

# Man-made disaster



# Nuclear disaster

- A nuclear and radiation accident is defined by the International Atomic agency as an “event that has led to significant consequences to people, the environment or the facility”. Examples include lethal effects to individuals, large radioactivity release to the environment, or “reactor core melt.”



**Chernobyl Nuclear Disaster**

# Major Nuclear Accident

- Chernobyl disaster – 1986
- Reactor core was damaged and significant amounts of radiation were released
- Worldwide – 99 accidents of nuclear power plants
- 57 Accidents have occurred since the Chernobyl disaster and 57% of all nuclear-related accidents have occurred in the USA.

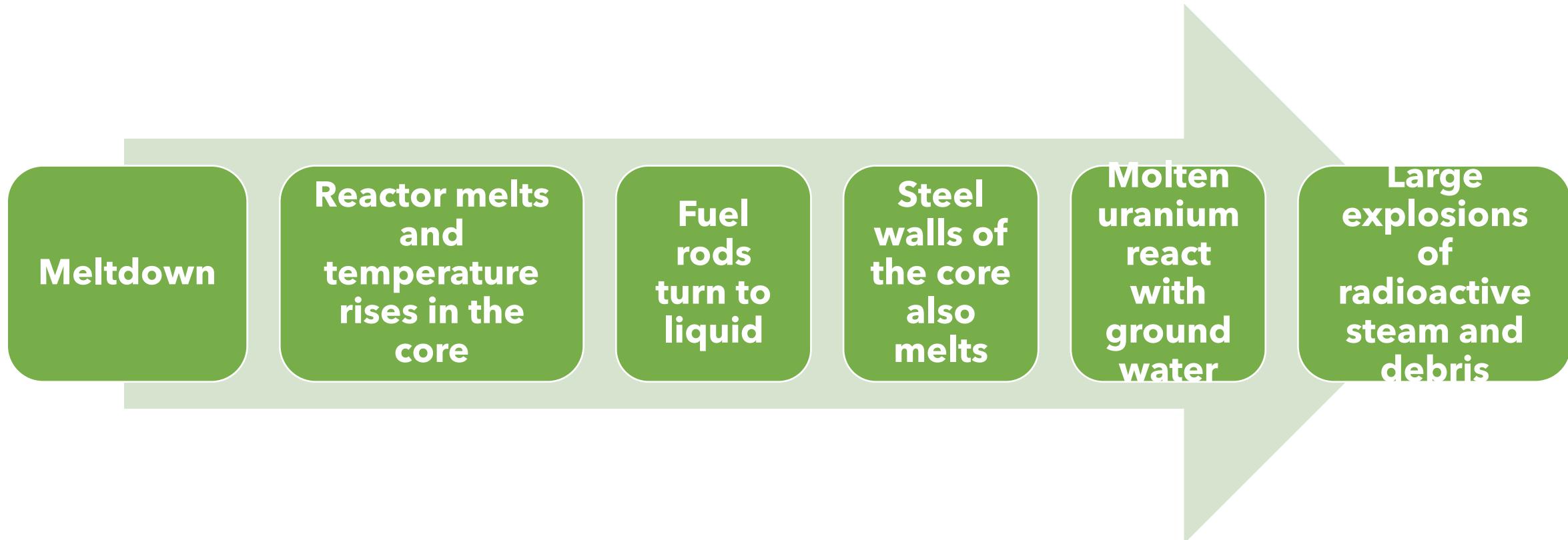
# Nuclear disaster

- The impact of nuclear accidents has been a topic of debate practically since the first nuclear reactors were constructed.
- Some technical measures to reduce the risk of accidents or to minimize the amount of radioactivity released to the environment have been adopted.
- Despite the use of such measures, “there have been many accidents with varying impacts near power plant”.

# Forms of Nuclear disaster

- Nuclear disaster – several forms
- Meltdown at a nuclear reactor plant
- Plant might not explode, but there will be the release of massive amount of radiation and radioactive material into the environment
- Takes hundred years to decay to near “Safe” levels

# Causes of Nuclear disaster



# Radioactive waste



- Generated at each stage – Mining, Power Generation
- Waste contaminates a huge area in its vicinity for 1000's of years
- Even if there is no nuclear accident near a nuclear plant or around nuclear waste – An area of 30-35 km radius gets contaminated by nuclear radiation regularly!

# Effects of radiation

- Impacts vegetation – Deformed seeds and agricultural produce is bound to carry unacceptable amounts of radioactive content
- Impacts animals
- Impacts human beings

# Effects of nuclear disaster

- Nuclear explosions produce both immediate and delayed destructive effects
- Immediate effects – blast, thermal radiation  
(Destruction within seconds or minutes)
- Delayed effects – damage over an extended period ranging from hours to centuries, and can cause adverse effects in locations very distant from the site of the disaster

Fukushima disaster 2011 Japan



# Effects of nuclear disaster

- Produce climate issues because the high temperatures of the nuclear fireball cause large amounts of nitrogen oxides to form from the oxygen and nitrogen in the atmosphere
- Rising fireball of a high kiloton or megaton will carry these nitric oxides into the stratosphere – reach the ozone layer
- Deplete the ozone layer

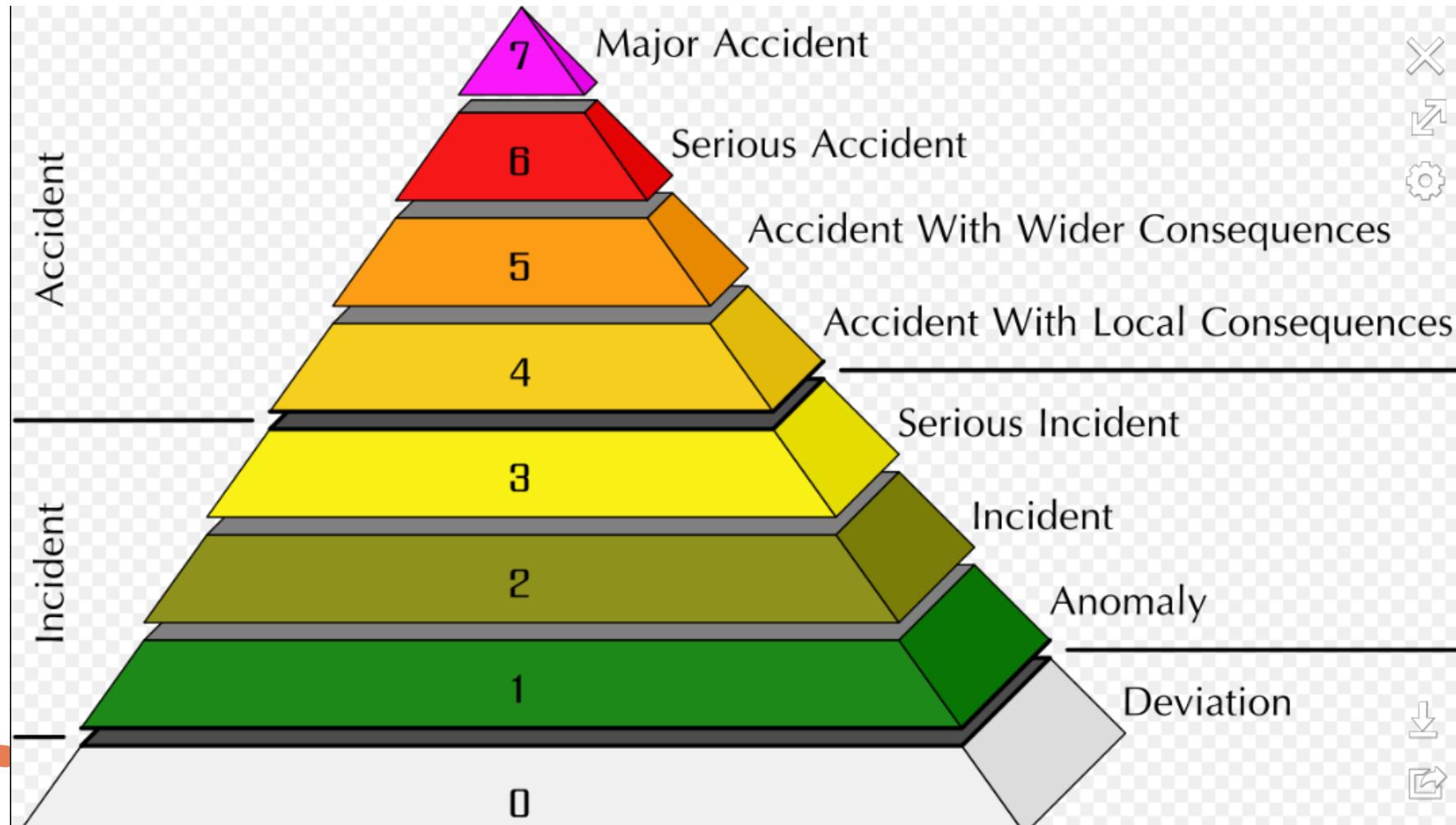
# Effects of nuclear disaster

- Release high levels of radiation
- Can damage DNA
- Radiation also remain in the atmosphere for decades, traveling great distances before it settles to the ground-level air or earth's surface

# Mitigation measures for nuclear reactor

- Fukushima disaster – 2011 (People became aware of potassium iodide tablets which is helpful in producing necessary hormones for metabolism and fetal brain development **(Protect from radioactive iodine-131)**)

# International Nuclear Event Scale



# Major nuclear accidents - 1

- Chernobyl Nuclear Disaster (Ukraine) – (26<sup>th</sup> April, 1986)
- Accident took lives of 30 people immediately and vast evacuation of 135000 people within 20 mile radius of the power plant

# Causes of the Accident

- Chain reaction occurred in the reactor got out of control, causing explosions and a huge fireball blew off the heavy concrete and steel lid on the reactor

Causes:

- Design fault in reactor
- Violation of procedures
- Breakdown of communication
- Lack of “Safety Culture” in the power plant

# Consequences of the Accident

## 1. Environmental Consequences

- Radioactive material got deposited over large areas of ground
- Radiation - Trees within 10 km radius of the power plant got affected but within 4 years of the accident, nature began to restore itself.

## 2. Health effects

- Huge increase in Thyroid Cancer in children
- 64% of Thyroid cancer patients lived in the contaminated areas

# Consequences of the Accident

## 3. Psychological consequences

- Anxiety, depression, helplessness and mental stress
- Stress - not because of radiation but because of stress due to evacuation, lack of information about accident, health condition

## 4. Economic, Political and Social consequences

- Birth rate decreased and migration numbers increased
- Shortage of labours
- Economic decline

# Major nuclear accidents - 2

- Fukushima Daiichi Nuclear Disaster (JAPAN) – (11<sup>th</sup> March, 2011) (following the Tohoku earthquake and Tsunami)
- Level 7 – disaster (International Nuclear Event Scale)
- Tohoku earthquake + tsunami



# **Causes of the accident**

- Earthquake generated a 14m high tsunami that swept over the plant's seawall and flooded the plant's lower grounds
- Loss of coolant
- Nuclear meltdowns
- Radioactive contamination

# **Consequences of the accident**

- Hydrogen explosions
- Core meltdowns in units 1, 2 and 3
- 154000 people were evacuated
- Release of radioactive contamination
- Contaminated water

# Major disasters

## Nuclear and radiological events

Classification of accidents according to the International Nuclear and Radiological Event Scale (INES)

### Examples

**Chernobyl, Ukraine – 1986**

Widespread health and environmental effects,  
external release of significant fraction of core

**Level 7:**

*Major accident*

**Kyshtym, Russia – 1957**

Significant release of radioactive material from  
explosion of waste tank

**Level 6:**

*Serious accident*

**Three Mile Island, U.S. – 1979**

Severe damage to reactor core

**Level 5:**

*Accident with wider consequences*

**Tokaimura, Japan – 1999**

Fatal overexposures of workers following a  
criticality event at a nuclear facility

**Level 4:**

*Accident with local consequences*

**Sellafield, U.K. – 2005**

Release of large quantity of radioactive material,  
contained within the installation

**Level 3:**

*Serious incident*

**Cadarache, France – 1993**

Spread of contamination to an area of the  
facility not expected by design

**Level 2:**

*Incident*

Any breach of operating limits at a  
nuclear facility

**Level 1:**

*Anomaly*

# Nuclear power plants - India

- India has 20 power reactors and three research reactors in operation along with five power reactors under construction
- System upgrades have been planned to mitigate/prevent emergencies during nuclear disaster

# Nuclear power plants -India

## India planning huge increase in nuclear power

India is making nuclear power one of its key policy initiatives, with plans to build 48 new reactors and boost output to 63,000 megawatts by 2032 – an almost 14-fold increase on current levels. The country's existing 20 nuclear reactors generate about 4,700 megawatts



The background features a complex, abstract geometric pattern. It consists of numerous small, translucent blue cubes of varying sizes suspended in space by thin, glowing gold-colored lines. The arrangement is organic and three-dimensional, creating a sense of depth and connectivity.

# *MAN-MADE DISASTER*

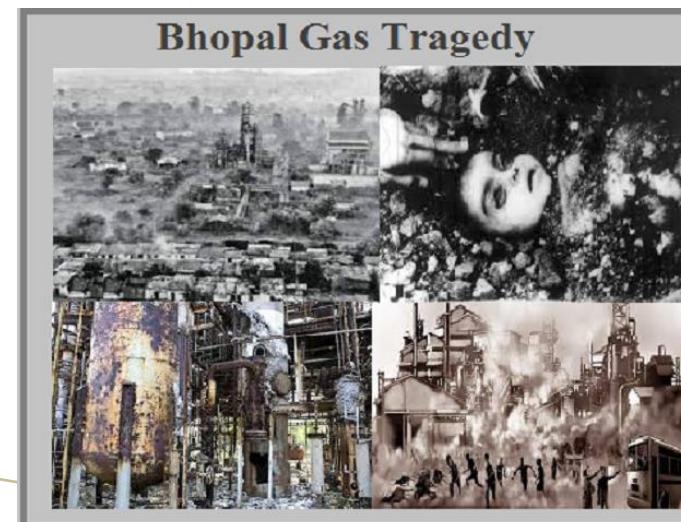
# CHEMICAL DISASTER

- A chemical disaster is the **unintentional** release of one or more hazardous substances which could harm human health and the environment.
- Chemical hazards are systems where **chemical accidents** could occur under certain circumstances.
- Such events include fires, explosions, leakages or release of toxic or hazardous materials that can cause people illness, injury, or disability.



# CHEMICAL DISASTER

- While chemical accidents may occur whenever toxic materials are stored, transported or used, the most severe are industrial accidents, involving major chemical manufacturing and storage facilities.
- The most dangerous chemical accident recorded in history was the 1984 Bhopal gas tragedy in India, in which more people had died after a highly toxic vapour, (methyl isocyanate), was released at a Union Carbide Pesticides factory.



# FORMS OF CHEMICAL DISASTER

Chemical disasters may arise in number of ways, such as:

- Process and safety systems failures-Human errors
  - Technical errors
  - Management errors
- Induced effect of natural calamities
- Accidents during the transportation
- Hazardous waste processing/ disposal
- Terrorist attack/ unrest leading to sabotage

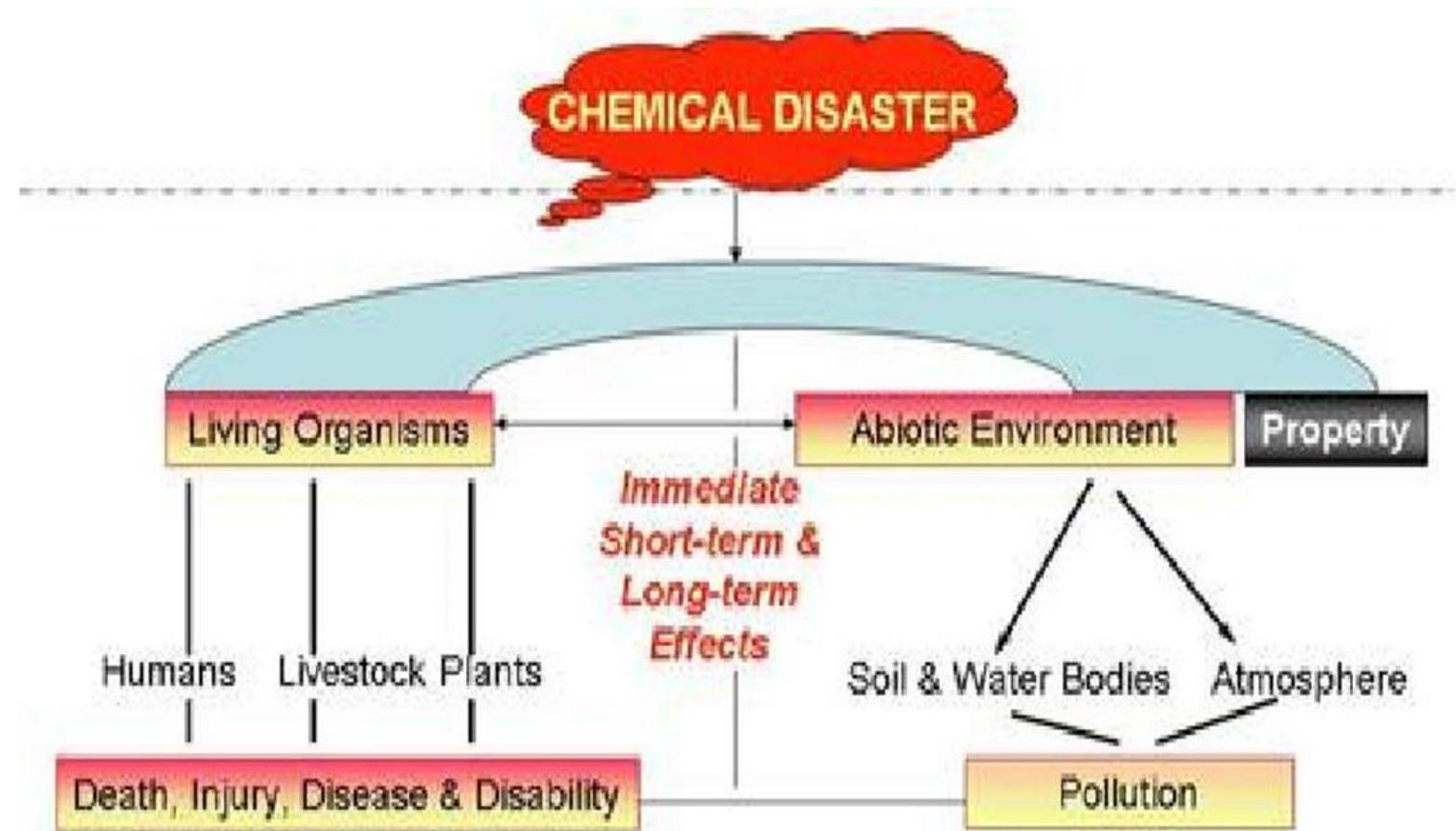
# EFFECTS OF CHEMICAL DISASTER

- Chemicals can affect the skin by contact or the body either through the digestive system or through the lungs if air is contaminated with chemicals, vapours, mist or dust
- Acute effect or chronic effect from the accumulation of chemicals or substances in or on the body

# EFFECTS OF CHEMICAL DISASTER

- Chemicals are released into our environment and disrupts the balance of our ecosystems – air pollution, food contamination etc.,.
- Chemicals – toxic to life and environment

# EFFECTS OF CHEMICAL DISASTER



# CHEMICAL HAZARDS

- Leakage of flammable material – LEADING TO A FIRE OR AN EXPLOSION (FIRE)
- Leakage of toxic material – FORMATION OF A TOXIC VAPOUR (EXPLOSION)

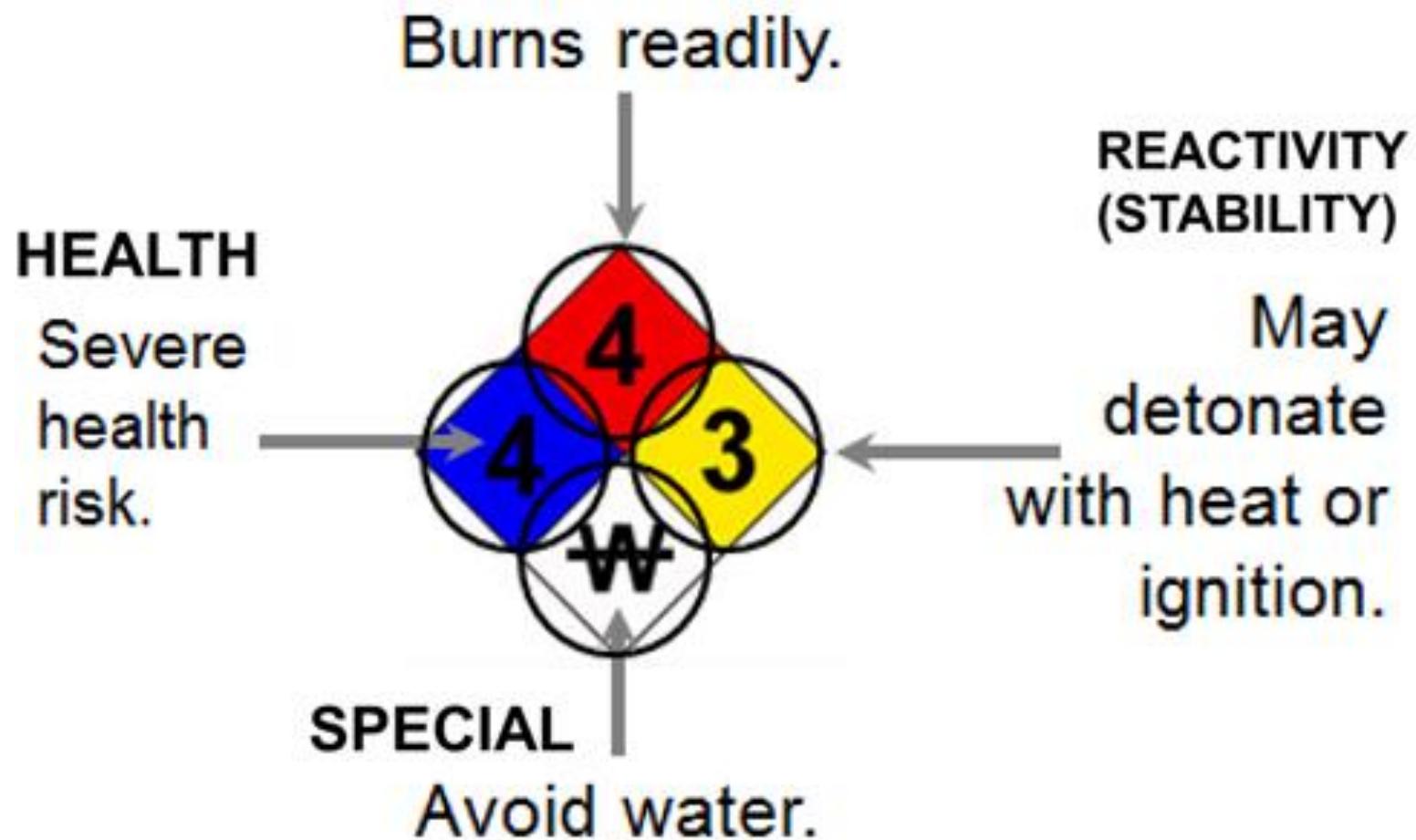
# INITIATORS OF CHEMICAL ACCIDENTS

- **Technical errors:** design defects, fatigue, metal failure, corrosion etc.
- **Human errors:** neglecting safety instructions, deviating from specified procedures etc.
- **Lack of information:** absence of emergency warning procedures, non-disclosure of line of treatment etc.
- **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.

# INITIATORS OF CHEMICAL ACCIDENTS

- Natural Calamities – Release of acrylonitrile at Kandla Port, during an earthquake in 2001
- Terrorist Attacks – Attack on HAZCHEM installations and transportation vehicles

# HAZARD LABEL



# SOURCES OF CHEMICAL POLLUTION

- Agriculture (Pesticides)
- Transportation
- Industry
- Anthropogenic activities

# HAZARDOUS CHEMICALS

- Flammable or explosive – Gasoline, kerosene
- Irritating to skin, lungs, eyes – Strong acids, strong alkali, paint fumes
- Interfere with oxygen uptake, delivery, and use in body – Carbon monoxide, Hydrogen Sulfide, Cyanide

# CHEMICAL DISASTERS - WORLD

- 2005 – Petroleum refinery (Texas city) US – 15 killed
- 2001 - Ammonium nitrate explosion
- 2000 – Poisonous chemical spills – 2.5 million people killed
- 2014 – Gas cylinder explosion – West Godavari

# CHEMICAL DISASTER RISK - INDIA

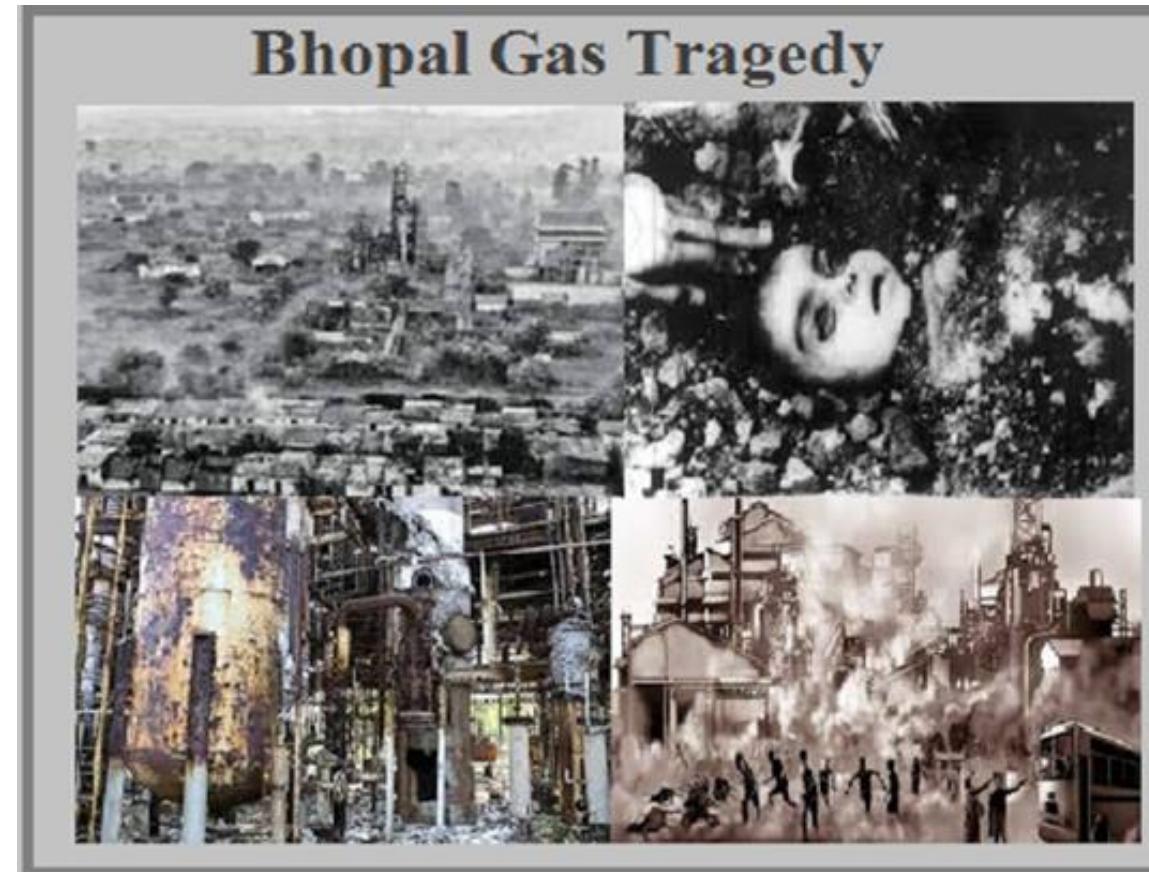
- India continued to witness a series of chemical accidents even after Bhopal had demonstrated the vulnerability of the country.
- Only in last decade, 130 significant chemical accidents reported in India, which resulted into 259 deaths and 563 number of major injured.
- There are about 1861 Major Accident Hazard (MAH) units, spread across 301 districts and 25 states & 3 Union Territories, in all zones of country.

# SAFETY INITIATIVES TAKEN IN INDIA

- Explosives Act 1884
- Petroleum Act 1934
- Factories Act 1948
- Insecticides Act 1968
- Environment Protection Act 1986
- Motor Vehicles Act 1988
- Public Liability Insurance Act 1991
- Disaster Management Act 2005

**Ammonia and Chlorine** – Toxic gases used in our industries by fertilizer plant and water treatment

# BHOPAL GAS TRAGEDY - 1984



# BHOPAL TRAGEDY

- December – 2<sup>nd</sup> and 3<sup>rd</sup>, 1984
- Union Carbide plant in Bhopal
- Due to run-away reactions, temperature and pressure rise, the safety valve lifted to the atmosphere
- 25 – 27 tons of deadly gas Methyl Isocyanate spread through the city of Bhopal
- Half a million people were exposed to the gas

# CAUSES OF THE ACCIDENT

- Protective systems that should have prevented or minimized discharge were **out of service**.
- Refrigeration system to **cool the reactor was down**.
- Scrubbing system to absorb the **released vapour was not immediately available**.
- Flare system to burn vapours getting past the scrubber **was out of service**.

# EFFECTS OF INHALING METHYL ISOCYANATE

- Effects at 0.4 ppm

- Breathlessness
- Choking
- Asthma
- Throat Irritation
- Eye Irritation
- Skin Damage
- Vomiting
- Muscular Weakness
- Altered Consciousness

- Effects at 21 ppm

- Pulmonary Edema
- Emphysema
- Hemorrhages
- Bronchial Pneumonia
- Death

# EFFECTS OF THE ACCIDENT – ANIMAL SLAUGHTER



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## REPERCUSSIONS OF THE DISASTER?

- Among the 500,000 people exposed to the gas:
  - 20,000 have died till date
  - 120,000 continue to suffer
- Out of every 3 children born after the Bhopal disaster, only 1 survived.

# VIZAG GAS LEAK

- May 7, 2020 – Visakhapatnam, Andhra Pradesh
- LG Polymers Plant
- Plant use Styrene monomer (Stored below 17°C) – Produce Expandable plastics

Styrene was not being stored at the appropriate temperature

Pressure build in the storage chamber

Break of valve

# STYRENE LEVELS

- On the day of the leak, the levels of styrene in the air in the area were 500 times higher than prescribed limit.
- Media reports said they were more than 2,500 parts per billion (ppb), while World Health Organization norms require them to be under 5 ppb. The Visakhapatnam facility is spread over 240 hectares (ha), including the nearby residential areas.
- There is also a revenue village nearby, which resulted in a higher rate of exposure.

# EFFECTS OF GAS LEAK

## 1. Acute effects

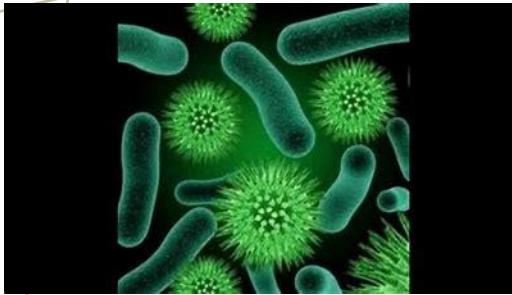
- Fumes spread over a radius of 3 km
- Breathing difficulties and burning sensations in eyes
- Unconscious as a result of gas exposure
- 13 deaths
- More than 1000 people were reportedly exposed to the gas

# EFFECTS OF GAS LEAK

- 200-250 families were evacuated from villages in a five-kilometre radius around the plant.
- About 300 people were hospitalized, according to a media report.

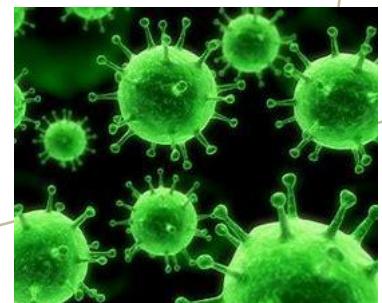


# BIOLOGICAL DISASTER



# BIOLOGICAL DISASTER

- Causative of process or phenomenon of organic origin or conveyed by biological vectors, including
- exposure to pathogenic micro-organisms, toxins and bioactive substances
- loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.



# BIOLOGICAL DISASTER

- Examples of biological disasters include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestation.



# FORMS OF BIOLOGICAL DISASTER

## Epidemic

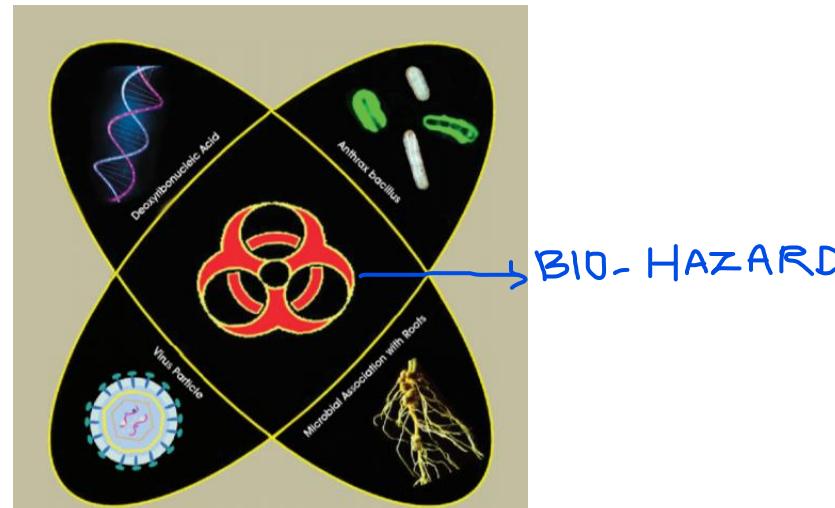
- Affecting a disproportionately large number of individuals within a population, community, or region at the same time
- Cholera, Plague, Japanese Encephalitis (JE)/Acute Encephalitis Syndrome (AES);

## Pandemic

- Epidemic that spreads across a large region, that is, a continent, or even worldwide of existing, emerging or reemerging diseases and pestilences
- Influenza H1N1 (Swine Flu).

# FORMS OF BIOLOGICAL DISASTER

- Man-made - intentional use of disease causing agents in **Biological Warfare (BW)** operations or incidents of **Bioterrorism (BT)**



# *DIFFERENCE BETWEEN EPIDEMIC AND PANDEMIC*



## **EPIDEMIC**

- An epidemic is an outbreak of disease that affects many in a population and begins to spread rapidly.
- An outbreak of disease is considered an epidemic if it affects a certain number of people within a short period of time, typically within 2 weeks.

## **PANDEMIC**

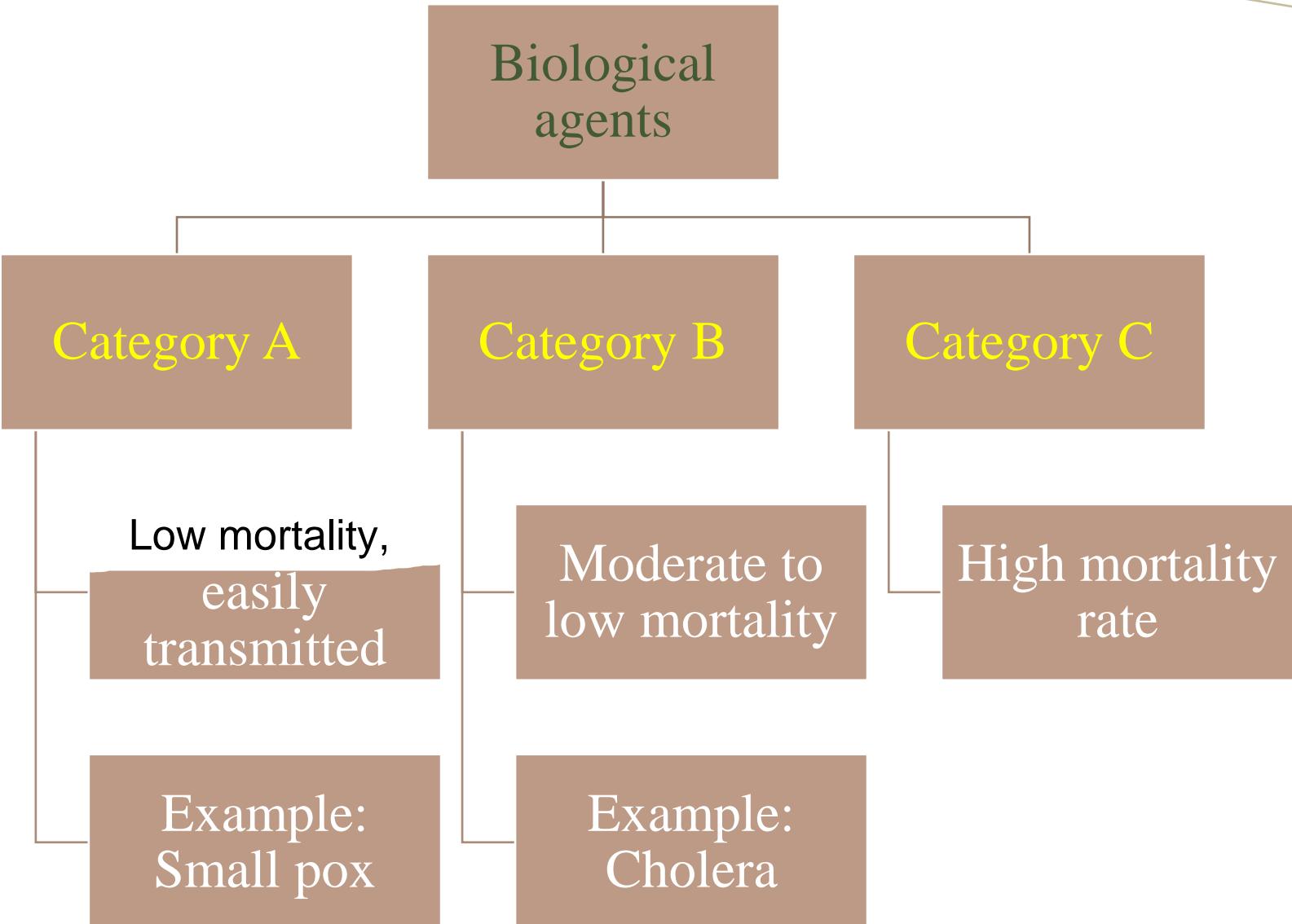
- Pandemic is a larger epidemic. A pandemic covers several countries or spreads from one continent to another.
- In pandemic outbreaks, the number of people affected or killed doesn't matter as much as the rate of spread and how far it has spread.

# SOURCES OF BIOLOGICAL AGENT

- Any human, animal or plant pathogen can cause an epidemic or be used as a biological weapon.
- The deliberate intention/action to cause harm defines a biological attack
- Anthrax, smallpox, plague, tularemia, brucellosis and botulinism toxin

# SPREADING OF AGENTS

- Aerosols
- Animals
- Food and water contamination
- Person to person



# IMPACT OF BIOLOGICAL DISASTER

- Outbreak of disease – kills many people
- Economic loss – Biological attack on agriculture can causes as much economic loss as an attack on human beings
- Demand for large scale vaccination

# GROUP OF DISEASES

- Diarrhoeal group of diseases including cholera
- Respiratory group of diseases like tuberculosis, influenza, chickenpox, meningitis
- Mosquito borne diseases like malaria, dengue, filaria, chikungunya

# PREVENTION OF BIOLOGICAL DISASTERS

- Assessment of **biothreats**, medical and public health consequences, medical countermeasures and long-term strategies for mitigation.
- Pre-exposure immunization (preventive) of first responders against anthrax and smallpox must be done to enable them to help victims post-exposure.

# PREVENTION OF BIOLOGICAL DISASTERS

- Vulnerability Analysis and Risk Assessment (macro level and micro level)
- Environmental management (Testing of water, personal hygiene, Vector control, Burial/disposal of the dead)
- Prevention of Post-disaster Epidemics
- Integrated disease surveillance systems (monitor the probable sources, modes of spread, and investigate the epidemics)
- Pharmaceutical Interventions (Wearing gloves, mask, eye shield, Vaccination)
- Non-pharmaceutical Interventions (Social distancing measures, Isolation and quarantine methodologies, Protection of Important Buildings and Offices)

# PREVENTION OF BIOLOGICAL DISASTERS



# FOREST FIRE

# Forest fire



- ▶ The word “fire” evolved from the Greek word “pyra” meaning growing embers
- ▶ Forest fire may be defined as an unclosed and freely spreading combustion that consumes the natural fuels.
- ▶ When a fire burns out of control it is known as Wild Fire

# Forest fire

- ▶ Pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity
- ▶ Forest fire causes imbalances in nature and endangers biodiversity by reducing faunal and floral wealth.
- ▶ Traditional methods of fire prevention are not proving effective and it is now essential to raise public awareness on the matter, particularly among those people who live close to or in forest areas.

# Forest fire

## Components:

Fire gas (Carbon Monoxide)

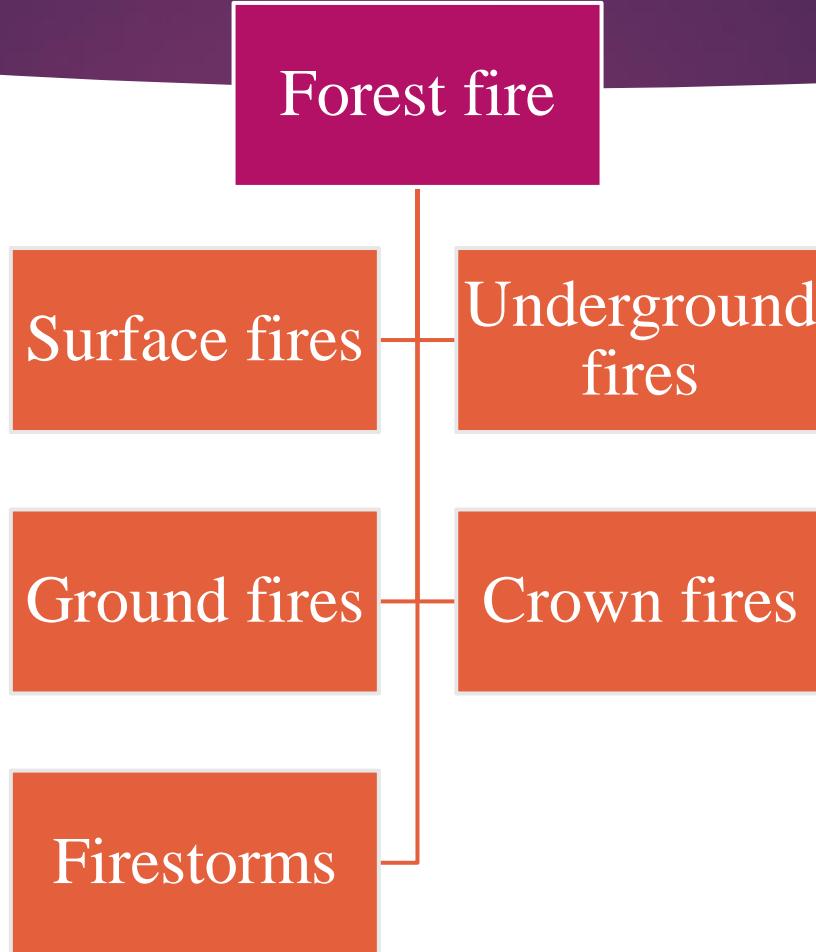
Flame

Heat

Smoke



# Types of forest fire



# Surface fires

- ▶ Common forest fires that burn undergrowth and dead material along the floor of the forest
- ▶ Burns surface litter, other loose debris of the forest floor and small vegetation (leaves and dry grasses etc.,.)
- ▶ A surface fire if spread may burn up to the taller vegetation and tree crowns as it progresses



# Underground fires

- ▶ The fires of low intensity, consuming the organic matter beneath and the surface litter of forest floor are sub-grouped as underground fire.
- ▶ These fires usually spread entirely underground and burn for some meters below the surface

# Ground fires

- ▶ Fires are fires in the sub surface organic fuels, such as duff layers under forest stands
- ▶ There is no clear distinction between underground and ground fires.
- ▶ This fire burns root and other material on or beneath the surface
- ▶ More damaging than surface fires, as they can destroy vegetation completely



# Crown fire

- ▶ Crown fire is the most unpredictable fires that burn the top of trees and spread rapidly by wind.
- ▶ Spreads from top to down of trees or shrubs, more or less interdependent of surface fires
- ▶ 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



# Why forests fire?

- ▶ More than ninety five percent forest fires are caused either by negligence or unknowingly by the human being.
- ▶ The rest of the fires are caused by natural reasons i. e. lightning, extreme rise in the temperature etc., which are very rare.
- ▶ The natural causes of forest fires are common in remote areas only.

# Causes for forest fire

Natural	Anthropogenic	
	Deliberate causes	Accidental causes
1. Lightning	1 Shifting Cultivation	1 Collection of Non Timber Forest Produce
2. Friction of rolling stone	2 To flush growth of <i>tendu</i> leaves	2 Burning farm residues
3. Rubbing of dry bamboo clumps	3 To have good growth of grass and fodder	3 Driving away wild animals
4. Volcanic explosion	4 To settle score with forest department or personal rivalry	4 Throwing burning <i>bidi</i> / cigarettes
.	5 To clear path by villagers	5 Camp fires by picnickers
.	6 To encroach upon the forest land	6 Sparks from vehicle –exhaust
.	7 For concealing illicit felling	7 Sparks from transformers
.	8 Tribal traditions/ customs	8 Uncontrolled prescribed burning
.		9 Resin tapping

# Anthropogenic Causes

## ► Deliberate or intentional causes

- Shifting cultivation
- To get good grass/ fodder crop
- For concealing the illicit felling
- For cleaning forest paths by the villagers

# Anthropogenic Causes

## ► Accidental or Unintentional causes

- Collection of Non Timber Forest Produce (NTFP)
- Burning farm residue
- Protecting crops from the wild animals
- Careless throwing of cigarettes, match sticks by grazers/travellers
- Negligence in camp fires and working operations near camping ground and fairs
- Sparks from transformers or vehicles passing through the forest
- Uncontrolled prescribed burning
- Heating coal tar for road construction
- Hunting by tribals

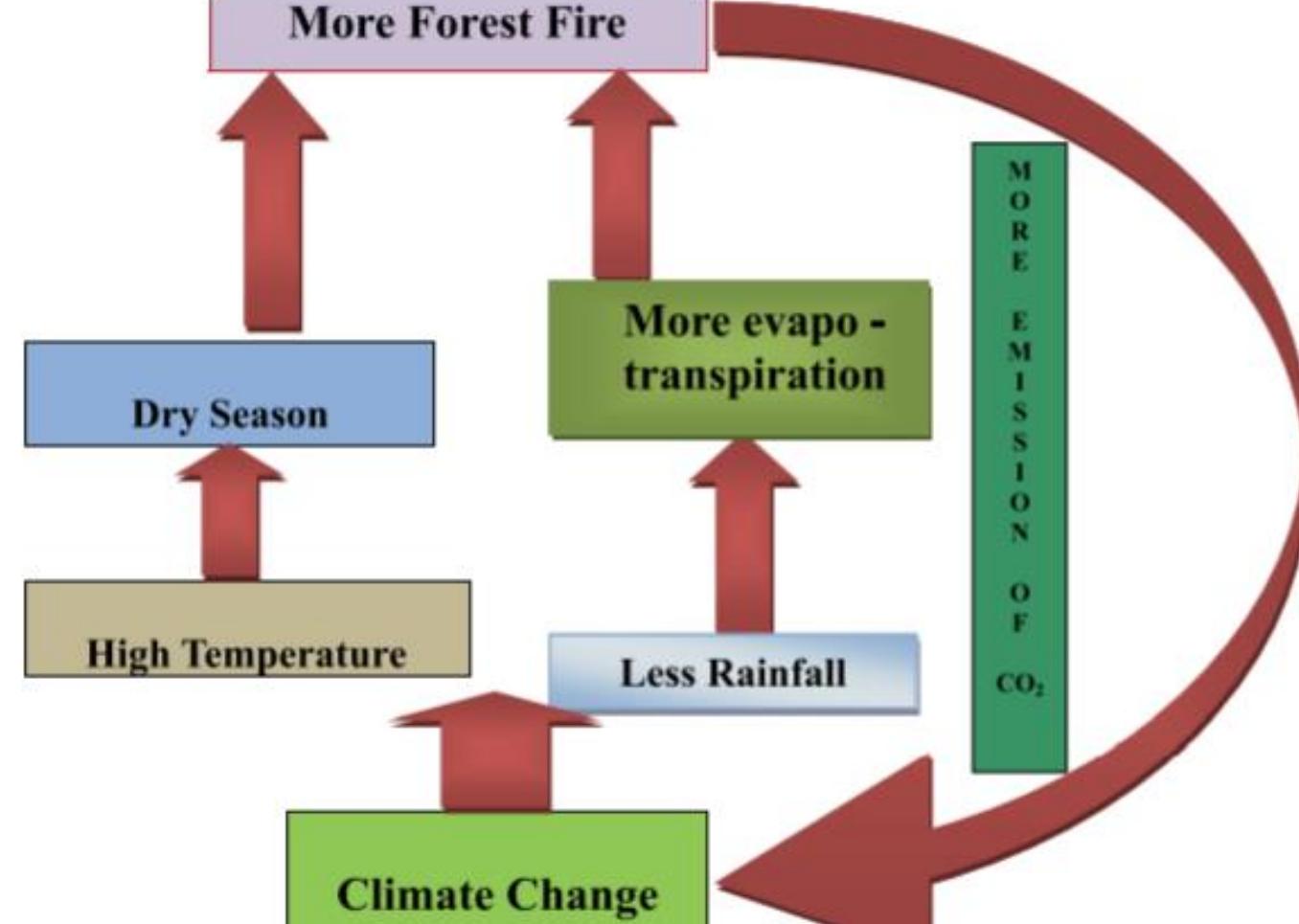
# Effects of forest fire

- Loss of valuable timber resources
- Degradation of catchment areas
- Loss of biodiversity and extinction of plants and animals
- Loss of wildlife habitat and depletion of wildlife
- Loss of natural regeneration and reduction in forest cover
- Loss of carbon sink resource and increase in percentage of CO<sub>2</sub> in atmosphere
- Change in the microclimate of the area with unhealthy living conditions

# Effects of forest fire

- Soil erosion affecting productivity of soils and production
- Ozone layer depletion
- Health problems leading to diseases
- Loss of livelihood for tribal people and the rural poor, as approximately 300 million people are directly dependent upon collection of non-timber forest products from forest areas for their livelihood

# Forest fire and climate change



# Forest Fire Disaster Management

- ▶ Fire Protection Plans
- ▶ Fuel management
- ▶ Environmental Protection
- ▶ Capacity building in fire management
- ▶ Strengthening early warning
- ▶ Prompt detection of fires



# Forest Fire - 2021

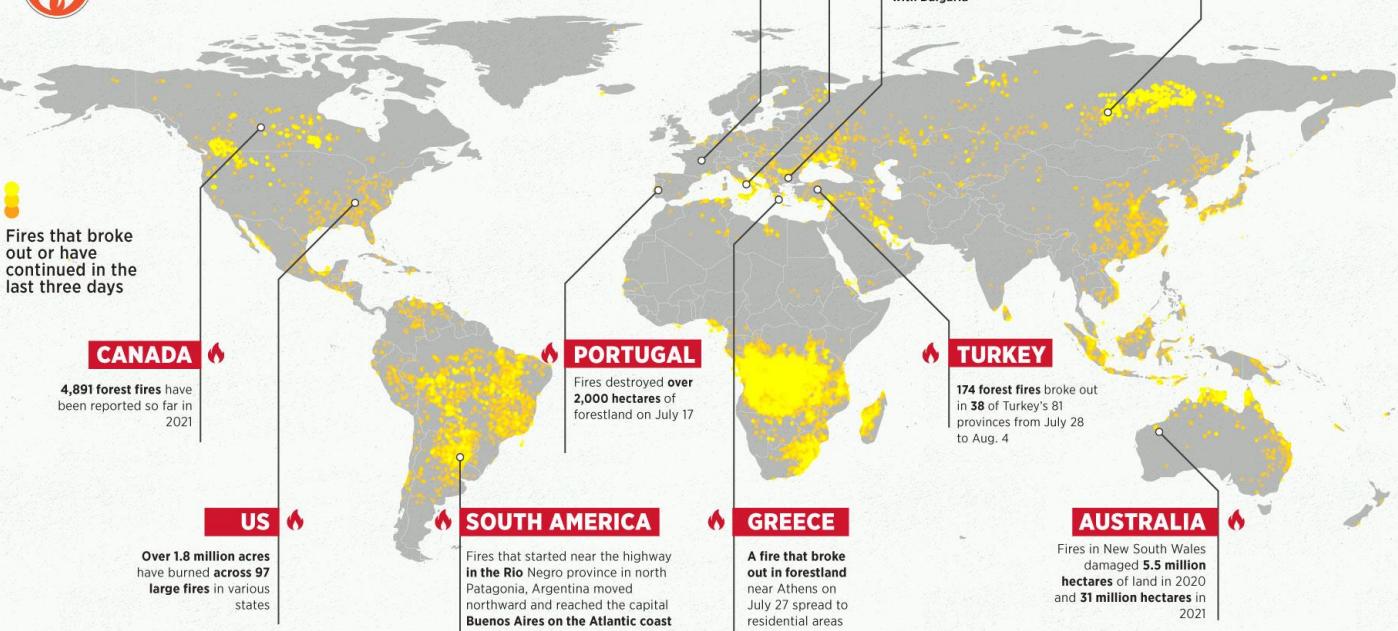


Forest fire in Uttarakhand

## World grappling with massive fires



Forest fires erupted in many continents from America to Europe, and from Africa to Asia, with rising numbers of fires in many countries compared to past years



# WILD FIRES AROUND THE WORLD

## WILDFIRES

4 million km<sup>2</sup> burned each year

According to the European Space Agency, “**fire affects an estimated four million square kilometres** (1.5 million sq miles) of Earth’s land each year”.

### Yearly fires

400,000,000 hectares  
(990,000,000 acres)



About half the size of the US

Larger than the area of India

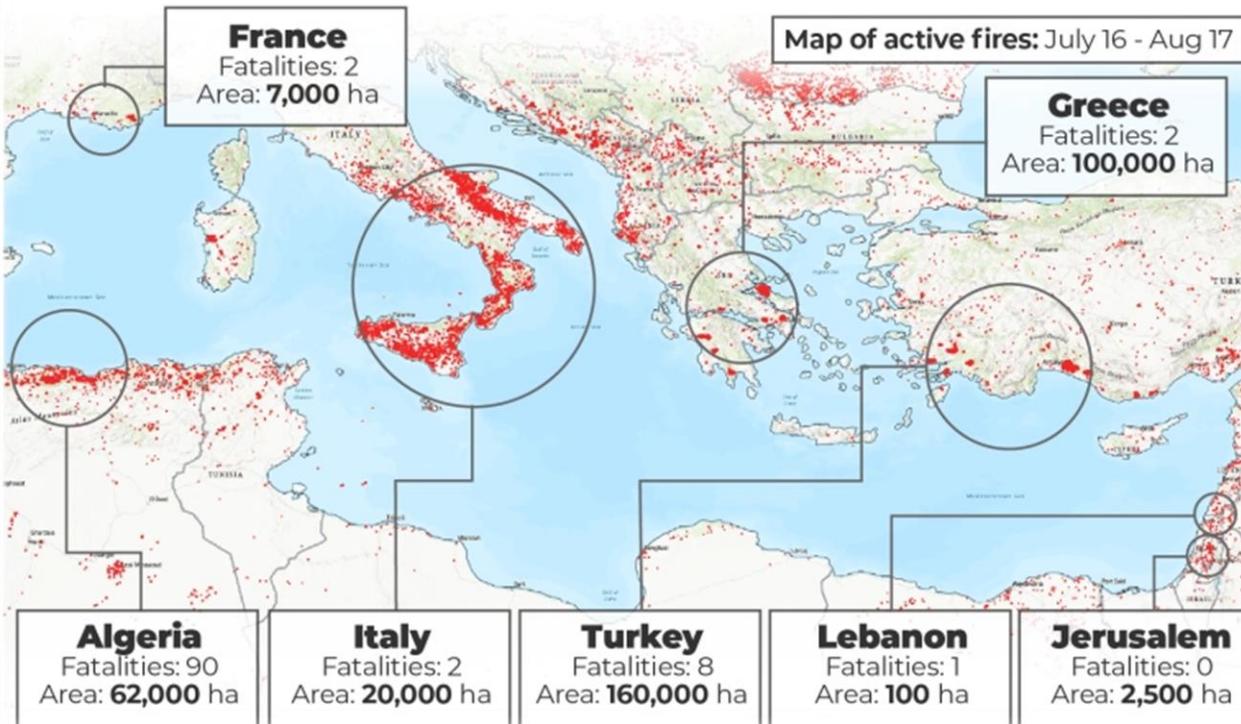
About four times the size of Nigeria

# WILD FIRES AROUND THE WORLD

## CLIMATE

### Mediterranean wildfires

A heatwave across southern Europe, fed by hot air from Africa, has led to wildfires across the region. **Hundreds of fires** have raged from Algeria to Jerusalem over the past month.



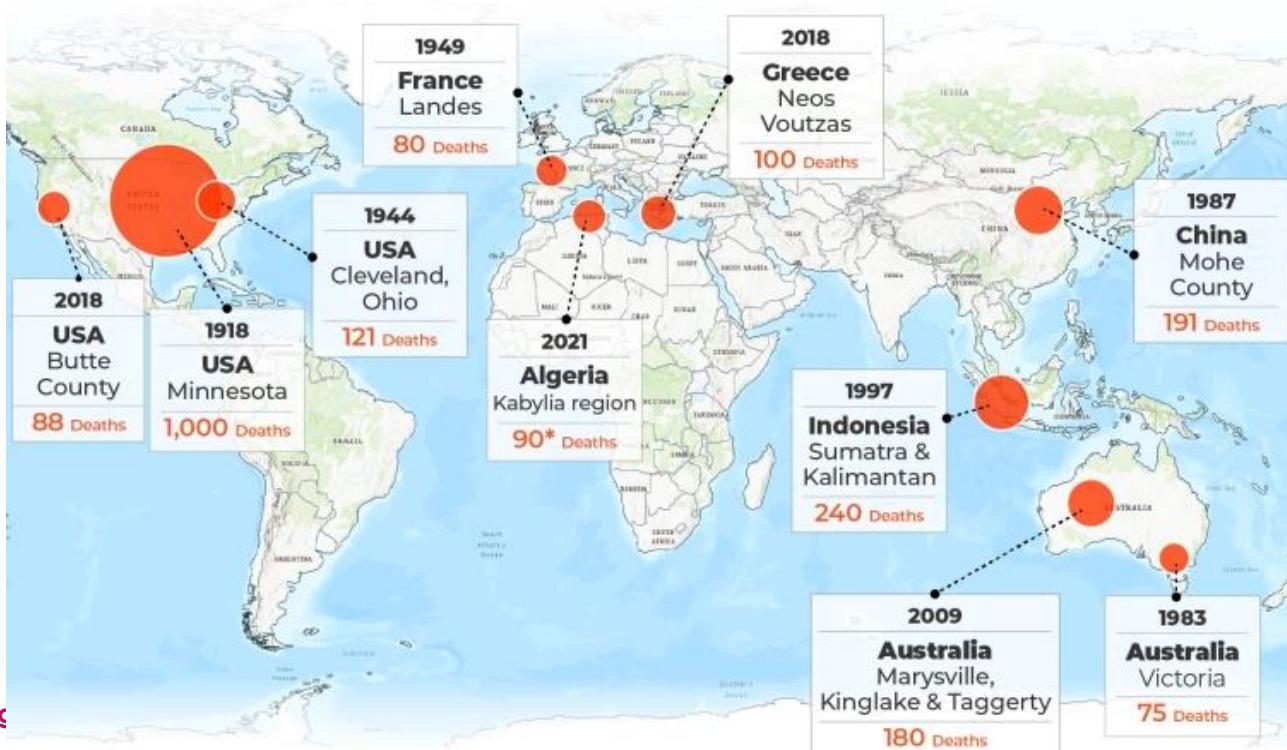
A man stands in the water watching as wildfire approaches Kochyli Beach near Limni village on the island of Evia, August 6, 2021. [Thodoris Nikolaou/AP Photo]

# DEADLIEST WILD FIRES IN HISTORY

## The deadliest wildfires in history

Since 1911, wildfires have killed at least 4,545 people, injured 11,379 and affected more than 17 million around the world.

Minnesota's Cloquet fire of 1918 is the deadliest on record, killing an estimated 1,000 (including missing people).





# OIL FIRE



# WHERE OIL FIRE OCCURS???

- OIL FIELDS (UPSTREAM)
- OIL STORAGE GODOWNS
- DURING TRANSPORT
- HOUSEHOLD ACTIVITIES



# OIL WELL

- OIL WELL FIRES CAN BE THE RESULT OF HUMAN ACTIONS, SUCH AS ACCIDENTS OR NATURAL EVENTS, SUCH AS LIGHTNING
- SMALL SCALE - OIL FIELD SPILL CATCHING FIRE
- HUGE SCALE - JETS OF FLAMES FROM IGNITED HIGH PRESSURE WELLS



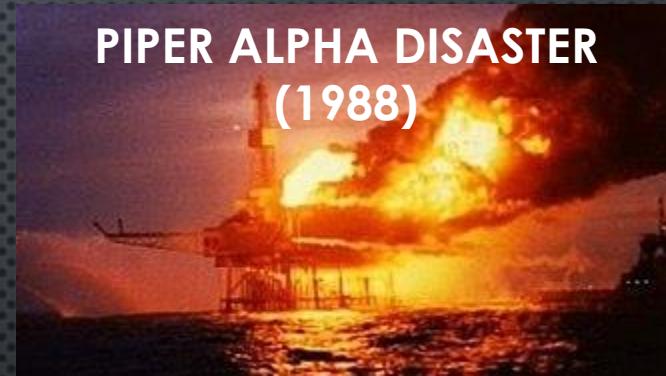
DEEPWATER HORIZON EXPLOSION

# EFFECTS OF OIL FIRE

- LOSS OF MILLIONS OF BARRELS OF CRUDE OIL PER DAY
- ECONOMIC LOSSES
- ECOLOGICAL PROBLEMS CAUSED BY THE LARGE AMOUNTS OF SMOKE AND UNBURNT PETROLEUM FALLING BACK TO EARTH
- SMOKE – TOXIC GASES - SULFUR DIOXIDE, CARBON MONOXIDE, SOOT, BENZOPYRENE, POLY AROMATIC HYDROCARBONS, AND DIOXINS

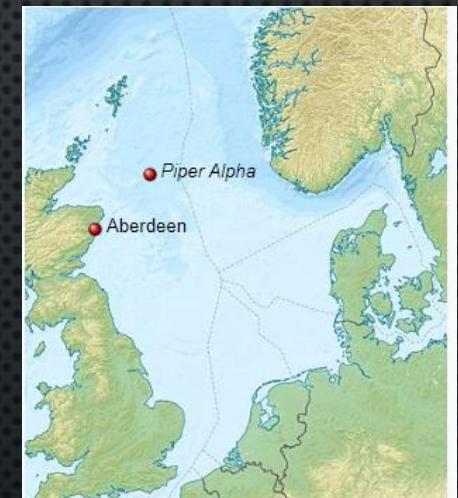
# OIL FIRE ACCIDENTS

- PIPER ALPHA, AN OIL RIG THAT CAUGHT FIRE
- KUWAIT OIL FIRES (1991)
- DEEPWATER HORIZON EXPLOSION



# PIPER ALPHA DISASTER

- PIPER ALPHA - OIL PLATFORM LOCATED IN THE NORTH SEA APPROXIMATELY 120 MILES (190 KM) NORTH-EAST OF ABERDEEN, SCOTLAND
- AN EXPLOSION AND RESULTING OIL AND GAS FIRES DESTROYED PIPER ALPHA ON **6 JULY 1988**, KILLING **167** MEN INCLUDING TWO CREWMEN OF A RESCUE VESSEL
- 61 WORKERS ESCAPED AND SURVIVED. THIRTY BODIES WERE NEVER RECOVERED.
- THE ACCIDENT IS THE WORST OFFSHORE OIL DISASTER IN TERMS OF LIVES LOST AND INDUSTRY IMPACT



# CAUSE OF ACCIDENT

- INITIAL CONDENSATE LEAK WAS THE RESULT OF MAINTENANCE WORK BEING CARRIED OUT SIMULTANEOUSLY ON A PUMP AND RELATED SAFETY VALVE.
- OCCIDENTAL (PIPER ALPHA'S OPERATOR), WHICH WAS FOUND GUILTY OF HAVING INADEQUATE MAINTENANCE AND SAFETY PROCEDURES
- THE ENQUIRY MADE 106 RECOMMENDATIONS FOR CHANGES TO NORTH SEA SAFETY PROCEDURES.

# LESSONS, ACTIONS FOR THE FUTURE

- REGULAR AUDIT AND REVIEW OF THE SYSTEM TO MAKE SURE IT IS BEING USED AND IS EFFECTIVE
- TRAINING IN USE AND TRAINING IN UNDERSTANDING THE RISKS OF THE OPERATION
- SEGREGATION OF HAZARDOUS AREAS FROM CONTROL ROOMS AND ACCOMMODATIONS
- USE OF FIREWALLS, BLAST WALLS, PROTECTED CONTROL ROOMS
- ACTIVE AND PASSIVE FIRE PROTECTION SYSTEMS
- A VARIETY OF ESCAPE SYSTEMS

# FINALLY?

- IT CAN HAPPEN, HAS HAPPENED AND WILL HAPPEN AGAIN, WITHOUT ACTION NEVER BE COMPLACENT

**DO NOT BE “TOO EASILY SATISFIED”**

# ASSAM'S BAGHJAN GAS WELL - GUWAHATI



Image tweeted by @ANI

The oil well at Baghjan Tinsukia, 500 km from main city Guwahati, had a blowout on May 27, 2020 and has been leaking gas since, causing damage to the region's wetlands and biodiversity.

**WHAT COULD  
HAVE PREVENTED  
THESE LOSSES?**



## **RISK CONTROL MEASURES**



Physical Protection



Procedural Protection



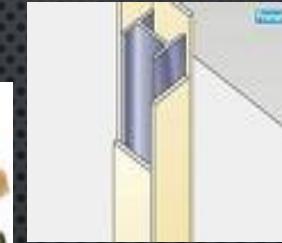
Educational Protection

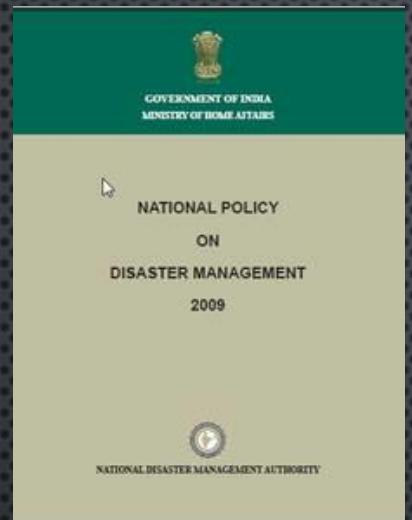
# Physical Protection



- Strict & Rigorous approach in following the Relevant Standards, Codes & Practices
- Built in Safety Devices and Safety System
- Venting through Tall stacks
- Field Monitors for Different Toxic Gases
- Burning Waste gases in a Flare System

- Provision of Wind Cones
- Fire Proofing of Steel Structures
- Passive Protection System
- Active Protection system
- Automatic Protection system

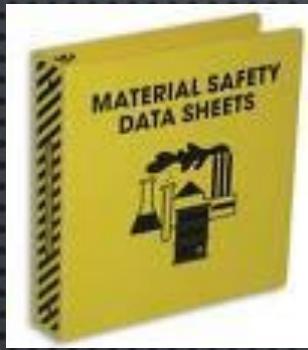


A sample 'Hot Work Permit' form. It includes fields for 'Hot Work Permit Number', 'Location', 'Date', 'Nature of Job', 'Name of Person Performing Hot Work', and a statement about fire safety precautions. It also has fields for 'Individual Responsible for Authorizing Operation', 'Title of Individual Responsible for Authorizing Operation', 'Permit Expires Date', 'Time', and an attachment note.

## PROCEDURAL PROTECTION

- Fire Emergency Procedure
- Disaster Preparedness Plan
- Mutual Aid Scheme
- No Smoking Policy
- Investigation of All Accidents
- Hazard Identification through Safety Committee, House Keeping Committee, Safety audit Committee
- Conducting Plant Survey, safety survey
- Work Permit System

## Contd.



- **Safety promotional activities**
- **Information notes on unsafe conditions**
- **MSDS – Material Safety Data Sheet**
- **Annual Medical Check up of Employees**
- **Safe Start up & Shut Down Procedure**
- **Regular and Preventive Maintenance**
- **Periodic testing of Fire Fighting Appliances**

# EDUCATIONAL PROTECTION



- Periodic Training Program on Safety, Fire Safety and Hazardous properties of materials
- Mock Fire Drill
- Safety Manuals
- Health & Safety News Bulletins, leaflets
- Safety Motivation schemes
- Plant Operating Manual
- Educating the Public Living nearby about the activities in the industry

# MAN MADE DISASTERS

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# Anthropogenic disasters

- Hazards which are due to human negligence.
- Manmade hazards are associated with industries or energy generation facilities and include explosions, leakage of toxic waste, pollution, dam failure, wars, or civil strife, etc.

# AIR POLLUTION

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# How pollution is linked with disaster?

- A study conducted by Japan's Ministry of Environment - **Air pollution from urban and industrial sources has lead to increased acid rain** by hurricanes and typhoons.
- Emphasizing and reinforcing the **centrality of environmental concerns** in disaster management has become a **critical priority**
- Requiring the **sound management of natural resources** as a tool **to prevent disasters or lessen their impacts on people**, their homes and livelihoods.
- Post-disaster assessment of hurricanes and typhoons have clearly illustrated that, along with disaster preparedness, **proper management of the environment - its air, land, water, forests, and wastes, go a long way in reducing the risks and vulnerabilities associated with typhoons**.

**AIR POLLUTION – A GLOBAL HEALTH HAZARD**

# What is air pollution?

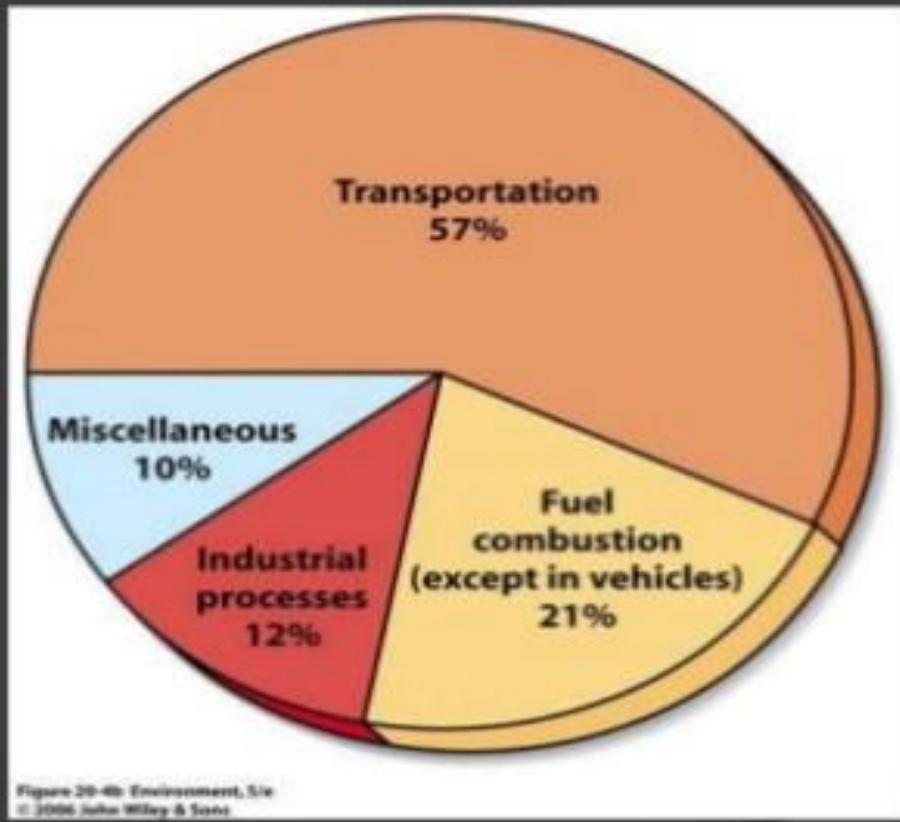
Air pollution consists of gases, liquids, or solids present in the atmosphere in high enough levels to harm humans, other organisms or materials.



# What is air Pollution?

- Air pollutants may be either emitted into the atmosphere or formed within atmosphere itself:
- Primary air pollutants:  
Sources such as factory chimney or exhaust pipe.
- Secondary air pollutants:

# Sources of Primary Air Pollutants



# Sources of air pollution

- Automobiles
- Industries
- Domestic sources
- Mining
- Other sources like fertilizer, pesticides

# Types of air pollution

- Indoor air pollution (domestic level)
- Outdoor pollution

# Indoor air pollution



# Indoor air pollution

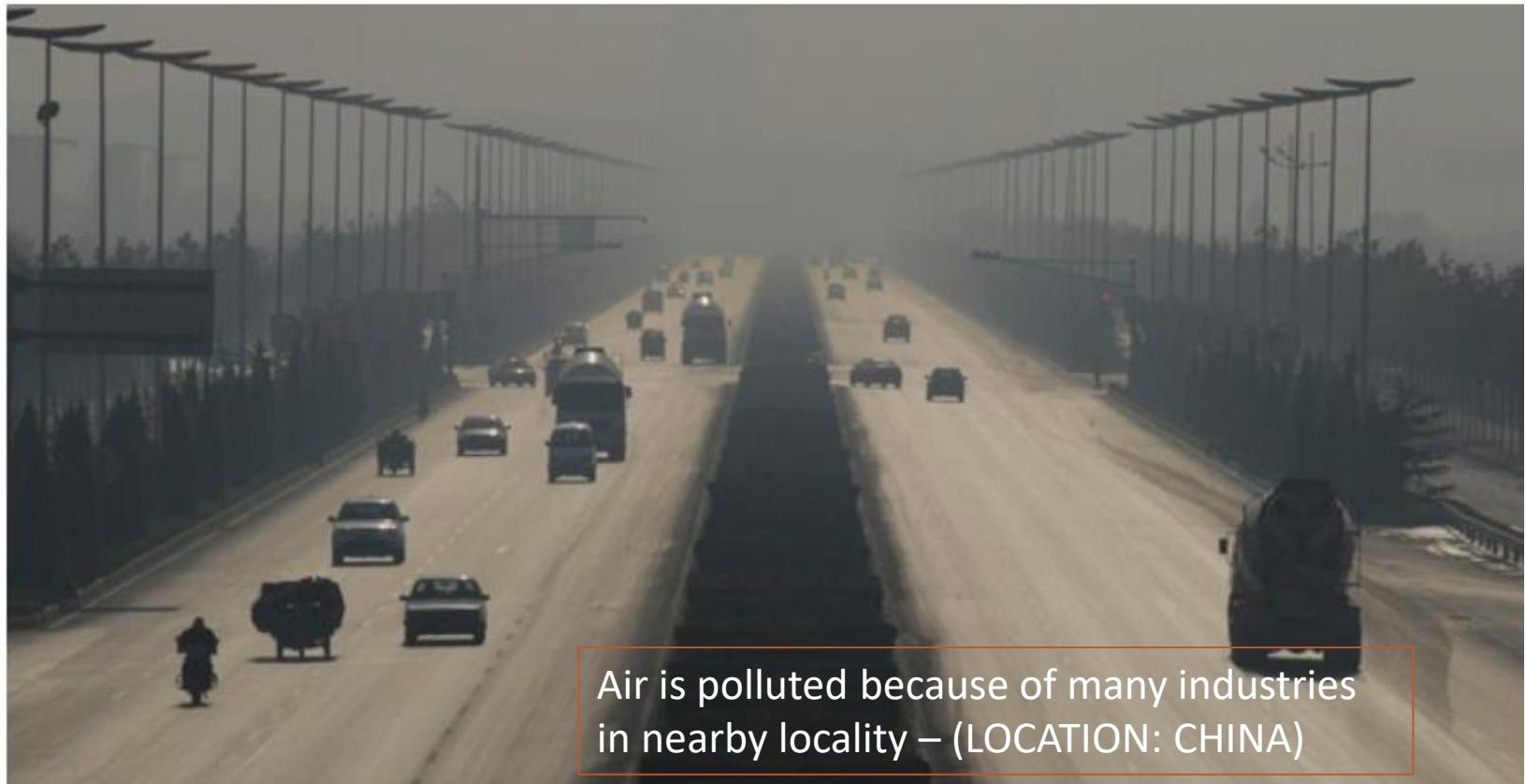
- Indoor air pollution is one of the most critical global environmental problems,
- probably exposes more people worldwide to important air pollutants than does pollution in outdoor air.
- Rural people in developing countries may receive as much as two-thirds **(2/3)** of global exposure to particulates.

Pollutant	Sources
Respirable particles	Tobacco smoke Stove Aerosol sprays
Carbon monoxide	Combustion equipment Stove Gas heaters
Nitrogen dioxide	Gas cookers Cigarettes
Carbon dioxide	Combustion Respiration
Formaldehyde	Particle board Carpet adhesives Insulation

# Effects of air pollution

- Emission of air pollutants (Green house gas effect)
- Acid rain
- Global warming and rise in temperature
- Ozone depletion

# Effects of air pollution



Air is polluted because of many industries  
in nearby locality – (LOCATION: CHINA)

# **WATER POLLUTION AND DISASTER**

Disaster Mitigation and Management - T. M. JEYASHREE



# Water Contamination Disasters

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- Industrial Pollution
  - Exxon Valdez Oil Spill 1989
  - Deepwater Horizon Oil Spill 2010
  - Woburn Massachusetts Water Contamination
- Drinking Water - Scarcity of water due to water contamination
  - Water Crisis
  - Yamuna India

## Exxon Valdez Oil Spill 1989

- *Exxon Valdez* was a VLCC (Very Large Crude Carrier) oil tanker that ran aground on Bligh Reef in Prince William Sound on March 24, 1989 at 12:04 AM.
- *Exxon Valdez* was carrying 1.26 million barrels of oil at the time of this collision, and, as a result of its grounding, spilled over one fifth (about 257,000 barrels) of its cargo.



The polluted ocean.

# Deepwater Horizon Oil Spill 2010

- *Deepwater Horizon* was a **semi-submersible oil drilling rig that was stationed in the Gulf of Mexico near Louisiana.**
- On April 20, 2010, a blowout aboard *Deepwater Horizon* caused an explosion which **killed 11 of the crew and displaced the rig from its attachment to the well at the bottom of the ocean.**
- The **well was not capped for another 87 days** because of the difficulty in sending a probe more than 5,000 feet beneath the surface. During this time more than 3.19 million barrels of oil were let into the ocean, more than twice as many as the *Exxon Valdez* spill from 20 years earlier. **Over 1,000 miles of shoreline along the Gulf were impacted by this spill.**



# Woburn Massachusetts Water Contamination

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- Industrial solvent is the reason causing the water pollution of the river in Woburn Massachusetts.
- Since 1969 to 1979, there were 12 incidence of childhood leukemia happening in this area.
- Other than the leukemia, the residents show high risks of **getting liver, kidney, prostate and urinary cancer**. The risks of congenital abnormalities and birth defects were also pretty high during that period. The **high chemical content** has found in the Woburn water contamination.



Chemicals from the bucket cause water pollution

# Water Pollution

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- Water pollution occurs when harmful substances—often chemicals or microorganisms—contaminate a stream, river, lake, ocean, aquifer, or other body of water, degrading water quality and rendering it toxic to humans or the environment.

## Causes of water Pollution

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- Water is uniquely vulnerable to pollution.
- Toxic substances from farms, towns, and factories readily dissolve into and mix with it, causing water pollution.



# How water gets polluted???

Groundwater

Contaminants — Pesticides And Fertilizers, Waste Leached From Landfills And Septic Systems—make Their Way Into An Aquifer, Rendering It Unsafe For Human Use

Surface Water

Nutrient Pollution - Farm Waste And Fertilizer Runoff. Municipal And Industrial Waste Discharges Contribute their fair Share of Toxins as well. .

## How water gets polluted???

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### Ocean water

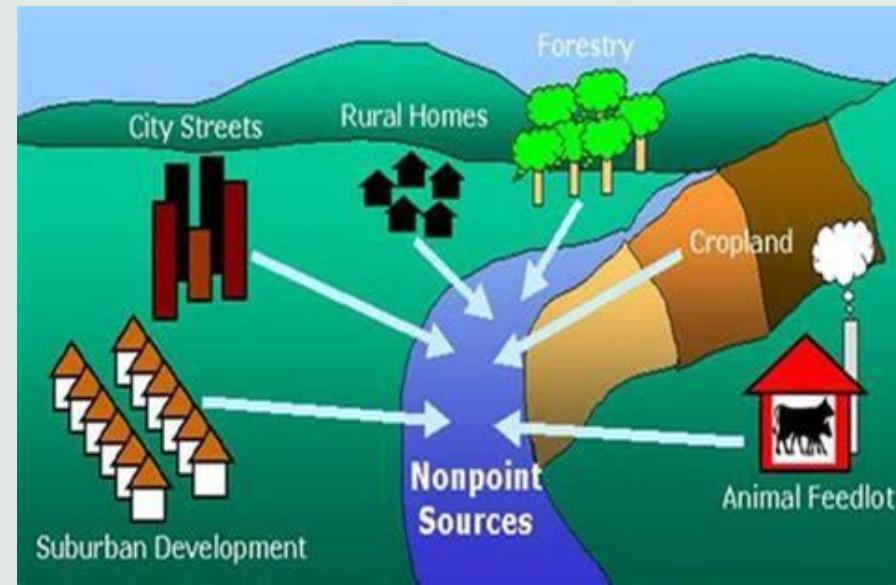
- Contaminants such as **chemicals**, nutrients, and heavy metals are carried from farms, factories, and cities by streams and rivers into our bays and estuaries; from there they travel out to sea.
- Meanwhile, marine debris—particularly plastic—is blown in by the wind or washed in via storm drains and sewers.
- Our seas are also sometimes spoiled by oil spills and leaks

# Sources of water pollution

## POINT SOURCE



## NON POINT SOURCE



# Effects of water pollution

- Water pollution kills. In fact, it caused 1.8 million deaths in 2015, according to a study published in The Lancet
- Waterborne pathogens, in the form of disease-causing bacteria and viruses from human and animal waste, are a major cause of illness from contaminated drinking water.



# Effects of water pollution

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- Water pollution causes an **algal bloom**
- **Oxygen levels in the water gets reduces.** This dearth of oxygen, known as eutrophication, suffocates plants and animals and can create **“dead zones”** where waters are essentially devoid of life. In certain cases, these harmful algal blooms can also produce neurotoxins that affect wildlife, from whales to sea turtles.

