Disaster Management

Disaster comes from the French word 'des-bad & aster-star'

Definition of Disaster:

"an event natural/man made, sudden progressive which impact with such severity that the community has to respond taking exceptional measures". It is a phenomenon involving extensive ecological disruption leading risk to life, property and health to an extent warranting extra ordinary response from outside the affected area.

Types of disaster :

1) natural disaster 2) manmade disaster

natural disaster

a)Earth quake b) Tsunami c) Drought d) Floods e) Snowfall f) Landslides

g) thunderstorms h)volcanic erruptions I)Landslides j)forest fires.

Manmade disaster:

a)global warming b) chemical and industrial hazards, c)nuclear hazards d) Accidental disasters

IMPACT OF DISASTER:

1. Impact is Unavoidable for National for National Security
2. Sudden socio-economic changes
3. Bio-diversity disturbed- plants- animals- sources of food
4. Environmental degradation – erosion- diseases etc.
5. Quality of life decline
6. Starvation – like animals, human beings hurdle together waiting for the death- kalahandi.
7. Whole family disturbed- divided- fragmented
8. Charity – begging- food aid.
9. Social chaos – crime – unrest- evils – terrorism.
10. Realization of economic and social injustices – national
11. Insecurity – both at national and regional level.
12. Loss of faith for the nation – a nation is not a nation.

13. Some other dangerous consequences for the individual- society and nation as a whole.

Earthquakes:

An earthquake (also known as a quake, tremor or temblor) is the perceptible shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's crust that creates seismic waves. Earthquakes can be violent enough to toss people around and destroy whole cities. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter magnitude scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly imperceptible or weak and magnitude 7 and over potentially cause serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.

Magnitude of earthquake:

Magnitude is a quantitative measure of the actual size of the earthquake. Professor Charles Richter noticed that (a) at the same distance, seismograms (records of earthquake ground vibration) of larger earthquakes have bigger wave amplitude than those of smaller earthquakes; and (b) for a given earthquake, seismograms at farther distances have smaller wave amplitude than those at close distances. These prompted him to propose the now commonly used magnitude scale, the Richter Scale. It is obtained from the seismograms and accounts for the dependence of waveform amplitude on epicentral distance. This scale is also called Local Magnitude scale. There are other magnitude scales, like the Body Wave Magnitude, Surface Wave Magnitude and Wave Energy Magnitude. These numerical magnitude scales have no upper and lower limits; themagnitude of a very small earthquake can be zero or even negative

Group	Magnitude
Great	8 and higher
Major	7 – 7.9
Strong	6 – 6.9
Moderate	5 – 5.9
Light	4 – 4.9
Minor	3 – 3.9
Very Minor	< 3.0

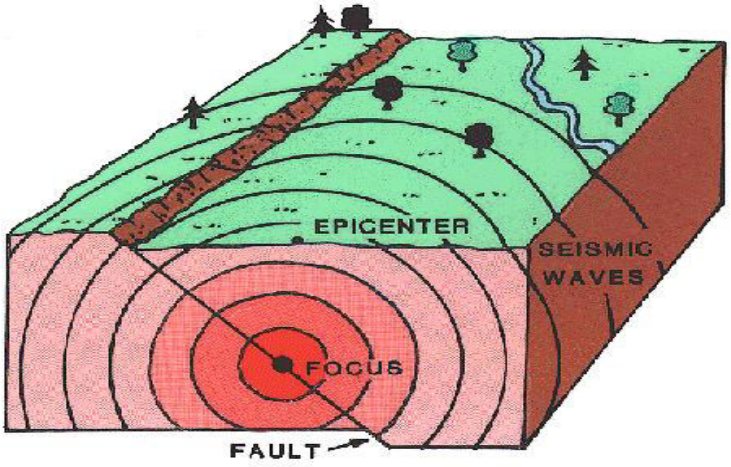
Intensity of earthquake:

Intensity is a qualitative measure of the actual shaking at a location during an earthquake, and is assigned as Roman Capital Numerals. There are manv intensity scales. Two commonly used ones are the Modified Mercalli Intensity (MM!) Scale and the MSK Scale. Both scales are quite similar and range from I (least perceptive) to XII (most severe). The intensity scales are based on three features of shaking - perception by people and animals, performance of buildings, and changes to natural surroundings. Table 2 gives the description of Intensity VIII on MSK Scale.

What causes earthquakes?

The shaking motion of an earthquake is the result of a sudden release of energy. Earthquakes are caused when stress, building up within rocks of the earth's crust, is released in a sudden jolt. Rocks crack and slip past each other causing the ground to vibrate.

Cracks along which rocks slip are called faults. They may break through the ground surface, or be deep within the earth. The location on a fault where slip first occurs is called the focus, whereas the position directly above it on the ground surface is called the epicentre.



Relationship between the focus of an earthquake and the epicentre.

Earthquakes rarely take place at the surface of the Earth but at some depth within it. Though focal depths are usually shallow, earthquakes have been detected as deep as 720 km. Based on the depth of the focus earthquakes can be classified as:

- *Shallow:* when the depth of origin is less than 60 km.
- *Intermediate:* when the depth of origin is between 60 and 300 km.
- *Deep:* when the depth of origin is greater then 300 km.

Seismic Waves in earthquake:

Large strain energy released during an earthquake travels as seismic waves in all directions through the Earth's layers, reflecting and refracting at each interface. These waves are of two types - body waves and surface waves; the latter are restricted to near the Earth's surface (Figure 1). Body waves consist of Primary Waves (P-waves) and Secondary Waves (Swaves), and surface waves consist of Love waves and Rayleigh waves. Under P-waves, material particles undergo extensional and compressional strains along direction of energy transmission, but under S-waves, oscillate at right angles to it (Figure 2). Love waves cause surface motions similar to that by S-waves, but with no vertical component. Rayleigh wave makes a material particle oscillate in an elliptic path in the vertical plane (with horizontal motion along direction of energy transmission). P-waves are fastest, followed in sequence by

S-, Love and Rayleigh waves. For example, in granites, Pand S-waves have speeds ~4.8 km/sec and ~3.0km/sec, respectively. S-waves do not travel through liquids. S-waves in association with effects of Love waves cause maximum damage to structures by their racking motion on the surface in both vertical and horizontal directions. When P- and S-waves reach the Earth's surface, most of their energy is reflected back. Some of this energy is returned back to the surface by reflections at different layers of soil and rock. Shaking is more severe (about twice as much) at the Earth's surface than at substantial depths. This is often the basis for designing structures buried underground for smaller levels of acceleration than those above the ground.

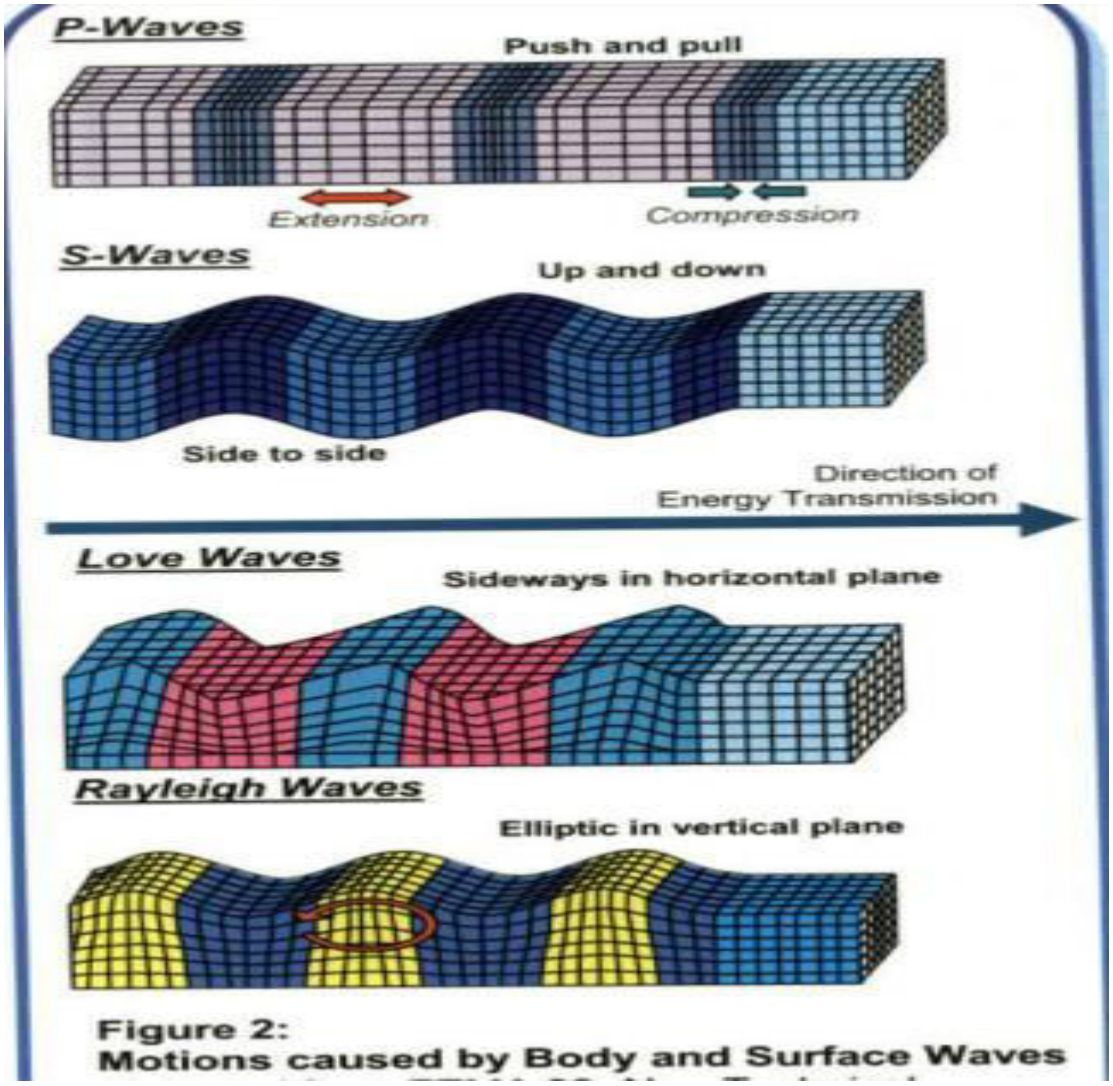


Figure 2:
Motions caused by Body and Surface Waves

Primary waves

Primary waves (P-waves) are compressional waves that are longitudinal in nature. P waves are pressure waves that travel faster than other waves through the earth to arrive at seismograph stations first, hence the name "Primary". These waves can travel through any type of material, including fluids, and can travel at nearly twice the speed of S waves. In air, they take the form of sound waves, hence they travel at the speed of sound. Typical speeds are 330 m/s in air, 1450 m/s in water and about 5000 m/s in granite.

Secondary waves

Secondary waves (S-waves) are shear waves that are transverse in nature. Following an earthquake event, S-waves arrive at seismograph stations after the faster-moving P-waves and displace the ground perpendicular to the direction of propagation. Depending on the propagational direction, the wave can take on different surface characteristics; for example, in the case of horizontally polarized S waves, the ground moves alternately to one side and then the other. S-waves can travel only through solids, as fluids (liquids and gases) do not support shear stresses. S-waves are slower than P-waves, and speeds are typically around 60% of that of P-waves in any given material.

Surface waves

Seismic surface waves travel along the Earth's surface. They can be classified as a form of mechanical surface waves. They are called surface waves, as they diminish as they get further from the surface. They travel more slowly than seismic body waves (P and S). In large earthquakes, surface waves can have an amplitude of several centimeters.[4]

Rayleigh waves

Rayleigh waves, also called ground roll, are surface waves that travel as ripples with motions that are similar to those of waves on the surface of water (note, however, that the associated particle motion at shallow depths is retrograde, and that the restoring force in Rayleigh and in other seismic waves is elastic, not gravitational as for water waves). The existence of these waves was predicted by John William Strutt, Lord Rayleigh, in 1885. They are slower than body waves, roughly 90% of the velocity of S waves for typical homogeneous elastic media. In the layered medium (like the crust and upper mantle) the velocity of the Rayleigh waves depends on their frequency and wavelength. See also Lamb waves.

Love waves

Love waves are horizontally polarized shear waves (SH waves), existing only in the presence of a semi-infinite medium overlain by an upper layer of finite thickness.[5] They are named after A.E.H. Love, a British mathematician who created a mathematical model of the waves in 1911. They usually travel slightly faster than Rayleigh waves, about 90% of the S wave velocity, and have the largest amplitude.

Seismic zones of earthquake:

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required to identify these regions. Based on the levels of intensities sustained during damaging past earthquakes, the 1970 version of the zone map subdivided India into five zones - I, II, III, rV and V (Figure 3). The maximum Modified Mercalli (MM) intensity of seismic shaking expected in these zones were V or less, VI, VII, VIII, and IX and higher, respectively. Parts of Himalayan boundary in the north and northeast, and the Kachchh area in the west were classified as zone V

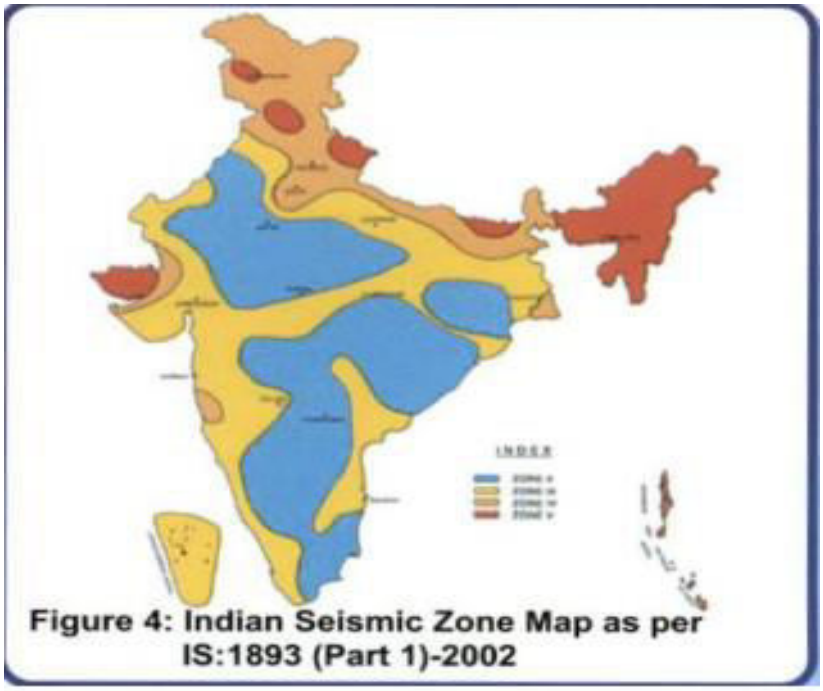


Figure 4: Indian Seismic Zone Map as per IS:1893 (Part 1)-2002

Floods:

It is a natural event or occurrence where a piece of land (or area) that is usually dry land, suddenly gets submerged under water. Some floods can occur suddenly and recede quickly. Others take days or even months to build and discharge.

When floods happen in an area that people live, the water carries along objects like houses, bridges, cars, furniture and even people. It can wipe away farms, trees and many more heavy items.

What causes flooding?

Rains:

Rivers can overflow their banks to cause flooding. This happens when there is more water upstream than usual, and as it flows downstream to the adjacent low-lying areas (also called a floodplain), there is a burst and water gets into the land.

Strong winds in coastal areas:

Sea water can be carried by massive winds and hurricanes onto dry coastal lands and cause flooding. Sometimes this is made worse if the winds carry rains themselves. Sometimes water from the sea resulting from a tsunami can flow inland to cause damage.

Dam breaking :

Dams are man-made blocks mounted to hold water flowing down from a highland. The power in the water is used to turn propellers to generate electricity. Sometimes, too much water held up in the dam can cause it to break and overflow the area. Excess water can also be intentionally released from the dam to prevent it from breaking and that can also cause floods.

Ice and snow-melts:

In many cold regions, heavy snow over the winter usually stays un-melted for sometime. There are also mountains that have ice on top of them. Sometimes the ice suddenly melts when the temperature rises, resulting in massive movement of water into places that are usually dry. This is usually called a snowmelt flood

Types of floods:

Some would like to see the causes of floods as types of floods, but on this page we shall look at three major flood types: Flash floods, Rapid on-set floods and Slow on-set floods.

Flash floods:

This kind occurs within a very short time (2-6 hours, and sometimes within minutes) and is usually as a result of heavy rain, dam break or snow melt. Sometimes, intense rainfall from slow moving thunderstorms can cause it. Flash floods are the most destructive and can be fatal, as people are usually taken by surprise. There is usually no warning, no preparation and the impact can be very swift and devastating.

Rapid on-set floods:

Similar to flash floods, this type takes slightly longer to develop and the flood can last for a day or two only. It is also very destructive, but does not usually surprise people like Flash floods. With rapid on-set floods, people can quickly put a few things right and escape before it gets very bad.

Slow on-set floods:

This kind is usually as a result of water bodies over flooding their banks. They tend to develop slowly and can last for days and weeks. They usually spread over many kilometers and occur more in flood plains (fields prone to floods in low-lying areas). The effect of this kind of floods on people is more likely to be due to disease, malnutrition or snakebites.

Which areas are more likely to flood?

Generally, the natural behavior of water (and flowing water) is that it moves from higher ground to lower ground. This means if there is a higher ground adjacent a lower ground, the lower ground is a lot more likely to experience floods.

Any plain low-lying area adjacent a river, lagoon or lake is also more likely to have floods anytime the water level rises. This includes coastal areas and shorelines, as seawater can easily be swept inland by strong winds, tides and tsunamis.

Main impacts of floods:

The primary effects of flooding include loss of life, damage to buildings and other structures, including bridges, sewerage systems, roadways, and canals.

Floods also frequently damage power transmission and sometimes power generation, which then has knock-on effects caused by the loss of power.

This includes loss of drinking water treatment and water supply, which may result in loss of drinking water or severe water contamination. It may also cause the loss of sewage disposal facilities. Lack of clean water combined with human sewage in the flood waters raises the risk of waterborne diseases, which can include typhoid, giardia, cryptosporidium, cholera and many other diseases depending upon the location of the flood.

Damage to roads and transport infrastructure may make it difficult to mobilize aid to those affected or to provide emergency health treatment.

Flood waters typically inundate farm land, making the land unworkable and preventing crops from being planted or harvested, which can lead to shortages of food both for humans and farm animals. Entire harvests for a country can be lost in extreme flood circumstances. Some tree species may not survive prolonged flooding of their root systems.

Flood safety planning:

1) observation of previous and present flood heights and inundated areas

2) statistical, hydrologic, and hydraulic model analyses

3) mapping inundated areas and flood heights for future flood scenarios,

4) long-term land use planning and regulation

5) engineering design and construction of structures to control or withstand flooding

6) intermediate-term monitoring, forecasting, and emergency-response planning

7) short-term monitoring, warning, and response operations**.**

8) Sea / Coastal Defence Walls

9) Retaining walls, town planning, vegetation

List of floods in india recent period:

1)Bihar flood, 1987 2)Assam Floods, 2012. 3)Maharashtra Flood, 2005. 4)Uttarakhand Flood, 2013. 5)Gujarat Floods, 2005. 6) Jammu & Kashmir Floods, 2014.

Drought

Drought is either absence or deficiency of rainfall from its normal pattern in a region for an extended period of time leading to general suffering in the society.

Approximately 80 per cent of earth's surface is covered with water but only 1% of it is fresh water that we can use. About 2.7 per cent of the total water available on the earth is fresh water of which about 75.2 per cent lies frozen in Polar Regions and another 22.6 per cent is present as ground water. The rest is available in lakes, rivers, atmosphere, moisture, soil and vegetation. This 1% of water is now threatened by pollution

Types of droughts:

1) Meteorological drought

Meteorological drought is simple absence/deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather.

2) **Hydrological drought**

Hydrological drought often leads to reduction of natural stream flows or ground water levels, plus stored water supplies. The main impact is on water resource systems.

3) **Agricultural drought**

This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. Initial consequences are in the reduced seasonal output of crops and other related production. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.

4) **Socio-economic drought**

Socio-economic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependant then drought may cause shortages in supply of these economic goods.

Effects of drought:

1)Deforestation 2) Global warming 3) Industrialization 4) Population growth and urbanization 5) Soil erosion 6) Poor water management

Impact of drought:

1) People might have to pay more for food.
2) Losses or destruction of fish and wildlife habitat
3) Lack of food and drinking water for wild animals
4) Migration of wildlife
5) Reduced incomes
6) Loss of human life
7) Health problems related to low water flows and poor water quality

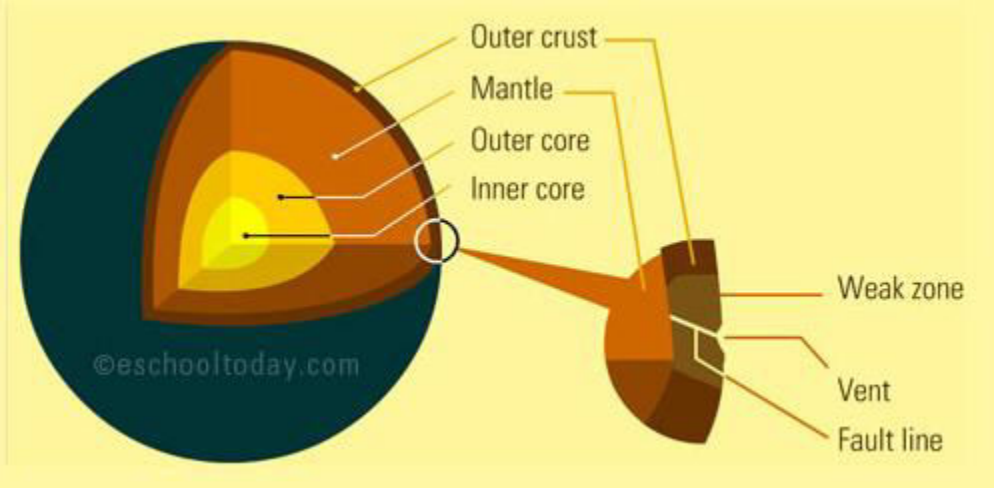
Possible Risk Reduction Measures of drought:

1) Public Awareness and education
2) Drought Monitoring:
3) Water supply augmentation and conservation
4) Expansion of irrigation
5) Drought planning

Volcanoes

A volcano is a rupture in the crust of a planetary-mass object, such as Earth, that allows hot lava, volcanic ash, and gases to escape from a magma chamber below the surface.

Why do volcanoes erupt?

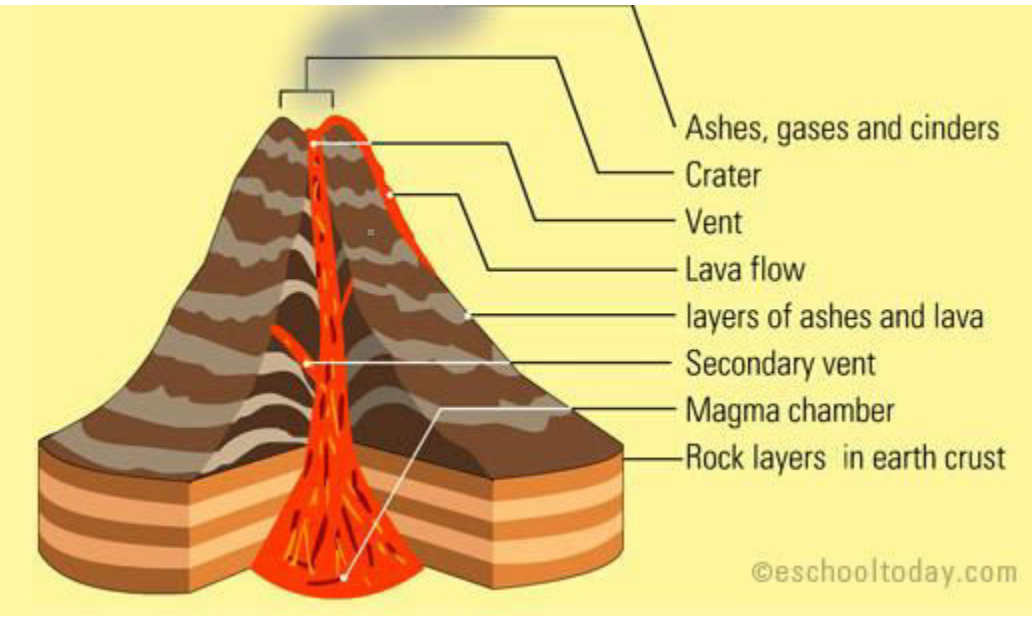


The earth is made up of three layer parts. The outer crust is the layer on which we live. It is estimated to be about 1800 miles deep. Then there is the mantle; and then the core (inner and outer core)

The mantle is made up of molten material and gases. Molten materials are solids (like rock) that have turned into liquid because of extreme heat. The name for molten rock and other gases in the earth's mantle is Magma. Magma is liquid made up of many crystals, fragments and gases including oxygen, silicon, iron, aluminium, magnesium and manganese. When they cool off on the earth's surface, they turn into magmatic or igneous rocks.

Whenever extreme pressure builds in the mantle, along fault lines (openings or cracks in weak spots in the earth's crust) an eruption is likely to happen next. During an eruption, molten materials (soon to become lava) gush out through spaces in the crust to the surface.

Fresh lava is believed to be about 2,200°F. It can be red hot as it shoots from the vent and turn into gray or black as it cools. Lava rich in silicon is like honey, and flows a lot more slowly from the vent. In other types, lava also comes in thick, pasty form.



The magma chamber: This is the area with massive collection of magma below the earth's crust from which magma flows out.

Crater: After an eruption, the tip or top of the volcano tends to get blown off, leaving a small depression at the top of it.

Main vent: This is the main exit point (opening or outlet) in a weak zone where molten magma is released to the surface.

Secondary vents: These are other smaller vents or opening through which ash and gases and lava escape.

Ashes, clouds and cinders: As the eruption continues, ashes and gases are discharged into the air, which is carried further by wind action.

Layers of ash and lava: The walls of a volcano are usually made up of solidified layers of lava and dust.

Types of volcanoes

1) Shield Volcanoes

This is very fluid lava, usually from multiple vents or fractures, spreading over very large areas. The fluid-like nature (viscous – say veez-kos) of the lava, it does not allow it to pile up like a cone. The result is usually an elevation with a shape like a warrior's shield. Mount Kilauea and Maunaloa in Hawaii are good examples of shield volcanoes. They are usually found at constructive or tensional boundaries.

2) **Lava Domes**

They are produced from eruptions with less viscous lava. Because it is less viscous, they do not spread far and cool off (hardens) sooner. This means they pile around the vent and the dome grows only because of the expansion of the vent area within. Lava domes tend to have steep walls and rock types such as andesites, dacites or rhyolites (say rai-o-lites)

3) **Cinder Cones**

These are the most common in the study of volcanoes. When lava is ejected into the air above, the fragments and fine particles fall as cinders (ash) around the vent, forming a cone. The height of cinder cones usually depend on how long the eruption takes and how much lava comes out. The cone has a depression (crater) in the middle where the vent is. Cinder cones can rise as high as 1200ft. A good example of a cinder cone is the Paricutin Volcano in Mexico.

4) Composite Volcanoes

These are usually awesome in nature, rising up to about 8000ft. They are also known as stratovolcanoes and they include Mount Cotopaxi in Ecuador and Mount Fuji in Japan. They are seen as massive mountains. They are formed by alternating layers of ash, rock, dust and lava, (pyroclastic) and hence the name 'composite'. They have steep slopes with a peak.

Effects of volcanic eruptions:

1) Eruptions occurring close to human settlements may spill and destroy lives and property. People often have to be evacuated.

2) Ash discharged very high into the stratosphere can have negative consequences on the ozone layer

3) Landscapes and natural sceneries can be destroyed.

4) Ash and mud can mix with rain and melting snow, forming lahars. Lahars are mudflows flowing at very fast pace.

Wildfire or forest fire

A wildfire is simply an uncontrolled fire that is wiping out large fields and areas of land. It is typically fires that started out of a lightning strike, or people carelessly starting it, or accidentally. These fires sometimes burn for days and weeks. They can wipe out an entire forest and destroy almost every organic matter in it.

How does a wildfire start?

Campfires:

In many places, camping is a big thing. People, both young and old spend time in the woods to enjoy the great outdoors. Sometimes fires are needed for various things during camping and they can start wildfires if not put out properly.

Smoking:

Some people smoke whiles driving, biking or walking. Sometimes the buds are not properly extinguished and thrown away. You never know where that bud will end up and start a fire.

Lightning:

A good number of wildfires were started by lightning. It is a bit hard to imagine, but investigators confirm this as very common. When lightning strikes, it can produce a spark. It can strike trees, power cables, rocks and many other things and just set them off.

Burning debris:

Refuse, junk and yard waste are common items that are permitted to burn in many places. People are therefore very quick to set anything ablaze as a way of disposing off them. But that can get out of hand and start a fire.

Accidents or equipment failure:

Car crashes, gas balloons, lawn mowers and many other equipment have been known to start fires when they go wrong. These are accidental but if not detected quickly, can cause massive problems. This is why fire fighters always move to an accident scene in anticipation of a fire break.

Fireworks:

Fireworks are banned in many places because of their explosive nature and high potential to start a fire. If fireworks are not blasted at the right places, they can end up as fires elsewhere.

Volcanic Eruption:

Hot burning lava, from volcanic eruptions, also causes wildfires.

Factors that makes wildfires burn more.

Wind:

Winds direct or change direction of fire to new areas with new fuels. Additionally, they provide fresh supply of oxygen, a key ingredient of fire, to the situation**.**

Slope:

Wild fires usually move faster uphill than downhill. The steeper the slope, the faster they burn. This is because steeper slopes tend to have lots of fuels in close proximity and the wind action if much more aggressive uphill.

Temperature:

Conditions with higher temperature tend to absorb moisture from fuels and make them conducive to catch fire. This is why areas with lots of sun and higher temperatures tend to be dry and has more fire events**.**

Humidity

Fuels in locations with high humidity and rainfall tend to be damp and moist. Humidity is the amount of water vapor in the air. The higher it is, the higher the moisture in the fuels there and the less likely they are to catch fire.

Times and seasons

In many places, the seasons tell a story. In the US, the summer stretch registers lots of fires. That is because the summer heat makes fuels drier and provides richer oxygen than the winter seasons. In many places in West Africa, the onset of the dry Harmattan Winds from the Sahara desert in the dry seasons make fires burn more.

Effects of Wildfires:

1) Wild fires take away homes, wildlife, as well as vegetation.

2) The soil in the area of the wildfire has been completely destroyed.

3) Animals lose their lives

4) Trees and plants are gone as well. Trees and plants help to produce oxygen in the world. The less trees and plants there are the less clean air we have to breathe. With no plants or trees, the animals that did survive no longer have anything to eat.

5) Large amounts of smoke is released into the air which makes it difficult to breathe and also causes air pollution.

6) Incomes and jobs are lost for workers in the agricultural field whose field crops and animals were destroyed by the wildfire. When people are out of work the economy suffers which makes it difficult to recover.

Preventive measures to Wildfires:

1) following all the local regulations and laws regarding burning fires during various times of day, year, and what materials and substances are permitted to be burned.

2) Keep up to date with the weather forecast.

3) Do not burn any materials that are combustible or unusual in nature

4) Public awareness.

Tsunami

The term Tsunami has been derived from a Japanese term Tsu meaning 'harbor' and nami meaning 'waves'. Tsunamis are popularly called tidal waves also known as a seismic sea wave.
a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean. These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruptions or large meteoroid impacts

Possible risk reduction measures:

1)building tsunami walls of up to 4.5m (13.5 ft) high in front of populated coastal areas.
2) Site Planning and Land Management
3) Engineering structures: Site selection, Construct the structure on a higher
ground level with respect to mean sea level.
4) Construction of water breakers to reduce the velocity of waves.
5) Flood management

Cause of Tsunami:

The geological movements that cause Tsunamis are three ways:

1) The common of these are faults movements on the sea floor accompanied by an earth-quake. They release huge amount of energy. The degree of movements depends on how fast the earthquake occurs and how much water displaced.

2) The second most common cause of Tsunami is landslides either occur in under water or above the sea

3) The third major cause of tsunamis is volcanic activity.

Characteristics of Tsunami:

Tsunami differs from ordinary ocean waves, which are produced by wind blowing over water. they travel much faster than ordinary waves. The ordinary waves travels 100 kilometers per hour. Tsunami waves travel 800km/hr. increase height up to 30-40 cm.

Predictability of Tsunamis:

1) International Tsunami warning system(Honolulu-Hawaii island)- Pacific ocean region

2) Regional warning systems

Landslide

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope due to gravity. The materials may move by falling, toppling, sliding, spreading, or flowing.

What causes a landslide?

Almost every landslide has multiple causes. Slope movement occurs when forces acting down-slope (mainly due to gravity) exceed the strength of the earth materials that compose the slope. Landslides can be triggered by rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors.

Types of Landslides:

Rotational slide: This is a slide in which the surface of rupture is curved concavely upward and the slide movement is roughly rotational about an axis that is parallel to the ground surface and transverse across the slide

Translational slide: In this type of slide, the landslide mass moves along a roughly planar surface with little rotation or backward tilting.

Block slide: is a translational slide in which the moving mass consists of a single unit or a few closely related units that move downslope as a relatively coherent mass.

Rock fall: Free falling of detached bodies of bedrock (boulders)from a cliff or steep slope.

Rock toppling: occurs when one or more rock units rotate about their base and collapse.

Lateral spreading: occurs when the soil mass spread laterally and this spreading comes with tensional cracks in the soil mass.

Debris flow: down slope movement of collapsed unconsolidated material typically along a stream channel

Natural causes of landslides:

- elevation of pore water pressure by saturation of slope material from either intense or prolonged rainfall and seepage
- vibrations caused by earthquakes
- undercutting of cliffs and banks by waves or river erosion
- volcanic eruptions.

Human causes of landslides:

- removal of vegetation
- interference with, or changes to, natural drainage
- leaking pipes such as water and sewer reticulation
- modification of slopes by construction of roads, railways, buildings, etc
- overloading slopes
- mining and quarrying activities
- vibrations from heavy traffic, blasting, etc
- excavation or displacement of rocks.

Effects of landslides:

1) Disruption of transport or blocking of communications by damaging roads and railways and telegraph poles

2) obstruction to the river flow in valleys, leading to their overflow and floods.

3)damage to sewer and other pipelines

4) burial or destruction of building and other construction.

Preventive measure of landslides:

1) **To counter the effect of slope**: Retaining walls may be constructed against the slopes, so that the material which rolls down is not only prevented from further fall but also reduces the slope.

2) **To counter the effect of water**: A proper drainage system is the suitable measure. This involue the quick removal of percolated moisture by means of surface drainage and subsurface drainage.

3) **To counter the structural defects:** The different structural defects such as weak planes and zones may be either covered or grouted suitably so that they are effectively sealed off.

4) **Not to resort reduce the stability of existing slopes:** This is done by not undertaking any undercutting on the surface slopes and by not undertaking any construction at the top of the hills.

5) **To counter the loose nature of overburden:** Growing vegetation ,plants and shrubs on loose ground helps in keeping the loose soil together.

6) Avoiding heavy traffic and blasting operations near the vulnerable places naturally helps in preventing the occurrence of landslides.

Nuclear hazards

What is nuclear energy?

Nuclear energy is the energy in the nucleus of an atom. Atoms are the smallest particles that can break a material. At the core of each atom there are two types of particles (neutrons and protons) that are held together. Nuclear energy is the energy that holds neutrons and protons. Nuclear energy can be used to produce electricity. This energy can be obtained in two ways: nuclear fusion and nuclear fission. In nuclear fusion, energy is released when atoms are combined or fused together to form a larger atom. The sun produces energy like this. In nuclear fission, atoms are split into smaller atoms, releasing energy. Actually, nuclear power plants can only use nuclear fission to produce electricity.

Main phenomenon of emission of energy Uranium 235

Some of the nuclear power plants in India:

Nuclear power plant Kudankulam(Tamil nadu)

Nuclear power plant Kaiga, uttarakannada (Karnataka)

Nuclear power plant Kakrapa(Gujarat)

Nuclear power plant Narora(Uttar Pradesh)

Nuclear power plant Rajasthan,kota(rajasthan)

Nuclear power plant Tarapur (maharastra)

Effects of nuclear hazards

The effects of radioactive pollutants depend upon half-life, energy releasing capacity, rate of diffusion and rate of deposition of the contaminant. Various atmospheric conditions and climatic conditions such as wind, temperature and rainfall also determine their effects.

All organisms are affected from radiation pollution, and the effects are extremely dangerous. The effects may be somatic (individual exposed is affected) or genetic (future generations) damage. The effects are cancer, shortening of life span and genetic effects or mutations. Some of the possible effects are listed as under:

1)Radiations may break chemical bonds, such as DNA in cells. This affects the genetic make-up and control mechanisms. The effects can be instantaneous, prolonged or delayed types. Even it could be carried to future generations.

2) Exposure at low doses of radiations (100-250 rads), men do not die but begin to suffer from fatigue, nausea, vomiting and loss of hair. But recovery is possible.

3)Exposure at higher doses (400-500 rads), the bone marrow is affected, blood cells are reduced, natural resistance and fighting capacity against germs is reduced, blood fails to clot, and the irradiated person soon dies of infection and bleeding.

4)Higher irradiation doses (10,000 rads) kill the organisms by damaging the tissues of heart, brain, etc.

5)Workers handling radioactive wastes get slow but continuous irradiation and in course of time develop cancer of different types.

6)Through food chain also, radioactivity effects are experienced by man.

Control of nuclear hazards:

On one hand, the peaceful uses of radioactive materials are so wide and effective that modern civilization cannot go without them; on the other hand, there is no cure for radiation damage. Thus the only option against nuclear hazards is to check and prevent radioactive pollution.

1)Leakages from nuclear reactors, careless handling, transport and use of radioactive fuels, fission products and radioactive isotopes have to be totally stopped;

2)Safety measures should be enforced strictly;

3)Waste disposal must be careful, efficient and effective;

4)There should be regular monitoring and quantitative analysis through frequent sampling in the risk areas;

5)Preventive measures should be followed so that background radiation levels do not exceed the permissible limits;

6)Appropriate steps should be taken against occupational exposure; and

7)Safety measures should be strengthened against nuclear accidents.

Disposal of nuclear wastes:

1)High Level Wastes (HLW): High level wastes have a very high-radioactivity per unit volume. For example, spent nuclear fuel. HLWs have to be cooled and are, therefore, stored for several decades by its producer before disposal. Since these wastes are too dangerous to be released anywhere in the biosphere, therefore, they must be contained either by converting them into inert solids (ceramics) and then buried deep into earth or are stored in deep salt mines.

2)**Medium level wastes (MLW):** Medium level wastes (e.g., filters, reactor components, etc.,) are solidified and are mixed with concrete in steel drums before being buried in deep mines or below the sea bed in concrete chambers.

3)**Low liquid wastes (LLW):** Low liquid wastes (e.g., solids or liquids contaminated with traces of radioactivity) are disposed of in steel drums in concrete-lined trenches in designated sites.

Precautions after the disposal of nuclear waste:

The careful, efficient and effective treatment/disposal of radioactive waste, just do not complete the task. A regular supervision of the disposal sites is must. The essential precautions, at the disposal sites, that have to be taken include:

1) Monitoring radioactivity around the disposal sites.
2) Prevention of erosion of radioactive waste disposal sites.
3) Prevention of any drilling activity in and around the waste disposal site.
4) Periodic and long-term monitoring of such disposal sites and areas of naturally occurring uranium rich rocks.

Civilian nuclear accidents during the history of nuclear energy

1952 and 1958 - Nuclear accident in the nuclear power plant Chalk River, Canada On December 12, 1952, in Canada, the first serious nuclear accident occurs in the nuclear reactor of Chalk River NRX.

On May 24, 1958, in the same nuclear power plant of Chalk River: in the NRU reactor a rod of uranium fuel caught on fire and it split in two while trying to remove it from the reactor core.

1957 - Nuclear Accident in Mayak, Russia

Mayak is the name given to a known center nuclear facilities located between the cities of Kaslo and Kyshtym, in the province of Chelyabinsk, Russia.

It is one of the points of the planet with pollution by radioactive materials, although it is not that known because the Soviet authorities have been trying to hide during 30 years that nuclear leaks have been occurring.

1957 - Nuclear accident at Windscale Pile, United Kingdom

In October 1957, a nuclear accident occurs at the Windscale reactor number one, in Cumberland (now Sellafield, Cumbria). This incident became the worst nuclear accident in history of the United Kingdom classified at Level 5 of the INES scale.

The fire at the nuclear reactor led to the release of radioactive material into the surrounding area. The radiation could have caused about 240 cases of cancer. Nobody was evacuated from the affected area, but there was concern about the possible contamination of the milk.

The air ducts of the reactor outlet were sealed and the fuel cartridges were removed. The second nuclear reactor at the site was also closed, although it was undamaged by fire.

1979 - Nuclear accident in the Three Mile Island nuclear power plant, USA

The Three Mile Island had a release of radioactive products.In March 1979, the nuclear power plant at Three Mile Island had a serious nuclear accident after the first year of operating. Misinterpretation of data caused serious errors in certain decisions of plant personnel. Although the core of the nuclear reactor was badly damaged, it had limited radioactive products escape outwards. The accident was classified as Level 5 on the International Nuclear Event Scale (INES).

1980 - Nuclear accident in the Saint Laurent des Eaux nuclear power plant, France

The worst nuclear accident in France occurred in the nuclear power plant Saint Laurent des Eaux next to the river Loire. It happened in March 1980. A failure in the cooling system caused the melting of a fuel channel in the Saint Laurent A2 reactor.This nuclear accident was classified as Level 4 on the INES scale. No radioactive material was released outside the plant.

1986 - Nuclear Accident in the Chernobyl nuclear power plant, Ukraine

Chernobyl nuclear power plant, the worst nuclear accident in historyIn April 1986, there was the largest nuclear accident in the history of nuclear power in Chernobyl by a several human errors in the course of a previously planned test. It was classified as level 7 ("major nuclear accident") on the INES scale.

1987 - Nuclear accident in Goiânia, Brazil

In September 1987 the city of Goiânia in Brazil had a radioactive contamination accident. Two men robbed a teletherapy device and they manipulated it. They extracted a cesium capsule from his protective housing what made it a radioactive cesium-137 source. The International Atomic Energy Agency (IAEA) highlighted that nuclear accident as one of the worst radiological incidents worldwide.The nuclear accident in Goiânia was considered Level 5 on the INES scale. Residences and public places are severely polluted. Four people died and 28 suffered radiation burns. As part of decontamination process, several buildings were demolished and farmland was removed.

1999 - Nuclear accident in the Tokaimura uranium fuel treatment plant, Japan

In September 1999, there was a nuclear accident at the Tokaimura uranium fuel treatment plant, owned by the company JCO in Tokaimura. All signs pointed out that it was due to human error. The accident was classified as level 4 according to INES scale ("accident without significant off-site risk"), since the amounts of radiation released to the outside were very small, and within the limits and within the site. The damage produced in the equipment and biological barriers was significant, addition to worker exposure fatal.

2011 - Nuclear accident in the Fukushima nuclear power plant, Japan

Fukushima nuclear power plant - The second worst nuclear accident in history

In Fukushima, on March,11 2011 witnessed one of the worst nuclear accidents in history after the Chernobyl nuclear accident. An earthquake measuring 8.9 on the Richter scale near the northwest coast of Japan and a subsequent tsunami affected severely the Fukushima nuclear power plant in Fukushima.

Chemical and industrial hazards

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

Chemical accidents may occur whenever toxic materials are stored, transported or used, the most severe accidents are industrial accidents, involving major chemical manufacturing and storage facilities. The most significant chemical accident in recorded history was the 1984 Bhopal disaster in India, in which more than 3,000 people were killed after a highly toxic vapour, (methyl isocyanate), was released at a Union Carbide Pesticides factory.

Factors Leading to Chemical Disasters:

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

Sources of Chemical Disasters

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

Initiators of Chemical Accidents

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

1. **Process and Safety System Failures**:

•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, nondisclosure 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.

2.Natural Calamities:

The Gujarat state is highly prone to natural disasters, which can also trigger chemical disasters. The release of acrylonitrile at Kandla Port, during an earthquake in 2001, is one of the example.

3.Terrorist Attacks

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

Accident reductions:

1. Follow the rules and regulations of industries by laws.
2. Fire extinguishers mush be placed properly
3. Frequent training on safety procedures
4. Perform hydrostatic tests to check pressure safety equipment
5. Protective eyewear

Types of Industrial Hazards:

1. **Chemical hazards**: are present when you are exposed to any chemical preparation (solid, liquid or gas) in the workplace. Examples include: cleaning products and solvents, vapours and fumes, carbon monoxide or other gases, gasoline or other flammable materials.

2. **Physical hazards**: can be considered as hazards that cause the body to become physically stressed. Unlike atmospheric hazards, physical hazards can be detected through your senses of (touch, sight).

Example: machinery, noise, vibrations

3. Biological hazards: come from working with people, animals or infectious plant material. Examples include: blood or other bodily fluids, bacteria and viruses, insect bites, animal and bird droppings.

List of Some Industrial disasters in the world:

BHOPAL GAS TRAGEDY, INDIA

The worst industrial tragedy ever known was a result of utter negligence on part of a pesticide manufacturing company and incompetence of the government authorities. Over 500,000 people were exposed to the deadly methyl isocyanate and other chemicals leaking from the pesticide plant of Union Carbide India Ltd at Bhopal, India on the night of December 2-3, 1984. The gas leaked spread in the town through air and water killing 8000 people within two weeks and injuring 558,125 of which of which approximately 3900 were seriously and permanently disabled. UCC had been warned before of potential leakages though no real efforts were made to improve the situation finally leading to a disaster which claimed thousands of life.

BENXIHU COLLIERY EXPLOSION, CHINA

The gas and coal-dust explosion in the Benxihu Colliery if reportedly world's worst coal mine disaster ever killing 1549 people on the fateful day of April 26, 1942 which accounted for 34% of mine workers working that day. The explosion in the jointly controlled Japanese and Chinese colliery sent flames bursting out of the mine shaft entrance. Also the Japanese workers of the mines are blamed of increasing the death toll as they attempted to curtail the fire underground by shutting off ventilation and sealing pit without fully evacuating it thus trapping many Chinese workers underground to suffocate. An investigation later conducted by the Soviet Union found that only some people died from the explosion while most deaths were due to the closing of ventilation after the initial explosion.

THE HALIFAX EXPLOSION, CANADA

The largest man-made explosion prior to the development of nuclear weapons destroyed the entire Richmond district of Halifax, Canada when a cargo ship fully loaded with wartime weapons collided with a Norwegian ship November 6, 1917. The collision soon resulted in a fire and ignited the explosives on the cargo which resulted in a huge explosion killing or injuring anyone in the vicinity. Around 2000 people were killed and 9000 injured by fires, debris of explosion and collapsed buildings. The explosion also resulted in a Tsunami which resulted in further causalities including five children and wiped out an entire community.

CHERNOBYL DISASTER, UKRAINE

The Chernobyl disaster occurred at Chernobyl Nuclear Plant, Ukraine is considered to be the worst nuclear power plant disaster ever as the explosion and fire released large quantities of radioactive particles into the atmosphere which spread over much of the western USSR and Europe. On April 26, 1986, a fire began at the reactor number four of the Chernobyl plant as a result of a series of stem explosions which happened while attempting an emergency shutdown due to an unexpected power surge during a test. The disaster claimed the lives of 54 workers instantly and over the years almost 4000 people have died due to diseases from the projection to radiations.

Fire hazards

What does *Fire Hazards* mean?

Fire hazards include all types of live flames, causes of sparks, hot objects, and chemicals that are potential for ignition, or that can aggravate a fire to become large and uncontrolled. Fire hazards also include all types of potential threats to fire prevention practices, fire fighting, built-in fire safety systems and situations that restrict the escape of people from an affected building or area in the event of a fire**.**

The following fire hazards are common at home, in public places, transports and work places:

The following fire hazards are common at home, in public places, transports and work places:

- All types of flames used for any work
- Electric wires, higher loads, loose connections and old electrical equipment
- All cooking and heat generating appliances
- All works and situations where fire is essential such as welding, cutting, metal casting etc.
- Improper stowage of tools, equipment and items during and at the end of the day's work
- Smoking and personal lighters and matches
- Fireworks, pyro techniques, ammunitions and explosives
- Improper and unauthorized stowage of flammable and hazardous materials and chemicals especially the flammable ones
- Insufficient capacity and numbers of emergency exits and stairs
- Hindrance to sight or reach fire fighting equipment, markings and alarm systems
- Insufficient numbers and types of fire extinguishers
- Absence of fire detection and alarm system
- Violation of building and fire codes

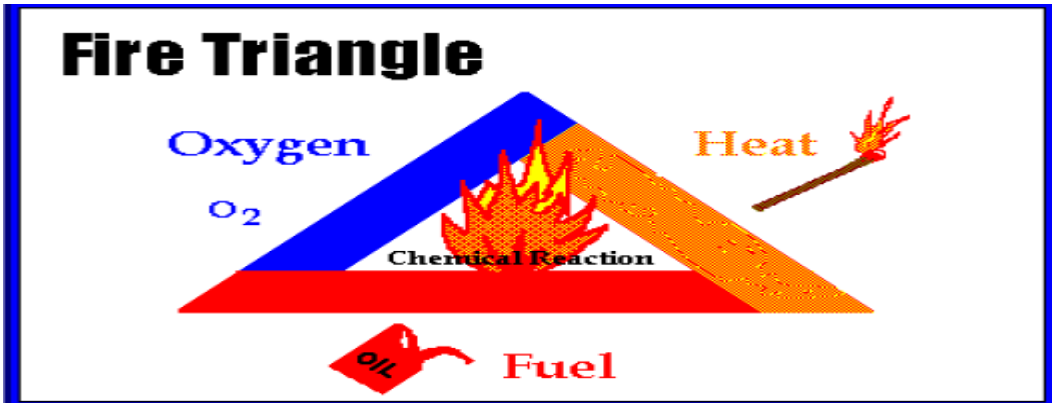
Fire is a chemical reaction that requires three elements to be present for the

reaction to take place and continue. The three elements are:

 Heat, or an ignition source

 Fuel

 Oxygen



These three elements typically are referred to as the “fire triangle.” Fire is the result of the reaction between the fuel and oxygen in the air. These three elements typically are referred to as the “fire triangle.” Fire is the result of the reaction between the fuel and oxygen in the air.
Fire Classifications:

Fires are classified as A, B, C, D or K based on the type of substance that is

the fuel for the fire, as follows:

Class A—fires involving ordinary combustibles, such as paper, trash, some plastics, wood and cloth. A rule of thumb is if it leaves an ash behind, it is a Class A fire.

Class B—fires involving flammable gases or liquids, such as propane, oil and gasoline

Class C—fires involving energized electrical components

Class D—fires involving metal. A rule of thumb is if the name of the metal ends with the letters “um,” it is a Class D fire. Examples of this are aluminum, magnesium, beryllium and sodium. Class D fires rarely occur in the roofing industry.

Class K—fires involving vegetable or animal cooking oils or fats; common in commercial cooking operations using deep fat fryers.

Fire safety measures:

1) No-smoking signs will be posted in all regulated areas.

2) Only approved containers will be used to store flammable or combustible materials

3) All work areas will be kept free of debris and other combustible materials.

4) No employee will be permitted to use an extinguisher without having been fully trained.

5) Fire extinguishers will be stored at a distance no greater than 10 feet from torch users.

6) Use of fire safety plans.