Training Module on

Chemical Industrial Disaster Risk Management

GUJARAT INSTITUTE OF DISASTER MANAGEMENT

BUILDING RESILIENCE

Training Module on Chemical Industrial Disaster Risk Management

Gujarat Institute of Disaster Management

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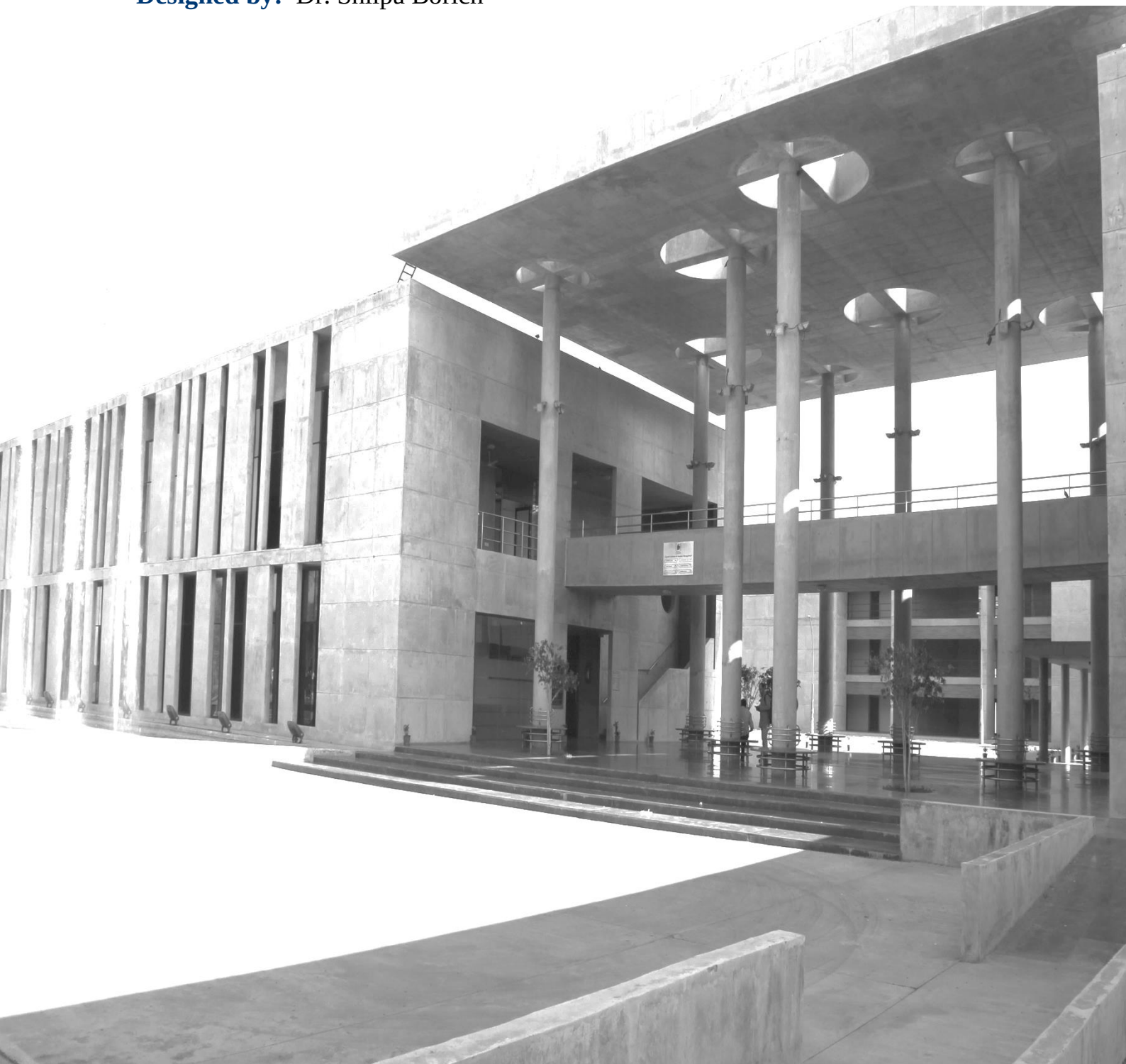


MESSAGE

Government of India has declared national policy on Environment, Health, Safety (EHS) at work place. The goal and objectives of the policy will be to improve quality of work and working life through dedicated and concerted efforts consistent with the requirements of Environment, Health, Safety (EHS) at work place. Fires, explosives and the release of toxic gas can cause deaths and injuries to public, resulting in evacuation of communities and adversely affect the environment as a whole. The prevention and control of major hazards have subsequently become a pressing issue in all parts of world. There are 633 MAH units in Gujarat State which is the highest number as compared to other States. The potential for major accidents caused by the increasing production, storage and use of dangerous substances implies that a well-defined and systematic approach is required, if major disasters are to be avoided and prevented.

It has been realized that effective Chemical Industrial Disaster Risk Management (CIDRM) is possible by the adoption of preventive and mitigation strategies as most chemical disasters are preventable in comparison to natural disasters that are difficult to predict and prevent. In this regard, GIDM has identified the need for implementation support and enhance capacity of institutions and individual dealing with Chemical & Industrial Disaster Risk Management. This module on Chemical & Industrial Disaster Risk Management will enable facilitators to adequately equip themselves in conducting training programs more effectively.

I appreciate the dedication and commitment of Mr. Ankur Srivastava, Mr. Tanmay Gound, Mr. Nisarg Dave and Ms. Anusha Vyas, GIDM for working on the module and bringing the manuscript to its present form.

The module is designed to be a living document. As capacity development needs and trends change over time, updated versions of this document will be released to reflect those changes, as and when required. I trust that users will communicate their views to us.

I am confident that the module will add value to our continuing state, and local efforts aimed at building coping capacities in Gujarat.

April, 2023
Gandhinagar, Gujarat

(P K Taneja)
Director General

ABBREVIATIONS

APELL:	Awareness and Preparedness for Emergencies at Local Level
BMHRC:	Bhopal Memorial Hospital and Research Centre
BLEVE:	Boiling Liquid Expanding Vapour Explosion
CAEPPR:	Chemical Accidents Emergency Planning, Preparedness and Response
CAIRS:	Chemical Accident Investigation Reporting System
CAPP-TZ:	Chemical Accident Prevention and Preparedness
CCG:	Central Crisis Group
CDMP:	Chemical Disaster Management Plan
COP21:	Conference of the Paris
CPAP:	Continuous Positive Air Pressure
CPCB:	Central Pollution Control Board
DCG:	District Crisis Groups
DEOC:	District Emergency Operations Centre
DISH:	Director Industrial Safety and Health
DPMC:	Disaster Prevention and Management Centre
DPPC:	District Contingency Planning Committee
EMS:	Emergency Medical Services
ERF:	Environment Relief Fund
FOEN:	Federal Office for the Environment
GCLA:	Government Chemist Laboratory Agency
GIDC:	Gujarat Industrial Development Corporation
GIDM:	Gujarat Institute of Disaster Management
GSDMA:	Gujarat State Disaster Management Authority
HAZCHEM:	Hazardous Chemicals
HBJ:	Hazira-Bijapur-Jagdishpur
HPC:	High Powered Committee
ILO:	International Labour Organization
IRS:	Incident Response System
LCG:	Local Crisis Groups

LCR:	Local / LCG Control Room
LEL:	Lower Explosive Limit
LERT:	Local Emergency Response Team
LO:	Liaison Officer
LSC:	Logistics Section Chief
LPG:	Liquid Petroleum Gas
MAH:	Major Accident Hazard
MFR:	Medical First Responder
MHA:	Ministry of Home Affairs
MoC&I:	Ministry of Commerce & Industry
MoEF:	Ministry of Environment and Forests
MoLE:	Ministry of Labour & Employment
MSIHC:	Manufacture, Storage and Import of Hazardous Chemicals
NATECH:	Natural Hazard Triggered Industrial Accidents
NDMA:	National Disaster Management Authority
OISD:	Oil Industry Safety Directorate
OSC:	Operational Section Chief
PCC:	Pollution Control Committees
PESO:	Petroleum and Explosives Safety Organization
PID:	Photo-Ionization Device
PLI:	Public Liability Insurance
PNGRB:	Petroleum and Natural Gas Regulatory Board
PPE:	Personal Protective Equipment
PPP:	Public Private Partnerships
QMRT:	Quick Response Medical Team
QSP:	Quick Start Programme
SAICM:	Strategic Approach to International Chemicals Management
SCG:	State Crisis Group
SDG:	Sustainable Development Goals
SERT:	State Emergency Response Team

SFDRR:	Sendai Framework for Disaster Risk Reduction
SPCB:	State Pollution Control Board
SPI:	Safety Performance Indicators
UNECE:	United Nations Economic Commission for Europe
UNEP DTIE:	United Nations Environment Programme, Division of Technology, Industry & Economics
UNFCC:	United Nations Framework Convention on Climate Change
UNISDR:	United Nations International Strategy for Disaster Reduction

DEFINITION & GLOSSARY OF KEY TERMS

Chemical Accident means an accident involving a fortuitous, or sudden or unintended occurrence while handling any hazardous chemicals resulting in continuous, intermittent or repeated exposure to death, or injury to, any person or damage to any property but does not include an accident by reason only of war.

Danger: A popular expression covering the subjective perception of hazard or risk.

Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area.

District Authority means the District Disaster Management Authority.

Dose: Quantity of an agent absorbed over a specified period of time.

Effect: Immediately or delayed result of an exposure.

Emergency is 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.

Event: The realization of a hazard.

Exposure: State of a specific target being open and vulnerable to the consequence of an event.

Incident is a situation in which people are potentially exposed to hazards to which they are vulnerable, with resulting public concern and the possibility

Industrial Pocket means any industrial zone earmarked by the Industrial Development Corporation of the State Government or by the State Government.

Local Authority includes Panchayati raj institutions, municipalities, a district board, cantonment board, town planning authority or any other body or authority, by whatever name

called, for the time being invested by law, for rendering essential services or, with the control and management of civic services, within a specified local area.

Major Chemical Accident means an incident involving loss of life inside or outside the installation or ten or more injuries inside and / or one more injury outside or release of toxic chemicals or explosion or fire or spillage of hazardous chemicals resulting in on site or off-site emergencies or damage to equipment leading to stopping of process or adverse effect to the environment.

Major hazard: A hazard having the potential of causing a major accident; i.e. a major emission, a fire or an explosion which leads to considerable social disruption as the result of serious adverse effects on the following targets:

Preparedness means the state of readiness to deal with a threatening disaster situation or disaster and the effects thereof.

Residual risk is the risk still remaining after the implementation of risk management.

Risk is the combination of a stated effect and its probability of occurring.

Risk assessment: The procedure to identify risk by combining the results of a hazard study with the probabilities of the events considered and their effects.

Risk management: The whole of actions taken to achieve and maintain the safety of an installation and its operation.

Safety: A situation without risks.

Site means any location where hazardous chemicals are manufactures or processed, stored, handled, used, disposed of and includes the whole of an area under the control of an occupier and includes pier, jetty or similar structure whether floating or not.

Societal risk: Risk to which a defined group or number of persons within a specific population is subjected simultaneously.

CONTENTS

INTRODUCTION TO THE MODULE

About the module

As one of the most developed and industrialized states in India, Gujarat is home to a high number of hazardous chemical industries. In addition to the chemical and industrial hazards posed due to such heavy industrialisation, Gujarat is also vulnerable to natural hazards such as cyclones, earthquakes, flooding, tsunamis, and storm surges. Particularly, the chemical industry occupies a pre-eminent position in the industrial sector of Gujarat, contributing to more than 40% of the industrial output. Almost the entire range of the chemical process industry exists in Gujarat, including hydrocarbon processing/refining products, petrochemicals-polymers and man-made fibres, fertilizers, health care products, plant protection chemicals, dyes, pigments and intermediates, fine chemicals, surface coating products, salt and salt-based products, ceramics, glass, cement, vegetable oils, fats, and detergents.

The training module on Chemical & Industrial Disaster Risk Management has been developed for trainers to educate the stakeholders and individual about the chemical & industrial risks around them and intuitively train them to be prepared for it. The module has been designed in an interesting way to avoid the use of complex scientific/ technical terminologies and Disaster Risk Reduction (DRR) jargons, which usually becomes confusing to a commoner after a point. The training module focuses on all parameters of chemical & industrial risk like hazard & vulnerability assessment, relevant exposure, Prevention & Mitigation measures and response/recovery plans without going into the technicalities. The ultimate objective of the module is to empower every participant to be able to assess chemical & industrial risks and be getting themselves acquainted with preparedness and response/recovery plan. This module aims to empower stakeholders and individual to do the same, although not with such high precisions or on a large scale but with enough credibility to act upon it. Thus, in a way, the module aims to inculcate a culture of resilience among everyone. Doing what is being taught is perhaps the best way to ensure that knowledge is retained and this forms the guiding principle of this training module. The module has been developed by the Gujarat Institute of Disaster Management (GIDM) with inputs from professionals working in this sector and by referring to several research articles.

Who shall use the Training Module?

It can be used in trainings relevant to chemical & industrial risk management for imparting training to anyone on the basics and fundamental understanding. The module can also be used for self-study by professionals or anyone who has interest in this field and intends to learn more about it. The following would be the expected target groups for the module:

- Civilians / residents.
- Undergraduate students; post-graduate students in the field of disaster risk management.
- Government authorities, either to foster their own interest in this subject or just as a part of being aware and prepared.
- NGOs working in this sector.

How to use the Training Module?

The module has been designed rationally to help the trainers or the self-learners to understand what is chemical & industrial risk. The use of technical terms or jargons has been avoided till the end so that the basics are not overlooked. Each session has been explained in detail, along with the session plan, content to be covered, methodology to be followed and instructions to trainers. The content of the module is expected to be inherently dynamic. The module also retains a degree of flexibility in the sense that the trainer can innovate on the methodology or activities according to the profile and need of participants.

Trainers' Guide

The trainer should consider the following guidelines:

- Registration of the participants should be electronic and must be made open on the eve of the program. This will help the trainer to understand the type of participants and he / she may consider making few last-minute changes in the style of delivery.
- The program must start with public dissemination of risk information of the venue which should be audio-visual (preferably) and the participants must be made aware of the evacuation routes, assembly points etc.
- Instead of abiding by the traditional practice of trainer-participant introduction, the participants should be introduced to each-other and the trainer should come up with interesting ways to do so.

- Each lecture session should end in a discussion. This will not only help the participants to learn more from each-other but also the trainer to understand whether he has been capable enough to get his ideas across to the participants or not.
- If possible, a qualitative assessment of the trainer should be conducted at the end of every lecture session. The questions should focus only on qualitative aspects of the lesson and the trainer. Such an assessment would be an effective tool to measure the performance of the trainer.
- If the same trainer is taking more than one session, then, the test would be able to let the trainer know which sessions were good, which were average and which needs to be improved.
- If the same session has been taken by different trainers over a period of time, such a test would be an effective way of knowing which trainer is better in imparting training in that particular topic / subject.
- The trainer, therefore, should plan the session in such a way that the first-half of the day is dedicated to teaching / learning, while the second-half is more about exercising the concepts that have been taught.

Target Group

The training is targeted towards the stakeholders and individual. It would not be out of place to suggest that the generic understanding of disaster risk management is either flawed or incomplete or reactive. These are major impediments to fostering a culture of disaster resilience and it is exactly these impediments that the module intends to address. Thus, anyone who is keen on learning about the Chemical Industrial Disaster Risk Management (CIDRM) can be the target group. The style of delivery, however, may differ depending upon the target group. A group size of 25 - 40 people would be ideal.

Entry Behavior

- Level of participants: Anyone
- Age Group: Less than 50 years
- Educational Qualification: Anyone who has a basic understanding of science
- Disaster Experience: Not at all mandatory

Objective of the programme

The overall objective of the programme is to impart adequate knowledge and skill to the trainees to deal with chemical & industrial risks in their respective spheres of life and empower them to formulate strategies/ action plan suitable to prevent risks and build resilience.

Methodology

The training will be conducted in an interactive mode with a judicious mixture of lectures, discussions, demonstrations, experience sharing, group work and case study analysis.

Teaching Aids

Training will have to be conducted with the help of the following:

1. Background reading materials / reference materials
2. Electronic handouts of presentations or additional material
3. Simulation exercise
4. A group is to be created on a social media to ensure that the participants are in touch and are actively sharing knowledge amongst each other. Such groups can also function as crowd-based sources of data.

Training Materials and Equipment Required

The training will essentially be classroom based and for simulation exercises, the venue institute should be used. The training materials for classroom teaching like Computers, LCD projectors, flip charts, markers etc. would be required.

Seating Arrangements

The seating arrangements should preferably be four or five circular tables to facilitate group work and allow the trainer to move around the class for interaction

Public Dissemination of Risk Information of the Venue (PDRIV)

In case the training is being conducted at GIDM or at any other physical venue, it is mandatory that an audio-visual clip be shown about the venue that informs the audience / participants about the hazards the venue or the surrounding is prone to, the risks, the escape routes or evacuation plan and emergency assembly points. The audio-visual clip to be shown must not contain mere presentations or verbal directions. It should be a visual document of the actual evacuation route from common points like corridors or lounges to the assembly points, which may or may not be within the same establishment.

Primarily, a venue may be exposed to various different types of hazards and for an event of a day or two, hazards like flood or drought may be irrelevant and in such cases more immediate hazards like fire or earthquake should be dealt with. The focus should be on preparing the audience for evacuation if such a need arises during the program. The clip may be allowed to run repetitively while the initial arrangements are being made on the day of inauguration or when the participants start coming in and settling down for the first session of the training program.

In addition to the audio-visual clip, along with the registration kit, a single-page document should be handed over to the participants with the evacuation routes marked and assembly points mentioned. Emergency contact numbers may also be provided if the participants come from other parts of the world.

Proper preparation in this regard on behalf of the organisers is also necessary. The venue selected for the training course must have a minimum standard of disaster preparedness measures. First of all, the venue must have a disaster management plan and an emergency evacuation strategy within it. For the evacuation strategy to be effective, proper signage should be placed on and around the campus premises. The evacuation strategy should have been a tested through mock-drills a couple of times keeping in mind the different groups and types of participants that might join the training program like differently-abled individuals or senior old-age personnel and for a mock-drill to be executed, the establishment must have a disaster management plan. Thus, everything is dependent on the other with the disaster risk management plan serving as the key document.

INAUGURATION AND PRE-TRAINING ASSESSMENT

Need of the session

This is supposed to be an introductory plenary to prepare the participants for upcoming sessions and in order to convene them on same page. Participants from different organization have different understanding/confusions regarding risk pertaining chemical & industrial emergencies. Their orientation about subject depends on their personal knowledge or whether they have worked in such situation. Therefore, this session is aimed towards assessing the entry behavior of participants. But it would not be the best case to directly plunge to the subject therefore the course-coordinator will have the job to informally introduce himself and facilitate the participants to introduce themselves. The first day of a course is essential to the success of the course. It is important to start the course on a positive note by making sure all of the participants feel comfortable and get to know each other as soon as possible. The course-coordinator shall use ice breakers at the beginning of a course to help the participants get to know each other. Following activity can be used for the purpose:

1. Provide a paper card to every participant.
2. Ask them to write their name on it and return to the coordinator.
3. The coordinator shall pick random cards to club the participants in 4-5 groups.
4. Now each group shall select a group-name for themselves condition being that it should have the first and last letter of the name of each member.

The introductory session can also be used to understand the expectations of the participants from the training. For this following activity may be used:

1. Give each group three-four minutes for discussion.
2. Ask each group to write their expectations from training on the chart paper.
3. Put all charts by the groups on a wall.
4. Write the common/relevant expectations on white board/flip chart.
5. Read out training objectives as mentioned in the beginning of the module.
6. Clarify that expectation outside the scope of training will be addressed where and when possible.

Objective of the session

This simple but elaborate session of around 90 minutes is expected to bring out:

1. The prior knowledge and understanding of the participants.
2. To build a rapport between the participants and the trainer or the course-coordinator and also among the participants.
3. Changes of content or delivery style that might be required on part of the trainer to meet the level of participants or their expectations from the course.

Duration: 60 minutes (40 + 20)

Training aids: Paper cards, Flip charts, Markers etc.

TECHNICAL SESSION 1
DISASTER RISK MANAGEMENT: CONCEPTS & PERSPECTIVES

Need of the session

To understand risk or disaster risk, one must have a very clear idea of its constituent parameters, which are hazard, vulnerability, exposure and coping capacity. While coping capacity and vulnerability are literally intertwined and are complementary to each other, the other three parameters (hazard, vulnerability and exposure) are primarily what defines disaster risk. A hazard is not a disaster and yet we use these terms interchangeably very often and this is where we commit the first mistake. We, in general, have a tendency to link everything with a buzz-word and the current catch-phrase being climate change, there is trend of relating every phenomenon to climate change, global warming and such apocalyptic events. We simply ignore the science behind the genesis of hazards and go on to link it with bigger events. This is where we commit the second mistake. Ignorance is off-course a bliss but in disaster risk reduction and disaster preparedness, ignorance is a bane. This is where this unit comes in to bridge the gap.

Units of the session

1. Learning Unit 1.1: Hazard, Vulnerability & Risks: A Conceptual Approach to DRM
2. Learning Unit 1.2: Managing Disasters to Managing Risks: An Overview
3. Learning Unit 1.3: Dealing with Disasters: post 2015 Global Frameworks for DRR
4. Learning Unit 1.4: Understanding Chemical & Industrial Disasters
5. Learning Unit 1.5: Reducing the Risk of NATECH Event

Objectives of the session

The primary objectives of this unit would be to:

- Explain to the participants what is Hazard, Vulnerability and Exposure.
- Exemplify how the scope of Managing Risks is broadening due to other global phenomenon.
- Inform the participants about the post 2015 global frameworks for DRR.
- To provide participants basic understanding of chemical & industrial disasters.
- To provide participants basic understanding of NATECH incidents.

Duration

330 minutes (90 + 45 + 45 + 45 +30) for the sessions and 15-minute spill over time from each session.

Methodology

The methodology of this session is no different from the overall methodology of the training program. Every lesson or every unit must start with a question to intrigue the participants and foster discussion. Building up on such discussions, the trainer must start his presentation or lecture.

Training aids: Power-point presentation, Flip-charts, Markers etc.

Flow of the session

The trainer may begin by narrating a small story or incident and asking the participant to identify the hazard in it.

"During monsoon season, at a gas processing plant, due to loosening of a valve caused a highly inflammable naphtha leak in the plant. It was heavily raining on the premises. The liquidized gas quickly spread into the surrounding and went to the storm water drains. The spark from the electrical circuit leading to the fire and spread through this storm water and took a path of the drain. Unfortunately, the storm water drainage was connected to the residential area drainage system (Nallah) which was open and eventually it affected five houses. Three workers from the site and Two from the residential area suffered from burns."

Hazard

The trainer will now have to instigate the participants to share their views on what the hazard in this particular example.

In industrial zones, multiple hazards can be identified as same in the provided case. The industry itself "possibly" comes under the MAH, (MAH has to be decided by the competent authorities) which itself is a hazard.

The process and hazardous chemicals (HAZCHEM) storage tanks can be easily identified as a hazard but multiple hazards which needs to be identified in advance. First hazard can be Storm water drain which is connected to the residential drainage system. This can be avoided. Another possible hazard is "open nallah" in the residential area.

Similar examples can be discussed to understand that hazard is anything which may have adverse effect and the effects can be injury, health impact, damage to property, disruptions of any form and even loss of life. Hazard should also be understood in terms of probability of happening. In light of the above example, the Chemical Industry itself is a hazard but its number of probabilities of actually event being taking place is also a hazards.

This perception of hazard is more meaningful in the context of disaster management and disaster risk reduction. The lesson should be concluded with a discussion over all other possibilities that could have been took place.

CLASSIFICATION OF HAZARDS: The widely accepted classification system used by the Disaster Information Management System of DesInventar classifies disasters arising from natural hazards into five major categories and is used globally for the Sendai targets monitoring:

1) Geophysical: Geological process or phenomenon that may cause loss of life, injury or other health impacts, properly damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hydro-meteorological factors are important contributors to some of these processes.

2) Hydrological: Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up.

3) Meteorological: Events caused by short-lived/small to meso-scale atmospheric processes (in the spectrum from minutes todays)

4) Climatological: Events caused by long-lived meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)

5) Biological: Process or phenomenon of organic origin or conveyed by biological vectors, including exposures to pathogenic micro-organisms, toxins and bioactive substances that may cause loss of life, injury, illness or later health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

A brief description of these five major categories of the disasters arising from natural factors with the sub-categories is given in following **Table 1**. The below classification on is not a watertight one. In real life situations, many disasters are a combination of different types of disasters. In addition, secondary disasters may occur after a disaster has occurred.

#	Family	Main Event	Short Description/ Secondary Disaster
1	Geophysical	Earthquake/ Mass movement of earth materials	• Landslide following earthquake; • Urban fires triggered by earthquakes;

			• Liquefaction – the transformation of (partially) water saturated solid state to liquid state caused by an earthquake • Mass movement of earth materials, usually down slopes • Surface displacement of earthen materials due to ground shaking triggered by earthquakes
		Volcano	• Surface displacement of earthen materials due to ground shaking triggered by earthquakes • A type of geological event near an opening/vent in the Earth's surface including volcanic eruptions of lava, ash, hot vapour, gas, and pyroclastic material. • Ash fall; Lahar – Hot or cold mixture of earthen material flowing on the slope of volcano either during or between volcanic eruptions; • Lava Flow • Pyroclastic Flow – Extremely hot gases, ash, and other materials of more than 1,000 degrees Celsius that rapidly flow down the flank of volcano (more than 700 km/h) during an eruption
		Tsunami	Tsunamis are difficult to categorize they are essentially an oceanic process that is manifested as a coastal water-related hazard. A series of waves (with long wavelengths when traveling across the deep ocean) that are generated by a displacement of massive amounts of water through underwater earthquakes, volcanic eruptions or landslides. Tsunami waves travel at very high speed across the ocean but as they begin to reach shallow water they slow down, and the wave grows steeper.
2	Hydrological	• Flood • Landslides • Wave Action	• Avalanche, a large mass of loosened earth material, snow, or ice that slides, flows or falls rapidly down a mountainside under the force of gravity • Coastal Erosion - The temporary or permanent loss of sediments or landmass in coastal margins due to the action of waves, winds, tides, or anthropogenic activities • Coastal flood - Higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding, which can last from days to weeks • Debris Flow, Mud Flow, Rock Fall - Types of landslides that occur when heavy rain or rapid

			snow/ice melt send large amounts of vegetation, mud, or rock downslope by gravitational forces • Flash Flood Hydrological - Heavy or excessive rainfall in a short period of time that produce immediate runoff, creating flooding conditions within minutes or a few hours during or after the rainfall • Flood Hydrological - A general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than normal levels along the coast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell (flash floods) • Wave Action: Wind-generated surface waves that can occur on the surface of any open body of water such as oceans, rivers and lakes, etc. The size of the wave depends on the strength of the wind and the travelled distance (fetch)
3	Meteorological	Hazard caused by short-lived, micro-to meso-scale extreme weather and atmospheric conditions that may last for minutes to days	• Cyclone, Storm Surge, Tornado, Convective Storm, Extra tropical storm, Wind Cold Wave, Derecho • Extreme Temperature, Fog, Frost, Freeze, Hail, Heat wave • Lightning, Heavy rain • Sandstorm, Dust-storm • Snow, Ice, Winter Storm, Blizzard
4	Climatological	Unusual, extreme weather conditions related to long-lived, meso- to macroscale atmospheric processes ranging from intra-seasonal to multi-decadal (long-term) climate variability	• Drought • Extreme hot/cold conditions • Forest/Wildfire Fires • Glacial Lake Outburst Flood (GLOF) • Subsidence
5	Biological	Exposure to germs and toxic substances	• Epidemics: viral, bacterial, parasitic, fungal, or prion infections • Insect infestations • Animal stampedes

Table 1: NDMP (2019) classification of hazards

To end this lesson, the trainer may urge the participants / groups to take a piece of paper and write down the hazards, not necessarily the ones mentioned in the national plan but any sort of hazard, that is predominant in their area and correctly classify it.

Case in point: Gujarat

Earthquake: As per Indian Seismic Zone Map, Gujarat region lies in three zones- Zone III, IV and V. Kachchh region (about 300km x 300km) lies in zone V where earthquakes of magnitude 8 can be expected. A belt of about 60-70km width around this zone covering areas of North Saurashtra and areas bordering Eastern part of Kachchh lie in zone IV where intensity VIII can be expected mainly due to earthquakes in Kachchh and some local earthquakes along North Kathiawar Fault in Northern Saurashtra. The rest of Gujarat lies in zone III where intensity VII earthquakes can be expected due to moderate local earthquakes or strong Kachchh earthquakes.

Drought: Gujarat is one the chronic drought prone state of India, with an average annual rainfall about 850 mm with more than half of the Talukas of Gujarat receiving rainfall less than 500 mm. Substantial portions of the State are arid to semiarid. Falling water tables have added stress on crops and water supplies.

Cyclone: Gujarat falls in the region of tropical cyclone. With the longest coast line of 1600 km in the country, it is highly vulnerable to cyclone and its associated hazards such as floods, storm surges, etc. Two cyclonic storm seasons are experienced in Gujarat: May to June (advancing southwest monsoon) and September to November (retreating monsoon).

Flood: Majority of the area of Gujarat is flood prone, irrespective of the size of the catchment. The flood risk in Saurashtra is lower than that of the South Gujarat plains. The relatively flat plains in the lower basic areas with hilly catchments in upper parts of South Gujarat accentuate flood risks. Few villages in the North Gujarat are flood prone too.

Tsunami: Gujarat is prone to tsunami risk due to its long coastline and probability of occurrence of near and offshore submarine earthquakes in the Arabian Sea. Makran Subduction Zone-South West of Karachi is an active fault area which may cause a high magnitude earthquake under the sea leading to a tsunami.

Fire, Industrial & Chemical, Accidents, Heatwave, Epidemic, Stampede, etc. are also frequent in Gujarat.

Vulnerability

To understand risk or disaster risk, one must have a very clear idea of its constituent parameters, which are hazard, vulnerability, exposure and coping capacity. While coping capacity and vulnerability are literally intertwined and are complementary to each other, the other three parameters (hazard, vulnerability and exposure) are primarily what defines disaster risk. After the last unit, it is expected that a fair amount of understanding of hazards would have been developed. Hazard is not a disaster in itself but a phenomenon or an event which may cause some damage and it is the vulnerability of the individual or community or the system in consideration which defines the risk a hazard pose. It is to be noted that the word system to be used hereafter can refer to an individual, a community, an administrative unit, production house or even a nation depending on the context.

The trainer may begin by reminiscing the example cited in the first unit.

"During monsoon season, at gas processing plant, due to loosening of a valve caused a highly inflammable naphtha leak in the plant. It was heavily raining in the premises. The liquidized gas quickly spread in to the surrounding, and went to the storm water drains. The spark from electrical circuit lead to the fire and it spread through this storm water and took a path of drain. Unfortunately, the storm water drainage was connected to the residential area drainage system (Nallah) which was open and eventually it affected five houses. Three workers from the site and Two from the residential area suffered from burns."

The hazards in this example has already been discussed and now the trainer should probe the participants as to state the vulnerabilities in the given scenario with a prior understanding that vulnerability is basically the potential of any event or phenomenon to cause damage. Similar examples can also be cited to involve the participants. The following questions can be posed by the trainer to instigate the participants:

- Was the gas processing unit itself was vulnerable?
- Was the weather (monsoon) a vulnerability?
- Were the location of houses vulnerable?
- In above context, what is/are the vulnerability/vulnerabilities according to you?

The trainer should understand that to explain the vulnerability these question helps to open different dimensions of vulnerability. Thus, it is the responsibility of the trainer to steer the participants into asking that how these above mentioned facts address the vulnerability.

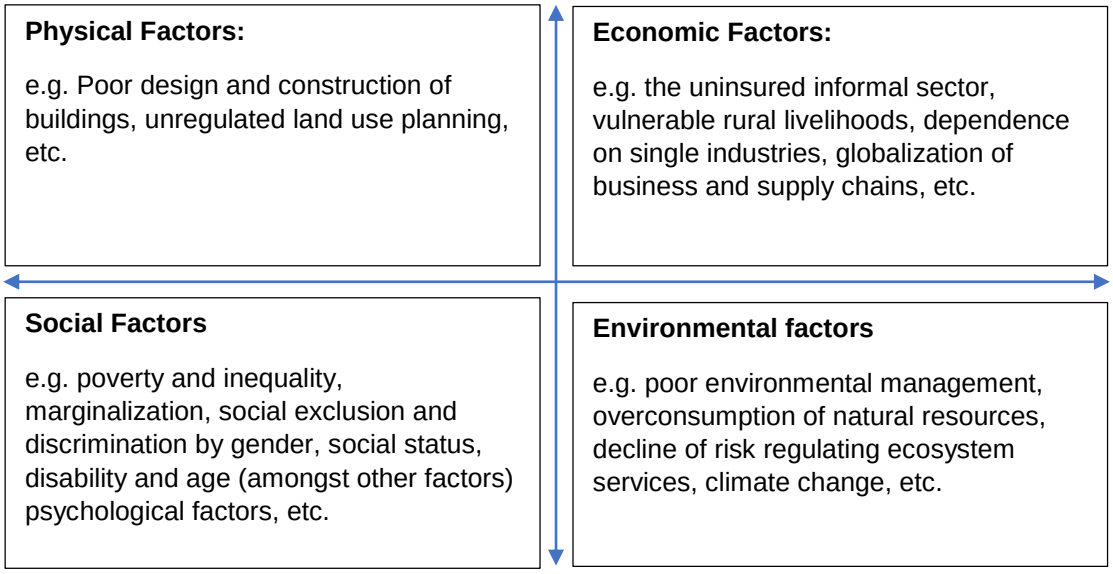
The concept of vulnerability being a degree or extent of impact is also to be illustrated here. To understand this, one must consider different simulations of the same example. What could have helped in above situation to save those five lives? Just an awareness and capacity to respond would have helped in reducing the vulnerabilities? These questions, targeted at the participants, would give them a feel that vulnerability has so many aspects and this would lead on to the next lesson.

Vulnerability can be a challenging concept to understand because it tends to mean different things to different people and because it is often described using a variety of terms including 'predisposition', 'fragility', 'weakness', 'deficiency' or 'lack of capacity'.

Vulnerability is the human dimension of disasters and is the result of the range of economic, social, cultural, institutional, political and psychological factors that shape people's lives and the environment that they live in.

Vulnerability is not simply about poverty, but generally the poor who tend to suffer worst from disasters. Poverty is both a driver and consequence of disaster risk (particularly in countries with weak risk governance) because economic pressures force people to live in unsafe locations and conditions. Poverty and the other multi-dimensional factors and drivers that create vulnerability mean that susceptibility to the impacts of hazards is often, but not always, associated with certain groups, including women, children, the elderly, the disabled, migrants and displaced populations, amongst others.

Vulnerability relates to a number of factors, including:



Many of the underlying drivers of vulnerability, including poorly managed urban development, are increasing, resulting in vulnerability increasing in many countries and regions of the world. While evidence suggests that wealthier, well governed countries are able to reduce disaster risks, some countries have exhibited rapid economic growth in the last few decades without a commensurable rate of vulnerability reduction.

At the end of this lesson, the participants must have a clear idea of how vulnerability is the extent of damage an event is caused and how broad its scope is.

Exposure

Exposure is, perhaps, the most important parameter when it comes to determining disaster risk. One needs to understand that hazard, which is an event or a phenomenon, will always be there and most of the time we can do very little to prevent it, but if we are exposed to it, it will surely impact us and then it is only our vulnerability which decides whether we would be severely, moderately or mildly impacted. To start with, the scope of exposure is anything tangible that may be susceptible to the impact of a hazard. It can be human life, property, farms, production houses etc. This is what the basic of exposure is, however, one needs to delve into depths to understand the true bearings of exposure. When considering human life, one needs to consider the demographics of the community or the area. Different age groups, or different sexes would have different levels of vulnerability to the hazard. Imagine a small town that has been in the nearby industrial vicinity. A gas leak happens in the one of the industry. The demographics plays a vital role in this town as old-age population, children are more vulnerable. This is how demographics change the scenario. Even if it had been a school filled with children, the exposure of the school would be much more devastating than an office being exposed as the small children may not know how to act and react. The trainer must be able to explain that exposure must account for the demographic divisions because vulnerability is ultimately decided by the demographics.

The next step would be to explain that it is exposure which actually contributes to the calculation of losses. If a farm is exposed to a hazard like flood, then the per hectare yield of the farm multiplied by the area of the farm exposed would be the resultant loss. Similarly, if an industry is exposed, then the worth of all of its processes, would be realised as the loss. However unethical it is, if a value can be assigned to human life, the numerical value of the population exposed to a hazard multiplied by the value of life would amount to the loss.

The last statement is indeed disturbing and the trainer must take care of whether to go with that or not. The basic idea is to explain that it is exposure which contributes toward calculation of losses.

Objectives of the lesson

The primary objectives of this lesson would be to:

- Explain what Hazard, Vulnerability and Exposure is
- Explain the ways in which all these are perceived and understood

Duration

90 minutes depending upon the potential of the trainer to fan discussion and debate.

Methodology

An animated clip can be used to depict a similar scenario and then the participants may be asked to depict the hazard in the scenario.

If the participants have already been divided into groups, then each group can be handed out a sheet of paper and asked to write down all the hazards they can find out in the given scenario. After completing the session, just for a competitive flavour, the team who identifies the hazards correctly, may be given a score or a recognition.

Training aids: Power-point presentation, flip-charts, A4s, markers, pens etc.

LEARNING UNIT 1.2: MANAGING DISASTERS TO MANAGING RISKS: AN OVERVIEW

Flow of the session

The trainer may start this session inviting reference to the earlier example of the industrial incident.

"During monsoon season, at gas processing plant, due to loosening of a valve caused a highly inflammable naphtha leak in the plant. It was heavily raining in the premises. The liquidized gas quickly spread in to the surrounding, and went to the storm water drains. The spark from electrical circuit lead to the fire and it spread through this storm water and took a path of drain. Unfortunately, the storm water drainage was connected to the residential area drainage system (Nallah) which was open and eventually it affected five houses. Three workers from the site and Two from the residential area suffered from burns."

The risk involved within the industry, the processes involved, the nature of chemicals creates numerous risks. It also creates risks to nearby vicinities where the workforce resides. Exposure to uncertain event will always be there. The trainer can move on to citing similar examples so as to explain the concept of disaster risk better. Majorly, industries works 24*7 hence there is always an exposure to humans. But with respect to natural hazards such as in case of an avalanche, there is a hazard, but there is no exposure and hence there is no disaster risk. If there is an earthquake, say in the night, there is a hazard and a school building is exposed to that hazard, but it has no vulnerabilities except the structural one. The trainer can go on to ask participants if they can come up with similar situations where there is a hazard but the overall risk is negligible.

The trainer should take this opportunity to establish the fact that disaster risk is nothing but a probability; in fact, probability of loss expressed in any desired unit. Disaster risk is dependent on hazard which is actually the probability of occurrence of any event that may cause damage, vulnerability which is the degree of damage the hazard can wreak and exposure which is the quantity of tangible elements exposed. Thus overall, disaster risk is a probability or a chance of loss if the said hazard strikes.

Intensive risk is disaster risk associated with low-probability, high-impact events, whereas extensive risk is associated with high-probability, low-impact events.

The above statement means that the risks are higher for hazards which have lower chance of occurrence and yet have the potential to create maximum damage; earthquake of higher magnitudes for example have a very high return period but when they occur they are catastrophic.

Disaster risk has many characteristics. In order to understand disaster risk, it is essential to understand that it is:

- **Forward looking:** it talks about the likelihood of loss of life, destruction and damage
- **Dynamic:** it can increase or decrease according to our ability to reduce vulnerability
- **Invisible:** it is comprised of not only the threat of high-impact events, but also the frequent, low-impact events that are often hidden
- **Unevenly distributed around the earth:** hazards affect different areas, but the pattern of disaster risk reflects the social construction of exposure and vulnerability in different countries
- **Emergent and complex**: many processes, including climate change and globalised economic development, are creating new, interconnected risks

The trainer can end this session with busting a myth; ***there is no such thing as natural disasters but disasters often follow natural hazards***. In addition to this, the trainer can also use the following statement:

Disasters threaten development, just as development creates disaster risk.

The key to understanding disaster risk is by recognising that disasters are an indicator of development failures, meaning that disaster risk is a measure of the sustainability of development. One cannot stop the development, but uncontrolled development leads to disasters, similarly, these disasters also creates pathway for development. Here we can say that, **Disasters & Development are the two sides of the same coin.** However, the trainer must allow the participants to interpret this on their own through discussions.

In addition to this, there is also acceptable and residual risk. The trainer may want to introduce the participants to these terminologies.

Hence, interpreting risk would be to incorporate the idea of perception of risk.

Coping Capacity

Coping capacity is ideally the capacity of a system (the connotation of system is the same as used during the illustration of vulnerability) to deal with a given risk. The system can be an individual, can be a community or even an organisation, institute or authority for that matter. It is obvious that when the capacity of the system is not enough to handle the risk, the consequences of the event are grave.

Coping capacity can be understood under similar heads as illustrated for vulnerability; i.e. physical, social and institutional. In fact, the ideology of vulnerability is counter-intuitive. If a particular system is vulnerable with respect to a particular parameter, the coping capacity of the system in regard to that parameter is low. For example, while talking about structural vulnerability within the physical dimension of vulnerability, if a building in zone 5 is not built according to the relevant building code and standards, structural vulnerability is prominent and hence coping capacity of the system is also questionable. However, if an important building in zone 4 is built according to the standards and regulations of zone 5, structural vulnerability is negligible and it can be said that the building has the capacity to cope with an earthquake of a certain intensity of earthquake. Not only for physical dimension, same analogies can be drawn in other dimensions as well.

The trainer can carry forward the session by giving several other examples to the participants to clarify the concept of coping capacity and its inverse relationship with vulnerability. The trainer can even perform a verbal exercise with the participants; the trainer can point out a very particular aspect in one of the dimensions of vulnerability and ask the participants to illustrate an example of how that aspect can contribute to vulnerability and how taking care of that aspect can increase the capacity. For example, the trainer can ask the participants to mention one aspect of socio-cultural dimension, the lack of which contributes to vulnerability and addressing it leads to improved capacity.

To put it mathematically for understanding, a disaster risk will remain a risk if the coping capacity of the system under consideration is substantially high, but, if the coping capacity is not up to the mark, the disaster risk would eventually become a disaster or a massacre.

$$Disaster\ Risk \propto \frac{Hazard \times Vulnerability \times Exposure}{Coping\ Capacity}$$

Understanding of disaster is often left to perception. One may even identify a small event as a disaster like fire in an apartment; such an event may be a disaster for the affected family but on a larger perspective, it cannot be termed as a disaster. Thus, it would not be incorrect to suggest that the understanding of disaster is dependent on the scope of the system under consideration. Usually, the scope of consideration is not less than a community.

Disaster Management to Risk Management

Now that the participants have a clear understanding of disaster, they are to be explained what disaster management is all about. This is to be done using the disaster management cycle. The trainer must make sure that he / she explains the disaster management cycle in the most intuitive manner possible; the participants are to be told that disaster management, however technical it might sound, is actually very logical and rational. The different phases of the cycle logically follow each other and the science can be found only within this phases and not between them.

The participants must also be given a flavour of how they can manage disasters at their own level, preferably at the family level or community level. This is to be done by introducing the participants to the bow-tie analysis tool. Once the participants feel empowered, they must be enlightened about the paradigm shift that is occurring; from disaster management to disaster risk management which circumscribes disaster risk reduction.

The trainer may begin by introducing the participants to the disaster management cycle. One may find different versions of the disaster management cycle from different sources, but it is the responsibility of the trainer to explain to the participants that the core rationale behind all such version is the same and is very rational for one to follow.

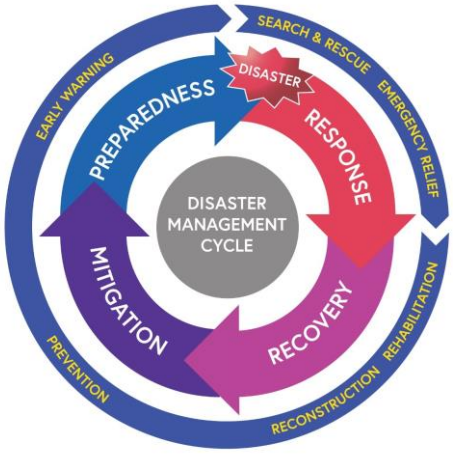


Figure 1: Disaster Management Cycle

Phase I: Prevention and mitigation

If it is known that a system (community, area, village etc.) is prone to or likely to be affected by a hazard or if it is established that there exists a risk, the first and the foremost logical thing to do would be to prevent the occurrence, if possible, or to mitigate the risk. This is what constitutes the first phase. Risks of hazards like earthquake cannot be prevented but they can be mitigated by ensuring physical (structural and non-structural), social and institutional vulnerabilities are addressed and the system is endowed with adequate capacity to deal with the risk.

Fire risks can generally be prevented by taking care of points of failures (vulnerabilities); for example, in an organisation with a risk of fire hazard, fire alarms are to be installed, fire extinguishers are to be placed at regular intervals, staffs are to be trained on how to use extinguishers and what to do in case the alarm rings etc. If a fire occurs, due to any random reason, even with such steps of prevention, the magnitude of loss will be reduced many folds. Thus, the idea here is to ensure prevention or mitigation of the impact of loss in any terms.

The trainer can then go about giving examples of what steps are generally taken in this phase. Care is to be taken that such examples are primarily from Gujarat so that the participants can easily relate to. Examples can be cited of the Heat-wave Action Plan prepared by the Ahmedabad Municipal Corporation every year. The National Cyclone Risk Mitigation Project can also be explained by the trainer in this regard. In fact, the prevention and mitigation part of all the state and national level plans can serve as a good resource material for this phase as well this entire section.

Phase II: Preparedness

Once all steps have been taken to prevent or mitigate the impact of losses, the second phase is all about readiness; to put it in terms of management and administration, this phase is about the preparedness of the system such that its leanness and agility is not compromised during the event.

The trainer can then go about giving examples of what steps are generally taken in this phase. Care is to be taken that such examples are primarily from Gujarat so that the participants can easily relate to. For example, the GSDMA in collaboration with NDMA has planned national level mock exercises in past. State level Chemical Disaster Management Plan (2013) has already been in place to respond to any unforeseen event. Similarly, training programs that are

conducted by state and national institutes to build the capacity of different stakeholders is a crucial aspect of preparedness.

The trainer can use this opportunity to emphasise the role of Gujarat Institute of Disaster Management in preparedness through capacity building initiatives.

Phase III: Response

After the first two phases, it is expected that the community or the system (speaking, generally), is ready to respond to any event. Off course, no one can predict the exact unfolding of events but then the first two phases of the cycle is all about preparing the system to respond to an event with the capacity to adjust to anything that exceeds the preparation. Everything that the system has been trained for is put to use in this phase and the failure to do so will actually make the effort put in the previous phases futile. The trainer can give examples of prepared responses and un-prepared responses as seen in Gujarat over the years. For example, the response in the 2001 earthquake can be compared to the response of any subsequent quakes. Response to floods as seen in Sabarkantha can also be exemplified here. The trainer must also emphasise on the fact that this phase constitutes of three prime activities; search, rescue and relief.

Even these sub-phases are intuitive in their discourse; one must search for a victim and then rescue him and finally, transfer him to a safe haven / shelter / relief camp, where he will be treated.

Phase IV: Recovery

After the immediate response to the event, what primarily becomes the objective of all and every operation is to reinstate normalcy. To put it in terms of management and administration again, the aim is to ensure business process continuity; the business here may refer to the day-to-day working of a community (district / state) and even the day-to-day life of an individual or a family. The core idea is however not just reinstating normalcy; it is more than that; the idea is to build back from the ruins to a system which would have the capacity to deal in a better way. Examples can be cited from the recovery projects undertaken after the Bhuj Earthquake of 2001.

Build Back Better

The trainer must lay emphasis on the fact that restoring normalcy, i.e., recovery is not the end. In fact, it is just the beginning of a new cycle. In the recovery phase, it is essential to find out

the causalities of the disaster, the points of failure or simply put, the vulnerabilities and ensure that while recovering or 'building back', efforts are put to 'build back better'. The basis of this lies in the fact that if normalcy is restored or the system is recovered to the state it was before the disaster hit, the vulnerabilities will also be a part of it and that may result in similar consequences.

The trainer may then categorically go ahead and explain the role of science and technology in steering the shift. The role of IMD, INCOIS as agencies of early-warning and their super-efficient prediction and dissemination system may be elaborated upon. New technologies that are being used for structural safety can also be shared with the participants. In this context, the trainer may introduce the participants to the concept of green and sustainable technologies. The core idea behind this is that disaster and development goes hand in hand; resources, the natural ones, are limited and full-fledged development can only be fostered when they are used along with the use of non-conventional sources. The depletion of natural resources or even their use and exploitation for the sake of development, will negatively impact the environment or the ecosystem and this will trigger the occurrence and recurrence of hazards. For example, building of dams is utmost necessary but their construction is always clouded with protests and negative impact assessment reports. Thus, development, in one way or the other, will trigger hazards, which, may or may not, become disasters. In fact, for a fast and steadily developing country like India, the use of natural resources is equally important as the use of non-conventional sources and thus, at the altar of development we are and we have to sacrifice, to some extent, the idea of not contributing to disaster risks. But, as is the case with so many other things, there is also a silver lining to this. Since development will beget disaster risk, why not look at it from the opposite perspective? In case of a disaster, the general tendency is to build back better, i.e., to develop in a better way. Thus, disaster begets development as well. Amidst this confusion, the best way out is to adopt a principle of development which ensures that the future generations do not suffer the wrath of exploitation and while we are at it, we must ensure that existing risks are mitigated or reduced and no new risks are created in the process.

This lesson in particular will remain the dynamic part of the module. It will be the responsibility of the trainer to make this lesson interesting through showing examples of the use of science and engineering in reducing disaster risk. The trainer may also take this opportunity to explain the concept of acceptable risk and residual risk and the different sorts of measures that are taken in terms of risk management, i.e., corrective, prospective and compensatory.

Objectives of the lesson

The primary objectives of this lesson would be to:

- Explain what Disaster is
- Illustrate the importance of the Coping Capacity using the formulae
- Illustrate the Disaster Management Cycle
- Explain the overall relationship of Disaster Management to Risk Management

Duration: 45 minutes

Methodology

This session is an informative session which needs illustration through the equations of disaster risk, i.e.,

1. Disaster Risk $\propto$ (Hazard) X (Vulnerability)

2. Disaster Risk $\propto$ (Hazard) X (Vulnerability) X (Exposure)

The first equation talks only about the 'impact' of a hazard based on the probability of occurrence and the degree to which the hazard can cause damage. The second equation helps in assigning a unit to disaster risk; if 'this' be the probability of occurrence and 'this' be the degree of damage it can cause and 'that' be the amount of assets costing 'this much', then the product of all these would give an idea of what damage and loss would be incurred by the hazard.

Training aids: Power-point presentation and Flip Chart

LEARNING UNIT 1.3: DEALING WITH DISASTERS: POST 2015 GLOBAL FRAMEWORKS FOR DRR

Flow of Session

In this session the participants would be introduced to coherence and mutual reinforcement of three post-2015 global frameworks for DRR i.e. the Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals and COP21 Paris Agreement on Climate Change. The trainer will have the discretion to include as much as information as possible. On one hand he can restrict himself to the frameworks mentioned in the lesson and on the other hand, he can also update the participants about the parallel developments that are taking place in climate change negotiations, development goals of United Nations etc.

The adoption of SDGs – 'Transforming Our World: The 2030 Agenda for Sustainable Development' is a global transformative plan of action that has poverty eradication as an overarching aim. It has, at its core, the integration of the economic, social and environmental dimensions of sustainable development.

The Paris Agreement on global climate change points to the importance of averting, minimizing, and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage.

DRR and resilience are recurring common theme in the three global agreements. All three agreements share a common aim of making development sustainable. **The most significant shift recognised in the Sendai Framework is a strong emphasis on disaster risk management in contrast to disaster management**. These three agreements recognize the desired outcomes in DRR as a product of complex and interconnected social and economic processes, which overlap across the agendas of the three agreements. Intrinsic to sustainable development is DRR and the building of resilience to disasters. Further, effective disaster risk management contributes to sustainable development.

Strong commitment to ambitious goals and accelerated implementation of these international agreements are global priority. Given the complementarities between the post-2015 agendas, synchronising and mutually reinforcing the actions in the three domains helps in better outcomes. Efforts must be made to ensure that each of them do not build in "policy risks" or, contradictory policies, that generate more - rather than less - risk in development. Promoting

coherence and mutual reinforcement in all three agreements requires political recognition, monitoring, reporting and supporting partnerships at various levels.

Sendai Framework for DRR

The Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 marks a definitive shift globally towards comprehensive disaster risk management aimed at disaster risk reduction and increasing disaster resilience going far beyond disaster management. This approach calls for setting the overall goal as that of preventing new and reducing existing disaster risk through the implementation of integrated measures. The goal now is on DRR as the expected outcome, setting goals on preventing the creation of new risks, reducing the existing ones, and strengthening overall disaster resilience. In addition, the scope of DRR has been broadened significantly to focus on both natural and human induced hazards including various related environmental, technological and biological hazards and risks. The Sendai Framework acknowledges the interlinkages between climate change and disaster risks. Disasters that tend to be exacerbated by climate change are increasing in frequency and intensity.

Outcome: The substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

Goal: To attain the expected outcome, Sendai Framework seeks to prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.

Priorities: The four priories for action under the Sendai Framework are:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.

Targets: The seven global targets set by the Sendai Framework are:

1. Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rates in the decade 2020–2030 compared to the period 2005– 2015;

2. Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015;
3. Reduce direct disaster economic loss in relation to global gross domestic product by 2030;
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030;
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030;
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

Sustainable Development Goals

The Sustainable Development Goals (SDGs), adopted by the UN General Assembly on 25 September 2015, consisting of 17 Global Goals and 169 targets, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.

Sustainable development and disaster risk reduction are closely interlinked. A single major disaster or "shock" incident (i.e. a rapid onset disaster like an earthquake, storm, tsunami or landslide) can undo hard-won development progress and set back development by years. A "stress" incident (i.e. a slow onset disaster like drought, sea level rise, and salinity intrusion into groundwater stocks) can also cause long-term socio-economic harm. Climate change aggravates impacts from both natural hazards and human-induced vulnerabilities by acting as a threat multiplier. Driven by climate change, there is increase in the frequency and severity of extreme weather events (including storms, droughts, heat waves and cold "snaps"). Such events multiply the risks that people living in areas prone to natural hazards already face.

The possibilities of attaining SDGs are jeopardized because disasters undermine economic growth and social progress. No country or sector is immune to the impacts of natural hazards, many of which – the hydro-meteorological – are increasing in frequency and intensity due to the impacts of climate change. While necessary and crucial, preparing for disasters is not enough, to realise the transformative potential of the agenda for SDGs, all stakeholders

recognize that DRR needs to be its integral core. Progress in implementing the Sendai Framework contributes to the progress of attaining SDGs. In turn, the progress on the SDGs helps to substantially build resilience to disasters. There are several targets across the 17 SDGs that are related to DRR. Conversely, all seven global DRR targets of the Sendai Framework are critical for the achievement of the SDGs.

Figure 2: Sustainable Development Goals

Resilience is acknowledged both explicitly and implicitly in the SDG targets. The vision set out in the SDGs – for people, planet, prosperity and peace – will inevitably fail if shocks and stresses are not addressed. The pledge that 'no one will be left behind' requires a specific focus on the poorest and most vulnerable people, which is a key challenge: up to 325 million extremely poor people are likely to be living in the 49 most hazard prone countries by 2030. A focus on strengthening resilience can protect development gains and ensure people have the resources and capacities to beer reduce, prevent, anticipate, absorb and adapt to a range of shocks, stresses, risks and uncertainties.

COP21 Paris Agreement on Climate Change Action

The Paris Agreement was adopted on 12 December 2015 at the Twenty-first session of the Conference of the Pares (COP21) to the United Nations Framework Convention on Climate Change (UNFCC) held in Paris from 30 November to 13 December 2015. The agreement builds upon the UNFCCC and brings together all nations into a common cause to undertake

ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so.

The agreement aims at "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above preindustrial levels, recognizing that this would significantly reduce the risks and impacts of climate change". Article-7 dwells on establishing "the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change".

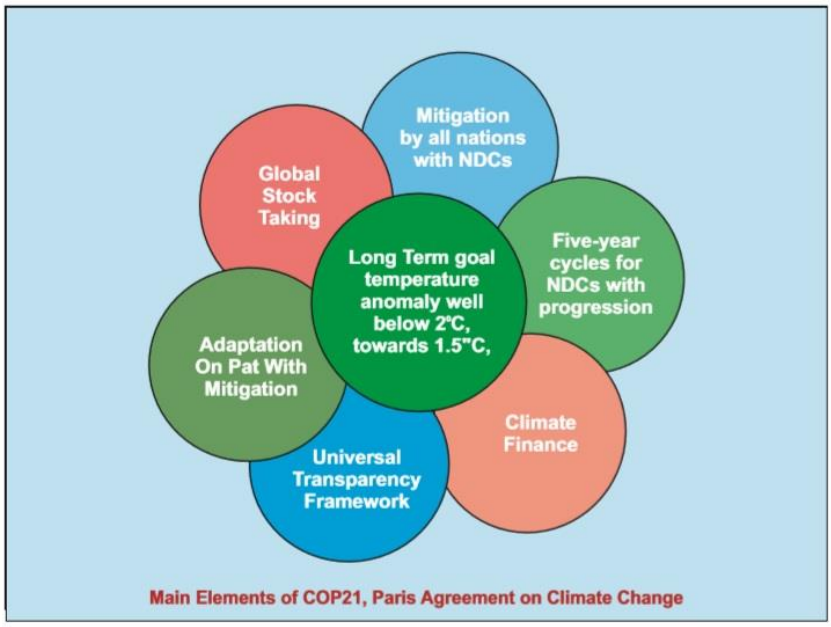


Figure 3: Main elements of CoP21

Coherence and Mutual Reinforcement

The presence of risk multipliers is a threat to the success of all development frameworks and coping with risks is a central to sustainable development. Given the changes in human demographics and trends in development, impact of climate change, and increasing exposure to disaster risks, there has never been a greater need to enhance coherence and coordination among all the major global initiatives to reduce risks, vulnerability to hazards and enhance resilience.

Effective reduction of losses and risks from natural hazards and climate extremes requires integrated actions at different levels of governance. One of the greatest challenges is of creating institutional convergence that integrates global goals emanating from these agreements. DRR and Climate Change Adaptation are part of key agendas being considered in all these recent

global agreements. All three agreements share a common aim of making development sustainable. Strong commitment to ambitious goals and accelerated implementation of these international agreements must be a global priority. Given the complementaries between the post-2015 agendas, leveraging the total impact of these instruments creates shared value.

Efforts must be deployed to ensure that each of them do not build in "policy risks" or, contradictory policies, that generate more - rather than less - risk in development. Taken together, the different priorities, targets and actions in the three frameworks constitute a more comprehensive resilience agenda than when implemented independently without mutual reinforcement because building resilience requires action that spans the multiple domains of development, humanitarian initiatives, responding to climate change and disaster risk reduction.

Objectives of the lesson

The primary objectives of this lesson would be to:

- Inform the participants about the post 2015 global frameworks for DRR.

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer must also ensure that he helps the participants to correlate the concepts that have been already taught with the national and international definitions / terminologies etc. For example, after explaining the priorities of Sendai Framework, the participants should be informed that the steps of bow-tie analysis adhere to the priorities.

Duration: 45 minutes

Training aids: Power-point presentation & Flip Chart

LEARNING UNIT 1.4: UNDERSTANDING CHEMICAL & INDUSTRIAL DISASTERS

Flow of Session

The growth of chemical industries has led to an increase in the risk of occurrence of incidents associated with hazardous chemicals (HAZCHEM). A chemical industry that incorporates the best principles of safety, can largely prevent such incidents. Common causes for chemical accidents are deficiencies in safety management systems and human errors, or they may occur as a consequence of natural calamities or sabotage activities. Chemical accidents result in fire, explosion and/or toxic release. The nature of chemical agents and their concentration during exposure ultimately decides the toxicity and damaging effects on living organisms in the form of symptoms and signs like irreversible pain, suffering, and death. Meteorological conditions such as wind speed, wind direction, height of inversion layer, stability class, etc., also play an important role by affecting the dispersion pattern of toxic gas clouds.

The Bhopal Gas tragedy of 1984—the worst chemical disaster in history, where over 2000 people died due to the accidental release of the toxic gas Methyl Isocyanate, is still fresh in our memories. Such accidents are significant in terms of injuries, pain, suffering, loss of lives, damage to property and environment. A small accident occurring at the local level may be a prior warning signal for an impending disaster. Chemical disasters, though low in frequency, have the potential to cause significant immediate or long-term damage.

A critical analysis of the lessons learnt from major chemical accidents exhibited various deficiencies. Laxity towards safety measures, nonconformities to techno-legal regimes and a low level of public consultation are a few such shortcomings. The scenario called for concerted and sustained efforts for effective risk reduction strategies and capacity development under a national authority to decrease the occurrence of such incidents and lessen their impact. Although tremendous efforts have been made to minimise such accidents and to improve emergency preparedness at all levels, substantial efforts are still required to predict the occurrence of disasters, assess the damage potential, issue warnings, and to take other precautionary measures to mitigate their effects. Another pressing need is to properly assess the potential of chemical emergencies and develop tools for emergency planning and response to minimise the damage in case of any eventuality.

Risks Posed by HAZCHEM

Increased industrial activities and the risks associated with HAZCHEM and enhanced vulnerability lead to industrial and chemical accidents. Chemical accidents may originate in the manufacturing or formulation facility, or during the process operations at any stage of the product cycle, material handling, transportation and storage of HAZCHEM. Vulnerability is sometimes compounded due to the location of Major Accident Hazard (MAH) industries closer to densely populated areas. Chemical and industrial accidents generally occur due to technical failures that can be anticipated. The risk associated with them can thus be predicted and reduced effectively by identification of risk areas, risk assessment and designing pre-operative measures. The occurrence of chemical accidents and probability thereof, manifesting in a disaster, remain a cause of concern.

Handling large quantities of HAZCHEM in installations, isolated storages, and during transportation, poses the grave risk of a sudden release of copious quantities of toxicants in the environment. There are about 1666 MAH units in India, handling a large number of chemicals as raw materials, in processes, products, and wastes, with flammable, explosive, corrosive, toxic and noxious properties. Any accident involving these may have an adverse impact on both the community and the environment.

Large quantities of chemicals are also stored/ processed in industries that are located in densely populated areas. Inappropriate and haphazard construction and the lack of awareness and preparedness on the part of the community further enhance their vulnerability. The potential of heavy losses and adverse consequences on the environment due to a chemical accident calls for further improvement of safety measures in all processes/procedures and the adoption of appropriate methods for handling HAZCHEMs.

The Bhopal Gas Disaster in December 1984 brought into sharp focus the unprecedented potential of HAZCHEM like Methyl Isocyanate in terms of loss of life, health, injury and the long-term effects on the population and environment. It created compelling evidence to approach DM and chemical safety holistically. The era of restructuring with the induction of new HAZCHEM control systems and procedures all over the world in the wake of the Bhopal disaster also resulted in the strengthening of institutional mechanisms at local, district, state and central levels for the management of chemical disasters in India. The consolidation of these institutional mechanisms and the mobilisation of corporate support for the preparation and implementation of emergency plans is an integral part of these Guidelines.

Sources of Chemical Disasters

Chemical accidents may originate in:

1. Manufacturing and formulation installations including during commissioning and process operations; maintenance and disposal.
2. Material handling and storage in manufacturing facilities, and isolated storages; warehouses and go downs including tank farms in ports and docks and fuel depots.
3. Transportation (road, rail, air, water, and pipelines).

Causative Factors Leading to Chemical Disasters

Chemical disasters, in general, may result from:

1. Fire.
2. Explosion.
3. Toxic release.
4. Poisoning.
5. Combinations of the above.

Chemical disasters may occur due to process deviations concerning the chemistry of the process, pressure, temperature and other identified parameters with regard to the state of the substance i.e., solid, liquid or gas, proximity to other toxic substances and the probability of a runaway reaction due to the incidental mixing of two or more HAZCHEMs with dissimilar properties. In addition, it may be due to hardware failure, resulting in large-scale spills of toxic substances (in any form) due to loss of containment, or an explosion. Further, Boiling Liquid Expanding Vapour Explosion (BLEVE) may occur due to sparks, shocks or frictional forces on the chemicals during transportation.

The effects can be further compounded by the micro-meteorology of the area, wind speed and direction, rate of precipitation, toxicity/quantity of chemical released, population in the reach of release, probability of formation of lethal mixtures (fuel-air or other mixtures) and other industrial activities being performed in closer vicinity.

It is very important to understand that the state of the chemical substance (solid, liquid or gas) contributes substantially to the gravity of the accident and affects control measures. Chemicals in solid form may have devastating effects if their properties are suddenly changed (e.g., sublimation) due to pressure and temperature conditions to which they are accidentally exposed. If solids continue to remain in solid form, the damage will be negligible.

Any human/mechanical failure may cause largescale spills of liquids or of compressed gases like chlorine or Liquid Petroleum Gas (LPG) which can cause BLEVE and can directly affect human lives and the environment. The release of compressed gases give rise to thermal and cryogenic stresses, which may also impact the surrounding structure or building, compounding the damage.

Initiators of Chemical Accidents

A number of factors including human errors could spark off chemical accidents with the potential to become chemical disasters. These are:

Process and Safety System Failures

1. Technical errors: design defects, fatigue, metal failure, corrosion etc.
2. Human errors: neglecting safety instructions, deviating from specified procedures etc.
3. Lack of information: absence of emergency warning procedures, nondisclosure of line of treatment.
4. Organisational errors: poor emergency planning and coordination, poor communication with public, noncompliance with mock drills/exercises etc., which are required for ensuring a state of quick response and preparedness.

Terrorist Attacks/Sabotage

Vulnerability to chemical disasters is further compounded by likely terrorist and warfare activities, which include sabotage and attack on HAZCHEM installations and transportation vehicles.

Impact of Chemical Disasters

In addition to loss of life, the major consequences of chemical disasters include impact on livestock, flora/fauna, the environment (air, soil, water) and losses to industry as shown in Figure 4. Chemical accidents may be categorised as a major accident or a disaster depending upon the number of casualties, injuries, damage to the property or environment. A major accident is defined in the Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989, issued under the Environment (Protection) Act, 1986, whereas ‘disaster’ is defined in the DM Act, 2005.

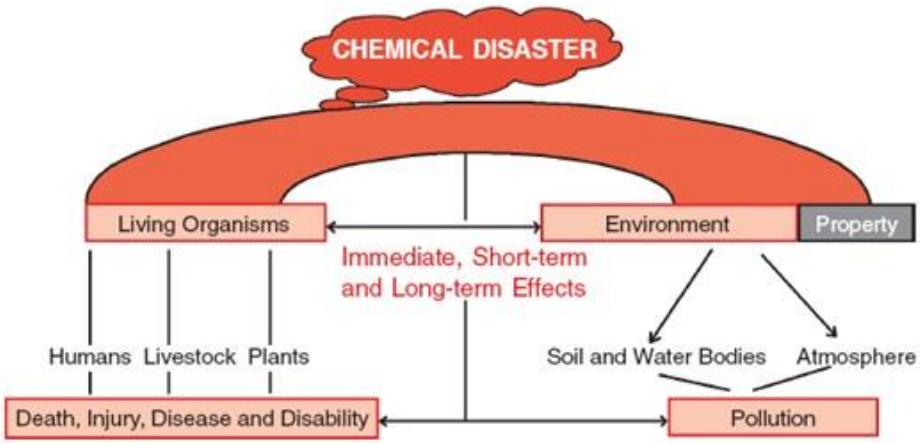


Figure 4: Impact of a Chemical Disaster

Objectives of the lesson

The primary objectives of this lesson would be to inform participants about:

- Risks posed by HAZCHEM.
- Sources of Chemical Disasters.
- Causative Factors Leading to Chemical Disasters
- Initiators of Chemical Accidents
- Impact of Chemical Disasters

Duration: 45 minutes

Methodology

The trainer may 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.

Training aids: Power-point presentation & Flip Chart

Flow of Session

Natural hazard triggered technological accidents involving the release of hazardous materials are known as NATECH. Natural hazards, such as earthquakes, floods, storms, or extreme temperatures etc., can cause the release of dangerous substances from hazardous installations resulting in fires, explosions or toxic or radioactive releases. These are called NATECH Event. They are frequent in the wake of natural disasters and have often had severe and long-term consequences on the population, the environment and the economy.

The Indian subcontinent is highly prone to natural disasters, which can also trigger chemical disasters. Damage to phosphoric acid sludge containment during the Orissa super cyclone in 1999 and the release of acrylonitrile at Kandla Port, during an earthquake in 2001, are some of the examples.

Any kind and size of natural hazard can trigger a NATECH accident. It does not necessarily require a major natural hazard event, like a strong earthquake or a major cyclone, to cause a NATECH accident. With increasing industrialisation and urbanisation coupled with climate change, NATECH risk is expected to increase in the future.

Key Considerations and activities for reducing NATECH risk include:

- Understanding how NATECH risk differs from conventional technological risk and engaging in dedicated training exercises for NATECH emergency management;
- Promoting an integrated risk-governance approach to address the safety of individual hazardous installations but also their interaction with other installations, lifelines, and nearby communities in case of a natural hazard induced event;
- Reassessing assumptions with regard to protecting hazardous installations from natural hazards, including recognition of design limits, in particular in the context of climate change;
- Understanding the potential for NATECH accidents to develop into large-scale disasters, and awareness that NATECH preparedness levels are low, even in generally well-prepared countries;
- Promoting the learning of lessons from past NATECH accidents and their implementation to prevent future accidents, enhance preparedness levels, and build back better;

- Developing assessment tools and guidance for industry and government authorities to support better NATECH risk management at national and local levels; and
- Encouraging cooperation among all stakeholders, and most importantly those at local level, in the design and implementation of preparedness planning for NATECH disasters.

Case Study: Flood induced Oil Spillage in the coastal areas of Gulf of Khambhat, Gujarat

Heavy rainfall (in August 2013) in the catchment area of Narmada River in MP and Gujarat and release of water from Sardar Sarovar Dam, resulted into heavy floods and erosion of Narmada river bank near village Bhadbhut (of Bharuch district) which exposed and damaged many oil and gas pipelines passing through the river.

On the night of 25-26 August, 2013 there were incident to multiple pipelines ruptures belonging to GAIL, ONGC and RIL. Oil spillage from ONGC pipeline was also reported in the coastal areas of Gulf of Khambhat.

Emergency Response

- District Administration immediately ordered to shut down all the pipelines passing through the area.
- All the pipeline operators asked to submit the Safety Undertaking before resuming operation by the Distinct Administration on August 26, 2013.
- Considering the issue of oil spillage from ONGC pipeline, Coast Guard was engaged to conduct surveillance in the affected areas.

Mitigation Measures

- GSDMA prepared/updated the oil and gas pipeline network of the state (it's a web-based system provides the detail of various pipeline passing through the state along with the details of critical amenities/resources)
- Round-table meeting to discuss the issues on pipeline safety among government officials and pipeline operators were organized at Gujarat Institute of Disaster Management (GIDM) in which senior officials from all the concerned organizations were presented.
- Construction of protection wall near Bhadbhut river bank have been started by Irrigation Department in cooperation with all concerned pipelines operators.

Third-party Inspection Report

GSPL had engaged M/s CEIL to carry out third part inspection after the incident. Some of the recommendations were given by the firm in the report are as under;

- Effective measures for prevention of river bank erosion should be taken.
- Advance warning of release of water from dams should be given to pipeline operators to take necessary precautionary measures.
- Relaying of damaged pipeline should be done adequately.

Objectives of the lesson

The primary objectives of this lesson would be to inform participants about reducing the risk of NATECH event.

Duration: 30 minutes

Methodology

The trainer may provide account of natural hazards that can trigger chemical industrial disasters, 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.

Training aids: Power-point presentation & Flip Chart

TECHNICAL SESSION 2
UNDERSTANDING CHEMICAL INDUSTRIAL RISK PROFILE OF GUJARAT STATE

Need of Session

As one of the most developed and industrialized states in India, Gujarat is home to a high number of hazardous chemical industries. The chemical industry in the state has grown by leaps and bounds, which has necessitated the need for improved safety standards. Particularly, the chemical industry occupies a preeminent position in the industrial sector of Gujarat, contributing to more than 40% of the industrial output. Almost the entire range of the chemical process industry exists in Gujarat, including hydrocarbon processing/refining products, petrochemicals-polymers and man-made fibres, fertilizers, health care products, plant protection chemicals, dyes, pigments and intermediates, fine chemicals, surface coating products, salt and salt-based products, ceramics, glass, cement, vegetable oils, fats, and detergents.

More than 50% of new investments in the state are in chemical and petrochemical sectors. Thus the diverse scope of chemical process industries and their lion's share in the state economy make it pertinent to have detailed understanding of Chemical & Industrial Risk Profile of the State.

Units of the Session

1. Learning Unit 2.1: An Anecdote of Industrial Profile of Gujarat
2. Learning Unit 2.2: Chemical & Industrial Hazard Analysis of Gujarat
3. Learning Unit 2.3: Chemical & Industrial Vulnerability Analysis of Gujarat

Objectives of the Session

The primary objectives of this session are following:

- To provide a brief description of Industrial Profile of Gujarat to the participants.
- To make participants identify potential chemical & industrial hazards of Gujarat.
- To provide a brief description about chemical & industrial vulnerability assessment of Gujarat.
- Improve understanding of risk management of chemical & industrial hazards as they relate to DRR.

Duration

165 minutes. (30 + 45 + 45) minutes for the sessions and 15-minute spill over time from each session.

Methodology

The trainer may start with a video clip on a chemical disaster e.g. Bhopal disaster and ask the participants to identify and apply the concepts of hazard and vulnerability they came across in technical session 1.

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 2.1: AN ANECDOTE OF INDUSTRIAL PROFILE OF GUJARAT

Flow of Session

Gujarat, one of the most industrialized states in the country, is known for its large concentration of chemical industries, particularly, in a stretch of 400 kilometres from Ahmedabad to Vapi, known as the **'Golden Corridor'**. In Bharuch district, Ankleshwar situated on the Narmada estuary, is Asia's largest chemical zone (Industrial Comissionerate 2011).

The post-independence era witnessed rapid development of textile industry in the State. To support the textile industry, a large integrated chemical complex came up at Atul in Valsad district. The findings of oil and gas in Ankleshwar and the surrounding areas led to the Gujarat Refinery. The downstream units in the form of Petrochemical Complex at present known as RIL and Fertilizer Complex at present GSFC at Vadodara were a logical step in producing value added indigenous products so vital for saving precious foreign exchange. The refinery and the petrochemical complex triggered the development of small and medium scale chemical industries for the production of chemicals first in Nandesari, followed by Vapi, Vatva, Ankleshwar and other places.

Gujarat has a very wide manufacturing base including world-scale petroleum refinery and petrochemical complexes. Chemical industry occupies a pre-eminent pride position in the industrial sector of Gujarat, contributing to more than 40% of industrial output. Gujarat contributes more than 20% of the country's chemical production. More than 50% of the new investments in the state are in chemical and petrochemical sectors. Almost the entire range of chemical process industry exists in Gujarat, including hydrocarbon processing/refining products, petrochemicals-polymers and man-made fibres, fertilizers, health care products, plant protection chemicals, dyes, pigments and intermediates, fine chemicals, surface coating products, salt and salt-based products, ceramics, glass, cement, vegetable oils, fats and detergents.

The major hydrocarbon manufacturing plants are located in Vadodara, Bharuch, Surat and Jamnagar districts. These include Gujarat Refinery**, Indian Petrochemicals Ltd. (at present RIL)** and **Gujarat State Fertilizer Co.** along with several downstream units in the Jawaharnagar (Koyali) Petrochemical complex area; Fertilizer plants at Vadodara, Hazira, Bharuch, Kalol and Kandla; Petrochemical complexes at Vadodara, Dahej, Hazira and Jamnagar. The caustic/chlorine manufacturing plants are located at Mithapur, Veraval,

Surendranagar, Vadodara, Dahej, Jhagadia and Atul. Toxic chemicals like cyanides are produced in GACL Baroda, Cyanides & Chemicals at Olpad, Dist. Surat.

A large number of medium and small-scale chemical industries are located in the industrial estates of Vapi, Ankleshwar, Panoli, Nandesari, Vatva and Naroda, which produce numerous organic chemicals for consumption in the country and for exports.

Gujarat has 1600 kilometres of coastline, which is being developed for ports. Considering the infrastructure proposed in the coastal areas, it is expected that port-based mega-chemical industrial estates would be developed.

In addition to the manufacturing industries, there are several infrastructures related projects including pipelines, storages and installations for Hydro Carbons and chemicals. India's first major in-land cross-country gas pipeline named the Hazira-Bijapur-Jagdishpur (HBJ) pipeline originates from Hazira. It traverses the states of Madhya Pradesh, Rajasthan and Uttar Pradesh. The main trunk of the HBJ pipelines consists of carbon steel pipeline ranging from 450 to 900 mm in diameter. Although, originally, 1,700 Km of pipeline was laid, subsequent extensions and spur lines were added increasing the length to over 2,300 km. There is a hydrocarbon supply pipeline from Kandla to Bhatinda, which crosses Rajasthan and other states. **Gujarat State Petroleum Corporation** and **Gujarat Gas Ltd.** have proposed a pipeline network of more than 1200 kilometres in the State.

Gas Authority of India has laid Jamnagar-Loni pipeline for carrying LPG. Major LNG terminals are proposed at Pipvav, Dahej and Hazira, which would necessitate laying of long cross-country pipelines for carrying natural gas. More than 50% of country's imported crude oil is being handled by the ports of Gujarat. The crude oil carrying pipelines include Salaya-Mathura, Viramgam Vadodara, and those proposed from Mundra to Punjab. The petroleum products carrying pipelines include Vadodara-Sabarmati, Kandla-Bhatinda and Jamnagar Kandla (off-shore).

There are several port-based installations for petroleum products, petrochemicals products, solvents and other hazardous chemicals at Kandla, Mundra, Vadinar, Porbandar, Dahej, Pipvav, and Hazira. Some of these locations are in earthquake/ and cyclone prone zones. There

are isolated storages in different regions, including petroleum storages and LPG bottling plants at Vadodara, Kheda, Sanand, Bavla, Rajkot and Bhavnagar.

Actions taken by Government of Gujarat *(Source: DISH Website, Accessed 13 December 2022)*

- Identified all chemical factories in FOUR categories first time in India, i.e. MAH, A, B, and C, type.
- Identified all the MAH Factories in the state.
- Formation of specialized team for inspection of MAH units and inspections are carried out by them regularly.
- MAH units of the Gujarat state are also inspected by chemical inspector of factories, Gujarat state.
- Constituted DCPC (District Contingency Planning Committee), under the chairmanship of District Collector and Factory Inspector as member secretary.
- Prepared off-site emergency plans in all districts.
- Off-site emergency mock exercises have been conducted in most of the district.
- Constituted district crisis group each district under a chairmanship of District Collector and Factory Inspector as a member secretary.
- Constituted local crisis group in each industrial pocket under a chairmanship of Sub-Divisional Magistrate/District Emergency Authority and Factory Inspector as a member secretary.
- Received updated on-site emergency plan from all MAH units in the state.
- The MAH units are carrying out on-site emergency plan mock exercises.

Objectives of the lesson

The primary objectives of this lesson would be to provide participants a brief perspective of industrial profile of Gujarat.

Duration 30 minutes

Methodology

This is an informative session.

Training aids Power-point presentation & Flip Chart

Flow of Session

The principal causative hazards for chemical & industrial disaster are fire, explosion and toxic release. These hazards have negative impacts on life system as well as non-living structures. Additional hazards include chemical spillage or spill over. Chemical corrosion too can cause damage to property and sometimes life. Chemical emergency or disaster can involve one or more of these hazards.

Fire

Fire occurs in industry more frequently than explosions and toxic releases. However, the consequences in terms of loss of life are generally less. The effects of fire on people usually take the form of skin burns due to exposure to thermal radiation. The severity of burns depends on the duration of exposure and the intensity of the heat. Heat radiation is inversely proportional to the square of the distance from the source. This means that at twice the distance from the source, the intensity will be reduced to a quarter. Fires also give off fumes, which may include toxic gases.

For example, combustion of polyurethane foam gives off cyanides. Fire can cause severe damage to physical structures either by combustion or by the effects of heat. It may also have an effect on essential services with damage to power and instrumentation, possibly causing an escalation of the incident. Fire can take several different forms including:

- **Jet fires:** a long, narrow flame produced, for example, from an ignited gas pipeline leak.
- **Pool fires:** produced, for example, by the ignition of crude oil released from a storage tank in to a bund wall.
- **Flash fires:** rapid, virtually instantaneous, ignition which could occur if an escape of gas reaches sources of ignition rapidly burnt back to the source of the release.
- **BLEVEs:** Boiling Liquid Expanding Vapour Explosions, sometimes called a ‘fireball’ – a combination of fire and explosion with an intense emission of radiant heat following failure of a pressure vessel due to overheating of the tank wall surrounding the vapour space.

Explosion

Explosions are characterized by a shock wave which can be heard as a bang. The shock-wave can cause damage to buildings and people can be blown over. Although the effects of over-

pressure can be fatal, the indirect effects of collapsing buildings, flying glass and debris cause far more loss of life and severe injuries. Explosions can be of a number of types:

- **Gas explosions** occur when considerable quantities of flammable gases are released and mix with air to form an explosive vapour cloud before ignition takes place.
- **Vapour cloud explosions** can be either confined such as those which occur within some form of containment (e.g. vessels, pipe work), or in less obvious situations (e.g. between buildings), or unconfined occurring within the open air.
- **Dust explosions** occur when solids in the form of very fine powder are intensively mixed with air and subsequently gets source of ignition.

It is sometimes difficult to make a distinction between a fire and an explosion. Often an explosion is followed by a fire, with damage and casualties being caused by both. Probably the greatest danger arises from the sudden massive release of flammable material producing a large cloud of flammable and possibly explosive vapour. If this cloud were ignited, the effects would depend on a number of factors including wind speed and the degree of dilution of the cloud with air. It could lead to large number of casualties and wholesale damage both on site and beyond. However, even in major incidents, the effects are generally limited to a few hundred metres from the site.

Toxic release

Sudden releases of toxic vapours have the potential to cause death and severe injuries at a much greater distance. In theory, such a release could produce lethal concentrations at several kilometres from the point of release. In practice, the actual number of casualties depends on the meteorological conditions, density of population in the path of the cloud, and the effectiveness of the emergency arrangements.

Toxic materials can also be carried considerable distances by water. Their release into the public sewerage system, or into rivers, canals and other water courses, either directly or through contaminated water used in firefighting can result in serious threats to public health.

Spillage

Spillage can cause a serious hazard. Gujarat has a large number of factories having storage capacity of more than 200 tonnes of hazardous chemicals.

Human Impact

Although they are individual accidents, different in the way in which they happened and the chemicals that were involved, they have one common feature:

- They are uncontrolled, involving fires, explosions or the release of toxic substances.
- They either result in the death and injury of large numbers of people inside and outside the factory or cause extensive damage to the property and the environment.
- Leakage of a flammable or toxic substance may result into mixing of the substance with air, formation of a flammable vapour cloud and drifting of the cloud to a source of ignition leading to fire or explosion.
- These clouds would directly affect the site as well as possibly the surrounding populated areas. In the case of flammable substances, the greatest danger arises from sudden massive escape of volatile liquids or gases. If the cloud were ignited, the effects of combustion would depend on many factors, such as wind speed and the extent to which the cloud was diluted. The area affected would generally be limited to a few hundred meters from the site.
- Much larger areas can be dangerously affected in a sudden release or / by very large quantities of toxic materials. In favourable conditions such a cloud can still contain lethal concentrations of toxic chemicals several kilometres from the accident site. The extent of casualty depends on the number of people in the path of the cloud and on the efficiency of emergency arrangements, for example, evacuation before the cloud reaches the populated areas.
- The effect can also migrate into other factories situated nearby and containing flammable, reactive or toxic chemicals, escalating the disaster. This is sometimes referred to as the `domino effect'.
- Not only, the cloud itself poses a health hazard, but the fire cause depletion of oxygen and fumes generated by the fire may contain toxic gases.

Environmental Consequences

The possible immediate environmental consequences of a chemical emergency include:

- The release into the atmosphere of toxic or corrosive gases, aerosols or particulate materials which could ultimately harm the aerial, terrestrial or aquatic environments.
- The release of liquids or solids which could adversely affect land or water courses and the flora and fauna therein.
- Fire or explosions causing damage to buildings or natural environment.
- The effects of environmental impact can be direct or indirect, immediate or delayed, temporary or persistent. The persistent effects are of particular importance, such as damage caused to habitats by fire.

Hazard wise Classification of Districts

The Government of Gujarat has categorized its districts on the basis of chemical and industrial hazards as per Table 2. This table may also help GSDMA prioritize the locations of RRTs. We understand that ERC are for multi-hazard responses and not only chemical, but the above table identifies districts as per only chemical hazard. The Government of Gujarat has categorized its districts on the basis of chemical and industrial hazards. The districts have been classified as follows: *(Source: State Crisis Plan July 2016, DISH)*

Sr.	Category	Districts
1	Highly Hazardous	Ahmedabad, Vadodara, Bharuch, Surat, Valsad, Kutch
2	Hazardous	Jamnagar, Rajkot, Panchmahal
3	Less Hazardous	Anand, Bhavnagar, Gandhinagar, Kheda, Mehsana, Porbandar, Amreli, Dahod, Dangs, Junagadh, Narmada, Navsari, Patan, Sabarkantha, Banaskantha, Surendranagar and Tapi

Table 2: Hazard wise Classification of Districts

Classification of Scale of Disasters

One of the ways of classifying chemical disaster is by the consequences according to the provisions of Manufacture, Storage and Import of Hazardous Chemicals, Rules 1989. Table 3 classifies chemical disasters as minor, moderate, major and catastrophic based on the consequence as per USEPA criteria. These classifications are useful for response capacity assessment and also help in standardizing definition of scale of disasters. *(Source: State Crisis Plan July 2016, DISH)*

Classification of Disasters				
Parameters	**Minor**	**Moderate**	**Major**	**Catastrophic**
Human Injury	Low potential	Up to 100 potential human injury	Up to 300 potential human injury	More than 300 potential human injury
Human fatality	Zero	Up to 10 potential human fatalities	Up to 100 potential human fatalities	More than 100 potential human fatalities
Need for evacuation	Not necessary. Public may be cleared from the immediate area of the spill/ discharge	Requires evacuation (Around 2000 people)	Requires evacuation (Up to 20000 people)	Requires evacuation (More than 20000 people)
Environment Contamination	Localized, non Severe Contamination Does not Require Expensive clean up and Immediate	Localized contamination. Requires a formal and quick clean-up effort	Significant contamination Requires a formal and possibly prolonged clean-up effort	Significant contamination. Requires a formal, prolonged and expensive clean-up effort

	Recovery Efforts			
Role of district and state authorities	Can be managed at local level	Possible assistance Required	Assistance needed from district, state and possibly central authorities	Assistance needed from district, state and central authorities, possible international help

Table 3: Classification of Scale of Disasters

Transportation of Hazardous Materials (by road, rail and waterways)

An accident occurring during the transport of hazardous goods can lead to catastrophic consequences. The hazardous properties of products or chemicals should be clearly stated so that people of all stages of the transport chain are aware of them. This information should always follow the goods so that people can recognize the risks, avoid accidental mishandling and have the right kind of the personal protection at their disposal in case of leakage. There is always a risk of spillage during the transport of hazardous goods. When incompatible substances mix with each other there is a possibility of a chemical reaction, which can produce enough heat to cause fire or explosion and can release dangerous gases. A risk of an accident is present when vehicles carrying dangerous goods are left to stand unattended;

- the vehicle or container runs loose because it is not properly connected or secured;
- the load starts to move during transport;
- spillage is not quickly washed away from the vehicles or containers; spillage is not properly cleaned.

Chemical Emergencies in Aftermath of Disasters due to Natural Hazards

Gujarat has been struck by natural hazards frequently in the recent past. These disasters have impacted industries considerably.

- The Kandla cyclone of 1998 affected oil terminals, jetties, transportation facilities, factories, buildings, warehouses, storage tanks, timber industry and, most important, the salt industry.
- There have been reports of chemical spill in Kandla port in the wake of January 26 earthquake in 2001.
- Oil production also suffered since the Hindustan Petroleum shifted its operations from Vizag to Kandla after the event of fire.
- Oil spill from pipelines near Bhadbhut (Gujarat) in Narmada river due to flooding in 2013.

The impact of these disasters could trigger a serious chemical accident in Gujarat, particularly in the port-based industries in coastal area that are vulnerable to earthquakes, tsunamis and flooding. Therefore, it is important to consider resilience against natural hazards while locating

and designing the new chemical industry. For existing chemical industries, a retrofitting of infrastructure to remain safe in case of earthquakes and flooding should be prioritized by the industry. There are two considerations in case of a combination of natural hazards and chemical disasters.

First, the causation of chemical emergency due to natural hazards depends on two factors: (a) what is released? Where? and how much? and (b) under what environmental/climate conditions? Toxic leaks caused by heavy winds have lesser of an impact because the weather helps in faster dissipation of the toxic cloud. Fire sparked by lightning in flammable liquid storage can be made worse by high levels of oxygen in the heavy winds, but this is possible only if flammable matter is available for ignition by lightening. In case of floods, both above ground and below ground tanks containing chemicals less dense than water tend to float. Even the tanks with denser chemicals can get caught in strong water currents that tear them from moorings. In flooding, chemical leaks in water bodies can cause significant environmental pollution.

Second, a serious concern is the extraordinary resource demands and limitations of responders, equipment, water, and others materials that will be needed to respond to a chemical emergency during a natural hazard event. Large-scale disasters can degrade or destroy the very infrastructure needed to respond to the chemical emergency. Earthquakes or Tsunamis may also initiate chemical events but the challenge will be the competing priorities for resources for these different types of emergencies.

Objectives of the lesson

The primary objectives of this lesson would be to provide participants a brief perspective of chemical & industrial hazard profile of Gujarat.

Duration 45 minutes

Methodology

This is an informative session.

Training aids Power-point presentation & Flip Chart

Flow of Session

Industrial concentration

The District-wise details of Major Accident Hazard (MAH) factories of Gujarat state is maintained by DISH. As of September 2022, there are 570 MAH Factories in Gujarat *(Source: DISH)*. Details of district-wise factories are given in Table 4.

S.N.	DISTRICT	TOTAL
1.	AHMEDABAD	53
2.	AMRELI	4
3.	ANAND	9
4.	ARAVALLI	5
5.	BANASKANTHA	1
6.	BHARUCH	98
7.	BHAVNAGAR	8
8.	BOTAD	0
9.	CHHOTAUDEPUR	0
10.	DAHOD	0
11.	DANG	0
12.	DEVBHUMI DWARKA	6
13.	GANDHINAGAR	31
14.	GIR SOMNATH	1
15.	JAMNAGAR	4
16.	JUNAGADH	1
17.	KHEDA	15
18.	KUTCH	56
19.	MAHISAGAR	0
20.	MEHSANA	13
21.	MORBI	61
22.	NARMADA	0
23.	NAVSARI	3
24.	PANCHMAHAL	7
25.	PATAN	1
26.	PORBANDAR	1
27.	RAJKOT	24
28.	SABARKANTHA	7
29.	SURAT	34
30.	SURENDRANAGAR	1
31.	TAPI	1
32.	VADODARA	82
33.	VALSAD	43
	Total	**570**

Table 4: District-wise details of Major Accident Hazard (MAH) factories of Gujarat (Source: DISH)

The Gujarat Industrial Development Corporation (GIDC) has a total of 224 industrial estates distributed across all the districts of Gujarat. Gujarat *(Source: GIDC Website).*

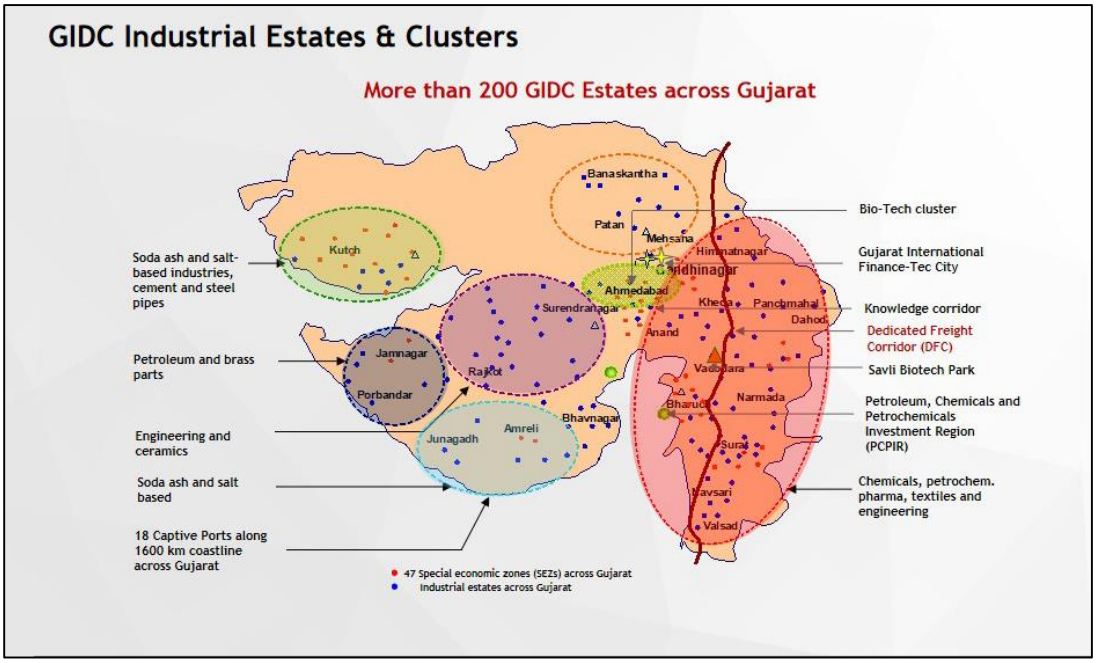


Figure 5: 216 GIDC Industrial Estates across Gujarat (Source: GIDC Website).

Out of these estates, the GIDC has designated 13 estates as chemical zones designated 13 estates as chemical zones as follows:

1. Ankleshwar - Bharuch
2. Dahej - Bharuch
3. Jhagadia - Bharuch
4. Nandesari - Vadodara
5. Naroda - Ahmedabad
6. Odhav - Ahmedabad
7. Panoli - Bharuch
8. Petrochemical Complex - Vadodara
9. Ranoli - Vadodara
10. Sachin - Surat
11. Sarigam - Valsad
12. Vapi - Valsad
13. Vatva – Ahmedabad. *(Source: State Crisis Plan July 2016, DISH).*

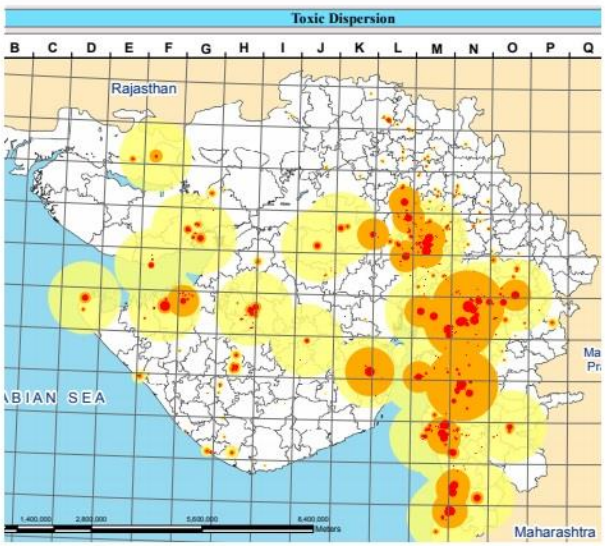
Worst Case Scenario Assessment *(Source: Gujarat Chemical Disaster Management Plan, 2013)*

A separate Vulnerability Assessment report includes **"Directory of Hazard Identification by Industry"** that describes, by district, the chemical industries in alphabetical order, their type (MAH, A or B), address, latitude-longitude, the chemicals in each industry, maximum unit storage quantity of the chemical, whether chemical has offsite consequence and hence modelled in ALOHA or not, and type of hazard possible for the chemical.

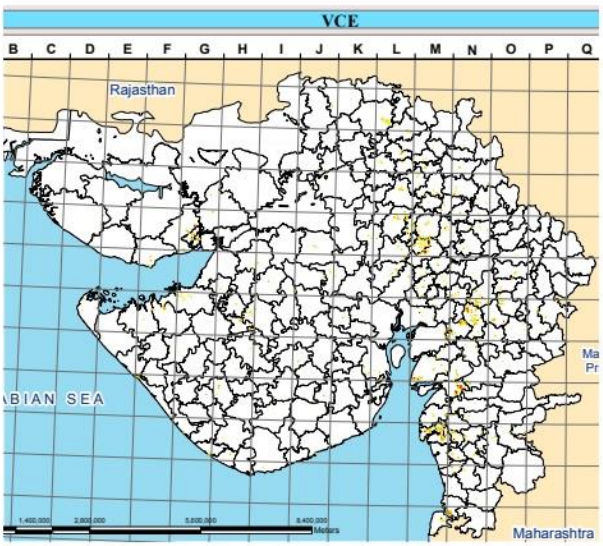
The detailed section of above report provides a detailed assessment for each chemical for each MAH, Type A and Type B industry for which we have data and where a consequence scenario is possible. We have estimated vulnerability of population, forests, water bodies, electrical installations, police stations, fire stations, and medical facilities. Overall, 350 unique chemicals in Gujarat could be identified. Of these, 114 have a consequence scenario that may have offsite consequence resulting in at least 10 deaths and may be assumed to require state level response support. Of these 114, 102 pose hazard of BLEVE, 44 pose hazard of VCE or Fire, and 96 pose toxic hazard.

Vulnerability assessment of pipelines or transportation corridors was not included in the scope of work because for planning purposes vulnerability assessment of only MAH units for worst case scenario will prepare the state for any type of chemical emergency. However, ALOHA and CAMEO suit can be readily used for vulnerability assessment of pipelines or any other source of hazard.

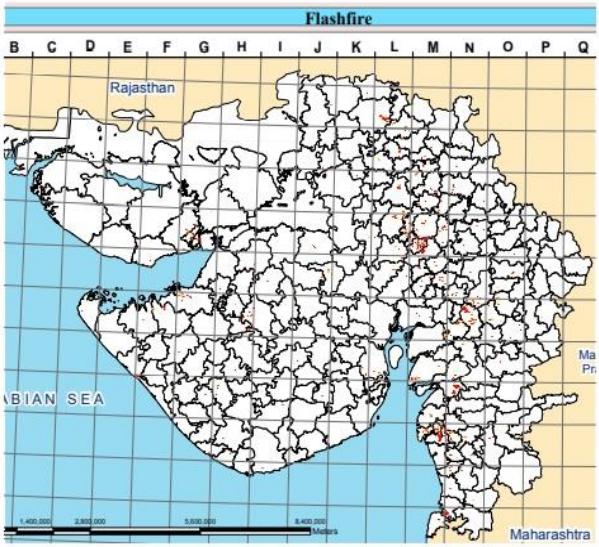
Following figures delineate vulnerable areas for toxic, vapour cloud explosion, flash fire and BLEVE hazards in Gujarat. The scale of the map makes it hard to know the exact areas affected but a separate vulnerability atlas provides more detailed information.



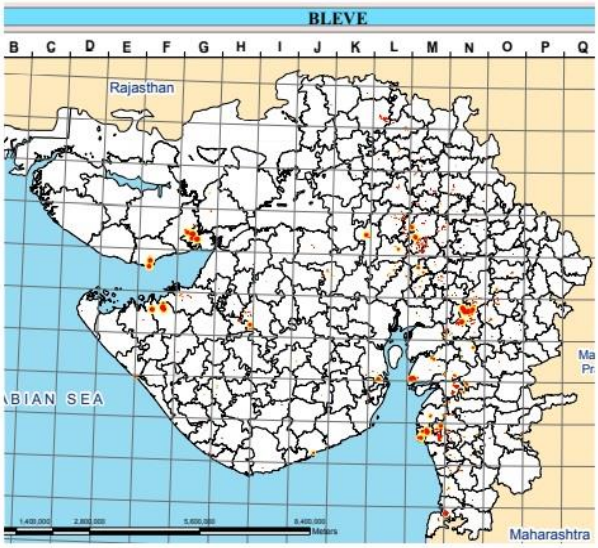
Vulnerable Areas in Gujarat for Toxic Hazards



Vulnerable Areas in Gujarat for Vapour Cloud Explosion Hazard



Vulnerable Areas in Gujarat for Flash Fire Hazards



Vulnerable Areas in Gujarat for BLEVE Hazards

(*Source: GSDMA: Gujarat State Chemical Disaster Management Plan)*

Objectives of the lesson

The primary objectives of this lesson would be to provide participants a brief perspective of chemical & industrial vulnerability profile of Gujarat.

Duration 45 minutes

Methodology

This is an informative session.

Training aids Power-point presentation & Flip Chart

TECHNICAL SESSION 3
STATUTORY, REGULATORY & INSTITUTIONAL CONNOTATIONS ON CHEMICAL & INDUSTRIAL

Need of Session

This session will provide information about statutory, regulatory and institutional frameworks relevant to chemical & industrial risk management at national as well as international levels. A comprehensive regulatory regime also forms the cornerstone for better management of chemical risks. There are statutory and regulatory provisions that subjectively hazardous industries and facilities are obliged to comply in order to demonstrate sound environmental and safety performance and minimize the chances of a major mishap. Some provisions focus on setting up an adequate institutional framework at the administration level to ensure proper decision-making issues related to emergency preparedness, response and mitigation while others try to ensure better risk management by potentially hazardous industries. Specific clauses in risk related legislation also lay stress on making risk information available to the stakeholders and the public so that they are better prepared to face emergencies.

Units of the Session

1. Learning Unit 3.1: Regulatory Framework for Managing Industrial Risk
2. Learning Unit 3.2: Synergies between Legal Frameworks and Institutional Plans
3. Learning Unit 3.3: Institutional Framework for Managing Industrial Risk
4. Learning Unit 3.4: Parallel National/International Initiatives
5. Learning Unit 3.5: Sendai Framework in Congruence with CIDRM: Priority 1 Understanding Disaster Risk

6. Learning Unit 3.6: Sendai Framework in Congruence with CIDRM: Priority 2 Strengthening Disaster Risk Governance to Manage Disaster Risk

Objectives of the Session

The primary objectives of this session are following:

- 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 chemical & industrial risk management in India.
- To appraise the participants on differences and synergies between Legal Frameworks and Institutional Plans.
- Appraise on international regulations and bindings on chemical safety and its implications for chemical risks in India.

Duration

125 minutes. (20 + 20 + 20 + 20 + 20) minutes for the sessions and 5-minute spill over time from each session.

Methodology

This session is an informative session. The trainer may review the pre-Bhopal and post-Bhopal regulations addressing concerns of chemical accident management. The trainer may refer the international conventions, treaties and bindings on chemical safety which are relevant for India and develop understanding on synergies between CDMP and Offsite plans. Finally, efforts should be made to relate with the holistic disaster management framework and concerns of national guidelines on chemical disaster management.

Training aids Power-point presentation, Flip Chart

Flow of Session

The **Factories Act, 1948** and regulations like the **Explosives Act, 1884**; the **Insecticide Act, 1968**; and the **Petroleum Act, 1934** are some of the pioneer regulations on chemical safety. The Factories Act 1948 is a social legislation that has been enacted for occupational safety, health, and welfare of workers at work place. The State of Gujarat has formulated its rules as envisaged under the Act and they are known as the **Gujarat Factories Rules, 1963**. Post 1972 Stockholm Convention, the Government of India formulated several environmental regulations starting with **Water Act of 1974**.

Bhopal disaster of 1984 forced to widen the scope of existing regulatory provisions to include issues like industrial hazards and associated risk. The magnitude of social loss caused by the Bhopal disaster laid an impetus for creating an umbrella Act, the **Environment (Protection) Act of 1986.** A number of subsidiary regulations in form of rules such as **Manufacture, Storage an Import of Hazardous Chemical (MSIHC) Rules of 1989**, the **Public Liability Insurance Act of 1991 (amended 1992)** and the **Chemical Accidents (Emergency Planning, Preparedness and Response) (CAEPPR) Rules 1996** were enacted thereafter. The overall regulatory framework for chemical risk management can be represented as in Figure 6.

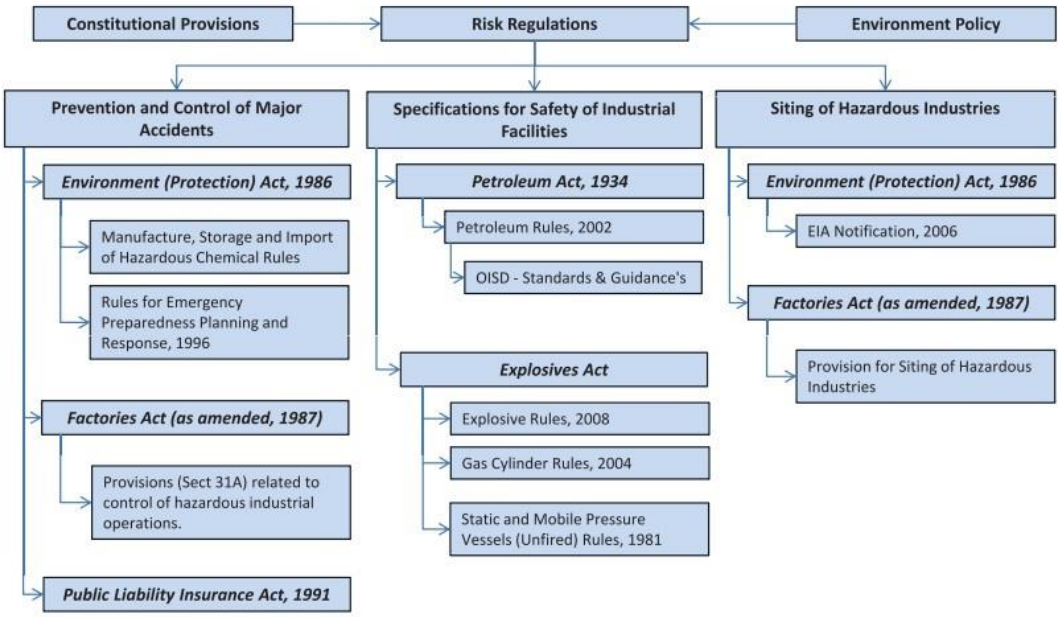


Figure 6: Regulatory Framework for Managing Industrial Risk *(Source: NIDM Training Module on Geo-informatics application in CRM)*

MSIHC Rules 1989 which as subsequently amended in 1994 and 2000, has principle objective of the Rules are the prevention of major accident arising from industrial activities, the limitation of the effects of such accidents both on man and on the environment and the harmonization of various control measures and agencies to prevent and limit major accidents. As per the provisions of the Rules, industries storing or handling more than a certain threshold of hazardous chemicals (as mentioned in Schedules of the Rules) are categorized as ***Major Accident Hazard (MAH)*** *industries.* These industries have to fulfil a number of obligations in order to ensure that they are in control of hazards and risks that may originate from the facility and ensuring the public is informed about suitable safety measures to be adopted in case of an accident. Following are the key requirements:

- Take necessary precautions to prevent major accidents and limit their consequences to humans and the environment;
- Bring major accidents involving the release of major emissions, fire or explosion linked with a hazardous chemical that the potential cause substantial loss of life and property or adverse impact on environment, to the notice of concerned authorities;
- Prepare safety reports on the industrial activity and submit it to competent authorities;
- Prepare an On-Site Emergency Plan;
- Inform the public about the accidents that might occur and the do's and don'ts in case of particular accidents; and
- Provide assistance in the preparation of an Off-Site Emergency Plan in accordance with guidelines provided.

CAEPPR Rules 1996 complement MSIHC Rules on accident prevention and preparedness and envisages a four-tier crisis management system in the country-involving the Central Crisis Group, the State Crisis Group, the District Crisis Group and the Local Crisis Group to manage emergencies arising out of industrial operations.

The Factories (Amendment) Act, 1987 introduced special provisions on hazardous industrial activities. It imposed a number of limitations on the factory management to insure health and safety of workers as inhabitants of surrounding areas.

Petroleum Rules of 2002 in addition to **OISD Standards and Guidelines** provide industry specific criteria with regard to operational procedures, maintenance of safety distances between the storages and safeguards for processes and equipment.

The Indian Regulatory System is comprehensive in nature but it needs to align itself with the prevailing pace of economic development. It needs to be flexible to acknowledge different kinds of environmental pressure and complexities arising due to severe industrialization and urbanization. The system needs to be robust and operate proactively in order to take efficient cognizance of upcoming issues.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand Regulatory Framework for Managing Industrial Risk.

Duration 20 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer can throw some light on chronology of the evolution of statutory provisions mentioned in the lesson to make the session interesting.

Training aids Power-point presentation & Flip Chart

Flow of Session

Difference and Synergies between Chemical Disaster Management Plan (CDMP) and Offsite Plans

MOEF took the leadership in setting up legal and institutional framework for managing chemical emergencies in industries through MSIHC Rules (1989) and CEAPPR Rules (1996) for more than two decades following the Bhopal Tragedy. One of the instruments for chemical management is offsite emergency plan by DCG and SCG. It is highly credible that MOEF has been effective in making such plans based on realities on the ground. However, the DM Act (2005) and GSDM Act (2003) were the paradigm shift in management of disasters in the country, including chemical disasters. DM Act (2005) and GSDM Act (2003) envision "All Hazard" concept to disaster management. These acts also mandated creation of state and district (and local) disaster management authorities. In some ways, this created a parallel structure to manage chemical emergencies, but in other ways these authorities or the crisis groups under MSIHC are not the response agencies themselves. Therefore, the responsibility for response is still with individual departments.

DM Acts also required preparation of DMP that consider the entire cycle of Prevention and Mitigation, Preparedness, Response, Recovery and Rehabilitation. On other hand, offsite plan under MSIHC Rules focus on response to chemical emergencies and preparedness to provide such response. The offsite plan thus included information that must be readily available during response to a chemical emergency, but offsite plans do not provide a "plan" to take a comprehensive approach to disaster management. While, nothing in MSIHC Rules stops the offsite from being developed in to a comprehensive plan for disaster management, the fact is that the newer DM Act use the term DMP to distinguish itself from Offsite Plan. As demonstrated in Figure 7 below, ideally an offsite plan can be an element of a more comprehensive DMP.

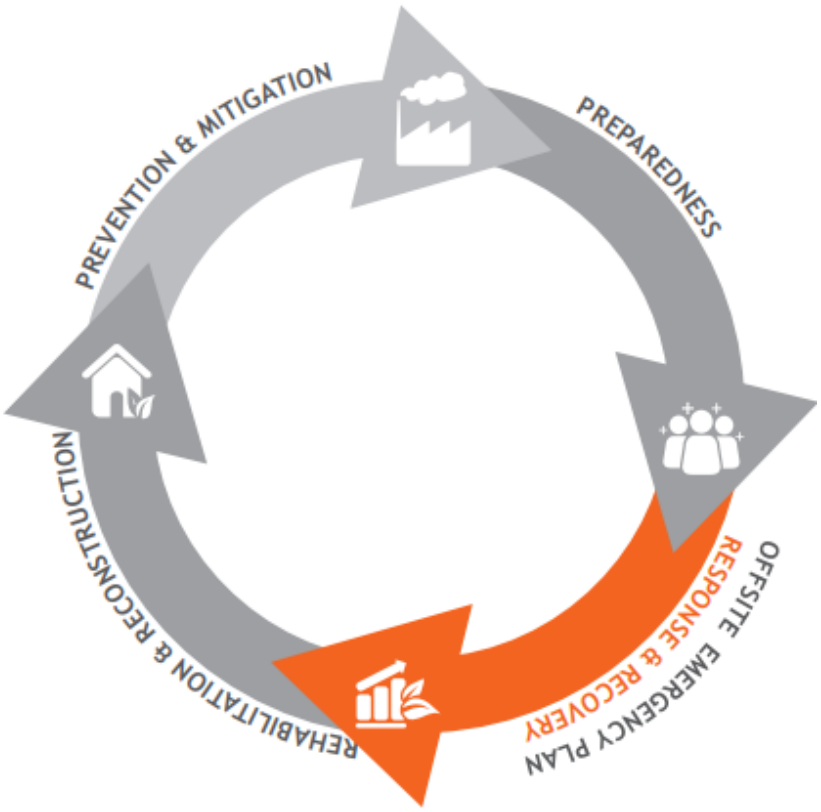


Figure 7: Disaster Management Cycle and Focus of Offsite Plan *(Source: GSDMA Gujarat State Chemical Disaster Management Plan)*

Hierarchy and Relationship of the Plans

MSIHC Rules 1989, CEAPPR Rules 1996, GSDM Act 2003, and DM Act 2005 recognize that disaster management is a participatory and bottom-up process. Therefore, all these Acts and Rules can work together to achieve the desired level of planning and preparedness.

As depicted in Figure 8, the onsite plan of the industry prepared under MSIHC Rules is the most important and basic element. The DCG offsite plan (and thus District CDMP) is based on the information contained in the onsite plans.

The state and national level plans are based on the information in district plans. For example, the onsite plans identify emergency scenarios which have potential for offsite consequences and thus need the assistance of offsite agencies at the local level. The local (LCG) or district level (DCG) plans for assistance to industries and identify scenarios that cannot be managed at local or district levels and must be scaled up to regional or state level. The state level plan provides for assistance to the district and also identifies scenarios which need national assistance. Each plan has procedures to request higher levels of assistance.

The CDMP assigns roles to different offsite response agency and government departments. These offsite agencies and state departments need to develop Preparedness Action Plans to develop their capacity and preparedness commensurate with their own roles and responsibilities.

Coordinating Structures Under CAEPPR Rules and DM Acts

MSIHC Rules and DM Act both provide for a different mechanism to plan for and respond to chemical disasters, but both assign the chief secretary and district collector a pivotal role in planning and response as shown in Figure 9. The chief secretary is the chairman of SCG under CAEPPR Rules as well as a designated member of GSDMA under DM Act and GSDM Act. The CEO of GSDMA can also be a member of state crisis group which ensures coordination of the structures at the state level. The District Collector (DC) is assigned the chairmanship for both the DCG and DDMA under CAEPPR Rules and DM Acts. Therefore, he is the appellate district emergency authority at the district level and the coordination between these two structures is automatically achieved at the district and LCG levels.

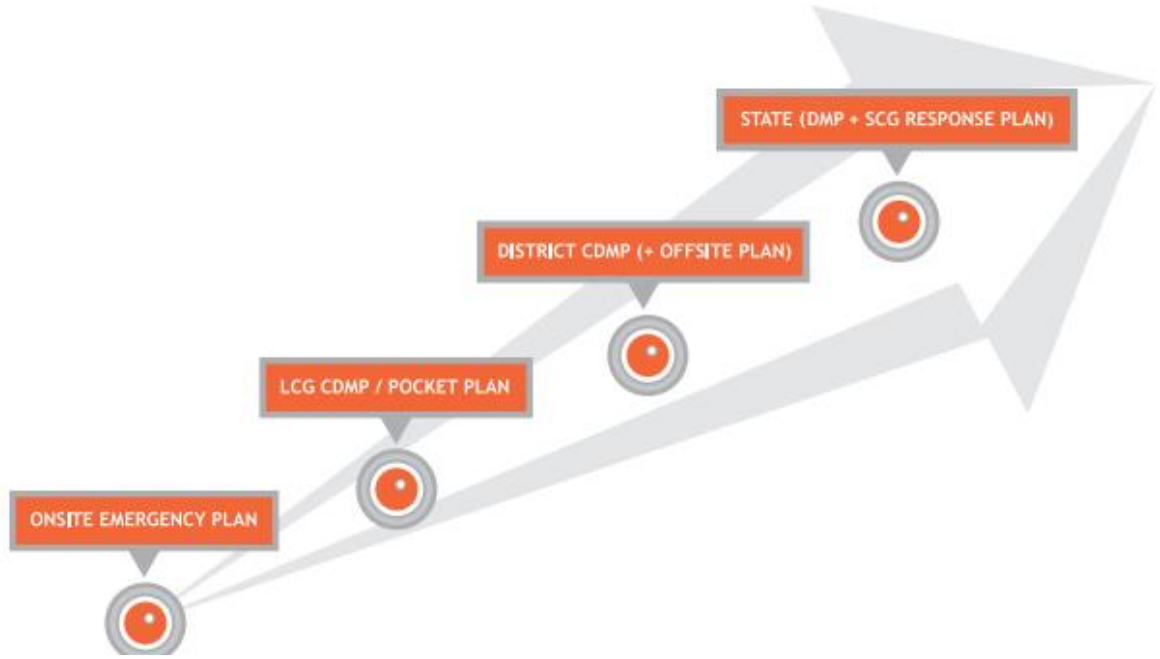


Figure 8: Bottom-up approach to the development of the Disaster Management Plan *(Source: GSDMA Gujarat State Chemical Disaster Management Plan)*

However, the Incident Response System recommended by NDMA requires appointment of Incident Commander (IC) to manage all response related activities and he is appointed by the DC who is designated as Responsible Officer (RO) under the IRS. This new terminology

can create some confusion because MSIHC has defined "similar sounding" roles for incident controller and district emergency authority. Incident controller is at the unit level and responsible for managing the response activities there whereas the incident commander manages the entire response operation when the emergency is offsite. The IC can in fact be the incident controller if the RO has appointed him as such. Further the RO and the DEA are both the district collector at district level, but the DC may appoint the IC to manage the response activities under his authority. At state level the chief secretary is the Responsible Officer under IRS and can designated a state level IC in case the emergency has to be managed by state level assets. In spite of these confusing terminologies, it must be noted that the IRS is an advanced emergency organization structure that is scalable, flexible and unified under one command for effective response.

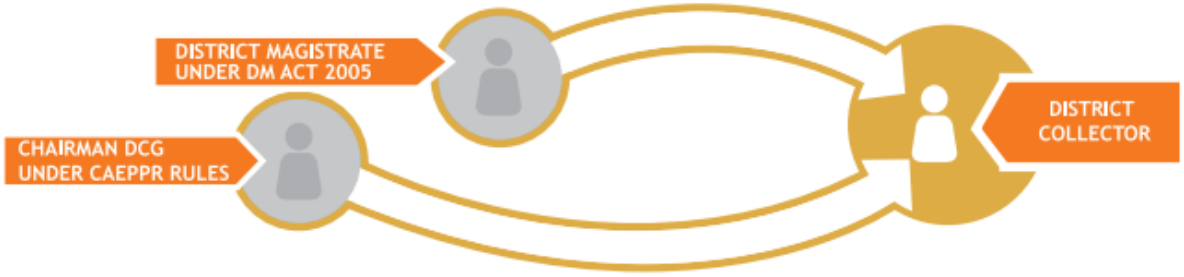


Figure 9: Coordination of Structures under DM Act 2005 and CAEPPR Rules 1996 *(Source: GSDMA Gujarat State Chemical Disaster Management Plan)*

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand Synergies between CDMP and Offsite Plans.

Duration 20 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer may explain the linkages between the plans and can indulge participants in discussion of synergies between CDMP and Offsite plans mentioned in the lesson to make the session interesting.

Training aids Power-point presentation & Flip Chart

Flow of Session

The regulations referred to in Learning Unit 3.1 provide for institutional framework for enforcement and monitoring of chemical safety and emergency management. The primary responsibility for dealing with chemical emergencies at national level lies with the Ministry of Environment, Forests and Climate Change (MoEFCC) which has also been designated as the nodal ministry for the same. It also involves Ministry of Home Affairs (MHA), Ministry of Labour & Employment (MoLE) and Ministry of Commerce & Industry (MoC&I). The MoLE through its state entities; the Inspectorate of Factories/Directorate of Industrial Safety and Health (DISH); the Central Pollution Control Board (CPCB) and the MoEFCC with its state entities, State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) of UTs monitors compliance of the various regulations.

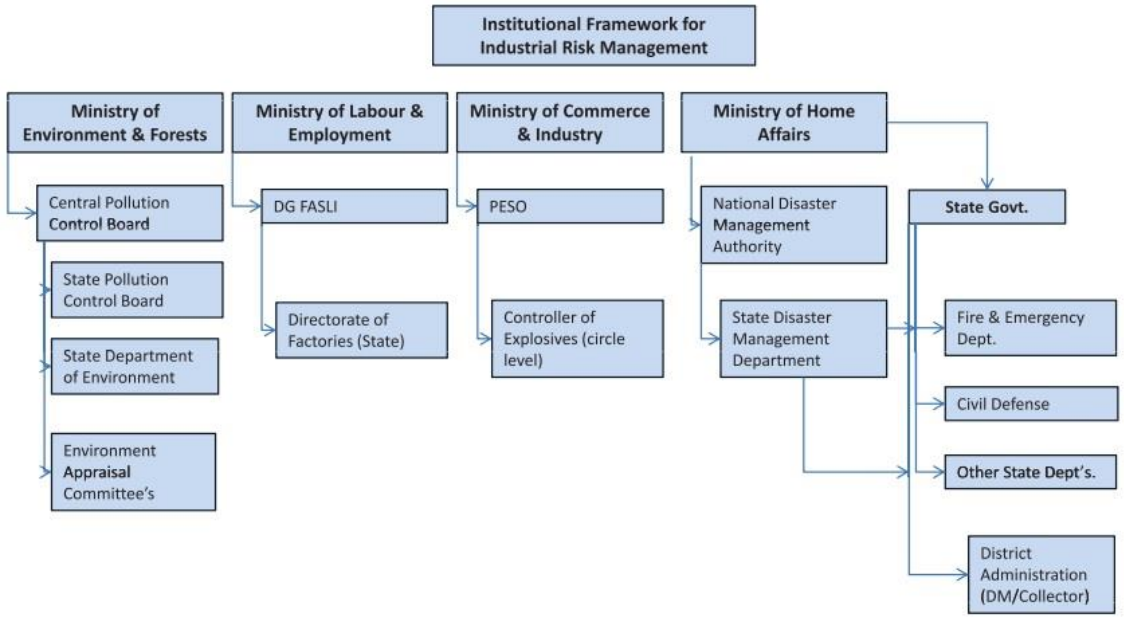


Figure 10: Institutional Framework for Managing Industrial Risk *(Source: NIDM Training Module on Geo-informatics application in CRM)*

The other regulatory authorities who are given a role in enforcing MSIHC Rules are the Chief Inspector of Dock Safety, appointed under the Dock Workers (Safety Health and Welfare) Act, 1986, the Chief Inspector of Mines, appointed under the Mines Act, 1952, the Atomic Energy Regulatory Board, appointed under Atomic Energy Act, 1972, and the Chief Controller of Explosives (now known as PESO), appointed under the Indian Explosives Act and Rules, 1983.

A review of the institutional framework for management of various aspects of chemical & industrial risk is depicted in Figure 7.

In Gujarat, Gujarat State Disaster Management Authority (GSDMA) Under DM Act 2005 & GSDM Act 2003 and the Department of Labour and Employment via the Directorate of Industrial Safety and Health (DISH) under MSIHC Rules deal with chemical accidents in the state. Details about stakeholders and their roles is provided herewith in Table 5.

Roles	State	District
Policy Formulation, Regulation, Enforcement	DISH GSDMA GPCB PNGRB Western Railways PESO CEI, DOT GMB Airport Authority of India	District and regional level representatives of above organizations
Planning, Coordination, Capacity Building, Training	DISH GSDMA State Crisis Group (SCG) GIDC PESO Dept of Transportation GMB Airport Authority	DCG LCG District Disaster Management Authority (DDMA)
Response, Coordination & Communication	SEOC ERC	District Emergency Operations Centre

	SDRF	(DEOC)
First, Primary Response	SDRF Fire Services Medical Services (108) Home/Police Dept	
Support in Response, Recovery & Rehabilitation	Health & Family WelfareDepartment Industries and Mines Department Roads & Buildings Department GPCB Department of Animal Husbandry and Dairying Agriculture, Farmers Welfare & Cooperation Department Commissionerate of Transport Ministry of Railways Home Department Ports & Transport Department	Revenue Dept. /Relief Commissioner /Collector's office as main coordinator. District Level representatives of the State level Agencies

Table 5: Stakeholders & Roles in Chemical Industrial Disaster Risk Management & Response

Structure of Crisis Management

Crisis group are formed at Central level, State level, District and Local Level. Their constitutional status, compositions and their functions are discussed below:

1. Central Crisis Group

Constitution

In accordance with the provisions of Rule 3(2) of Chemical Accidents (EPPR) Rules 1996, the Central Government is to constitute a Central Crisis Group (CCG) for management of chemical accidents and set up a Central Crisis Alert System. The CCG is to meet at least once in six months and follow such procedure for transaction of business as it deems fit.

Composition

As per Schedule 5 of the aforesaid Rules, the CCG would comprise the following:

1.	Secretary, Govt. of India, Ministry of Environment & Forests	Chairperson
2.	Joint Secretary/Adviser (Environment & Forests)	Member Secretary
3.	Joint Secretary (labour)	Member
4.	Joint Secretary/ Adviser (Chemical & Pharmaceuticals)	Member
5.	Director General, Civil Defence	Member
6.	Fire Advisor, Directorate General Civil Defence	Member
7.	Chief Controller of Explosive	Member
8.	Joint Secretary, (Dept. of Industries)	Member
9.	Director General, Indian Council of Medical Research	Member
10.	Joint Secretary (Health)	Member
11.	Chairman, Central Pollution Control Board	Member
12.	Director General, Indian Council of Agriculture Research	Member
13.	Director General, Council of scientific & Industrial Research	Member
14.	Four Experts (Industrial Safety and Health)	Member
15.	Joint Secretary (Fertilizers)	Member
16.	Director General (Telecom)	Member
17.	Two Representatives of Industries nominated by the Central Govt.	Member
18.	Joint Secretary (Surface Transport)	Member
19.	General Manager (Rail safety)	Member
20.	Adviser, Centre for environment and Explosive safety	Member
21.	One Representative of Indian Chemical Manufacturers Association to be nominated by the Central Govt.	Member

Functions

1. The Central Crisis Group shall be the apex body to deal with major chemical accidents and to provide expert guidance for handling major chemical accidents.

2. Without prejudice to the functions specified under sub-rule (I), The Central Crisis Group shall:
   a. Continuously monitor the post-accident situation arising out of a major chemical accident and suggest measures for prevention and to check recurrence of such accidents;
   b. Conduct post-accident analysis of such major chemical accidents and evaluate responses;
   c. Review district off-site emergency plans with a view to examine its adequacy in accordance with the Manufacture, Storage and Import of Hazardous Chemicals Rules and suggest measures to reduce risks in the industrial pockets;
   d. Review the progress reports submitted by the State Crisis Groups;
   e. Respond to queries addressed to it by the State Crisis Groups and the District Crisis Groups;
   f. Publish a State-wise list of experts and officials who are concerned with the handling of chemical accidents;
   g. Render, in the event of a chemical accident in a State, all financial and infrastructural help as may be necessary.

2. State Crisis Group

Constitution

In accordance with the provisions of Rule 6(2) of Chemical Accidents (EPPR) Rules 1996, the State Government is to constitute a State Crisis Group (SCG) for management of chemical accidents. The SCG is to meet at least once in three months and follow such procedure for transaction of business as it deems fit.

Composition

As per Schedule 6 of the aforesaid Rules, the SCG would comprise the following:

1.	Chief Secretary	Chairperson
2.	Secretary (Labour)	Member Secy.
3.	Secretary (Environment)	Member
4.	Secretary (Health)	Member
5.	Secretary (Industries)	Member
6.	Secretary (Public Health Engg.)	Member
7.	Chairman, State Pollution Control Board	Member

8.	4-Experts (Industrial Safety & Health) to be nominated by the State Govt.	Member
9.	Secretary/Commissioner(Transport)	Member
10.	Director(Industrial Safety)/Chief	Member
11.	Inspector of Factories	Member
12.	Fire Chief	Member
13.	Commissioner of Police	Member
14.	1 Representative from the Industry to be nominated by the State Govt.	Member

Functions

The State Crisis Group shall be the apex body in the State to deal with major chemical accidents and to provide expert guidance for handling major chemical accidents. Without prejudice to the functions specified under sub-rule (I), The State Crisis Group shall:

1. Review all district off-site emergency plans in the State with a view to examine its adequacy in accordance with the Manufacture, Storage and Import of Hazardous Chemicals Rules and forward a report to the Central Crisis Group once in three months;
2. Assist the State Government in managing chemical accidents at a site;
3. Assist the State Government in the planning preparedness and mitigation of major chemical accidents at a site in the State;
4. Continuously monitor the post-accident situation arising out of a major chemical accident in the State and forward a report to the Central Crisis Group;
5. Review the progress report submitted by the District Crisis Groups;
6. Respond to queries addressed to it by the District Crisis Groups;
7. Publish a list of experts and officials in the State who are concerned with the management of chemical accidents.

3. District Crisis Group

Constitution

In accordance with the provisions of Rule 8 of Chemical Accidents (EPPR) Rules 1996, the State Government is to constitute District Crisis Groups (DCG) for management of chemical accidents. The DCG is to meet at least once in forty-five days and send a report to the State Crisis Group.

Composition

As per Schedule 7 of the aforesaid Rules, the DCG would comprise the following :

1.	District Collector	Chairperson
2.	Inspector of Factories	Member Secy.
3.	District Energy Officer	Member
4.	Chief Fire Officer	Member
5.	District Information Officer	Member
6.	Controller of Explosives	Member
7.	Chief, Civil Defence	Member
8.	One Representative of Trade Unions to be nominated by the District Collector	Member
9.	Deputy Superintendent of Police	Member
10.	District Health Officer/Chief Medical Officer	Member
11.	Commissioner, Municipal Corporations	Member
12.	Representative of the Department of Public Health Engineering	Member
13.	4 Experts (Industrial Safety & Health) to be nominated by the District Collector	Member
14.	Commissioner (Transport)	Member
15.	One Representative of Industry to be nominated by the District Collector	Member
16.	Chairperson/Member Secretary of Local Crisis Groups	Member

Functions

The District Crisis Group shall be the apex body in the district to deal with major chemical accidents and to provide expert guidance for handling major chemical accidents. Without prejudice to the functions specified under sub-rule (I), The District Crisis Group shall:

1. Assist in the preparation of the district off-site emergency plan;
2. Review all the on-site emergency plans prepared by the occupier of major Accident Hazards installation for the preparation of the district off-site emergency plan;

3. Assist the district administration in the management of chemical accidents at a site lying within the district;
4. Continuously monitor every chemical accident;
5. Ensure continuous information flow from the district to the Centre and State Crisis Group regarding accident situation and mitigation efforts;
6. Forward a report of the chemicals accident within fifteen days to the State Crisis Groups;
7. Conduct at least one full scale mock-drill of a chemical accident at a site each year and forward a report of the strength and the weakness of the plan to the State Crisis Group.

4. Local Crisis Group

Constitution

In accordance with the provisions of Rule 8 of Chemical Accidents (EPPR) Rules 1996, the State Government is to constitute Local Crisis Groups (LCG) for management of chemical accidents. The LCG is to meet at least once a month and send a copy of the proceedings to the District Crisis Group.

Composition

As per Schedule 8 of the aforesaid Rules, the LCG would comprise the following:

1.	Sub-Divisional Magistrate / District Emergency Authority	Chairperson
2.	Inspector of Factories	Member Secy.
3.	Industries in the District/Industrial area/ industrial pocket	Member
4.	Transporters of Hazardous Chemicals(2 Numbers)	Member
5.	Fire Officer	Member
6.	Station House Officer (Police)	Member
7.	Block Development Officer	Member
8.	One Representative of Civil Defence	Member
9.	Primary Health Officer	Member
10.	Editor of local News paper	Member
11.	Community leader/Sarpanch/Village Pradhan nominated by Chairperson	Member

12.	One Representative of Non-Government Organisation to be nominated by the Chairperson	Member
13.	Two Doctors eminent in the Local area, to be nominated by Chairperson	Member
14.	Two Social Workers to be nominated by the Chairperson	Member

Functions

The Local Crisis Group shall be the body in the industrial pocket to deal with Chemical accidents and coordinate efforts in planning, preparedness and mitigation of chemicals accidents. Without prejudice to the functions specified under sub-rule (I), The Local Crisis Group shall:

1. Prepare local emergency plan for the industrial pocket;
2. Ensure dovetailing of the local emergency plan with the district off-site emergency plan;
3. Train personnel involved in chemical accident management;
4. Educate the population, likely to be affected in a chemical accident, about the remedies and existing preparedness in the area;
5. Conduct at least one full scale mock-drill of a chemical accident at a site every six months and forward a report to the District Crisis Group;
6. Respond to all public inquires on the subject.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand Institutional Framework for Managing Industrial Risk.

Duration 20 minutes

Methodology

This session is an informative session. The trainer can indulge participants in discussion of roles of various ministries and agencies mentioned in the lesson.

Training aids Power-point presentation & Flip Chart.

Flow of 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. As per the DM Act, 2005, the **National Disaster Management Authority (NDMA)** is required to prepare national Guidelines, based on which the nodal ministry will prepare a detailed Action Plan in consultation with states and other stakeholders for the better and effective management of chemical disasters. A meeting on Chemical Disaster Management was convened by the NDMA on 17 February 2006 with various ministries of the Government of India (MoEFCC, MoLE, MoSRT&H, MHA), regulatory agencies (DGFASLI), NSC, R&D institutes (Bhabha Atomic Research Centre, Defence Research and Development Organisation (DRDO), Indian Institute of Chemical Technology, Industrial Toxicology Research Centre, National Institute of Occupational Health, NEERI, All India Institute of Medical Sciences, professional institutions (NIDM, Delhi and DMI, Bhopal), apex industrial associations (CII, FICCI) and the DM Authority of the Delhi Government, along with a large number of professionals and experts from the field of CDM. During the workshop, the present status of Chemical Disaster Risk Management in India was discussed and salient gaps were identified. The workshop also identified priority areas for prevention, mitigation and preparedness of chemical disasters and provided an outline of comprehensive guidelines to assist in the preparation of plans by ministry/states. It was decided to articulate the CDM guidelines through a document called the National Disaster Management Guidelines—Chemical Disasters. A core group of experts was constituted to assist the NDMA in preparing these Guidelines. Several meetings of the core group were held to review the draft versions of the document in consultations with ministries concerned, regulatory bodies and industries to evolve a consensus on the various issues of the Guidelines

After the devastating Earthquake of 26 January 2001, the Government of Gujarat enacted the **Gujarat State Disaster Management Act 2003** with a view to mitigating the loss of lives and detrimental effects of disasters on overall socio-economic development of the state. The **Gujarat State Disaster Management Authority (GSDMA)** came into existence as authority from 1 September 2003 with its headquarters at Gandhinagar. The GSDMA is responsible for

effective management of disasters, mitigation of their effects and facilitating emergency relief during and after occurrence of disasters and also for implementing, monitoring and coordinating reconstruction and rehabilitation in the aftermath of disasters. GSDMA and the Department of Labour and Employment via the Directorate of Industrial Safety and Health (DISH) under MSIHC Rules deal with chemical accidents in the state.

The International Labour Organisation (ILO) convention No. C 174, adopted on 22 June 1993, dealing with the prevention of major industrial accidents involving hazardous substances and the limitation of the consequences of such accidents, is directly relevant for Chemical Disaster Risk Management in India.

Awareness and Preparedness for Emergencies at the Local Level (APELL) Project is a tool developed by the United Nations Environment Programme, Division of Technology, Industry and Economics office (UNEP DTIE) in 1988 to minimise the occurrence of harmful effects of technological accidents and emergencies.

United Nations Office for Disaster Risk Reduction (UNISDR) is promoting chemical disaster risk reduction by educating and involving the community and civil authorities.

UN ARISE is the Private Sector Alliance for Disaster Resilient Societies, is a network of private sector entities led by the UN Office for Disaster Risk Reduction (UNDRR). ARISE is a private sector initiative, which in conjunction with the UNDRR, works towards a resilient, prosperous future where fewer lives are lost to disasters, capital assets and investments are risk-informed, and infrastructure is resilient to natural and man-made hazards. Members voluntarily commit to support and implement the Sendai Framework Disaster Risk Reduction 2015 - 2030, aligned with the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs), Paris Climate Agreement, New Urban Agenda and Agenda for Humanity.

UNEP APELL Programme is being strengthened as a key vehicle for UNEP work, at the local level in preventing and preparing for natural and other disasters, such as industrial disasters.

Strategic Approach to International Chemicals Management (SAICM) is a voluntary agreement to ensure the safe use of chemicals by 2020. In February 2006, over 190 countries including India acceded to the SAICM. India has decided to contribute to the newly created Quick Start Programme (QSP) trust fund. This initiative of UNEP consists of an overarching policy strategy and a global plan of action. There are 192 activities that have been identified for a global plan of action. 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.

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 law-making 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.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand some of the National/International Initiatives for Managing Industrial Risk.

Duration 20 minutes

Methodology

This session is an informative session.

Training aids Power-point presentation & Flip Chart.

Flow of Session

Understanding disaster risk in its various dimensions (vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment) is necessary in order for new and effective policies and practices for disaster risk management to be developed and implemented. Such knowledge can include pre-disaster risk assessments and is used for prevention and mitigation, but also for the development and implementation of appropriate preparedness and effective response to disasters.

A chemical accident is defined as "any unplanned event involving hazardous substances that causes or is liable to cause harm to health, the environment or property, such as loss of containment of hazardous substances, explosions, and fires". The impact at a local level of a chemical or industrial accident can be significant for the surrounding community, and may also lead to contamination having a substantial and long-term impact on the environment and livelihoods.

Key Considerations and activities for better understanding the risk of chemical/industrial accidents include, but are not limited to, the following:

- Identifying, understanding and prioritizing hazards and risks at national and local levels, determining what related public authority bodies and resources exist, and where gaps remain. This could be done by establishing criteria for identifying hazardous installations considered to have the potential to cause accidents, as well as a system to obtain information concerning certain specified categories of hazardous installations;
- Establishing effective public governance for chemical/industrial accident prevention, preparedness and response; including land-use planning, inspection strategies, transboundary issues, involvement and communication with the public, and accident follow-up;
- Ensure adequate communication on risk amongst stakeholders, including corporate management in hazardous facilities, public authorities, academia, labour unions, international organizations, NGOs, community representatives and the media;
- Timely and effective sharing of data between relevant authorities and stakeholders (i.e., information on the location of hazardous facilities, residential areas, critical infrastructure

including utilities, transportation routes, medical facilities, schools and vulnerable environmental sites);

- Preparing and making available procedures and communication materials for relevant stakeholders such as responders, public health authorities and the public on what actions to take in case of an accident; and
- For industry, developing a strong operational safety culture in facilities, which is at the heart of business operations, and understanding the risks posed by organizational activities dealing with hazardous substances.

Case Study: Protecting the Danube Delta from industrial accidents

Under the United Nations Economic Commission for Europe's (UNECE) project on hazard and crisis management in the Danube Delta (2010–2015), a hazard map was developed by the Republic of Moldova. Romania and Ukraine indicating hazardous facilities in the Danube Delta. The project aimed at protecting the Danube Delta from industrial accidents and to improve cooperation on industrial accidents between the three countries. It sought to enhance and, where possible, harmonize the mechanisms and approaches for efficient and effective hazard and crisis management. As a result of the cooperation, a joint agreement between the three project countries was drafted. Another goal was to improve understanding between authorities and industrial operators and strengthen their cooperation. In terms of hazard sources, the project focused specifically on the oil terminals located in all three

countries directly above the Delta. These terminals generate an increased hazard potential for the ecosystem and natural heritage of the Delta.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand the SFDRR First Priority of Action I.e. Understanding Disaster Risk in context with Chemical & Industrial Disaster events.

Duration 20 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer must also ensure that he helps the participants to correlate the concepts with risks pertaining to chemical & industrial hazards prevalent in Gujarat. The trainer can present a hypothetical case of chemical/industrial unit and ask the participants to list down the risk they can observe in that facility.

Training aids Power-point presentation & Flip Chart

LEARNING UNIT 3.6: SENDAI FRAMEWORK IN CONGRUENCE WITH CIDRM: PRIORITY 2 STRENGTHENING DISASTER RISK GOVERNANCE TO MANAGE DISASTER RISK

Flow of Session

Improved governance of disaster risk is vital for more effective and efficient disaster risk management at local, national and global levels. The strengthening of disaster risk governance for prevention, mitigation, preparedness, response, recovery and rehabilitation benefits from greater collaboration across mechanisms and institutions in implementing DRR measures.

This section on Sendai Framework priority 2 - Strengthening Governance for Disaster Risk – addresses all stages of disaster risk management, from prevention to mitigation, preparedness and response to recovery. Since all levels of government and societal sectors are concerned, approaches should be designed to mainstream DRR through legal frameworks and policies, and DRR strategies and plans drawn up and implemented for man-made hazards.

The potential for major industrial accidents has become greater with the increasing production, storage and use of hazardous substances. Major accidents as well as smaller, recurrent chemical accidents cause severe harm to workers, communities, municipalities, businesses and the environment. Consequently, a systematic approach to controlling hazardous substances is needed. Central to such an approach is strengthening the governance framework, which can be achieved through the development of a national chemical accidents program and adapted to a country's specific circumstances. Effective governance on process safety is essential both for a sustainable business performance and to minimize the frequency and severity of chemical and industrial accidents. Good governance is particularly important when siting hazardous industrial activities, making changes to such activities, and when planning land use around existing sites, for example, for housing, schools, hospitals and other public services as well as infrastructure development.

Key Considerations and activities for strengthening governance for chemical/industrial risk include the following:

- Integrating emergency planning for chemical and industrial accidents into local and national DRR and emergency plans and updating these plans on a regular basis;
- Making use of relevant guidance, such as the "OECD Guiding Principles for Chemical Accidents Prevention, Preparedness and Response", which aims to help public authorities,

industry and communities worldwide to prevent chemical/industrial accidents and improve preparedness and response, should an accident occur;

- Ensuring involvement of all relevant stakeholders and public authorities in the governance of chemical and industrial accidents;
- Furthering the cooperation and coordination of government authorities to improve information sharing and enable effective management across the whole risk management spectrum;
- Developing the inspection and supervision capacity of government authorities and other sectors involved with assessing progress;
- Initiating a process for developing, implementing and reviewing laws, regulations, policies, guidance and other instruments, as part of an effective chemical/industrial accidents governance program;
- Guaranteeing that operators (international companies, local companies and government-owned enterprises) of chemical/industrial facilities operate to the same highest standards of safety, accept responsibility for chemical and industrial accident risk management at the highest level of the organization. This includes the setting of clear policies by senior leaders, where public authorities should make this expectation known and part of a clear risk management enforcement strategy.
- Transboundary cooperation through regional and sub-regional mechanisms and instruments for cooperation for technological disaster risk reduction, such as the UNECE Convention on the Transboundary Effects of Industrial Accidents.

Case Study: The Flexible Framework for Chemical Accident Prevention and Preparedness in Tanzania

Over 90% of chemicals used by companies in Tanzania are imported. Many chemical spillages accidents have been reported in road transport of substances by fuel tankers and trucks. These accidents have resulted in fires, and frequently, human fatalities. Recognizing the need to improve the sound management of chemicals, the Government Chemist Laboratory Agency (GCLA), the implementation Agency for Industrial and Consumer Chemicals in Tanzania, in collaboration with UN Environment and the Swiss Federal Office for the Environment (FOEN), initiated the Chemical Accident Prevention and Preparedness (CAPP-TZ) programme project in Tanzania, in order to prevent and prepare for major chemical and industrial accidents in Tanzania.

While policies, regulations and guidelines for the proper management of chemicals existed in Tanzania, there was an acknowledged need to improve the compliance and enforcement of laws, cooperation/coordination between stakeholders, and greater awareness among stakeholders about existing legislation for improved management. The collaboration among multiple levels of governance provided a positive setting for the development of policies to improve chemical and industrial safety and the safety of local communities nearby areas of potential risk.

Case Study: Coordination between authorities on land-use planning in Estonia

The Estonian Rescue Board (crisis management department and regional and local rescue centres) is responsible for prevention and emergency preparedness for industrial accidents. The Board is actively involved in siting and land-use procedures, related environmental impact assessment and strategic environmental assessment processes, including screening and scoping, and has a number of binding powers in this respect. Comprehensive, special or detailed spatial plans and building design documentation must be submitted to the Board for approval when: selecting the location of a new establishment; expanding the operations of an existing establishment or increasing production, provided that a plan needs to be initiated or amended or a building permit needs to be granted; and planning an area located in the danger zone of a hazardous enterprise, an enterprise with a major hazard, or planning construction works there.

The Board assesses whether the plan or construction works increase the major-accident hazard or the severity of its consequences; or the planned accident prevention measures are sufficient; or the operator of the establishment must submit additional information to the local authority and to the Board before the plan is adopted or the building permit is granted.

The Board may reject a proposal if a planned activity in the plan or in the building design documentation increases the risk of a major accident occurrence, or the severity of its consequences, and the planned accident prevention measures are insufficient.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand the SFDRR Second Priority of Action I.e. Strengthening Disaster Risk Governance to Manage Disaster Risk in context with Chemical & Industrial Disaster events.

Duration 20 minutes

Methodology

The trainer must ensure that brainstorming over prevailing policies to tackle chemical & industrial catastrophic events is instigated. The participants should be led to envisage the steps that are needed to strengthen the corresponding risk governance process in Gujarat. The trainer can present an actual case study of chemical & industrial disaster event and direct participants to investigate the lacunae in policy framework that caused the resulting mishap.

Training aids Power-point presentation & Flip Chart

TECHNICAL SESSION 4
PREVENTION & MITIGATION OF CHEMICAL & INDUSTRIAL RISK MANAGEMENT

Need of Session

It has been realised that effective Chemical & Industrial Disaster Risk Management is possible by the adoption of preventive and mitigation strategies as most chemical disasters are preventable in comparison to disaster induced by natural hazards that are difficult to predict and prevent. The aim of prevention and mitigation can be achieved with the introduction of safer process technologies, improved performance of safety devices and reduction of human error. Immediate effects of a disaster can be mitigated through installing engineering systems like scrubbers, flares and venting systems.

This session deals with the prevention and mitigation of the risks posed by hazardous chemical manufacturing, storage, handling, and transportation at the state level. The approach to prevention and mitigation is focused on regulatory and planning strategies.

Units of the Session

1. Learning Unit 4.1: Strengthening of Existing Framework
2. Learning Unit 4.2: Stakeholder Roles in Prevention and Mitigation
3. Learning Unit 4.3: Sendai Framework in Congruence with CIDRM: Priority 3 Investing in Disaster Risk Reduction for Resilience

Objectives of the session

The objective of the session is to understand national and state level policies and steps applied for Prevention & Mitigation of Chemical & Industrial Risk.

Duration

105 minutes. (30 + 30 + 30) minutes for the sessions and 5-minute spill over time from each session.

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer must also ensure that he helps the participants to correlate the concepts that have been already taught with the national and international definitions / terminologies etc.

Training aids Power-point presentation, Flip Chart

Flow of Session

A hierarchy of concepts can be used for reducing the risks of chemical disasters. These include:

1. Eliminating or reducing the use of toxics
2. Implementation of risk management programs to minimising opportunities for release to occur and mitigation of any release at source.
3. Implementation of land use restrictions
4. A rapid, timely and qualified emergency response capacity to control and reduce the quantity of hazardous chemicals leaked and to reduce the duration of such a leak
5. Establish plans, develop public warning systems, and conduct public outreach and training on evacuation and shelter-in-place actions

Strengthening of Legal Framework

One of the key approaches to prevention and mitigation is strengthening of the legal framework. National Level recommendations by NDMA expert group for strengthening the legal gaps are as follows:

- Enforcement of safety provisions for isolated storages should be with CIF (or DISH) in place of SPCB/CPCB
- Enforcement of MSIHC rules to include intermediate, minor and private ports (Other ports) that do not fall under the category of major ports
- Using "Worst Case scenario" as the basis for risk assessment, selection of process technology, and designing of safety systems measures and procedures including emergency responses capabilities by MAH installations.
- Land use policy for buffer zone around MAH installations (Handling/ storing extremely/ highly toxic chemicals)
- Applicability of rules regarding safety reports and safety audit reports should be extended to all MAH installations instead of only certain MAH installations having the threshold quantities of identified hazardous chemicals.

In addition to the above national level recommendations there are some state level regulatory recommendations which includes:

- Harmonisation of state acts and rules with respect to DM Act, 2005 for effective dovetailing of frameworks under MSIHC and NDMA guidelines.
- Requirement of Emergency Management Plans for hazardous waste management facilities.
- Framing of State rules and regulation to bridge legal gaps under GSDM Act 2003 to manage chemical emergencies.
- Several guidelines – for example, responder safety and training needs, immediate notification of chemical leaks, incident response system, etc. – are recommended. Guidelines are usually more efficient and less resistant approach to making a policy change. On basis of experience with these guidelines, the state should consider forming appropriate rules to provide statutory support to these guidelines.

Strengthening of Enforcement Agencies

The next focus area in prevention and mitigation is strengthening of enforcement agencies themselves. Recommendations for strengthening of enforcement agencies are:

Strategic Re-Organization of the Agencies - Organizational structure on the basis of subject or function at the top level, and by geographic reach at the field level is most suitable for regulatory agencies. For example, the state-level head office of the regulatory agency can have a specialist chemical emergency planning cell that will be helpful in preparing guidelines and procedures for the inspection, enforcement, and legal compliance by the industry, and serve as a key knowledge resource in planning for and responding to chemical emergencies.

Programmatic approaches for compliance - Programme mode approach to safety promotion brings together regulators and industries on a common platform to seek mutually agreeable solutions. This approach seeks to improve efficiencies by removing redundancies in overlapping regulations by different regulators, to combine resources of regulators, to build consensus with industries, to partner with industry for funding, technology and knowledge, and to develop guidelines and systems for ease of compliance under the programme. An example of Toxic Risk Reduction Programme is provided.

Use of third Party professionals to Strengthen Enforcement - To resolve the manpower crunch in regulatory agencies, we recommend a third party professionals/competent persons to carry out usual inspections, report filing, checking, collection of fees, scrutiny of applications, checking of onsite plans, and several such routine tasks. A necessary pre-condition is that such competent persons (a) are selected after a rigorous selection, training, and certification process;

(b) undergo continuous training to upgrade skills and knowledge; (c) demonstrate no conflict of interest in discharging their role; and (d) are subject to a credible audit system to make them accountable.

Significant reliance on E –Governance - Web and internet based technology not only helps in efficiency but also in accountability. Several systems are suggested including information on compliance by industry, the inspection reports and accident investigations, and safety and audit reports, GIS based modelling, database and decision support system, hazard and vulnerability profiles of areas, and others.

Developing inspection manuals - Regulatory agencies should update detailed inspection manuals and conduct regular training of their staff and third party professionals on these. These manuals must detail the procedure of inspection, industry specific guidelines, standard templates, and check lists for inspections, and SOPs for action after inspection. There should be a system of maintaining inspection records on a web-platform.

Using accident reporting system - MOEFCC has developed web-based Chemical Accident Investigation Reporting System (CAIRS) to register chemical accident and investigation information. While CAIRS can be much improved, the use of CAIRS is recommended or Gujarat can develop its own system over time. In addition to the above, the following strategies and actions are recommended for prevention and mitigation Promoting preventive programs in industry- Prevention programs in industry for capacity building can include safety reviews and training for workers and contractors, implementing maintenance management systems, written safety procedures and work aids for employees and contractors and conducting compliance audits.

Co-ordination between enforcement agencies

There are several key regulatory and technical agencies that play a role in prevention and mitigation of chemical emergencies. However, a common platform for effective coordination amongst them need to be strengthen. GSDMA should take a lead to improve coordination between DGFASLI, Airport Authority, Western Railways, PNGRB, GMB, PESO, CEI, DISH, GPCB, DOT, and others to meet the common objective of reduced risk of chemical accidents. Some suggested mechanisms include:

- Quarterly meeting of SCG as envisioned in the CAEPPR Rules.

- Establishing programmatic approaches, use of third party professionals and accident investigation system can improve coordination among regulatory agencies.
- Table top exercises, functional drills, and full scale mock drill are multi-agency tasks and need coordination. They should be promoted instead of only full scale mock drills.
- A quarterly/yearly magazine on hazardous chemical incidents, accident report findings, new technologies, and other chemical emergency related information can be published.

Training & Capacity Building

Regulatory agencies must maintain and upgrade their knowledge and skills continuously. The staff needs specialized, focused training of fresh recruits and continuing education for other staff. The training material, examination pattern, and certification requirements can be developed internally, or in collaboration with other agencies and training institutes with similar purpose. Capacity building efforts should include regular internal and external seminars and workshops. Also, the regulatory agencies are responsible for building the capacity of the industry they regulate. Strong internal training materials for regulatory agencies can be used as outreach and safety promotion material for the industry with minor modification. Regulatory agencies can also develop certification and training programmes in collaboration with professional training institutes for the industries (e.g., training requirement for contract workers, training for workers handling Hazardous chemicals, etc.).

Disaster Risk Reduction through Land Use Planning

As per the NDMA recommendations, it is necessary to have in place a mandatory mechanism by which the concerned authorities are able to regulate the development of population settlements in the proximity of the installations. A “no-population buffer zone” of 500 meters around the perimeter of the MAH installations is to be set up for future installations.

Objectives of the lesson

1. The primary objectives of this lesson would be to make participants understand the need of following intervention for prevention & mitigation of chemical & industrial disasters:
2. Strengthening of Legal Framework
3. Strengthening of Enforcement Agencies
4. Co-ordination between enforcement agencies
5. Training & Capacity Building
6. Disaster Risk Reduction through Land Use Planning

Duration 30 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing.

Training aids Power-point presentation & Flip Chart

LEARNING UNIT 4.2: STAKEHOLDER ROLES IN PREVENTION AND MITIGATION

Flow of Session

There are several key regulatory and technical agencies that play a role in prevention and mitigation of chemical emergencies. However, a common platform for effective coordination amongst them does not exist. Therefore, a key responsibility of GSDMA is to improve coordination between DGFASLI, Airport Authority, Western Railways, PNGRB, GMB, PESO, CEI, DISH, GPCB, DOT, and others to meet the common objective of reduced risk of chemical incidents. The main mechanism to achieve improved coordination between these agencies is provided for under MSIHC rules by constituting SCG, DCG, and LCG. GSDMA needs to play a significant role in ensuring this mechanism functions in the true spirit of the law. The table below summarizes the key activities required for prevention and mitigation and the responsible agencies.

#	Prevention & Mitigation Activity	Primary Responsibility at State/District Level	Secondary Responsibility/Support at State or District Level
1	Ensuring safety of chemical storage vessels regulated by PESO	PESO	DISH
2	Enforcement of safety provisions for isolated storages	DISH (Recommended)	GPCB
3	Overall chemical safety of the unit including process safety, PPE, staff training, etc.	DISH	
4	Ensuring no or minimal environmental impact owing to operations and possible accidents at the site	GPCB	DISH
5	Ensure safe electrical conditions and that electrical hazards will not trigger chemical accidents	CEI	DISH
6	Reducing/Eliminating use of toxic materials and /or using alternative non-toxic materials	Industry	DISH
7	Risk management programs and installation of passive and active mitigation systems	Industry	DISH

8	Dovetailing of Structures under MSIHC Rules, 1898 and the DM Act, 2005.	GSDMA	SCG, Chief Secretary of State
9	Extension of requirement of Onsite Emergency Plans to include MAH as well as and Type A and Type B industries	DISH, CEI, PESO, GIDC, DoT	Industry
10	Requirement of Onsite emergency plans for Hazardous Waste Management Facilities (TSDF)	TSDF facility	Regional GPCB
11	Onsite Emergency plans and enforcement of MSIHC rules in intermediate, minor and private ports in addition to major ports	Respective Port Authority	Regional GPCB, DISH
12	Onsite emergency plans for isolated storage facilities	Isolated storage facility, Regional GPCB	DISH
13	Emergency response plans for transport of HAZCHEM	DISH	Department of Transport, Western Railways, Traffic Police
14	Land use policy on 'no-population buffer zone around MAH industries. Vulnerability Assessment based siting of chemical industries	State level Land use and town planning related agencies/Dept.	GPCB,GSDMA,DC DCG, Revenue Dept.
15	Implementation of programmes such as Toxic Risk Reduction Programme	DISH, GPCB ,GIDC, DoT, PESO	
16	Use of Third Party professionals for strengthening enforcement	PESO,CEI,DISH	
17	Implementation of E-Governance	GSDMA, DISH	DCG, DDMA, LCG (all for data and implementation support)
18	Development of Inspection manuals	Relevant Agencies	
19	Promotion of preventive programs in industry	DISH, PPP models	GSDMA, DCG, DDMA, collaboration between multiple regulatory agencies

20	Coordination between different enforcement agencies	GSDMA	GFASLI, Airport Authority, Western Railways, PNGRB, GMB, PESO, CEI, DISH, GPCB, DOT
21	Training and Capacity Building	GIDM, Departmental Training Institutes	Regulatory Agencies, DISH, DDMA and DCG

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand key activities required for prevention and mitigation and the responsible agencies.

Duration 30 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing.

Training aids Power-point presentation & Flip Chart

Flow of Session

Prevention and reduction of disaster risk can be fostered through private and public investment, including structural and non-structural measures. Investment in the form of human and financial resources is essential for enhancing the economic, social, health and cultural resilience of persons, communities, countries and the environment. Investments are not only cost-effective, but also vital for preventing and reducing losses and saving lives.

Investing in DRR is a cross-sectoral and multi-level effort. This means that investments must be made in all sectors of the society and at all levels – including local, national to regional levels. A multi-faceted approach is required which involves many types of actions and stakeholders. In addition to prevention and preparedness, investments should also cover the recovery and rehabilitation from man-made disasters.

Investing in resilience means that chemical safety should be an integral part of all phases of the development of a hazardous facility: from choosing and planning the location, design and construction, through operation and maintenance, to decommissioning/closure/demolition. This also means that chemical accidents prevention and response should be part of sound chemicals management, not only to prevent injury, save lives and protect the environment, but also to safeguard the viability of emerging economies and to maintain the economic viability of the enterprises concerned.

Key considerations and activities for investing in resilience in the chemical/industrial accident domain include, but are not limited to, the following:

- Making resources available to capture, analyse and learn from adverse or unexpected outcomes, in order to improve prevention and response. Enhancing learning from past events and incidents, recognising that many accidents have similar underlying causes;
- Advancing and improving the use of inherently safer technologies;
- Investing in and conducting land-use planning assessments prior to development of infrastructure near to facilities containing hazardous substances; and
- Developing and using Safety Performance Indicators (SPIs) to help measure the effects of investment in resilience. SPIs are used to assessing performance related to the prevention of, preparedness for and response to chemical accidents. As such, they improve the ability of industry, public authorities and community organizations to measure whether steps taken to

reduce the preparedness and response to accidents lead to safer communities and reduced risks to human health and the environment.

Case Study: Tailings management

Failures at Tailings Management Facilities – where mine waste is held – may lead to major environmental catastrophes with devastating effects on humans and the environment both within and across countries, as demonstrated by major past accidents such as the dam break of a tailings pond at a mining facility in Baia Mare (Romania, 2000), the aluminum sludge spill in Kolontar (Hungary, 2010), the accident at the Talvivaara Mining Company (Finland, 2012) and the Bento Rodrigues disaster (Brazil, 2015) mentioned in the introduction.

In response to needed improvements in the safety of tailings management facilities, UNECE member States decided to develop safety guidelines and good practices for tailings management facilities under two UNECE Conventions — the Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention). The guidelines and good practices were published in 2014. In addition, a methodology for tailings safety – comprised of a tailings hazard index, and checklists and measures catalogue – was developed and tested within a project on improving tailings safety in Ukraine, financed by Germany under the framework of the Industrial Accidents Convention in 2013-2015.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand the SFDRR Third Priority of Action I.e. Investing in Disaster Risk Reduction for Resilience in context with Chemical & Industrial Disaster events.

Duration 30 minutes

Methodology

The trainer may ask participants to list down the aspects and features they think require investments to ensure business continuity and resilience from catastrophic events for chemical and industrial unit. The trainer can present a hypothetical scenario where participant shall brainstorm over all phases of the development of a hazardous facility: from

choosing and planning the location, design and construction, through operation and maintenance, to decommissioning/closure/demolition.

Training aids Power-point presentation & Flip Chart

TECHNICAL SESSION 5
PREPAREDNESS

Need of Session

Preparedness is focusing on measures to allow for appropriate reaction to an accident. Examples include development of accident preparedness plans, early warning measures, communication with the public, and emergency exercises. As part of the preparedness planning process, there should be an elaboration of possible scenarios, and an identification of the potential risks and the geographical zones where effects are likely to occur in the event of an accident. The zones should indicate, inter alia, the public potentially affected and those areas for which decisions concerning evacuation, sheltering in place, or other actions to limit exposure may have to be taken. The identification of such zones should also provide an indication of the nature and extent of resources that may be needed in the event of an accident. Preparedness should take into account potential complicating factors that could be associated with accidents at hazardous installations, as well as factors that may make response more difficult. These include, for example, extreme weather conditions, disasters, loss of power or water supplies, problems with communication and transportation systems, synergistic effects of accidents with multiple substances, “domino effects”, and sabotage.

Units of Session

1. Learning Unit 5.1: Preparedness Planning
2. Learning Unit 5.2: Strengthening of Response Mechanism
3. Learning Unit 5.3: Emergency Preparedness and First Response
4. Learning Unit 5.4: Community Preparedness

5. Learning Unit 5.5: Medical Preparedness
6. Learning Unit 5.6: Sendai Framework in Congruence with CIDRM: Priority 4

Objectives of Session

- To elucidate elements of preparedness planning.
- To explain steps needed for effective response mechanism.
- To explains nitty gritty of community preparedness.
- To explain details of medical preparedness.

Methodology

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 trainer / 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 preparedness planning risks and therefore aspects of planning, risk analysis needs to be elaborated. 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.

Duration

260 minutes (30 +30 +30 +30 + 30 + 20) minutes for the sessions and 15-minute spill over time from each session.

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 5.1: PREPAREDNESS PLANNING

Flow of Session

At the State level, the key responsibility of planning and monitoring of preparedness is with the GSDMA and SCG, who are responsible for revision and updating of Chemical Disaster Management Plan, training and capacity building and industry co-ordination. The following points may be considered during the preparedness planning.

Development of an Agency-Department-Specific Action Plan

Preparedness actions plans are critical to move from planning to implementation. Each offsite response agency and the state government department assigned a role in the CDMP must develop a preparedness action plan and present it to the SCG and GSDMA. The annual review and updating of the state DMP should also review the progress of offsite agencies and state departments, as per their own preparedness action plans.

Improvement in Chemical Disaster Risk Management Planning

- Co-ordination between GSDMA and SCG, DCG, and LCG in planning, preparedness and capacity building should be strengthened which include establishing a chemical emergency cell at GSDMA, developing a system for mock drills, integrating role or DDMA and DCG.
- Appointing of a technical officer to provide support in CIDM activities to DDMA and DCG.
- Strengthening of onsite plans and synchronization with the offsite plans.
- Developing Emergency Responder Safety Guidelines to deal with training needs, work experience requirement, PPEs, safe work practices and policies, equipment for monitoring, medical assessments, decontamination, and others.
- Developing guidelines for immediate reporting of hazardous chemical leak.
- Using Chemical Accident Investigation Reporting system (CAIRS) developed by the MoEFCC at the state level for formal after action reporting.

Enhance Chemical Disaster Response Capacity

- Government or public agencies should preferably lead offsite chemical emergency responses but the industry personnel can be integrated in this response structure.

- The fire stations in Gujarat need to be strengthened with adequate manpower, equipment and finances as per NDMA guidelines on improving fire services.
- The State Emergency Response Team (SERT) will augment the capacity of RRT to provide qualified HAZMAT response for high-risk, high-volume, and thus, less frequent incidents that surpass the capacity of RRTs. SERT should be housed as a part of an agency or force where personnel are not transferred frequently because significant resources, training, and funds are invested in raising and building capacity of SERT and because SERT develops higher levels of skills through experience of working together as a team.

Plan for Training, Equipment & Resource for HAZMAT Response

A start of a good resource plan is recognition that "the emergency responders at all levels are an important community asset and they form the basis of the community's response and resiliency to all chemical and industrial disasters". Adequate knowledge and safe operations are imperative resources that need to be provided through training, teaming, equipment, tools, and supplies.

Public Private Partnerships (PPP) for Disaster Response

PPP allows us to combine the authority and resources of government with skills, technology and resources of the private agencies. Partnerships can also be formed between two public agencies to give structure to their joint training, resource sharing and other such plans instead of responding to ad-hoc cries for help. Some suggestions are:

- Expand mutual aid between large industries
- Replicate successful model of DPMC – Ankleshwar elsewhere
- Public private partnership to respond to road emergencies
- Forming mutual aid between neighbouring districts
- Improving preparedness of ports and forming mutual aid with corresponding DCG
- Improving preparedness of airport and forming mutual aid with DCG
- Improving preparedness of railways and forming mutual aid with DCG

Objectives of Session

To make participant understand:

- Development of an Agency-Department-Specific Action Plan
- Steps for Improvement in Chemical Disaster Risk Management Planning

- Steps for enhancing Chemical Disaster Response Capacity
- Plan for Training, Equipment & Resource for HAZMAT Response
- Public Private Partnerships (PPP) for Disaster Response

Duration 30 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer must also ensure that he helps the participants to correlate the concepts that have been already taught with the national and international definitions / terminologies etc.

Training aids Power-point presentation, Flip Chart

Flow of Session

The following measures maybe take into consideration while strengthening the response mechanism.

Incident Response System

It is advisable establish an Incident Response System (IRS) to provide a scalable and flexible response structure for different types and scales of chemical emergencies managed at different levels. The IRS provides a system for all responsible parties – government authorities, industries, offsite response agencies, NGOs, private business, communities to participate and respond in a coordinated way. The IRS allows for one incident command structure to prioritize and accomplish multiple objectives. The following schematic representation based on NDMA guidelines on IRS shows the structure of IRS System for during emergencies.

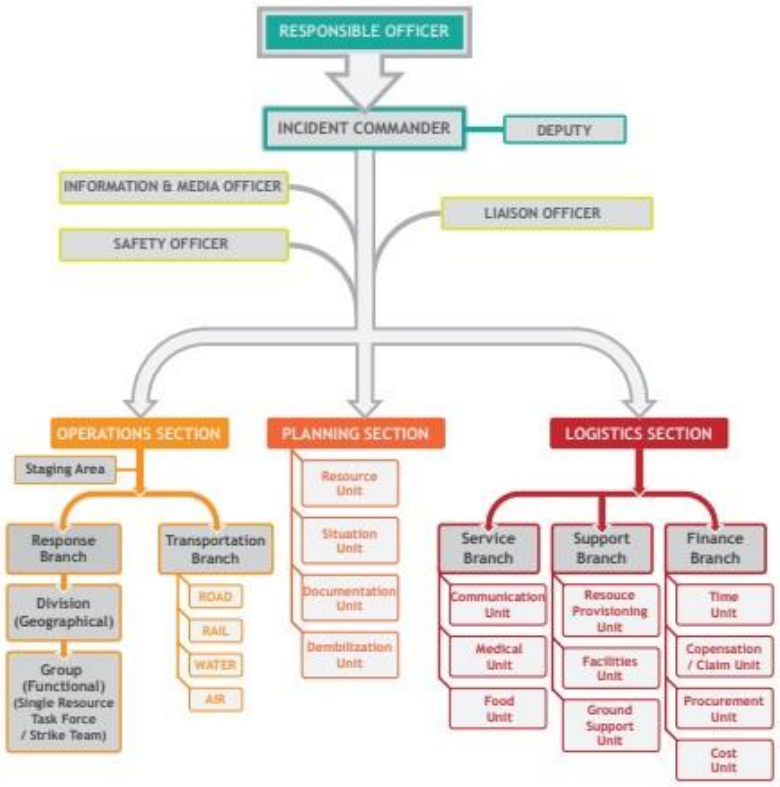


Figure 11: Incident Response Team Structure according to the IRS Recommended by the NDMA

Improving Control Room Management

The control room is a critical asset for effective response. Following steps maybe included while strengthening of SEOC:

- Ability to receive and direct notification of emergency
- Adequate equipment to ensure the self-sufficiency of the control room
- Avoiding conflicting agency-specific control rooms for coordinated response and better communication
- Establishing procedures for deactivation and demobilization of the local control room
- Additionally, communication among different stakeholders must be significantly improved through state-wide communication plan and regular communication exercises

Situational Awareness

Situational awareness is not a one time but continuous activity. The use of the Emergency Response Guidebook (2020) provides quick and adequate information to first responders and others.

Emergency Public Information

The community in immediate vicinity of a hazardous chemical unit may face very high levels of hazard within very short time in case of a chemical leak. They should be immediately intimated through a public address system.

Mass Care & Management of Dead

Each district should identify appropriate structures or buildings to be used as emergency shelters following a chemical / industrial incident as well as develop capacity to manage a large number of fatalities through a plan and procedures to locate, activate, mobilize, and provide additional personnel, transportation, last rites, and temporary cold storage facilities for a mass fatality incident.

Objectives of Session

To make participant understand:

- Incident Response System
- Improving Control Room Management
- Situational Awareness

- Emergency Public Information
- Mass Care & Management of Dead

Duration 30 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer may explain the importance of Incident Response System and subsequent details with group exercise must be included to ensure that he helps the participants to correlate the concepts that have been already taught to them.

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 5.3: FIRST RESPONSE

Flow of 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 people's 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 become 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. Additionally, Fire being a routine hazard is dealt by State Fire Prevention Services for state of Gujarat. Civil defence 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, 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 defence volunteers also work closely with hazardous industries associated with their off-site safety concerns, drills, medical response, public management, information dissemination, etc.

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 defence, etc. in chemical incidents with potential to reach impacts offsite.

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

Duration 30 minutes

Methodology

The trainer 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.

Training Aid Presentation/lecture, discussion, video-clips Media LCD, Flip chart, White board.

LEARNING UNIT 5.4: COMMUNITY PREPAREDNESS

Flow of 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. 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 and hence they are not prepared to deal with chemical emergencies.

“Aapda Mitra”, Civil defence, State Disaster Management Force (SDRF) 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. “Aapda Mitra”and Civil defence volunteers also work closely with hazardous industries associated with their off-site safety concerns, drills, medical response, public management, information dissemination, etc.

Community Preparedness and full co-operation and participation by local people is sine-qua-non-for the successful implementation of any plan of action for meeting emergency situation before, during or after the occurrence of a disaster. The District Disaster Management Committee (DDMC) will publicise the nature of hazards which affect the vulnerable areas and the ‘do’s’ and ‘don’ts’ the general public has to follow; also, various Government agencies,

which are responsible for precautionary measures through effective media such as Radio, Press, Film, Brochures, Social Media etc. Also traditional method of communication through loud speaker, beat of drums, sending errand and announcement through religious places etc. be utilised to warn the public.

Educational media, Radio, Press and Films

The Director of Information, in consultation with All India Radio Station in Gujarat, will arrange suitable programs for educating the public about possible and the steps that need to be taken to mitigate distress. This shall be done more frequently in April and May, particularly in educational programme, local news program and rural program. This at times may be in the form of interviews, short lectures, etc. School children should be encouraged to hear these broadcasts along with the teachers about all relevant information pertaining to disaster. The rural people should also be encouraged to hear the AIR broadcasts.

The Director/ Commissioner of Information will arrange to exhibit suitable films in vernacular language, with special focus on "Chemical Disaster" Posters clearly depicting the hazards and precautions to be taken by the affected persons are exhibited in all busy localities and prominent places such as cinema houses, railway stations, bus terminus, etc. Standing arrangements should be made by the Collectors with the local cinema houses of vulnerable areas to exhibit slides on the subject. The Commissioner of Information will also arrange for publication of suitable pictures of disasters and of popular articles in the local newspapers. He would also arrange for publication of handbills explaining hazards and the precautions to be taken by the people residing in the vulnerable areas.

DOs and DON'Ts for Chemical Hazards

Before Chemical and industrial Hazard

- Avoid housing near the industries producing or processing poisonous chemicals, if possible.
- The people living near industrial units should gather information about the nature of industrial units located near their houses.
- Read literature, leaflets, newsletters and televisions / radio publishing about the properties and characteristics of hazardous chemicals.
- Participate in all the capacity building programmes organized by the government/ voluntary organizations / industrial units.

- Take part in preparing disaster management plan and identify safe shelter along with safe and easy access routes.
- Prepare a family disaster management plan and explain it to all the family members.
- Make the family aware of the basic characteristics of various poisonous chemicals and the first aid required to treat them.

After Chemical and industrial Hazard

- When you notice any chemical leak/accident evacuate calmly and quickly against the wind direction.
- Keep a wet handkerchief or piece of cloth on face during evacuation.
- As far as possible try to attract other's attention on your way to the scene of chemical disaster.
- Avoid visiting and become audience to the risky areas.
- Don't be obstacle to the people who are managing the disaster.
- Keep the sick, elderly, weak, handicapped and other people who are unable to evacuate inside house and close all the doors and windows tightly.
- Inform Fire & Emergency Services, Police and medical services from safe location by calling 101, 100 and 108 respectively.
- Obey any instruction of the District authorities who will be doing their best to ensure the safety of you, your family and society as a whole and also try to save the property and the environment.
- *Provide correct and accurate information to government official.*
- *Turn on local radio/ TV channels for advice from District Emergency Operation Centre/health authorities*
- *Inform others on occurrence of event at public gathering places (like school, shopping centre, theatre etc.).*
- *Wait for other instructions by authorised people after reaching at safe place.*
- *Don't pay attention to the rumours and don't spread rumours.*

(Source: GSDMA Website)

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 develop efficient mechanism for risk communication, early warning etc.
- To understand the role of Civil Defence in chemical disaster preparedness.

Duration 30 minutes

Methodology

The trainer 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 Defence. 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 amongst the participants.

Training Aid Presentation/lecture, discussion, video-clips Media LCD, Flip chart, White board.

Flow of Session

Medical preparedness is aimed to prepare medical and other authorities to develop the capacity of first responders and upgrade infrastructure so that they can handle a mass casualty event. Emergency medical units should collaborate with stakeholders to develop, implement and maintain a comprehensive strategy to prepare for, respond to, and recover from health emergencies of known and unknown origins.

Gujarat Medical Emergency Services Act

Gujarat Medical Emergency Services Act (2007) is one of the earliest efforts in the country to regulate Emergency Medical Services (EMS) in the country. The act allows makes provisions for: (a) technical and financial assistance for EMS; (b) planning, accreditation, certification and licensing; and (c) training of EMS responders and doctors. Particularly this act can be used to integrate the role of 108 as Medical First Responder (MFR) for chemical emergencies, their training, and coordination of 108 Ambulance with other EMS resources.

Creation of Trained Medical First Responder (MFR)

Trained MFR should be made available at the incident site as well as at the reception area of the hospital to carryout triage, medical decontamination, resuscitation, etc. This needs to match the district's vulnerability to chemical emergencies and other natural risks in the area. A training programme and participation of private industry are key in these efforts.

Formation of Quick Response Medical Team (QRMT)

QRMT is a designated group of healthcare clinicians who can be assembled quickly to deliver critical care expertise in response to grave clinical deterioration of a victim at chemical incident site itself, if the site can be safely accessed. QRMTs may consist of the following staff positions:

a) Physician – senior resident or hospitalist;
b) Physician's assistant;
c) Critical care unit Specialists;
d) Clinical nurse specialist and;
e) Respiratory therapist.

They all need to be trained in managing victims of chemical incidence.

Creation of Stationary & Mobile Decontamination Facilities

The medical posts within the factory should have a station decontamination facility for the incident site decontamination/primary treatment to safeguard the victim. There should be at least two medical posts perpendicular to each other with an appropriate evacuation route and assembly point to ensure that wind flows in the opposite direction of the leak. DISH may encourage the industry to take appropriate action in this regard. Mobile Decontamination Facility should also be planned either through mutual aid or by District Administration. There should be stationary decontamination units at hospitals to ensure that hospitals are safe for use. Under no circumstances shall a person be allowed to even enter a medical facility without decontamination.

Provision for Mobile Hospital

The mobile hospital/medical teams are essential to relieve the pressure from the earmarked hospital, especially in the case of combined disaster emergencies. The capacity of a mobile hospital depends on the magnitude of the disaster and population to be treated. Such cases are applicable to chemical leaks as secondary disasters, as observed in the case of the Bhuj Earthquake. The state can support the district develop this capacity with appropriate funding and training. District preparedness capabilities should ensure that four triage categories of victims and affected population receive sufficient vehicles for evacuation to assembly areas, temporary shelters, or to designated hospitals.

Stocking for Antidotes & Chemical Causality Treatment Kit

A proper chemical casualty treatment kit has a composition of burn care, first aid for ABC (airway, breathing and CPR) and advance support care, trauma care, and specialised antidotes and essential medicines, etc. It is essential to develop mitigation reserves at the district level to ensure the availability of required materials at right time. The antidotes required for chemical incidences along with the essential medicines need to be stocked at locations to ensure their availability in the least possible amount of time to site where it is required. In addition, direct stocking at the responder level ensures their safety and victim’s safety too. The primary sites for stocking are MAH units- medical posts, ambulances, and earmarked health facilities for both public and private sector.

Crisis Management Plan at Hospital

A crisis management plan will be prepared by all earmarked hospitals. The responsibility for preparation and implementation of the plan should lie with the medical superintendent of the hospital. The crisis management plan or hospital disaster management plan should cater for surge capacity, continuous information exchange with other hospitals, temporary makeshift arrangements for mass casualties, etc. The hospital disaster management plan should cater for the development of facilities to conduct a set of minimal tests and follow ups to ensure the toxicological impact of chemical. A hospital disaster management plan has the following components:

- Specify the roles and responsibilities identified for managing chemical disasters. This should include identification of a hospital incident command system, the command nucleus, the quick response teams, etc.
- The contact details of the members of the command nucleus and quick response teams.
- Plan for and participate in offsite drills.
- Regular updating of hospital disaster management plans.
- Develop capacities to handle large number of casualties, a contingency plan for bed expansion, and decontamination facilities.
- Training of medical personnel.
- Antidote stocking and procurement plan.
- Plan for availability of sufficient quantity of other medical stores such as antibiotics, other drugs and life- support equipment, oxygen, continuous positive air pressure (CPAP) ventilators, dialysis facilities, blood and IV fluid for transfusion, and other equipment.
- Procedures for accurate accounting of morbidity and mortality data.

Objectives

To make participants understand need of:

- Creation of Trained Medical First Responder
- Quick Response Medical Team
- Stationary & Mobile Decontamination Facilities
- Mobile Hospital
- Stocking for Antidotes & Chemical Causality Treatment Kit
- Crisis Management Plan at Hospital

Duration 45 minutes

Methodology

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.

Training Aid

Presentation/lecture, discussion, video-clips Media LCD, Flip chart, White board.

LEARNING UNIT 5.6: SENDAI FRAMEWORK IN CONGRUENCE WITH CIDRM: PRIORITY 4

Flow of Session

Capacities for effective response and recovery at all levels should be put in place. Increasing population density, urbanization and pressures from a rapidly changing environment, including the effects of climate change, showcase need to take concrete measures that improve preparedness and ensure that capacities are in place to effectively respond and recover at the local and national level to Man-made / Tech hazard events. The concept of "Building Back Better" is to make communities and nations more resilient to disasters, including by integrating DRR into recovery, rehabilitation and reconstruction and development.

Enhancing emergency preparedness requires cooperation among various stakeholders including, amongst other things, response personnel, health personnel, the private sector and representatives of the public and the media. For chemical accidents, industry has the primary responsibility for on-site planning, and public authorities have primary responsibility for off-site planning.

Key Considerations and activities related to enhancing preparedness for chemical/industrial accidents and building back better include, but are not limited to, the following:

- Ensuring preparedness policies, plans and programs address cascading events, such as Natural Hazard Triggered Industrial Accidents (NATECH), and other accidents that can lead to the release of hazardous substances;
- Developing minimum standards and guidelines beyond the national level and ensure they are implemented (i.e., industry, international/regional environmental standards, sector-specific guidelines, or others as applicable). Information to include are the composition of response teams, type of response strategy, equipment needed and stand-by or ready-to-deploy mechanisms;
- Integrating chemical / industrial accident preparedness plans into development frameworks, with focus on vulnerable areas;
- Establishing appropriate communication and early warning systems between public authorities and the general public. Ensuring the general public is informed about potential chemical and industrial hazards and is engaged in emergency preparedness measures and

response through, for example, a national educational campaign on specific chemical- and industry-related hazards and how to act in the event of such an accident;

- Developing capacity of national governments to improve contingency planning and response to chemical and industrial emergencies;
- Developing joint public and private capacity building projects to support emergency preparedness and contingency planning at the local and national level;
- Liaising with organizations working in a specific domain to implement workshops aimed at strengthening preparedness for chemical and industrial accidents;
- Regularly review and update plans, conducting preparedness exercises and simulations. Incorporate lessons learnt from past emergencies and accident; and
- Increasing collaboration among private, public and government actors, where preparedness programs can be funded through a variety of national governments and civil society organizations. Pilot projects are suggested if none currently exist.
- Consider possible transboundary impacts of chemical/industrial hazards, including through accidental water pollution; develop joint or harmonized contingency plans, test and update these regularly; conduct emergency preparedness and response exercises (table-top and in-field) in cooperation with neighbouring and riparian countries, develop bi-or multilateral agreements on the provision of mutual assistance.

Objectives of the lesson The primary objectives of this lesson would be to make participants understand the SFDRR Fourth Priority of Action I.e. Enhancing Disaster Preparedness for Effective Response and Build Back Better in Recovery, Rehabilitation and Reconstruction in context with Chemical & Industrial Disaster events.

Duration 20 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer must also ensure that he helps the participants to correlate the concepts on the above mentioned case study.

Training aid Power-point presentation & Flip Chart

TECHNICAL SESSION 6
RESPONSE IN CHEMICAL & INDUSTRIAL EMERGENCIES

Need of Session

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 chemicals 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 of chemical & industrial disaster risk 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. 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 lifesaving, transport route controls, and handling transport emergencies involving hazardous chemicals are important aspects for off-site emergency preparedness and response.

Units of the Session

1. Learning Unit 6.1: Response Plan
2. Learning Unit 6.2: Emergency Responders
3. Learning Unit 6.3: Transportation Emergencies for Hazardous Chemicals
4. Learning Unit 6.4: Medical Response in Chemical Emergencies
5. Learning Unit 6.5: Case Study of 2013 IOCL- Hazira Fire Accident

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 defence, 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.

Duration

260 minutes (45 + 45 + 45 + 30 + 20) minutes for the sessions and 15-minute spill over time from each session.

Methodology

Focus of this module is on emergency response, medical response and transport emergency risks and therefore these aspects can be elaborated with subsequent case studies. 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.

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 6.1: RESPONSE PLAN

Flow of Session

The Chemical Emergency Preparedness Plan is a shared responsibility of the Government of Gujarat and the management of the chemical industries. There must be regular meetings of the officials at the state and district level and the representatives of the chemical industries to review the preparedness / measures. A joint sector program in chemical safety is the foundation on which the emergency response plan can be effective.

All the MAH factories have updated their On-Site Emergency Plans, which have been reviewed by the Deputy/Asstt. Director, Industrial Safety and Health. MAH units conduct mock drills of the on-site emergency plans regularly. The amended MSIHC rules, 1994 lays down the requirement of a full scale mock trial of the on-site emergency plan every six months. All the factories have shown due diligence in instituting safety management mechanisms in their premises in accordance with the provisions of the Factories Act. All the districts have prepared an Off-Site Emergency response plan for chemical and hazardous substances. The Western railway has prepared its response plan for the entire railway network in Gujarat. Gujarat Maritime board and the Kandla Port trust have prepared their respective response plans for the ports and coastal area waters of Gujarat. As per Gujarat Disaster Management Act, 2003, different departments have prepared their own departmental crisis plan e.g. Police, Health, Transportation etc.

The district-level Chemical Emergency Preparedness Plans are available to all the members of the District Crisis Group. All the participating agencies in the Chemical Emergency Preparedness Plans such as the police, fire services, and medical services have participated in the mock exercises and rehearsals. According to the MSIHC rules, a full-scale mock drill of the district off-site emergency plan is carried out every year in the presence of concerned District Magistrate. There is a mutual aid agreement among fire stations belonging to different agencies. There is a mutual aid agreement among neighbouring chemical factories.

The steps involved in emergency response to chemical hazards:

1. Warning and alarm systems
2. Emergency equipment and facilities available in plants, industrial estates, and during transport

3. Plant emergency plans with adequate documentation
4. Emergency Operations Center with communication and transmission facilities
5. Emergency organization with services:
    a. Local Crisis Group Leaders, experts, specialists
    b. Emergency responders, including plant and municipal fire brigades and Police
    c. Health and medical services
    d. Environmental and Technical services
    e. Transport and Logistics
    f. Personnel services
    g. Security
    h. Public information service (media)
6. Coordination of plant emergency response plan with local authorities
7. Periodic information of neighbourhood / population on emergency response and behaviour
8. Emergency drill and periodic exercises

Immediate Response

Following steps are involved in organizing the immediate response:

Reporting of Accidents

In an accident involving chemicals the available time for response is generally short. The occupier/manager of the establishment must notify the local emergency control room about the incident and its potential consequences. After receiving information about the incident, the emergency responders-on-site emergency personnel, fire brigade, police, and Deputy Director/Asstt. Director/ Officer, Industrial Safety and Health begins the response. The Site Main Controller of the establishment specifies the immediate cause of the accident, the release of hazardous substance, possible consequences and provide written reports on actions taken and on health effects. The factory management provides the material safety data sheet (MSDSs) or a list of hazardous chemicals on-site (above "threshold quantities") to the Local, District, and State Crisis Groups and other agencies.

Responsibility of the Management of Industrial Activity

The owner of the industrial activity, under the Manufacture, Storage and Import of Hazardous Chemicals rules, 1989, is responsible for but not limited to:

- Identification of major accident hazards.

- Adequate steps to prevent major accidents and to limit their consequences to persons and the environment.
- Notification of major accident.
- Preparation and submission of safety reports and safety audit reports.
- Preparation of onsite emergency plan.
- Information to be given to person liable to be affected by a major accident.
- Arrangement to obtain or develop MSDS.

Alert System

An alert notification by competent authority, which could be Local Crisis / District Crisis / State Crisis Group, of a chemical emergency is issued. A notification is useful for:

- Confirming that a chemical emergency has originated.
- Estimating the actual or potential environmental impact andassessing the local response capacity.
- Identifying expert assistance required.

Set up a Response Command

A Response Command will include the Emergency Operations Center / District Control Room and the officials comprising the command. EOC in the State Emergency Response Center will direct response operations.

Command and Coordination

The chain of command in each of these facilities will be organized as follows:

Emergency Operations Center (State-level Crisis Group)	(1)	Chief Secretary
	(2)	Secretary, Labour & Employment
	(3)	CEO, GSDMA
	(4)	Relief Commissioner
	(5)	Others as required
District Control Room (District Crisis Group)	(1)	District Collector
	(2)	Member Secretary DCG
Local Crisis Group	(1)	Sub Divisional Magistrate
	(2)	Member Secretary LCG

State Level Response Command will always be responsible to the Chief Minister and the State Cabinet. All the decisions taken in course of responding to the emergency shall be reported to the Cabinet. The Cabinet will issue appropriate instructions to the agencies and authorities, if necessary. *(Source: State Crisis Plan, 2016)*

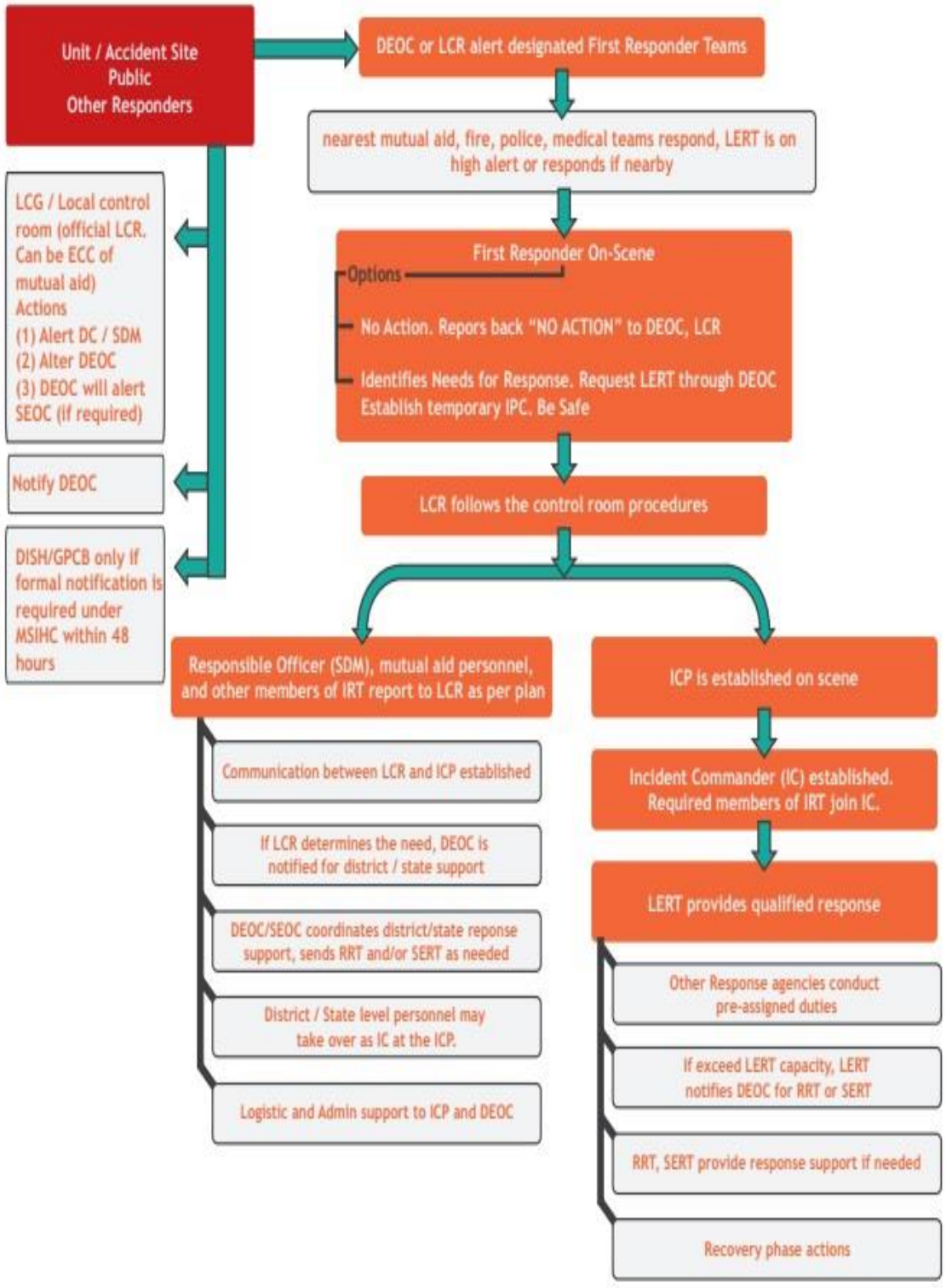


Figure 12: Emergency Response Process as per IRS

Report to the State EOC

- In case of any chemical emergency, the Chief Secretary, Secretary-Labour and Employment, CEO-GSDMA, and the Relief Commissioner shall immediately report to the State EOC.
- The State EOC will represent the collective command of these key officials.
- The State EOC will establish contact with the district / local crisis center.
- The State EOC will summon all the state-level experts, who are members of the State Crisis Group.
- The State EOC will alert or direct all the emergency responder agencies at the state and district level for providing their services immediately.
- The State EOC will immediately take decision to deploy rapid response teams in the affected areas.
- The State EOC will take all measures to contain damages from the chemical accident by regulating traffic in the contaminated zone or evacuating people from the affected area.

Secure information about the chemical emergency

It is of vital importance to identify as soon as possible that a chemical emergency has actually occurred. During the initial stages of the emergency there will be unclear and conflicting reports, therefore, the officials conducting the assessment should secure reliable sources of information to allow an objective assessment of the situation. These sources of information are:

1. The District Administration
2. The Directorate, Industrial Safety and Health
3. Gujarat Pollution Control Board
4. Gujarat Industrial Development Corporation
5. Fire Brigade
6. District Police
7. Management of Industrial Units

The assessment will include on-site visits to the affected area and personnel are warned not to jeopardize their safety by taking unnecessary risks or entering contaminated areas.

The assessment will include casualty, material damages, and the likely health consequences. It will suggest antidotes and treatment regimens for those affected by medical care.

Inform the Community

The State / District-Level Crisis Group will provide information to the people through All India Radio, Doordarshan, and Cable TV. It is extremely important that the information released is through reliable sources. The Chief Secretary / Secretary-Labour and Employment / CEO-GSDMA / Relief Commissioner will be the official spokesperson of the Government at the state-level. The District Collector will be the official spokesperson at the district level.

Establish communication with agencies

The State Crisis Group will be in contact with the District-Level Crisis Group, District Control Room, and Local Crisis Group on a continuous basis through:

- Hotlines
- Mobile Phones
- Video-conferencing Wireless
- Telephones
- E-mail/voice mail Satellite Phones

The State EOC must establish contact with major industrial installation in the private and public sector, with an objective of accessing and deploying their resources.

The State EOC must establish immediate communication with the members of the Central Crisis Group.

The State EOC must have the addresses and phone numbers of all the responder agencies at the state and district level.

Deploy Resources

The State EOC shall have a complete inventory of all the available facilities and resources. The most important resources relate to fire-fighting, emergency medicine, transport for evacuation, and trained and expert personnel. The State EOC must be able to access these resources and deploy them as necessary. The State EOC must have a list of resources available with major industrial installations in the private sector.

Protect Personnel

The State EOC shall be careful about the personal safety of emergency responders while issuing instructions. Only those with the protective equipment and trained should be allowed to enter the contaminated zone.

Objectives of Session

To make participant understand:

- Cycle of Chemical Accidents
- Immediate Response
- Standard Operating Procedure of Emergency Response

Methodology

This session is an informative session.

Duration: 45 minutes

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 6.2: EMERGENCY RESPONDERS

Flow of Session

In the event of a crisis, local and district crisis groups will respond. The State level crisis group will guide, coordinate and supplement their efforts.

Fire Services

1. Fire services are provided by three agencies within the state: State Fire Prevention Services, Municipal Corporations, public and private sector industries, and Gujarat Industrial Development Corporations (GIDCs).
2. The role of fire brigade in case of an industrial and chemical accident is to rescue people, extinguish / contain fire, and contain / confine the release of toxic gas.
3. The State Crisis Group will assess the need for fire tenders. Normally, the GIDC industrial estate and Municipal Corporation, in whose jurisdiction the accident has taken place, will rush all the available fire tenders.
4. If these fire tenders are inadequate, they will be sent from the other municipal corporations, and GIDC estates. The State Crisis Group must establish a state-wide protocol of mutual aid in providing fire services.
5. Director, State Fire Prevention Services under UD&UHD Department and Fire Controller will coordinate the deployment of fire tenders from other places.
6. Secretary, Industries will coordinate redeployment of GIDC fire tenders from other places.
7. Secretary, Industries will coordinate with the private and public sector industries to send their fire brigades to the site of the accident.
8. The State-level Crisis Group in consultation with the District Collector and other local officials will ensure that fire services must work closely with the Deputy/Asstt. Director, Industrial Safety and Health, Police, and Health Personnel.

Gujarat Pollution Control Board

1. The Gujarat Pollution Control Board (GPCB) will coordinate with the EOC and the district administration regarding the release of toxic material and its environmental and health consequences.

2. The GPCB will provide its expert services for assessing damages and response resources. The GPCB will also make available its inventory of chemicals, and it will specify the level of contaminants that can be accepted as safe.
3. The GPCB will make available its laboratories for the testing hazardous substances.
4. The GPCB can provide expertise on environmental effects of oil; discharge or releases of hazardous substances, pollutants, or contaminants and environmental pollution techniques.

Department of Health

1. The Secretary, Health, Commissioner of Health, and emergency medicine experts will provide the necessary expertise and specialized services to the State Crisis Group.
2. The State Crisis Group will consider the level of exposure on the basis of situation estimate received from the district administration. It will consider the intrinsic toxic potential of the chemical, its concentration, the duration of exposure, and the health status of the people exposed.
3. Based on the information upon the level and extent of contamination, the State Crisis Group will decide on the issue of alert and warning to the people in the affected areas through the All India Radio, Doordarshan, and Cable TV.
4. The State Crisis Group will contact the Civil Surgeon, and the District Health Officer of the concerned district and ask them to deploy all the necessary medical facilities including doctors, nurses, medicines, and ambulances.
5. The State group will alert major hospitals in the area, and ask them to be in readiness for receiving patients. A list of main hospitals in different cities, with their phone numbers is included in the plan.
6. In case the nature of contamination requires much greater intervention, the State Crisis Group will inform the Central Crisis Group and ask for the necessary medical assistance of experts, doctors and equipment. The relevant agency for emergency medicine in the Government of India is the Directorate General of the Health Services (DGHS) in the Ministry of Health and Family Welfare. The DGHS has set up the Emergency Medical Relief cell, for dealing with these contingencies.
7. The State Crisis Group will refer to the medical management plan for acute chemical exposure. There must be a medical management plan for acute chemical exposure. The State Crisis Group will review the medical management plan in its periodic meetings,

based on reported incidents of exposure and contamination. A note on the preparation of medical management plan is included in the plan.

8. The State Crisis Group will review the diagnostic support services: clinical laboratory, blood banks, radiology, pathology, pharmacy, paramedics, Red Cross, NGOs and volunteer personnel. It will seek all the steps to organize the necessary medical help through the deployment of doctors, paramedics, and provision of blood and medicines.
9. The State Crisis Group will review the administrative support required for the situation, which includes communications, transport of the victims and of the personnel, feeding of the personnel and patients, and supplies.
10. The State Crisis Group will collect information on the number of deaths and persons injured, the nature of injuries, and the likely long-term consequences.
11. The State Crisis Group must assess the medical needs of the area on the basis of likely long-term consequences and take steps to equip local medical facilities for treating people on a long-term basis. The State Crisis Group must also make financial provision for spending on long-term treatment.

Department of Transport

1. Secretary, Home (Transport), and the Managing Director, Gujarat State Road Transport Corporation (GSRTC) will work as part of the State Crisis Group for the implementation of the transport plan.
2. The Crisis Group will handle all the major accidents arising out of transport of hazardous substances through the intervention of the Police and Road Traffic Officers.
3. The Crisis Group will take decisions regarding cordoning of the area, the diversion of traffic, testing of materials for identification, and decontamination of the area, in consultation with the district-level officials.
4. The Crisis Group will issue and review instructions regarding safe transportation of hazardous substances in accordance with the relevant rules.
5. In case of major off-site emergencies, Secretary, Home (Transport) and the Managing Director, GSRTC, will contact the GSRTC bus depots and private transport operators for the requisitioning of vehicles.
6. The State Crisis Group will assess the transport needs for the responders. The police and medical staff may need vehicles to carry them to the site. The State Crisis Group will organize buses and private vehicles immediately for the transportation of the responders.

7. The State Crisis Group will assess the transportation support required for the evacuation. It will order deployment of the GSRTC buses and trucks in adequate numbers for this purpose. In extreme case, special trains must be run to help people reach some other place. In such cases, the State Crisis Group will contact the local railway officials for arranging a special train service.
8. The State Crisis Group may stop the public transport system to operate in the area, if it will expose the passengers to the dangerous chemical substances.
9. After a major chemical mishap, the people may voluntarily like to leave the place for a few days. In such a case, the State Crisis Group should arrange as many buses to accommodate all the passengers. The failure to do so may lead to unmanageable situations.
10. The State Crisis Group, after receiving a situation estimate, may also decide to stop passage of any vehicle, which is carrying dangerous substances through the area.

Relief Commissioner

1. Relief Commissioner through the Department of Revenue will provide the immediate relief to all the affected people.
2. The relief assistance may consist of *ex-gratia* financial assistance, temporary shelter, and food.

The Relief Commissioner may provide assistance for rehabilitation, depending upon the nature of damages to the property and assets.

Home Department and Police

1. Secretary, Home and Director-General (DG), Police will direct the participation of police in the emergency response. Secretary, Home and DG, Police will constitute an integrated command.
2. The Secretary, Home and DG, Police will report to the EOC, immediately upon the receipt of information about the accident.
3. The DG will establish contact with the District Police Control Room immediately. He will get a situation estimate and assess the operational requirements for the police.
4. The DG will issue an alert to the DIG and the surrounding districts. He will direct all the police officials and forces in adjacent districts to be deployed if necessary. The DG will ensure that the police forces required for traffic management, evacuation and law and order are available with the district administration.
5. The DG will review the dissemination of warning and the need for evacuation. He will help the Fire Brigade and the Deputy/Asstt. Director, Industrial Safety and Health with Police Wireless sets, so that there is continuous communication among the first responders in the emergency situation.

6. The DG will ensure that the police force will not enter the contaminated area without the permission of the Factory Inspector and Fire Brigade.
7. In case of big explosion and fire, the DG will assess the situation and suggest a plan of action based on his assessment of the immediate causation.
8. The DG will order deployment of the police force for evacuation of the people from the zone of the danger.
9. The DG, Police will send instructions for the cordoning of the area. People should not be allowed access anywhere close to the site of the accident.
10. The DG, Police will review the traffic management in the area. The primary aim would be to ensure the transport of the injured to the hospital, easy access for emergency responders and safe evacuation of the people from the danger zone.
11. The DG, Police will also issue directives that all the private and public transport (trains and buses) be diverted from the disaster area.
12. The DG will contact the DIG and ask him to organize the deployment of police force from other district, based on the need assessment. The DG will also contact the Central Industrial Security Forces, and other para-military forces to seek their deployment.
13. The DG will supervise law and order situation. He will take all the possible precautions to ensure that public order is maintained, and no one takes undue advantage of the situation.

Ports Department

In the event of a major hazardous material emergency, the Harbour Division's mission is to ensure the safety of its employees and tenants, and to provide minimum disruption of Port commerce fishing, and recreation. The department will,

1. Ensure the health and welfare of employees and tenants.
2. Provide for Port security.
3. Regulate anchorage and movement of vessels.
4. Monitor clean-up efforts on Port property.

Airport Authority

In the event of a major chemical disaster, the Airports Authority has the responsibility of keeping the four airports under its jurisdiction in safe operations and restoring disrupted operations as soon as possible.

Airport Authority, Airport Managers' Officers, Airfield Operations, Airport Police, Construction and Maintenance and Public Relations Officers coordinate all other emergency procedures.

Objectives of Session

- 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 defence, etc. in chemical incidents with potential to reach impacts offsite
- To analyse the capacities and roles of civil defence in off-site emergency context in mobilizing the emergency first response, delivering first response and managing people and their reactions Public Private Partnerships (PPP) for Disaster Response

Methodology

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.

Duration: 45 minutes

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 6.3: TRANSPORTATION EMERGENCIES FOR HAZARDOUS CHEMICALS

Flow of Session

With the rapid growth of industry in India, the growth in transportation of hazardous chemicals by road has taken place. These carriers of the hazardous substances, when involved in accidents, may cause disastrous consequences duo to fire, explosion or toxic spillage resulting in damage to the property both sides along the route including the loss of human lives and environment pollution.

Transportation Route Survey

It is essential that the routes of transportation by road for hazardous chemicals are required to be identified and restricted to that only, so that the least populated area is chosen to minimise the effects. Accordingly, it is also prudent to mention that a population survey on both sides of the proposed transportation routes up to 500 m is undertaken to identify beforehand the approximate number of people likely to be affected and the necessary evacuation and medical preparedness are taken. The actions for initial cordoning by Police to be done based on the knowledge of immediate danger area and evacuation carried out, if required, as guided by the Table-1. In most of the cases and for most of the chemicals initial isolation distances if cordoned and subsequent firefighting / neutralisation or capping actions are taken, a thorough evacuation may not be necessary. But in case of LPG or liquefied flammable gases tanker accidents, the minimum distance for a small leak case has to be cordoned because of BLEVE hazard which can go up to 500 - 900m depending on the quantity being transported.

Transport Route for hazardous chemicals in Gujarat are as under: *(**Source**: State Crisis Plan, July 2016)*

- **Road**
  - Ahmedabad – Vadodara – Ankleshwar – Panoli – Surat – Valsad – Vapi
  - Ahmedabad – Limdi – Morbi – Kandla
  - Rajkot – Kandla
  - Ahmedabad – Mehsana – Siddhapur – Palanpur
  - Palanpur - Radhanpur – Samakhiyali
  - Rajkot – Samakhiyali – Gandhidham – Mundra

- **Rail**
  - Ahmedabad – Vadodara – Surat – Valsad

- Mumbai – Valsad – Surat – Vadodara - Kandla
- Abu Road – Mehsana – Ahmedabad

- **Port**
  - Kandla
  - Hazira
  - GCPTCL & Private Jetty, Dahej (Dist.: Bharuch)
- **Airport –** Ahmedabad, Vadodara, Jamnagar, Rajkot, Surat etc.
- **Pipeline** – GAIL, ONGC, IOCL, ESSAR, LNG Petronet, Reliance

Response to HAZCHEM Transportation Emergencies

The organization structure for response, concept of emergency operations, and roles and responsibility of key stakeholders remains almost the same in case of emergencies involving the transportation of hazardous chemicals. The special considerations while responding to transportation emergencies are:

Pipeline Transportation

The initial notification may be done by the occupier/owner of the pipeline or by the local community or by the contractor who caused the damage to the pipeline. Therefore, it is important that all pipelines nodes and routes clearly display the emergency contact information in case of any accident with the pipeline. Once the initial notification of an accident is obtained the response operations are similar to other chemical accidents.

Road Transportation

In case of an emergency involving a road tanker carrying hazardous chemical, the driver of the tanker is expected to be well-trained to handle emergency situations and have up-to-date contact information. The notification will be done by the driver by calling DEOC (# 1077) and Local Police Station. The consigner and consignee may also make these calls. The tanker must display emergency information panel and driver should carry the Transport Emergency Card or TREMCARD which has detailed instructions on response actions for fire, spillage or leakage. Driver should take protection actions by stopping traffic and general citizens from approaching the accident site until police arrive for help. The driver can try to stop the leak (if any) only if he is adequately trained and equipped to do so.

The police officer on scene will most likely be the first IC until a more qualified response team arrives. The most important action by the police is to cordon off the site of the accident, divert

and regulate traffic, and evacuate/shelter in place citizens in close proximity on a priority basis. The ERG (2020) which has been developed primarily for response to chemical emergencies during road transport should be followed. It is also important that untrained and unequipped first responders should not try to stop the leak or enter the hot zone and should instead wait for a qualified response.

Objectives of Session

To make participant understand:

- 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

Methodology

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.

Duration 45 minutes

LEARNING UNIT 6.4: MEDICAL RESPONSE IN CHEMICAL EMERGENCIES

Flow of 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 & industrial disaster risk 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 defence, 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, local clinics, physicians, 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 counselling.

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.

- 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.

Objectives of Session

- 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 analyse 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 30 minutes

Methodology

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 nonchemical 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.

Training aids Power-point presentation, Flip Chart

LEARNING UNIT 6.5: CASE STUDY OF 2013 IOCL- HAZIRA FIRE ACCIDENT

Flow of Session

IOCL – Hazira has 9 storage tanks having Petrol, Diesel and Kerosene. These products have been distributed through tankers from the storage tanks.

About the Disaster

- A major fire broke out with an explosion at IOC – Hazira on 5th January 2013 at about 12:41 hours in the tank No. 4. Due to explosion, part of the floating roof of the tank was blown off.
- Dead bodies of the three contract workers were found at some distance away from the tank while another two were found within the sludge of the tank at the bottom after the fire was extinguished.
- Adjacent tanks (No. 3 and 5) were severely exposed to the heat from the tank fire.

The detail on storage of products as on 05/01/2013 is as below; (Source: DISH Report)

Tank No.	***Product***	***Capacity (KL)***	***Actual Storage (KL)***
1.	Petrol	2200	0
2.	Petrol	2176	829
3.	Petrol	5145	2116
4.	**Petrol**	**9563**	**5004**
5.	Petrol	9555	7841
6.	Kerosene	5450	3467
7.	Kerosene	5528	1016
8.	Diesel	5519	179
9.	Diesel	5520	1915

Fire Fighting

- 71 Nos. of fire tenders from different Municipal Corporations, Municipalities and Industries were applied for firefighting and transportation of water.

- The strategy adopted was to prevent spread of fire to adjacent tanks and allow the affected tank to burn under control.

- The fire completely doused at 11.30 am on 7th January 2013 (almost after two days) and all clear message was given to CEO-GSDMA, Municipal Commissioner and District Collector at 11.31. *(Source: CFO- SMC's report)*

- 6 nos. of foam tenders with water bowser were kept stand by in IOC campus till 8th January 2013.

- The details on Fire tenders, man-power and foam concentrate been utilised to extinguish fire are as under;

Resources	**SMC**	**VMC**	**AMC**	**Municipalities**	**Industries**	**Total**
Fire Tenders *(including 2 Nos. of Hydraulic platform from SMC)*	25	3	4	25	14	**71**
Manpower	192	28	34	75	75	**404**
Foam	**90,000 L**					

- Total 90,000 Litre foam concentrate applied for the purpose of the firefighting. (Out of total 90,000 L of foam concentrate, 41,000 L foam concentrate was from SMC while the rest from the industries).

Figure 13: Firefighting Activities being carried out

Cause of disaster

- The floating roof was not working properly. Explosive mixture of petrol vapour and air was accumulated in the tank.

- It is speculated that spark might have been generated due to unsafe repair procedure (un-utilization of spark-proof equipment / PPEs) of floating roof in the tank no. 4.

Shortcoming of IOCL

- There were couple of dedicated water tanks for firefighting having capacity of 18,50,000 litre each. One of them was under maintenance and other was empty.
- There were two foam tanks of inadequate capacity which were empty.
- The existing hydrant line for firefighting had a rupture.
- Inadequate sprinkler system on each tank.
- Work-permit was not issued to workers for the maintenance/ repair work.
- SOP for safety procedure was not followed.
- No qualified supervisor was available on site to oversee the repair work.
- Repair work was undertaken without shifting product to another tank.

Violation of the Acts & Laws

S. No.	Violation of Act & Rules	Reason
1.	Gujarat Factories Rule 1963 – Rule 102 Schedule -19, Part 2, sub-rule 18 (b)	No work permit to entry in confine space
2.	Gujarat Factories Rule 1963 – Rule 102 Schedule -19, Part 2, sub-rule 6	Unauthorised entry in hazardous area
3.	Gujarat Factories Rule 1963 – Rule 102 Schedule -19, Part 2, sub-rule 20 (a)	Unavailability of supervisor to oversee the repair work
4.	Factory Act – Para No. 37 (1) (c)	Not using spark proof equipments/PPEs at hazardous site
5.	Factory Act – Para No. 61 (1)	Not keeping workers register
6.	Gujarat Factories Rule 1963 – Rule 103 (3)	Not reporting accident with 12 hours in prescribed format

Remedial Measures *(From CFO- Surat)*

- Minimum 25,000 l foam concentrate should be reserved for the tank farm fire in IOC campus.
- Fire protection system should be as per OISD and NFPA requirement.

- Water barrier system should be installed in between tanks to protect them from radiant heat.
- Disaster management plan should be prepared as per OISD requirement.
- Trained fire personnel should be posted in tank farm.

Key learning

- Whenever possible avoid hot work and consider alternative methods.
- Before the initiation of hot work analyse the hazard and monitor the atmosphere by conducting effective gas monitoring in the work area using gas detectors.
- Prior to carry out any maintenance/repair activities near highly flammable liquid/ gas drain and/or purge all equipments and piping.
- Ensure that qualified personnel familiar with the site specific hazard review and authorise all hot work and issue permit specifically identifying the work to be conducted.
- Trained personnel on hot work procedure. Use of proper safety equipments including PPEs.
- Set up SOPs and follow it.
- All existing safety systems (firefighting, safety, etc.) at the factory must be as per the standard and up-to-date all the time.

TECHNICAL SESSION 7
RECOVERY & REHABILITATION AFTERMATH OF CHEMICAL & INDUSTRIAL DISASTER

Need of Session

Once the response phase and its activities cease, the recovery phase commences. This phase focuses on returning the disaster-impacted community to normalcy (i.e., pre-disaster conditions). Emphasis is on assisting individuals and households in meeting basic needs like food, clothing and shelter.

This phase also centers on the provision of temporary but essential utility and infrastructure such as road, housing, power and water delivery infrastructure, medical and public health services, and restoring basic community services and functions. The phase can last from days to months and lays the groundwork towards social, political, and economic restoration and functioning such as the re-opening of schools, government offices, social centers, and recreational attractions.

Thus, in this session we elucidate the strategies that the decision maker should consider that will contribute to the re-establishment of 'normality'.

Units of the Session

1. Learning Unit 7.1: Principles of Recovery & Rehabilitation in Chemical & Industrial Disaster
2. Learning Unit 7.2: Case Study: Recover & Rehabilitation after Bhopal Gas Tragedy

Objectives of the Session

The primary objectives of this session are following:

- To provide the participants an idea of important principles involved in recovery & rehabilitation aftermath of chemical disaster.

Duration

120 minutes. (45 + 45) minutes for the sessions and 15-minute spill over time from each session.

Methodology

The trainer may ask participants to visit website of the Department of Bhopal Gas Tragedy Relief and Rehabilitation and instigate brainstorming over different aspects of recovery phase.

Training aid Power-point presentation & Flip Chart

Flow of Session

Disaster recovery has three distinct but interrelated meanings. First, it is a goal that involves the restoration of normal community activities that were disrupted by disaster impacts – in most people's minds, exactly as they were before the disaster struck. Second, it is a phase in the emergency management cycle that begins with stabilization of the disaster conditions (the end of the emergency response phase) and ends when the community has returned to its normal routines. Third, it is a process by which the community achieves the goal of returning to normal routines.

The recovery process involves both activities that were planned before disaster impact and those that were improvised after disaster impact. Irrespective of the nature and scale of the incident, there is a need to consider recovery related issues from the outset of the incident response, although there are no exact boundaries between these two phase. For large scale incidents, the amount of resources required during the recovery and remediation stage may be greater and required for longer than during the initial acute response. Same idea is depicted in Figure 14.

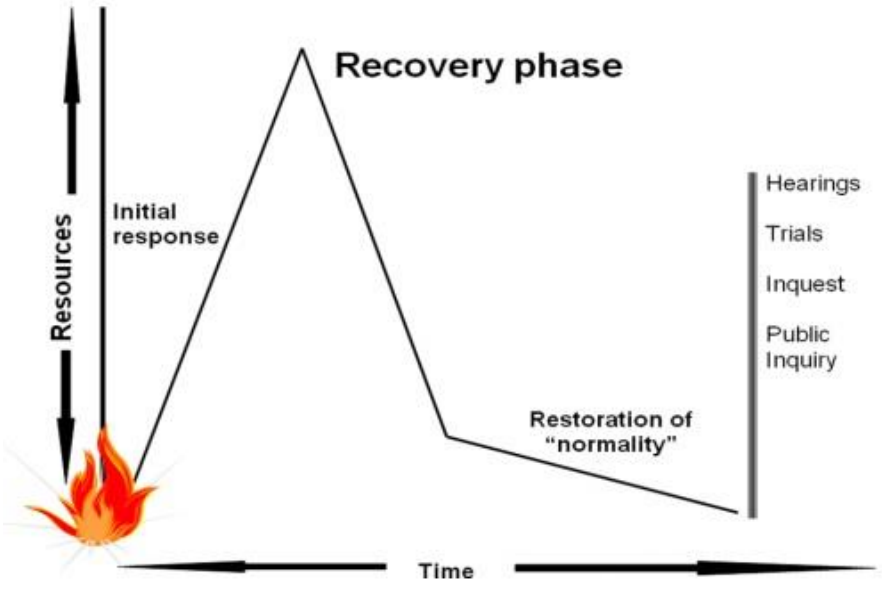


Figure 14: Overview of Incident Response and Recovery phase of managing an incident *(Source: UK Recovery Handbook for Chemical Incidents)*

Functions of Recovery

For the purpose of effective coordination, aspects of recovery are conceptually grouped into four functions. It is important to acknowledge that the four functions of recovery overlap and recovery arrangements must reflect the inter-relationship between each of these functions.

Infrastructure

Infrastructure, or built environment, recovery includes repair and reconstruction of residential and public buildings, commercial, industrial and rural buildings and structures, government structures, utility structures, systems and services (transport, water, sewage, energy, communications), and other essential services.

Human-Social

Human-social recovery includes personal support and information, physical health and emotional, psychological, spiritual, cultural and social well-being, public safety and education, temporary accommodation, and financial assistance to meet immediate individual needs.

Economic & Livelihood

Economic recovery includes renewal and growth of the micro economy (within the affected area) and the macro economy (overall economic activity of the state). Economic recovery includes individual and household entities (e.g. employment, income, insurance claims), private and government business enterprises and industry. It includes assets, production and flow of goods and services, export of goods and services from the affected region, and securing confidence of overseas markets.

Environment

Environment, or natural environment, recovery includes restoration and regeneration of biodiversity (species and plants) and ecosystems, natural resources, environmental infrastructure, amenity/aesthetics (e.g. scenic lookouts), culturally significant sites and heritage structures. It includes management of environmental health, waste, contamination, pollution and hazardous materials.

Transition from Response to Recovery

The after-stage of response is defined as the period when there is no further requirement for the coordination of response activities. As recovery activities begin within the response phase,

it also signals the transition from response to recovery mode. In this transition the emergency is declared over and the IRT hands over the planning and operations to the relief commissioner or others as appointed by the chief secretary. Careful planning and handover is essential with proper documentation for a successful transition. The major steps taken during transition are as follows:

1. Preliminary Damage Assessment: State should deploy multidisciplinary team to determine the extent of damage to communities.
2. Aids & Assistance: Identification of the type of public or individual assistance necessary in an emergency declaration. These can be housing, grants, low-interest loans, relocation, unemployment assistance, food commodities, or legal services. Also includes assistance for community such as debris removal, emergency protective measures, roads and bridges, drinking water, buildings and equipment, and other utilities.
3. Mobilization of essential resources: Coordinate and ensure mobilization of essential resources to a temporary location of emergency mass care where impacted survivors of disasters go for limited services and information within 24- 96 hours following the disaster. Such temporary locations could be termed as “Disaster Recovery Centre”. Their responsibility can be shared by the affected district, state and central authorities.
4. Community Groups: Community groups should be deployed in the affected community areas to disseminate information. They will identify and report local unmet human needs and assist survivors.
5. Expenditure: Estimation of cost to be incurred by the agencies responsible for relief and recovery should be made.

Counselling & Rehabilitation of Victims

The psychological impact of a chemical disaster manifests as psychosocial trauma including psychological reactions, post-traumatic stress disorder, and other psychological ailments in displaced disaster victims which needs to be addressed. Counselling by psychologists and psychiatrists for those suffering from mental trauma is an essential element of medical rehabilitation.

Immediate Financial Relief to Victims

Under the Public Liability Insurance Act, 1991, MOEF has published the list of chemicals and threshold qualities beyond which the occupier or owner must take third party PLI for providing relief to accident victims as per the direction of the collector. The Act also provides for an

Environment Relief Fund (ERF) and enables payment of relief over and above the insured amount. The occupier or owner should pay an amount equal to the PLI premium to the ERF and deposit the same with the insurer. At state level GPCB is responsible to ensure compliance with PLI Act and at district level the collector and regional officer of GPCB are responsible.

This act provides for immediate access to relief funds so that the compliance with Act should be verified and strengthened. We have already recommended that the maximum liability under the Act (currently Rs 5 cores) should be substantially enhanced.

Penalties & Compensation

Beyond the immediate relief through provisions of PLI Act, the major compensation for disaster victims comes from the Prime Minister's Relief Fund and National Disaster Response Fund. State Government also provides compensation for disaster victims through the State Disaster Response Fund. According to a strict concept of liability, the industries responsible for the accident are liable to pay compensation to victims. Therefore, legal actions can be initiated against the occupier for additional compensation.

Restoration & Regeneration of Ecosystem

The potential of chemical accidents to cause severe environmental damage has been realized on a number of occasions such as at Seveso, Bhopal, Mexico City (LPG disaster), Chernobyl, and Alaska (Exxon Valdez). For the remediation of the affected environment, it is essential to assess the environmental impacts, which includes determining the quantitative and qualitative nature of impact, and ascertaining the components of the environment most at risk from chemical accidents. This assessment is dependent on certain factors such as the chemicals involved, pollutant concentrations in the environment, environment media polluted by the accident, topography, and meteorology. After assessing the impact, the government can choose the appropriate recovery strategy.

Reconstruction of Damaged Structures & Services

Major and catastrophic fires and explosions can result in significant damage to structures although less in extent compared to natural disasters. Reconstruction offers us a chance to build back better and safer. Reconstruction and restoration of infrastructure shall be achieved at the earliest as per the following guiding principles laid out in the national policy on disaster management.

1. Consideration should be given in planning to open spaces, water and sanitation infrastructure health care facilities, education infrastructure and roads.
2. Reconstruction plans should be a participatory process involving the government, affected community, NGOs and the corporate sector. After the planning process is over, owner driven construction is a preferred option but as per the guidelines and specifications in the plan.
3. Essential services and intermediate shelters/ camps should be established in the shortest possible time. The restoration of normalcy and day-to-day functioning is an important factor for consideration. For permanent reconstruction, the relocation option should be considered in case the affected community was in the highly vulnerable zone (e.g. squatters or developments within buffer zone around a company). In case of large chemical facility, the community may be persuaded to shift to a distance further away from the unit. The structure and electrical safety audit of all damaged building should be done and they should be repaired accordingly. New construction should ideally be completed within 2-3 years.

Objectives of the lesson

The primary objectives of this lesson would be to make participants understand:

- Functions of Recovery
- The transition involved from Response to Recovery
- Need of Counselling & Rehabilitation of Victims
- Restoration & Regeneration of Ecosystem
- Reconstruction of Damaged Structures & Services

Duration 45 minutes

Methodology

This session is an informative session which would involve the trainer doing most of the knowledge sharing. However, the trainer must also ensure that he helps the participants to correlate the concepts in the case study on Bhopal Gas Tragedy mentioned in next learning unit.

Training aid Power-point presentation & Flip Chart

(Source: Department of Bhopal Gas Tragedy Relief and Rehabilitation, Govt. of Madhya Pradesh)

Flow of Session

On a cold wintry night of December, 2nd /3rd December, 1984, when the residents of capital city of Bhopal went to their beds, they had no inkling that many of them were doing so for the last time. Not far from them in the factory of Union Carbide (India) Limited, a chemical reaction had already started to that end. At around midnight, this chemical reaction culminated in the leakage of deadly Methyl Isocyanate (MIC) gas from one of the tanks of the factory. A cloud of gas gradually and surely started descending and enveloping the city in its lethal folds. And soon all hell broke loose. The city of hills and lakes turned into a gas chamber. Bhopal was witnessing the worst ever industrial disaster.

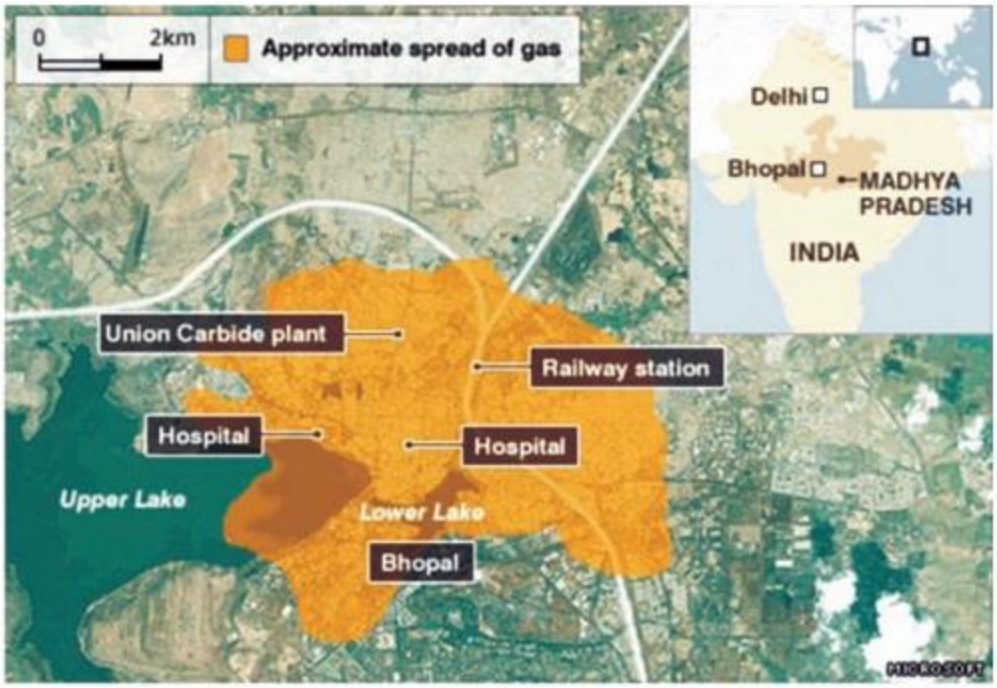


Figure 15: The Extent of the Affected Area

The Aftermath

On the morning of December, 3, the whole world learnt about the holocaust in shocked disbelief. The tragedy took an immediate toll of about 3000 innocent lives and left thousands and thousands of innocent citizens physically impaired or affected in various degrees. Livestock were killed, injured and infected. Business were interrupted. Environment was

polluted and the ecology affected with flora and fauna disturbed. Such was the enormity of the tragedy that all available instruments in the field of health care, administration and law were found to be inadequate.

Figure 13: 'Bhopal Gas Disaster Girl' Photographed by Pablo Bartholomew

The State Takes Over

It became apparent on the very first day of the tragedy that an exclusive administrative machinery was needed to tackle the aftermath of the disaster. An ad hoc administrative machinery was created almost immediately and it rendered yeoman service in organizing relief and in restoring confidence among the citizens of Bhopal. The first few weeks, however, demonstrated clearly that the problems created by the disaster would persist for a long time and a special administrative set up would be needed to tackle them. Thus, early in 1985 a **Department of Bhopal Gas Tragedy Relief and Rehabilitation** was created under the charge of the Chief Minister to undertake the colossal task of relief and rehabilitation.

At present, the Department is under the charge of a Cabinet Minister of the State Government. A Principal Secretary of the State Government has been entrusted with the Department. A Directorate of Gas Relief and Rehabilitation has been set up to ensure proper coordination between the Department and the field formations. The entire MIC affected area spread over 36 wards and having a population of more than six lacs has been placed under the charge of Director, Gas Relief and Rehabilitation. The disaster area has also been constituted into a medical district under the charge of a Chief Medical Officer to coordinate and supervise the working of all the medical units created to look after the victims of the gas. The administrative

machinery created for the disaster area has helped cut down response time drastically. The involvement of public men and the creation of a special administrative machinery has enabled organization of systematic relief and rehabilitation in the disaster area. Voluntary agencies have helped in a big way in providing relief and rehabilitation. They were in the field from the very night of the disaster and they are still at work in the disaster area.

Recovery & Rehabilitation

Health care

The Government of India had focused primarily on increasing the hospital-based services for gas victims thus hospitals had been built after the disaster. When UCC wanted to sell its shares in UCIL, it was directed by the Supreme Court to finance a 500-bed hospital for the medical care of the survivors. Thus, Bhopal Memorial Hospital and Research Centre (BMHRC) was inaugurated in 1998 and was obliged to give free care for survivors for eight years. BMHRC was a 350-bedded super specialty hospital where heart surgery and hemodialysis were done. Eight mini-units (outreach health centers) were started and free health care for gas victims were to be offered until 2006. Sambhavna Trust is a charitable trust, registered in 1995, that gives modern as well as ayurvedic treatments to gas victims, free of charge.

Environmental rehabilitation

When the factory was closed in 1986, pipes, drums and tanks were sold. The MIC and the Sevin plants are still there, as are storages of different residues. Isolation material is falling down and spreading. The area around the plant was used as a dumping area for hazardous chemicals. In 1982 tube wells in the vicinity of the UCIL factory had to be abandoned and tests in 1989 performed by UCC's laboratory revealed that soil and water samples collected from near the factory and inside the plant were toxic to fish. Several other studies had also shown polluted soil and groundwater in the area. Reported polluting compounds include 1-naphthol, naphthalene, Sevin, tarry residue, mercury, toxic organochlorines, volatile organochlorine compounds, chromium, copper, nickel, lead, hexachloroethane, hexachlorobutadiene, and the pesticide HCH.

In order to provide safe drinking water to the population around the UCIL factory, Government of Madhya Pradesh presented a scheme for improvement of water supply. In December 2008, the Madhya Pradesh High Court decided that the toxic waste should be incinerated at Ankleshwar in Gujarat, which was met by protests from activists all over India. On 8 June

2012, the Centre for incineration of toxic Bhopal waste agreed to pay ₹250 million (US$3.5 million) to dispose of UCIL chemical plants waste in Germany. On 9 August 2012, Supreme court directed the Union and Madhya Pradesh Governments to take immediate steps for disposal of toxic waste lying around and inside the factory within six months.

A U.S. court rejected the lawsuit blaming UCC for causing soil and water pollution around the site of the plant and ruled that responsibility for remedial measures or related claims rested with the State Government and not with UCC. In 2005, the state government invited various Indian architects to enter their "concept for development of a memorial complex for Bhopal gas tragedy victims at the site of Union Carbide". In 2011, a conference was held on the site, with participants from European universities which was aimed for the same.

Occupational and habitation rehabilitation

33 of the 50 planned work-sheds for gas victims started. All except one was closed down by 1992. 1986, the MP government invested in the Special Industrial Area Bhopal. 152 of the planned 200 work sheds were built and in 2000, 16 were partially functioning. It was estimated that 50,000 persons need alternative jobs, and that less than 100 gas victims had found regular employment under the government's scheme. The government also planned 2,486 flats in two- and four-story buildings in what is called the "widow's colony" outside Bhopal.

Economic rehabilitation

Immediate relieves were decided two days after the tragedy. Relief measures commenced in 1985 when food was distributed for a short period along with ration cards. Madhya Pradesh government's finance department allocated Rs. 874 million (US$12 million) for victim relief in July 1985. Widow pension of Rs. 200 (US$2.80)/per month (later Rs. 750 (US$11)) were provided. The government also decided to pay Rs. 1,500 (US$21) to families with monthly income Rs. 500 (US$7.00) or less. As a result of the interim relief, more children were able to attend school, more money was spent on treatment and food, and housing also eventually improved. From 1990 interim relief of Rs. 200 (US$2.80) was paid to everyone in the family who was born before the disaster.

The final compensation, including interim relief for personal injury was for the majority Rs. 25,000 (US$350). For death claim, the average sum paid out was Rs. 62,000 (US$870). Each claimant was to be categorized by a doctor. In court, the claimants were expected to prove "beyond reasonable doubt" that death or injury in each case was attributable to exposure. In

1992, 44 percent of the claimants still had to be medically examined. By the end of October 2003, according to the Bhopal Gas Tragedy Relief and Rehabilitation Department, compensation had been awarded to 554,895 people for injuries received and 15,310 survivors of those killed. The average amount to families of the dead was $2,200. In 2007, 1,029,517 cases were registered and decided. Number of awarded cases were 574,304 and number of rejected cases 455,213. Total compensation awarded was Rs. 15,465 million (US$220 million). On 24 June 2010, the Union Cabinet of the Government of India approved a Rs. 12,650 million (US$180 million) aid package which would be funded by Indian taxpayers through the government.

Objectives of the lesson

The primary objectives of this lesson would be to tell participants about the social, economic and environmental losses incurred in Bhopal Gas tragedy and subsequent recovery and rehabilitation efforts taken by National and State Govt.

Duration 45 minutes

Methodology

Trainer can use video clippings and other medium to give an idea about the wrath that can be caused by chemical & industrial disaster. Participants can visit website of recovery and rehabilitation efforts taken by National and State Govt. A brainstorming can be initiated to list steps that are needed to prevent such mishap in future.

Training aid Power-point presentation & Flip Chart

POST -TRAINING EVALUATION & CONCLUSION

Context & Description

At the end of the training, evaluation of the knowledge, skill and attitude of the participants would determine their exit behaviour. The level of increase of knowledge and skill from the inputs given through the training has to be evaluated. Feedback from trainees regarding the training and related facilities would help in modifying future modules to make it more effective.

Objectives

- To assess the exit behaviour of the participants at the end of the course.
- To evaluate the knowledge and skills gained during the course.
- To carry out formal internal evaluation

Duration: 75 minutes

Methodology

Any one of the following methods can be followed, according to the trainers' discretion:

- Formal structured questionnaire – Each trainee is asked to fill up a structured questionnaire that evaluates their knowledge gained through the course.
- Quiz on the course – Divide into groups and give points for correct answers. The group that wins, gets a small prize.
- Informal discussion– The trainees divide into groups and identify the key learning points of the training and write them on a flip chart. After they finish, they move on to the next flip-chart and add or comment on the points raised by other groups. At the end of the exercise, all the points are collated by the trainer and discussed.

Trainers' Note and Session Plan

The session should be covered in two parts; evaluation of knowledge and exit behaviour and feedback of the training. The first 30 minutes of the training should be devoted to evaluation of knowledge gained during the course of the programme through any of the methods described above. The last 30 minutes should be devoted to taking feedback from the trainees and their suggestions for more effective implementation of training in future.

This can be done either through a structured questionnaire or through discussion wherein the training team notes down the suggestions of participants.

Training/ Performance Aids

Depending on the methodology chosen:

• Copies of pre-decided questionnaires or

• Flip charts, Markers, Tag-boards to pin the handouts

This successfully concludes the "Training Programme on Chemical Industrial Disaster Risk Management".

A formal closing ceremony can be organized according to the protocol/ tradition followed by the host organization after the conclusion of the course.

GUJARAT INSTITUTE OF DISASTER MANAGEMENT

BUILDING RESILIENCE

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