TRAINING MODULE

Chemical (Industrial) Disaster Management

nidm
Towards a disaster free India

NATIONAL INSTITUTE OF DISASTER MANAGEMENT
MINISTRY OF HOME AFFAIRS, GOVERNMENT OF INDIA

TRAINING MODULE

Chemical (Industrial) Disaster Management

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FOREWORD

Unlike natural disasters like cyclone, flood, tsunami; chemical and industrial disasters are non inevitable, and hence is the concept of 'zero tolerance' as the standard for disaster prevention. However, human errors – operational dimensions, and availability of relevant information during various phases of disaster management have emerged as critical areas of concern. Proper decisions starting from site selection, public participation in clearance, industrial layout planning, disaster mitigation measures, on-site and off-site emergency coordination planning play key roles in furthering the objectives of a comprehensive framework of disaster management at local and district level.

Factories Act and Environmental legislations viz. Environmental Protection Act, Public Liability Act, and rules there under prescribe the planning, preparedness and response in chemical emergencies, whereas Disaster Management Act (2005) provided a holistic framework for multi-hazard disaster management at various levels. National Disaster Management Authority (NDMA) has been entrusted the responsibility of developing policies and guidelines on various aspects of disaster management. Ministry of Environment & Forests has been identified as a nodal agency for management of chemical disasters in the country. Ministry of Labour & Employment through its organization at state level on industrial safety and/or factories and boilers provide a framework for implementation and monitoring at state, district and sub-district levels.

National Institute of Disaster Management (NIDM) has been mandated under the Disaster Management Act for capacity building including training, research, documentation and policy advocacy on all aspects of disaster management. In this context, a training module on Chemical (Industrial) Disaster Management has been developed by the institute for use by different institutions dealing with disaster management in the country at various levels. I hope the initiative of the institute shall be of significant contribution in advancing the goal of national capacity development on disaster management.

- Dr. Satendra, IFS
Executive Director, NIDM

PREFACE

The Bhopal Gas disaster brought in a global awareness on the importance of preventing chemical disasters and the damage to environment and health. The realization that a lapse in safety and environmental aspects of economic development can have grave consequence in terms of toll of life, besides serious and long-term damage to natural resources, health, social harmony and peace, and can diminish the social image of the corporate units. Public outcries and litigations relating to the chemical disasters have brought in the serious concern for maintaining faith in the civil governance as well. Environmental legislations as well as Disaster management Act has adhered the responsibility of planning for disaster management and also for off-site emergencies with the District Collector. Various departments and stakeholders envisaged with different roles and responsibilities during different stages of chemical disaster risk management need to be put-in appropriate integration along the holistic disaster management framework.

Capacity development initiatives in the area of chemical disaster risk management have taken place in India as well, with the UNEP's APELL (Awareness and Preparedness for Emergencies at Local Level). A global initiative of the chemical industry known as 'Responsible Care' has also drove in the concept of 'safety circle' in Indian industry as well and the prescriptions of safety audit, safety review and safety surveillance. Risk assessment and disaster management planning for chemical disasters were although brought in the practice in chemical industry during late 1980s, its implementation remained focused to large industrial units. The concept of incident control system for chemical/industrial emergencies was mooted worldwide during 1990s. Ministry of Environment & Forests along with Central and State Pollution Control Boards, Director General of Factory Advise Service and Labour Institutes, State Factories/Industrial Safety Inspectorate, and Industrial estate management/ industrial associations, installed a systematic approach to chemical disaster risk management.

Experiences under World Bank aided Projects on Industrial Safety & Disaster Prevention, and Industrial Pollution Control during 1990s, UN-IDNDR (1990-99), and UNDP-DRM project emphasize the need for greater focus on off-site concerns of risk management and its integration with the holistic disaster management. A national workshop was organized by NIDM in collaboration with MoEF during October 2008 in order to draw the framework for national action

plan on chemical disaster management. NIDM has been organizing courses on the subject since 2005. Experiences from Gujarat, Maharashtra, Rajasthan, Chhattisgarh, Karnataka, Orissa and Tamilnadu and the national programmes organized have been incorporated in developing the module. Authors hope the module shall be of significant use by disaster management at training institutions in the country who deliver courses on Chemical (Industrial) Disaster Management.

Anil K Gupta &
Sreeja S. Nair
(Authors)

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CONTENTS

KEY FEATURES

- **Title:** Chemical (Industrial) Disaster Management
- **Module Users:** Disaster Management Trainers
- **Training Targets:** State Government and District officials / Disaster Management Authorities / Disaster Management Planners and Responders
- **Training Duration:** 5 working days (one week)
- Trainers Input: Multi-disciplinary
- **Training methods:** Lecture, Discussion, Film Show, Field Visits, Group Exercise.
- **Training size:** 15-20 trainees in one course batch.
- **Training Location:** Disaster Management Institute/ Centre of State
- **Sub-modules Selection:** Five / Need based implementation recommended.
- **Challenges:**
  - o Heterogeneous entry-behavior and motivation-level of trainees nominated by the Government.
  - o Industry-Government-Trainer cooperation in field visits
  - o Learner's attitude in participants rather than inspector's role while visiting industry

1 Preamble

India is developing as a key global player in industrial and technology sector. Rapid industrialization has increased the hazard, risk and vulnerability of the industry and the environment. Chemical being at the core of modern industrial and production systems, the risk of accidents involving chemicals has attained a very serious concern for disaster management within the government, corporate sector and the community at large. Major chemical (industrial) disasters are low in frequency but are significant in terms of potential loss of lives, injuries, environmental impacts, property damage and socio-economic implications.

Major Impacts of Chemical disasters are illustrated in Figure 1. Frequency and severity of chemical disasters has increased in last few years due to rapid development of chemical industries of a wider range – manufacturing & formulation, petro-chemicals, pharmaceuticals, agro-chemicals – fertilizers, pesticides, industrial chemicals, and facilities that store hazardous chemicals – oil depots, exploration/ mining and beneficiation sites, ports, docks, treatment plants, power, etc. Increase in size of plants, storage and carriers specially in densely populous areas has posed the greater risk and vulnerability for such disaster likeliness.

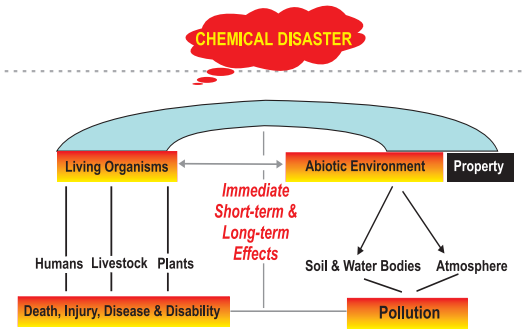


Figure 1: Impacts of a Chemical Disaster

WHO defines disaster as "any occurrence causing damage, ecological disruption, loss of human lives, deterioration of health and health services on a scale sufficient to warrant any extraordinary intervention from outside the affected community"(1). With the enactment of the Disaster Management Act 2005 there is a ***paradigm shift*** in approach to disaster management from post-disaster relief and rehabilitation to pre-disaster prevention and preparedness. At the state level – State Disaster Management Authority, Department of Factories and Boilers/Industrial Health and Safety, Labour, Department of Health, Environment, Pollution Control, Labour, Police, Fire, Industry & Commerce, etc. are directly responsible for disaster response. However, there is a visible gap in understanding and coordination among various agencies and disaster prevention-mitigation and disaster response related *organizations* in the context of industrial (chemical) disasters. There is a need to work out better

and effective institutional mechanism, coordination and strategies for ensuring synergy in the various activities of different Ministries and organization.

The causes of industrial and chemical hazards and their disasters are malfunctions, failures, unanticipated side-effects of technological systems. But this is a misleading over-simplification and many other factors are involved. The calculus of industrial hazard is a blend of industrial systems, people and environments that include geological, atmospheric, ecological, psychological and social components[2]. It is, therefore, required to develop a strategic framework especially towards capacity building and integration with holistic environmental risk management within the broader system of multi-hazard risk reduction and mitigation. These combine in different ways to create a specific hazard. For example, faulty equipment, operator error, and a south-westerly air flow all helped to shape the events that occurred at Three Mile Island Nuclear power station (Sills et al. 1982, Houts et al, 1988). The challenger space shuttle disaster involved, among others, a vulnerable fluid seal, cold weather, and an impatient launch team – although the official inquiry blamed only the seal. Bhopal disaster was a result of less than poor safety maintenance, government negligence of factory and audit inspection, economic downfall for the product, chilly and calm winter night weather, lack of information about chemical and antidote, no system of disaster response and relief in such cases, and lack of occupiers liability. Thus, a number of factors could trigger chemical accidents, some of which are as follows:

(a) Process and safety system failures

- Technical errors
- Human errors

(b) Natural Calamities: For example, Release of acrylonitrile at Bhuj during earthquake 2001, damage to Phosphoric acid sludge containment during Orissa supercyclone 1999, hazardous chemical releases in China earthquake, and release of radiation in Japan earthquake, etc.

(c) Terrorist attacks/sabotage

(d) Hazardous waste processing/disposal

There are over 1894 Major Accident Hazard (MAH) units in the country (as in December 2010). Besides, there are several millions of registered and hazardous factories (below MAH criteria) and un-organized sectors dealing with numerous range of hazardous material posing serious and complex levels of disaster risks.

Off-site perspectives of chemical disaster management needs multi-disciplinary inputs and interdisciplinary coordination, effective information processing and management system and integration with the holistic multi-hazard disaster management framework along all stages starting from hazard/risk assessment, prevention & mitigation, preparedness, response, relief and rehabilitation and within the broader framework of planning and development at local/regional level.

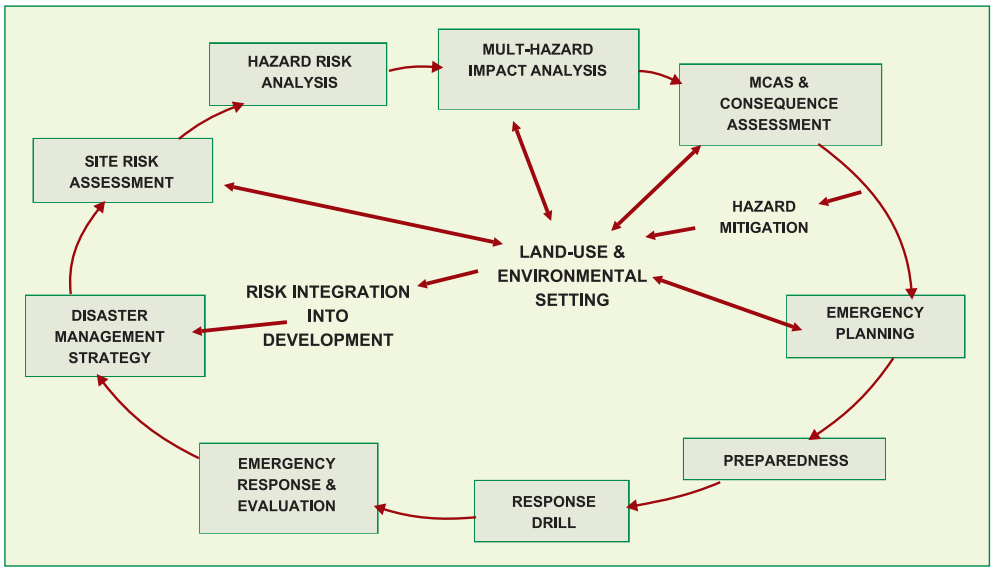


Figure 2. Important Components in Chemical Disaster Management [6]

Broadly, the chemical disaster management like the case of other disasters – can be categorized into two major cycles: (1) Hazard and Risk Mitigation and (2) Emergency Management and Post-disaster relief and Rehabilitation. However, there are facets that overlap between the two and thus are interlinked. The chemical disaster reduction concept begins with the selection of site for an industry and selection of process, raw materials, capacity, etc. Major aspects of chemical disaster management are given in **figure 2**.

Government-industry-community interface plays major role in off-site risk management and in responses during emergencies. Role of various services and subject experts ranging from geologists, meteorologists, hydrologists, GIS/geography and land-use/regional planning, law and jurisprudence, emergency and community medicine, socio-psychological and trauma care, communication, etc. This is different from the core focus of on-site disaster management plan that mainly focuses on environmental systems, chemistry, process, incident-control, fire, occupation health and safety, first medical response and emergency care, international transport and control system, etc.

2 TRAINING DESIGN BRIEF

Introduction

The Disaster Management Act 2005 and the subsequent initiatives have institutionalized the preparation (and implementation) of Disaster Management Plan at District and State level(s) whereas the Rules under Environmental Protection Act 1986 and Public Liability Insurance Act 1980 has required Off-site Emergency Plan to be prepared and implemented by the District Administration. Besides, the institutional framework including Crisis Groups and Disaster Management Authority have come up and brought in numerous questions about coordination, planning and disposal of implementation duties for which lack of adequate understanding and skills of officials in the relevant Government Departments is prime cause. Looking to the challenge it is proposed to organize series of training courses of one week duration to abolish the performance pwroblem of multi-disciplinary coordination, paradigm shift to prevention and mitigation, and effective preparedness for emergency response, disaster relief and rehabilitation including delivery of compensations, liabilities, issues related to litigations and public outcries, etc. The present focus of industrial and chemical disaster management aims at 'zero tolerance' principles and the philosophy of 'extended producer liability' regarding risks throughout the life-cycle of a hazardous material. In order to plan and perform effectively, information, reporting and knowledge systems play central role and therefore, tools like geoinformatics, web-enabled system and communication technologies now offer much significant roles than earlier. Focus on site risk assessment and in view-of multi-hazard disaster risks, the need of emphasizing multi-dimensional, multi-tier and multi-disciplinary and multi-stakeholder approach to risk management has become important in capacity building for chemical disaster risk management.

Performance Problem

Target officials are not able to achieve/deliver the desired level due to

(a) Inadequate knowledge about the multi-dimensional aspects of causes and sources of chemical disaster risk, scenarios and probable impact/ consequences on human and other lives, environment, social and economic systems

(b) Lack of skills in stating and planning risk reduction opportunities at different stages, legal/regulatory framework, approach and tools, role of geoinformatics, information and communication technologies and preparedness for emergencies

(c) poor coordination on issues related to chemical disasters among the departments dealing with disaster management in general (holistic), labour/ factories and industry, chemicals, and integration, environmental planning and management, and various services in emergencies and relief.

(d) Less integration of chemical disaster risk reduction and preparedness along regional & urban planning and mainstreaming into developmental process.

Aim of Training

The aim of the training is to update the knowledge and skills of the participants on multi-dimensional aspects of chemical disaster risk management and emergency incident-response, effective planning, integration and coordination.

Target Groups

The module is developed looking to the performance gaps and needs of middle level officials in state and district level functionaries/departments or agencies including public sector and associated non-government/industrial members involved in assessment, planning, implementation or monitoring of any aspects of disaster management, factories/industry, environment and development. An exemplary list (not limited to) of such departments/agencies is given following:

(i) **Administration (Disaster Management Authorities and Crisis groups)**

Department of Disaster Management/State or District Disaster Management Authority (Districts having MAH units), State and District Crisis group, Disaster Response Force, Member/official(s)/related institute's faculty members and trainers.

(ii) **Regulators**

Department of Labour/ Factories & Boilers/ Industrial Safety, Pollution Control Board/Committee,Department(s) of Environment & Forests, Petroleum and Explosives safety organization (PESO), DGFASLI

(iii) **Officials from other Ministries and Department**

Science & Technology, Geology & Mines, Planning, Public Information, department of Industry/Industrial estates/corporations/public sector/ Power & electricity, Agrochemicals, Department(s) of Fire, Police, Medical, Transport, Food, Water Supply, etc.

(iv) **Industries**

Industries can be thought of as potential target groups. For industries special focus needs to be given on Onsite Emergency Management and this module is focusing more on offsite plans and integration with Disaster Management Framework. However 4-5 participants from Industries may be

considered for every training since offsite plan requires information from Industries as well.

Entry Behaviour

Target level of Trainees:	Middle level officers, DMA & Crisis Group members, Faculty/trainers
Nature of Group:	Heterogeneous (mix of representatives with direct and indirect-but important mandates/deliveries)
Age:	25-50 years
Qualification:	Post-Graduate / Graduate or Diploma engineering / Graduate with substantial experience in related work/ department/ responsibility.
Disaster related experience:	Not necessary but may be an advantage.
Medium of instructions:	Mainly English (with some blend of regional/state language).
Challenges:	Varying motivation levels of participants, un-even awareness about disaster or chemical disaster related issues, 'business as usual' attitudes, and participants from different departments/ professional background are the main challenges.
Strategies to overcome:	Providing reading/study materials at time of course registration itself so that participant have a glimpse at contents/topics/scope of course, Films show as subject introduction strategy, general question-answer based on perceptions and experiences, and familiarity with the participants will help in reducing and handling the troubles of heterogeneity of entry behavior of participants.

Course Objectives

The objectives of the course designed for the present module on 'Chemical (Industrial) Disaster Management' is to enable the participants to assess and deliver their respective aspects and roles in relation to chemical disasters management and delineate strategies for risks mitigation and implementation of effective response in case of emergencies.

Learning Objectives

The objectives of the course are to enable the participants (for following):

(1) To understand the scenario and challenges associated with chemical disaster risks and consequences

(2) To state various legal/regulatory framework, provisions, guidelines and institutional arrangements for concerning activities

(3) To mention and explain visible/described observations/perceptions about chemical disaster risks, mitigation measures and response mechanism

(4) To enumerate various tools, technologies and methods in chemical disaster management, including GIS, ICT & web-enabled systems. Accident reporting, investigation, risk assessment and root cause analysis etc

(5) To describe preparedness for chemical emergencies and response of various services in chemical disasters.

(6) To integrate environmental planning with disaster management in siting of Industries and Industrial estates

(7) Develop capabilities for the evaluation of the effectives of onsite and offsite plans

Course Contents

Course contents, in general, shall cover the following aspects of chemical disaster management, and will be drawn looking to the target participants, resources and contexts of the particular batch and course programme:

- General concepts and terminologies in disaster management – risk management and emergency response, nature of subject, etc.
- Chemical Disaster example(s) – Bhopal, Sevaso, Jaipur Fire, etc. (preferably a documentary or film on Bhopal gas tragedy)
- Chemical Disasters – Global and National Scenario
- Chemical Hazards and related disasters – State Profile
- Chemical disasters – Causes, Nature and Consequences
- Legal Framework for Chemical Disaster and Management in India
- Institutional and organizational framework for Disaster Management in India – Chemical accidents context
- International organizations, bindings and guidelines on chemical incidents
- Disaster Management Act 2005 and Disaster Management Policy
- National Guidelines on Disaster Management (for Chemical Disasters), Medical Response, Non-government organizations, etc.
- Risk visualization, on-site and off-site vulnerability perceptions, safety systems/procedures, incident reporting and response drills, review, briefing, etc. (to be facilitated as a field/industrial visit)
- Off-site emergency Planning – Principles and guidelines, evaluation of plans

- Role of ICT and Geoinformatics in Chemical Disaster Management (GEPR, CAIRS, ERRIS, CAMEO, ALOHA , MARPLOT, IDRN, SDRN, etc)
- Integration of off-site emergency plan with holistic disaster management
- Preparedness and first response in chemical emergencies, roles, responsibilities, coordination and command system – police, fire, civil defence, etc.
- Medical response planning, preparedness and coordination
- Community awareness on risk management, preparedness and response in chemical accidents.

Case studies (suitable cases to be chosen for teaching session /group work or discussion based on type of resource persons & facilities available, core aim of course batch and state/regional contexts):

- GIS based Emergency Planning and Response System
- Web-enabled Chemical Accident Information & Reporting System
- Industrial Siting in a Multi-hazard Environment for Risk Management
- Hazardous Waste Management – Risks and Emergencies
- Awareness and Preparedness for Emergencies at Local Level
- Planning and Management of Mock-drills for Chemical Disasters
- Integration of Off-site Emergency Plan with Holistic Disaster Management
- Legal implications and litigation cases on chemical accidents and risks
- Chemical Disaster incident case study analysis – Issues Analysis

Training Methods

Training methods shall be chosen for teaching a particular topic/aspect of chemical disaster, from a range of following:

- Film show followed by question-answer, discussion
- Lecture followed by query-answers
- Presentation (slides) and discussion
- Group discussion
- Group work / assignment - exercise
- Field visit followed by discussion
- Mock exercise/ drills/
- simulation, table-top
- Demonstration /Hands on exposure (Computer based)
- Panel discussion

Training Materials and Facilities

- Training hall / class room with suitable capacity and fixers
- Computers (for demonstration of GIS/ICT applications and modeling tools/ scenarios)
- LCD projector
- Screen
- Mike(s) and speaker(s)
- Flip chart,
- White board
- Computer stationary
- Folder, Pen, etc.

Performance Aids

- Reading material – easy to understand and handle, containing reference literature about the course topics/contents
- Case Studies – printed versions
- Exercise Plan and Guidelines
- Copies of existing Off-site plans for evaluation/assessment
- Film on chemical disaster (for example, Bhopal tragedy)
- CD of Software – ALOHA, MARPLOT, AFFECTS, CAMEO, etc.
- Field visit arrangements – including safety helmets, field visit plan, etc.
- Handouts of Presentations: should be clear enough to read and with space for additional notes and writings must be provided
- Lecture notes: Some background information about the topics and themes of course lectures/case studies must be provided in the reading material.

Trainers/Learning Facilitators/Resource Persons

A minimum team consisting **three or more faculty members** is required to organize (design, conduct and coordinate) the course. One of the team members must have some background of the specific state / region. The subject composition must encompass *environment and earth science, disaster mitigation, environmental law, geoinformatics, information/communication technology,* industrial chemistry / toxicology, emergency response, community preparedness.

Field Visit

A field visit to a MAH Unit or industrial area with hazardous units/operations is part of the suggested training module. It will provide real feel of the off-

site and on-site associated with the location of the unit, its hazard potential in terms of hazardous goods and processes, transport, etc. in the background of vulnerability of communities including their properties and environment, to realize the emergency response issues.

Visit shall also be helpful in developing/improving understanding of the participants on aspects of impact assessment, site selection, housing, and emergency response planning and preparedness including routes, resources, locations, and coordination issues based on Hazard, risk, vulnerability and capacity (HRVC) rapid assessment.

Expected Outcome

- Better assessment of chemical disaster related risks and vulnerabilities
- systematic approach in planning, preparedness and mitigation for chemical disasters
- Cost and time effectiveness in disaster response by adapting ICT tools including GIS, RS and GPS
- Improved coordination amongst various agencies and organizations
- Integration of on site and offsite plans with Disaster Management Plans and holistic DRR framework.

Evaluation and Validation

Two types of formal evaluations need to be carried out during the five days of training. The trainer is expected to evaluate day-wise individual sessions based on the feedback received during the recapitulation session. Apart from that, a formal evaluation of the programme will be done after the programme. Impact assessment evaluation of knowledge would be done through pre- and post training assessment scales. The evaluation of skill transfer would be done during various question-answer and exercise sessions.

Constraints and strategies to overcome

This is a comprehensive course and need to cover all important aspects of chemical disaster management and its integration with the holistic framework/

If planned properly, most of the contents can easily be covered in the schdeuled duration by avoiding duplication of content by different resource persons of different sessions. The objective is to touch upon various issues pertinent to the participants and hence region/ state specific modifications can be addressed while preparing the training schedule.

INSTRUCTIONS TO USE THE MODULE

- The course module can be implemented at a state/regional level institute of training / education, for example, disaster management institute/centre, urban development centre, industrial planning centre, environmental institute, etc. as per the mandate/scope of work of the institute/centre.
- This module is meant for use by the coordinator/members of the course organizing faculty and the speakers/resource persons identified for taking specific sessions / group work or case studies.
- The module has certain options / choices within the overall design in case of sub-modules, sessions and case studies. The course faculty team / coordinator must view in the light of context of specific course objectives, target participants, duration, resources available, etc. and utilize the flexibility of selecting sub-modules/case studies, etc. and also of customizing as per the situation.
- The training programme is divided into certain sub-modules, each of it is a course module in itself and can be implemented independently also with customization, separately or in association with any suitable course theme on disaster management, environment, development, planning, laws, etc.
- Each sub-module contains items like, Context, Objectives, Learning Units Learning Methodology, Trainers Note, Session plan, etc. to serve as a training manual for the course coordinator to identify the expertise and resources needed for delivering the course lectures, conducting exercises, field visits, etc.

Module A

INTRODUCTION TO CHEMICAL (INDUSTRIAL) DISASTER MANAGEMENT

A INTRODUCTON TO CHEMICAL (INDUSTRIAL) DISASTER MANAGEMENT

A basic training module on Industrial (Chemical) Disaster Management as an overview or refresher course for sensitization of disaster management professional/officials and other officials of general administration, industrial associations/corporations, academicians, NGOs, etc.

Enabling Objective

At the end of this learning unit, the participants will be able to:

- define and distinguish between chemical and industrial hazards
- describe their causes and impacts
- mention the global, national and state/regional scenario
- enumerate the factors responsible in chemical disasters

There are 4 learning units delineated to draw this module:

1. Pre-post Training Assessment
2. Chemical Disasters - Global and National Scenario
3. Chemical Hazards & Disasters – State Profile
4. Chemical Disasters: Causes and Consequences

Figure 3: Hazard Risk and Exposure

Learning Objectives

The key objectives of this module are following:

- To carry out a pre training assessment to know the entry level behaviour of the participants
- Provide an global and national overview on past incidences of chemical accidents and prevailing risks
- To enumerate the 'state or UT' specific issues of chemical disaster – incidences and risk in the context of regional state profile
- To discuss the causes, sources and effects of chemical disasters

Duration

About 3 hours including the inauguration session.

Methodology

- film on a chemical disaster (e.g. Bhopal disaster)
- Perception check questionnaire (or question-answer session)
- Lecture/power point presentation
- Case study (preferably based on film)
- Group exercises
- Experience sharing
- Discussion

Expectation Sharing

Sharing expectations from both sides, from participants as well as from the faculty/trainers and course director/coordination team is important to start from and finally arrive at a common point of learning scope to be fulfilled during the course. Other expectations regarding punctuality of the participants during the sessions and associated activities, response, discipline, etc. need to be shared during this information round.

Trainers' Hint

The course coordinator shall conduct an ice breaking exercise to allow trainees to introduce themselves. This session may be included within the inaugural/introductory session so that the luminary experts of inaugural session are also apprised with the background and profile of the participants. The trainees shall be asked to introduce themselves mentioning their name, designation, qualification and area of interest/work, organization, sate/district, previous exposure on disaster management, etc.

Introduction round can also be done separately and relatively comprehensive. Even if a small and formal introduction round during the inaugural session, a more informal and detailed introduction of participants can be organized withing the ice breaking session, for around 30 minutes that would help the participants to know each other. It will also initiatiate some level of group participation process to continue during the entire training course.

In case of 'no formal inaugural function', the programme director and coordinators/trainers shall explain to the participants about the programme objectives and contents, limitations, the process of participatory learning and some general ground rules of the course, if any.

Material: Course Brochure & Programme Schedule

Learning Unit A.1 Pre Training Assessment

Context and description of the Session

The session shall consist of either written tor oral question-answer/discussion round o under the perception level of the participants before at the entry level of the training course. This would be repeated at the end of the course (post-training session) during valediction to understand the impact of the course by facilitation a comparison of entry and exit behaviour of the participants.

A film can also be shown to trigger the expression of participants prevailing knowledge and/or perception on aspects of chemical disaster management.

Learning Objectives

- To compare the entry and exit behaviour of the trainees
- To evaluate the knowledge and skills gained from the training
- To assess perceived competency of participants on chemical (industrial) disaster management
- To carry out a formal internal evaluation methodology using questionnaires

Duration

30 minutes

Method

Film show, Question-answers, Discussion

Media

LCD presenter, White board, Flip-chart / Interactive board

Resource person

Course Coordinator/NIDM or DMC faculty

Questionnaire Tips

Following the screening of a film pertaining to a case of chemical (industrial) disaster preferably in Indian context, a questionnaire based assessment of the participants perception at the entry level (and also at the exit level) may be carried out. Alternatively, a discussion based on question-answers focusing on various aspects of chemical disaster management cycle. The questions shall be identified/framed by the course director/coordination team looking into

the course module's scope, participants profile and duties/background, and context of the film being screened.

It is suggested that the discussion/ assessment shall cover the entire range of issues involved in prevention, mitigation including risk management and legal framework, planning and preparedness, emergency response, relief and long-term issues of litigations, compensations and futuristic lessons.

Figure 4: Jaipur Fire

Trainers Note

It is advised that the course coordinator / trainers keeps pre-developed notes as own tips and hints for delivering course session. The resource person for this session is expected to have a broad knowledge of all aspects associated with chemical disaster management and the national and international framework for dealing with the subject, ideally a team of two or three resource persons drawn with background of environment & earth science, environmental law, industrial management and geoinformatics, having prior experience of disaster management.

Learning Unit A.2 | Chemical Disasters - Global and National Scenario

Context and description of the Session

India witnessed the worst Industrial disaster in the history in the year 1984, the Bhopal Gas Tragedy. Following the Bhopal Gas Disaster in 1984, major incidences of chemical disasters in India include a fire in an oil well in Andhra Pradesh (2003); a vapour cloud explosion in the Hindustan Petroleum Corporation Limited Refinery (HPCL), Vishakhapatnam (1997); and an explosion in the Indian Petrochemicals Corporation Limited (IPCL), Gas Cracker Complex, Nagothane, Maharashtra and recent Jaipur Fire in 2009. This session is to highlight the major industrial disasters worldwide and the Hazard Profile of India (with major focus on Chemical Hazards)

Table 1: Examples of major chemical incidents worldwide

Top 10 most important Industrial Accident disasters for the period 1900 to 2011, Sorted by numbers of killed at the country level		
Country	**Date**	**No Killed**
Colombia, Explosion	7-Aug-1956	2,700
India, Gas Leak	3-Dec-1984	2,500
China P Rep, Other	26-Apr-1942	1,549
France, Explosion	10-Mar-1906	1,099
Nigeria, Explosion	17-Oct-1998	1,082
Iraq, Explosion	17-Aug-1989	700
Soviet Union, Explosion	4-Jun-1989	607
Germany, Explosion	21-Sep-1921	600
United States, Explosion	16-Apr-1947	561
Brazil, Explosion	25-Feb-1984	508

Source: http://www.emdat.be/

Bhopal Gas Tragedy (1984) is noted as the worst industrial (chemical) disaster in the history, besides Minemata (1956), Sevaso (1976), Three Mile Island (1979), Chernobyl (1986) among a long list of major technological disasters.

The Indian chemical industries comprise small, medium and large-scale units. The chemical industry which includes basic chemicals and their intermediates, petrochemicals, fertilizers, paints, pesticides, bulk-drugs and pharmaceuticals is one of the most diversified industrial sectors covering more than 70,000

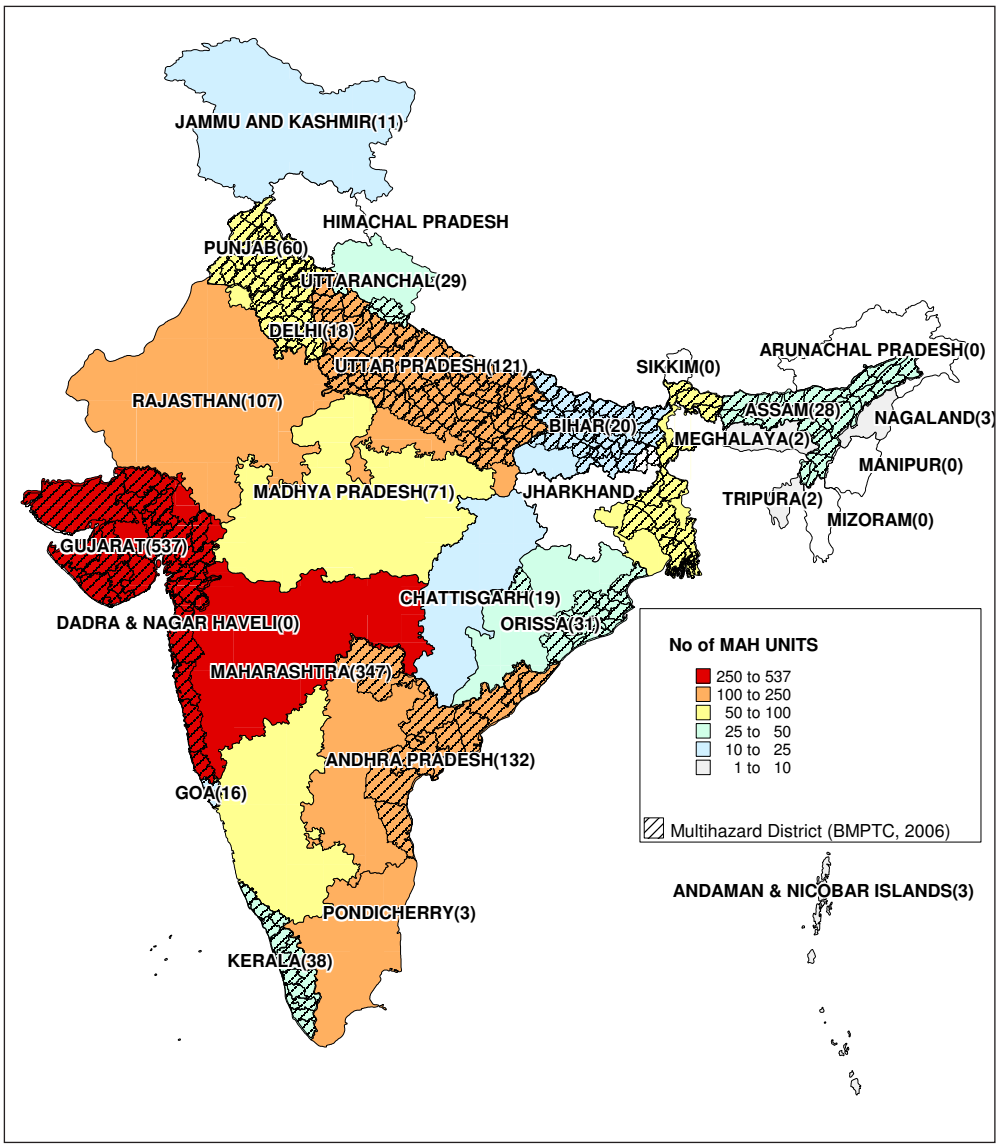


Figure 5: Map showing concentration of MAH Units and multi-hazard districts in States/UTs.

commercial products. Emergencies may arise from industrial manufacturing, storage or process, transport or other incidents involving hazardous substances, including waste.

It is important to appraise the participants about the past incidences of disasters involving chemicals that took place in India and in other countries, besides

describing the present account of installations and industries that encompass the risk of chemical disasters. Based on threshold criteria in the law (MSIHC Rules, 1989) certain installations are categorized as Major Accident Hazard (MAH) Units. At present, 286 districts spread in 26 states and Union Territories of India have been identified as industrial hazard prone due to the presence of one or more than one of the 1894 Major Accident Hazard (MAH) industries (refer to Figure 4).

Learning Objectives

- To make an overview on past chemical disasters and present state of risk at global level,
- Case review of past major chemical disasters with an example for detailed discussion
- To review national scenario of past chemical disasters and present hazards and risks in India

Duration

60 minutes

Contents

- Industrial disasters
- Chemical disasters
- Major chemical disasters
- Policy implications
- Bhopal tragedy and other major chemical disasters
- Natural hazards triggering chemical accidents
- Current Scenario
- Gaps

Method

Lecture, discussion

Media

LCD, White board, Maps

Resource persons

Course coordinator (NIDM or DMC Faculty in the case of courses organized at NIDM and States)

Trainer's note and tips

Session faculty is advised to provide a past account of industrial/chemical accidents globally and nationally, with some examples of major chemical accidents including Bhopal tragedy. It is important to give the participants an idea the trend in chemical industry's growth and diversity of hazardous chemicals and type of installations and facilities which can result in disasters, and related issued of policy challenges for the disaster managers and the Government. Examples of natural disasters that can trigger industrial/chemical disasters shall also be discussed in brief, to give an idea on the scale and urgency of focus at global and national level on planned approach for prevention and preparedness for chemical disasters.

RECENT INDUSTRIAL DISASTERS IN INDIA

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.

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

5 March: *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

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

19 September : *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).

*(**Sources:** Pandey, B. and M. H. Fulekar (2011). Environmental Management - Strategies for chemical disaster, Research Journal of Chemical Sciences Vol. 1 (1), 111-117, and other media based sources including newspapers, websites and magazines. The details given here are cited for academic understanding on the implications of chemical accidents and are not meant for any kind of evidence or ground for litigation of official proceedings, in any circumstances).*

Five Major Chemical Disasters in the World

By their nature, the manufacture, storage, and transportation of chemical substances are accidents waiting to happen. Chemicals can be corrosive, toxic, and may react explosively. The impacts of chemical accidents can be deadly, for both human beings and the environment. Reasons behind such disasters range from human errors to the use of outdated equipment and the careless handling of dangerous chemical substances.

In 2005, a disaster at a major petroleum refinery in Texas City, United States, was considered US' worst industrial disaster in 15 years. A series of explosions took place when a hydrocarbon isomerization unit was restarted and a distillation tower flooded with hydrocarbons. As a result, 15 were killed and another 180 were injured.

In September 2001 an explosion occurred in a shed containing about 300 tones of downgraded ammonium nitrate at a chemical plant in Toulouse, belonging to one of France's leading fertilizer producers. The explosion caused 31 deaths and injured more than 4,500 people, while destroying 27,000 buildings in the area.

In February 2000 a poisonous chemical spill that took place in the Romanian city of Baia Mare destroyed wildlife and fish stocks while threatening the water supplies of 2.5 million people all over the Central and Eastern Europe. Approximately 100,000 m3 of cyanide, used in the gold extraction process at a local mine, was released into the river Somes when a reservoir wall at the mine collapsed. The event was described as Europe's worst disaster since Chernobyl.

One of the deadliest chemical accidents took place in 1984 at a pesticide plant in the state of Madhya Pradesh in central India. On the midnight between December 2nd and 3rd, a combination of factors ranging from hazardous handling of dangerous chemical substances to the use of outdated and malfunctioning industrial equipment led to the exposure of over 500,000 people to toxic gases and byproducts, resulting in nearly 3,800 officially confirmed human deaths.

In June 1974, near the village of Flixborough in the United Kingdom, took place an event which led to a significant tightening of the UK government's regulations covering hazardous industrial processes. A locally owned chemical plant, while repairing one of its chemical reactors, produced in less than a minute a leak of 40 tones of cyclohexane, which formed a vapor cloud with a diameter of about 200 m. The cloud exploded and completely destroyed the plant, also damaging about 1,800 buildings on a more than 1,5 km radius.

The history of modern industry shows that organizations in the chemical business can never be too careful while operating with such substances, nor too quick or well equipped when trying to contain the effects.

Article Source: http://EzineArticles.com/?expert=Jack_Wogan (2010)

Bhopal Gas Tragedy, India, 1984

The night of 2-3 December 1984 in Bhopal, India, was one of those nights where the week winds kept changing direction. Under the dear dark sky, the key units of the Union Carbide India Limited facility, one of the largest employers in the city, were quietly waiting to be dismantled and shipped to another developing country.

The Union Carbide plant had once been port of an ambitious Indian plan to achieve self-agricultural production by increasing the national production of pesticides, but the plan was severely curtailed by the crop failures and famine that spread across India in the early 1090s. The rising level of formers' indebtedness dramatically decreased investments in expensive pesticides, and the plant was now operating of only one quarter of its production capacity.

At 23:00, while most of Bhopal's 900 000 inhabitants were sleeping on operator of the Carbide plant noticed a small leak as well as elevated pressure inside storage tank 610, which contained methyl isocyanate (MIC), a highly reactive chemical used as a intermediate in the production of the insecticide Sevin. The leak had been created by a strong exothermic reaction resulting from mixing of one tone of water normally used for cleaning internal pipes with 40 tonnes of MIC contained in the tank.

Because coolant for the refrigeration unit had been previously for use in another part of the plant, tank 610 could not be cooled quickly. Therefore, pressure and heat continued to build inside the tank and the tank continued to leak. Both the vent gas scrubber and the gas flare system, two safety devices designed to neutralize potential toxic discharges from the tank before they escaped into the atmosphere, had been turned off several weeks before. At around 1:00, a loud rumbling echoed around the plant as the safety valve of the tank gave way. Nearly 40 tonnes of MIC gas were released into the morning air of Bhopal. It did not take long for the plume, carried by the changing winds, to spread over a large area.

At least 3800 people died immediately, killed in their sleep or during the flight that ensued. Local hospitals were soon overwhelmed with the thousands of injured people. The crisis was further deepened by a lack of knowledge of exactly which gas was involved and hence what the appropriate course of treatment should be. Estimates of the number of people killed in the first few days by the plume from the Union Carbide plant are as high as 10 000, with 15 000 to 20 000 premature deaths reportedly occurring in the subsequent two decades. The Indian government reported that more than half a million people were exposed to the gas. The greatest impact was on the densely populated poor neighborhoods immediately surrounding the plant.

The Bhopal incident was the result of a combination of legal, technological organizational and human errors. While the immediate course of the incident was the unintended release of a large amount of water into a storage tank, the severe health effects of the chemical reaction that ensued were certainly aggravated by the failure of the various safety measures and the lack of community awareness and emergency preparedness. Economic pressure faced by industry, communities and governments can be a contributing factor that influences the likelihood and security of a chemical incident.

Learning Unit A.3 | Chemical Disaster Risks : State Profile

Context and description of the Session

Type, scale and damageability of chemical disaster risk depends on industry type, hazardous materials, off-site habitations couples with geo-environmental and climatic features in the area. Industrial or chemical installations and isolated storages largely depend on developmental requirements, raw materials, industrial and economic policies, manpower and trans-boundary issues. State profile of chemical industries, isolated storages, hazardous goods transport, and locations of major industries, industrial estates, and chemical usage in various developmental activities shall be discussed in the session to appraise the participants about the seriousness of the subject of chemical disaster management in the regional/provincial context.

Learning Objectives

- To review the hazardous chemicals based activities in the state/region and past record of chemical accidents
- To inform the participants about disaster risk associated with these chemicals
- To enumerate the state profile of chemical disaster risk in context of storage and industries, industrial estates, etc.

Duration

45 minutes

Contents

- Industrial profile of the state/region
- Chemical intensive activities in the state/regions
- Major industries and industrial estates
- MAH Units in the states with reference to geographical areas
- Past record of accidents involving chemicals
- Status of chemical disaster risk in the state/region

Method

Presentation/Lecture, discussion

Media

LCD, White board, Maps

Resource persons

Invited resource person (may be from Deptt. of Industries/ Factories & Boilers/ Pollution Control Board)

Trainer's note and tips

This module is applicable for State Level programmes. Resource person shall use various datasets from authentic sources regarding profile of chemical based activities, besides location maps of major industries and industrial estates. Alternatively state's map can be used to discuss the concentration of types of industries, transport routes or isolated storages, etc. to describe the areas/ localities with varying levels of impending risk of facing a chemical disaster.

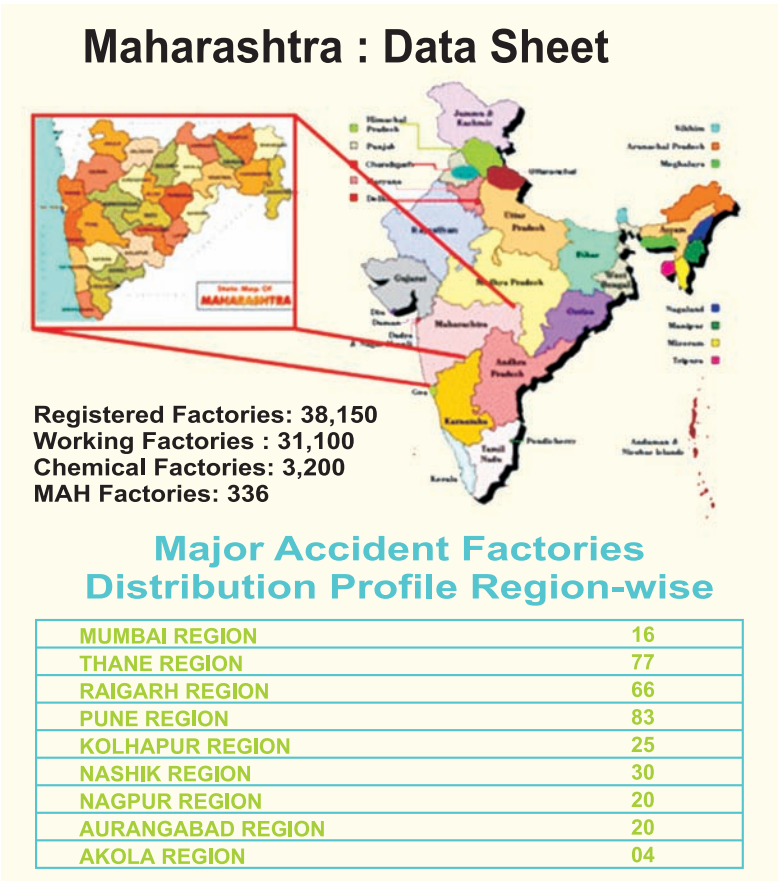


Figure 6: Map showing the major accident factories and region wise distribution

Learning Unit A.4 | Chemical Disasters: Causes and Consequences

Context and description of the Session

Key terminologies

Industrial Disaster, Chemical Disaster Hazard, Risk, Accident, Disaster, Vulnerability, Maximum Credible Accident, Event Tree, Fault Tree, Risk Acceptance, HAZOP, HAZAN, Consequence, Risk Contours, DMP, EMP

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 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).

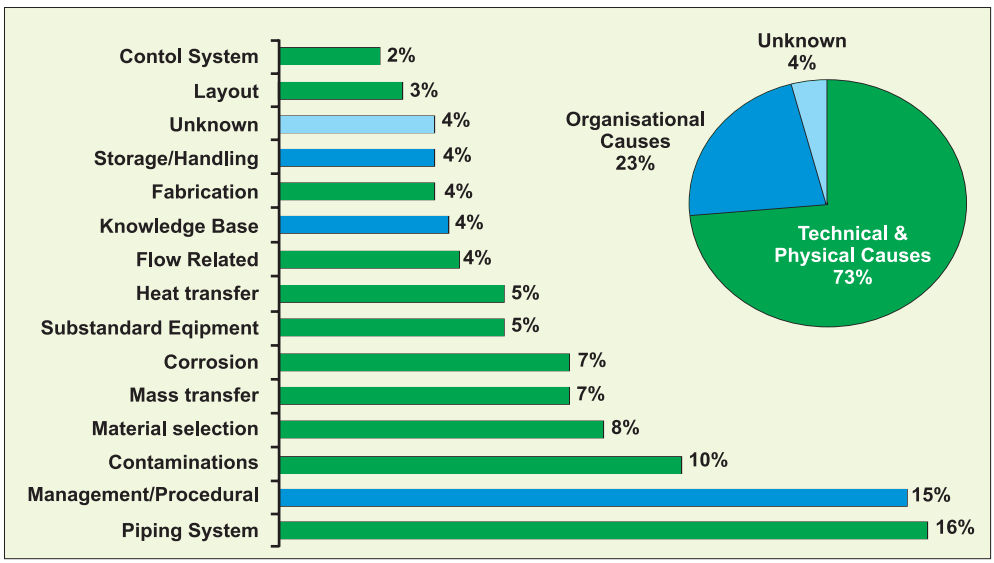
Chemical and industrial emergencies may arise in a number of ways:

- 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

A chemical is known to be hazardous by possessing one or more of the following characteristics:

- Flammable and/or explosive
- Toxic
- Highly reactive
- Corrosive
- Radioactive

The general (pie chart) and immediate (bar chart) causes of accident.[16]



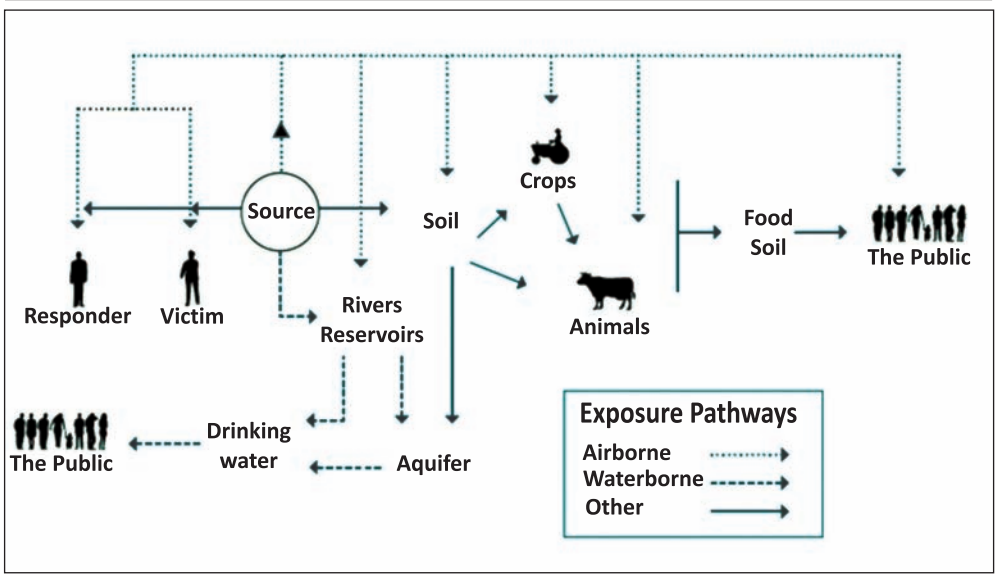


Figure 7 : Exposure Pathways.

The BLEVE occurs when the catastrophic failure of a vessel containing liquid flammable material in pressurized condition takes place. The visual effects of the BLEVE is shown in the photo

Figure 8 : Boiling liquid expanding vapour explosion (BLEVE)

A session devoted to sources, causes, effects and consequences is important to appraise the participants about the hazardous chemical incidents – physical effects and effects on people or property. Hazard Risk and Consequence Assessment (HARCO) aims at risk characterization and forms the key activity in chemical disaster risk management. It incorporates developing possible physical effect scenarios after a likely initiating event coupled with profile of vulnerability. Following aspects are important in physical effect of a chemical release incidence:

- Characteristics of material and inventory
- Conditions at storage and handling (process, transport, disposal, etc.)
- Climate/meteorological characteristics in the area/region
- Geo-hydrological characteristics of the area/location
- Trigger factor / components and chemical release type(s)

Learning Objectives

- To review the sources and causes of chemical incident that can result into a disaster
- To inform the participants about routes and effects of incidents involving hazardous chemicals
- To enumerate the consequences of different chemical disasters

Duration

45 minutes

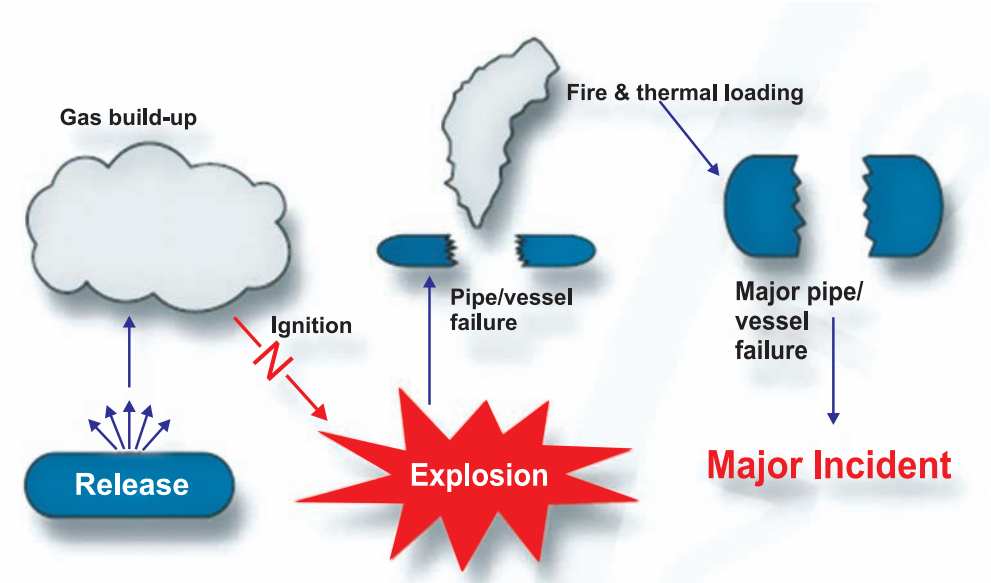


Figure 9 : Explosion leading to major incident

Contents

- Key terminology in chemical disaster risk management
- Hazardous goods/chemicals definition and characteristics
- Chemical disaster sources and causes
- Meteorological and surface characteristics in chemical dispersion/ transport
- Vulnerability to chemical disasters
- Hazard, risk and consequence analysis issues
- Examples of short-term and long-term effects of major chemical disasters
- Socio-economic, legal and psychological aspects of chemical disasters

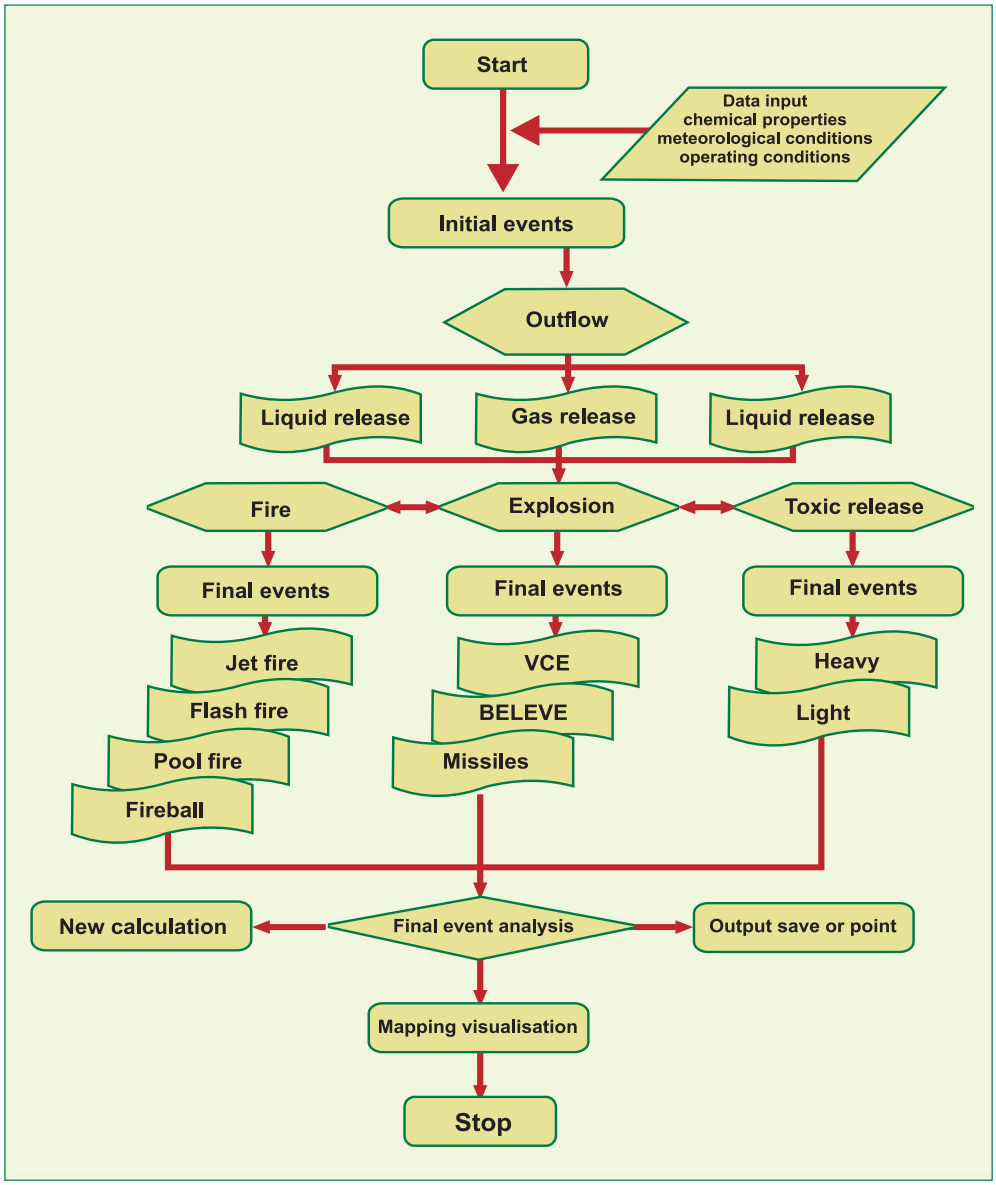


Figure 10: Physical effect risk assessment chart

Method

Presentation/Lecture, Film show, discussion, case study

Media

LCD, White board, Video clips

Resource persons

NIDM Faculty Member / Invited Resource Person

Trainer's note and tips

The trainer faculty taking this session shall draw the comprehensive overview of what are the root causes of such incidents leading to disasters and how these affect the community and development. Various media including a short-film can be used to appraise the participants on types of chemicals, types of physical scenarios of liquid, gas, solid or mixed phase of chemical release, on-site and off-site vulnerability and consequences of a chemical disaster. Resource person can use short-stories or experience sharing also as a means to bring out participants own knowledge into sharing with others on these aspects.

Module B

LEGAL & INSTITUTIONAL FRAMEWORK ON CHEMICAL DISASTERS

B LEGAL & INSTITUTIONAL FRAMEWORK ON CHEMICAL DISASTERS

The regulatory framework on chemical safety can be traced back to chemical class-specific regulations like the Explosives Act, 1884; The Petroleum Act, 1934; The Factories Act, 1948, The Inflammable Substances Act, 1952; The Insecticide Act, 1968 and Static & Mobile Pressure Vessels Rules, 1981, that provided on safety management but the focus was mainly on-site. Institutional and legal framework for management of hazardous substances, industrial/chemical risk management and disaster prevention in India came into place in the following reaction to world's worst environmental disaster in 1984. Most of other acts have also been amended in post-Bhopal era to strengthen safety and disaster prevention related provisions.

The Government of India has further reinforced the legal framework on chemical safety and management of chemical accidents by enacting new rules and amendments to the existing legislations. The Environmental Protection Act, 1986, known as umbrella act, provided a comprehensive coverage and framework for all environmental issues including risk management. Rules and Guidelines have been issues under the EPA, 1986, for hazardous chemicals, hazardous waste, biomedical waste, hazardous microorganisms, emergency preparedness and planning, etc. A number of regulations covering safety in transportation, insurance, liability and compensations were enacted in 1990s.

It was 1996, when CA(EPP&R) Rules (under EPA, 1986) provided for *institutional mechanism* at *National, State, District* and *Local level* for disaster preparedness, planning and Response in case of chemical accidents, that has been later incorporated in DM Act, 2005, with a holistic view for covering all the disasters. As per the Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996, (CA(EPPR)), the District Crisis Group (DCG) is responsible to review the on-site emergency plans prepared by occupiers of the units, monitor chemical accidents and conduct full-scale mock trials every year. The plans must be modified based on the lessons learnt from the Mock trials subsequently conducted. As per the CA (EPPR), the Local Crisis

Group (LCG) is responsible to educate the population likely to be affected in a chemical accident and conduct one full-scale mock trial of a chemical accident every six months.

There are many Ministries and institutions involved in chemical disaster management i.e. NDMA, Ministry of Environment and Forest (Nodal Ministry), Ministry of Home Affairs, Ministry of Labour & Employment, Ministry of Petroleum, Ministry of Agriculture, Ministry of Industry, Ministry of Health, etc at national level. At state level SDMAs, Departments of Factories and Boilers, Pollution control, Medical and health, Police, Fire, Industry & Commerce, etc. are directly responsible for industrial accident related issues. NIDM is mandated for capacity building, research, training, documentation and related activities.

Enabling Objective

At the end of this learning unit, the participants will be able to:

1. Review the pre-Bhopal and post-Bhopal regulations addressing concerns of chemical accident management
2. Refer the international conventions, treaties and bindings on chemical safety which are relevant for India
3. State the evolution of environmental jurisprudence and role of litigations and liability issues
4. Relate with the holistic disaster management framework and concerns of national guidelines on chemical disaster management

There are 4 learning units delineated to draw this module

LU-1 : Legal Framework on Chemical Disaster Management in India

LU-2 : International Bindings and Guidelines

LU-3 : Environmental Jurisprudence, Liability and Litigations

LU-4 : Disaster Management Act and National Guidelines

Learning Objectives

The key objectives of this module are following:

- Inform/update the participants on various acts and laws concerning different aspects of chemical disaster risk management and emergency response and recent developments
- Appraise on international regulations and bindings on chemical safety and its implications for chemical risks in India

- To assess the development of laws concerning chemical disasters especially in post-Bhopal period, related with occupiers liability, compensation, tribunal, and role of litigations
- To update the participants on DM Act and its provisions in offering a holistic framework for multi-hazard disaster risk management and related guidelines

Duration

About 4 hours including the presentation/lectures and discussion.

Methodology

- Lecture/power point presentation
- A Case study (case law)
- Discussion

Trainers Tips

Subject of legislation and standards/ codes, guidelines forms a dry subject for some of the participants and in certain occasions as it doesn't involve many live examples or logical/thematic discussions, stories, pictorials, etc. Thus, it presents a challenge before the resource person on how to make these topics and contents interesting by involving the participants in the discussions. Good handouts, pictures, cases depicting legal issues and if possible short video clips can help the trainers manage the challenge.

Learning Unit B.1 | Legal & Institutional Framework in India

Context and description of the Session

Regulatory Framework for management of Chemical Disasters can be broadly classified in two phases - Pre Bhopal and Post Bhopal. Pre Bhopal regulations were focused on on-site safety of workers and legal system to regulate Off-site emergency system, Safe storage of hazardous materials and Safe transportation of hazardous materials was hardly existing.

A list of Acts and Laws with relevant provision on Chemical Risk Management and Disaster Prevention is given below.

- Explosive Act 1884 and explosive Rules 2008
- The Petroleum Act, 1934
- The Insecticide Act, 1968
- Factories Act, 1948 and Rules made there under
- Factories Act and Factories Amendment Act 1987
- Static & Mobile Pressure Vessels Rules, 1981
  - Environment (Protection) Act, 1986
  - The Environment (Protection) Rules, 1986 (amended 2004).
  - The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (amended, 1994 and 2000).
  - The Manufacture Storage, Import and transboundary movement of Hazardous Chemicals Rules (2008 amended in 2009)
  - The Hazardous Wastes (Management and Handling) Rules, 1989 (amended 2000 and 2003).
  - The Environment Impact Assessment Notification, 2006.
  - The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996.

- Public Liability Insurance Act, 1991
- National Environmental Tribunal Act, 1995

- Disaster Management Act, 2005
- Amendments to Pre-Bhopal legislations including Factory Safety Act and Motor Vehicles Act
  - o The Insecticides Act, 1968 (amended 2000) and The Insecticide Rules, 1971 (amended 1999).
  - o The Motor Vehicles Act, 1988 (amended 2001).
    - The Central Motor Vehicles Rules, 1989 (amended 2005).
  - o The Explosives Act, 1884 (amended till 1983).
    - The Gas Cylinder Rules, 2004.
    - The Static and Mobile Pressure Vessels (Unfired) Rules, 1981 (amended 2002).
    - The Explosives Rules, 1983 (amended 2002).

Apart from the above, legal instruments for management of hazardous wastes includes the Biomedical Wastes (Management & Handling) Rules, 1998/2000 and the Batteries (Management & Handling) Rules, 2001, and Hazardous Microorganism Rules, 1989. Major responsibility for implementing these Rules is with the Central Pollution Control Board and State Pollution Control Boards (SPCBs) / Pollution Control Committees (PCCs) and also with the State Departments of Environment.

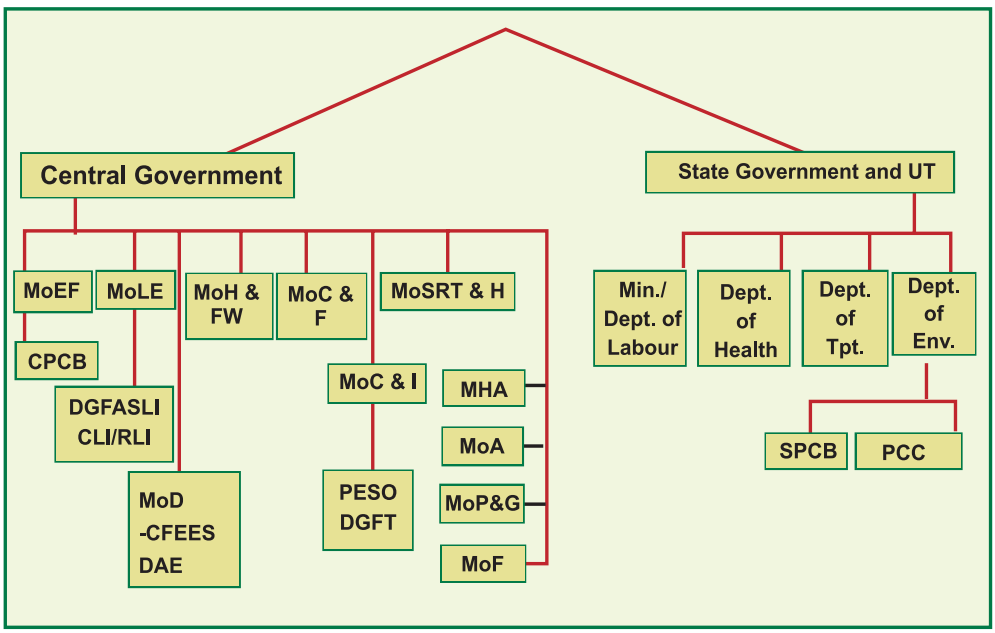


Figure 11. Institutional setup for chemical disaster management

Learning Objectives

- To appraise/update the participants on legal provisions for preventive aspects of chemical disasters including site clearance, impact assessment, license and public participation in decisions
- To inform the participants on legal and institutional framework for safe storage, handling, transport and disposal of hazardous goods/chemicals

To enumerate the legal provisions of chemical disaster planning, preparedness, response and relief to the victims/affected

Duration

90 minutes

Contents

- Constitutional provisions on environment
- Regulations on factory safety, hazardous chemicals and hazardous wastes
- Threshold and provisions for Major Accident Hazard (MAH) Units
- Regulations on Site clearance, EIA, and environmental clearance
- Regulations on On-site Emergency Plan and Off-site EPP
- Regulations on Crisis Group and Emergency Planning, Response
- Institutional Framework for policy making, clearance and license
- Institutional Framework for emergency planning and response
- Latest updates/amendments and futuristic legal issues

Method

Presentation/Lecture, discussion

Media

LCD, White board

Resource persons

Course Faculty/ Resource person

Trainer's note and tips

Salient features of various Acts, Rules, Guidelines that address the issues of chemical disaster prevention and response by means of hazard or vulnerability reduction, safety systems, on-site and off-site emergency planning, mock-drills, public information, response coordination, need to be enlisted and shown to the participants within the presentation/lecture.

Learning Unit B.2 International Bindings and Guidelines

Context and description of the Session

Agenda 21 (Chapter 19) provides for environmentally sound management of toxic chemicals, including prevention of illegal international traffic in toxic and dangerous products. The sound management of chemicals and hazardous waste was addressed at the World Summit on Sustainable Development (WSSD), held in Johannesburg from 26 August to 4 September 2002.

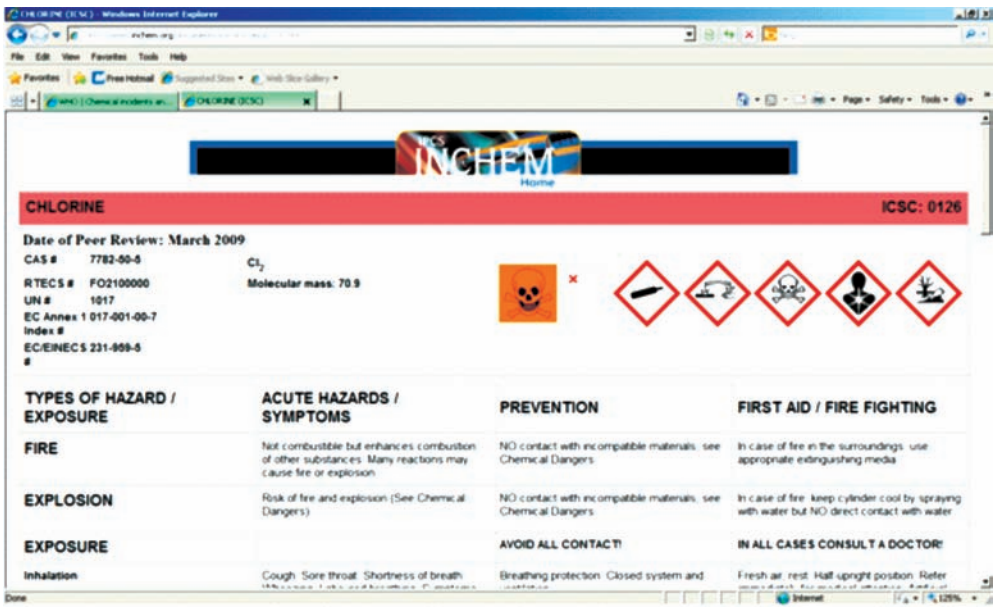


Figure 12: INCHEM home page showing the hazardous properties, acute hazard symptoms prevention and first aid measures for various chemicals

Delegates agreed to text in the Johannesburg Plan of Implementation supporting entry into force of the Rotterdam PIC Convention by 2003 and the Stockholm POPs Convention by 2004. The Plan of Implementation also contains commitments to:

- reduce the significant effects of chemicals and hazardous waste on human health and the environment by 2020;
- encourage countries to implement the new globally harmonized system for the classification and labeling of chemicals, with a view to having the system operational by 2008;

- promote efforts to prevent international illegal trafficking of hazardous chemicals and hazardous waste, as well as damage resulting from the transboundary movement and disposal of hazardous waste; and
- further develop a strategic approach to international chemicals management based on the Bahia Declaration and Priorities for Action beyond 2000 of the Intergovernmental Forum on Chemical Safety (IFCS) by 2005.

United Nations Environment Programme has a Chemical Section and the programmes there under are: Persistent Organic Pollutants, Mercury Programme, Land & Cadmium Activities, Legal File, SAICHEM, Chemical Information Projects and Consultant Roster. In Feb 2006, over 190 countries including India acceded to a Strategic Approach to International Chemicals Management (SAICM)- a voluntary agreement to ensure safe use of chemicals by 2020.

The participation and involvement in international agreements concerning management of chemicals is well developed in India. Most of the major international organizations such as the WHO, ILO, World Bank, UNIDO, FAO and others are working actively in India.

Learning Objectives

- To inform the participants on global/ international initiatives on chemical safety and disaster management including response preparedness
- To update the participants on India's national commitment and binding to various international obligations
- To assess the implications of the international programmes and guidelines on chemical disaster management in India

Figure 13: INCHEM – chemical Safety Information from Intergovernmental Organization.

Duration

30 minutes

Contents

- International Programme of Chemical Safety (IPCS),
- Strategic Approach to International Chemicals Management (SAICM), including:

  - Rotterdam Convention on Prior Informed Consent Procedure (PIC) for highly hazardous industrial chemicals and pesticide formulations in international trade, adapted in 1998
  - Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal, adapted in 1992
  - Stockholm Convention on Persistent Organic Pollutants (POP), adapted in 2001
- International Register for Potentially Toxic Chemicals (IRPTC) and UNEP cleaner production programme.
- UNITAR – Globally Harmonized System for Chemical Classification and Labelling
- Asia Pacific Environmental Innovation Strategy Project

Method

Presentation/Lecture, discussion

Media

LCD, White board

Resource persons

Course Faculty/ Resource person

Trainer's note and tips

Trainer can appraise the participants about these programmes and can also give their weblinks so that they can keep an update about the activities and the new sets of literature or guidelines coming up for wider use. Secretariat or offices of these conventions or programmes also conduct various knowledge and skill development activities and some of the participants may find these useful to them. This will in turn generate interest in learning about the provisions therein these programmes/ guidelines and their impacts on chemical disasters in India. This session can be included in the introductory part for the State Level Courses. For national courses it can be included in the time slot for state profile.

Strategic Approach to International Chemicals Management (SAICM)

The Strategic Approach to International Chemicals Management (SAICM) was adopted at the International Conference on Chemicals 6. February 2006 It was subsequently endorsed by the ninth special session of UNEP Governing Council in its decision SS.IX/1 on 9 February 2006. Further information on the Strategic Approach can be found on www.chem.unep.ch/saicm. SAICM comprises three core texts:

- The Dubai Declaration, which expresses the commitment to SAICM by Ministers, heads of delegation and representatives of civil society and the private sector.
- The Overarching Policy Strategy, which sets out the scope of SAICM, the needs it addresses and objectives for risk reduction, knowledge and information, governance, capacity-building and technical cooperation and illegal international traffic, as well as underlying principles and financial and institutional arrangements. The ICCM adopted the Overarching Policy Strategy which together with the Dubai Declaration constitutes a firm commitment to SAICM and its implementation.
- A Global Plan of Action, which sets out proposed "work areas and activities" for implementation of the Strategic Approach. The ICCM recommended the use and further development of the Global Plan of Action as a working tool and guidance document.

Learning Unit B.3 | Environmental Jurisprudence, Liability and Litigations

Context and description of the Session

Development of legislation in area of chemical disaster management owes to environmental jurisprudence and also to the lawsuits in form of public interest litigations. Under the Public Liability Insurance Act, 1991 as amended in 1992, all the MAH units handling chemicals in excess of the threshold quantities referred to in the Schedule, are mandated to take an insurance policy before starting his activity, on behalf of the off-site population, and deposit an equal amount in the Environment Relief Fund (ERF) to ensure immediate payment to the chemical accident victims. This relief shall be paid on "Principle of no fault" that is the claimant shall not be required to plead or establish that the death, injury or damage was due to any wrongful act neglect or default.

A number of chemical specific codes of practices published by the Bureau of Indian Standards (BIS), the Oil Industry Safety Directorate (OISD) and guidelines brought out for chemical accident management by the MoEF.

A Central Insecticides Board and Registration Committee (CIBRC) have been constituted under the Insecticides Act 1968. A National Register for Potentially Toxic Chemicals (NRPTC) as a network of International Register had been maintained (at IITR, Lucknow) under the UNEP-MoEF.

The National Environment Tribunal Act, 1995 is enacted to setup legal institution across the country to provide for strict liability for damages arising out of accidents occurring during handling of hazardous substances and for establishment of National Environment Tribunal for effective and expunction disposal of cases arising from such accidents, with a view to giving relief and compensation for damages to person, property and the environment. Several important and lawmaking decisions were taken by the Hon'ble supreme court of India on public interest litigations even under the constitutional provisions on environment or right to life.

Learning Objectives

- To discuss the development of legislations on environmental protection, hazardous chemicals and liability to pay compensation to affected

- To describe the provisions and status of implementation of Public Liability Insurance Act/Rules
- To assess the implications of litigations including public interest litigations on environment and chemical emergency related laws

Duration

60 minutes

Contents

- Environmental jurisprudence on chemical safety and compensation to affected
- Salient features of Public liability act and rules
- Implementation of public liability act and related cases
- Features of Environmental Tribunal Act and its implementation
- Public interest litigations and other legal cases on chemical accidents, environment and liability to pay compensation
- Liability of stakeholders other than occupiers in relation to chemical safety and emergency management
- Role of insurance in chemical disaster risk management
- Safety auditing, review and company certification – role in risk reduction

Method

Presentation/Lecture, discussion

Media

LCD, White board

Resource persons

Course Faculty/ Resource Person with Legal Practice Background

Trainer's note and tips

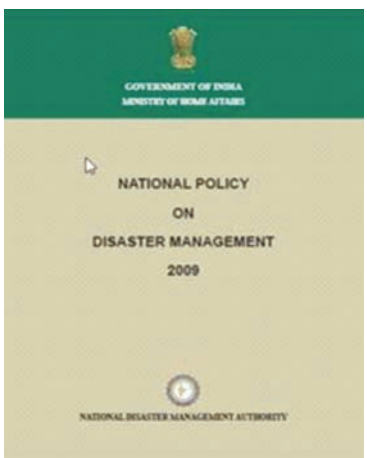
Course delivery during this session would be interesting and effective if some cases from India, few from international contexts and few from state's contexts are discussed with the participants. Some participants can also quote examples of litigation and liability cases involving chemical hazards and accidents and would be useful to discuss.

Learning Unit B.4 | Disaster Management Act and National Guidelines

Context and description of the Session

The Disaster Management Act 2005' came into force on 26 December 2005 with the objective of holistic disaster management with focus on all stages with paradigm shift from 'response to relief' to 'prevention and mitigation'. The Act seeks to institutionalize the mechanisms at the national, state and district levels to plan, prepare and ensure effective response in disasters including accidents. The Act mandated for: (a) a national apex body, the National Disaster Management Authority (NDMA) (b) State Disaster Management Authorities (SDMAs), and (c) District Disaster Management Authority at District level for the coordination and monitoring of the disaster management activities. Disaster Management is a State Subject and as per the Act (Sec 22). DM Act mandated the National Institute of Disaster Management for capacity building including training, research, documentation and policy advocacy on all aspects of disaster management.

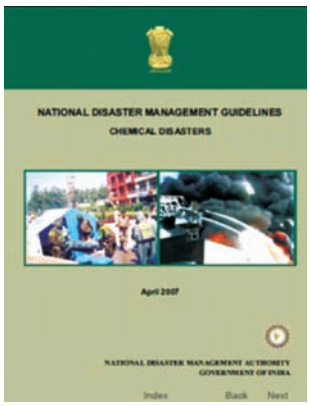
A State Executive Committee has to be set up at every state for implementing the National Plan and State Plan and act as the coordinating and monitoring body for management of disaster in the State and examine the vulnerability of different parts of the State to different forms of disasters and specify measures to be taken for their prevention or mitigation. The state plan should include the roles and responsibilities of each Department of the State Government in both pre-disaster and post disaster phase. NDMA is mandated for development of national guidelines on disasters and their holistic management.



Learning Objectives

- To inform the participants on salient features and provisions of Disaster Management Act 2005

- To describe the provisions and features of National Guidelines on chemical (industrial) disaster management
- To assess cross-sectoral issues, challenges and need for integration



Duration

60 minutes

Contents

- Salient features and provisions of Disaster Management Act
- Definition of 'disaster' and 'disaster management'
- Institutional mechanism and disaster management planning
- National Guidelines on Chemical (Industrial) Disaster Management
- Integration of disaster mitigation with developmental planning
- Salient features of Disaster Management Policy

Figure 15: National Disaster Management Framework (www.ndma.gov.in)

Method

Presentation/Lecture, discussion

Media

LCD, White board

Resource persons

Course Faculty/ Resource Person from State Disaster Management Authority

Trainer's note and tips

This session shall cover the legal framework under the DM Act for holistic management of disasters including Chemical Disasters. Trainer can also discuss the present state of developing the institutional mechanism at various levels, multi-hazard risk assessment and disaster management planning incorporating industrial/chemical disasters and also about the National Disaster Management Guidelines.

Module C

FIELD EXPOSURE TO CHEMICAL DISASTER RISK AND MANAGEMENT

C FIELD EXPOSURE TO CHEMICAL DISASTER RISK AND MANAGEMENT

A field visit to a major accident hazard (MAH) unit in the nearby location in an organised way shall enable the participants carryout observations on off-site context of vulnerable habitations, urbanization and transport issues, domino-risk due to other hazardous installations in the area, emergency resources and critical facilties in handling major accident emergencies outside the factory/ storage premises. Identification of the industry/installation to be choosen for industrial visit shall be done by the course faculty under discussion with senior official(s) of Pollution Control Board/Department of Factories & Boilers/ Industries or Industrial Association of the area or in some cases direct consultaton with the major industiral unit's divison of safety health & environment.

Figure 15: Off-site perspectives for chemical disaster risk and vulnerability.

Enabling Objective

At the end of this learning unit, the participants will be able to:

- Understand and describe in brief about the objectives and structure of an onsite emergency management plan
- Understand various measures (Safety) taken in the industry to prevent

Chemical disasters

- Describe the on-site hazards and risks of accident that can lead to disaster within premises and out-side
- State the industrial siting aspects of off-site emergencies in case of a chemical disasters
- Analysis the vulnerability of the off-site population, property and environment to the risk of a chemical disaster
- Assess the risk perception level, mitigation and preparedness including response measures, planning, coordination and command system on-site and off-site for handling emergencies
- To define the need and modes to integrate off-site emergency plan with disaster management plan

Figure 17: Landscape and land-use concerns of chemical disaster impacts.

There are 4 learning units delineated to draw this module:

LU-1 : Field Visit: Objective Setting and Planning

LU-2 : Field work appraisal of the participants

LU-3 : Field Visit Coordination and Observations

LU-4 : Discussion and Query Satisfaction

Figure 17: Process Control System appraisal

Learning Objectives

The key objectives of this module are following:

- To facilitate participant plan objective assessment of off-site risk and vulnerability to impact of a chemical disaster from a major hazard installation
- To help participant understand and practice the conduct and deciplines, while taking observations on various aspects of disaster risks and mitigation

Figure 18: Helmet distinction

- To coordinate the participants observations and comments towards developing a useful outcome to improve risk management practices in given situation
- To update the participants on various risk mitigation and response measures, planning and preparedness by facilitating interaction, discussion and query-response session with the industrial managers.

Duration

About 6 hours including the presentation/ lectures and discussion.

Methodology

» Lecture / power point presentation

» Plant description and guided visit

Figure 19: Visit preparation

» Description of on-site and off-site plan and emergency coordination

» A short mock drill / exercise to demonstrate emergency response

» To satisfy queries of the participants on various aspects of on-site and off-site risk management issues during by facilitating discussion/moderated interaction

Trainers Tips:

Effective learning outcome from the field visit based exposure help the participants developing own insights about the significance of the risk management in off-site perspectives. However, it is equally important that the field visit shall be safe and happy learning, and for this certain necessary instructions are needed to be given to participants. Some of such tips for the visit planner and coordinators are following:

1. Send the list of participants to the industry/installation management for preparation of visitors pass (displayable) in advance and entry pass.
2. Obtain and carry the travel map and route map of the area to reach the unit and to reach the primary assembly point in the plant. Carry the maps with the vehicle.
3. Irrespective of male or female, advise all participants to wear shoes.
4. Mobile, camera and other electronic equipment shall not be allowed to be taken within the plant premises.
5. All participants, faculty and associates entering the plant premises shall wear the safety helmet of specified color during the visit within the plant premises.
6. Smoking shall be strictly prohibited during the visit and inside plan premises.
7. All participants and supervisors/faculty and associates shall maintain good behavior and conduct with the industry officials and staff.
8. No panic behavior shall be shown and any critical issue shall be expressed in a polite and organized manner.

9. No articles shall be touched by the participants without proper knowledge or otherwise asked to do so.
10. Participants shall take observations silently and shall reveal their views and feedback in the review or discussion session.

Learning Unit C.1 | Field Visit : Objective Setting and Planning

Context and description of the Session

Figure 20: Briefing and objective setting before field visit

A well planned field visit module for studying hazards, vulnerability, risk and disaster management issues in on-site and off-site context shall be effective in yielding the stipulated outcomes.

Therefore, the plan of the field visit shall be developed along the finalisation of the course design and schedule. Scheme of the field visit with its objective, scope, limitations, ground rules and broad guidelines, coordination structure and organization shall be drawn and shall be informed to the faculty team and all the participants well before proceeding for the field visit.

Learning Objectives

- To systematically implement field visit with clear objective and vision of learning
- To observe the coordinated learning process by guided personal observations and demonstrations
- To help clarify participants doubts and curiosity by coordinated interaction with management and trainer faculty

Duration

30 minutes

Contents

- Objective of the visit
- Plan and framework of visit
- Safety and learning tips
- Do's and Don'ts during the visit
- Assembly points and headcount/attendance procedure
- Visit team coordination and administration

Method

Presentation/Lecture, Notes

Media

LCD, White board, Map

Resource persons

Course Faculty/ Resource Person from Factories Department/Pollution Control Board

Trainer's note and tips

Trainers and field visit coordinator need to be humble but clear on the requirement of punctuality, discipline, conduct and behavior and observations regarding safety of participants and of the site being visited. This shall manifest from the deliberations of the trainer during the visit planning and appraisal session before the actual visit starts. Briefing shall be done a day before the visit and also during the journey to the site. In case of the bus/vehicle carrying the participants enters the facility/installation premises; it is advisable to install spark arrester in the bus/vehicle.

Learning Unit C.2 | Field work appraisal of the participants

Context and description of the Session

A well planned visit module for studying hazards, vulnerability, risk and disaster management issues in on-site and off-site context shall be effective in yielding the stipulated outcomes. Therefore, the plan of the field visit shall be developed along the finalisation of the course design and schedule. Scheme of the field visit with its objective, scope, limitations, ground rules and broad guidelines, coordination structure and organization shall be drawn and shall be informed to the faculty team and all the participants well before proceeding for the field visit.

Learning Objectives

- To promote the participants knowledge and perception enhancement
- To facilitate learning by seeing and self-insights by observing risk management and emergency procedures on-site
- To help participants interaction with industry management and personnel associated with risk management

Figure 21: Safety Gazettes and Instructions

Duration

60 minutes

Contents

- Field visit coordinators (from plant management/ staff) introduction
- Plant description and background
- Plant layout and design
- Hazards and safety systems and procedures
- Safety, health, environment and disaster management policies of the company / plan
- On-site of the factory and linkage with off-site plans

Method

Presentation/Lecture, Notes, Film-show

Media

LCD, White board, Map, P&I Diagram, Models

Resource persons

Management / supervisory personnel of Industry or Safety/Training in Charge of the Industry

Trainer's note and tips

Coordinator shall tie up with the industry to include the onsite plan and linkage to offsite plan during the introductory presentation during the field visit. While taking the charge of the participant's team from the course coordinators/ faculty, it is necessary to include them also among the visitors group of learners and appraise them about all safety related issues and ground rules of the visit besides the instructions by the Industry.

Learning Unit C.3 | Field Visit Coordination and Observations

Context and description of the Session

Figure 20: Team coordination

Industrial management and personnel hosting the field visit of the trainees of a course on chemical (industrial) disaster management need to draw a plan for organizing such visit including their logistics, for example, refreshment, lunch (if any), depositing mobile phones and other electronic equipment, issue of visitor pass and displays, and providing visitor's specific safety helmet, etc. Such a plan needs to be developed before the visit actually starts. A list of the participant shall be obtained from the course director/coordinator or faculty in-charge of the Disaster Management Centre, directly or through official of State Pollution Control Board or Factory inspectorate facilitating for the visit. A route map along the contact numbers of key personnel shall be made available to the coordinator and/or bus driver for reaching the industrial site and entry gate.

Figure 21: IFFCO plant, Paradeep, Orissa

Figure 22: Meteorological station and control room

Learning Objectives

- To facilitate mutual interaction and learning by sharing the information
- To facilitate a soft review of the safety systems and on-site procedures of risk management and emergency response through a short mock-exercise
- To develop coordination and facilitate synergy with various government departments for inducing clarity on risk management challenges in major hazard units

Figure 22: Various tips for in-plant observations

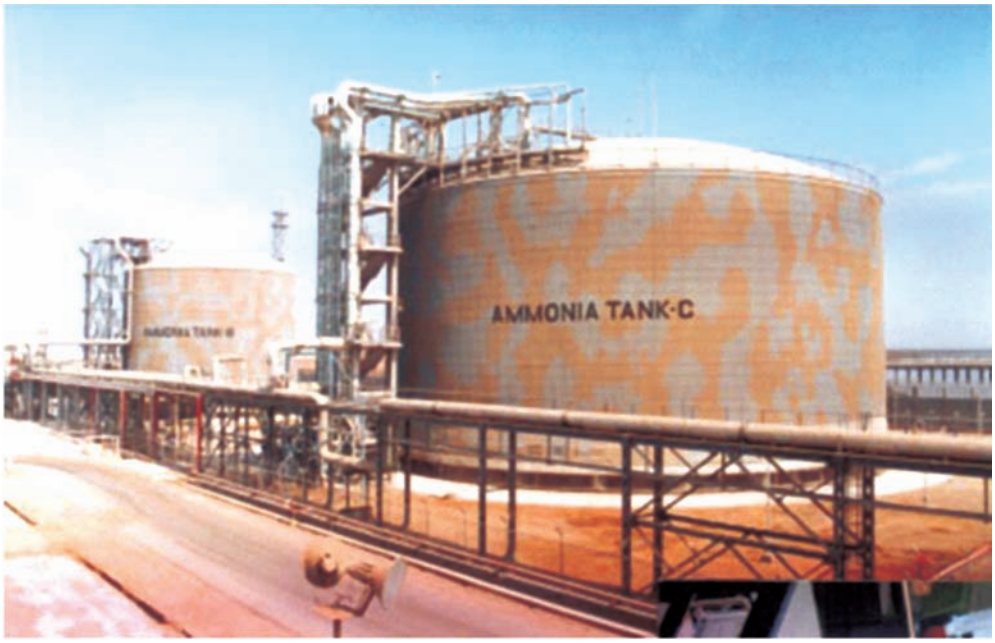


Figure 23: Chemical Storage units

Duration

120 minutes

Contents

- Visit of plant – hazard locations, storages, controls
- Observation of safety and communication systems and EOC
- Mock exercise of alarm, signal and emergency response
- Emergency response resources
- On-site and off-site coordination and mutual aid in response
- Workers education and preparedness

Method

Mock-exercise, site/facility visit and demonstration/ description, observations/ feedback

Media

Industrial/facility unit

Resource persons

Management / supervisory personnel of Industry or Safety/factory in-Charge

Figure 24: Storage Vessel

Figure 25: Horton Spheres

Figure 26: Fire Curtain

Learning Unit C.4 | Discussion and Query Satisfaction

Context and description of the Session

Industrial visit and mock-exercise shall generate numerous thoughts and will trigger several questions in the mind of the participants which need to be answered with adequate satisfaction level. Some participants may like to give the feedback, appreciation and would like to greet the host team and factory managers for their seriousness on risk management efforts and for good coordination of emergency operations. Few may like to point out mistakes and critical concerns for improvement. A discussion session following the visit and drill where the plant managers/trainers and coordinating officials shall respond to queries of participants and shall interact in an organized manner. Other officials of Pollution Control Board, Factories//Labour, Police/fire, nearby industry and course coordinator may also address. A vote of thanking to the host shall be good to be extended by course coordinators.

Learning Objectives

- To synergies the knowledge update by query satisfaction
- To facilitate learning balance with unlearning of improper notions
- To develop harmonized understanding on various aspects of risk management

Duration

30 minutes

Contents

- Count all participants and visiting team members
- Welcome at the discussion session
- Observation and Feedback from participants
- Query- answer and discussions
- Addresses and interactions

Method

Discussion / interaction

Trainer's note and tips

An objective plan needs to be drawn in consultation with peers, regarding visit of the team, mock-exercise, controls and feedback procedure. Visiting team/ participants shall be instructed with proper location and action guidelines during mock-exercise phase.

Media

Industrial/facility unit's assembly point or Board room

Figure 27: Mock exercise

Resource persons

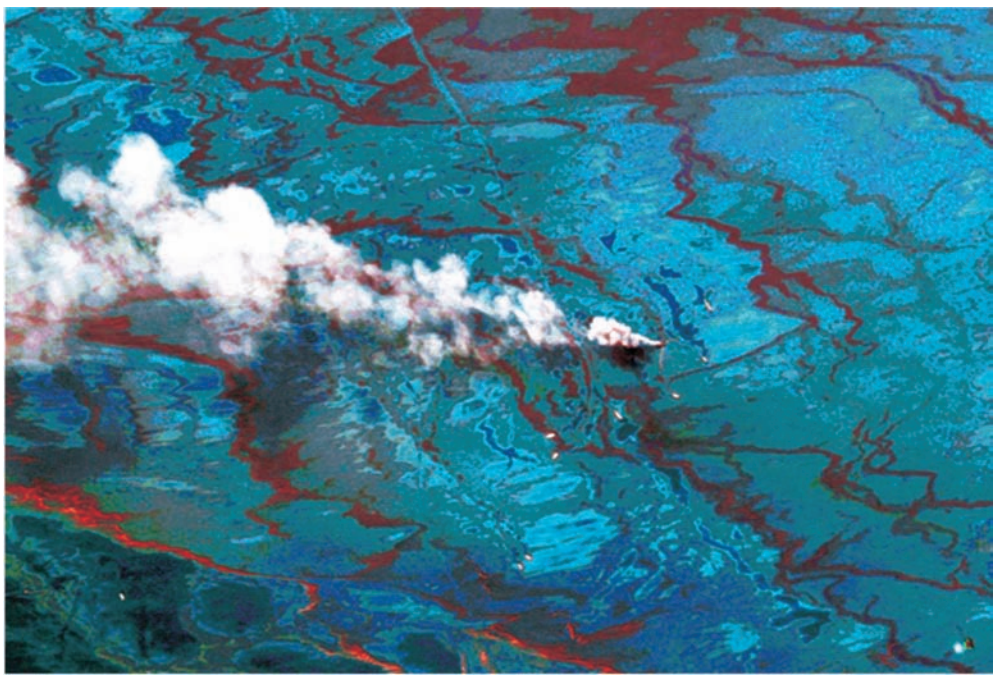
Management / supervisory personnel of Industry or Safety/factory in-Charge

Trainer's note and tips

Facilitators shall coordinate with the course coordinators to conduct the session within proper ground rules of behaviour, conduct and politeness from all sides. Feedback shall be listening with patience and shall be responded with clarifications, if any. Participant need

behave like learners and trainees and shall not enter their official or professional portfolio during the visit or discussion.

Participants need to deposit/return back the helmet, badges/entry pass or any other materials provided by the factory management or security office (returnable) while leaving the premises. They can take back their deposited mobile phone, electronic items, bag/purse etc from the locker/deposit site.



Module D

TOOLS AND TECHNIQUES IN CHEMICAL DISASTER MANAGEMENT

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In order to effectively organize the preparedness and responses to likely chemical emergencies, an objective, systematic, written and applicable plan need to be in place at different levels, viz. the industry, local, district, state and Central level. A holistic risk management framework for chemical-disaster prevention and management, thus, is a multi-disciplinary state of affairs, involving expertise from hard and soft disciplines of environmental studies; as mentioned below:

(a) Off-site perspectives : geography / land-use / regional planning, geo-informatics, disaster risk mitigation, environmental law, emergency planning, emergency medicine system, socio-psychological & trauma care, emergency communication, etc. The Off-site Emergency Plan shall be prepared by the District Collector in consultation with the Industries and Government Departments. Factories department play a key role in offsite emergency planning in many states.

(b) On-site perspectives: environmental system, chemistry, process engineering, incident-control system, fire, occupational health care & emergency medical system, internal transport, communication, etc. Responsibility to prepare and maintain an on-site emergency plan lies with the occupier of the facility or installation.

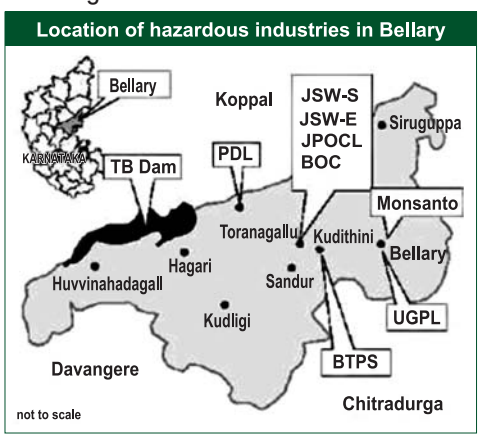
In order to address the paradigm shift envisaged under the DM Act 2005, pro-active risk management framework for chemical disasters is expected to encompass the stages, viz. (a) sensitivity based site assessment (b) hazard analysis and physical risk assessment (c) vulnerability analysis and mapping (d) multi-hazard impact analysis (e) maximum credible accident scenario analysis and consequence assessment (f) disaster risk mitigation (structural & non-structural) (g) emergency planning and preparedness (h) emergency response drills, and (i) operations and evaluations. A Crisis Group is envisaged at various levels for handling chemical disaster management, whereas the DM Act 2005 provided for Disaster Management Authority at all such levels with

preparation of DM Plans (e.g. District Disaster Management Plan). DM Plans prepared yet lacking in or very poorly emphasized the chemical/industrial disaster risks and potential implications of natural hazards on industrial systems and bulk chemical inventories.

Enabling Objective

At the end of this learning unit, the participants will be able to:

1. Describe the various concepts and terminologies used in risk assessment and the tools, techniques and methods
2. Understand and apply various ICTs and Geoinformatics tools for Chemical Disaster Management
3. Describe the requirement, framework and procedures for off-site emergency planning
4. Assess the strengths and weaknesses of a off-site plan/ document and to suggest improvements
5. To explain the roles and requirements of various stakeholders and agencies in relation to chemical disaster risk management and emergency response



There are 4 learning units delineated to draw this module:

LU-1 : Risk Assessment Concepts, Tools and Methods

LU-2 : Geoinformatics and ICT application in chemical disaster management

LU-3 : Off-site Emergency Plan – Guidelines for formulation

LU-4 : Analysis/review of off-site plans and status of implementation: Group work on roles, requirements and responsibilities

Learning Objectives

The key objectives of this module are following:

- To facilitate participant's knowledge and update on requirement, structure and process of off-site plan formulation
- To help participant understand the strengths and weaknesses of an off-site emergency plan (by case study)
- To develop knowledge and skills on ICT and geoinformatics application in chemical disaster risk & vulnerability assessment, emergency planning and accident reporting

- To update the participants ability on defining respective roles, needs and issues of coordination among agencies/stakeholders and integration of off-site emergency plan with disaster management plan of the district/area

Duration

About 6 hours including the lectures, discussion on case study and guided group-work.

Methodology

- Lecture / power point presentation and discussion
- Case study (analysis/review of plan documents)
- Demonstration and hand-on exercise on ICT/Geoinformatics tools
- Group-exercise/group-work

Trainers Tips

Course director/coordinator shall assess on the basis of participants profile and entry behavior coupled with course facilities and scope set for, the formation of groups for group work, assignment of moderator for the groups, objective setting for the group work, presentation mode of the group work (power point/ flip chart / white board / solo oral, etc.).

Course coordinator with the concerned faculty will also decide whether to conduct a hand-on exercise session or to conduct only a demonstration based session on role of ICT and GIS application in disaster management, which actually forms a very crucial aspect in chemical disaster management in the present context of inform ation flow requirements, reporting procedures and fast track decisions using the information on maps.

Group-work shall also facilitate the understanding on issues related with community preparedness for emergency preparedness at local level, public involvement in decisions and the implications of previous programmes of community involvement in industrial disaster risk management. A group of participants or the moderator/coordinator shall focus on issues pertaining with integration of crisis groups with disaster management authority as well as the Off-site plans with Disaster Management plans at respective levels with help of case study(ies).

Learning Unit D.1 | Risk Assessment Concepts, Tools, Techniques and Methods

Context and description of the Session

Hazard Mapping and Risk Assessment is the first step towards the development of an effective plan at the industry level, local level (at the industrial cluster) or at the district level. Risk Assessment is simply a careful examination of whatever that could cause harm, so that one can determine what precaution or controls are necessary to prevent harm. Risk Assessment helps in forecasting any unwanted situation, estimating damage potential of such situation, effective decision making to control such situation and evaluating effectiveness of control measures. In order to prevent a hazard from becoming a disaster and to minimize the likely impacts on human life, property and environment, it is necessary to assess all possible hazardous consequences and to delineate the mitigation measures for all the probable off-site emergencies. Although Industrial pocket-wise hazard analysis studies undertaken since 8th Plan out of the 286 districts, hazard analysis studies initiated for 103 and only 85 completed (in December 2009) and only 26 off- site plans were based on hazard studies .Still most of the DM Plans prepared are not considering chemical / industrial disasters.

Risk Assessment is a 4 Step process (i) Hazard Identification, What chemicals are present and what are the hazardous properties? (ii) Exposure Assessment Who is exposed, at what concentration, how often, and for how long? (iii) hazardous property and threshold i.e. How is it toxic and at what exposure levels? and Risk Characterization i.e. What does the risk assessment tell us about this situation.

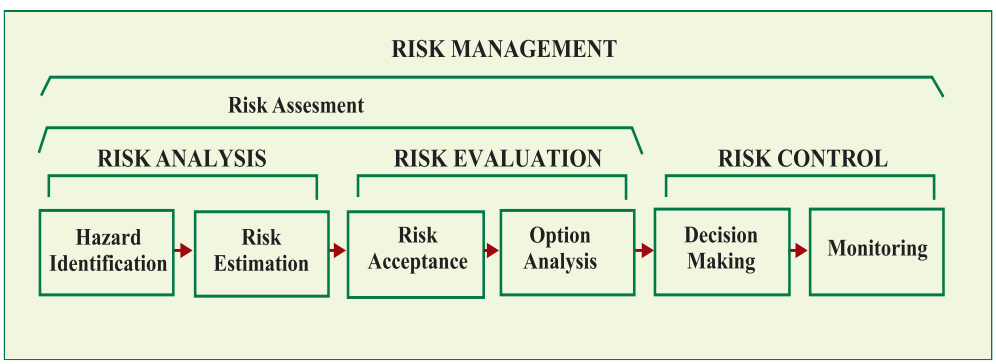


Figure 28: Components of risk management process

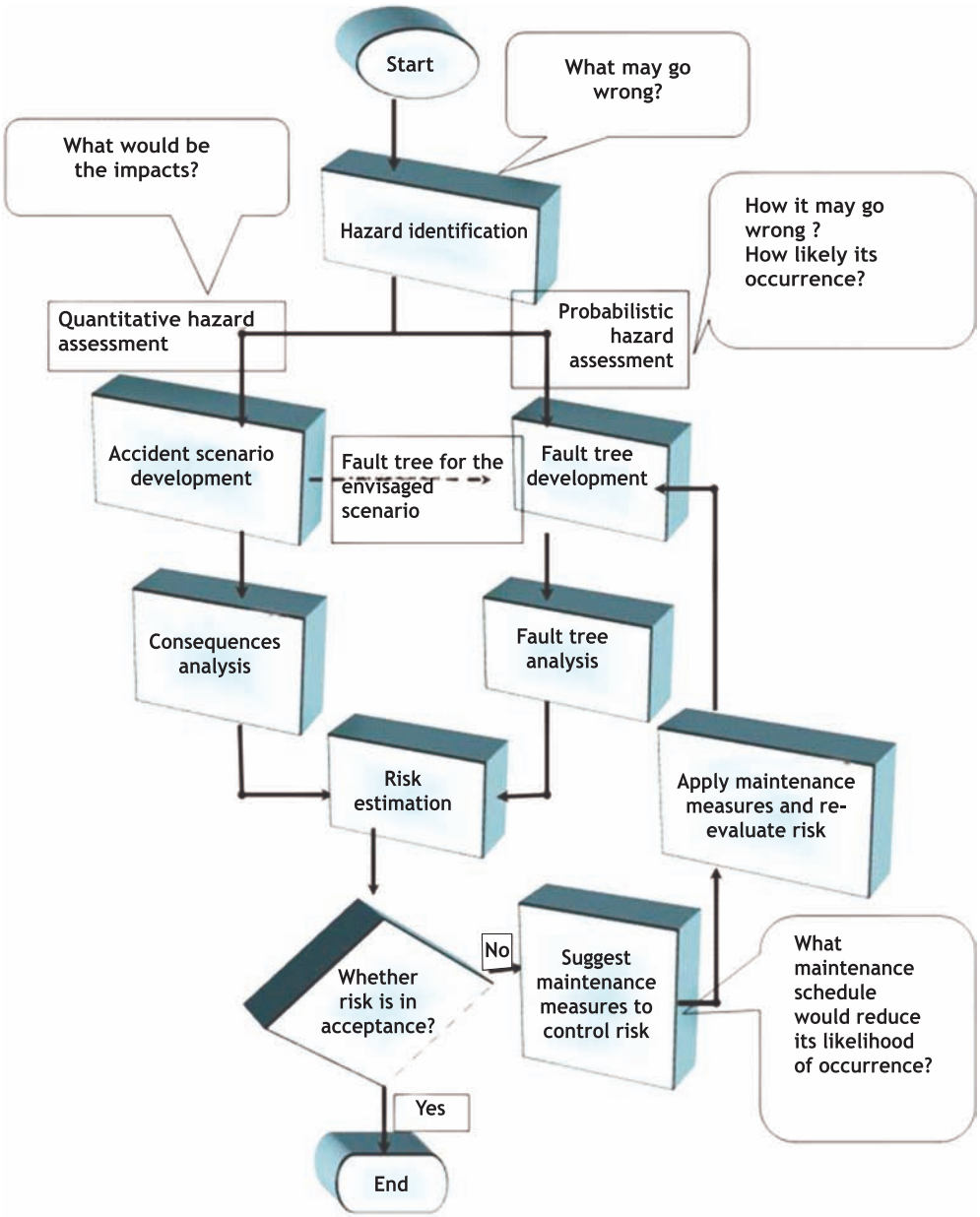


Figure 29: The Four Step Risk Assessment Process

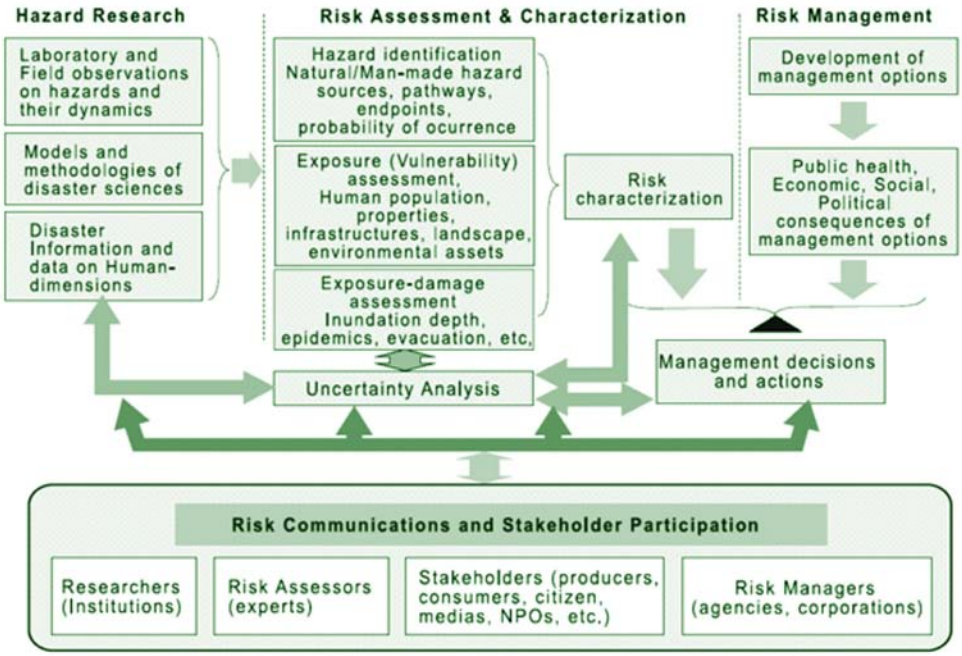


Figure 30: an integrated risk analysis framework for emerging disaster risks

Learning Objectives

- To understand the concept of hazards and risks at various levels Safety Risks i.e Life and property (human and its resources), Environmental risks Including Water, sanitation, food safety, energy, climate, waste management), Health Risks Injuries, Disease/epidemics, endemics (human/animals), Public-welfare risks, Communication, Transport, Tourism, Education, industry, Ecological Risks including Landscapes, rivers, lakes, ecosystems, forests, land & water resources, etc and Financial risks to Industry, agriculture, forestry, mining, commerce, insurance, etc., Socio-cultural risks Security, confidence in governance, relations, harmony, peace, cooperation
- Risk assessment and risk communication steps and strategies.
- Understand the advantages and limitations of Risk Assessment Tools and methods.

Duration

60 minutes

Module D

Contents

- Key terminologies : Hazard, Vulnerability and Risk (context of Chemical/ Industrial Hazards)
- LOAEL – Lowest Observed Adverse Effect Level,NOAEL – No Observed Adverse Effect Level , RfD – Reference Dose ,Maximum Credible Scenario
- Steps in risk Assessment: Hazard identification, Exposure Assessment, Risk assessment and Characterization.
  - o Hazard Identification Steps
  - o Exposure Assessment
  - o Dose response Curve
  - o Risk characterization
- Fault tree and Event Tree Analysis
- Limitations of Risk Assessment

Method

Presentation/ lecture and discussion

Media

LCD / White board

Resource persons

Expert in Chemical Risk Assessment from Academic and research Institutions or consultants having expertise in Risk Assessment

Trainer's note

Resource trainers shall coordinate with the course faculty and shall make available few copies of the guideline-document on off-site emergency planning for ready look by the participants. Flow chart of the activities in preparation of such plan can be prepared to help the participants understand and appreciate the process. Provoking discussion with the officials previously involved with the preparation of the off-site emergency plan and/or district or state disaster management plan shall be very useful for generating practical insights among other participants new to the operation aspects of such planning process.

Chemical Hazard/Risk Assessment Models

Purpose	Technique	Data required
Hazard identification	Engineering judgment FETI NFPA Thermo-chemical analysis	Properties Process sequence Operation details Safety data sheets Equipment specifications
Hazardous effects	HAZOP Chemical outflow Effect scenario Modeling accident Safety audit	Process flow sheet P&I Diagram Engineering Drawings Operations manuals Equipment specs Meteorological data
Consequence analysis (outflow, dispersion, evaporation, radiation, BLEVE,VCE)	WHAZAN EFFECT SAFETI ARCHIE, etc	Plant layout Past accident information All above
Probabilistic risk assessment	System reliability ETA/FTA FMEA QRA	Failure probability Accident data Human reliability All above
Risk mitigation and Emergency Response	CAMEO ALOHA MARPLOT	Base Maps, Chemicals Atmospheric conditions Surface Conditions

Note: although the softwares/ models and tested there are limitations. Models are based on assumptions. E.g. ALOHA is not useful under stable atmospheric conditions and is not considering chemical reactions.

Learning Unit D.2 Geoinformatics and ICT application in chemical disaster management

Context and description of the Session

Right Information to right people in right time is crucial for disaster management . Ignorance of essential facts and messages will lead inexorably to a catastrophic outcome. Many incidents, including Bhopal, provide lessons on improving Safety Information Management (SIM). Evaluating safety information management (SIM) performance can provide interventions to prevent disasters, improve mitigation and emergency communication and to perform effective responses.

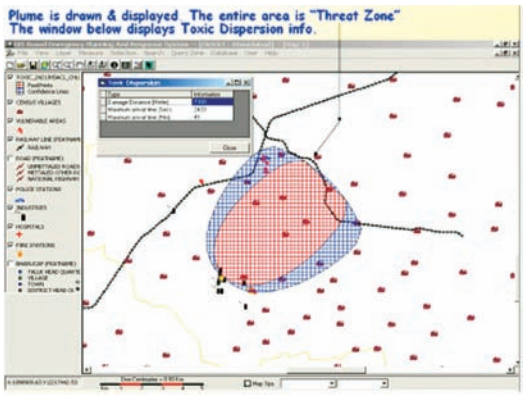


Figure 31: GEPR - plume dispersion scenario

Figure 32: Chemical incident scenario- Web enabled GEPR

Geoinformatics applications in disaster management include prevention, reduction or mitigation of risks, and planning for preparedness, response and recovery for the probable or real-time natural or human caused disasters. life, property, and critical infrastructure from natural and human-caused disasters;

The key applications are hazard mapping, multihazard risk assessment, developing DSS for planning and emergency response evacuation and shelter planning, perform what if scenarios, modeling and simulation, carry out damage assessment, and a community's need assessment.

Industrial siting is a primary level risk management that forms the background vulnerability for a hazard to become a disaster out of a initiating event of mishap in a hazardous chemical location within a chemical plant or storage. Mapping based approaches make the site assessment in a multi-hazard background offers potential of precise decisions with correct information and

time and cost effectiveness. It also helps in wider dissemination and sharing of information in an easily understandable manner so that people's participation and multi-stakeholder involvement in decision is possible. This is also important from the viewpoint of mainstreaming disaster risk reduction into developmental planning. Risk sensitive land-use planning is now being recognized as a key strategy for risk and vulnerability reduction in case of chemical disaster management. Remote sensing offers the observations over time series on temp oral scales and on spatial scales for tracking sources of chemical accident, effects, plume, area affected, and background geo-morphological and ecological features, enabling the assessment of short-term and long-term impact of a liquid or gas release or a incident like fire, explosion, oilspills, etc.

Figure 33: Chemical Accidents Information and Reporting System (CAIRS)

Figure 34: Emergency resources location

In United States, the EPA program, named ASPECT (airborne spectral photometric environmental collection technology), is the nation's only always-on-call emergency response system capable of mapping a chemical-plume hazard. The aircraft's infrared systems detect and track vapor plumes via two spectral systems. The first sensor is a multispectral, high-spatial-resolution infrared imager that creates two-dimensional images.

CAMEO is a system of software applications used widely to plan for and respond to chemical emergencies. It is one of the tools developed by EPA's Office of Emergency Management (OEM) and the National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA), to assist front-line chemical emergency planners and responders. ALOHA is an atmospheric dispersion model used for evaluating releases of hazardous chemical vapors. ALOHA allows the user to estimate the downwind dispersion of a chemical cloud based on the toxicological/ physical characteristics of the released chemical, atmospheric conditions, and specific circumstances of the release.

MARPLOT 4.1.2 is a Windows application that can be run on XP, Vista, or Windows 7. Macintosh users can still run an older version of MARPLOT. CAMEO is a database application that includes eight modules (such as Facilities and Contacts) to assist with data management requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA).

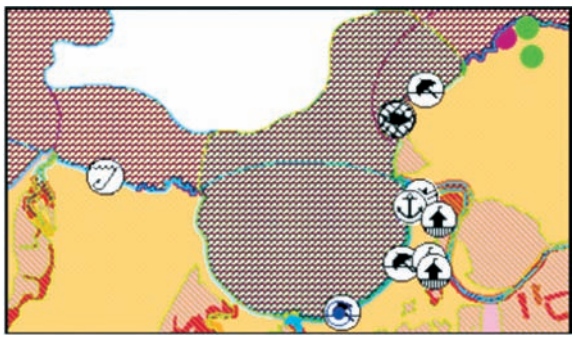


Figure 35: Repreenting industries and resources on MARPLOT

Learning Objectives

- To understand the potential of geoinformatics and ICT tools in chemical disaster risk management and emergency response
- To review and understand the prevailing approaches, tools and methodologies for risk and vulnerability assessment, planning and response coordination

Figure 36: Damage and distance modeling using ALOHA and MARPLOT represented on Google earth.

To understand and learn the use of these tools and techniques through demonstration/hands-on exercise

Duration

90 minutes

Contents

- Geoinformatics Introduction : Definition of Remote Sensing, GIS and GPS
- India Disaster Resource Network
- Accident Reporting System
- Hazard Mapping and Risk Assessment
- GIS based DSS – GEPR tool or other similar DSS
- Industrial Development and Environmental Conservation – India Examples , ERRIS, RMIS etc

- CAMEO- Computer Aided Management of Emergency Operations including CAMEO chemicals , ALOHA and Marplot and linking the output to Google Earth.

Method

Presentation and discussion, Demonstration

Media

LCD, Computers with GIS software, Internet connectivity, White board.

Resource persons

NIDM/DMC Faculty or Senior NIC Professional dealing with GIS application in chemical disaster management. Alternatively a professor from an IIT or other institute well versed with the subject can take the session after developing the case studies and necessary preparation by acquiring the software, application manuals, data, maps, etc.

Trainer's note

Faculty/resource person shall customize the delivery and contents in a simplistic way so that the subject becomes interesting for the participants with less or least knowledge of the GIS's hands on experience. The level of demonstration/ exercise needs to be adjusted with the type of participants group or their entry behaviour in context of ICT and GIS use.

Existing GIS and MIS tools – Examples

ENVIRONMENT RISK REPORTING AND INFORMATION SYSTEMS (ERRIS)

The Environmental Risk Reporting and Information System (ERRIS) project is a Corporate Social Responsibility initiative of the India Chamber of Commerce. The goal of ERRIS is to set up a structured and transparent framework for voluntary reporting of environmental hazards and risks by industries and disseminate such information to key stakeholders through a distributed GIS based Risk Management Information System (RMIS). At the same time, it is envisaged that the RMIS would gradually evolve as an important tool for Local Administrators by helping them to take informed emergency response decisions during a potential risk scenario in the area of concern. www.erris.org

GIS BASED EMERGENCY MANAGEMENT SYSTEM (Developed by MOEF with technical support of NIC)

A pilot study entitled "GIS based Emergency Planning and Response System for chemical accidents in MAH installations in major industrial clusters" in four identified industrial States - Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh" was done. The system would help response agencies, mainly, Central Crisis Group (CCG). District Crisis group (DCG) and Local crisis Group (LCG), in planning for and response to major chemical emergencies to contain damages to the minimum. To ensure proper implementation of the software at district level, training programmes have been conducted for the members of the State Crisis Group, District Crisis Group of the districts covered under this project. This project has been extended now to cover NCT Delhi, Rajasthan, Uttar Pradesh, Haryana, Karnataka, Kerala, West Bengal, Assam , Madhya Pradesh and Punjab. www.gis2.nic.in/gepr

CHEMICAL ACCIDENTS INFORMATION REPORTING SYSTEM

A web based accident information system using reporting requirements of all concerned authorities is under development. A unique system for online reporting of chemical accidents in both pre-set & common format.It is a highly interactive web based, user friendly customized system for various authorities under MSIHC Rule for sharing of Chemical accident information amongst various authorities. www.moef.nic.in/cairs

CENTRAL CRISIS CONTROL ROOM

MoEF has set up a Crisis Control Room for fast flow of information and coordination of activities during an emergency. The Control Room is part of the Crisis Alert System (CAS), located at Room No. 705 in Paryavaran Bhawan with a 24 hour contact telephone number.

EMERGENCY RESPONSE CENTRES

Four Emergency Response Centres (ERC) have been funded - Manali (Chennai), Bhopal (M.P), Mahad (Maharastra) and Vishakhapatnam (Andhra Pradesh) which serve as a link between DCG and the industry. Emergency Response Centres primarily deal with chemical emergencies in an area and disseminate technical information relating to the chemicals involved. Presently the ERCs do not cater in transport emergencies.

NATIONAL POISON INFORMATION CENTRE

The centre functions round the clock, 365 days in year and provides information on various poisonings and treatment protocols on telephone, fax, e-mail and in person.

INDIA DISASTER RESOURCE NETWORK (Ministry of Home Affairs)

India Disaster Resource Network portal is a National initiative under the Govt. of India-UNDP DRM programme in collaboration with National Informatics Center, Government of India. This portal is having online database of countrywide inventory of equipments and skilled human resources for emergency response including chemical disasters. A database is aimed at

minimizing emergency response time by effective decision making on mobilization of human & material resources. Similarly State Disaster Resource Network was developed by Gujarat State Disaster Management Authority. www.idrn.gov.in

CAMEO

CAMEO is a system of software applications used widely to plan for and respond to chemical emergencies. It is one of the tools developed by EPA's Office of Emergency Management (OEM) and the National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA), to assist front-line chemical emergency planners and responders. CAMEO can be used to access, store, and evaluate information critical for developing emergency plans. In addition, CAMEO supports regulatory compliance by helping users meet the chemical inventory reporting requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III). CAMEO also can be used with a separate software application called LandView to display EPA environmental databases and demographic/economic information to support analysis of environmental justice issues. The CAMEO system integrates a chemical database and a method to manage the data, an air dispersion model, and a mapping capability. All modules work interactively to share and display critical information in a timely fashion. The CAMEO system is available in Macintosh and Windows formats. http://www.epa.gov/oem/content/cameo/request.htm

CAMEO has three modules

1. CAMEO Chemicals - Chemical Response Datasheets and Reactivity Prediction Tool

CAMEO Chemicals has an extensive chemical database with critical response information for thousands of chemicals. There are two primary types of datasheets in the database: chemical datasheets and UN/NA datasheets. Chemical datasheets provide physical properties, health hazards, information about air and water hazards, and recommendations for firefighting, first aid, and spill response. In addition to the information on the datasheets, you can also add chemicals to the MyChemicals collection to see what hazards might occur if the chemicals in the collection were mixed together. CAMEO Chemicals is available online (http://cameochemicals.noaa.gov) and as a downloadable version.

2. ALOHA - Areal Locations of Hazardous Atmospheres

ALOHA is an atmospheric dispersion model used for evaluating releases of hazardous chemical vapors. ALOHA allows the user to estimate the downwind dispersion of a chemical cloud based on the toxicological/physical characteristics of the released chemical, atmospheric conditions, and specific circumstances of the release. ALOHA can estimate threat zones associated with several types of hazardous chemical releases, including toxic gas clouds, fires, and explosions. Threat zones can be plotted on maps with MARPLOT to display the location of other facilities storing hazardous materials and vulnerable locations, such as hospitals and schools. Specific information about these locations can be extracted from CAMEO information modules to help make decisions about the degree of hazard posed.

http://www.epa.gov/oem/content/cameo/aloha.htm

3. MARPLOT - Mapping Applications for Response, Planning, and Local Operational Tasks

MARPLOT is the mapping application. It allows users to "see" their data (e.g., roads, facilities, schools, response assets), display this information on computer maps, and print the information on area maps. The areas contaminated by potential or actual chemical release scenarios also can be overlaid on the maps to determine potential impacts. CAMEO Chemicals - Chemical Response Datasheets and Reactivity Prediction Tool. Results of the analysis can be converted in KML format and can be viewed on google earth.

http://www.epa.gov/oem/content/cameo/marplot.htm

Learning Unit D.3 | Off-site Emergency Plan – Guidelines for formulation

Context and description of the Session

The effects of a major accident in an industrial set up are not always restricted to the boundaries of the industrial installation. They may affect to the community and environment in vicinity. Therefore, the Government authorities and emergency agencies are required to prepare themselves and be in a state of readiness at all times to limit the consequences of any such emergency to protect the people and the environment. A systematic approach is required to plan and prepare authorities and agencies to tackle any emergency due to hazardous chemicals.

The MSIHC Rules, 1989 via its Schedule-5 assigns the responsibility of preparation of the off-site emergency plan of a district to the District Collector of the district or the District Emergency Authority (DEA), if such is explicitly designated by the State Government. The Chief Inspector of Factories (CIF) appointed under the Factories Act, 1948 is required to assist the District Collector in the preparation of the off-site emergency plan. The Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and need the Chemical Accidents Emergency Planning, Preparedness and Response (EPPR)] Rules, 1996 provide a statutory structure for controlling major hazards posed by hazardous chemicals. The rule 13(1) of MSIHC Rules requires the occupier of any Major Accident Hazard (MAH) installation to prepare and On-site Emergency Plan. Likewise, the rule 14(1) of MSIHC Rules requires the District Authorities to prepare an Off-site Emergency Plan. The Plan is required to be prepared in consultation with the occupiers of MAH installation in the area. District Collector/Magistrate is also responsible for preparation and maintenance of Multi hazard District Disaster Management Plan (including human induced disasters) mandated under the DM Act 2005 and issues of integrating the two has arisen to be resolved by finding a feasible mode of structural and operational synergy. Such planning can be done at district level for better organization and administrative control of emergency response and services.

Onsite - Offsite linkage

Factors involved in preparation of On-Site Emergency Management Plan are Hazardous properties of chemicals involved, identification of the hazards, Identification of Maximum Credible Accidents (MCAs), Consequence Analysis,

Analysis of potential/probability of for different types of scenarios, formulation of organization chart, appointment of key personnel and their duties, deployment of fire fighting equipments across the installation, Deployment of various Personal Protective Equipments (PPE) across the installation, various fire/ leak detection systems used, various types of external fcators like storms, flood, earthquakes, bomb threats etc., designated places as emergency control centres, assembly points, escape routes etc and Communication system for both internal and external communication.

Steps involved in preparation of Off-Site Emergency Management Plan also includes properties of the material being handled, Identification of Hazards, Identification of Maximum Credible Accidents (MCAs), Consequence Analysis, Analysis of potential for different types of incidents and scenarios, availability of various nearby organizations, special equipment including Fire Fighting Materials/ Equipments, liasioning of responsibilities to various organizations, identification of transport routes and communication media etc . Information required for the offsite plan shall be taken from the plan of the MAH unit and the Industrial Pocket plan. MAH units also include a brief plan to respond to offsite emergency although district authorities are primarily responsible for the preparation of offsite plan.

Learning Objectives

- To understand the scope and need of of off-site emergency plan
- To incorporate inputs from On – Site Plans in developing an Off – Site Plan
- To appreciate the responsibility and process of preparation, updating and implementing of off-site emergency plan
- To understand the off-site risks and requirements to tackle the emergencies
- To appraise the structure, key contents and data requirements of the off-site plan

Duration

90 minutes

Contents

- Offsite emergency and need and scope of offsite emergency management plan
- Role of district administration, factories department and Industries
- Requirements including data for Off-site planning and the sources

- Strategy, procedure and coordination for Off-site plan preparation
- Approval of the plan and endorsement of the plan by the competent authority
- Offsite Mock drill and importance
- Industrial siting in multi-hazard environment and land-use aspects of chemical disaster risks

Method

Presentation/ lecture and discussion, Guide-document review and discussion

Media

Guidelines document, LCD / White board, Flip chart

Resource persons

District Collector of a MAH District / Labour Commissioner/ Expert from Factory Inspectorate or Pollution Control Board or Ministry of Environment / Labour.

Trainer's note

Ideally the offsite plan of district should be presented by the district collector who is involved in the preparation and implementation of offsite plan for district having major accident units. If the DM is not available for taking the session CIF or Inspector of factories shall take the session. The coordinator shall make available few copies of the guideline-document on off-site emergency planning for ready look by the participants. Flow chart of the activities in preparation of such plan can be prepared to help the participants understand and appreciate the process. Provoking discussion with the officials previously involved with the preparation of the off-site emergency plan and/or district or state disaster management plan shall be very useful for generating practical insights among other participants new to the operation aspects of such planning process.

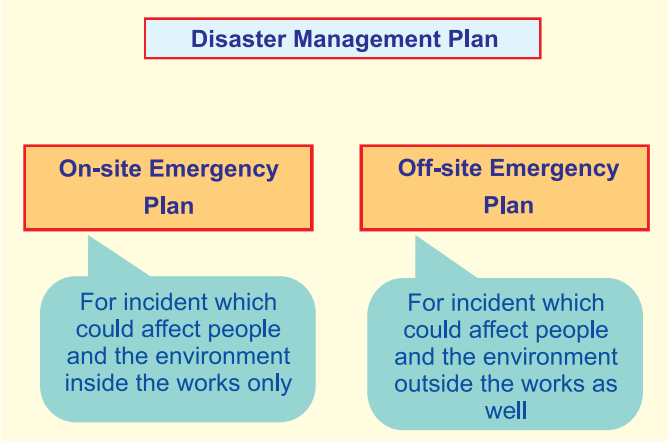


Figure 37. On-site and off-site emergency management plan

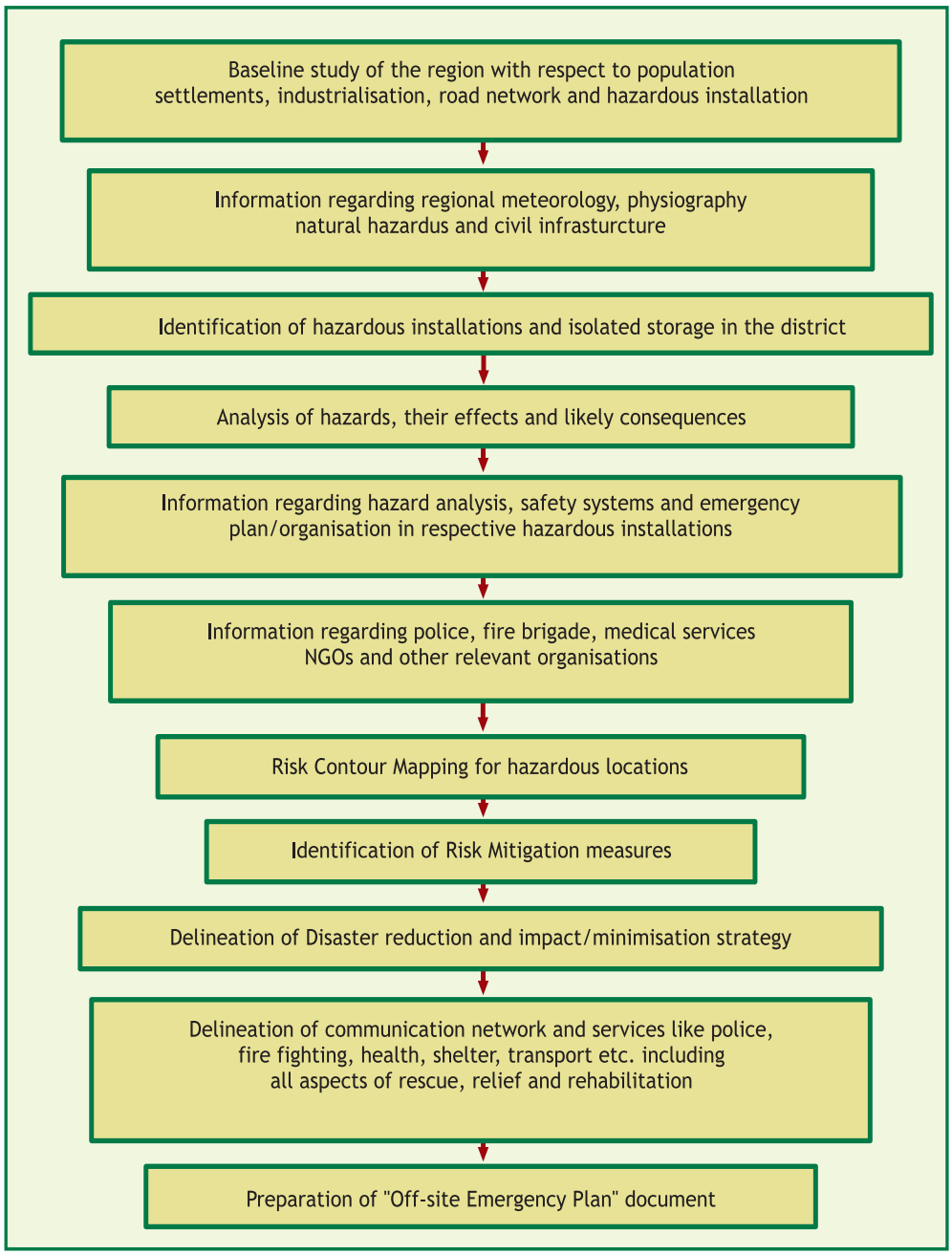


Figure 38. A schematic diagram representing the preparation of off-site disaster management planning [7].

Learning Unit D.4 | Analysis & review of off-site plans and District DM Plan

Context and description of the Session

Environmental Protection Act, 1986, and rules there in have prescribed the provisions and procedures of Crisis Group at various levels and required the preparation of Off-site Emergency Plan Disaster Management Act 2005, provided a holistic paradigm of multi-hazard disaster management framework, provision "disaster management plan" at national, state and district (and also local) levels. As per the Vulnerability Atlas (1997 revised in 2006) compiled by Building Material Technology Promotion Council of India, 241 districts have been identified as multi-hazard districts in India. Reportedly there are ~ 294 districts with Major Accident Hazard (MAH) units. More than 100 districts with MAH units are also multi-hazard districts. However, lack of integration has prevailed between the disaster management plan and the off-site emergency plan, in most of such districts.

The country is rapidly growing and exposure to risk and hazards demanding quick response from public services are increasing. Districts have traditional townships with old heritage with features that lead to complex situations as far as administration is concerned. Ill-planned or unorganized settlements and slums/colonies upcoming in the peripheral area of the industrial unit is a common phenomenon observed most cases despite of provisions of land-use control. It is, in many cases, not possible to redesign entire township. However, it is certainly possible to consider various variable complexities and difficulties in a systematic and scientific manner and then develop a system by virtue of which the administration is able to respond quickly and accurately. Besides this, community vulnerability, domino risk and location of critical response resources are important in such plans. Data put in the plants are expected to be latest, realistic and verifiable. These aspects can serve as the yardsticks to help evaluate the Off-site plan prepared a district or MAH unit context to be whether a good plan or a bad plan or a plan with mixed valuation.

Learning Objectives

- To delineate the concept and yardsticks of a good Off-site emergency plan and District Disaster Management Plan
- To evaluate the given plans for their 'strengths' and 'weaknesses' by review/analysis and discussion with the group peers

- To develop review report, suggestions and recommendations for improvement of given plan in the light of group's knowledge and skills

Duration

90 minutes

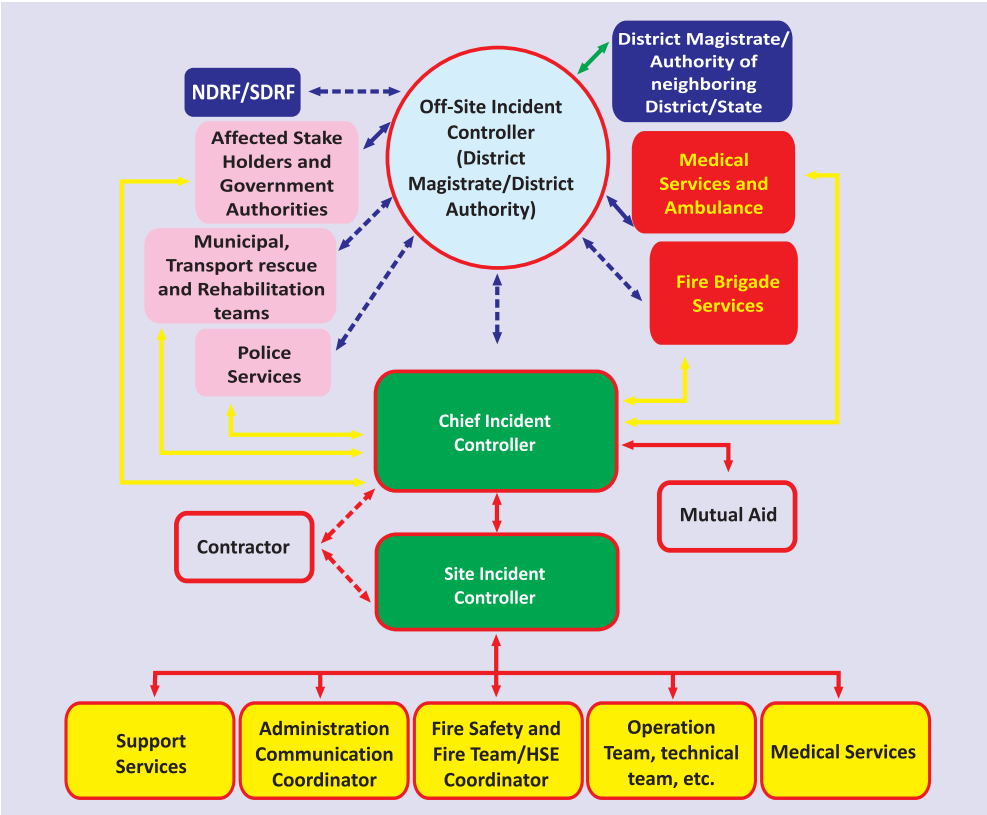


Figure 39 : Institutional setup for chemical disaster management at district level

Contents

- Preparation of review/analysis strategy and checklist / matrix for assessment of the given off-site plan
- Review/analysis of the plan-document and record of observations
- Discussion among the group peers over the observations
- Identification of the strengths and weaknesses, and suggestions
- Writing review report from the group based on peers consensus
- Preparation and making of group presentation

Method

Guided group work, discussion and Presentation

Media

Off-site Plan documents (of 2 districts), LCD, Flip chart, Color pens, Drawing sheets

Resource persons

Course faculty/coordinators

Trainer's note

Guided group work can be performed by placing the participants in 2 groups each with 10 to 12 participants (tentatively) and to sit in different locations for carrying out review of the off-site plan and further group discussion based on the observations. If the number of participants is more than 20 more groups needs to created. Each group shall be provided with the copy of the Off-site plans and District Plan for a district. The group work shall be moderated by the course faculty. Each group shall be asked to identify a group representative or spokesperson to present the group findings or group report. Observers from the groups can be identified from each group to give the feedbacks on presentations.

As the time provided for the group work on assessment of the Off-site plan shall not be adequate to read the document fully by each participant in the duration, therefore, it is advised that the document copies can be circulated (in rotation mode) on day-1 of the course itself in an organised rotation mode so that each participant gets the copies for a pre-groupwork look at these documents.

A participant can be identified to organize this systematic rotational circulation of the copies so that all the copies are returned back to the course coordinator in the morning session of day-4, to be used in the actual group work session. Time management in the group work is another aspect and the course faculty need to play important role in moderating/facilitating the groups and motivating them to complete the task is systematic manner to complete within the time. The media for preparation of presentation shall be provided timely so no time is wasted waiting for such things.

Learning Unit D.5 | Scenario Analysis: Needs, Role & Responsibilities

Context and description of the Session

Group work and guided group work or group exercise, are the recogn ized participatory training methods under andragogy mode of learning (meant for adult learning). It also provides option for coordinated and joint learning, and improves cohesiveness with varying ideas and notions on common issues and ability to work in team. Disaster risk management and response need coordinated approach to planning, implementation and monitoring. Participants from wide range background of department, education, geographical region, age/gender, etc. when work in a group (may be group randomly or on basis of some common roles) generate strong learning by doing outcomes.

Different agencies/departments and stakeholders, for example, industry, government, community, and their sub-categories can be assessed to have specific type of requirements/ expectations, roles and responsibilities in relation to chemical disaster management in pre-disaster risk management phase as well as during actual emergen cy phase post-disaster. These are to be clearly envisaged in the action plan for disaster prevention & mitigation plan and also in disaster response plan at different levels. A scenario (past disaster or hypothetical scenario) shall be very useful in this context.

Learning Objectives

- To appreciate the coordinated and teamwork in planning and decisions

- To review and understand the given scenario of the (1) chemical disaster scenario, and (2) pre-disaster risk management contexts
- To review and analysis the expectations, roles and responsibilities of different stakeholders/agencies in chemical disaster management
- To arrive at consensus mode of comments and suggestions from the group

Duration

90 minutes

Contents

- Multidisciplinary group and team-work
- Read the scenario (off-site emergency) documents and guide checklist provided for group work
- Discussion in the group on roles, expectations and responsibilities of the respective group (stakeholder/agency)
- Expectations from other (stakeholder/agency)
- Suggestions and weaknesses
- Group report presentation

Method

Guided group work, Presentation and discussion

Media

Scenario documents (A hypothetical or past scenario of chemical disaster) and related Drawings/ maps, etc, Flip chart, Color pens, Computer/laptops for making group presentations, LCD

Resource persons

Course faculty/coordinators

Trainer's note

Course faculty coordinating/facilitating the session shall provide a model (past or hypothetical scenario of a chemical disaster accident or a MAH risk scenario) for the group exercise by the participants. Alternatively, the scenarios suggested in a comprehensive risk analysis portion of an on-site plan or an off-site emergency plan can be prescribed for group work. Groups will further the implication of such scenario for the respective stakeholders/agency. The material/documents to be provided to the groups shall be prepared in advance by the resource persons/team. This shall include scenario document(s), suggested maps, drawing sheets, group work guide and checklist, etc. Clear objectives and scope of the group work shall be appraised to the participants before the actual group work begins. It is also possible and shall be preferable to support the exercise with application of GIS based maps, overlay technique and projections for understanding affected area, exposure, population, routes, critical resources, etc.

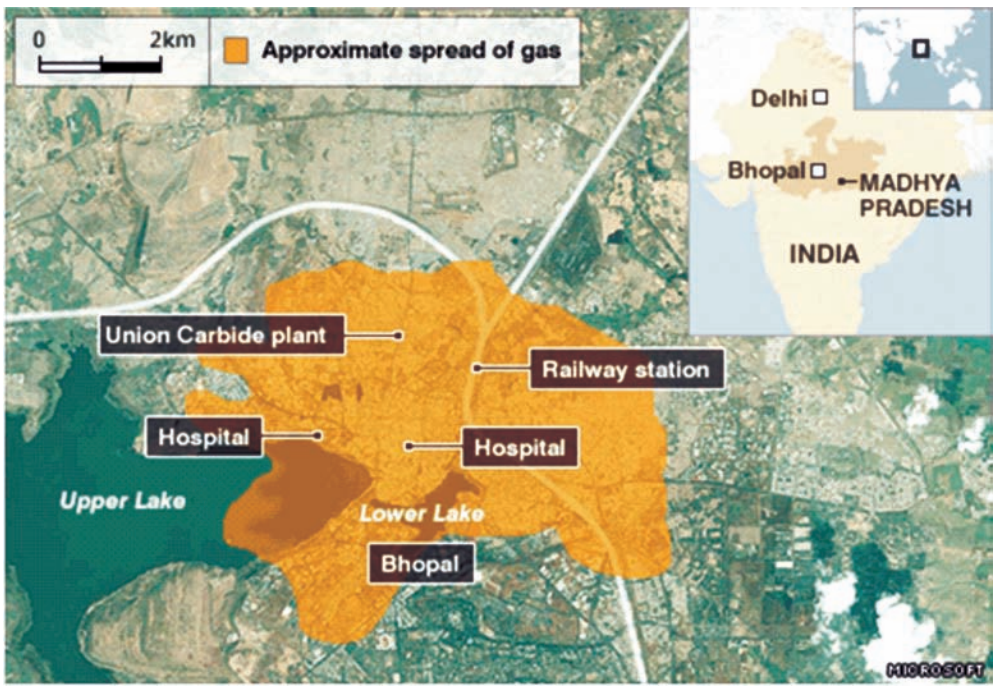


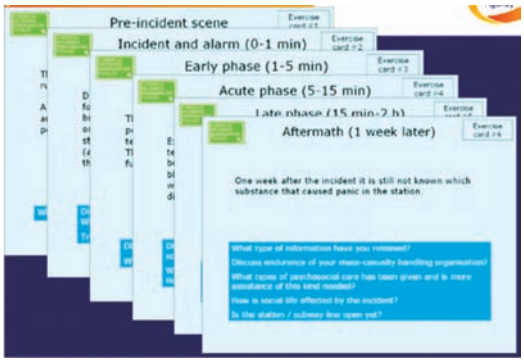
Figure 40 : Bhopal disaster site on the map

Module E

PREPAREDNESS AND RESPONSE IN CHEMICAL EMERGENCIES

E PREPAREDNESS & RESPONSE IN CHEMICAL EMERGENCIES

Concept of 'emergency response' worldwide has emerged from the set of actions envisaged for saving people and property from substantial damage or sustaining loss or impairment under the impact of a major incident involving some hazardous chemical, be in industry/process, manufacturing, storage, transport of in armed attacks, explosions, bombing, and other forms of fire or mass poisoning incidents. Emergency response pertains to rapid and immediate



action with very short-notice in case of an alert or call. Thus, 'time' of initiating and performing the designated action is most important, and therefore, specialized knowledge and skills in particular for response functions related with professional services and preventive and protective actions from the workers, communities and other non-professional (organized or unorganized) group of people is crucial in preparedness aspect chemical disaster management.

Emergency Management is the generic name of an interdisciplinary field dealing with the strategic organizational management processes used to protect critical assets of an organization from hazard risks that can cause disasters or catastrophes, and to ensure their continuance within their planned lifetime. Assets are categorized as either living things, non-living things, cultural or economic. On-site and plan/ unit level emergency response system has well evolved command system operational approach whereas the off-site response system is still evolving. Off-site emergency response is relatively more complex and complicated as it involves unorganized, multi-stakeholder and multi-agency coordination.

EMERGENCY

Outgrowth of a disaster, in which the affected communities' capability to react has been overwhelmed and where rapid and effective action is required to prevent further loss of life and livelihood.

INCIDENT

Situation in which people are potentially exposed to hazards to which they are vulnerable, with resulting public concern and the possibility of immediate or delayed risks to health.

Wisner B, Adams J (eds). Environmental health in emergencies and disasters, a practical guide. Geneva, World Health Organization, 2002.

Emergency management is a strategic process, and not a tactical process, thus it usually resides at the Executive Level in an organization. It normally has no direct power, but serves as an advisory or coordinating function to ensure that all parts of an organization are focused on the common goal. Effective Emergency Management relies on a thorough integration of emergency plans at all levels of the organization, and an understanding that the lowest levels of the organization are responsible for managing the emergency and getting additional resources and assistance from the upper levels. First response from police, fire, medical aid and life saving, transport route controls, and handling transport emergencies involving hazardous chemicals are important aspects for off-site emergency preparedness and response.

Enabling Objective

At the end of this learning unit, the participants will be able to:

1. Describe major stakeholders of emergency first response – emphasizing role of police, fire, civil defense, community etc.
2. State medical response requirements and related functions during major chemical emergencies
3. To emphasize risk management and response during transport of hazardous goods
4. To conclude the key issues of chemical disaster management, emergency response and integration with holistic framework

There are 4 learning units delineated to draw this module:

LU-1: Emergency first response – Police, fire, civil defense

LU-2: Community Preparedness and Response

LU-3: Medical response in chemical emergencies

LU-4: Transportation of hazardous Chemicals

Information that should be in the Chemical Hazard Database

As a minimum, the database should include:

- location of the hazardous site
- chemical(s) found on the site
- actual quantity/quantities of chemical(s) found on the site, including intermediates and waste products
- contact information for the management of the site.

In addition to this primary information, the database might include:

- existence of an emergency and evacuation plan for the site
- materials and first aid available on-site
- presence of decontamination equipment, for personnel on-site, patients, first responders and equipment

Module E

Learning Objectives

The key objectives of this module are following:

- To facilitate participant's knowledge and update on roles/responsibilities of different stakeholders in emergency first response
- To help participant understand the key functions expected from agencies like police, fire, civil defense, etc.
- To develop understanding on medical response requirements in case of chemical accidents
- To conclude on key aspects of chemical disaster management and need of integration with multi-hazard framework and development, and appreciate the learnings.

Duration

About 6 hours including the lectures, discussion on case study and guided group-work.

Methodology

» Lecture / power point presentation and discussion
» Case study (analysis/review of chemical incent examples)
» Demonstration (if possible, medical response)
» Video clippings
» Round-table and experience sharing

Trainers Tips

As this module is scheduled to be implemented following 4 previous modules in sequence, there is challenge before the course faculty to avoid unnecessary repetition of the contents in lessons/discussion. As the trainers / resource persons for these sessions shall be subject experts from respective departments or their concerned academies/institutes, it shall be advisable that the resource person makes a prior assessment/overview of the contents already been taught. Focus of this module is on emergency first response and transport emergency risks and therefore aspects of planning, risk analysis, etc. can be avoided. Video or photographic presentation of examples shall be very useful. Besides, it shall also be taken care that the participants do not feel course/lecture fatigue. Participants inputs sharing examples from their real experience shall be very useful.

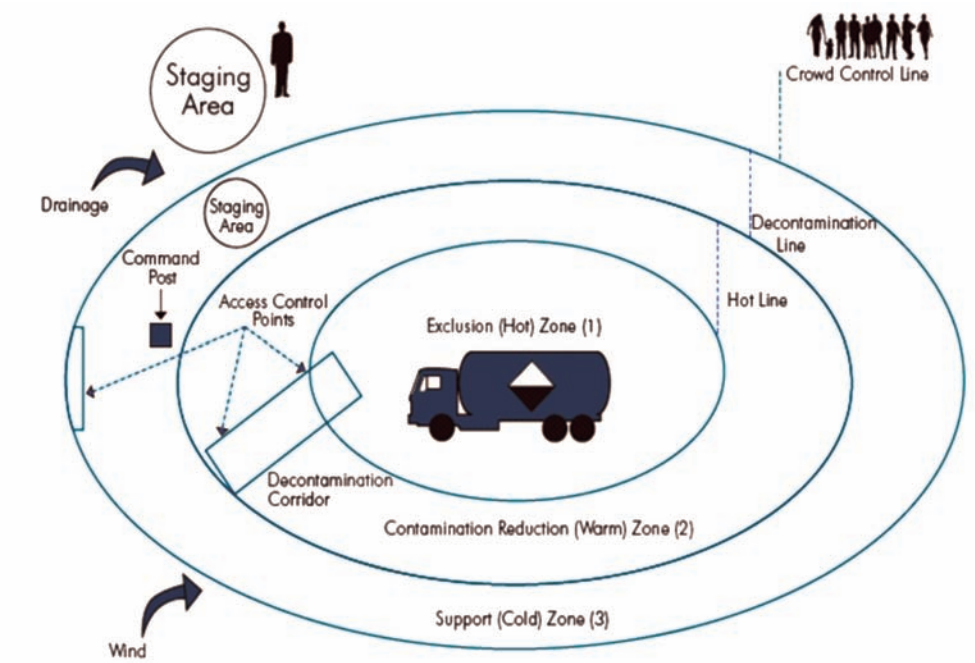


Figure 41 : Emergency control system and incident response landscaping

Learning Unit E.1 | Emergency Preparedness and First Response

Context and description of the Session

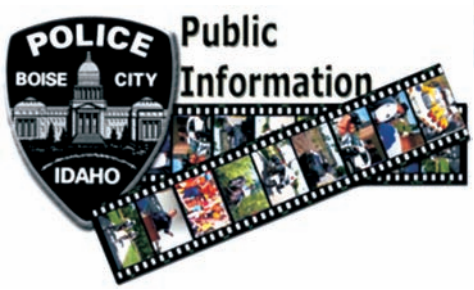
Chemical disaster risk management is a multi-stakeholder multi-agency intervention, and disaster emergency response involved multiple stakeholders in impact. However, peoples and environment as peoples resources are prime concern for emergency response. Emergency first response concerns with alert, evacuation, saving life and channelizing first information so as to trigger on a systematically provisioned emergency response plan, on-site or off-site. Thus, emergency first response is the actual situation even prior to the incident command system takes over the situation. The present module discusses the interventions for emergency first response in case a major chemical disaster where impact is likely to go off-site or already have gone outside the premises of industry/ installation, be the fire, explosion, toxic release, etc. Emergency first response is actually meant to take place immediately after the initiating accident and shall aim at not allowing the disaster to take a shape of catastrophe or tragedy.

In most off-site cases, police becomes the first response despite the nature or size of incident as any such event or impact poses threat to life, causes panic and mass dislocation, affects law and order and disrupts traffic, etc. In many states/districts fire services are also dealt by police department's fire section, and in others there is a

separate fire division. Civil defense plays vital role in disaster risk management capacity development by mobilizing community awareness and preparedness for organized response during such emergencies by virtue of working closely with the people. Medical services – Government dispensaries/hospitals, private clinics, vaidyas, physicians, and industrial/community first aiders have a key and crucial role in emergency first response for saving life, giving first level treatment for the injuries, burns, poisoning – decontamination, administering antidote, etc. Civil defense volunteers also work closely with hazardous industries associated with their off-site safety concerns, drills, medical response, public management, information dissemination, etc.

Learning Objectives

- To understand the situation's requirement for immediate concern and emergency first response
- To review and enlist roles of first responders – police, fire services, civil defense, etc. in chemical incidents with potential to reach impacts off-site



- To analyze the capacities and roles of civil defense in off-site emergency context in mobilizing the emergency first response, delivering first response and managing people and their reactions

Duration

45 minutes

Contents

- Emergency first response during major chemical incidents
- Role of police and fire services in emergency first response at the site and managing community discipline in off-site context

Figure 42 : Visitors around Jaipur fire disaster site

Method

Presentation/lecture, discussion, video-clips

Media

LCD, Flip chart, White board

Resource persons

Senior/top officials from State Police/fire /Civil Defense or faculty from relevant academy

Trainer's note

Resource person / faculty conducting this training session shall plan the presentation/lecture according the constitution of the participant group and entry behaviour. Repetitions of the contents already delivered during previous modules shall be avoided to focus more on actual issues of emergency first response during such emergencies more in off-site context. Examples of real case experiences would be useful and participants shall be mobilized to share their own experiences as well. Use of video clipping or photographs can be useful.

Figure 43: Fire tender

Learning Unit E.2 | Community Preparedness and Response

Context and description of the Session

In order to survive, societies have always found ways to cope with disasters caused by natural hazards like storms, floods and earthquakes. Chemical hazards, however, present a different challenge to society than the more familiar natural disasters, because they are not so well understood. They are not a part of a society's shared past, and relatively few communities have as yet experienced an accident (Kasperson and Pijawka, 1985). Appropriate ways and necessary social structures to deal with them have not yet evolved (Wenger, 1978). While the use of chemicals is not a new phenomenon, the production and use of chemical products has increased exponentially. Despite the increased potential for accidents in chemical plants, in transportation, storage, and disposal facilities (Smith, 1981; Wright and Her-ron, 1985), the increased production and use of chemicals have been so rapid that only quite recently have such well-publicized events as the Love Canal, Seveso, and Bhopal led to widespread recognition of the hazards chemicals present to societies.

Not only is our consciousness of the hazard relatively new, but in addition, given the vast number and possible combinations of chemical materials within or passing through communities, there is a variety of accidents possible. Furthermore, the materials are relatively unstable and capable of changing so that the threats in chemical accidents are complex. Because of the nature of the materials, chemical accidents often require specialized protective measures and highly sophisticated responses. These responses are not well understood even by emergency agency personnel in the local communities, and certainly not by the general public.

Local organizations are most likely to be the first responders; local communities are most likely to be affected by long-term consequences Community (individual human being or group) and hence the actual first responder who gives its first reaction to any incident, whether noticed/recorded or not, and therefore, it is important to generate community awareness towards preparedness at local level. In most of the cases community is not aware of the nature of the hazards associated with Chemicals are they are not prepared to deal with chemical emergencies.

Civil defense plays vital role in disaster risk management capacity development by mobilizing community awareness and preparedness for organized response during such emergencies by virtue of working closely with the people. Civil

defense volunteers also work closely with hazardous industries associated with their off-site safety concerns, drills, medical response, public management, information dissemination, etc.

Learning Objectives

- To generate awareness regarding the vulnerability of communities to chemical disasters
- To understand the role of community in preparedness, response and risk reductions and enhance the capacity of the community
- To describe various means for generating awareness of the community and assuring community participation
- To develop efficient mechanism for risk communication, early warning etc.
- To understand the role of Civil Defense in chemical disaster preparedness an

Duration

45 minutes

Contents

- Community : Risks and Capacities
- Role of community
- Generating community Awareness
- Civil defense concept and structure/function in India and their capacities/ roles in administering/ mobilizing emergency first response in case of off-site emergencies
- Needs of developing further knowledge/skills and capacities of these first responders in context of chemical disaster management
- Developing emergency first response capacities and mass preparedness at local level and within community
- Risk Communication and Early Warning Systems
- Example of implemented programmes on community preparedness (UNEP-APELL) or community and Civil defense response case studies.

Method

Presentation/lecture, discussion, video-clips

Media

LCD, Flip chart, White board

Resource persons

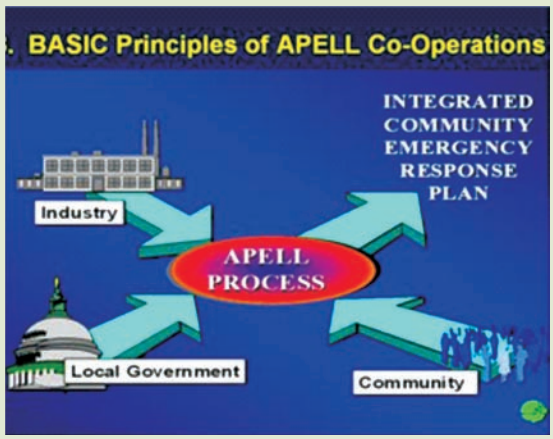
Senior/top officials from NGOs or CSOs or Civil Defense officials who are involved in community preparedness and response.

Trainer's note

Resource person / faculty conducting this training session shall plan the presentation/lecture according the constitution of the participant group and entry behaviour. Repetitions of the contents already delivered during previous modules shall be avoided to focus more on actual issues of emergency first response during such emergencies and role of community and Civil Defense. Examples of real case experiences would be useful and participants shall be mobilized to share their own experiences as well. Use of video clipping or photographs can be useful. UNEP-APELL or similar case studies can generate interest amonst the participants.

UNEP APELL – CASE STUDY

APELL stands for Awareness and Preparedness for Emergencies at Local Level (APELL). APELL was a programme evolved by UNEP after the Bhopal disaster. It is a programme designed to (i) Create and increase public awareness of possible hazards within a community (ii) Stimulate the development of co-operative plans to respond to any emergency that might occur; (iii) Encourage prevention of accidents (iv) APELL is an initiative sponsored by the DTIE of UNEP, in co-operation with the US Chemical Manufacturers' Association and the Conseil European des Federations de Industrie Chimique (CEFIC). There are three stake holders: industry, local government and local community were involved within the APELL process, as these three are the major stakeholders in emergency response.



These three key stake holders have to come together to evolve an integrated community response plan. This feature is very important because the main stakeholders in managing the emergency owned the plan, and the implementation was more effective. It stimulated the development of cooperation plans. APELL consisted of two parts (1) provision of information to the community, referred to as "community awareness"; (2) formulation of a plan to protect people, property and the environment, referred to as "emergency response". APELL addresses all emergencies with potential for fire, explosion, spills or releases of hazardous materials. The possibility of "combination accidents" should be noted at this point; for example, an earthquake which triggers an emergency in a chemical factory, determination of which potential hazards should be covered by the APELL process is in principle the result of a risk assessment. In most cases, however, common sense will be sufficient to identify the facilities or areas which present a risk of a major accident. The criteria (lists of substances and threshold levels) given in international or national regulations or recommendations may also provide guidance. Key advantage of APELL programme

is its flexibility. Countries differ in culture, value systems, legal and regulatory requirements, community infrastructure and response capabilities and resources. However, it is recognized that national governments and the chief executive officers of industries have a fundamental role in promoting and supporting these local efforts. Industry associations also have an important part to play in encouraging industry participation.

The APELL process consists of ten steps. (I) identify the emergency response (ii) participants and establish their roles, resources and concerns (iii) evaluate the hazards and risks that may result in emergency situations in the community (iv) have participants review their own emergency response plans for adequacy relative to a co-ordinated response (v)identify the required response tasks not covered by existing plans and match these tasks to the resources available from the identified participants (vi) make the changes necessary to improve existing plans, integrate them into an overall community plan and gain agreement (vii) commit the integrated community plan to writing and obtain approval from local governments (viii) educate participating groups about the integrated plan and ensure that all emergency responders are trained (ix) establish procedures for periodic testing, review and updating of the plan (x) educate the general community about the integrated plan. In order to assure the success of APELL Process the key stake holders ie. (i) Local authorities : include provincial, district, city or town officials, either elected or appointed, who are responsible for safety, public health and environmental protection in their area.(ii) Industry: Industrial plant managers from either state-owned or private companies are responsible for safety and accident prevention in their operations who prepare and implement specific emergency measures within the plant and review their application.. As leaders of industrial growth and development, they are in the best position to interact with leaders of local authorities and community groups, in order to create awareness of how the industrial facility operates and how it could affect its environment and to help prepare appropriate community response plans in the event of an emergency. The involvement and active participation of the workforce is also very important. (iii) Local community and interest groups: Such as environmental, health, social care, media and religious organisations and leaders in the educational and business sectors who represent the concerns and views of their members or constituents in the community. There are other partners, e.g. non-governmental organizations (NGOs).

Learning Unit E.3 | Medical response in chemical emergencies

Context and description of the Session

Emergency medical response i.e. first aid and critical care, intermediate treatment and specialized/advanced facilities including burn wards, fracture clinics, poison treatment, and also the trauma treatment, are very important aspects of chemical disaster management.

Medical facilities of different levels and categories need to be established and preparedness from the medical system and first medical response from primary first responders including police, fire, civil defense, and community need to be identified in pro-active mode based on risk assessment on-site and off-site context of possible chemical disaster due to installation of a major hazard unit or other hazardous storage or industrial facility in the area with due consideration to the aspects of weather factors including humidity, wind direction, etc.

Emergency medical system and Critical care is although a specialized discipline of medical science capacity development and practice, however, in the present context of spread and transport of chemical disaster risk over communities, and focus on emergency response preparedness at local level, it has to be inculcated at community level by involving civil dispensaries, hospitals, vaidyas, prival local clinics, phys icians, nurses and volunteer groups. Primary objective of the medical first response is saving life and extending care for managing the case for further treatment/healing including counseling.

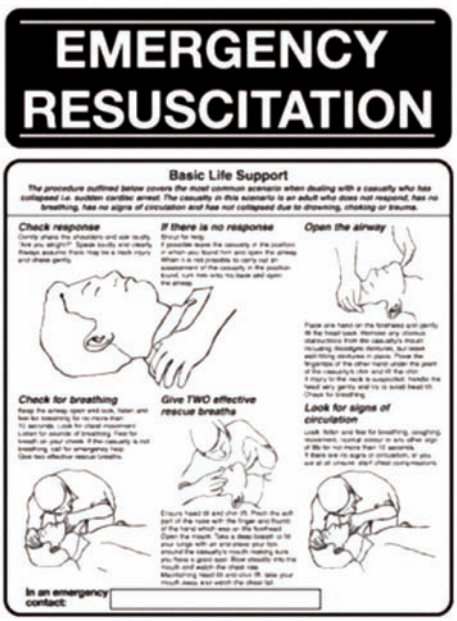


Figure 42: Decontamination

Injury mechanisms

Chemical incidents can cause injury through four basic injury mechanisms: fire, explosion, toxicity and the experience of traumatic events. These injury mechanisms may appear to be quite distinct, but in reality are strongly interrelated [10].

- Fire produces injuries through heat and exposure to toxic substances (including combustion products). A secondary effect of a fire may be an explosion or tank failure due to heating of tanks holding chemicals. Every major fire can be considered a chemical incident.
- An explosion produces traumatic (mechanical) injuries through the resulting shockwave (blast), fragments and projectiles. As a secondary effect an explosion may result in a fire or loss of containment resulting in release of and exposure to toxic chemicals (e.g. through penetration of an adjacent tank by fragments: so-called domino effects).
- Toxicity may result when humans come into contact with a chemical released from its containment, be it from storage or transport, or as reaction or combustion products. Toxicity can cause harm by a wide array of toxic mechanisms ranging from chemical burns to asphyxiation and neurotoxicity.
- Mental health effects, the final type of "injury" are not only determined by exposure to the chemical, fire or explosion but also by "exposure to the event" itself. Severe incidents have the potential to disrupt the lives of victims through injury, loss of relatives, property or employment and societal disruption. A substantial proportion of victims of major incidents have been shown to experience long-lasting mental health problems.

Learning Objectives

- To review and analysis the emergency preparedness and medical first response for victims/affected in terms of resuscitation, critical care and first level handling of burns, fractures, trauma cases
- To review and enlist roles of first medical responders and emergency medical system

- To analyze the requirement and capacities for local and regional arrangements of emergency medical preparedness for chemical disasters and linkages with specialized facilities including poison information centres, trauma care centres, etc.

Duration

90 minutes

Contents

•Life saving and medical first response during chemical emergencies

•Medical first response in exposure to toxic chemicals release

- Concepts, resources and functions of detection, protection & decontamination and role of civil 'hazmat' services
- Fire and explosion hazards and issues related with treatment of burn injuries, fractures, trauma, etc.
- Poison information centre, trauma centre and linkage with emergency medicine specialized system including telemedicine
- Issues of medical preparedness including local commuity response preparedness and role of prior fitness, occupation health & safety.
- Training and awareness needs for enabling effective medical response in emergencies in off-site context

Method

Presentation/lecture, discussion, video-clips, Demonstration

Media

LCD, Flip chart, White board, Medical centre

Resource persons

Senior official from medical/health department of Government or Industry or Faculty from Medical College/Health Training Institute or Professional doctor with experience of relevant practice in industrial areas.

Trainer's note

The medical professional or an experienced toxicologist or an expert from occupational or community health background with experience of handling chemical emergencies medical cases or response functions shall be able to manage the session well. However, other resource person shall need to prepare for the session by acquiring relevant materials including video clippings, photographs, sketches, etc. to discuss the subject with suitable examples. Cases can be discussed from past disaster scenarios, accidents from even non-chemical accidents which may be equally relevant for chemical emergencies as well. Some resource persons may like to use demonstrating resuscitation and critical care using human dummy or a video clipping or other pictorials. If the time permits, participants can be taken for a short round to the nearby dispensary/emergency medical centre for real feel of the resources and associated functions of primary and secondary medical response.

EMERGENCY PLANNING FOR MEDICAL FACILITIES

Hospitals and other treatment facilities should develop emergency plans (co-ordinated with local off-site plans). As part of emergency planning, hospitals and other treatment facilities should:

- maintain an inventory of available equipment that might be needed, and have up-to-date information on how to obtain additional support;
- ensure that decontamination equipment and facilities are available (if not on-site, then by mobile units);
- maintain a register of health/medical personnel who could be called upon to assist the hospitals/facilities providing care during an emergency;
- have plans/procedures for sending patients to other hospitals/facilities when necessary (these plans/procedures should be developed in co-operation with other public authorities);
- have a designated (separate) telephone line, in service 24 hours a day every day, for use by emergency services in the event of an accident, with a back-up communication system established in the event the phone line is not available following an accident;
- have access to specialised information, and to specialists, for appropriate treatment of exposed victims; (this should include biological sampling, as soon as possible, of those who have been exposed or might have been exposed to hazardous substances, including those who do not exhibit any immediate symptoms);
- have procedures for registering all individuals who arrive at the hospital/treatment facilities for treatment as a result of exposure to hazardous substances;
- have procedures to protect other patients and staff from contamination; and
- establish mechanisms for follow-up and monitoring.

Learning Unit E.4 | Transport of Hazardous Goods

Context and description of the Session

With the increase in chemical intensive development, agriculture, energy and health systems, movement of hazardous chemicals has gone manifolds in quantities and distances being transported. Poor conditions and inadequate maintenance of carriages, staff, traffic managers and road, coupled with wider and abrupt variation in climatic parameters with changing geo-physiography in India being a vast country of diversities, the challenge of safe transport of hazardous goods has become all the more alarming day by day.

International agencies like UNEP, WHO, IPCS, ILO have been advocating safe transport of hazardous goods within and across states/ nations, reducing risk of spillage and accidents and preparing for effective response to handle emergencies on road.

Various legal provisions in India including MSIHC rules (1989), Central Motor Vehicles Act (1988), Petroleum Act and Explosives Act and the rules (2008) concerned prescribe the provisions for safe transport and handling emergencies associated with hazardous goods in India.

As the hazardous goods concerns with 'moving hazards' and presents a set of dynamic risk across changing profile of vulnerability with change in administrative and emergency response jurisdictions in off-site chemical emergency scenario. Location of vehicles carrying of hazardous goods is important in this line to mobilize emergency response

with time effectiveness and role of Global Positioning System coupled with space technology for vehicle tracking offers significant help in this direction. Besides this, training of drivers, traffic police and other relevant personnel for inspection, reporting and maintaining a database of incidences is Important.

Learning Objectives

- To review and understand the need of emphasis on safe transportation of hazardous goods

- To enlist various techno-legal aspects on risk management and emergency preparedness for hazardous goods transport
- To assess roles, responsibilities and capacities for different actions in risk management and emergency response during transport emergencies involving hazardous goods including chemicals and wastes

Figure 44: GPS Instrument

Duration

45 minutes

Contents

- Hazards and causes of accidents during transport of chemicals, and vulnerability of different regions
- Technical and planning issues for risk management for transport of hazardous goods
- Road safety and hazardous goods transport
- Legal frameworks and guidelines
- role of different stakeholders/agencies including occupier, consigner, consignee, transporter, driver, police, fire, community, etc.
- Emergency response resources and preparedness measures
- Emergency response procedures, cases and examples of handling transport emergencies involving chemicals.
- Emergency Communication, GPS, GPRS, Mobile communication etc

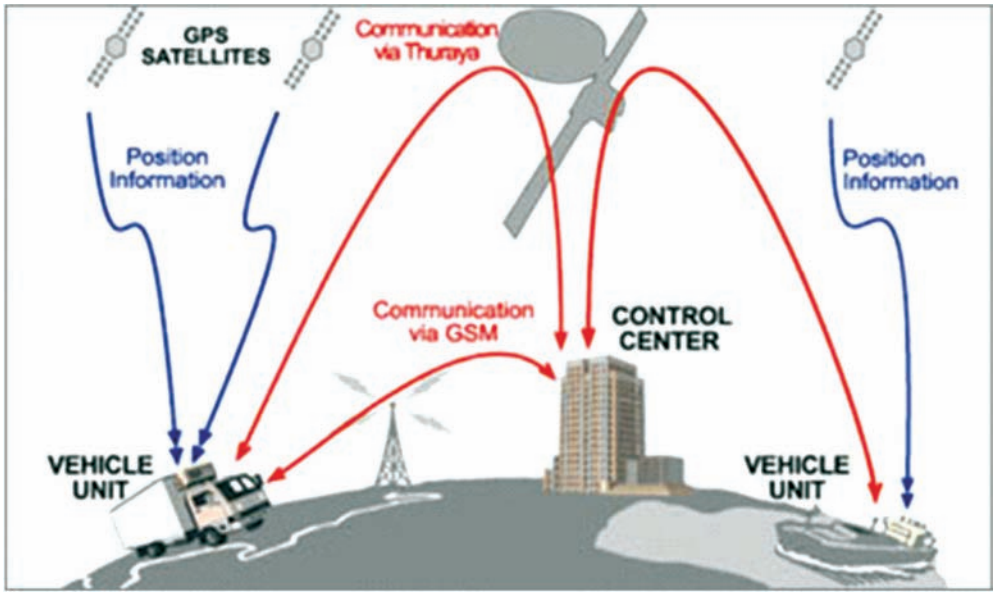


Figure 45: Vehicle tracking using satellite based network with GPS

Method

Presentation/lecture, discussion, video-clips

Media

LCD, Flip chart, White board

Resource persons

Director or senior official from state transport department or Police Department (traffic) , or a faculty on transport management/planning.

Trainer's note

Resource person shall discuss the subject with participants on the bases on technical, legal and administrative framework for management of hazardous goods from off-site emergency perspectives. Discussion on capacity building of various stakeholders including involvement of driver,

transporter and police training shall be important. Integration of the subject with holistic disaster management and functions of disaster management authority with equal concern on risk management shall be useful to discuss. A brief introduction to GPS, GPRS enabled communications can be included in this session if not included in the ICT session.

Figure 45: Class labels for hazardous goods transport

TREMCARD

TRANSPORT EMERGENCY CARD (ROAD)

ENG

Load

1866 RESIN SOLUTION, special provision 640E — Class 3F1 III
Resin solution X 50 — UN 1866
Colourless liquid with perceptable odour.
Not or partially miscible with water.
Lighter than water.

Nature of danger

Flammable (flash point between 23° and 61° C).
Vapors are invisible, heavier than air and spread out on the floor.
Develops explosive mixtures in combination with air, even in empty uncleaned receptacles.
Health risk.
Can cause poisoning if inhaled, swallowed or absorbed by the skin. Symptoms of poisoning may appear even after several hours.
Severe imitation of eyes and skin.
Water polluting.
Heating up leads to increase of pressure-danger of bursting and exploding.

Personal protection

Protecting goggles or safety mask.
Gloves made of plastic or rubber.
Protective shoes or boots.
Respiratory protection for escape (escape mask or bonnet).
Eye-irrigation bottle with pure water.

General actions to be taken by briver

Turn off engine.
No open fire, no smoking.
Mark roads and warm other road users and passers-by.
Inform the public about the hazzard and give advice to keep upwind.
Notify police and fire brigade as soon as possible.

Fire brigade	Police
999	999

Additional and/or special actions to be taken by driver

Equipment
- Covers for sewers and drains
- Suitable absorbent

Care about self-protection

Seal leaks, if possible.
Cover sewage system, evacuate basements and workpit.s
Avoid liquid seepage into sewage system, workpits and basements-Vapours cause danger of explosion.
Block leaking liquid with soil, sand or other absorbing substances.
If substance seeps into water course or sewage system or has contaminated the ground or vegetation, inform fire department or police.
Remove or make all source of ignition ineffective (e.g. blinking lights, switch off engines).

Fire, information for the driver in case of fire

Extinguish only early stages of a fire.
Do not extinguish load fire.
Stay on upwind side.

FIRST AID

If substance enters the eyes, immediately rinse with plenty of water for several minutes.
Immediately remove substance contaminated clothes and wash affected skin areas with soap and water.
Medical aid is necessary if symptoms appear to be an obvious conseqence of inhalation.

Additional information

Protection of the public

TELEPHONE INQUIRY:

FEEDBACK & VALEDICTORY SESSION

Context and description of the Session

Participant's feedback on the programme – design, contents, learning and resources, are important for the continuous improvement of the course and its delivery. Besides, it also generates many innovative ideas and options for diversifying the courses for effective and objective course deliveries. Feedback of the course faculty/coordinators on the course participants and overall conduct of the course will also be important at the end. A pre-developed feedback format shall be given to the participants for their entries before the valedictory session, which shall be later analyzed and be used in developing summary course-report.

Valedictory session is important which can be chaired by the host institute's Director/Head or Secretary/Commission of Relief/Labour/Environment or a senior academic faculty on related subject. Alternatively the course Director/ DM Faculty Head shall preside the session. A brief course report following the welcome note, will be followed by few brief feedback rounds from the participants and messages of long-term interaction and continuous learning on the subject. Valedictory session shall aim at generating the feeling that the training objectives shall be fulfilled by putting in-use of the lessons discussed in the course, and by initiating a process of improving the delivering on routine basis towards effective risk management and response. A formal vote of thanks shall be given at the end to express gratitude towards the participant's organizations, host institution, collaborators, resource persons, associates, team and all other whose contribution was important in making the course a success.

Learning Objectives

- To review and understand the suitability of course design and contents for future courses
- To review and enlist the possible improvements/changes and diversifications in the course design and deliveries
- To assess possible cooperation, network and future strategies of applying the course lessons in line functions and practice.

Duration

20+50 minutes

Contents

- Course feedback and lessons
- Course brief-report
- Roadmap for implementing knowledge and skills
- Broad guidelines for future strategies

Method

Brief addresses, interventions, discussion.

Resource persons

Director/Head of Host Institute, Course Director & Coordinator/Faculty, Senior Officials of concerned departments.

Trainer's note

Course coordinator/director shall coordinate the session with positive attitude for furthering the cause of risk management and emergency preparedness by generating long-term and effective strategies of cooperation among stakeholders at various levels. Coordinator shall extend thanks to all including dignitaries, team of faculty and all associates personally after the session.

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ANNEXURES

Annexure I

SAMPLE SCHEDULE

Day &Time	Topic	Resource Persons
	DAY 1	
10:00 – 10:15	Registration	Training Assistant
10:15 – 11:00	**Inaugural Session** Welcome address, Inaugural Address, Introduction to Course Introduction of participants & expectation from this course	Course Director Inaugural Dignitaries Course Coordinators/faculty
	INTRODUCTION TO CHEMICAL (INDUSTRIAL) DISASTERS, CAUSES, IMPACTS AND MANAGEMENT	
11:15 – 12:15	Film on Bhopal Tragedy Group discussion	Course Director/Coordinator
12 15- 13 00	Chemical Disasters: Causes and Consequences	Course Director/Coordinator
14:00 – 15:30	Chemical Disasters - Global and National Scenario and State Profile	Course Director/Coordinator State Resource Person
15:45 – 17:00	Legal Framework for Chemical Disaster Management in India	Course faculty/ Resource Person
17:00 – 17 30	Group creation and brief about group exercise planned on day 4	Course faculty/ Resource Person
	DAY 2	
	LEGAL AND INSTITUTIONAL FRAMEWORK FOR CHEMICAL DISASTER MANAGEMENT	
10:00 – 10:45	International bindings and guidelines	Resource Person
10:45 – 11:45	Environmental Jurispudence and Public Interest Litigations - Cases on Chemical Disasters and environmental issues	Resource Person with Legal Practice Background
12:00 – 13:00	DM Act 2005 National Disaster Management Guidelines	Course faculty/ Resource Person

Day &Time	Topic	Resource Persons
TOOLS TECHNIQUES AND METHODS (SCIENTIFIC)		
14:00 – 15:15	Risk Assessment – tools techniques and methods	Course faculty/ Resource Person
15:15 – 17:00	Applications of ICTs and Geoinformatics in CDM	Course faculty/ Resource Person
17:00- 17:30	Summary of Session and briefing –field visit	Course faculty
DAY 3		
FIELD VISIT, OBSERVATION AND ASSESSMENTS		
8:00 – 8:15	Orientation to field Visit	Course faculty team
10:30 – 13:00	Field Visit to MAH Unit – brief presentation of on-site plan, etc. Demonstration of safety equipments/ procedures,	Resource Person from Industry with the help of Department of Factories/Labour, State Pollution Control Board
14:00 – 15:30	Short-drills, Control room demo, Personal review, Discussion with officials of Industry Regarding the Plan and integration with other plans	
DAY 4		
10:00 – 11:30	Preparedness and First response to Chemical Disasters- Role of Fire, Police,	Invited Resource Person
11:15 – 13:00	Community preparedness and response to Chemical Disaster Management	Invited Resource Person
14:00 – 15 30	Offsite Emergency Management Plans abd DDMP Guidelines for Formulation	State Resource Person / Course faculty
15: 45 – 17:00	Analysis of 2 offsite Plan and status of implementation and issues - Group Work / Discussion by Participants	Course team (facilitators)

Annexure I

Day &Time	Topic	Resource Persons
DAY 5		
PREPAREDNESS AND FIRST RESPONSE TO CHEMICAL DISASTERS		
10:00 – 11:00	Medical Preparedness and response for CDM	Invited Resource Person (Preferably a doctor working with Industrial units or have managed chemical emergency)
11:00– 12:00	Transportation of Hazardous chemicals	Invited Resource Person / Director of State Transport Department
12:00 – 13:00	Group presentations Experience Sharing	Participants and Course faculty
13:00	Valedictory Session	Participants Course Director/Coordinator Director General-DMC/ATI or Secretary/ commissioner form Disaster Management/ Labour/ Environment

Annexure II

Pre-training Questionnaire

Time 15 minutes

Name of the Participant:

1. Disaster Management Act was enacted in
   (a) 2000 (b) 2008 (c)1999 (d) 2005
2. Nodal Ministry for Disaster management is
   (a) Ministry of Agriculture (b) Ministry of Earth Science (c) Ministry of Environment and Forest (d) Ministry of Home Affairs
3. Disaster Management is synonymous to Emergency Management
   (a) True (b) false
4. How many multi hazard prone districts are in India (as per the BMTPC Atlas)
   (a) 241 (b) 600 (c) 160 (d) 405
5. EPPR rule stands for
   (a) Emergency Planning preparedness and response rules (b) Environmental Protection and Preparedness Rules (c) None of the above
6. Chemical (Industrial) Disaster management is the responsibility of
   (a) Department of Factories (b) Department of Industry (c) Ministry of Environment and Forest
7. Number of MAH units in India
   (a) More than 1000 (b) More than 5500 (c) More than 1800
8. Onsite emergency management plans are prepared by
   (a) Factories inspector (b) Occupier (c) District Collector (d) SDMA
9. Preparation of Offsite emergency management plan is the responsibility of
   (a) Factories inspector (b) Industry (c) District Collector (d) DDMA
10. Disaster Management Act is for
    (a) Floods (b) Earthquake (c) All disasters (d) Chemical Disasters
11. Local Crisis Groups (as per EPPR) are set up at
    (a) Block level (b) Community level (c) Tahsil level (d) Industrial Cluster level
12. PLIA (1991) is for
    (a) Providing insurance to Industry (b) Immediate compensation to victims
    (c) Rest oration of damage to Environment and Wildlife (d) none of the above.

Annexure III

EVALUATION / FEEDBACK FORM

Name of the training programme :

Name of the Participant:

Organization:

Thanks in advance for giving your assessment. Just encircle the option that expresses you truly.

1. I think the structure and organization of the course fulfill the objectives of the training Workshop.

   Very well Well Moderate Average Unstructured

2. I feel this training would be useful to me in my job.

   Very much Quite Moderately Limited use Not at all

3. I feel this inspires me to take up assignments related to disaster management

   Very strongly Strongly Can not say Low Do not feel at all

4. I have benefited from interaction with fellow participants in the course

   Very much To a large extent Not sure Little extent Not at all

5. I found the course materials supplied to us to be

   Very relevant Relevant Can not say Little relevance no relevance

6. Your overall impression of the training course

   Excellent Very Good Good Fair Poor

7. As per the objectives of the training, any element that is left out in your view.

8. Which portion of the training you found least helpful

9. Any specific observation/ comments you wish to make.

10. Any suggestion regarding the training methods.

11. Any suggestion regarding topic and speakers.

12. Any particular faculty you have in mind, give the subject and session of that faculty

13. Your comments on administrative/logistic arrangements (Just encircle the option that expresses you truly):

Sl. No.	Item	Comments				
a.	Reception & Registration	Excellent	Very Good	Good	Satisfactory	Poor
b.	Drinking water arrangements in the Lecture hall	Adequate		Inadequate		
c.	Lunch and Tea during the Programme	Excellent	Very Good	Good	Satisfactory	Poor

14. Participant's evaluation of the Group Exercise

Sl. No	Parameters					
		EX	VG	G	A	P
1.	Briefing about the Exercise					
2.	Facilitation during the Exercise					
3.	Supply of Material					
4.	Overall Utility of the excercise					

Field Visit

Sl. No	Parameters	EX	VG	G	A	P
1.	Briefing about the field visit					
2.	Administrative and logistic arrangement					
3.	Presentation of On-site Plan and Safety Measures					
4.	Plant visit					
5.	Mock Drill					
6.	Overall Utility of the field visit					

Annexure III

19. Participant's evaluation about the resource persons

DATE/ TIME	Session - Topic	Resource Person				
			Excellent	V. Good	Good	Average
Day 1, Monday						
DAY 2, Tuesday						
DAY 4, Thursday						
DAY 5, Friday						

19. Any other comments/ suggestions to improve the training programme.

Glossary of Terms

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 within 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.

Hazardous Chemical (HAZCHEM): Chemical substances which are in solid, liquid or in gaseous form and used in many processing industries in India causes acute or chronic health effects on the individuals exposed to these chemicals. The chemicals causing the health hazard are carcinogenic, toxin or highly toxic agents, irritants, corrosives and these agents can damage the lungs, skin, eye or mucous membranes are called as hazardous chemicals.

Emergency Information Panel: Every goods carriage used for transporting any hazardous goods marked with an emergency information panel on both sides and in front and rear side of the vehicle.

Environmental Protection Act (EPA), 1986: Most comprehensive Act relating to Environmental Protection. Objective is to implement the decisions made at the U.N. Conference on the Human Environment at Stockholm, June 1972. A general law on Environmental Protection which could cover uncovered areas of major environmental hazards as the existing environmental laws were mainly focused on pollution. Umbrella Act covers various issues of air, water, land, human beings and other living creatures and property.

APELL: Awareness and Preparedness for Emergencies at the Local Level. APELL programme was launched in 1986 by UNEP to raise awareness of local communities that live close to industrial activities on how to react if an accident happens. It is a multi-stakeholder dialogue tool that establishes adequate coordination and communication in situations where the public might be affected by accidents and disasters

Major Accident Hazard (MAH) Unit 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 SCHEDULE 3 of EPA Act respectively.

Methyl isocyanate (MIC): Methyl isocyanate (MIC) is an organic compound with the molecular formula CH3NCO. Methyl isocyanate (MIC) is extremely toxic. The threshold limit value set by the American Conference on Government Industrial Hygienist was 0.02 ppm. MIC can damage by inhalation, ingestion and contact in quantities as low as 0.4 ppm. Damage includes coughing, chest pain, dyspnea, asthma, irritation of the eyes, nose and throat, as well as skin damage. Higher levels of exposure, over 21 ppm, can result in pulmonary or lung edema, emphysema and hemorrhages, bronchial pneumonia and death.

MCA: Maximum Credible Accident (MCA) is a postulated accident that a facility must be designed and built to withstand without loss to the systems, structures, and components necessary to assure public health and safety.

Event Tree: Event tree analysis is a logical evaluative process which works by tracing forward in time or forwards through a causal chain to model risk. It does not require the premise of a known hazard.[3] An event tree is a inductive investigatory process.

Fault Tree: Fault tree analysis (FTA) is a top down, deductive failure analysis in which an undesired state of a system is analyzed using boolean logic to combine a series of lower-level events. This analysis method is mainly used in the field of safety engineering and Reliability engineering to determine the probability of a safety accident or a particular system level (functional) failure.

HAZOP: Hazard and Operability Study (HAZOP) is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment, or prevent efficient operation. The HAZOP technique was initially developed to analyze chemical process systems, but has later been extended to other types of systems and also to complex operations and to software systems

EMP: Environment Management Plan (EMP) comprehensively covers all aspects of the natural and human environment so that adverse impact, if any is taken care of and the project does not create any hazard or affect the quality of life for generations. The plan also indicates the details as to how various measures have been or are proposed to be taken including cost components as may be required.

EIA: Environment Impact Assessment is a planning tool that is now generally accepted as an integral component of sound decision-making. The objective of EIA is to foresee and address potential environmental problems/concerns at an early stage of project planning and design. EIA/EMP should assist planners and government authorities in the decision making process by identifying the key impacts/issues and formulating mitigation measures.

Class Labels: A set of Dangerous Goods Class labels based on UN Model Regulations 14. Class 1 - Explosives ,Class 2 - Gases ,Class 3 - Flammable Liquids, Class 4 - Flammable Solids; Substances Liable to Spontaneous Combustion; Substances Which, in Contact with Water, Emit Flammable Gases ,Class 5 - Oxidizing Substances and Organic Peroxide ,Class 6 - Toxic and Infectious Substances, Class 7 - Radioactive Materials,Class 8 - Corrosives and Class 9 - Miscellaneous Dangerous Goods

Material Safety Data Sheet (MSDS) or internationally known as Safety Data Sheet (SDS) also known as PSDS, Product Safety Data Sheet is an important component of workplace safety. It is intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.

Transport Emergency (TREM) Card: Tremcards (Transport Emergency Cards) are written instructions for drivers of vehicles, ships' captains, and rail personnel. They are intended primarily so that drivers and crew can take the correct emergency actions and also for the police, firefighters, and other emergency services can prevent accidents resulting .In accordance with the different mode-of-transport categories, the tremcard can contain specific instructions for actions to be taken to prevent or minimize hazards.

Strategic Approach to International Chemicals Management (SAICM): Strategic Approach to International Chemicals Management (SAICM) is a policy framework to foster the sound management of chemicals Adopted by the International Conference on Chemicals Management (ICCM) on 6 February 2006 in Dubai, United Arab Emirates.

Computer-aided management of emergency operations (CAMEO): CAMEO is a system of software applications used widely to plan for and respond to chemical emergencies. It is one of the tools developed by EPA's Office of Emergency Management (OEM) and the National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA), to assist front-line chemical emergency planners and responders.

ALOHA (Areal Locations of Hazardous Atmospheres): ALOHA is a program designed to model chemical releases for emergency responders and planners. It can estimate how a toxic cloud might disperse after a chemical release and also features several fires and explosions scenarios.

MARPLOT: Software used for representing ALOHA threat zones on a Map.

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