaster, the mississaque accidents due to collision of wagons of chlorine & propane Massachusetts spill of phosphorous tri-chloride Mexico explosion involves liquefies gas & Bhopal disaster 1984.

Chemical disaster management has 2 major components:

a) Disaster risk reduction & management

b) Emergency preparedness, response & mitigation

Various steps of chemical disaster risk management are categorised to 5 groups.

1. Hazard & Risk assessment

- HAZAN
- HAZOP
- Event tree & Fault tree analysis
- Maximum Credible Accident Analysis (MCAA)
- Consequence analysis
- Exposure & Vulnerability study
- Risk Characterisation
- Risk evaluation & acceptance

2. Prevention & Mitigation

- Technology/material substitution & mitigation
- Disaster management (safety system) plan
- Planning & response
- On-site response
- Off-site emergency plan including domino effect

3. Integration in to main stream

- Integration of risk management in to overall environment policy.
- Integration of chemical disaster risk management in to multi risk management procedure & District DM plan.

4. Integration into development

1.0 HAZARD IDENTIFICATION:

The identification of areas of vulnerability of specific hazards is of fundamental importance in preventing disaster. Once this is identified the battle is half won. There are now a numbers of hazard identification methods which can be used.

The choice of hazard identification technique also depends on purpose for which the study is done. For identification of hazard & operating problems on a plant a HAZOP study is suitable which for identification of source of release for hazard assessment, it is necessary to carry out a specific review of such sources. The use of standards & codes helps to avoid hazards of which people may not be even aware. HAZOP studies are used to identify how often familiar hazards may be realised in a new plant.

1.1 HAZARD STUDY:

Hazard is the potential to cause harm while risk is the likelihood of harm. People care more for risk than hazard. The truth is risk can be reduced or eliminated by making events less hazardous.

There are a number of methods that have been developed for identification of hazards.

Some of the methods are

1.1.1 What if analysis

1.1.2 PHA

1.1.3 Screening analysis technique

1.1.4 HAZOP study

1.1.5 FMECA(Failure mode effect & criticality analysis)

1.1.1 What if analysis : - an early method of hazard identification to review the design by asking series of questions beginning with what if?

1.1.2 PHA : - normally used to describe qualitative technique for identifying hazards early in design process.

This is an initial study to determine hazard causes, effects & controls. Facts of proposed product process or operation are to be known to determine hazards. For example for using electric power, the hazard to be presumed are electric shock, burns, fire, hot surface failure of equipment to operate at a critical time to cause accident, radiation effect electrical explosions.

Similarly adverse effects of foreseeable cause like chemical exposure, reactions, acceleration can be listed. Then appropriate remedies are selected & applied.

Its basic steps are: -

a) Assume a type of hazard possible (fire, explosion, toxic release etc.)

b) Find which plant component system or machine can cause this accident, storage vessel, reactor, pipe line etc.

c) Find out the event initiating the hazard (release of explosion or toxic gas runaway reaction, leakage etc)

This will naturally suggest corresponding safety device.

1.1.3 Screening analysis technique : -

The screening analysis is done at early stages in design where there is a block layout of plant items. The objective is to determine whether there are problems in areas such as data on chemicals, information about hazards, features of design & sitting of plant.

The block layout may show a storage tank containing flammable liquids. The application of guidewords 'fire' to this tank might raise a number of queries.

Among those that may be considered are frequency of fire, fire detection, fire fighting access, effect of radiant heat, need for disaster plan.

1.1.4 HAZOP Study : -

The basic concept of HAZOP study is to take a full description of process and to question every part of it to discover what deviation from design intention can occur and what cause & consequences of these deviations may be. This is done systematically. The important features of study are:

1. Design intent
2. Deviation from intent
3. Cause of deviation
4. Consequences

a) Hazards

b) Operating difficulty

The design intent is examined in respect of

1. Material
2. Activity
3. Equipment
4. Sources
5. Destinations

In some applications other relevant entities are

6. Time
7. Space

Guide words: -

- No or not
- More
- Less
- As well as
- Reverse
- Other than

1.2 SAFETY AUDIT:

One of the systematic methods of hazards identification used in chemical industry is safety audit. A safety audit subjects all aspects of organisation activity to systematic critical examination. It aims at finding strength & weakness and areas of vulnerability.

The audit has 5 main elements:

1. Identification of possible hazards
2. Assessment of potential consequences of realisation of these hazards.
3. Selection of measures to minimise frequency and/or consequences of realisation.

4. Implementation of these measures
5. Monitoring changes.

The IS 14489 deals in detail how to conduct the safety audit in an industry.

1.3 FAULT TREE & EVENT TREE ANALYSIS:

1.3.1 Fault tree analysis: - A fault tree is used to develop causes of an end event. It starts with end event of interest. The fault tree is both a qualitative & quantitative technique. Qualitatively it is used to identify the individual path that led to top event while quantitatively it is used to estimate the frequency or probability of that event.

The identification of hazards is usually carried out using HAZOP study. This will throw up cases generally small in number where a more detailed study is required and fault tree analysis can be used.

1.3.2 Event tree analysis: - An event tree is used to develop the consequences of an event. It starts with a particular initial event such as power failure and is developed. It is both qualitative & quantitative.

Qualitatively it is used to identify the individual outcome of initial event while quantitatively it is used to estimate frequency or probability of each outcome.

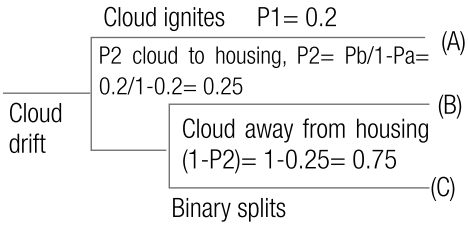
Example: -

Pa cloud ignites (Pa=0.2)

Pb | cloud drifts to housing (Pb= 0.2)

Pc | cloud drifts away from housing (Pc= 0.6)

Multiple splits

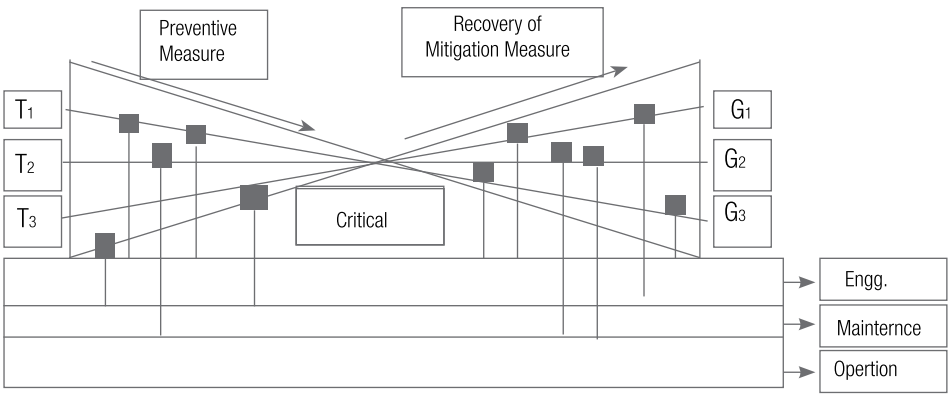


For construction of event tree normally a binary splits is used rather than multiple splits.

1.4 Bow tie diagram: -

The use of Bow tie diagram is more common in risk studies to identify the safety barriers that can be implemented to prevent a critical event after it has occurred. This tool is good representation of hazard analysis & hazard management.

It can be used for demonstrating that sufficient controls are in place for effective management of hazards & risks. In Bow tie diagram a fault tree & event tree are linked to a critical event that is related to undesired event. In this way Bow tie represent the relationship that exists between hazard, threats safety prevention barrier, safety mitigation barrier & consequences.



T1, T2, T3= threat (preventive barriers)

C1, C2, C3= consequence (Mitigation barriers)

HAZARD INDICES:

This is a method of identifying and ranking of hazards present in a process plant. It was developed by DOW chemical, USA and is usually known as DOW Fire & Explosion Index. ICI: improvement on this is known as 'Mond index'. The index provides weight-age for inventory flammability, reactivity, toxicity and hazards due to reaction exotherm etc.

The ranking indicates damage radius, maximum probable property damage & maximum possible days outage.

The ranking is useful for decision making.

The hazard indices have been developed to

1. Quantity expected damage due to fire, explosion or toxicity.
2. Identify the equipment that would create or escalate an accident.
3. Communicate such risk potential to management to take necessary remedial measure like increasing separation distance erecting a blast wall or fire proof construction and updating fire fighting and gas control facilities.

1.5 Causes Consequence Analysis: -

The cause consequence analysis identifies potential accident consequence and its basic cause. Any hazard or risk assessment is incomplete if the consequences of a possible accident are not known. Therefore last stage of hazard assessment is to analyse the consequence of that potential major accident on plant, workers, public and environment.

Therefore accident consequence analysis should contain

1. Cause of accident (fire, explosion, rupture etc)
2. Estimate of mass released (flammable, explosive, toxic quantity)
3. Calculation of dispersion of material released and damage distance (liquid, vapour gas)
4. Estimate the effects (heat radiation blast wave toxic, degree of born severity etc)

Mathematical models are used for calculation & estimation of item 3 & 4.

1.6 Vulnerability Analysis: -

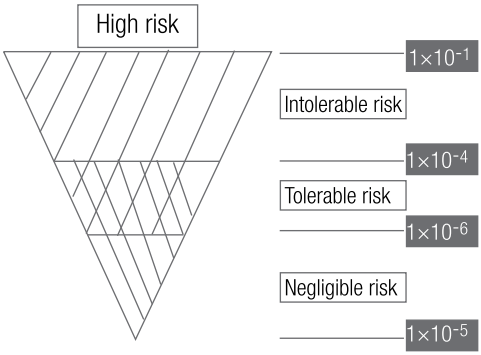
Vulnerability is the susceptibility of life, property & the environment to injury or damage if a hazard manifests its potential.

Vulnerability analysis identifies what part of the community is susceptible to more damage if a hazardous substance is released.

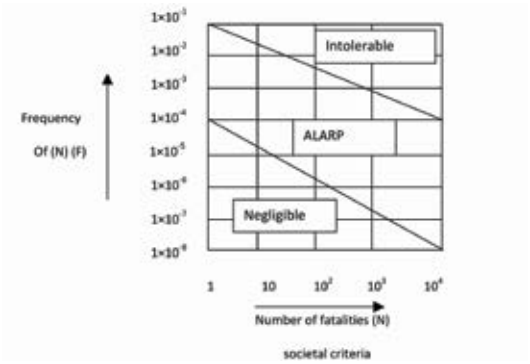
1. Vulnerable zone for a spill or toxic release and the condition that affect the zone. (wind speed, direction & size of release)
2. Population density & type: residence, hospital, school, stadium etc.
3. Private & public property that may be affected including essential support system.
4. Environment (Land, air, water bodies, crops, animal) that may be affected.

To get information on item (1) computer models on gas dispersion models, toxic concentration explosion effects are calculated. Gaussian, ALOHA computer models etc are used for assessment of this type of risks.

The risk acceptable criteria



F-N curve for societal risk



1.1.7 RISK ASSESSMENT: -

Risk assessment usually deals with major hazards that could cause a high death toll.

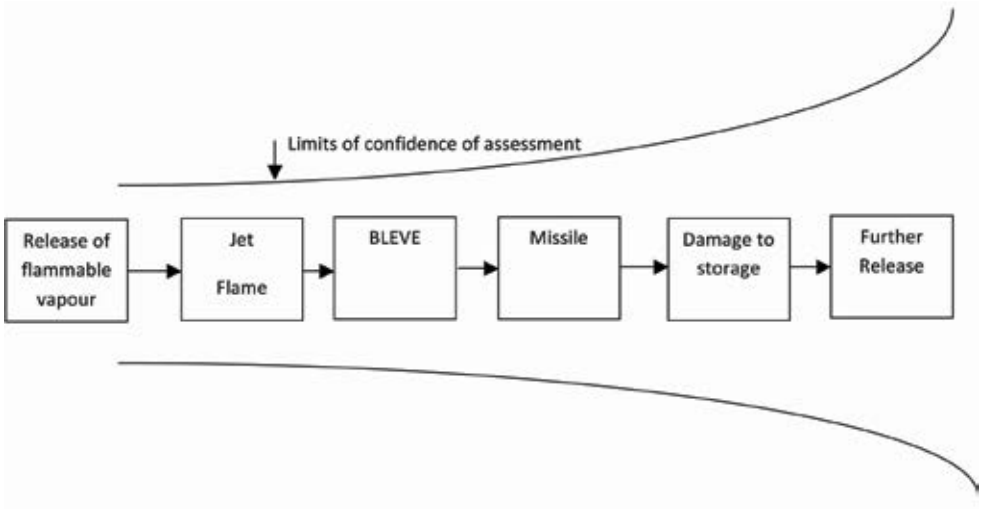
The society of risk analysis defines risk analysis as a detailed examination that includes risk assessment, risk evaluation and risk management. It is an analytical process aimed to understand the consequences of undesired events and to quantify the probabilities & its expected consequences. Risk assessment is a process to determine information regarding acceptable level of risk for individual, society or environment. Risk management can be understood as a systematic application of procedure & policies aimed to identify, analyse, evaluate, monitor & handle risk.

A full risk analysis involves the estimation of the frequency & consequences of a range of hazard scenario of individual & societal risk and the decision process to decide if the risk is tolerable or risk reduction measures are required.

Identification of the hazards is the first step. The quality of hazard assessment depends critically on the comprehensiveness of hazard identification. The method relevant to risk assessment is the review of release source. It is also necessary to identify vulnerable targets, both person & property.

A release scenario is then developed for each potential release. The releases can typically flammable release or toxic release. The scenario defines the nature of release and thus determines the subsequent chain of consequences. For each release scenario a set of consequence chain is developed showing escalation of events. Conclusions which effect the development of the event can be wind direction, velocity and stability conditions. For flammable release ignition source.

A set of consequence chain is conveniently represented in the form of event tree. Each of branches of event tree represents a single consequence chain. The outcomes are generally defined as events such as flash fire, vapour cloud explosion or toxic cloud. It is then necessary to identify any features that may mitigate the effects of these events on people or property. The factors that modify the exposure of people include shelter, escape or evacuation.



CONCLUSION:

For calculation and prediction of disaster effect, various tools & techniques are available. Industrial disaster initially starts from seemingly minor problem. If these problems are tackled in time, major disasters can be avoided to a large extent. There needs to be system in place to foresee the detects and eliminate then before it becomes beyond control.

7

OVERVIEW OF LEGAL FRAMEWORK FOR CHEMICAL DISASTER MANAGEMENT

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There have been few distinct stages in which Legal Framework related to Chemical Disaster Management (CDM) in our country and can be identified as

Post Independent Phase upto 1974

1974 to 1986

1986 t0 2004 and

Post 2004

When the Legal Framework is reviewed for the period related to Post Independent Phase, there has not been much of emphasis on CDM except, the provisions as laid out in Explosives Act, Mines Act and Factories Act 1948, Docks Workers (Regulation of Employment)Act 1948. Other than these, Local Administration specifying measures under Gram Panchayat Act or Municipalities Act or Corporations Acts and the measures taken by respective large industry like Steel Plants, Fertilisers Plants or Petrochemical Plants. These chemical process plants were considered to have disaster potential.

It may be heartening to note that under even under the provisions of Factories Act 1948 itself, certain operations carried out are declared as Dangerous Operations. In few of such declared operations, Chemical Emergency was considered. The provisions covered handling and storage of chemicals, control of escape of substances into atmosphere, fire and explosion risks, Risks of Toxic Substances, duties and obligations of workers, conducting fire drills, mock drills periodically and review.

The Water (Prevention and Control of Pollution) Act was enacted in 1974 to provide for the prevention and control of water pollution, and for the maintaining or restoring of wholesomeness of water in the country. The Act was amended in 1988. The Water (Prevention and Control of Pollution) Cess Act was enacted in 1977, to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003. It dealt with Water Pollution and did not focus on Chemical Disasters. Air (Prevention and Control of Pollution) Act 1981 dealt with Air Pollution in general but not focussed towards Chemical Disaster. Rules were published under respective Acts and Notifications (for example, Ambient Air Quality, Standards for Treatment of Water Pollution etc) were issued from time to time.

Major initiatives towards CDM triggered only after Bhopal Tragedy (1984) and that tragedy had an impact on Global Approach on Chemical Disaster Management and is continuing in phases. This has lead to development of First specific piece of Legislation came out in 1986 in the form of Environment (Protection)Act with a unified approach towards Air, Land, Water Contaminations (with a larger ambit of Environment as such) in case of Chemical Disasters. The objective was to provide for the protection and improvement of the environment. The Act was last amended in 1991. Rules were published in 1986. They covered issues like

Coastal Regulation Zone

Delegation of Powers

Eco-marks Scheme

Eco-sensitive Zone

Environmental Clearance - General

Environmental Labs

Environmental Standards

Hazardous Substances Management

Loss Of Ecology

Noise Pollution

Ozone Layer Depletion

Water Pollution

2-T Oil

And to some extent covered chemical disaster related issues.

However, the Rules were published under Environment(Protection) Act (In 1989 and 1996) and had significant contribution towards CDM. The provisions of Rules towards CDM would be discussed subsequently.

In 1987, Factories Act 1948 has undergone major revision, taking into consideration of experiences of chemical disasters. The focus in the amendments has been towards Prevention of CDM through identification of hazardous processes, introducing general duties of occupiers and manufacturers. This has covered introduction of an exclusive chapter of provisions dedicated to Hazardous Processes. It covers constitution of Site Appraisal Committee, compulsory disclosure of information by occupier, specific responsibility of occupier in relation to hazardous processes, Development of Emergency Standards, Permissible Limits of Exposure of Chemical and toxic Substances, Right of workers to be warned of imminent Danger, Measures to be taken by workers in Handling Hazardous Subsstances (which would also be useful in CDM). In addition, Rules for Control of Major Accident Hazards (CIMAH Rules 1999) have been included in Factories Act and Rules which cover Hazardous Chemicals, industrial activities, preparation of Onsite Emergency Plans by Occupier, Preparation of Offsite Emergency Plans by District Collector. In case of Hazardous Chemicals, certain Threshold Quantity has been included for preparation of Emergency Plans..

Safe use and Management of hazardous substances including hazardous chemicals and hazardous wastes, in order to avoid damage to health and environment is envisaged by Ministry of Environment and Forests. Focus is given to four International Conventions viz. Basel Convention on Control of trans boundary movement of Hazardous waste and their disposal; Rotterdam Convention on Prior Informed Consent Procedure for certain Chemicals and Pesticides in International trade and Stockholm Convention on Persistent Organic Pollutants, the Minamata Convention on Mercury and Strategic Approach to International Chemicals Management and addressed CDM.

The above is the direct initiative and covers Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness and Response) (CAEPPR) Rules, 1996 for ensuring CDM in the Country.

These rules delineate the criteria for identification of Major Accident Hazard (MAH) unit.

These cover industrial activity (which includes an operation or process,-

carried out in an industrial installation involving or likely to involve one or more hazardous chemicals), isolated storage(storage of a hazardous chemical other than storage associated with an installation on the same site that storage involves at threshold quantities) and pipeline (a pipe (together with any apparatus and works associated therewith) or system of pipes (together with any apparatus and works associated therewith) for the conveyance of a hazardous chemical other than a flammable gas as set out)

MSIHC Rules envisage notification of sites, updating information on threshold quantities of chemicals, preparation of Safety Report in case of certain threshold quantities and Conducting Safety Audit in such cases, updating Safety Reports, Issue of Improvement Notices by authorities

These rules envisage distinction between

Onsite and Offsite Emergencies, preparation of Emergency Response Plans, Typical Contents of such response plans etc. As per the rules, Central Crisis Group, State Crisis Groups, District Crisis Groups and Local Crisis Groups at Central, State, District and Local level are required to be set up for the management of accidents due to handling of hazardous chemicals listed in the rules. An off-site emergency plan for a district having MAH unit(s) is required to be in place so as to mitigate the impact of chemical accidents. They cover information to be given to public. Generic contents of Onsite and Off-site Emergency Plans are laid out.

Responsibilities of Importer of Hazardous chemicals are specified.

CAIRS a integrated web based Chemical Accident Reporting System

It is a Web Based System where concerned authorities as mentioned in schedule 5 of Manufacture, Storage, and Import of Hazardous Chemical Rule(MSHIC) Rule 1989 can online register (with password security) and post chemical accident information in the pre-set formats. It provides storing, retrieving and analyzing data in visual form for all the information related to the chemical accidents happening in India.

Public Liability Insurance Act related to Chemical Disasters was enacted in 1991 and amended in 1992. Rules under the Act were made in 1991 and amended in 1993. Objective of this legislation is to provide for public liability- insurance for the purpose of providing immediate relief to the persons

Affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto. It covers that the organisation has to take one or more insurance policies, Role of Insurer, Role of Collection in disbursing the relief and administering.

Under Motor Vehicles Act (1988) and Central Motor Vehicle Rules (1989, Amended in 1993), certain provisions are made related to dangerous or hazardous goods under transport. Primary risk and Subsidiary Risk are defined. Emergency Information Panel is made mandatory. Responsibilities of Driver, Transporter, Owner, Consignor are specified with reference to emergency / accident etc. The requirements include route finalisation, speed limitation, vehicle condition, qualification, training and authorisation of driver, reporting of accidents. In case of Explosives being transported, there is a requirement of Tracking the movement of vehicle for safety and security reasons. However consignors have been not able to comply with to satisfaction.

In 1996, Building and Other Construction Workers (Regulation of employment and conditions of service) Act was made and in 1998, Rules under the Act are made at central government level and also by different states. Under the provisions of the Rules, An employer shall ensure at a construction site of a building or other construction work that in case more than five hundred building workers are employed at such construction site emergency action plan to handle the emergencies like,-

(a) fire and explosion,

(b) collapse of lifting appliances and transport equipment,

(c) collapse of building, sheds or structures etc.,

(d) gas leakage or spillage of dangerous goods or chemicals,

(e) drowning of building workers, sinking of vessels, and

(f) land slides getting building workers buried, floods, storms and other natural

calamities, is prepared and submitted for the approval of the Chief Inspector of building and other construction works.

In Construction Industry the use of chemicals is limited to Detonators and other Blasting agents used before excavation or for demolition.

After great deal of debating and coordination among stakeholders, Disaster Management Act was enacted in 2005. Under the provisions of this act, a high power National Authority, Nation Level Executive Committee are appointed for developing and detailed guiding in the matters of Disaster Mitigations. Of course, under the Act, Disaster has a wide coverage including Manmade, Natural Disasters and CDM is only one part of the same.

The Act specified responsibilities toward developing National Disaster Management Plan, State Plan, District Plan and Local Area Plans and Integration of the same. Constitution of State Level Disaster Management Authorities, State Level Executive Bodies and similarly at other levels. The Act covers role and responsibilities of different Ministries and Departments at central and state level. The act envisages training, resourcing of the activities, research etc and capacity building. Involvement of experts, specialists, industry and other stakeholders at different levels in considered for effective prevention, mitigation and management. Guidelines for minimum standards of relief are considered. The Act suggests contents of the Disaster Management Plan at different level. The Act has provision for developing Disaster Management Training Institute at Apex Level and increasing awareness. Act also provides for raising a specialised trained Teams of Personnel to be developed and placed at in length and breadth of the country to response for disasters. These requirements of the Act are materialised and are functioning as NDMI and NDRF.

Act also envisages taking up with contraventions of the requirements of the Act by Organisations, Departments, individuals at different levels and such contraventions are made punishable.

Thus the expectation is consolidation of the effort done till today by different agencies and organisations under different legislations towards optimisation of prevention and mitigation efforts.

In 2006, An Act for regulating Petroleum and Natural Gas providing for the establishment of Petroleum and Natural Gas Regulatory Board to regulate the refining, processing, storage, transportation, distribution, marketing and ensuring un interrupted supply of petroleum and natural gas. However, this act does not focus much on Chemical Disaster Management.

In 2008, Explosives Rules made under Explosives Act, 1884 were amended in detail. As requirements of these rules, Licensee has to develop Safety Management emergency response planning and preparedness such as first aid, testing of emergency plan once in a year and provision of escape route; evacuation plan, appropriate fire fighting controls, consequence minimising steps like control of spills, appropriate off-site response plan etc.; maintenance of records; procedures to be taken during emergency, to make all employees conversant with Emergency Plan.

Normally, nuclear or radiological emergencies are within the coping capability of the plant/ facility authorities. A nuclear emergency that can arise in nuclear fuel cycle facilities, including nuclear reactors, and the radiological emergency due to malevolent acts of using Radiological Dispersal Devices are the two scenarios that are of major concern. The impact of a nuclear disaster (scenario will be well beyond the coping capability of the local authorities and it calls for handling at the national level). Therefore, it is deliberately not dealt here. However, NDMA and AERB have brought out publication of Management of Nuclear and Radiological Emergencies. In addition, these situations are also monitored by IAEA also.

Essence of various studies and seminars related to Chemical Disaster Management leading to further work and action plan are as follows:

With the Comprehensive Act in place, there is need for reviewing and repealing superfluous or overlapping provisions of other acts and to further consolidation of single legislation and make it simplified for compliance.

One important issue is deciding upon threshold quantities. Under MSIHC and CEPPR, certain chemicals are identified and for them threshold planning quantities are mentioned. It would be prudent practice to avoid such limitation to such specific chemicals and instead recognize them by TLV or STEL or IDLH or reactive nature etc. This would simplify listing so many chemicals and each time adding new chemicals etc.

Review of hazardous chemical inventory and transportation requirements, minimizing inventory and transportation across habitation is to be considered.

Review of location of Isolated storages and warehouses (Regulated and Non Regulated). In case of regulated storages, at least, controls can be envisaged. In case of non regulated isolated

storages, they are not coming under any regulatory agency for safety and emergency. Many a times, emergencies are occurring among domestic clusters leading to escalation of problems.

Mechanism to cover all major chemical disasters and reporting mechanisms at the district level.

Consolidating regulations governing HAZCHEM and Chemical Disaster Management

Coordination and Streamlining of CDM at National, State, District and Local Area (Like isolated locations, industrial estates, pipelines, warehouses

Rationalising format of Chemical Disaster Plan (as on day, different models under Manufacture, storage import of Hazardous Chemicals, National Disaster Management Act etc)

Standardisation of Hazard Identification Techniques, Risk Criteria, Risk Assessment Techniques so that actions would be based on similar rational rather than variation in approach

Identifying infrastructure needs for formulating the mitigation plans including emergency situations identification, emergency organisation, communication facilities, chemical disaster mitigation and management, rigorous training and up keep.

Safety Levels, Preparedness of Hazardous Chemicals transportation by pipelines (Under ground and above ground), by road need further focus and attention.

Concept of storing highly hazardous chemicals getting popularised, emergency management in such cases also needs to be reviewed (hazardous chemical storage under ground is considerably safe).

Bulk Storage of Chemicals in containers and sea transport and port storage is a popular way handling of chemicals in bulk. There is need for integrating those issues also into onsite emergency response and management.

Similar approaches are to be considered for off-shore chemical disasters.

Interface between a Natural Hazard triggering Chemical Disaster needs to be reviewed and appropriate linkages are to be provided.

So is the case with sabotage and cross-border terrorism activities.

Identification of financial resources and allocation of funds for different national at all levels

Developing manpower like ERT Members Pool (first responders) which include those at National Level, State Level, District Level, Industry or Occupation Level with tools and tackles and integration of other specialised resources in Defence, Para Military (CISF, BSF etc), Police and other specialised teams like NDRF / Home Guards / Civil Defence.

Integrating emergency facilities from bottom to top (like Emergency Medical Services, Emergency Transport Services, Rescue and Rehabilation Facilities, Emergency Communication Arrangements)

Building a Bank of Expert and Talent Personnel and Organisations for Emergency Response Guidance and inventory of emergency infrastructure available at any location for deployment (Tools, Tackles, special protective inventory etc)

Appropriate Sensitisation of community / stakeholders regarding their role and responsibility and reaction during chemical disaster.

Use of Modern Technology like GIS towards early identification, analyse and communicate to concerned for response action.

Review of existing policies, procedures and legislative requirements towards preventive, protective and mitigative approach.

On going interaction among Government, Stake Holders towards prevention of chemical disasters, optimising resources preparedness. This would help in taking the concept to rock-bottom level and every individual is sensitized to the required level of awareness and preparedness. This may take long time but is the need of the hour.

In preparing this note for the benefit of participants attending workshop at MDC, Bhubaneswar, I have made extensive reference of different documents published by Ministry of Environment & Forests, National Disaster Management Institute and different authors. I thank the organisations and individual authors.

8

COMMUNITY AWARENESS AND PREPAREDNESS FOR CHEMICAL DISASTERS

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As defined by SADKN, chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity (handling, storage or transportation) or due to natural events leading to serious effects leading to serious effects inside or outside the installation likely to cause damage to life and property.

Today we see that disasters have become a regular phenomenon. They strike at different places at different times and cause untold damage to the point of impact. However, limiting the effects of these disasters in order that they don't reach the full potential is something that should be worked upon and looked into very seriously.

Preparedness for the after-effects of a disaster can become a reality only once we acknowledges that the threat of a disaster is very real and are aware of ways of averting the same. An organised effort calls for a separate team to specialise in preparation to take evasive measures on a short notice to reduce the impact of the disaster. For the preparedness to be fruitful the support of the general public is paramount. In the absence of a synchronised effort in a moment of crisis under rides all efforts to reduce the impact of the disaster.

With this brief background let us understand the evolution of our preparedness and awareness towards Chemical Disasters.

Let us understand what a Disaster is?

According to the Disaster management Act 2005, "A disaster is an event of natural or manmade causes that leads to a sudden disruption of normalcy in the society causing damage to life and property to such an extent that is beyond the capacity of normal social and economic mechanism to cope up with."

The Wikipedia describes Disaster as "A natural or man-made hazard resulting in an event of substantial extent causing significant physical damage or destruction, loss of life, or drastic change to the environment"

As seen above, disasters can be either natural or man-made. Natural disasters occur spontaneously and even with the developments in science today, they remain very difficult to predict. It is therefore difficult to get a hold on the possible extent of damage. This is however not the case with man-made disasters. Man-made disasters are mostly industrial in nature. It has now become possible to isolate and map possible hazards arising from the setting up of an industrial unit. As we shall later see, the Industrial law in India necessitates the mapping and preparedness for hazards before setting up of the industry itself. It is therefore more systematic and relatively easier to visualise the hazards arising out of an industrial setup and taking measures to limit the damage in case of occurrence of a disaster.

The installations of warning systems for Tsunamis and earthquakes have today provided a wider window of opportunity to take evasive measures. The extent of preparedness in this case has a pre-decided time frame to act. This is not the case with an Industrial disaster. The time between the detection of an exploding risk and its manifestation into a full scale disaster is often very short. Short enough to not allow for any planning but only fast and efficient execution of prepared instructions to limit the effect.

Industrial disasters are caused by Chemical, Mechanical, Civil, electrical or other process failures, due to accidents, negligence or incompetence in an industrial plant because of which spill over to the areas outside the plant takes place causing damage to life and property.

A sub class of Industrial disasters that have been a major cause of accidents and loss to society are chemical disasters. Most chemical installations involve use of chemicals that are hazardous in nature and inappropriate handling might lead to disastrous consequences. A lot of other chemical installations involve the generation of hazardous by products. Thus it is important to visualise the risks arising out of these installations and having a contingency plan to deal with these risks if and when they arise. Depending on the probability of occurrence of these risks and their severity in manifesting into a disaster, the community in and around the installation needs not only to be aware of the risks but also be prepared to act on short notice. The reaction time available to handle to safeguard oneself in the event of occurrence of an industrial disaster is very less. Thus instant action is the need of the hour in such scenarios for both the specialised team directing efforts to take people to safety as well as the people in themselves to respond in a timely manner.

So far we have seen that-

- The need to tackle disasters is of paramount importance as the full potential of damage of such events can be catastrophic.
- It is more systematic to plan for a Industrial disaster than a natural disaster as the risks associated can be mapped and emergency measures can be taken.
- The reaction time available in case of an industrial disaster is far less than that of a natural disaster. This reaction time only leaves sufficient window for executing a well prepared and aware plan. Definitely no scope for formulating and then executing a plan.

Looking up at one of the most significant events in the domain of disaster management in India, Bhopal Gas Tragedy set up the theme for strengthening Disaster Preparedness and awareness building.

Bhopal Gas Disaster

On the night of 2nd December 1984, at Union Carbide Factory in Bhopal a major chemical disaster took place. A poisonous gas Methyl Isocyanate (MIC) which was used to produce the deadly pesticide carbaryl leaked. The first symptom of this was felt when factory workers felt their eyes burning and tears forming in their eyes. The disaster had proceeded too fast by the time the factory management decided to react to it. A thick white cloud of gas seeped out from a ruptured valve in the factory. Winds blew the fumes over a 50km area and cool temperature in the night ensured that the gas cloud kept low engulfing the whole city close by.Many citizens awoke from their sleep coughing and suffocating while a lot others died in their sleep. Many who somehow escaped the disaster were treated in emergency medical centres. However a lot of them were blinded for life.

The official death toll was declared as 3589, however actual numbers are claimed to be much higher. Over 50000 people were severely affected while another 150000 suffered from after effects. Although the leak was sealed within 45 minutes of detection, the gas leaked in that period had caused catastrophic and irreparable damage to the public. Birth defects continue to be reported till date from the area. Families have yet not been compensated appropriately for the damage caused to them.

Major causes of the disaster:-

1. Bypassing the safety system
2. Lack of preparedness to handle such a leak
3. Lack of idea on the urgency of the situation
4. Lack of awareness in the public to react to such an event

Flixborough

In the international front let us look at the Flixborough (UK) explosions. The Flixborough explosions occurred on 1st June 1974. In a

caprolactum plant, a temporary bypass pipe was broken and vapours came out. It resulted into fire and explosion. The plant was ruined into pieces. 1821 buildings and 167 shops broken down. 28 people were killed and 36 injured. The explosion was said to be so loud that it could be heard 27 miles away. The explosion destroyed the 72 million dollar Nyro plant completely.

Major cause of the disaster-

1. Attempt was made to bypass a reactor
2. The manner of bypass has several shortcomings.
3. No proper stress analysis was carried out and design considerations were ignored
4. Lack of qualified and skilled engineer to take the decision
5. No information provided to the public on the nature of chemicals stored
6. No restrictions on proper storage of chemicals at the factory

Seveso

At the Icmosa Chemical Company Co. at Seveso in North Italy on 10th July 1976, a reactor safety valve vented to the atmosphere TCCD a deadly toxic gas. Its cloud drifted over the adjacent town and came to earth with subsequent rains. Due to a communication problem the mass communication system could not be used to inform the people in the town, and it being a weekend, the key people in the town could not be reached to initiate a emergency plan. Even later when the evacuation plan was finally initiated, the people did not have a clear idea on what to do. Even after massive expenditure of US $200 million, the area has not been completely cleaned.

Major cause of the disaster:-

1. Lack of preparedness for the disaster
2. Lack of awareness on what to do in case of such an event
3. No active emergency channel to convey the message on a short notice

Inference from these disasters

The common inference from these three major disasters can clearly be seen as-

1. Lack of awareness in the public about the hazards involved in the factory
2. Lack of preparedness to tackle the emergency situation.
3. Lack of readiness to execute emergency plans
4. Huge expenses involved in post disaster clean up operations

Post Disaster Legislation

All the three industrial disasters served as important benchmarks in the course of setting up a stable and strong legal system. In India post Bhopal Legislations to address chemical disasters include:-

1. Environment (protection) Act, 1986

a. The Environment (Protection) Rules, 1986 (amended 2004)

b. The Manufacture, Storage and Import of hazardous Chemicals Rules, 1989 (amended, 1994 and 2000)

c. The Hazardous Wastes (Management and Handling) Rules, 1989 (amended 2000 and 2003)

d. Environment Public Hearing Notification 1996

e. The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996

f. Public Liability Insurance Act, 1991

g. National Environment Tribunal Act, 1995

h. Disaster Management Act, 2005

i. Environment impact Assessment Notification 1994 and Environmental Impact Assessment Notification-2006 and State Level Environment Impact Assessment Authority (SEIAA)- 2007

j. Hazardous Wastes (Management, Handling and Tran Boundary Movement) Rules, 2009

2. Amendments to Pre Bhopal Legislations including Factory Safety Act and Motor Vehicles Act

a. The Insecticides Act, 1968 (amended 2000) and the Insecticide Rules, 1971 (amended 1999)

b. The Motor Vehicles Act, 1988 (amended 2001)

c. The Central Motor Vehicles Rules, 1989 (amended 005)

d. The Explosives Act, 1984 (amended till 1983)

   i. The gas cylinder Rules, 2004

   ii. The Static and Mobile Pressure Vessels (Unfired) Rules, 1981 (amended 2002)

   iii. The explosive Rules, 1983 (amended 2002)

As per The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996-

1. It is required to prepare a Onsite Emergency Plan
2. It is required to prepare a Offsite Emergency Plan
3. It also mentions that point 12-
   a. The major Accident hazard installations in the industrial pockets in the district shall aid, assist and facilitate functioning of the District Crisis Group;
   b. The Major Accident Hazard installations in the industrial pocket shall also aid, assist and facilitate the functioning of the Local Crisis Group
4. At Point 13 regarding the information to the public-
   a. The Central Crisis Group shall provide information on request regarding chemical accident prevention, preparedness and mitigation in the country
   b. The State Crisis Group shall provide information on request regarding chemical accident prevention, preparedness and mitigation to the public in the State.
   c. The Local Crisis Group shall provide information regarding possible chemical accident at a site in the industrial pocket and related information to the public on request.
   d. The Local Crisis Group shall assist the Major Accident hazard installations in the industrial pocket in taking appropriate steps to inform persons likely to be affected by a chemical accident

Awareness and Preparedness

When the effect of an emergency situation remains within the boundary of a factory, it is termed as On-site Emergency Plan

When the consequences of an emergency go beyond the boundary of a factory effecting the general public in its vicinity and the environment, it is termed as Off-site Emergency.

These plans are an important component of the preparedness component. They help in systematising and mapping risks and allocating responsibilities to the disaster management and emergency teams. The stronger and better planned these components are, the better is the functioning and coordination during the times of emergency.

As seen in the previous segment, the reaction time available to execute a counter measure in case of an industrial disaster is very less, one needs to be in an always ready state to act and execute an On-site plan or an Off-site plan. Thus making a structured plan is only the first step in the process of preparing for countering an emergency situation.

Staying thoroughly prepared to execute the plan and keeping people aware on the drill in case of such an incident is equally important. Preparedness and Awareness are two components that only when together work properly in averting a disaster. It is for the rescue forces and emergency teams to be prepared to execute the plan when it so calls for. It is for the public surrounding the installation to stay aware on the possible effects of the disaster and the course of action they need

to take when an emergency situation occurs. It is only through a proper combination of awareness of public and preparedness of emergency teams that the effects of a disaster can be minimised.

In this context properly executed Mock drills plan an important role in strengthening preparedness and awareness and most importantly avoiding chaos in the time of an emergency. Mock drills make the people aware on the exact course of action, their role in it, the time frame involved and the need to listen to instructions given out by the emergency aid teams. Besides it helps in educating the people on what to do and what not to do in such times. This helps in giving a sense of direction to the people in the event of an emergency. Awareness through drills also brings to light the fact that the people know that Hazardous chemical is being used in the installation and the dangers associated with it.

National Safety Council, Mumbai has taken up the awareness building activity between 1992-1999 with the association of United nation Environment Programme (UNEP). The major points considered during these awareness building activities:

1. To create and increase public awareness of possible hazards to the community because of the chemical installation
2. To stimulate the development of cooperative plan to respond to any emergency that might occur
3. To work for prevention of Chemical Accidents.

APELL

APELL is an initative sponsored by Industry Environment Office of the UNEP. It is policy document that sets the objective and overall organisational framework for handling Emergencies at a ground level. It has two basic aspects:-

- To create and/or increase community awareness of the possible hazards involved in the manufacture, handling and use of hazardous materials, and the steps taken by authorities and industry to protect the community from them
- To develop, on the basis of this information and in cooperation with the local communities, emergency response plans involving the entire community, should an emergency endangering its safety arise

It basically describes the process for local cooperative action to improve community awareness and emergency preparedness. While it is aimed to make the ground level infrastructure stronger and more prepared to handle different scenarios, the involvement of higher authorities is of prime importance. It is necessary to provide a cooperative climate for better preparedness and serves to make the emergency plan more dynamic and implement a sense of ownership.

The major obstacles to implementing a APELL framework are:

- Over confidence (A plan is already prepared)
- Apathy (Cant happen here)
- Cost concerns (cant afford it)

To overcome this there are two things that need to be acted upon:-

- Provision of information to the community
- Formulation of plan to protect the public in case of an emergency

APELL needs active involvement and partnership at different levels:-

- National Level: Authorities including Ministers, departments, agencies
- Local Authorities: State/Province, Industry owners/managers, Local community and interest groups
- Other APELL partners: International Organisations, trade agencies, NGO's

APELL defines the responsibilities of each and every partner:-

- National Government:

o Provide guidelines to encourage and support local authorities and industry to initiate coordinated emergency response plans at local level in all industrial and development areas

- Disseminate information about the APELL process and make Handbook and other resources available on wide scale
- Promote and sponsor workshops and training on APELL
- Provide adequate resources for local community to respond effectively as soon as emergency occurs at a local level
- Monitoring of the implementation of APELL process
- Industry Owners/Managers
- To provide strongest possible support and resources to the plant managers so that the best accident prevention and emergency preparedness procedure are in place in the industrial facility
- To encourage facility managers to commit themselves to APELL process
- To monitor involvement of facilities in the process
- Members of the public would turn for information to the local plant manager, who should be prepared to respond to such queries
- Facility Managers
- Develop outreach programmes in response to public demand for information to create a well informed community capable of effective participation in emergency response programmes without harboring unfound fears of hazards
- Establish close and good working relationships with the emergency response agencies in the local community
- Establish close links with the local community officials and leaders and keep them properly informed about plant safety measures
- Be the catalyst in the formation of the coordinating group
- Local authorities are responsible for safety, public health and environment protection in their area.
- Raise public awareness and mobilize public support in the APELL process
- Establish a climate for a cooperative program to develop
- Coordinate emergency and other public group participation
- Train personnel in emergency response
- Acquire and mobilize resources needed
- Ultimately approve the emergency plan developed through APELL, implement and communicate it to the public
- Community Leaders
- Communicate with local authorities and industry leaders on the issues of importance to their constituency in the community
- Communicate with their constituency on plans and programmes developed to protect public health and environment
- Provide leadership through religious establishments, community based organisations, schools and other programmes to train the public on the details of the plan
- Help mobilize local support and participation in the APELL process
- UNEP
  - Dissemination of information on APELL
  - Seeking commitment from industry to participate
  - Establishing goals for countries' participation and follow up implementation

The overall 10 step process that serves as the guideline for APELL:-

1. Identify Participants and define their roles
2. Evaluate and reduce risks
3. Review existing plans and identify their weakness
4. Task identification
5. Match tasks and resources
6. Integrate individual plans into overall plan and reach agreement
7. Draft final plan and obtain endorsement
8. Communication and training

9. Testing, reviewing and updating
10. Community education

Additional collaborative efforts:-

A major task for the planning team is to identify all potential communities to partner with to aid in the information decimation process. Community forums, Teacher forums, local business associations etc are ideal forms to educate people on the importance of disaster awareness and enable them with the knowledge and responsibility of spreading the information in simple and easy to understand form. This opens up a free channel of communication and helps in better understanding of the risk at hand and also opens doors for creative ways of spreading information. Also going through the public in themselves via these forums, the information builds a degree of authenticity to itself. This also provides for additional resources from the local business bodies to be used for display of critical information like pamphlets, posters at locations frequented by people etc.

Running activities that involve the public and generate a subconscious awareness like poster making events and essay writing events also helps build a ground level awareness among the public.

Conclusion

Preparedness is the prime goal to counter any emergency whether it be natural or man made. In order to be prepared, it is important to understand and analyse the possible scenarios, map out arrange of impact, mature of damage and involvement of organisations and powers at different levels to counter them. Doing so only works if it is done in an organised fashion. APELL framework serves as a general guideline to build awareness amongst all level of community. Involving the local community organisation and local business in an effort to spread the knowledge becomes very critical to have a strong foundation.

9

RISK SENSITIVE LAND USE PLANNING FOR CHEMICAL DISASTER

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Land Use Planning in modern national and sub area development including macro and macro development, is recognized as an important component. Industrial and other infrastructure developers, local government, local communities, State and Central Governments and all stake-holders have influence on land-use outcomes. In fact, Land Use Planning is a double edged strategy and has often landed in controversies with different view points.

Therefore, the process calls for wide community consultation, during planning and execution stage, as well as continual monitoring and review throughout the life of the plan.

Present context is Strategic land-use planning with focus on Chemical Industry Development and Disaster Mitigation. The land use planning (LUP) in respect of Chemical Disasters is much more complicated. LUP with reference to Chemical Disaster Management is a subset of General LUP. General LUP supports various planning elements in effective utilisation of Land or optimised use of Land which is becoming scarce commodity with the population growth.

Any strategically wrong approach can result in severe and complicated development pattern and can result in irreversible situations.

Though it is a Government / Administrative Subject, it involves interested parties like general population, civic planners, industrial organisations, infrastructure builders etc and needs close and concerted harmonization of policy and practices towards optimum utilisation with least negative effect..

As it is, if any previous agreed land use for industry is daily becoming disputable for various reasons and many a times, disharmony and chaos are up-surging, having effect on social life and environment and ecology. These effects are short time and long time effects in nature.

After all, any application of technology in industry is for the overall benefit of society but is also bringing certain unbearable negative effects.

Immediately after independence, the focus of Government and Planners has been on irrigation projects and heavy industry. Where ever such projects have been initiated and executed, there has been uprooting of certain population and definitely such families have suffered and sacrificed for the nation. However, such families were rehabilitated to the extent feasible.

Now population growth, rapid industrialisation and infrastructure development has become need and one of such developmental activity is growth of chemical process industry which include heavy, inorganic, organic, petro-chemical industries etc. All these activity needed conversion of more habitable land into industrial land.

On one side human settlements are leading to imbalance in bio-life cycle distrubances and biodegradation and ecological disasters. Many a times, correction of such problems seemingly not possible and leading to more serious imbalances. Added to this episodal chemical disasters make the problem much more complex. Thus, at every phase of LUP, a trade- off and profit –loss analysis are essential at least to prevent further damage.

After all, when a chemical industry is established,

impending disaster of small or large size cannot be totally ruled out in spite of best mitigation policy and technology. Therefore, there is need for adequate spacing between human habitation and chemical industry. It may be called safety distance or buffer distance or so. Compared to 1950s, operating technological parameters and volumes of operation have phenomenally increased. Obviously means need more buffer distances. What is in practice is observed is, initially, considerable buffer distances are maintained taking into technological needs and disaster mitigation competencies. However, over a period of time, habitation is growing towards industry for various reasons and vulnerability of consequences of chemical disasters is increasing. All such growth has small percentage of unauthorised growth but remaining is in some way other, is allowed growth. It may not be one authority directly but cumulative inaction from various angles and not understanding the gravity of allowing such growth.

There have been number of situations through out the country, where once upon a time the industrial location was less habitated and of late, housing colonies etc come forward towards the compound of the chemical industry. This has become more concern.

Experts going into these problems have often pointed out the authorities who have permitted such colonies and have taken such decisions for various socio-political reasons. Obviously such locations become mutually dangerous (habitation becoming dangerous to industry and industry becoming dangerous to dwelling)

Land-use management involves legal, technical, and social dimensions: The regulatory dimension includes laws, decrees, ordinances and other regulations adopted by national and local governments. The technical and instrumental dimension includes planning tools and instruments that regulate uses of land and strive for the best balance between private interests and the public good.

As far as considering industrial use of land, according to CPCB (1997), every air polluting industry has been categorized into three classes, depending on the air pollution they cause. Similarly, surface water polluting industry and groundwater polluting industries have been classified into three classes. Sensitivity assessment means determination of the vulnerability of area towards air, surface water and groundwater pollution. This vulnerability is measured in terms of three classes-high, medium and low. The sensitivity of an area due to pollution from industries needs to be evaluated so as to minimize the environmental impacts and risks. The major components of the sensitivity are Air, Surface Water and Ground Water Pollution. During normal operations with acceptable levels of pollution control, during emergency or disaster situations, the effect is severe and runs beyond all norms and contaminates. While Japan's Minamata Disease is a global example, locally there are many cases of industrial activities near water bodies (which may be a consumption source for population), all over the country. So are the cases of industrial towns and cities where morning and evening, air chokes the people and is responsible for variety of exposures and diseases even during normal time, leave alone, during disaster situation.

A welcome step is made towards developing a draft Policy (2013) on LUP but did not get finalised to full shape. A policy document strengthens decision maker.

Added to this, during severe and high speed cyclones and other natural disasters, the problems are more significant. Recent havoc of Hudhud Cyclone has indicated the earlier designs of structures for resisting wind velocities are not seemingly adequate and need technical revision.

Attention is invited to a research paper presented by Dr RB Nukala at World Bank Forum, where he suggested nine categories of Land Use and out of these, Mining, Transportation, Industry and Major Hazard Vulnerable Areas are significant to industrial operations. This study also supports importance of Planning at National, State, District and Application Areas. The paper suggests phases of LUP, viz.,

Data and information gathering, review and evaluation, including land information and associated attribute data.

Identification of targets, goals and needs catering to development requirements, protection or conservation requirements, and socio economic and environmental requirements.

Land suitability assessments and preparation of sectoral plans for all key sectors including rural, agriculture, urban, industrial, environmental and transportation. Appraisal of sectoral plans, negotiation and integration.

Plan approval.

Plan implementation.

Monitoring and evaluation.

Assessment of plan revision requirements.

According to Dr S. K. Kulashrestha Major settlements (300,000 population):

At the time of siting of the industry if any major settlement's notified limit is within 50 km, the spatial direction of growth of the settlement, for at least a decade, must be assessed and the industry shall be sited at least 25 km from the projected growth boundary of the settlement

Siting Criteria (as per Ministry of Environment & Forests)

No forest land conversion

No prime agricultural land conversion

One kilometre (to be left as green belt) away from any adjoining large scale industries

Suggested Areas to be Avoided (as per Ministry of Environment & Forests) while siting

Ecologically sensitive areas: at least 25 km away

Coastal areas: at least 1/2 km from High Tide Line.

Flood Plain of the Riverine Systems: at least ½ km from flood plain Transport/Communication System: at least 1/2 km from highway and railway.

Recent fires in Pesticide and Insecticide manufacturing industries (all are at approved locations) and resulted in severe and toxic emissions and during accidents, fire water used has seeped into ground with chemical contamination and has definitely damage beyond comprehension. The causes for such conditions are many. We have no right to pollute ground water and ground water is a legacy for next generation. In one such fire case, there was a conflict of interest. Villagers around the factory staged dharana that factory is to be shifted from the present location. Employees staged another dharana on the other side that the factory can not be shifted.

In another case, the villagers in hundreds literally blocked the road for the factory and did not allow authorities and police to intervene as they were choked and had to escape out on previous day because of toxic products of combustion which choked them. They used all sorts of transport to run away, leaving their houses. This also brings out another dimension of capability of the organisation to prevent such situation by competent technology / controls and operations.

The following can be attributed for such above situations :

1. Inadequate comprehension of normal and emergency consequences and their effects on legal and illegal population around such industries
2. Development of habitation around such industry over a consideration time lapse and ultimately today, resulting in mutual hazard, i.e. Industry has risk on people and habitation causes risk on industry. There are many examples that can be quoted for this.
3. While industry cannot fight the situation, today, villagers are insisting industry has to be relocated. Industry brings economic growth to a location and the cost of such growth is disaster consequence.
4. Industry has to understand the sentiment and right of the neighbouring population and indirectly support their cause by setting a part of investment and profit, for people / place

development as a part of Corporate Social Responsibility.

5. Issues arising due to siting of thermal power plant and nuclear power plant are known well.
6. A code of discipline among industry and neighbourhood is need of hour and both have to respect for their co-existence. For example, in our country, there have been fires in industry because of fireworks in the neighbourhood. Also, Hazardous Chemicals Transport vehicles have caused innumerable problems of release of hazardous chemicals during road accidents in the neighbourhood. Access to very hazardous industrial activities have been narrow roads with heavy traffic and resulting traffic accidents.
7. Assessment of Impact of Chemical Disasters has to be more pragmatic and realistic. It is not just a chemical release or fire consequence but rigidness of people not prepared to leave the dangerous zone in the event of chemical disaster is also to be considered.
8. There are instances, where important service facilities like Fire Fighting Services, Ambulances and other special infrastructure could not be rushed to the site of disaster because of either traffic congestion or narrow approach roads or normal roads blocked due to emergency situation.
9. Even in cases of Special Economic Zones (SEZs) and other industrial layouts, buffer distance between general public areas and industrial plants seem to be not adequate and just across the fencing of the industrial estate, habitation is permitted in the name of cost and optimisation. Wall to wall industrial units are planned and permitted and this has resulted in providing only one entrance which is to be used for emergency exit.
10. When this gate becomes vulnerable for fire, there is no way of assisting industry from outside or persons from industry not being able to escape or cannot be rescued. Looking at this which cannot be resolved now after construction, who is owner of the problem ? In the event of an emergency, fire tender or emergency transport be able to access on all four sides of the industry and unfortunately, on three sides of industry, other industries are located. Is it because of cost of land or planners not providing for emergency mitigation?
11. Even today, there are industries, where one side the chemical process shed is leaning on to the compound wall. Industry may look small scale but hazard potential is very high. Who permitted them or the management just because of the cost wants to use every bit of land for operational purpose is a matter of prudence. Has no one, any control or is it part of liberalisation policy is to be answered by those who have responsibility for such situation.
12. It is high time that code of mutual safe existence, acceptance of all stake holders, (forgetting political affiliations and interests) is to be placed early, uniform in nature is to be brought out and practiced.
13. Our national leadership's call for 'make-india' concept does not mean deviating or shortening environmental and safety priorities. With in the National Land Use Planning Philosophy ambit, industrialisation is to be achieved. Safety Needs and Environmental Protection Needs for mitigating Chemical Disasters are not to be considered as red-tapes. Any wilful delays by individuals or authorities in project development can not be tolerated but if more time is required for proper evaluation of sites and disaster consequences, that cannot be termed as result of bureaucratic delay. Adequate time is to be allowed for siting / review such hazardous projects. Our next generation should not curse for irresponsible decisions in the name of ease of business or window delivery of approvals without going into details. Probably this needs to be made clear to those involved land use planning in respect of chemical disasters. In the absence of clear cut guidelines, it would be difficult to take objective decision.

14. Under the provisions of Factories Act as amended in 1987, Site Appraisal Committee is entrusted with such responsibility of siting hazardous installations etc but in many states, such committees are not constituted or where they are constituted, are unable to discharge their legitimate responsibilities for various reasons and effort is duplicated by Environmental Clearance after Environmental Impact Assessment, Consent for Establishment. The objective of EIA is to identify more than one site and compare and contrast with reference to Impacts and then take a decision. Often most of the EIA Reports take one site, evaluate the same site, revolve around to establish that site selected is best.
15. If one goes into detailed reasons why population in the vicinity of proposed chemical industries are not ready to accept the industry, is failure on behalf of the industry and authorities, to keep up promises of proper rehabilitation and are often leading to Law and Order Problem.
16. Cases can be cited where, industry before grounding the project, have taken the neighbourhood / villagers into confidence, complied with various promises made during EIA hearing in case of compensation, employment, medical benefits and social obligations. There have never been much difficulties during the project execution and villagers have adopted the industry and industry adopted the village. This is the desirable trust-building activity which goes a long way for so called sustainable LUP. Such a situation is result of not only administrative ability, trust building and also the tact and transparency of the activity.
17. There is need for industrial managements, administration, intellectuals, academicians, learned and committed NGOs and all concerned in LUP to work in this direction and achieve industrialisation facilitating disaster mitigation.
18. Our country needs industry. A bit of responsibility, technical evaluation and prudence would result in good and improved LUP resilient against chemical disasters. The ill effects of irresponsible industrialisation in some countries around us are the glaring examples of ill planning. At least for future industry, careful planning based on the nature of industrial hazards and balanced approach, reviewing various situations cited above is essential.

The Views Expressed above are based on my observation of four decades of contemporary industrial situation and are not against any individual, authority, agency or organisation.

10

DISASTER MANAGEMENT IN COAL MINES WITH SPECIAL REFERENCE TO MINES FIRE, EXPLOSION AND INUNDATION

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1. Indian Electricity Scenario and Role of Coal

- Coal plays a major role in Indian Electricity generation scenario and its contribution is 57%.
- Total Thermal Energy share is 67%, followed by Hydro-Electricity share of 19%, Nuclear Energy share of 2 % and Renewable Energy Sources to the tune of 12%.
- There is no chance of improvement in Hydro-Electricity and Nuclear Energy, rather they are shrinking year by year due to various socio-political reasons.
- Due to its cost of per unit of Electricity Generation, Renewable Resources are also not gaining momentum at the desired level. Coal is therefore dominating the market due to its lowest cost per unit generation.
- India has a good reserve of coal. As on 01.04.2012 the estimated reserves of coal was around 293 billion tones out of which 118 BT is proved reserve and at the present consumption pattern it can last for more than 200 years. Coal deposits are mainly confined to eastern and south central parts of the country. The states of Jharkhand, Orissa, Chhattisgarh, West Bengal, Andhra Pradesh, Maharashtra and Madhya Pradesh account for more than 99% of the total coal reserve.

Indian Electricity Scenario (As on 31/12/2012)

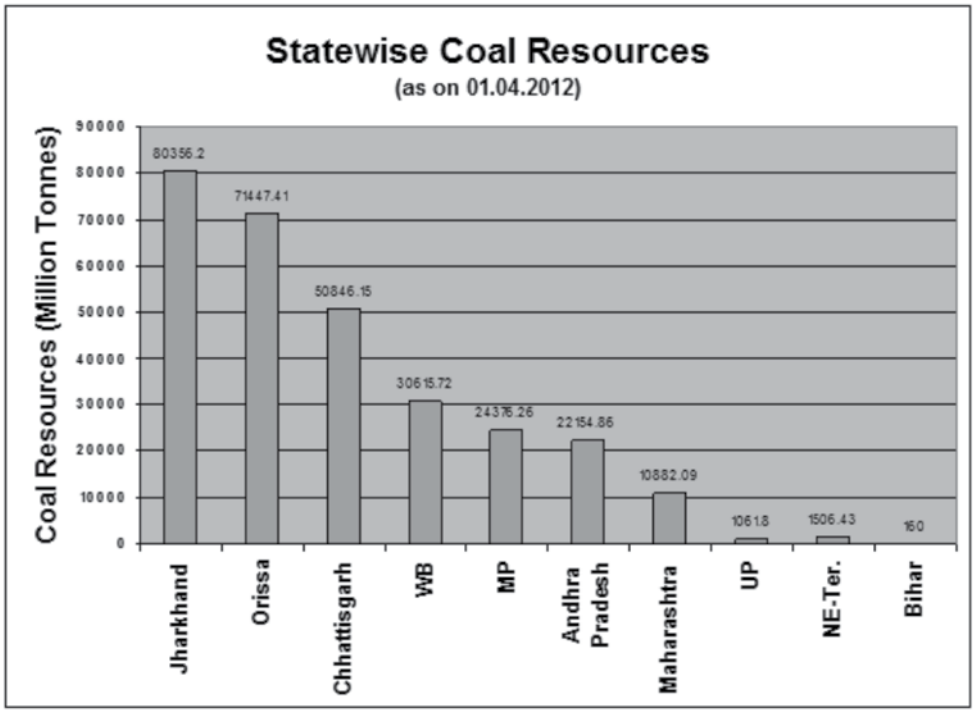
Fuel		MW	%age
Total Thermal		1,40,976	66.83
	Coal	1,20,873	57.3
	Gas	18,903	8.96
	Oil	1,200	0.57
Hydro		39,339	18.65
Nuclear		4,780	2.27
Renewable (RES)		25,856	12.26
Total		**2,10,951**	**100**

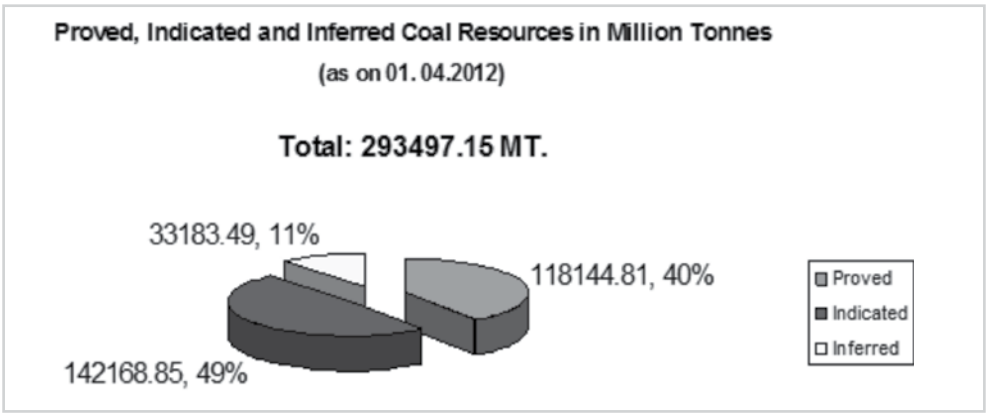
2. Indian Coal Mining Scenario with Special Reference to Odisha

- Out of India's total Coal Reserve of 293 BT, Share of Odisha is 71 BT and out of this 64% is available in Talcher Coalfield and 36% in Ib-Valley Coalfield.
- Total Number of Coal Mines in India is 574.
- Total Coal Production in India during 2011-12 was 559 Mte against the demand of 649 Mte and thus there was a gap of 90 Mte out of which 51 Mte was imported. Out of this Coal India produced 436 Mte (78%) and MCL Producced 103 Mte (18%).
- For the year 2012-13 projected Production for India is 580 Mte, CIL 450 Mte, MCL 109 Mte against the demand of 772 Mte leaving a gap of 192 Mte and projected Import of 143 Mte.
- Share of Opencast and Underground Coal Production in CIL is 91% & 9%, similar figure for Odisha is 98% & 2%.
- Coal Bearing Area inTalcher Coalfields is 1,86,000 ha (30%) out of the Total Angul District Area of 6,25,000 ha. Coal Bearing Area in Ib-Valley Coalfield is 1,37,500 ha.

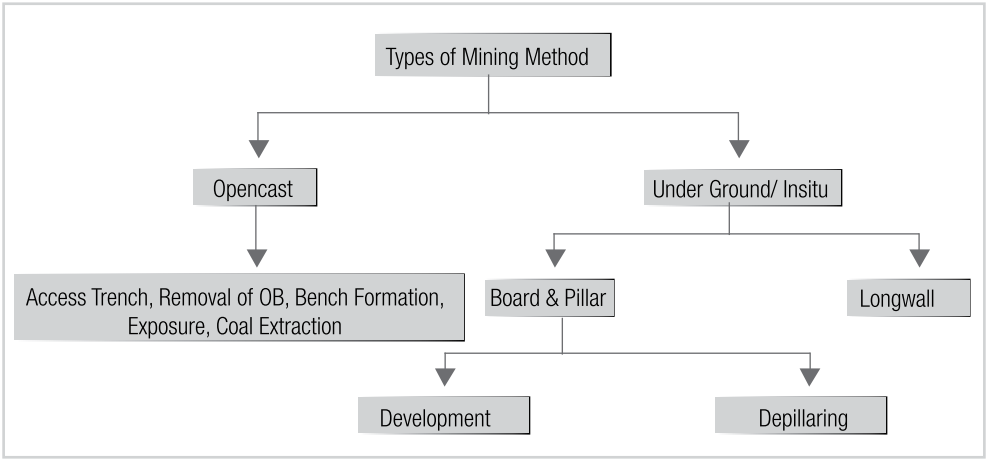
Inventory of Geological Resources of Indian Coal as on 1st April 2012.

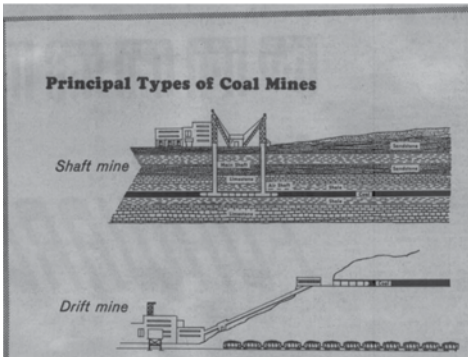
Type of Coal	Proved(Mt)	Indicated(Mt)	Inferred(Mt)	Total(Mt)	% Share
Prime Coking	4614.35	698.71	0.00	5313.06	1.81%
Medium Coking	12836.84	11951.47	1880.23	26668.54	9.09%
Semi Coking	482.16	1003.29	221.68	1707.13	0.58%
Sub-total of Coking:	17933.35	13653.47	2101.91	33688.73	11.48%
Non-coking	99617.65	128416.04	30282.09	258315.78	88.01%
Tertiary coal	593.81	99.34	799.49	1492.64	0.51%
Total All Types:	118144.81	142168.85	33183.49	293497.15	100.00%
% Share	**40.25%**	**48.44%**	**11.31%**	**100.00%**	

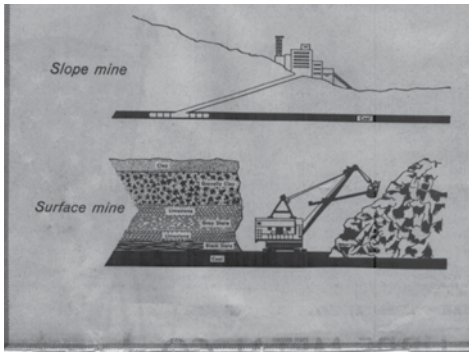




3. Method of Mining-Briefly Explained







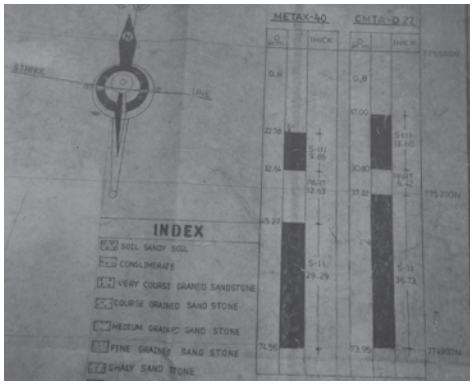
View of an Underground Mine



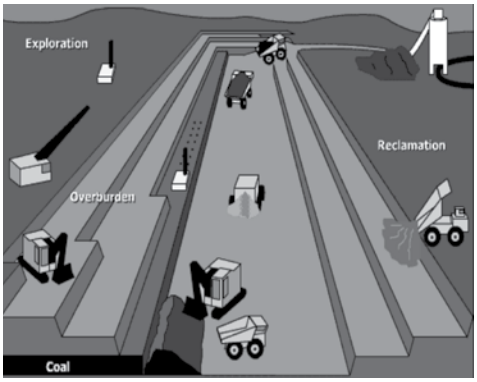
Open cast Coal Mine



General Coal Seam Occurance at Talcher Coalfield from Borehole Data



Conceptual View of a Opencast Mine



Shovel-Dumper Mining-Cycle of Operation



Truck and shovel operations are used to remove the upper layers of overburden.



The electric shovels scoop up the material loosened by blasting and place it in large trucks.



The trucks transport the overburden to area which was previously mined.



After the overburden is dumped, the truck returns for another load.

Removal of top cover by Back-hoe, without blasting



Shovel Exposing Coal Seam



Removal of top cover by Back-hoe, without blasting



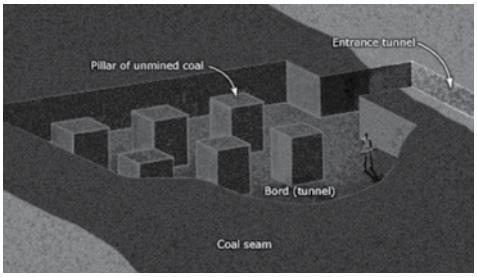
Shovel Loading OB in 50 T Dumper

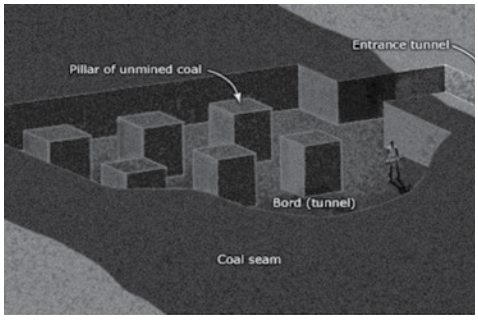


Surface Miner cutting coal

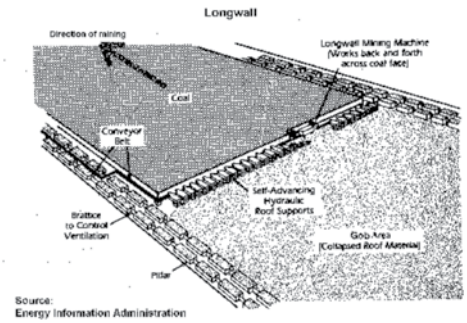


Board & Pillar Mining





Longwall Mining



Underground Mine Ventilatior

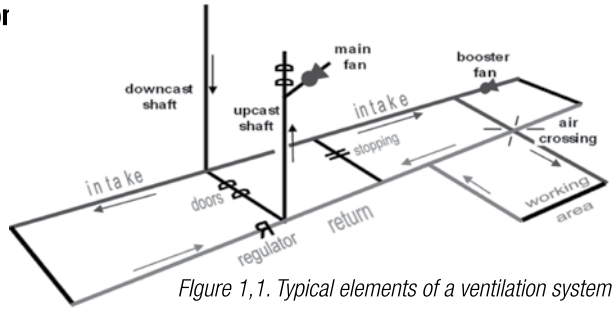


FIgure 1,1. Typical elements of a ventilation system

4. Disaster Statistics in Indian Context

- Coal Mining is probably one of the most disaster prone industries
- History of mining is globally marred by many disasters.
- Worst: Couriers Mine in France in 1906 when an explosion took toll of 1100 precious lives
- In India there were 53 disasters (10 or more deaths) from 1901 and 2000 and 4 disasters between 2001 and 2008

Mine accidents have been classified into the following categories:

(a) Disaster: Mine accidents having very high risks and potential to inflict heavy fatality/

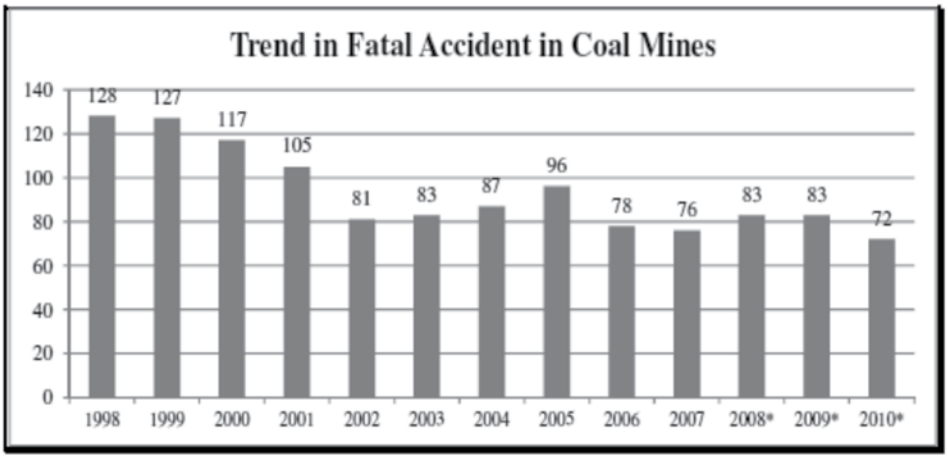
casualty to persons and destroy/damage the mining conditions are considered disasters. In the terms of fatalities, the occurrences of accident with 10 or more fatalities are considered disaster.

(b) Major Accidents: Accidents involving fatality to more than 3 and less than 10 persons areconsidered to be major accident.

(c) Fatal Accidents: Accidents resulting in fatality upto three persons are normally considered fatal accident.

(d) Serious Accidents: Serious accidents have been defined under the Mines Act, 1952 describing that "Serious bodily injury" means any injury which involves, or in all probability will involve, the permanent loss of any part or section of a body or the use of any part or section of a body, or the permanent loss of or injury to the sight or hearing or any permanent physical incapacity or the fracture of any bone or one or more joints or bones of any phalanges of hand or foot.

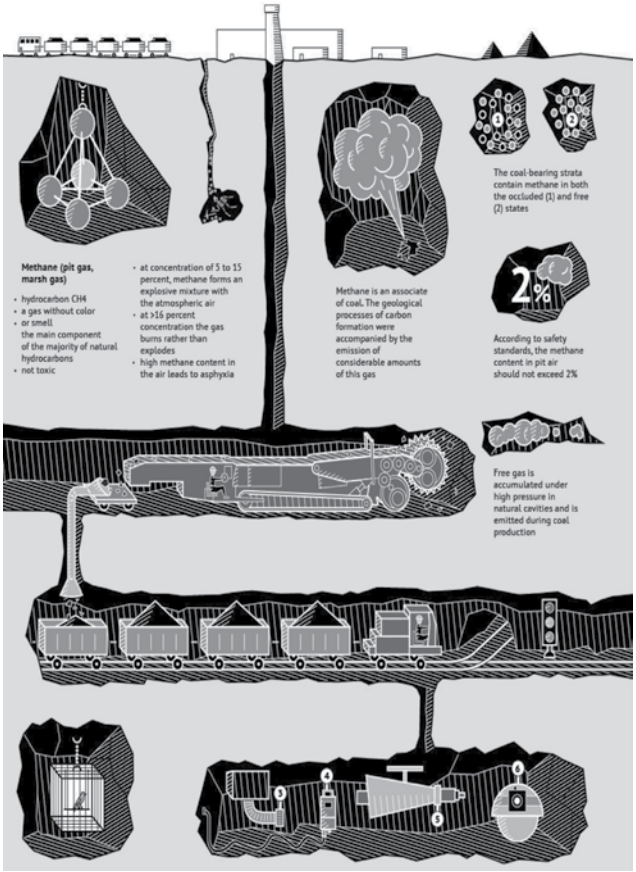
(e) Reportable Accidents: "reportable injury" means any injury other than a serious bodily injury which involves, or in all probability will involve, the enforced absence of the injured person from work for a period of seventy two hours or more.



Sl.	Date of Accident	Name of Mine	Killed	S/Injured	Cause of Accident No.
1	28/01/51	Ranipur	9	3	Descending Shaft
2	12/07/52	Dhemo Main	12	0	Fall of Roof
3	05/08/53	Majri	11	0	Irruption of Water
4	14/03/54	Damra	10	0	Explosion/Ingnition of Firedamp
5	10/12/54	Newton Chikli	63	0	Irruption of Water
6	05/02/55	Amlabad	52	1	Explosion of Inflammable Gas
7	26/09/56	Burradhemo	28	0	Irruption of Water
8	19/02/58	Chinakuri 1 & 2 Pits	176	7	Explosions
9	20/02/58	Central Bhowrah	23	0	Irruption of Water
10	02/01/60	Damua	16	0	Irruption of Water
11	28/05/65	Dhori	268	9	Explosion of Coal Dust
12	11/04/68	West Chirimiri	14	16	Fall of Sides
13	18/07/73	Noonodih Jitpur	48	13	Explosion / Ingnition of Ga Dust
14	08/08/75	Kessurgarh	11	1	Fall of Roof
15	18/11/75	Silewara	10	1	Irruption of water
16	27/12/75	Chasnalla	375	0	Irruption of Water
17	16/09/76	Central Saunda	10	0	Irruption of Water
18	04/10/76	Sudamdih Shaft	43	3	Explosion/Ignition of Gas/Dust
19	22/01/79	Baragolai	16	0	Explosion / ignition of Gas/Dust
20	24/06/81	Jagannath	10	4	Fire
21	16/07/82	Topa	16	4	Fall of Roof
22	14/09/83	Gurriladih	19	0	Inundation
23	19/11/93	Tipong	9	0	Explosion / ignition of Gas/Dust
24	25/01/94	New Kenda	55	0	Fire
25	27/09/95	Gaslitand	64	0	Irruption of Water
26	03/03/97	New Moghla	10	12	Explosion / ignition of Gas/Dust
27	24/06/00	Kawdi Open Cast	10	0	Fall of Sides
28	02/02/01	Bagdigi	29	0	Irruption of Water
29	16/06/03	Godavari Khani No. 7 LEF	17	0	Irruption of Water
30	17/10/03	Godavari Khani No. 8A	10	2	Fall of Roof
31	15/06/05	Central Sounda	14	0	Irruption of Water
32	06/09/06	Bhatdee	50	0	Explosion / ignition of Gas/Dust
33	06/05/10	Anjan Hill	14	5	Explosion / ignition of Gas/Dust
		Total	**1522**	**81**	

5. Disaster due to Explosion in Mines : Prevention, Control and Management

- A dust explosion is the fast combustion of dust particles suspended in the air in an enclosed location. Coal dust explosions are a frequent hazard in underground coal mines, but dust explosions can occur where any powdered combustible material is present in an enclosed atmosphere.
- Explosion: is a sudden increase in volume & release of energy in an extreme manner, & generation of high temperatures and release of gases.
- It creates a shock wave and turns into a coal mine disaster.
- Methane is main reason behind gas explosion in coal mine.
- When methane is mixed with air, at 5-15% of the mixture, it is highly explosive and generally responsible for the explosions in underground coal mines all over the world.
- Other two important factors are: presence of explosive mixture of Methane - Oxygen and source of ignition.
- Once ignited flame will self propagate throughout the mixture independently and away from source of ignition.
- In the case of explosion, it is normally associated with coal- dust explosion as the temperature rises up to 700 degree centigrade and it can cause explosion in the air-coal-dust mixture.
- For ignition of Methane explosion, there should be a spark or heated-surface for a definite time. For electrical spark, the current must be more than 750 /1000 ma





Statistics of Mine Disasters due to Explosion is given in the table below:

Sl. No.	Date of Accident	Name of Mine	Killed	S/Injured	Cause of Accident
1	14/03/54	Damra	10	0	Explosion/Ignition of Firedamp
2	05/02/55	Amlabad	52	1	Explosion of Inflamable Gas
3	19/02/58	Chinakuri 1 & 2 Pits	176	7	Explosions
4	28/05/65	Dhori	268	9	Explosion of Coal Dust
5	18/03/73	Noonodih Jitpur	48	13	Explosion/Ignition of Gas/Dust
6	04/10/76	Sudamdih Shaft	43	3	Explosion/Ignition of Gas/Dust
7	22/01/79	Baragolai	16	0	Explosion/Ignition of Gas/Dust
8	19/11/93	Tipong	9	0	Explosion/Ignition of Gas/Dust
9	03/03/97	New Moghla	10	12	Explosion/Ignition of Gas/Dust
10	06/09/06	Bhatdee	50	0	Explosion/Ignition of Gas/Dust
33	06/05/10	Anjan Hill	14	5	Explosion/Ignition of Gas/Dust
		TOTAL	**696**	**50**	

- It has been well acknowledged that coal mine methane gas is main hazard leading to mine explosions, apart from being a source of green house gas.
- As such extraction of Virgin Coal Mine Methane (VCMM), Coal Mine Methane (CMM) and Abandoned Coal Mine Methane (ACMM) in many coal producing countries and utilizing it for commercial purposes is right and positive direction in not only addressing mine safety issues, but also environmental issues.
- Commercial benefits and carbon credits are added advantages. Steps have also been taken in India to allocate blocks to public and private operators for extraction of VCMM.
- Pilot projects under UNDP Aid for extraction of CMM and its commercial utilisation has produced successful results in Sudambih and Monidih mines of BCCL.
- The primary causes of disaster due to explosion in coal mines are presence of methane or inflammable gas, sources of ignition from explosive, spontaneous heating or fire, electrical or frictional sparks.
- The explosion in most of the cases is followed by coal dust explosion which is more dangerous and devastating.
- Although all underground coal mines in the country have been declared gassy mines but degree III gassy mines are the highly risky in terms of presence of inflammable gas (methane) and ignition thereof.
- The degree II gassy mines come next to degree III in priority. The mines having degree III gassy seams and seams prone to spontaneous heating and fire combined together shall be considered mines having

very high degree risk of explosion. Such mines shall be in the hot list of priorities in this Directorate.

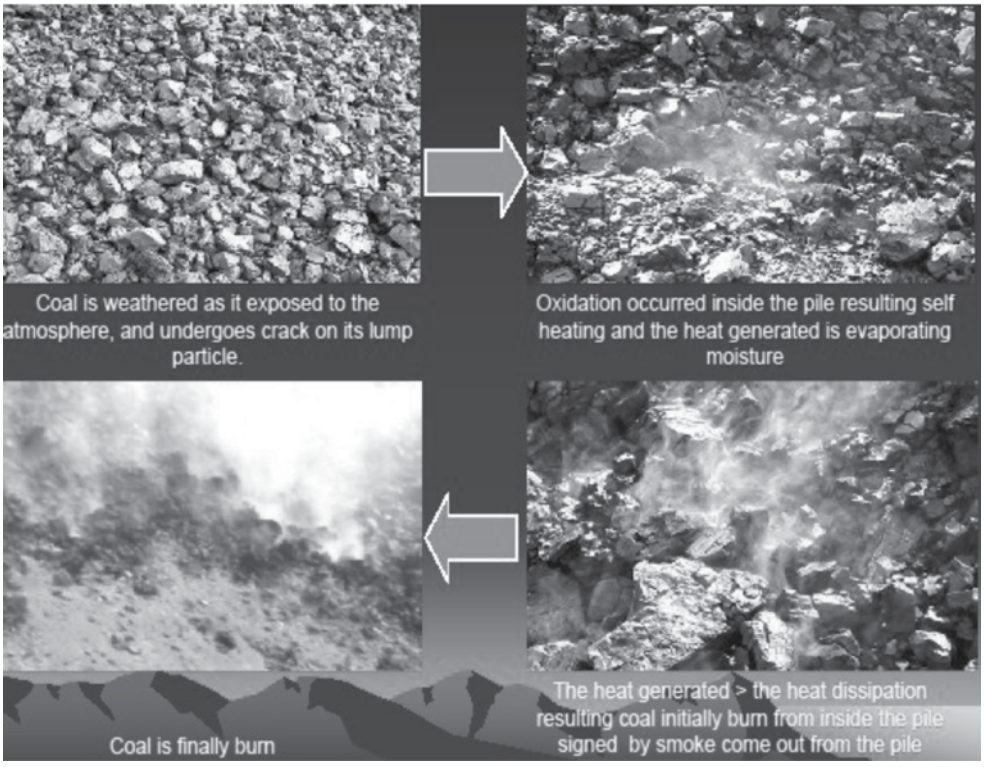
- Similarly mines having degree II gassy seams and presence of spontaneous heating and fire shall be treated equally to that of degree III gassy seams in terms of xplosion risk index. The third parameter contributing to explosion is the ventilation. Good ventilation always helps reduce risk of presence of inflammable gas in the mine atmosphere. Therefore it is essential to monitor the ventilation system in such mines preferably by online environmental monitoring system.

6. Disaster due to Mine Fire : Prevention, Control and Management

- Mine Fire are classified as Underground and Surface. Surface Fire may again be classified as Stock fire and Seam Fire.
- Mine Fires are consuming coal seams in major coal producing countries including China, United States, India and Indonesia.
- Numerous seams have been burning for decades and some in China for several centuries.
- Environmentally catastrophic effects for the coal fires include the emission of noxious gases particulate matter into the atmosphere for air pollution condensate products responsible for water and soil pollution

  - There are 3 major coal fires in the world
  - Coal fires in Northern China
  - Coal fire in Pennsylvania of USA
  - Coal fire in Jharia coalfields in India

- In India major coal fires in Jharia and Raniganj have killed people, forced entire communities to abandon their homes and business





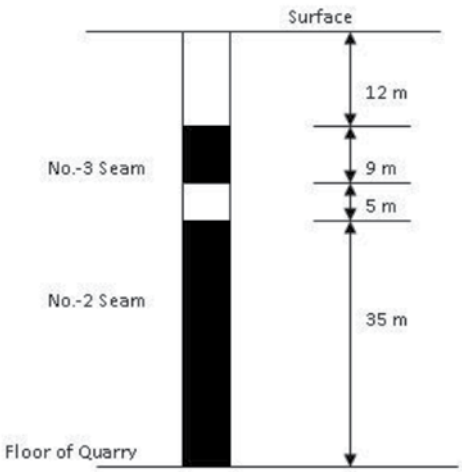
The Statistics of Mine Disasters due to Spontaneous heating, Fires and Noxious Gases

Sl. No	Date of Accident	Name of Mine	Killed	S/Injured	Cause of Accident
1	24/06/81	Jagannath	10	4	Fire
2	25.01.94	New Kenda	55	0	Fire
	Total		65	4	

- Coal seams are prone to be spontaneous heating/spontaneous combustion on exposure to atmosphere under certain conditions.
- The proneness of coal seams to spontaneous heating or fire depends on chemical and petrological characteristics of the seam which include auto ignition temperature of coal.
- The other physical characteristics include loss of coal in goaf and associated ventilation conditions.

Mine Fire Disaster at Jagannath OCP, Talcher Coalfield

At about 1 p.m. on 24.6.1981 a very unique kind of accident occurred at Jagannath opencast mine when a large quantity of hot ash and dust was ejected from the southern side of the quarry and was spread over a wide area. Fourteen workers, then present at a distance of about 60 m from the south quarry face, were engulfed in a cloud of ash and were severely burnt. Ten of them succumbed to their injuries within a few days while the remaining four survived with serious injuries.



This incident is the only one of its kind in this country and, as far as is known, it has no parallel anywhere else in the world. Because of the uniqueness of this accident, the Court of Inquiry decided to have the matter investigated thoroughly by scientists from CMRS and CFRI. Unfortunately, however, the Court and the scientists could make the first inspection of the site only after about 6 months of the occurrence when most of the field evidence was lost. The court's analysis was therefore based on facts brought out in the reports of the DGMS and the management and the evidence of the witnesses.

7. Mine Disaster due to Inundation

Statistics of Mine Disasters due to inundation is given in the table below:

Sl. No.	Date of Accident	Name of Mine	Killed	S/Injured	Cause of Accident
1	05/08/53	Majri	11	0	Irruption of Water
2	10/12/54	Newton Chikli	63	0	Irruption of Water
3	26/09/56	Burradhemo	28	0	Irruption of Water
4	20/02/58	Central Bhowrah	23	0	Irruption of Water
5	05/01/60	Damua	16	0	Irruption of Water
6	18/11/75	Silewara	10	1	Irruption of Water
7	27/12/75	Chasnalla	375	0	Irruption of Water
8	16/09/76	Central Saunda	10	0	Irruption of Water
9	14/09/83	Hurriladih	19	0	Irruption of Water
10	27/09/95	Gaslitand	64	0	Irruption of Water
11	02/02/01	Bagdigi	29	0	Irruption of Water
12	16/06/03	Godavari Khani No.7 LEP	17	0	Irruption of Water
13	15/06/05	Central Sounda	14	0	Irruption of Water
		TOTAL	679	1	

Reasons for Inundation: In-rush of waters to the mine areas

1. From surface water

- River
- Nallah
- Water course
- Water reservoirs
- Low lying areas

2. From adjoining mine having dis-used water logged old workings

3. From the same mine having water-logged old working in other seam/horizon

- A special initiative requires to be undertaken to identify mines working in and around rivers, nullah and water courses on surface as well as the sources of water belowground.
- The risks associated with such water bodies should be evaluated for each mine.
- The precautions against danger of inundation from surface as well as underground are available in most of the cases but due to changes in the working places and conditions, they need up-dation every year before onset of monsoon.
- Monsoon preparations are a part of normal preparedness in every mine. However, slippage is always there which lead to such accidents/ dangerous occurrences. Chasnala Mine Inundation (1975, 375 Deaths)

- This has been the greatest mine disaster in India so far cawing the highest number of deaths, Inrush of a large volume of water into the 13/14 combined seam workings of the new deep shaft mine from old abandoned incline workings in the same seam.
- The deep shaft mine was started in the mid-1960s and was developed on the horizon system. The first horizon was located 172 m below the surface and the second horizon 291 m below the surface. Fig.-1 shows a schematic diagram of the old working of 3 & 4 Inclines. Incline No.3 was driven along the true dip of the seam while Incline No.4 was driven along an apparent dip direction. The plan of the old mine showed that the workings had stopped at K-level. However, after the accident and dewatering of the mine, it was seen that No.3 Incline had gone down to an inclined distance of about 6 m beyond K-level and No.4 incline had gone to an inclined distance of 49 m below K-level. Line QQ represents horizon No.1 of the new shaft workings
- The old workings were full of water from K-level to C-level and must have contained about 500,000 m3 of water. K-level had 118 m of head of water above it. The connection between the old workings and the new workings was made in horizon No.1 at the inbye end of 15 m long ventilation cross-cut being driven from the hangwall towards the footwall. Fig.2 shows the details.

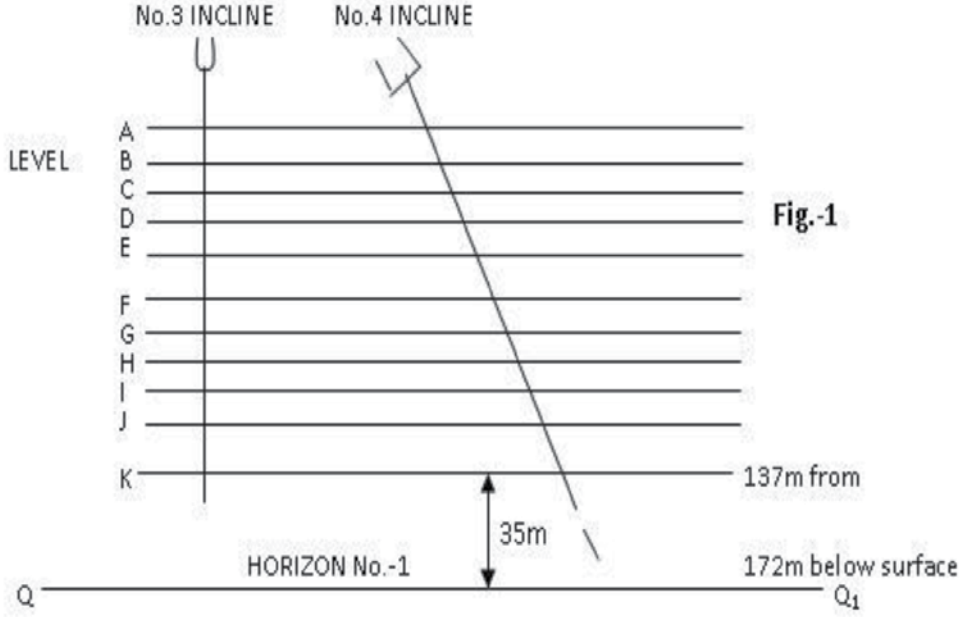


Fig.-1

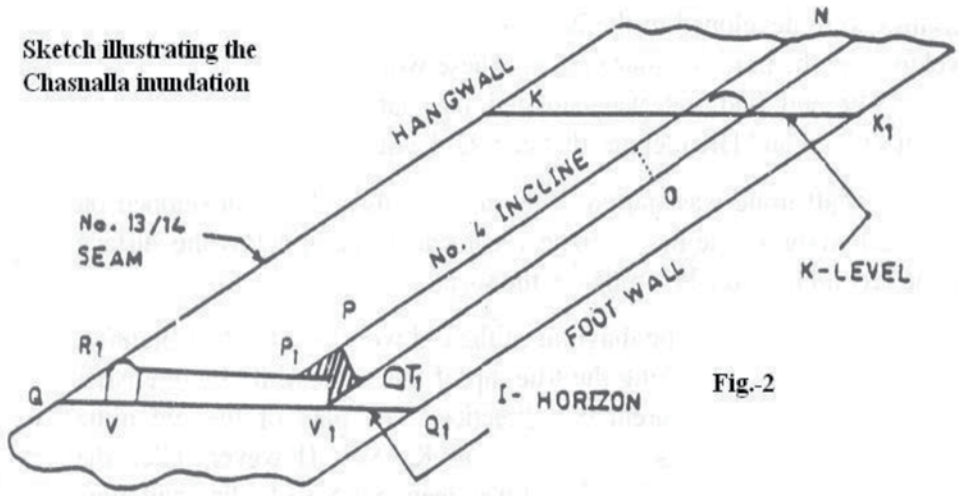
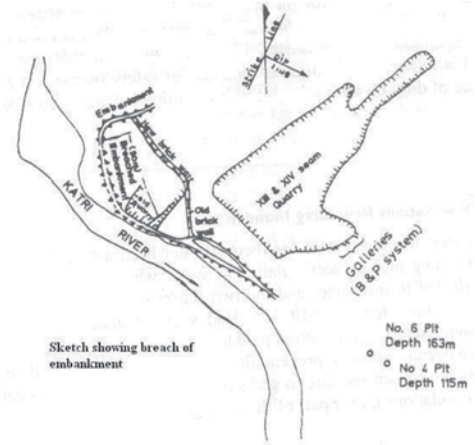


Fig.-2

Gazlitand Mine Inundation (1995, 64 Deaths)



Gaslitand Colliery, Date of the Accident – 26/27.9.1995,Owner – Bharat Coking Coal Ltd. ,Number of persons killed – 64

Place – Jharia Coalfield

Rising water of the flooded Katri River breached its embankment and entered underground workings through galleries exposed in the worked out quarry. Gaslitand mine, situated on the bank of Katri River.

There was an unusually heavy rainfall on the night of 26th September which surpassed all previous records. Against an average rainfall of 1350 mm per year in the Jharia Coalfield, rainfall of 330 mm was recorded on 26th September. The rain had started as a light drizzle at 4 p.m. and soon turned into a heavy downpour from 6 p.m. In just 3 hours between 8 p.m. and 11 p.m., a rainfall of 210 mm was recorded. Strong winds accompanied the rain. At 9.15 p.m. there was complete electrical power failure and the entire area was plunged into darkness in the stormy night. All machinery and equipment operated by electricity, including the main mechanical ventilator, stopped functioning.

The level of water in the Katri River was rising menacingly and must have crossed the danger mark and the withdrawal mark by 10 p.m. but unfortunately on that fateful night no guard was on duty in the second shift to keep a watch on the level of water in the Katri River. While some of the neighbouring mines had withdrawn all persons working belowground by 10 p.m., the management of Gaslitand Colliery remained insensitive to the impending danger and failed to take this basic precaution.

8. Concluding Remarks

Coal Mining Industry is a hazards Industry and although Mine Fire, Explosion and inundation are

more relevant for underground Coal Mines but due to the proximity of the Mines and related road and rail infrastructure to the highly populated areas, disaster for the entire community cannot be ruled out due to the above accidents.

Hence all precautions are required to be undertaken and to be monitored very sincerely to avoid loss of precious human life and property. This paper deals with these hazards related with Coal Mining activities for the awareness in general.

The views expressed are necessarily of the Author and not the organization to which he belongs.

The author is grateful to the MDC on SHE for giving this opportunity to share the information and is also grateful to Chairman-Cum Managing Director, MCL and General Manager, Jagannath Area to allow him for presenting the paper.

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ACTS AND RULES

I

THE CHEMICAL ACCIDENTS (EMERGENCY PLANNING, PREPAREDNESS, AND RESPONSE) RULES, 1996

MINISTRY OF ENVIRONMENT & FOREST
SNOTIFICATION
(New Delhi, the 1st August, 1996)

RULES ON EMERGENCY PLANNING, PREPAREDNESS AND RESPONSEFOR CHEMICAL ACCIDENTS

***G.S.R.347(E) :-** In exercise of the power conferred by Section 6, 8 and 25 of theEnvironment (Protection) Act, 1986 (29 of 1986), the Central Government herebymakes the following rules, namely

1. Short Title and Commencement-

(I) These rules may be called the ChemicalAccidents (Emergency Planning, Preparedness, and Response) Rules, 1996.

(II) They shall come into force on the date of their publication in the Official Gazette.

2. Definitions :- In these rules unless the context otherwise requires-

a) "chemical accident" means an accident involving a fortuitous, or Sudden orunintended occurrence while handling any hazardous chemicals resulting incontinuous, intermittent or repeated exposure to death, or injury to, any personor damage to any property but does not include an accident by reason only ofwar or radio-activity;

(b) "hazardous chemical" means :-

(i) any chemical which satisfies any of the criteria laid down in Part I of Schedule1 or is listed in Part 2 of the said schedule;

(ii) any chemical listed in Column 2 of Schedule 2;

(iii) any chemical listed in Column 2 of Schedule 3;

(c) "industrial activity" includes an operation or process,-

(i) carried out in an industrial installation referred to in Schedule -4 involving orlikely to involve one or more hazardous chemicals;

(ii) on-site storage or on-site transport which is associated with that operation orprocess as the case may be;

(iii) isolated storage;

(iv) pipeline;

(d) "industrial pocket" means any industrial zone ear-marked by the IndustrialDevelopment Corporation of the State Government or by the StateGovernment;

(e) "isolated storage" means,- storage of a hazardous chemical other than storageassociated with an installation on the same site specified in Schedule 4where that storage involves at least the quantities of that chemical set out inSchedule-2;

(f) "major chemical accident" means, - an occurrence including any particularmajor emission, fire or explosion involving one or more hazardous chemicalsand resulting from uncontrolled developments in the course of industrialactivity or transportation or due to natural events leading to serious effects bothimmediate or delayed, inside or outside the installation likely to causesubstantial loss of life and property including adverse effects on theenvironment;

(g) "Major Accident Hazards (MAH) Installations".- means, isolated storage andindustrial activity at a site, handling (including transport through carrier orpipeline) of hazardous chemicals

equal to or, in excess of the thresholdquantities specified in column 3 of Schedule 2 and 3 respectively;

(h) "Manufacture, Storage and Import of Hazardous Chemical, Rules" means, - the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, published in the notification of Government of India in the Ministry of Environment & Forests No. S.0.966 (E), dated 27th November, 1989;

(i) "off-site emergency plan" means,- the off-site emergency plan prepared underrule 14 of the Manufacture, Storage and Import of Hazardous ChemicalsRules;

(j) "pipeline" means,- a pipe (together with any apparatus and works associatedtherewith) or system of pipes (together with any apparatus and worksassociated therewith) for the conveyance of a hazardous chemical other than aflammable gas as set out in column 2 of Part 11 of Schedule 1, at a pressure ofless than 8 bars absolute;

(k) "site" means,- any location where hazardous chemicals are manufactured orprocessed, stored, handled, used, disposed of and includes the whole of anarea under the control of an occupier and includes pier, jetty or similarstructure whether floating or not;

(l) "transport" means.- movement of hazardous chemicals by any means overland, water or air.

3. Constitution of Central Crisis Group.-

(a) The Central Government shallconstitute a Central Crisis Group for management of chemical accidents and set up a Crisis Alert System in accordance with the provisions of Rule-4 within thirty days fromthe date of the commencement of these rules

(b) The composition of the Central Crisis Group shall be as specified in Schedule 5.

(c) The Central Crisis Group shall meet at least once in six months and follow suchprocedure for transaction of business as it deems fit.

(d) Notwithstanding anything contained in sub-rule (2), the Central Crisis Group mayco opt any person whose assistance or advice is considered useful in performing anyof its functions to participate in the deliberations of any of its meetings.

4. Constitution of Crisis Alert System :-

The Central Government shall,-

(a) set up a functional control room at such place as it deems fit;

(b) set up an information net working system with the State and district controlrooms;

(c) appoint adequate staff and experts to man the functional control room;

(d) publish a list of Major Accident Hazard installations;

(e) publish a list of major chemical accidents in chronological order;

(f) publish a list of members of the Central, State and District Crisis Groups;

(g) take measures to create awareness amongst the public with a view topreventing chemical accidents.

5. Functions of the Central Crisis Group:

(I) The Central Crisis Group shall be tileapex body to deal with major chemical accidents and to provide expert guidance forhandling major chemical accidents.

(II) Without prejudice to the functions specified under sub-rule (1), the Central Crisis Group shall,-

(a) continuously monitor the post accident situation arising out of a majorchemical accident and suggest measures for prevention and to checkrecurrence of such accidents;

(b) conduct post-accident analysis of such major chemical accidents and evaluateresponses;

(c) Review district off-site emergency plans with a view to examine its adequacy inaccordance with the Manufacture, Storage and Import of HazardousChemicals, Rules, and suggest measures to reduce risks in the Industrialpockets;

(d) Review the progress reports submitted by the State Crisis Groups;

(e) Respond to queries addressed to it by the State Crisis Groups and the DistrictCrisis Groups;

(f) Publish a State-wise list of experts and officials who are concerne" with thehandling of chemical accidents;

(g) Render, in the event of a chemical accident in a State, all financial and infra-structural help as may be necessary.

6. Constitution of State Crisis Group.-

(I) The State Government shall constitute aState Crisis Group for management of chemical accidents within thirty days from thedate of the commencement of these rules.

(II) The composition of the State Crisis Group shall be as specified in Schedule 6.

(III) The State Crisis Group shall meet at least once in three months and follow suchprocedure for transaction of business as it deems fit.

(IV) Notwithstanding anything contained in sub-rule (2), the State Crisis Group mayco-opt any person whose assistance or advice is considered useful in performing anyof its functions, to participate in the deliberation of any of its meetings.

7. Functions of the State Crisis Group :-

(I) The State Crisis Group shall be theapex body in the State to deal with major chemical accidents and to provide expertguidance for handling major chemical accidents

(II) Without prejudice to the functions specified under sub-rule (1), the State CrisisGroup shall,-

(a) Review all district off-site emergency plans in the State with a view to examineits adequacy in accordance with the Manufacture, Storage and Import ofHazardous Chemicals, Rules and forward a report to the Central Crisis Grouponce in three months;

(b) Assist the State Government in managing chemical accidents at a site;

(c) Assist the State Government in the planning, preparedness and mitigation ofmajor chemical accidents at a site in the State;

(d) Continuously monitor the post accident situation arising out of a majorchemical accident in the State and forward a report to the Central Crisis group;

(e) Review the progress report submitted by the District Crisis groups;

(f) Respond to queries addressed to it by the District Crisis groups;

(h) Publish a list of experts and officials in the State who are concerned with themanagement of chemical accidents.

8. Constitution of the District and Local Crisis Group.-

(I) The State Governmentshall cause to be constituted within thirty days from the date of commencement ofthese rules,-

(a) District Crisis Groups;

(b) Local Crisis Groups;

(II) The composition of the District Crisis Groups and the Local Crisis Groups shall beas specified in Schedule 7 and 8 respectively.

(II) The District Crisis Group shall me et every forty five days and send a report to theState Crisis Group;

(IV) The Local Crisis Group shall meet every month and forward a copy of theproceedings to the District Crisis Group.

9. Functions of the District Crisis Group.-

(I) The District Crisis Group shall be theapex body in the district to deal with major chemical accidents and to provide expertguidance for handling chemical accidents;

(II) Without prejudice to the functions specified under sub-rule (1). the District Crisis Group shall,-

(a) Assist in the preparation of the district off-site emergency plan;

(b) Review all the on-site emergency plans prepared by the occupier of MajorAccident Hazards installation for the preparation of the district off-site emergencyplan;

(c) Assist the district administration in the management of chemical;

(d) Continuously monitor every chemical accident;

(e) Ensure continuous information flow from the district to the Central and State CrisisGroup regarding accident situation and mitigation efforts;

(f) Forward a report of the chemical accident within fifteen days to the State CrisisGroup;

(g) Conduct at least one full scale mock-drill of a chemical accident at a site each yearand forward a report of the strength and the weakness of the plan to the State Crisis Group.

10. Functions of the Local Crisis Group :-

(I) The Local Crisis Group shall be thebody in the industrial pocket to deal with chemical accidents and coordinate efforts inplanning, preparedness and mitigation of a chemical accident;

(II) Without prejudice to the functions specified under sub-rule (1), the Local CrisisGroup shall.

(a) Prepare local emergency plan for the industrial pocket

(b) Ensure dovetailing of the local emergency plan with the district off-siteemergency plan;

(c) Train personnel involved in chemical accident management;

(d) educate the population likely to be affected in a chemical accident about theremedies and existing preparedness in the area;

(e) conduct at least one full scale mock-drill of a chemical accident at a site everysix months forward a report to the District Crisis Group;

(f) respond to all public inquiries on the subject.

11. Powers of the Members of the Central, State and District Crisis Groups:-

(I) the Members of the Central Crisis Group, State Crisis Groups and District CrisisGroups shall be deemed to be persons empowered by the Central Government inthis behalf under sub-section (1) of section 10 of the Environment (Protection) Act,1986.

12. Aid and Assistance for the functioning of the District and Local CrisisGroups:-

(I) The Major Accident Hazard installations in the industrial pockets in the districtshall aid, assist and facilitate functioning of the District Crisis Group;

(II) The Major Accident Hazard installations in the industrial pockets shall also aid,assist and facilitate the functioning of the Local Crisis Group.

13. Information to the Public.-

(I) the Central Crisis Groups shall provideinformation on request regarding chemical accident prevention, preparedness andmitigation in the country;

(II) The State Crisis Group shall provide information on request regarding chemicalaccident prevention, preparedness and mitigation to the public in the State;

(III) The Local Crisis Group shall provide information regarding possible chemical accident at a site in the industrial pocket and related-information to the public onrequest;

(IV) The Local Crisis Group shall assist the Major Accident Hazard installations in theindustrial pocket in taking appropriate steps to inform persons likely to be affected bya chemical accident.

Sr.No.	Schedules	Files		
1	Schedule 1	[html]	[pdf]	[word]
A	Part I	[html]	[pdf]	[word]
B	Part II: List of Hazardous and ToxicChemicals	[html]	[pdf]	[word]
2	Schedule 2	[html]	[pdf]	[word]
3	Schedule 3: Named Chemicals	[html]	[pdf]	[word]
4	Schedule 4	[html]	[pdf]	[word]
5	Schedule 5: Composition of the CentralCrisis Group	[html]	[pdf]	[word]
6	Schedule 6: Composition of the State CrisisGroup	[html]	[pdf]	[word]
7	Schedule 7: Composition of the DistrictCrisis Group	[html]	[pdf]	[word]
8	Schedule: Composition of the Local CrisisGroup	[html]	[pdf]	[word]

II

Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000.

Ministry of Environment and Forests New Delhi, the 19th January, 2000
Notification

S.O.57(E) --Whereas certain draft rules further to amend the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 were published under the notification of the Government of India in the Ministry of Environment and Forests number S.O. 25(E) dated 21st January, 1999 inviting objections and suggestions from all persons likely to be affected thereby before the expiry of the period of sixty days from the date on which the copies of the Gazette containing the said notification are made available to the public; And whereas copies of the said Gazette were made available to the public on the 4th March, 1999; And whereas objections and suggestions received from the public in respect of the said draft rules have been duly considered by the Central Government; Now, therefore, in exercise of the powers conferred by sections 6,8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, namely: -

the Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000.

1. (i) These rules may be called the Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000.

   (II) They shall come into force on the date of their publication in the Official Gazette.

2. In the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (hereinafter referred to as the said rules), in rule 2,- i. in clause (e) for the words and figure "Schedule-1 and is" the words and figure "Schedule-1 or" shall be substituted; ii. for clause (j), the following clauses shall be substituted, namely;- '(j) "major accident" means - an incident involving loss of life inside or outside the installation, or ten or more injuries inside and/or one or more injuries outside or release of toxic chemicals or explosion or fire or spillage of hazardous chemicals resulting in on-site or off-site emergencies or damage to equipment leading to stoppage of process or adverse affects to the environment;

   (ja) "major accident hazards (MAH) installations" means - isolated storage and industrial activity at a site handling (including transport through carrier or pipeline) of hazardous chemicals equal to or , in excess of the threshold quantities specified in, column 3 of schedule 2 and 3 respectively;'

3. In rule 4of the said rules in sub-rule (1), -

   (i) in clause (a), for the words "and is listed", the words "or listed" shall be substituted;

   (ii) for clause (b), the following clause shall be substituted, namely:- "(b) isolated storage of a hazardous chemical listed in Schedule 2 in a quantity equal to or more than the threshold quantity specified in column 3, thereof."

4. In rule 6 of the said rules, in sub-rule (1), in clause (b) for the words and figure "Column 4", the words, figures and brackets "Columns 3 and 4 (rules 10-12 only for column 4)" shall be substituted.

5. In rule 7 of the said rules, for the marginal heading "Notification of sites" the heading "Approval and Notification of sites" shall be substituted.
6. In rule 10 of the said rules, for the marginal heading "Safety Reports" the marginal heading "Safety reports and safety audit reports" shall be substituted.
7. In rule 17 of the said rules, in sub-rule (1) for the words "and is listed" the words "or listed " shall be substituted.
8. In rule 18 of the said rules, in sub-rule (1), for the words "and is listed" the words "or listed " shall be substituted.

9. In the said rules, for Schedule-1and the entries relating thereto, the following Schedule and entries shall be substituted, namely :- [See rule 2e(i), 4(1)(a), 4(2), 17 and 18]

[Part - I]

(a) 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	Toxicity	Oral toxicity LD50(mg/kg)	Dermal toxicity LD50(mg/kg)	Inhalation toxicity LC50(mg/l)
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

(b) Flammable Chemicals:

(i). flammable gases: Gases which at 200C and at standard pressure of 101.3 KPa are:-

a. ignitable when in a mixture of 13 percent or less by volume with air, or
b. have a flammable range with air of at least 12 percentage points regardless of the lower flammable limits.

Note:- The flammability shall be determined by tests or by calculation in accordance with methods adopted by International Standards Organisation ISO Number10156 of 1990 or by Bureau of Indian Standards ISI Number 1446 of 1985.

(ii). extremely flammable liquids: chemicals which have flash point lower than or equal to 230C and boiling point less than 350C

(iii) very highly flammable liquids: chemicals which have a flash point lower than or equal to 230C and initial boiling point higher than 350C.

(iv) highly flammable liquids: chemicals which have a flash point lower than or equal to 600C but higher than 230C.

(v) flammable liquids: chemicals which have a flash point higher than 60oC but lower than 900 C.

(c) Explosives : explosives means a solid or liquid or pyrotechnic substance (or a mixture of substances) or an article.

(a) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings;

(b) which is designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self sustaining exothermic chemical reaction.

PART-II
LIST OF HAZARDOUS CHEMICALS

1. Acetaldehyde
2. Acetic acid
3. Acetic anhydride
4. Acetone
5. Acetone cyanohydrin
6. Acetone thiosemicarbazide
7. Acetonitrile
8. Acetylene
9. Acetylene tetra chloride
10. Acrolein
11. Acrylarnide
12. Acrylonitrile
13. Adiponitrile
14. Aldicarb
15. Aldrin

16. Allyl alcohol
17. Allyl amine
18. Allyl chloride
19. Aluminiurn (powder)
20. Aluminiurn azide
21. Aluminiurn borohydride
22. Aluminium chloride
23. Aluminium fluoride
24. Aluminium phosphide
25. Amino diphenyl
26. Amino pyridine
27. Aminophenol-2
28. Aminopterin
29. Amiton
30. Amiton dialate
31. Ammonia
32. Ammonium chloro platinate
33. Ammonium nitrate
34. Ammonium nitrite
35. Ammonium picrate
36. Anabasine
37. Aniline
38. Aniline 2, 4, 6-Trimethyl
39. Anthraquinone
40. Antimonypentafluoride
41. Antimycin A
42. ANTU
43. Arsenic pentoxide
44. Arsenic trioxide
45. Arsenous trichloride
46. Arsine
47. Asphalt
48. Azinpho-ethyl
49. Azinphos methyl
50. Bacitracin
51. Barium azide
52. Barium nitrate
53. Barium nitride
54. Benzal chloride
55. Benzenamine 3-Trifluoromethyl
56. Benzene
57. Benzene sulfonyl chloride
58. Benzene 1-(chloromethyl)-4 Nitro
59. Benzene arsenic acid
60. Benzidine
61. Benzidine salts
62. Benzimidazole, 4, 5-Dichloro-2 (Trifluoromethyl)
63. Benzoquinone-P
64. Benzotrichloride
65. Benzoyl chloride
66. Benzoyl peroxide
67. Benzyl chloride
68. Beryllium (powder)
69. Bicyclo (2, 2, 1) Heptane-2 -carbon itri le
70. Biphenyl
71. Bis (2-chloroethyl) sulphide
72. Bis (Chloromethyl) Ketone
73. Bis (Tert-butyl peroxy) cyclohexane
74. Bis (Terbutylperoxy) butane
75. Bis (2,4,6-Trimitrophenylamine)
76. Bis (Chloromethyl) Ether
77. Bismuth and compounds
78. Bisphenol-A
79. Bitoscanate
80. Boron Powder
81. Boron trichloride
82. Boron trifluoride
83. Boron trifluoride comp. With methylether, 1: 1
84. Bromine
85. Bromine pentafluoride
86. Bromo chloro methane
87. Bromodialone
88. Butadiene
89. Butane
90. Butanone-2
91. Butyl amine tert
92. Butyl glycidal ether
93. Butyl isovalarate
94. Butyl peroxymalente tert
95. Butyl vinyl ether
96. Butvl-n-mercaptan

97. C. I. Basic green
98. Cadmium oxide
99. Cadmium stearate
100. Calcium arsenate
101. Calcium carbide
102. Calcium cyanide
103. Camphechlor Toxaphene)
104. Cantharidin
105. Captan
106. Carbachol chloride
107. Carbaryl
108. Carbofuran (Furadan)
109. Carbon tetrachloride
110. Carbon disulphide
111. Carbon monoxide
112. Carbophenothion
113. Carvone
114. Cellulose nitrate
115. Chloroicetic acid
116. Chlordane
117. Chlorofenvinphos
118. Chlorinated benzene
119. Chlorine
120. Chlorine oxide
121. Chlorine trifluoride
122. Chlormeplos
123. Chlormequat chloride
124. Chloroacetal chloride
125. Chloroacetaldehyde
126. Chloroaniline-2
127. Chloroaniline-4
128. Chlorobenzene
129. Chloroethyl chloroformate
130. Chloroform
131. Chloroformyl morpholine
132. Chloromethane
133. Chloromethyl methylether 134. Chloronitrobenzene
135. Chlorophacinone
136. Chiorosulphonic acid
137. Chlorothiophos
138. Chloroxuron
139. Chromic acid
140. Chromic chloride
141. Chromium powder
142. Cobalt carbonyl
143. Cobalt Nitrilmethylidyne compound
144. Cobalt (powder)
145. Colchicine
146. Copper and compounds
147. Copperoxydiloride
148. Counialuryl
149. Couniaphos
150. Couniatertralyl
151. Crimidine
152. Crotenaldehyde
153. Crotonaldehyde
154. Cumene
155. Cyano-en bromide
156. Cyano-en iodide
157. Cyariophos
158. Cyanothoate
159. Cyamiric fluoride
160. Cyclo hexylanline
161. Cyclohexane 1
62. Cyclobexatione
163. Cyclohexim ide
164. Cyclopentadiene
165. Cyclopentane 1
166. Cyclotetramethylenetetranitramine
167. Cyclotrimethylenetrinitramine
168. Cypermethrin
169. DDT
170. Decahorane (1:4)
171. Demeton
172. Demelon S-Methyl
173. Di-n-propyl peroxydicarbonate (Conc = 80%)
174. Dialifos
175. Diazodinitrophenol
176. Dibenzyl peroxydicarbonate (Conc > 90%)

177. Diborane
178. Dichloroacetylene
179, Dichlorobenzalkonium chloride
180. Dichloroethyl ether
181. Dichloromethyl phenylsilane
182. Dichlorophenol-2.6
183. Dichlorophenol-2.4
184. Dichlorophenoxy acetic acid
185. Dichloropropane-2,2
186. Dichlorosalicylic acid-3,5
187. Did-lo-rvos (DDVP)
188. Dicrotophos 189.Dieldrin
190. Diepoxy butane
191. Diethyl carbamazine citrate
192. Diethyl chlorophosphate
193. Diethyl ethanolamine
194. Diethl peroxydicarbonate (Conc 330%)
195. Diethyl phenylene diamine
196. Diethylamine
197. Diethyfeneglvcol
198. Diethylene glycol dinitnate
199. Diethylene triamine
200. Diethleneglyrol butyl ether
201. Diglycidyl ether
202. Digitoxin
203. Dibydroperoxypropane (Conc- 30%)
204. Diisobutyl peroxide
205. Dinietox 206. Dimethoate
207. Dimethyl dichlorosilane
208. Dimethyl hydrazine
209. Dimethyl nitrosoamine
210. Dimethyl P phenylene diamine
211. Dunethyl phosphoramidi cyanidic acid (TABUM)
212. Dimethl phosphorochloridothioate
213. Dirnethyl sufolane (DMS)
214. Dirnethy! sulphide
215. Dimethylamine
216. Dimethylaniline
217. Dimethlcarbonyl chloride
218. Dimetilan
219. Dinitro O-cresol
220. Dinitrophenol
221. Dinitrotoluene
222. Dinoseb
223. Dinoterb
224. Dioxane-p
225. Dioxathion
226. Dioxine N
227 Diphacinone
228. Diphosphoramide octagnethyl
229. Diphenyl methane di-isocynate (MDI)
230. Dipropylene Colycol Butyl ether
231. Dipropylene glycolmethylether
232. Disec-butyl peroxydicarbonate (Conc > 80%)
233. Disufoton
234. Dithiazamine iodide
235. Dithiobiurate
236. Endosulfan
237. Endothion
238. Endrin
239. Epichlorohydrine
240. LPN
241 Ergocalciferol
242. Ergotamine tartarate
243. Ethanesulfenyl chloride, 2 Oloro
244. Ethanol 1-2 dichloracolte
245. Ethion
246. Ethoprophos
247. Ethyl acetate
248. Ethyl alcohol
249. Ethyl benzene
250. Ethyl bis amine
251. Ethyl-bromide
252. Ethyl carbamate
253. Ethyl ether
254. Ethyl hexanol-2
255. Ethyl mercaptan
257. Ethyl methacrylate
258. Ethyl nitrate
259. Ethyl thiocyanate

260. Ethylamine
261. Ethylene
262. Ethylene chlorohydrine
263. Ethylene dibromide
264. Ethylene diamine
265. Ethylene diamine hydrochloride
266. Ethylene flourohydrine
267. Ethylene glycol
268. Ethylene glycol dinitrate
269. Ethylene oxide
270. Ethylenimine
271. Ethylene di chloride
272. Femamiphos
273. Fernitrothion
274. Fensulphothion
275. Pluemetil
276. Fluorine
277. Fluoro 2-hydroxy butyric acid amid salt ester
278. Fluoroacetamide
279. Fluoroacetic acid amide salts and esters
280. Fluoroacetylchloride
281 Fluorobutyric acid amide salt esters
292. Fluorocrotonic acid amides salts esters
293. Fluorouracil
294. Fonofos
295. Formaldehyde
286. Formetanate hydrochloride
287. Formic acid
289. Formoparanate
289. Formothion
290. Fosthlotan
291. Fuberidazole
292. Furan
293. GAlium Trichloride
294. Glyconitrile (Hydroxyacetonitrile)
295. Guanyt-4-nitrosaminoguynyl-1-tetrazene
296. Heptachlor
298. Hexachlorobenzene
299. Hexachlorocyclohexan (Lindane)
300. Hexachlorocyclopentadiene
301. Hexachlorodibenzo-p-dioxin
302. Hexachloronapthalene
303. Hexafluoropropanone sesquihydrate
304. Hexamethyl phosphoroamide
305. Hexamethylene diamine N N dibutyl
306. Hexane
307. Hexanitrostilbene 2 2 4 4 6 6
308. Hexene
309. Hydrogen selenide
310. Hydrogen sulphide
311. Hydrazipe
312. Hydrazine nitrate
313. Hydrochloric acid (Gas)
314. Hydrogen
315. Hydrogen bromide
316. Hydrogen cyanide
317. Hydrogen fluoride
318. Hydrogen peroxide
319. Hydroquinone
320. Indene
321. Indium powder
322. Indomethacin
323. Iodine
324. Iridium tetrachloride
325. Ironpentacarbonyl
326, Iso benzan
327. Isoamyl alcohol
328. Isobutyl alcohol
329. Isobutyro nitrile
330. Isocyanic acid 3 4-dichlorophenyl ester
331. Isodrin
331. Isofluorophosphate
333. Isophorone diisocyanate
334. Isopropyl alcohol
335. Isopropyl chlorocarbonate
336. Isopropyl formate
337. Isopropyl methyl pyrazolyl dimethyl carbamate
338. Juglone (5-Hydroxy Napthalene- 1, 4 dione)
339. Ketene
340. Lactonitrile

341. Lead arsenite
342. Lead at high temp (molten)
343. Lead azide
344. Lead styphanat e
345. Leptophos
346. Lenisite
347. Liquified petroleum gas
348. Lithium hydride
349. N-Dinitrobenzene
350. Magnesium powder or ribbon
351. Malathion
352, Maleic anhydride
353. Malononitrile
354. Manganese Tricarbonyl cyclopentadiene
355. Mechlor ethamine
356. Mephospholan
357. Mercuric chloride
358. Mercuric oxide
359. Mercury acetate
360. Mercury fulminate
361. Mercury methyl chloride
362. Mesitylene
363. Methaacrolein diacetate
364. Methacrylic anhydride
365. Methacrylonitrile
366. Methacryloyl oxyethyl isocyanate
367. Methanidophos
368. Methane
369. Methanesulphonyl fluoride
370. Methidathion
371. Methiocarb
372. Methonyl
373. Methoxy ethanol (2-methyl cellosolve)
374. Methoxyethyl mercuric acetate
375. Methyacrylol chloride
376. Methyl 2-chloroacrylate
377. Methyl alcohol
378. Methyl amine
379. Methyl bromide (Bromomethane)
380. Methyl chloride
381. Methyl chloroform
382. Methyl chloroformate
383. Methyl cyclohexene
384. Methyl disulphide
385. Methyl ethyl ketone peroxide (Conc. 60%)
386. Methyl formate
387. Methyl hydrazine
388. Methyl isobutyl ketone
389. Methyl isocyanate
390. Methyl isothiocyanate
391. Methyl mercuric dicyanamide
392. Methyl Mercaptan
393. Methyl Methacrylate
394. Methyl phencapton
395. Methyl phosphonic dichloride
396. Methyl thiocyanate
397. Methyl trichlorosilane
398. Methyl vinyl ketone
399. Methylene bis (2-chloroaniline)
400. Methylene chloride
401. Methylenebis-4, 4(2-chloroaniline)
402. Metolcarb
403. Mevinphos
404. Mezacarbate
405. Mitomycin C
406. Molybdenum powder
407. Monocrotophos
408. Morpholine
409. Muscinol
410. Mustard gas
411. N-Butyl acetate
412. N-Butyl alcohol
413. N-Hexane
414. N-Methyl-N, 2, 4, 6-Tetranitroaniline
415. Naphtha
416. Naphtha solvent
417. Naphthalene
418. Naphthyl amine
419. Nickel carbonyl/nickel tetracarbonyl
420. Nickel powder
421. Nicotine
422. Nicotine sulphate

423. Nitric acid
424. Nitric oxide
425. Nitrobenzene
426. Nitrocellulose (dry)
427. Nitrochlorobenzene
428. Nitrocycfohexane
429. N itrogen
430. Nitrogen dioxide
431. Nitrogen oxide
432. Nitrogen trifluouide
433. Nitroglycerine
434. Nitropropane-1
435. Nitropropane-2
436. Nitroso dimethyl amine
437. Nonane
438. Norbormide
439. O-Cresol
440. O-Nitro Toluene
441. O-Toludine
442. O-Xylene
443. O/P Nitroaniline
444. Oleurn
445. OO Diethyl s ethyl suph. methyl ph
446. OO Diethyl s propythio methyl phosdithioate
447. OO Diethyl s thylsulphinylmethylphosphorothioate
448. OO Diethyl s ethylsulphonvimethylphosphorothioate
449. OO Diethyl s ethylthiomethylphosphorothioate
450. Organo rhodium complex
451. Orotic acid
452. Osmium tetroxide
453. Oxabain
454. Oxamyl
455. Oxetane, 3, 3,-bis(chloromethyl)
456. Oxidiphenoxarsine
457. Oxy disuffoton
458. Oxygen (liquid)
459 Oxygen difluoride
460. Ozone
461. P-nitrophenol
462. Paraffin
463. Paraoxon (Diethyl 4 Nitrophenyphosphate)
464. Paraquat
465. Paraquat methosulphate
466. Parathion
467. Parathion methyl
468. Paris green
469. Penta borane
470. Penta chloro ethane
471. Penta chlorophenol
472. Pentabromophenol
473. Pentachloro naphthalene
474. Pentadecyl-amine
475. Pentaerythaiotol tetranitrate
476. Pentane
477. Pentanone
478. Perchloric acid
479. Perchloroethylene
480. Peroxyacetic acid
481. Phenol
482. Phenol, 2, 2-thiobis (4, 6-Dichloro)
483. Phenol, 2, 2-thiobis (4 chloro 6 methyl phenol)
484. Phenol, 3-(1-methyl ethyl)-methylcarbamato
485. Phenyl hydrazine hydrochloride
486. Phenyl mercury acetate
487. Phenyl silatrane
488. Phenyl thiourea
489. Phenylene P-diamine
490. Phorate
491. Phosazetin
492. Phosfolan
493. Phosgene
494. Phosmet
495. Phosphamidon
496. Phosphine
497. Phosphoric acid
498. Phosphoric acid dimethyl (4-methl thio) phenyl

499. Phosphorothioic acid dimethyl S(2-Bis) Ester
500. Phosphorothioic acid methyl (ester)
501. Phosphorothioic acid, 00 Dimethyl S-(2-methyl)
502. Phosphorothioic, methyl-ethyl ester
503. Phosphorous
504. Phosphorous oxychloride
505. Phosphorous pentaoxide
506. Phosphorous trichloride
507. Phosphorous penta chloride
508. Phthalic anhydride
509. Phylioquinone
510. Physostignine
511. Physostignine salicylate (1:1)
512. Picric acid (2,4,6-trinitrophenol)
513. Picrotoxin
514. Piperdine
515. Piprotal
516. Pirinifos-ethyl
517. Platinous chloride
518. Platitnim tetrachloride
519. Pottasium arserute
520. Potassium chlorate
521. Potassium cyanide
522. Potassium hydroxide
523. Potassium nitride
524. Potassium nitrite
525. Potassium peroxide
526. Potassium silver cyanide
527. Powdered metals and mixtures
528. Promecarb
529. Promurit
530. Propanesultone
531. Propargyl alcohol
532. Propargyl bromide
533. Propen-2-chloro-1,3-diou diacetate
534. Propiolactone bela
535. Propionitrile
536. Propionitrile, 3-chloro
537. Propiophenone, 4-amino
538. Propyl chloroformate
539. Propylene dichloride
540. Propylene gglycol, allylether
541. Propylene imine
542. Propylene oxide
543. Prothoate
544. Pseudosumene
545. Pyrazoxon
546. Pyrene
547. Pyridine
548. Pyridine, 2-methyl-3 -vinyl
549. Pyridine, 4-nitro-I -oxide
550. Pyridine, 4-nitro- I -oxide
551. Pyriminil
552. Quinaliphos
553. Quinone
554. Rhodium trichloride
555. Salcomine
556. Sarin
557. Selenious acid
558. Selenium Hexafluoride
559. Selenium oxychloricle
560. Semicarbazide hydrochloride
561. Silane (4-amino butyl) diethoxy-meth
562. Sodium
563. Sodium anthra-quinone-1-sulphonaie
564. Sodium arsenate
565. Sodium arsenite
566. Sodium azide
567, Sodium cacodylate
568. Sodium chlorate
569. Sodium cyanide
570. Sodium fluoro-acetate
571. Sodium hydroxide
572. Sodium pentachloro-phenate
573. Sodium picramate
574. Sodium selenate
575. Sodium selenite
576. Sodium sulphide
577. Sodium tellorite
578. Stannane acetoxy triphenyl
579. Stibine (Antimony hydride)

580. Strychnine
581. Strychnine aulphate
582. Styphinic acid (2.4.6-trinitroresorcinol)
583. Styrene
584. Sulphotec
585. Sulphoxide 3-chloropropyl octyl
586. Sulphur dichloride
587. Sulphur dioxide
588. Sulphur monochloride
589. Sulphur tetrafluoride
590. Sulphur trioxide
591. Sulphuric acid
592. Tellurium (Powder)
593. Tellurium hexafluoride
594, TEPP (Tetraethyl pyrophosphate)
595. Terbufos
596. Tert-Butyl alcohol
597. Tert-Butyl peroxy carbonate
598. Tert-Butyl peroxy isopropyl
599. Tert-Butyl peroxyacetate (Conc>=70%)
600. Tert-Butyl peroxypivalate(Conc>=77%)
601. Tert-Butyperoxyiso-butyrate
602. Terta hydrofuran 60-3. Tetra methyl lead
604. Tetra nitromethane
605. Tetra-chlorodibenzo-p-dioxin, 1,2,3,7,8, (TCDD)
606. Tetraethyl lead
607. Tetrafluoriethyne
608. Tetramethylene disulphotetramine
609. Thallic oxide
610. Thallium carbonate
611. Thallium sulphate
612. Thallous chloride
613. Thallous malonate
614. Thallous sulphate
615. Thiocarbazide
616. Thiocynarnicacid, 2-(Benzothiazolyethio) methyl
617. Thiofamox
618. Thiometon.
619. Thionazin
620. Thionyl chloride
621. Thioplienol
622. Thiosenlicarbazide
623. Thiourea (2-chloro-phenyl)
624. Thiourea (2-methyl phenyl)
625. Tirpate (2.4-diinetlivi-1,3-di-thiolane)
626. Titanium powder
627. Titanium tetra-chloride
628. Toluene
629, Toluene 2.4-di isocyanate
630. Toluene 2,6-di isocyanate
631. Trans-1,4-di chloro-butene
632. Tri nitro anisole
633. Tri (Cyclohexyl) methylstannyl 1,2,4 triazole
634. Tri (Cyclohexyl) stannyl- I H-1,2,3-triazole
635. Triaminotrinitrobenzene
636. Triamphos
637. Triazophos
638. Tribromophenol 2,4,6
639. Trichloro napthalene
640. Trichloro chloromethyl silane
641. Trichloroacetyl chloride
642. Trichlorodichlorophenylsilane
643. Trichloroethyl silane
644. Tricbloroethylene
645. Trichloromethane sulphenyl chloride
646. Trichloronate
647. Trichlorophenol 2, 3, 6
648. Trichlorophenol 2, 4, 5
649. Trichlorophenyl silane
650. Trichlorophon
651. Triethoxy silane
652. Triethylamine
653. Triethylene melamine
654. Trimethyl chlorosilane
655. Trimethyl propane phosphite
656. Trimethyl tin chloride
657. Trinitro aniline
658. Trinitro benzene
659. Trinitro benzoic acid

660. Trinitro phenetole
661. Trinitro-m-cresol
662. Trinitrotoluene
663. Tri orthocresyl phosphate
664. Triphenyl tin chloride
665. Tris (2-chloroethyl) amine
666. Turpentine
667. Uranium and its compounds
668. Valinomycin
669. Vanadium pentaoxide
670. Vinyl acetate mononer
671. Vinyl bromide
672. Vinyl chloride
673. Vinyl cyclohexane dioxide
674. Vinyl fluoride
675. Vinyl norbornene 6
76. Vinyl toluene
677. Vinyledene chloride
678. Warfarin
679. Warfarin sodium
780. Xylene dichloride
681. Xylidine
682. Zinc dichloropentanitrile
683. Zinc phosphate
684. Zirconium & compounds

10. In Schedule 2 of the said rules :-

(I). Under the sub-heading" Threshold quantities (tonnes)":-

a. For the existing entries, the following shall be substituted, namely:- " For application of rules 4,5,7 to 9 and 13 to 15";

b. For existing entries, the following shall be substituted, namely:- "For application of rules 10 to 12";

(II). For serial number 7 and the entries relating thereto the following serial number and entries shall be substituted, namely:-

7.	Extremely flammable liquids as defined in Schedule 1, paragraph (b) (ii)	5000	50,000"

I. after serial number 27 and the entries relating there to, the following serial numbers and entries shall be inserted, namely:-

28	Very Highly flammable liquids as defined in Schedule 1, paragraph (b)(iii)	7,000	7,000
29	Highly Flammable liquids as defined in Schedule 1, paragraph (b)(iv)	10.000	10,000
30	Flammable liquids as defined in Schedule-1, paragraph(b)(v)"	15,000	1,00,000

10. In schedule 3 of the said rules,-

i. in PART-1, in Group-4 relating to Explosive substances against serial numbers 150,160, 163, 164, and 165, in column 3 , for the existing entries, the figures and letter "100 kg" shall respectively be substituted.

ii. for Part-II and the entries relating thereto the following shall be substituted, namely:-

PART -II

Classes of substances as defined in PART-I, Schedule-1 and not specifically named in PART-I of this Schedule.

1	2	3	4
Group 5 - Flammable substances			
1.	Flammable Gases	15T	200T
2.	Extremely flammable liquids	1000T	5000T
3.	Very Highly flammable liquids	1500T	10000T
4.	Highly Flammable liquids which remains liquid under pressure	25T	200T
5.	Highly Flammable liquids	2500T	20000T
6.	Flammable liquids	5000T	50000T"

10. In Schedule 4 of the said rules, in serial number 4 after the words "production, processing" the word "use" shall be inserted. 11. In Schedule 5 of the said rules, -

i. against serial number 3, in column 2, for the words "State Pollution Control Board" the words "State Pollution Control Board or Committee" shall be substituted;

ii. against serial number 5 , in column 3, for the words "inside a port", the words "inside a port {covered under the Dock Workers (Safety, Health and Welfare) Act, 1986}" shall be substituted;

iii. against serial number 6, in column 3, the words "and pipelines including inter-state pipelines" shall be omitted.

iv. against serial number 7, in column 3, for the existing entries, the following entries shall be substituted, namely:-

"Enforcement of directions and procedures regarding: -

(a). Notification of major accidents as per rule 5(1) and 5(2)

(b). Approval and Notification of Sites as per rule 7;

(c). Safety report and safety audit reports as per rule 10 to12;

(d). acceptance of On-Site Emergency plans as per rule 13;

(e). assisting the District Collector in the preparation of Off-Site emergency plans as per serial number 9 of this Schedule;

i. against serial number 8, in column 3, after the brackets, letter and words, "(b) The Calcium Carbide Rules, 1987," the following shall be inserted, namely:-

"and in respect of Industrial installation and isolated storages dealing with hazardous chemicals and pipelines including inter-state pipelines regarding:-

a. Notification of major accidents as per rule 5;

b. Approval and notification of Sites as per rule 7;

c. Safety report and safety audit reports as per rules 10 to 12;

d. acceptance of On-Site Emergency plans as per rule 13;

a. assisting the District Collector in the preparation of Off-Site emergency plans as per serial number 9 of this Schedule." (vi) against serial number 10 , in column 2, for the words brackets and letters "Directorate of Explosive Safety (DES)", the words, brackets and letters "Centre for Environment and Explosive Safety (CEES)" shall be substituted.

(Dr. V. Rajagopalan)
Jt. Secretary to the Govt. of India
{F. Number 17-4/90- HSMD}



National Centre for Disaster Management (NCDM) set up under the Department of Agriculture and Cooperation. Ministry of Agriculture in the March 1995. NCDM has been upgraded into full-fledged National Institute of Disaster Management in October 2003 Under the Disaster Management Act., 2005, the Institute has been entrusted with the nodal national responsibility for human resource development, capacity building, training, research, document and policy advocacy in the field of disaster Management.

NIDM is steadily marching forward to fulfill its mission to make a disaster resilient India by development and promoting a culture of prevention and preparedness at all levels. Both as a national Centre and then as the national Institute, NIDM has performed a crucial role in bringing disaster risk reduction to the forefront of the national agenda. It is our belief that disaster risk reduction is possible only through promotion of a "Culture of Prevention" involving all stakeholders.

WE work through strategic partnerships with various ministries and departments of the central, state and local governments. Academic, research and technical organizations in India and abroad and other bilateral and Multi-lateral International agencies.



The Multi Disciplinary Centre on Safety, Health and Environment (MDC on SHE), launched at the behest of Biju Patnaik, the then Chief Minister of Odisha during 1992-93 for promotion of industrial safety, occupational health, environment etc. in the industries of Odisha has turned out to be a successful and unique experiment. The Centre has earned laurel and commendations from different sectors, cross sections, stakeholders, state governments, union government, ILO and others.

As a part of fulfilment of the objectives, the MDC on She has promoted a rich and updated 'Library' having adequate collections on Industrial Safety, Occupational Health, Industrial Pollution Control, Environment Management, Technological Disaster Management, Hazardous Substance Management, Battery Management, Biomedical Waste Management, Municipal Solid Waste Management, Prevention and Management of Chemical Accident, Mine Safety, First Aid etc. which are very useful to the students of Technical Education Institutions, Industrial Employees, Regulators and Professionals in the Field.

The Centre has developed a modern 'Laboratory' having equipment relating to Industrial Safety, Occupational Health and Environment Monitoring, where practical training on safety is imparted to the engineers.

Appreciating the splendid performance of the MDC on SHE, the Union Government in the Ministry of Environment & Forests and Home Affairs have sponsored number of programmes in the areas of (a) Technological Disaster Management (b) HAZAN & HAZOP (c) Hazardous Substance Management (d) Prevention and Management of Chemical Accident (e) Biomedical Waste Management, (g) Chemical (Industrial) Disaster Management and provided funds for conducting these programmes across the state.

Post Diploma Course in "Industrial Safety" and "M. Tech. in Safety Engineering"

With the approval of the State Government in the Industry Department, Odisha, a regular full time "Post Diploma Course on Industrial Safety" has been introduced from the 2009-10 academic session. Besides, regular course on "M. Tech. in Safety Engineering" has also been introduced in collaboration with the National Institute of Technology (NIT) Rourkela from the academic session 2014-15.

Industrial Safety Museum

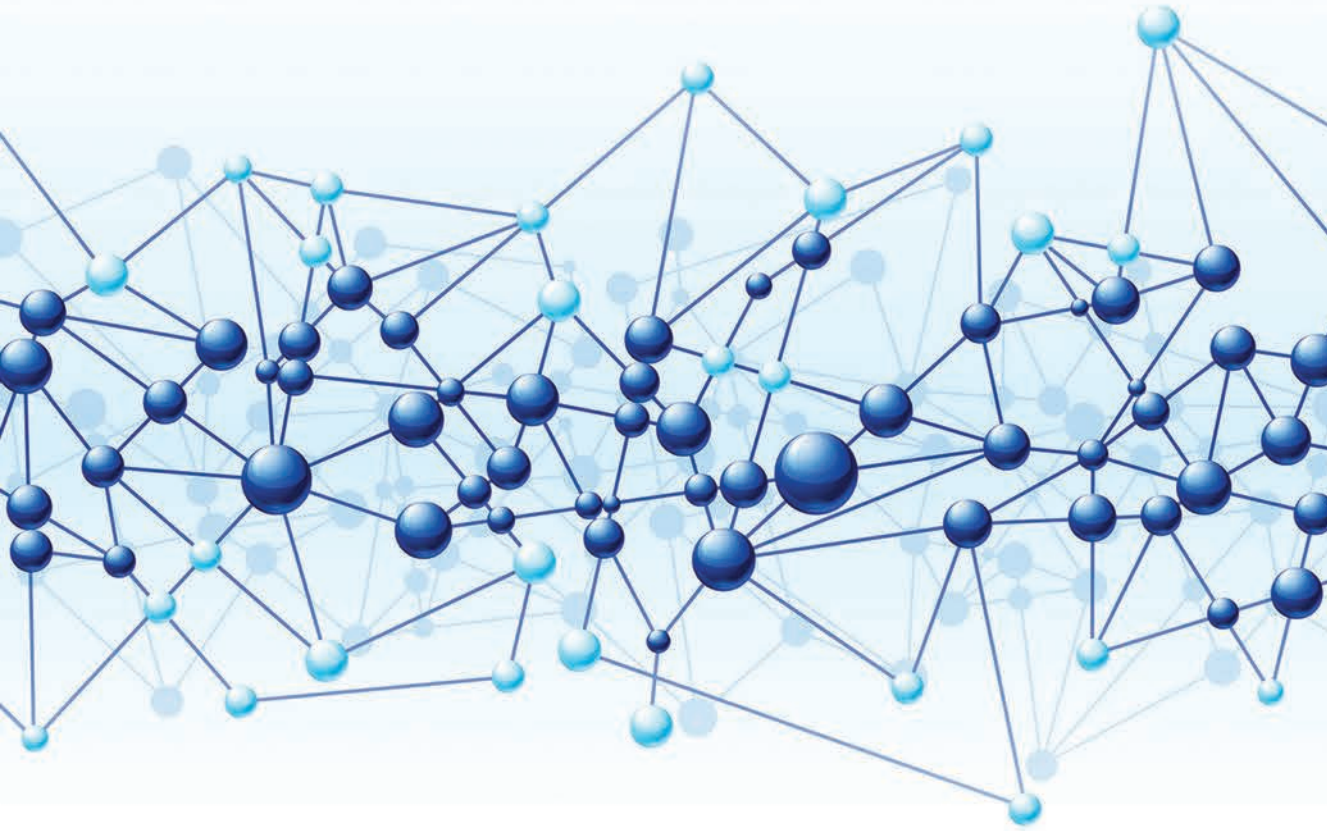
An Industrial Safety Museum encompassing Safety, Occupational Health and Pollution Control, first of its kind in the state will be an unique contribution to the Society. Once the Museum becomes a reality and functional, it would serve as a Modern Learning Centre for the engineering students and industrial employees of the state.

Focus Areas

The MDC on SHE envisages to focus on the safety, health, environment, pollution control and all such need of the industries in the state besides, opening "Centre of Excellence on Industrial Safety" having research facility.

www.nidm.gov.in

www.mdconshe.org



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