
UNIT 3 TYPES OF DISASTER-II (OTHER INCLUDING HUMAN MADE)

Types of Disaster-II
(Other Including Human Made)

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3.0 OBJECTIVES

After reading this unit, you should be able to:

- explain the salient features of man-made disasters;
- describe the implications of Chemical, Biological, Nuclear and other human induced disasters;
- explain the general threat perceptions of man-made disasters;
- list various preparedness and mitigation measures for combating such man-made disasters;
- chalk out response strategy for such disasters; and
- list down Do's and Don'ts for man-made disaster emergencies.

3.1 INTRODUCTION

In the decade 1990-2000, an average of about 4344 people lost their lives and about 30 million people were affected by disasters every year. A Hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (DM Act, 2005) and these hazards can include conditions that may lead to future threats and can have different origins:

- Natural (geological, hydro-meteorological)
- Induced by human process or man-made (environmental degradation and technological hazards)

A Disaster is an event of nature (hazard) or man-made cause that leads to sudden disruption of normal life of society, causing damage to life and property, to such an extent that normal social and economic mechanisms available are inadequate to restore normalcy (DM Act, 2005). Floods, droughts, cyclones, earthquakes, landslides and avalanches are some of the major natural disasters that repeatedly and increasingly affect globally. On the other hand, the fast pace of growth and expansion without preparedness has brought forth a range of different kinds of issues which seek urgent attention at all levels. In the absence of such preparedness measures, the growing numbers in our population are at a risk of prospective hazards such as air, rail or road accidents, boat capsizing, building collapse, electric fires, festival related disasters, forest fires, mine flooding, oil spills and serial bomb blasts besides nuclear, chemical and biological threats which are apparent in the present scenario. Considering the above, In India, a High Power Committee (HPC) was constituted at the behest of the Prime Minister by the Ministry of Agriculture in August 1999 under the Chairmanship of Shri J.C. Pant and had members from various Ministries, States, NGOs and experts from relevant fields. It was the first attempt in India towards evolving a systematic, comprehensive and holistic approach towards all disasters. Classifications of disasters identified by this HPC (HPC Report 2001) are as follows:

a) *Water and Climate related disasters:*

Floods and Drainage Management, Cyclones, Tornadoes and Hurricanes, Hailstorm, Cloud Burst, Heat Wave and Cold Wave, Snow Avalanches, Droughts, Sea Erosion and Thunder and Lightning.

b) *Geologically related disasters:*

Landslides and Mudflows, Earthquakes, Dam Failures/ Dam Bursts, Mine Fires.

c) *Chemical, Industrial and Nuclear related disasters:*

Chemical, Industrial and Nuclear Disasters.

d) *Accident related disasters:*

Forest and Urban Fires, Mine Flooding, Oil Spill, Major Building Collapse, Serial Bomb Blasts, Festival related disasters, Electrical Fires, Air, Road and Rail Accidents, Boat Capsizing and Village Fire.

e) *Biologically related disasters:*

Biological Disasters and Epidemics, Pest Attacks, Cattle Epidemics, Food Poisoning.

Types of Man-made disasters and concerned Nodal Ministry

Man-made Disaster	Nodal Ministry
Air Accidents	Ministry of Civil Aviation
Civil Strife	Ministry of Home Affairs
Railway Accidents	Ministry of Railways
Chemical Disasters	Ministry of Environment and Forests
Biological Disasters	Ministry of Health
Nuclear Accident	Dept. of Atomic Energy
Natural Disasters	Ministry of Agriculture

(Source: HPC Report; GoI, 2001)

3.2 NUCLEAR DISASTERS

The occurrence of nuclear or radiological disaster is of the great concern. It is accompanied with sudden release of huge amount of harmful radiations or radioactive materials (Isotopes of Cesium, Cobalt, Iridium, Iodine, Strontium, Uranium, Plutonium etc.) or both together in environment in a small area. It is described as a disaster caused due to an extraordinary emission of radioactive material or radiation either through explosion of a nuclear bomb or in the operation of nuclear reactors and other nuclear related activities (Simone, 2006).

Causes

Intentional Use of Nuclear Weapons in the event of war: With the advancement of scientific research, several countries have acquired the technology to produce Nuclear Arms, which are more destructive and harmful than the atom bomb used more than half a century ago. Nuclear bombs have openly been used twice, both times by the United State against Japan during World War II (1939-1945). On August 6, 1945, the city of Hiroshima was almost completely destroyed, and three days later the city of Nagasaki was bombed.

Accidental Explosion of Nuclear Weapons: Nuclear weapons are designed with great care to explode only when deliberately armed and fired. Nevertheless, there is always a possibility that, as a result of accidental circumstances, an explosion will take place inadvertently and such accidents might occur in areas where weapons are assembled and stored, during the course of loading and transportation on the ground, or when actually in the delivery vehicle, e.g., an airplane or a missile.

Accidents in Nuclear Power Project: There is also a risk of accidental exposure to harmful radiation from the several nuclear reactors used for generation of power. The potential threat from an accident at a nuclear power plant is exposure to radiation which would occur from the release of radioactive material into the environment and the area affected would depend on the amount of the release, wind direction and speed and weather conditions.

Terrorist Attacks or Dirty Bombs: Through use of 'Radiological Dispersion Device' (ROD), an expedient weapon, wherein radioactive material is disseminated by using conventional explosives and debris is subsequently scattered across the targeted area. Also through other modes like attack of the nuclear power plant or facility using or processing radioactive material via air craft strike or bombardment with heavy munitions or sabotage (Source: India Disaster Knowledge Network Portal, 2008 <http://192.168.0.118/idknnew/>).

Response

The emergency response actions will focus on reducing the effects of immediate effect that shall comprise- fire, destruction, damaged vegetation, dead, wounded human beings and animals, psychological phobia. This demands judicious planning, and multi-faceted preparations that shall include store management, training, communication and command, etc surmount the nuclear emergency.

Do's and Don'ts

Do's:

- Plug ears, save skin from heat, put on head gear, know the explosion site and go away from ground zero, breath normally, stay calm.
- Lie down on ground with face down - head away from ground zero, cover face with handkerchief. It will avoid internal contamination

- If in shelter, close doors/windows, switch off AC and remain inside, evacuate, relocate, fallout may continue for more than 24 hours depending upon weather.
- Go underground to reduce external radiation and avoid external contamination. (Wet sand and 30 cm earth give 20 P.F.).
- If contaminated, remove clothes and put them in poly bags, take showers, stay in tunnels, trenches, foxholes, tents vehicles decontaminate food or areas. (Covered items like bread, butter, jam can be consumed after removing wrapper.
- Put on mask to avoid inhaling contaminated air.
- Put on protective suits, if available help injured. Become part of rescue team.
- Consume Bio-protectors like KI, KIO₃, Beer, Tulsi, Arnica, Caffein, Diltiazem, Vitamin C/E, podophylum.
- Get treatment for burn, cut and other injuries.
- Keep monitoring radiation level/radiation dose

Don'ts:

- Do not look at blinding flash, don't go in to cloud/rain/fog.
- Do not run or get panicky.
- Do not spread rumours.
- Do not crowd the site: Keep away.
- Do not crowd hospitals/road/areas.
- Know the explosion site and do not go in downwind direction.
- Do not go to radioactive contaminated area.
- Do not remain in open air. Water is a good neutron shield.
- Do not spread radioactive contamination (External and Internal).

3.3 FOREST FIRES

The word “wildfire” originated as a synonym for Greek fire, a napalm-like substance used in medieval Europe as a naval weapon. Forests face many hazards but the most common hazard is fire. They pose a threat not only to the forest wealth but also to the entire regime of fauna and flora seriously disturbing the bio-diversity, the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twigs, which would burst into flames ignited by the slightest spark. The Himalayan forests particularly Garhwal Himalayas of Uttaranchal State have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region. Forest fires can be either natural or controlled and caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect). Sometimes, forest fires are intentionally or purposely caused by local inhabitants for their selfish motives.

Vulnerable Himalayan States of India towards Forest Fire (*ha- Hectares)

S.No.	State	Total land Area (ha*)	Forest area Recorded (ha*) %	Total cropped area (ha*)
1	Manipur	2211000	602000 (27.23)	186000
2	Arunchal Pradesh	8374300	5154000 (61.55)	167369
3	Himanchal Pradesh	3367600	1046900 (31.09)	974800
4	Assam (Hill Distt)	1522200	296200 (19.46)	169300
5	Sikkim	710000	257000 (58.95)	152000
6	Meghalaya	2243000	940000 (41.91)	241000
7	Mizoram	2102000	1303000 (61.99)	65000
8	Tripura	1049169	606168 (57.78)	456000
9	Nagaland	1513774	862532 (56.98)	200500
10	Uttaranchal	5358595	3424857 (63.91)	1099306
11	Jammu & Kashmir	4505000	2747000 (60.98)	1066000

* *Source:* Manual on Natural Disaster Management in India, NDM Division, IIPA, GoI, 2005

Causes

Forest Fires are, not an unusual phenomenon, they occur regularly, especially in summers, throughout the world. Forest fires can broadly be classified into three categories:

- Natural or controlled forest fires.
- Forest fires caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect) and
- Forest fires purposely caused by local inhabitants.

Many forest fires start from natural causes such as “Lightning” which set trees on fire. Periodic lightning induced fires have been recorded throughout history from India, South eastern and Central United States, Australia, Finland and Eastern and Southern Africa. Most forest fires are the result of human neglect caused by casual throwing away of a smoldering bidi, cigarette butt or a spark from a picnicker's open hearth in a desiccated forest can often be sufficient to start a fire in summer. Such fires usually start on the ground as the dry litter (senescent leaves and twigs) catches fire easily. Then, flamed by strong winds, the flames soon engulf vast tract forest turning them to ashes and, therefore, cause extensive damage unless controlled in time (Luna, 2007).

Types of Forest Fire

Forest fires differ depending upon its nature, size, spreading speed, behavior etc. basically this can be sub-grouped into four types depending upon their nature and size as follows (Source: Manual on Natural Disaster Management in India, NDM Division, IIPA, GoI, 2005):

- 1) **Underground Fire:** Underground fire is the fire of low intensity consuming the organic matter beneath and the surface litter of forest floor is sub-grouped as underground fire. In most of the dense forests occurring in the wetter parts

of Himalayas, a thick mantle of organic matter is found on top of the mineral soil. This fire spreads in by consuming such materials. These fires usually spread entirely underground and burn for some meters below the surface and spreads very slowly and in most cases it becomes very hard to detect and control such type of fires. They may continue to burn for months and destroy vegetative cover of the soil. The other terminology for this type of fire is *Muck fires* while in some countries; it is referred to as *Ground fires*.

- 2) **Surface Fires:** Surface fire is the most common forest fires that burn undergrowth and dead material along the floor of the forest. In general it is very useful for the forest growth and regeneration. If grow in size this fire not only burns ground flora but also results to engulf the undergrowth and the middle story of the forest. Surface fires spread by flaming combustion through fuels at or near the surface- grass, dead and down limbs, forest needle and leaf litter, or debris from harvesting or land clearing. Thus a surface fire is “A fire that burns surface litter, other loose debris of the forest floor and small vegetation. This is the most common type of fire in timber stand of all species. It may be a mild, low-energy fire in sparse grass and pine needle litter, or it may be a very hot, fast moving fire where slash, flammable under story shrubs or other abundant fuel prevails. A surface fire if spreads, may burn up to the taller vegetation and tree crowns as it progresses”.
- 3) **Ground Fires:** There is no clear distinction between underground and ground fires. The smoldering for sometime under ground fires changes into Ground fire. This fire burns root and other material on or beneath the surface i.e. burns the herbaceous growth on forest floor together with the layer of organic matter in various stages of decay. They are more damaging than surface fires and they can destroy vegetation completely. These fires are fires in the sub-surface organic fuels, such as duff layers under forest stands, Arctic tundra or taiga, and organic soils of swamps or bogs. Ground fires burn underneath the surface by smoldering combustion and are most often ignited by surface fires. Thus a Ground Fire consumes the organic material beneath the surface litter of the forest floor and fighting such fires is very difficult and tedious job.
- 4) **Crown Fires:** Crown fire is the most unpredictable fire, which burns the top of trees and spread rapidly by wind. In most of the cases surface fires invariably ignite these fires. Thus a Crown Fire is a fire that advances from top to top of trees or shrubs more or less Independently of the surface fire. In dense conifer stands on steep slopes or on level ground, with a brisk wind, the crown fire may race ahead of the supporting surface fire. This is most spectacular kind of forest fire. Since it is over the heads of ground force it is uncontrollable until it again drops to the ground, and since it is usually fast moving it poses grave danger to the fire fighters becoming trapped and burned.
- 5) **Firestorms:** Among the forest fire, the fires spreading most rapidly are the firestorm, which is an intense fire over a large area. As the fire burns, heat rises and air rushes in, causing the fire to grow. More air makes the fire spin violently like a storm. Flames fly out from the base and burning ember spew out the top of the fiery twister, starting smaller fires around it. Temperatures inside these storms can reach around 2,000 degrees Fahrenheit.

Do's and Don'ts:

What to do BEFORE and DURING Fire:

- Try to maintain FOREST BLOCKS to prevent dry litter from forests during summer season.
- Try to put the fire out by digging or circle around it by water, if not possible to call a Fire brigade.

- Move farm animals and movable goods to safer places.
- During fire listen regularly to Radio for advance information and obey the instructions cum advice.
- Forests Officials, Local people and Tribals living in Forests should play a constructive role before, during and after the fire of the Forest.
- Follow the effective monitoring and warning systems (including remote sensing for curing or drying out of vegetation).
- Teach the causes and harm of fire to your family and others.
- Do not be scared when a sudden fire occurred in the Forest, be calm, encourage others and community to overcome the problem patiently.
- Do apply seasonal mitigation measures i.e. Fuel reduction.

What one should not do:

- One should not throw smoldering cigarette butt or bidi in the forests.
- Do not leave the burning wood sticks.
- Don't enter the forest during the fire.
- Do not leave the dry litter during summer season.
- Tribals should not use Slash and Burn method indiscriminately on large scale.

3.4 STAMPEDE

A stampede is an act of mass impulse among a crowd of people in which the crowd collectively begins running with no clear direction or purpose. Stampedes are believed to originate from biological responses in the brains and endocrine systems of the crowd and this large stampede will frequently destroy anything in its way. By an analogy, the term human stampede is applied to a sudden rush of a crowd of people, usually resulting in many injuries and death from suffocation and trampling. In stampede the term mob or crowd is used to refer to a congregated, active, polarized aggregate of people, which is basically heterogeneous and complex. Its most salient features include homogeneity of thought and action among its participants and impulsive and irrational actions by its participants. The two major behavioral reasons of any stampede are anxiety and panic. They are manifestation of our inborn “flight or fight” system, which is essential to our survival. Just as physical pain alerts us to diseases, so anxiety, panic and alarm alerts us to any sign of danger. Panic can appear to come from nowhere at all, but all that stampede needs is a small trigger caused by panic, such as feeling loneliness and helpless in a crowd, or trapped in an auditorium, staircase etc resulting in a truly horrible feeling which has an immediate effect on bodily functions. Nervousness can act as an addendum for such acts whereby people act baselessly seeing others rather than thinking for themselves.

Types of Stampede

Incidents of stampedes can occur in numerous socio-cultural situations. The causes and gravity of these situations vary from each other. The following list provides a fair idea about various types of situations where stampedes can occur:

- Air raid shelter
- Entertainment events

- Escalator and moving walkways
- Food distribution
- Funeral procession
- Natural disasters
- Power failure
- Religious events
- Fire incidents in religious/other events
- Riots
- Sports events
- Weather related

Causes

Causes of stampedes can be better understood through the FIST MODEL, which describes the primary elements involved in crowd disasters. In other words, the elements provide a model for understanding the causes of crowd disasters, means of prevention, and possible mitigation of an ongoing crowd incident. The acronym “FIST” is defined as follows: FORCE (F) of the crowd, or crowd pressure; INFORMATION (I) upon which the crowd acts or reacts, real or perceived, true or false; SPACE (S) involved in the crowd incident, standing area, physical facilities - stairs, corridors, escalators; TIME (T) duration of incident, event scheduling, facility processing rates.

Dos’ and Don’ts:

- One must be very alert to the fact that some pilgrims of certain nationalities come in bunches and batches and push their way through. Pilgrims should not get into their way or try to stop them as one could get harmed in the process. It will be more sensible to avoid their path and wait till they get out.
- It is advisable to move in groups from the camps with the assistance of the controlling authority or group leader or police person.
- Do not try to go against the direction of the crowd. Move with the crowd.
- Do not lose temper and do not fight with others. If required, pilgrims can retrace steps after the rush has passed.
- Understand the evacuation routes, emergency exits and layout of the place of event.
- Keep calm. Don’t panic.
- In case of emergency do not run.
- Think before you do. Do not just blindly follow others.
- Open area is safer. On exit try to get away in diverse directions.
- Follow instructions given by the authorities, public address system etc.
- Do not spread rumors.
- Assist and collaborate with the organizers, authorities, fire services. Police etc.
- Try to help others in your best capable way.

3.5 EPIDEMICS

The prevalence of a disease is the number of diseased individuals at any one time (point prevalence) or over a given period (period prevalence). Individual cases of disease in widely separated geographic areas or otherwise independent cases are said to be sporadic. The term epidemic has been derived from two Greek words, “Epi” means “upon” and “Demos” means “people”. Thus, an epidemic of an infectious disease is the occurrence of a number of cases of a disease, known or suspected to be of infectious origin, that is unusually large or unexpected for the given place or time. An epidemic often evolves rapidly and requires a susceptible human population, the presence of a disease agent, and the presence of a mechanism or mode of large-scale transmission (e.g. contaminated water supply, poor sanitation and vector population). This definition covers the usual epidemic diseases such as, measles, chickenpox, and cholera, which are compressed in time, but also the modern “slow” epidemics of non-communicable diseases like diabetic, heart attacks, and depression. Common cold is endemic in northern latitudes. Cholera and malaria are endemic diseases in some parts of India. Infectious diseases are major causes of morbidity and mortality in many parts of our country.

Types of Epidemics

There are two major types of infectious diseases which can develop into epidemics: “*common source*” and “*host-to-host*”. Common source epidemics arise from a contaminated source, such as water or food, while host-to-host infections are transmitted from one infected individual to another via various, perhaps indirect routes. Common source epidemics usually produce more new cases earlier and faster than host-to-host epidemics. Host-to-host epidemics are slower to grow and slower to diminish. Anything causing disease is called a *pathogen*. A vector is an organism that serves as an intermediary in the transmission of a host-to-host disease. For instance, many infections are transmitted by mosquitoes, fleas, ticks, etc. to people. A fomite is any inanimate object that adheres to or transmits infectious material, e.g., bedding, clothing, surgical instruments, etc.

Check Your Progress I

Note: Use the space provided for your answer.

- 1) List two or three different communicable diseases and categorize them based on source or point-to-point epidemics

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Impact

Epidemics and outbreaks of different communicable diseases have plagued mankind since time immemorial. According to estimates made by World Health Organization, worldwide 17 million deaths were attributed to infectious diseases during 1997;

hundreds of million were disabled and incapacitated with economic loss that defies any precise calculations. Advances in public health and medicine, sanitation and vector control have led to considerable prevention and control of these diseases in some countries, but have had minimal impact in the majority of developing countries of the world due to lack of funds. Moreover, within a country, there continues to be enormous disparities in mortality, disability and exposure to infection among social classes with the poor, socially backwards and children suffering extremes of ill-health in all societies.

Increased rates of morbidity and mortality due to communicable diseases occur more frequently in association with complex emergencies than other disasters. In many of these settings, especially those occurring in developing countries, between 60% and 90% of deaths have been attributed to one of four major infectious causes: measles, diarrhoea, acute respiratory infections and malaria. Acute malnutrition is often associated with increased case fatality rates of these diseases, especially among young children. There have also been outbreaks of other communicable diseases, such as meningococcal meningitis, yellow fever, viral hepatitis and typhoid, in certain settings.

Mitigation Measures

Significant improvements have taken place in health services in India during the past 58 years.

Current system of surveillance and mechanism to control the outbreak of endemic diseases: For diseases with significant mortality and morbidity, the federal government has launched national Programmes which include malaria, tuberculosis, leprosy etc. Though the funding, technical designing as well as monitoring is done by the Central Government, the responsibility of implementation of these programmes rests with the respective state governments.

National Programme for Surveillance of Communicable Diseases (NPSCD): Efforts have already been made by the Government of India to strengthen the health machinery for early detection of epidemic-prone diseases under its National Programme for Surveillance of Communicable Diseases. The Government of India has launched National Surveillance Programme for Communicable Diseases (NSPCD) during 1997-98 as Central Scheme. The main objective of this programme is capacity building at the state and district levels for early identification of outbreaks of communicable diseases and appropriate and timely response to these outbreaks. The programme is being implemented by the state governments through their existing infrastructure. Under the programme, the surveillance system is strengthened through training of medical and paramedical personnel, dissemination of technical information and guidelines, up-gradation of laboratories, modernization of communication and data processing systems.

A strong public health and surveillance system is required for quick detection and control of communicable diseases. At present the public health infrastructure in India is inadequately prepared to sense early warning signals of outbreak of an epidemic and to respond in time.

3.6 ACCIDENTS

Air Accidents

Air accidents are by and large of three types; mid-air collisions, forced landings, crash due to technical snags and air-crash in mountainous terrain due to poor visibility. While air accidents can occur at any time and at any place, areas within about 30 - 40 kms radius of airports are most vulnerable. Past experience shows

that majority of air accidents occur either during take-off or landing near about major airports where flight paths get congested. In addition, air accidents also take place at remote inaccessible places like forests, hilly and mountainous regions, high seas, etc. Causes of air accidents are either human failure of pilots, air traffic controllers or technical failures of on board, landing instruments. In rare cases it may also be the result of terrorist activities.

Boat Accidents

With the increase in volume of inland boats and sea fishing, boat capsizing is a distinct possibility. The factors, which contribute to this disaster have been identified as partly due to natural hazards such as cyclones or floods and greater part has been the due to man made causes such as over loading of the boat, poor quality of equipment in the boat, poor maintenance and consequent breakdown and of course human error of judgment. Boat accidents are found to occur mainly during the flood season, more so during bad weather and also under conditions of impaired visibility. Boats are more vulnerable during large gatherings such as melas, festivals etc. especially during their opening time when people want to reach early before its start or at closing time when there is a rush of people wanting to return home before night fall. Poor visibility at the time has also contributed to boat accidents especially those cases that take place due to collision. In many cases large number of boats gather during festivals, resulting in inadequate space for maneuvering the boat. Sometimes it may not be possible for authorities concerned to exercise full control on the river boat traffic due to non-availability of adequate security staff, logistic and other problems.

Oil Spills

Today the sea is being a key source of food, fresh water, and minerals including oil and natural gas and renewable energy. The rapid industrial growth in recent years and the tremendous increase in human population are generating huge quantities of waste materials to be disposed off from land. Thus, the use of marine environment as a dumping ground of waste material has been constantly on the increase and this has caused pollution of the marine environment. In addition to industrialization and increase in population, urbanization, deforestation, increase in number and size of ships, demand for oil, oily wastes arising from ships, tankers and offshore installation, chemicals and dangerous goods, dumping of nuclear waste and leakage of under water pipelines is a long list being one of the causes of marine pollution in our coastal waters. Areas having off shore oil installations, under sea pipelines, sea routes traversed by oil tankers, refineries and under ground pipelines for oil transportation are vulnerable to oil spills.

Rail Accidents

The Indian railways, is the largest railway system in Asia and the first largest railway system under a single management in the world. Railways is the principal mode of transport for both passengers and goods in the country. Railway is the life line of the nation particularly amongst the developing countries like India where infrastructure developments are accorded high priority to boost the nations wealth. The success of any transport organization is gauged by the parameters such as punctuality, reliability, safety, frequency and adaptability. In the course of the working, the railways are confronted with disasters arising out of cyclone, floods, fires, bomb blasts and accidents etc., involving trains. While a railway accident can occur at any stretch of railway track, experience has shown that portion of railway track having double line sections are particularly vulnerable to serious rail accidents.

Road Accidents

Both National and State Highways are particularly vulnerable to serious road accidents since it is on these stretches that high speed accidents occur. Apart from these, roads in hilly sections and ghat areas are also vulnerable to road accidents due to road vehicles falling into pits. The problem of road traffic accident has assumed alarming proportion with ever increasing number of motor vehicles competing for the limited paved space. The resultant congestion in traffic is inevitable and the consequences of congestion are road accidents. It is observed that loss of life and injuries in road accidents are high in developing countries as compared to the developed countries. It is interesting to note that while there is a reduction of deaths due to road accidents in the developed countries the picture emerging from the developing countries shows an abnormal increase. Road safety, as a problem, has been analyzed in many different ways. Prominent amongst them are the four basic elements; **1) Machine Factor, 2) Human Factor, 3) Engineering Factor and 4) Environment Factor.**

Causes

Air Accidents: Causes of air accidents are either human failure of pilots, air traffic controllers or technical failures of on board, landing instruments. In rare cases it may also be the result of terrorist activities.

Boat Accidents: Boat accidents occur mainly due to overloading, overcrowding, unruly behavior, panic amongst passengers and capsizing. Overloading of the boat results in very low freeboard allowing water to enter the boat easily. Flash-floods and strong currents in the river also result in boat accidents, especially in cases where there are no proper communication available with boat operators regarding the weather. A major cause for boat accidents is lack of safety consciousness on the part of crew, which leads to unsafe situations such as overloading, overcrowding, sailing in adverse weather and collision.

Oil Spills: Causes of oil spills are invariably leakage somewhere in the pipeline. Leakage in the pipeline in turn can be due to a variety of reasons such as sub-standard pipes, corrosion of metal, pipes having outlived their life, poor maintenance etc. Factors that contribute to oil spills are: **(a) Collision at sea:** Due to transit of number of tankers in the area to transport oil from oil extraction platforms, the eventuality of tanker collision off the coast resulting in spill and turning into major oil spill catastrophe cannot be ruled out, **(b) Oil extraction activities:** Defect/malfunctioning of oil extension pipe line/oil spill in the vicinity of oil extraction platform is ever present. The chances of these oil rigs coming under the attack of our enemies during the hostility further enhances the chances of oil spill disaster scenario. **(c) Grounding:** There have been number of instances where due to Navigational errors number of ships have run aground, **(d) Tanker routes pumping out of bilges:** Due to various oil tankers transiting, accidental discharge on the oil route can not be ruled out. Number of ships also find it convenient to pump out from bilges in Open Ocean and the bilges mostly contains the oil and **(e) Danger of spillage while transferring oil from ship to shore facilities:** Danger of oil spillage always loom large when the oil is being transferred from the offshore terminal to the ship and from the ship to shore facilities in various ports.

Rail Accidents: Causes in most cases are human failure. Factors that contribute to Rail accidents are:

- Breaches of tanks due to heavy rains
- Cyclone/flash floods
- Human failures

- Equipment failures
- Heavy rains leading to washing away of the track / collapse of bridges
- Land slides
- Breach of rules on unmanned railway level crossing
- Sabotage
- Tampering with track
- Act of God

Road Accidents: Causes in most cases are human failures and in a few rare cases these are caused by technical failures such as failure of brakes etc. Road accidents also occur under conditions of impaired visibility, slippery road surface etc.

Response Action

Accident victims succumb to injuries due to shock, bleeding and head injuries. If necessary first aid and replacement of fluid can be arranged within the first hour of injury many lives could be saved. *“The first hour is called the golden hour”*. Common injuries include crush injuries, fractures, bleeding and victims in a state of shock. In case of all accidents involving casualties and injuries:

- Inform the nearest traffic police station, post through passing vehicles on either side.
- Look for and rescue the injured or those still trapped inside.
- Arrange for transport of the injured to the nearest medical care center by first available means.
- Place dead bodies on one side to avoid obstructions.
- Traffic control should be organized locally using available manpower to avoid traffic jams.
- Discourage people from crowding near the accident spot.
- Prevent people from looting goods from the accident site.

Air Accidents: In cases where the accident occurs beyond visual contact of the Aerodrome Control Tower, information of such accident is preceded by information of aircraft missing or contact having been lost with the Air Traffic Control. Search operations are initiated with the help of the State Administration and local police of the area where the aircraft was last reported. In case of a mid-air collision or an air crash into mountainous terrain, not much rescue work is possible since most passengers on board would have perished instantaneously. In case of forced landing, some amount of rescue work would still be possible by means of evacuating passengers from the crippled air-craft and moving them to safety.

Boat Accidents: Rescue boat passengers, give first aid and rush to nearby hospitals. In situations, where it is not possible to provide rescue, relief operations at short notice, it becomes necessary that administrative authorities concerned should periodically review logistics and other arrangements that may be required for such operations. In cases, where the number of crew members on the boat and life saving equipments like life jackets, inflatable rafts etc. are inadequate, it forces the passengers to either swim or else wait for some form of rescue team to arrive from close by locations so, under these conditions, the only response possible has to be provided by local people living nearby in immediate vicinity of the waterway.

Oil Spills: Once an oil spill is reported, members of response and base team shall be notified and base control room should be established and contact numbers of base control room should be reported to all concerned for effective co-ordination. On-scene coordinator who should be a senior level executive trained in oil spill management must immediately take charge of base control room after reporting of spill.

Rail Accidents: The guard and driver of the train should inform the local divisional control office regarding occurrence of the above accident. Divisional office in turn must organize rescue and relief work by way of ordering Accident Relief Medical Van and Accident Relief Train to be rushed to the site of accident. Normally, it takes railway's medical and rescue teams 3 to 4 hours time to arrive at the accident site. During this initial period, it is the local population that helps organize rescue and relief work along with railway staff traveling on the accident affected train.

Road Accidents: In such cases involving passenger carrying vehicles: Inform the nearest traffic police station and fire brigade; Look for and rescue the injured or those trapped in vehicles; Arrange for transport of the injured to the nearest medical center, Place dead bodies on one side to avoid obstructions; Traffic control should be organized locally using available manpower to avoid traffic jams; Discourage people from crowding near the accident spot, In case such accidents involve hazardous chemical, do not go anywhere near the accident spot since contents may explode or catch fire and prevent people at the accident site from lighting matches for cigarettes etc.

3.7 TERRORISM

Terrorism is the use of force or violence against persons or property in violation of the criminal laws for purposes of intimidation or ransom. Terrorists often use threats to: Create fear among the public, Try to convince citizens that their government is powerless to prevent terrorism, Get immediate publicity for their causes. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber attacks (computer-based); and the use of chemical, biological, nuclear and radiological weapons (Robert, 2003).

Terrorism: “An act intended to cause death or serious bodily harm to civilians or non-combatants with the purpose of intimidating a population or compelling a government or an international organization to do or abstain from doing any act.” (UN Panel on Terrorism)

What is Terrorism?

- A complicated phenomenon
- Specialized form of political violence
- Viscous species of psychological warfare
- The target is different from the intended audience
- The goal is not to kill, but to make an impact

Classification of Terrorism:

International Terrorism: Acts of violence by nationals of one country against the citizens / state of another country (*Al-Qaeda, LeT, JEM, Hezbollah*).

State: The state uses weapons of the state against its own people. Acts of violence and intimidation by the state against its own population e.g. Argentina's 'Dirty War' (*Hitler, Saddam Hussein*).

State-supported: The state uses its weapons to attack other country acts of violence supported by an or funded by external state actors (Proxy war). Eg. RUF in Sierra Leone.

Sub-state: A small group within the state is trying to use violence to accomplish its own goal.

Domestic: Acts of violence by non-state actors against domestic political opponents. Domestic terrorism is of two types:

- Ideological (e.g. Marxist, Islamist)
- Ethnic e.g. ETA (Spain), GIA (Algeria)

Social revolutionary: rebel against corrupt old ways (e.g. Baader- Meinhof gang in Germany)

National Separatists: Trying to carry on the family mission (E.g. Palestinian Terrorists, Northern Irish).

Religious Fundamentalists: they kill in the name of God. (E.g. Usama Bin Laden, abortion clinic bombers).

New Religion: The cults defending new religions (e.g. Shinrikyo in Japan (sarin gas in subway)).

Right Wing: They see the government as the enemy and illegitimate. (E.g. Neo-Nazis, Timothy McVeigh, Klu Klux Klan).

Single Issue: (e.g. animal rights, ecologic terrorism (Usually single people willing to kill)).

Check Your Progress II

Note: Use the space provided for your answer.

- 1) Briefly list down the major terrorist activities in India in the last 10 years.

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3.8 BIOLOGICAL DISASTERS

Biological Disaster may be described as a disaster caused due to natural outbreaks of epidemics or intentional use of biological agents (Viruses/bacteria etc.) through dissemination of micro-organism or toxins in food or water or insect vector or by aerosol to harm human population, food crops and livestock to cause outbreaks of diseases. Biological agents are living organisms or their toxic products that can kill or incapacitate people, livestock, and plants. Biological weapons are referred to as a “poor man’s bomb” because they are easy to manufacture, can be deployed

without sophisticated delivery systems, and have the ability to kill or injure hundreds of people (Roberts, 1993) Simple devices such as crop dusting airplanes or small perfume atomizers are effective delivery systems for biological agents.

Causes

Natural outbreaks: Natural outbreaks of disease may become epidemics and assume disastrous proportion if not contained in the initial stages.

Use of Biological Agents by Terrorists: Use of biological agents to cause death, disability or damage mainly to human beings to prevail mass panic and slow mass casualties and an intentional use of biological agents to cause disease or death through dissemination of micro-organism or toxins in food or water or insect vector or by aerosol to harm human population, food crops and livestock.

Mode of Delivery

Biological agents can be dispersed by spraying them into the air, by infecting animals that carry the disease to humans, and by contaminating food and water.

- a) **Aerosols** - biological agents are dispersed into the air, forming a fine mist that may drift for miles. Inhaling the agent may cause epidemic diseases in human beings or animals.
- b) **Animals** - some diseases are spread by insects and animals, such as fleas, mice, flies, mosquitoes, and livestock.
- c) **Food and water contamination** - some pathogenic organisms and toxins may persist in food and water supplies. Most microbes can be killed, and toxins deactivated, by cooking food and boiling water. Most microbes are killed by boiling water for one minute, but some require longer.
- d) **Person-to-person** - spread of a few infectious agents is also possible. Humans have been the source of infection for smallpox, plague, and the Lassa viruses.

Impact

Even a small-scale biological attack with a weapon grade agent on an urban center could cause massive morbidity and mortality, rapidly overwhelming the local medical capabilities. For example, an aerosolized release of little as 100kg of anthrax spores upwind of a metro city of a size of Washington DC has been estimated to have the potential to cause up to three millions of deaths.

Agents likely to be used for Bio-terrorism

Sl. No.	Disease	Agent
1.	Anthrax	Bacillus Anthracis
2.	Plague	Yersenia pestis
3.	Q fever	Coxiella brunetii
4.	Botulism	Clostridium botulinum
5.	Cholera	Vibrio cholerae
6.	Shiegellosis	Shigella dysenteria (causes severe disease), flexneri, boydii, sonnei (short clinical course)
7.	Small Pox	Variola virus
8.	Viral Haemorrhagic fever	Ebola virus, Marburg virus, Lassa virus

Do's and Don'ts

A biological attack is the release of germs or other biological substances. The germs must be inhaled, enter through a cut in the skin or be eaten to make you sick. Some biological agents can cause contagious diseases, others do not. Further, a biological attack may or may not be immediately obvious. One may probably learn of the danger through an emergency radio or TV broadcast. In rural areas, a loudspeaker or other methods such as used for a cyclone warning may be used to warn you.

Before: Children and older adults are particularly vulnerable to biological agents. Ensure from a doctor/the nearest hospital that all the required or suggested immunizations are up to date.

During: In the event of a biological attack, public health officials may not immediately be able to provide information on what you should do. It will take time to determine what the illness is, how it should be treated, and who is in danger. Watch television, listen to radio, or check the internet for official news and information including signs and symptoms of the disease, areas in danger, if medications or vaccinations are being distributed, and where you should seek medical attention if you become ill. The first evidence of an attack may be when you notice symptoms of the disease caused by exposure to an agent and be suspicious of any symptoms you notice, but do not assume that any illness is a result of the attack.

After: Pay close attention to all official warnings and instructions on how to proceed. The delivery of medical services for a biological event may be handled differently to respond to increased demand. The basic public health procedures and medical protocols for handling exposure to biological agents are the same as for any infectious disease. It is important for you to pay attention to official instructions via radio, television, and emergency alert systems.

3.9 CHEMICAL DISASTERS

Industrial disasters are disasters caused by chemical, mechanical, civil, electrical or other process failures due to accident, negligence or incompetence, in an industrial plant which may spill over to the areas outside the plant or with in causing damage to life, property and environment. Chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity (handling), storage or transportation or due to natural events leading to serious effects inside or outside the installation likely to cause loss of life and property including adverse effects on the environment. These accidents involved chemicals like chlorine, ammonia, LPG and other Hazardous chemicals. Following the Bhopal Gas Disaster in 1984, major incidences of chemical disasters in India include:

- A fire in an oil well in Andhra Pradesh (2003).
- A vapour cloud explosion in the Hindustan Petroleum Corporation Limited Refinery (HPCL), Vishakhapatnam (1997).
- An explosion in the Indian Petrochemicals Corporation Limited (IPCL) Gas Cracker Complex, Nagothane, Maharashtra (1990).

Causes

Industrial (chemical) hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems

they give rise to industrial disasters. Industrial hazards can occur at any stage in the production process, including extraction, processing, manufacture, transportation, storage, use, and disposal. Losses generally involve the release of damaging substances (e.g. chemicals, radioactivity, genetic materials) or damaging levels of energy from industrial facilities or equipment into surrounding environments. This usually occurs in the form of explosions, fires, spills, leaks, or wastes. Releases may occur because of factors that are internal to the industrial system (e.g. engineering flaws) or they may occur because of external factors (e.g. extremes of nature). Releases may be sudden and intensive, as in a power-plant explosion, or gradual and extensive, as in the build-up of ozone-destroying chemicals in the stratosphere or the progressive leakage of improperly disposed toxic wastes (Simone, 2006).

Causes of Chemical Disaster

A number of factors could trigger chemical accidents, some of which are Process and Safety Control System Failures: (1) Technical errors (2) Human errors, Natural calamities: For example, Release of acrylonitrile at Bhuj, during earthquake in 2001, and damage to Phosphoric acid sludge containment during Orissa Supercyclone in 1999 and Terrorist attacks/Sabotage (Source: Strategy Document on Chemical Disaster Management, MoEF, GoI; 2005).

Sources of Chemical Disasters

The sources could be Manufacturing and Formulation Facility (including during Commissioning and Process Operation, Maintenance, Disposal and Waste Management), Material Handling and Storage, Bulk Storages in manufacturing facilities and isolated storages (including tank farms in Ports and Docks), Storages of Small Containers. In manufacturing facilities, in isolated warehouses and godowns, Storage of Fuels (LPG Depots etc.) and Pipelines, and Transportation (road, rail, air and waterways)

Impact

The impact from such emergencies may range from death, injury, physiological health effects and losses, damage to environmental resources, like land/soil, land-use, water bodies/resources, air-quality and movements, local-climate, crops/forests and bio-products, disruption of environmental services, e.g. water supply, aesthetic and recreation, environmental and public health, sanitation, garbage management, damage and losses to structures, buildings, machines/equipment, facilities, psychological trauma, stress and lack of well-being, insurance losses, and economic losses related to disruption of productivity, wages, remuneration, incentives, increase in vulnerability to other hazards including natural and environmental exposures and/ or law and order instability, community outcries, litigations and public governance disruption (Simone, 2006).

Preparedness Strategies

Chemical disaster management has two major components, viz. (a) Disaster Risk Reduction and Management and (b) Emergency Preparedness, Response and litigations. In order to effectively organize the preparedness and responses to likely chemical emergencies, an objective, systematic, written and applicable plan need to be in place at different levels, viz. the industry, local, district, state and Central level. Development of policy directives, guidelines and strategic tools, e.g. assessments (EIA, Audit, LCA, Risk Analysis, Multi-hazard vulnerability analysis), fiscal (PLI, Cess, Levi), market based (labeling, ISO), planning (on-site and off-site, carrying capacity based developmental planning, land-use governance, industrial estate planning, site selection), enforcement (law, rules, protocols), policy (industrial ecology,) and voluntary arrangements are to be made more integrated, practical and effective.

A holistic risk management framework for chemical-disaster prevention and management, thus, is a multi-disciplinary state of affairs, involving expertise from hard and soft disciplines of environmental studies; as mentioned below:

Off-site perspectives: geo-hydrology, atmospheric science, geography/land-use/regional planning, geo-informatics, disaster risk mitigation, environmental law, emergency planning, emergency medicine system, socio-psychological and trauma care, emergency communication, etc.

On-site perspectives: environmental system, chemistry, process engineering, incident-control system, fire, occupational health care and emergency medical system, internal transport, communication, etc.

(Source: National Disaster Management Guidelines)

3.10 SHORT CASE STUDIES

Bhopal Gas Leak

The gas leak incidence at the Union Carbide Chemical Plant in Bhopal, Madhya Pradesh was the worst possible industrial disaster that occurred on the unforgettable night of 2-3 December 1984. Over 40 tons of Methyl Iso-cyanate (MIC) and other lethal gases including hydrogen cyanide leaked from Union Carbide Chemical plant, and caught people unawares, immediately killing 8000 people. It has affected thousands of people who till this day are experiencing the deadly after effects of the gas leak to which they had been exposed. More than 25 Research studies have been conducted so far which state that the health of more than 530,000 people has been severely affected causing multi-systemic injuries. Death toll has crossed 20,000 and 15 years after the disaster, 10-15 people continue to die every month. The Union Carbide Chemical (UCC) Plant had been set up in the year 1969 as an outcome of the Indian Governments move towards the 'Green Revolution' and were committed to increase India's agricultural productivity through mechanized agricultural techniques, construction of dams, and production of chemicals and fertilizers. The gas leak has had the most catastrophic effect on the health of the people who have been exposed and has affected people over a large area. 36 municipal wards were affected by the carbide gas leak. The poisonous gas was absorbed into the blood stream of the people, which has caused lasting and damaging effect to the lungs, brain, kidney, reproductive as well as the immune system of the victims. Even after 10 years of the carbide gas leak, in 1992, exposed people continue to suffer menstrual irregularities, abortions, and neurological disorders and mental abnormalities. The cases of respiratory problems, early eye cataract, still birth rates have all increased three folds. Expectant women, who were exposed to the gas leak, gave birth to children who had delayed motor and language sector development.

Surat Plague

Surat, India's diamond city, so called because of its flourishing diamond industry, can be cited as a classic example of disaster due to environmental neglect and degradation. On the 22nd of September 1994, hospitals in the city started reporting deaths due to plague. Within forty-eight hours over 600,000 people had fled the city. With these people the suspected plague germs also spread to other parts of the country and the world, giving rise to international panic. The plague of Surat could have been predicted and avoided through timely action of cleaning up the city of its garbage dumps and unsanitary conditions. Yet people continued to live quietly amidst the filth till they were given some cause for concern by the dying rats, and it finally took human toll to get the residents and the government into action for cleaning up the city.

Uphaar Cinema Fire

Fifty-nine people were killed and more than 100 injured in a fire that broke out in a packed Uphaar grand cinema theater in Green Park Extension in South Delhi in 1997. Most of the victims, including a number of children, teenagers and women died of asphyxiation. The rest were trampled in the stampede as people tried to escape the thick black smoke engulfing the four storey theatre. An electric transformer in the basement burst during the movie show with more than 1000 viewers. Spewing boiling oil, the transformer burst caused mayhem in the ground floor car parking area. The petrol tanks of some vehicles exploded stoking the fire, and the smoke soon filled the theater. Fire safety norms were violated through the installation of a transformer within the building. Many shopkeepers and passers-by launched rescue operation. Some used cellular phones to alert the police. Angry people said that the first fire engine arrived about 45 minutes after the first call. "We got stuck in the narrow lanes and heavy traffic in the area," said a fire official. Scores of policemen and firemen in gas masks took over. Using three 100-foot hydraulic snorkels, firemen brought out unconscious persons from upper floors. It took almost 2 hours, interspersed with heart rending scenes of comatose children being brought out, to completely evacuate the theatre, with police gypsies and ambulances rushing the victims to the nearby hospitals.

3.10.4 The Chernobyl Accident

On 26th April 1986, the world's most severe nuclear accident had occurred at Chernobyl, USSR (now Ukraine). When operators tested the capability of the plant's electrical back-up system, at that time part of the plant was shut down for routine maintenance. There was no exchange of communication and coordination between the Testing Team and Team responsible for operation and safety. In addition, the enormity of the accident was compounded by reactor design drawbacks. Soon the sudden and uncontrollable power surge was triggered; it resulted into violent explosion and almost destruction of the reactor. About 120 million curies of radioactivity and about 6-7 tons of materials were released contaminating more than 210,000 square kilometer area of Ukraine, Belarus and Russian Federation. Within 2 hours and 45 minutes, 40,000 persons were evacuated from when radiation dose was about 1 rad/hr. As on 1.1.95 145,000 km² has more than 1 Ci/km² on which 7 million people live. 800,000 people were involved in the accident, 116,000 persons were evacuated until mid August 1986 and additionally 52,000 in Ukraine, 106,00 in Belarus and 47,500 in Russian Federation were resettled. 237 persons were hospitalize due to over exposure and first degree burns. 134 persons were diagnosed for Acute Radiation Syndrome (ARS), 56 got radiation burn injuries including 2 with additional skin injuries. Of the 31 deaths, 28 persons died of over exposure, 2 persons due to explosion and 1 person due to prospective coronary thrombosis. 5 persons died between 1987 -90 and nine from 1992-96 due to ARS. A total of almost 17 million people, including 2.5 million younger than 5 years of age, were exposed to excess radiation.

Check Your Progress III

Note: Use the space provided for your answer.

- 1) Briefly describe a man-made disaster event known to you and also write its impact and any preparedness strategy/ policies/ guidelines laid down to combat it in future.

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3.11 LET US SUM UP

Floods, droughts, cyclones and earthquakes are a recurrent phenomenon all across the globe. Susceptibility to disasters is compounded by frequent occurrences of manmade disasters such as fire, epidemics etc. The changing topography due to environmental degradation has also increased the vulnerability. In the last two decades, over 3 million people have been killed in natural disasters. According to statistical evidence, there have been three times as many losses resulting from disaster events in the past ten years than was the case in the 1960s. Disasters whether natural or man-made present considerable challenges for poverty reduction and sustainable development because they affect a wide range of social and ecological systems. Man-made disasters can be grouped into Chemical, Industrial and Nuclear related disasters, Accident related disasters like Forest and Urban Fires, Stampede, Mine Flooding, Oil Spill, Major Building Collapse, Serial Bomb Blasts, Festival related disasters, Electrical Fires, Air, Road and Rail Accidents, Boat Capsizing and Village Fire and Biologically related disasters like Epidemics, Pest Attacks and Food Poisoning etc.

The time has come to bring the full force of scientific and technological advances to the reduction of human tragedy and economic losses from natural and man-made disasters. We must take an Integrated Approach to disaster reduction, bringing new emphasis to research on disasters, on pre-disaster planning, on prevention or preparedness, identifying their causes and subsequent impact while we sustain our post-disaster relief capabilities and enhance the response and mitigation strategies and strictly follow the Dos' and Don'ts'.

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