M.Sc. PLANT AND MACHINERY VALUATION
SECOND YEAR
ENVIRONMENTAL REGULATIONS AND
STATUTORY INDUSTRIAL COMPLIANCE

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Air / Water / soil / Noise / toxic material disposal / zero waste requirements, Emergency response & Disaster Management requirements.


Case laws on Environmental Issues.

References


2) Guidelines for Environmental clearance of various projects, Dept. of Environment, Govt. of India.


# M.Sc. Plant and Machinery Valuation

## Second Year

**Environmental Regulations and Statutory Industrial Compliance**

## Content

<table>
<thead>
<tr>
<th>Lesson No.</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of Environmental Regulations - (As applicable to Industries)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Statutory Approvals-(Establishing &amp; Commissioning a Large Industrial Project)</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Case Studies- Major Industrial Disasters</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Liquid Effluent Treatment – Zero Discharge</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Clearance</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>Risk Assessment</td>
<td>39</td>
</tr>
<tr>
<td>7</td>
<td>ISO 14000 Series - Environmental Management</td>
<td>44</td>
</tr>
<tr>
<td>8</td>
<td>OHSAS 18001:2007 - Occupational Health and Safety Assessment</td>
<td>50</td>
</tr>
</tbody>
</table>
OVERVIEW OF ENVIRONMENTAL REGULATIONS 
(AS APPLICABLE TO INDUSTRIES)

1.1 INTRODUCTION

It is very essential to have a robust set of Rules & Regulations to ensure that Industrial Activity takes place in a sustainable manner without undue damage to the Environment. Over the years as awareness & technology progressed, Government & Society have begun to impose more stringent conditions for conduct of business activity. Environmental Regulations are part of this effort.

1.2 OBJECTIVE

- A good understanding of various Environmental Regulations helps the Valuer in assessing the “Value” of a given enterprise. Valuation practice includes the obligation of the Valuer to determine whether an asset performance is “legally permissible” as part of determining market value (IVS).

- This requirement requires the Valuer to be familiar with Environment Protection Regulations. It is necessary to understand the spirit of the Law rather than the Law per-se, to appreciate the need for these regulations and their compliance. In this lesson we look at some relevant regulations as applicable to industries in general.

1.3 CONTENT

A good environment is a constitutional right of Indian Citizens. Environmental Protection has been given the constitutional status. Directive Principles of State Policy states that, it is the duty of the state to ‘protect and improve the environment and to safeguard the forests and wildlife of the country’. It imposes Fundamental duty on every citizen ‘to protect and improve the natural environment including forests, lakes, rivers and wildlife’.

**Government has enacted several laws for Environmental Protection**

The Environment (Protection) Act, 1986, is the umbrella legislation that authorizes the Central Government to protect and improve environmental quality, control and reduce pollution from all sources, and prohibit or restrict the setting and /or operation of any industrial facility on environmental grounds.

According to the Act, the term "environment" includes water, air and land and the inter-relationship that exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property. Under the Act, the Central Government shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of environment and preventing, controlling and abating environmental pollution.

**Ministry of Environment and Forests (MOEF) is the apex administrative body for**

(i) regulating and ensuring environmental protection;

(ii) formulating the environmental policy framework in the country;
(iii) undertaking conservation & survey of flora, fauna, forests and wildlife; and
(iv) planning, promotion, co-ordination and overseeing the implementation of
environmental and forestry programmes.

Approval, Monitoring, prevention and control of industrial pollution is
administered by the Central Pollution Control Board (CPCB) at the Central Level,
and State Pollution Control Boards at the State Level.

The Central Pollution Control Board (CPCB) has developed National Standards for
Effluents and Emission under the statutory powers of the Water (Prevention and Control

These standards have been approved and notified by the Government of India,
Ministry of Environment & Forests, under Section 25 of the Environmental
Protection Act, 1986.

Pollution Control Boards regulate & monitor implementation & compliance of
the following Acts.

◊ Air (Prevention & Control of Pollution) Act, 1981
◊ Environment (Protection) Act, 1986 and Rules made there under
◊ Manufacture, storage and Import of Hazardous Chemicals Rules, 1989
◊ Bio-medical Waste (Management & Handling) Rules, 1998
◊ Plastics wastes Rules, 1999
◊ Coastal Regulation Zone Rules, 1991
◊ Public Liability Insurance Act, 1991

**The Water (Prevention and Control of Pollution) Act**

Acts relating to Water Pollution are comprehensive in their coverage, applying to
streams, inland waters, subterranean waters, and seas or tidal waters. These acts also
provide for a permit system or 'consent' procedure to prevent and control water
pollution. They generally prohibit disposal of polluting matter in streams, wells and
sewers or on land in excess of the standards established by the state boards.

It is estimated that 75% to 80% of water pollution by volume is caused by
domestic sewage. The major industries causing water pollution include: distilleries,
sugar, textile, electroplating, pesticides, pharmaceuticals, pulp & paper mills,
tanneries, dyes and dye intermediates, petro-chemicals, steel plants etc. Non-point
sources such as fertilizer and pesticide run-offs in rural areas also cause pollution.
Only 60% of chemical fertilizers are utilized in soils and the balance is leached into
soil polluting the ground water. Excess phosphate run-off leads to eutrophication in
lakes and water bodies.

The Central Pollution Control Board in consultation with State Pollution
Control Boards has identified 24 areas in the country as critically polluted areas.
These are: Bhadravati (Karnataka), Chembur (Maharashtra), Digboi (Assam), Govindgarh (Punjab), Greater Cochin (Kerala), Kala-Amb (Himachal Pradesh), Parwanoo (Himachal Pradesh), Korba (Madhya Pradesh), Manali(Tamil Nadu), North Arcot (Tamil Nadu), Pali (Rajasthan), Talcher (Orissa), Vapi (Gujarat), Visakhapatnam (Andhra Pradesh), Dhanbad (Bihar), Durgapur (West Bengal), Howrah (West Bengal), Jodhpur (Rajasthan), Nagda- Ratlam (Madhya Pradesh), Najaragarh Drain (Delhi), Patancheru Bollaram (Andhra Pradesh), Singrauli (Uttar Pradesh), Ankleshwar (Gujarat), Tarapur (Maharashtra)

Water act came into effect in 1974 to prevent pollution of water by industrial, agricultural and household water. The main objectives of this act are listed below:

◊ Prevention, control and abatement of water pollution.
◊ The act also aims at restoration of wholesomeness of water.
◊ The water act is designed to assess pollution levels and punish polluters.
◊ The central government and state governments have set-up pollution control boards to monitor water pollution.
◊ The water act of 1974 along with amendments in 1978 is an extensive legislation with more than sixty sections for prevention and control of water pollution.
◊ Central and state boards have been created under this act for preventing water pollution.
◊ The act empowers the board to take:
  water samples for analysis
  govern discharge of sewage
  trade effluents
  study or inspect appeals
  revision of policies
  set minimum and maximum penalties
  publication of names of offenders
  offences by companies or government departments
  establish or recognize water testing laboratories and standard testing procedures
◊ Prevention and control of water pollution is achieved through a 'permit' or a consent administration procedure.
◊ Discharging effluents is permitted by obtaining the consent of state water boards.

**Power & Responsibility of SPCB**

◊ Issue “Consent to Establish”
◊ Issue “Consent to Operate”
◊ Renewal of the “Consent to Operate” before the expiry of validity period
Consent to be deemed as granted automatically and unconditionally after four months from the date of application already given or refused before this period

Refusal of “Consent” where applicable (to be recorded in writing)

The Air (Prevention & Control of Pollution) Act, 1981

Salient Features

Acts relating to Air Pollution, are aimed at prevention, control and abatement of air pollution. An elaborate list of pollutants like particulates & gases has been notified, and their permissible levels have been prescribed under the Act.

It is necessary for every Industry to conform & restrict emissions to within permissible levels as specified. Over the years it has been the endeavour of the government to reduce permissible levels in keeping with technology trends. These days most PCB have stipulated installation of on-line, real-time emission monitoring systems in specified factories for purposes of monitoring air pollution.

Pollution & pollutants discharged through industrial emission is monitored by pollution control boards set up in every state.

PCB collects and disseminates information in respect to air pollution and performs functions prescribed by the act.

The state boards possess the right to inspect at all reasonable times any control equipment, industrial plant or manufacturing process and give orders to take necessary steps to control pollution.

The state board inspects air pollution control areas at regular intervals or whenever necessary.

They are empowered to provide standards for emissions to be laid down for different industrial plants with regard to quantity and composition of emissions.

A state board may recognize or establish a laboratory for this purpose.

State government has powers to declare air pollution control areas after consulting with state boards. In the same manner, state government can give instructions to ensure standards of emission from automobiles and restrict operation of certain industrial units.

Penalties are imposed by the state board and it might appeal to the court to restrain persons for causing air pollution.

Any person who contravenes any provision of the act is punishable with imprisonment for a term extending to three months or a fine of Rs. 10,000 or both. If the offence continues, an additional fine may extend to Rs. 5000 per day for everyday during which the contravention continues after conviction for the first contravention.

Power & Responsibility of SPCB

Issue “Consent to Establish”

Issue “Consent to Operate”

Renewal of the “Consent to Operate” before the expiry of validity period
Consent to be deemed as granted automatically and unconditionally after four months from the date of application already given or refused before this period

Refusal of “Consent” where applicable (to be recorded in writing)

Noise Pollution (Regulation & Control) Rules, 2000

Rules relating to Noise pollution, aim at controlling noise levels in public places from various sources like industrial activity, construction activity, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices having deleterious effects on human health and the psychological well being of the people.

Ambient standards in respect of noise for different categories of areas (residential, commercial, industrial) and silence zones have been notified under the Environment (Protection) Act, 1986. Noise limits have been prescribed for automobiles, domestic appliances and construction equipment at the manufacturing stage. Standards have been evolved and notified for the gen sets, firecrackers and coalmines. Regulatory agencies have been directed to enforce the standards for control and regulate noise pollution.

The prescribed Ambient Noise Levels are to be complied with

A loud speaker should not be used except after obtaining written permission from the authority

If the noise level exceeds the ambient standards by 10d(B) A, complaint can be lodged to the authority.

The Hazardous Waste (Management And Handling) Rules, 1989, with Amendments

A detailed list of materials that constitute hazardous waste has been prepared & notified. Any Industry that produces, stores, processes such waste has to comply with the provisions of this Act.

The State Pollution Control Boards monitor & control these provisions,

Every Industry is required to Check whether the waste(s) generated covered in Schedule 1 and 2 of the amendment rules, 2000

◊ If covered, apply in the Prescribed Format to obtain an “Authorization” for proper treatment and disposal of hazardous waste(s) and comply with the conditions specified in the authorization
◊ Take steps, wherever feasible for reduction, recovery and recycling of wastes
◊ Ensure proper collection, reception, treatment, storage and disposal of hazardous wastes
◊ Apply for renewal of authorization before expiry of the validity period
◊ Maintain records of hazardous wastes handling (Form 3)
◊ Submit “Annual Returns” to the SPCB (Form 4)
◊ Report to the SPCB any accident
Labeling, Packaging, Transportation of HW as per Motor Vehicle Act, 1988 and Rules 1989

**Bio-medical Waste (Management & Handling) Rules, 1998**

This Act intends to regulate & monitor generation and disposal of bio-medical waste. As health care service / industry expanded and spread throughout India, it became apparent that a lot of bio-medical waste was being generated on a daily basis and disposal became an issue.

- Proper segregation of wastes & Labeling as specified
- Install Pollution Control Systems Like Incinerators, autoclaves or microwaves or adopt deep burial and meet the prescribed limits of emissions
- Comply with the dead-line stipulated to install the pollution control systems
- Transportation of waste as per the norms.

**Hazardous Wastes (Management and Handling) Amendment Rules, 2000**

With a view to monitoring generation and disposal of specified type of hazardous wastes Rules were amended to impose restrictions on manner & type of persons authorised to dispose of wastes.

- The waste materials targeted: waste oils, lead – acid batteries, non-ferrous wastes other specified hazardous wastes.
- The auction / sale of these materials to only authorised recyclers who are registered with the Ministry of Environment & Forests, Govt of India
- No trader can take such type of waste

**Batteries (M & H) Rules, 2001**

Lead acid batteries are the main source of storage of electric power. They are used extensively in applications like – Automobiles, Commercial & other vehicles, UPS back-up power systems etc. Lead is a major component by weight in Lead acid batteries. Lead is a pollutant and lead poisoning has been shown to cause major ailments and is injurious to health. Hence an Act to regulate manufacture & disposal of lead waste became necessary in public interest.

- This Act imposes Responsibilities for Manufacturers, users auctioneers, dealers and importers of batteries
- Manufactures are to take initiatives to collect the spent batteries back
- Recyclers / re-processors of batteries need to register themselves with the MoEF

**The Public Liability Insurance Act, 1991**

This Act is intended provide relief in case of death or injury or damage to property from an accident on the principle of no fault.

Acts relating to Public Liability Insurance, provide for public liability insurance (immediate relief) to the persons affected by accidents occurring while handling any hazardous substances.
The main objective of the Public Liability Insurance Act 1991 is to provide for damages to victims of an accident that occurs as a result of handling any hazardous substance. The Act applies to all owners associated with the production or handling of any hazardous chemicals.

**Forest Conservation**

Acts relating to Forest Conservation provide for the conservation of forests and for matters connected therewith or ancillary or incidental thereto.

Acts relating to Wildlife Protection provide for the protection of wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto with a view to ensuring the ecological and environmental security of the country.

**Biological Diversity**

Acts relating to Biological Diversity provide for conservation of biological diversity, sustainable use of its components as well as fair and equitable sharing of the benefits arising out of the use of biological resources and knowledge associated with it.

**Collection & Dissemination of Information**

Environmental Information System (ENVIS) has been established as a plan program and as a comprehensive network in environmental information collection, collation, storage, retrieval and dissemination to varying users. The focus of ENVIS since inception has been on providing this environmental information to decision makers, policy planners, scientists and engineers, research workers, etc all over the country. ENVIS has developed itself with a network of participating institutions/organisations. A large number of nodes, known as ENVIS Centres, have been established in this network to cover the broad subject areas of environment with the focal point at the Ministry of Environment and Forest. These Centres have been set up in the areas of pollution control, toxic chemicals, central and offshore ecology, environmentally sound and appropriate technology, biodegradation of wastes and environment management, etc.

**Manufacture, Storage And Import Of Hazardous Chemical (Amendment) Rules, 1994, 2000**

This Act seeks to regulate manufacture, storage & transport of hazardous chemicals. An inclusive elaborate list of chemicals & quantities thereof are prescribed – that come within the ambit of the Act.

It is mandatory for every Industry that deals with any of the specified chemicals to get their process & plant approved & periodically inspected.

**Important requirements under the Act:**

- Identify whether the chemicals handled, used and stored or imported are covered in the Schedule 1 and/or 3 of the Rules, Schedule 2 for isolated storages.

If covered in schedule 1
Occupier to identify hazards associated with industrial activity and take adequate steps for prevention and control
Occupier to provide relevant information to persons liable to be affected by a major accident
Occupier to develop information in the form of a safety data sheet
Occupier to notify the concerned authorities within 48 hours of the occurrence of a major accident
Occupier to label the specified information on every container of hazardous chemicals.
Occupier to submit, an up-to-date safety report at least ninety days before making any modification.
Occupiers of new and existing industrial activities to carry out safety audit and submit report within 30 days.
Occupier to submit a safety audit update report once a year and forwarding a copy within 30 days.
Occupier to prepare up-to-date on-site emergency plan before commencing a new industrial activity involving specified chemicals.
Occupier shall conduct a mock drill of emergency plan every six months and submit a report.
Occupier to maintain records of imports of hazardous chemicals and to provide information to the concerned Authority.
Occupier to ensure the transportation of hazardous chemicals as per the Provisions of the Motor Vehicles Act, 1988.

1.4 REVISION POINTS
1. Regulation
2. Environment
3. Noise Pollution

1.5 INTEXT QUESTIONS
1. Define The Water (prevention and Control of Pollution act) Act., and state its objectives.
2. Define Air (Prevention and control of Pollution) Act and state its objectives.
3. State some of the methods used for preventing and controlling Air Pollution.
4. State some rules that aim at preventing noise pollution
5. State the salient features of The Hazardous Waste Management & Handling Rules
6. State some measures to be adopted by an Industry before and after commencement of activities that produces hazardous waste in order maintain safety standards.

1.6 SUMMARY
Directive Principles of State Policy states that, it is the duty of the state to ‘protect and improve the environment and to safeguard the forests and wildlife of

We looked at various important provisions under these Acts.

1.7 TERMINAL EXERCISES
1. State some rules that aim at preventing and controlling air pollution.

1.8 SUPPLEMENTARY MATERIALS
1. https://en.m.wikipedia.org
2. https://www.epa.gov

1.9 ASSIGNMENTS
1. Visit a nearby chemical process factory and identify activities that come under the ambit of Environmental Regulations.

1.10 SUGGESTED READINGS / REFERENCE BOOKS
2. Guidelines for Environmental clearance of various projects, Dept. of Environment, Govt. of India.
3. D.K. Asthana and Meera Asthana, Environment problems & solutions,

1.11 LEARNING ACTIVITIES
1. Group discussion on during PCP day’s Environmental regulation.

1.12 KEY WORDS
1. Prevention, Pollution, Environment
**ANNEXURE**

**COMPRENDIUM OF ENVIRONMENTAL REGULATIONS IN INDIA**

**Disclaimer**

This list is illustrative and is not intended to be a complete or inclusive list.

**Reference & Courtesy: Dr. Asit K Patra, Asset Director, DMI, Bhopal**

<table>
<thead>
<tr>
<th>Year</th>
<th>Environmental Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>Water (Prevention &amp; Control of Pollution Act) Amendments, 1988</td>
</tr>
<tr>
<td>1975</td>
<td>The Water (Prevention &amp; Control of Pollution) Rules</td>
</tr>
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<td>1977</td>
<td>The Water (Prevention &amp; Control of Pollution) Cess Act</td>
</tr>
<tr>
<td>1978</td>
<td>The Water (Prevention &amp; Control of Pollution) Cess Rules</td>
</tr>
<tr>
<td>1981</td>
<td>The Air (Prevention &amp; Control of Pollution) Act, Amendments, 1987</td>
</tr>
<tr>
<td>1982/1983</td>
<td>The Air (Prevention &amp; Control of Pollution) Rules</td>
</tr>
<tr>
<td>1986</td>
<td>The Environmental (Protection) Rules</td>
</tr>
<tr>
<td>1997</td>
<td>Amendments in the Environment Clearance, Notification – “Public Hearing” made mandatory</td>
</tr>
<tr>
<td>1995</td>
<td>The National Environment Tribunal Act</td>
</tr>
<tr>
<td>1997</td>
<td>Prohibition on the Handling of Azo dyes</td>
</tr>
<tr>
<td>1997</td>
<td>The National Environment Appellate Authority Act</td>
</tr>
<tr>
<td>1998</td>
<td>The Bio-Medical Waste (M&amp;H), Rules</td>
</tr>
<tr>
<td>1999</td>
<td>Notification for making 100% Utilization of Fly-ash made mandatory</td>
</tr>
<tr>
<td>2000</td>
<td>Municipal Solid Waste (M&amp;H) Rules</td>
</tr>
<tr>
<td>2000</td>
<td>Ozone Depleting Substance (R&amp;C) Rules</td>
</tr>
<tr>
<td>1999</td>
<td>Regulation on recycling of Waste Oil and Non-ferrous scrape</td>
</tr>
<tr>
<td>2000</td>
<td>Noise Pollution (Regulations and Control)</td>
</tr>
<tr>
<td>2001</td>
<td>Batteries (M&amp;H) Rules</td>
</tr>
</tbody>
</table>
Jurisdiction of Environmental Legislation in India

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<tr>
<th>Central Government</th>
<th>State Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>◊ Ministry of Environment &amp; Forest</td>
<td>State Dept of Environment</td>
</tr>
<tr>
<td>◊ Regional Offices</td>
<td>State Pollution Control</td>
</tr>
<tr>
<td>◊ Central Pollution Control Board</td>
<td>State Pollution Control / Board</td>
</tr>
<tr>
<td>◊ Zonal Offices (6)</td>
<td></td>
</tr>
<tr>
<td>◊ State Pollution Control</td>
<td></td>
</tr>
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<td>◊ Committee</td>
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</tr>
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<td>◊ - Regional Offices</td>
<td></td>
</tr>
</tbody>
</table>

1. The Water (Prevention and Control of Pollution) Act, 1974
   ◊ Provide information to the SPCB
   ◊ Provide access to the SPCB for taking samples
   ◊ Allow entry to the SPCB to ascertain that the provisions of the Act are being complied with.

Responsibilities
   ◊ Obtain “Consent to Establish”
   ◊ Obtain “Consent to Operate”
   ◊ Apply for renewal of the “Consent to Operate” before the expiry of validity period
   ◊ Consent to be deemed as granted automatically and unconditionally after four months from the date of application already given or refused before this period
   ◊ Refusal of “Consent” to be recorded in writing
   ◊ Pay Water Cess as indicated in the assessment order
   ◊ Affix water meters of the prescribed standards
   ◊ Provide access to SPCB
   ◊ Pay interest in case of delay in paying the Water Cess
   ◊ Pay penalty for non-payment of Cess
   ◊ Industry is entitled to 25% rebate if meeting certain conditions

2. The Air (Prevention & Control Of Pollution) Act, 1981
   ◊ Comply with the conditions in the “Consent to Establish” or “Consent to Operate”
   ◊ Not to discharge air pollutant(s) in excess of the prescribed standards
   ◊ Furnish information to the SPCB of any accident or unforeseen act or event
   ◊ Allow entry to the SPCB to ascertain that provisions of the Act are being complied with
   ◊ Provide information to enable SPCB to implement the Act
   ◊ Provide access to the SPCB for taking samples
   ◊ Comply with the directions issued in writing by the SPCB
   ◊ Obtain “Consent to Establish”
◊ Obtain “Consent to Operate”
◊ Apply for the renewal of “Consent to Operate” before expiry of the validity period
◊ Consent to be deemed as granted after four months from the date of receipt of application if no communication from the SPCB is received
◊ A prior “Notice of Inspection” to be served by the SPCB
◊ Industry to ensure that specified emission sampling procedure is being followed by the SPCB
◊ Opportunity to file objections with the SPCB within 15 days from the date of service of notice
◊ PCB to record reasons in writing in case it does not provide an opportunity to the industry to file objections

3. Environment (Protection) Act, 1986
◊ Comply with the directions issued by the Central Government. The direction may include:
  ➢ closure, prohibition or regulation of any industry, or
  ➢ stoppage or regulation of the supply of electricity, water or any other service
◊ Prevent discharges or emissions excess of the prescribed standards
◊ Furnish information of any accidental or unforeseen event
◊ Allow entry and inspection to ascertain compliance
◊ Allow samples to be taken
◊ Submit an “Environmental Statement” every year before 30th September to the SPCB
◊ Obtain prior “Environmental Clearances” from MoEF, in case of a new project or for modernization/expansion of the existing project

◊ Check whether the waste(s) generated covered in Schedule 1 and 2 of the amendment rules, 2000
◊ If covered, apply in the Prescribed Format to obtain an “Authorization” for proper treatment and disposal of hazardous waste(s) and comply with the conditions specified in the authorization
◊ Take steps, wherever feasible for reduction, recovery and recycling of wastes
◊ Ensure proper collection, reception, treatment, storage and disposal of hazardous wastes
◊ Apply for renewal of authorization before expiry of the validity period
◊ Maintain records of hazardous wastes handling (Form 3)
◊ Submit “Annual Returns” to the SPCB (Form 4)
◊ Report to the SPCB any accident
Labeling, Packaging, Transportation of HW as per Motor Vehicle Act, 1988 and Rules 1989

   ◇ Clarification on the definition of Hazardous Wastes
   ◇ List of hazardous waste according to schedule 1 is being modified
   ◇ Procedure for registration of re-processors of non-ferrous scrap and waste oil
   ◇ Schedule for hazardous wastes prohibited for import to and export from India

   Identify whether the chemicals handled, used and stored or imported are covered in the Schedule 1 and/or 3 of the Rules, Schedule 2 for isolated storages.
   If covered in schedule 1:
   ◇ Occupier to identify hazards associated with industrial activity and take adequate steps for prevention and control
   ◇ Occupier to provide relevant information to persons liable to be affected by a major accident
   ◇ Occupier to develop information in the form of a safety data sheet
   ◇ Occupier to notify the concerned authorities within 48 hours of the occurrence of a major accident
   ◇ Occupier to label the specified information on every container of hazardous chemicals.

   Owner to provide relief in case of death or injury or damage to property from an accident on the principale of no fault.
   ◇ Owner to draw insurance polices more than the paid-up capital but less than Rs. 50 Crores.
   ◇ ‘Paid-up Capital’ is the market value of all assets and stocks on the date of insurance.
   ◇ Owner to pay additional amounts as contribution to the ‘Environmental Relief Fund’.
   ◇ Owner to provide any information required for ascertaining compliance with the provisions of the Act.
   ◇ Owner to allow entry and inspection to ascertain compliance with the provisions of the Act.
   ◇ Owner to pay the amount of an award as specified by the Collector.

Comply with the directions issued in writing by the Central Government, directions may include
   i) prohibition or regulations of handling of any hazardous substances, or
   ii) stoppage or regulation of the supply of electricity, water or any other service.

 Proper segregation of wastes & Labeling as specified
◊ Install Pollution Control Systems Like Incinerators, autoclaves or microwaves aor adopt dee burial and meet the prescribed limits of emisions
◊ Comply with the dead-line stipulated to install the pollution control systems
◊ Transportation of waste as per the norms.

The waste materials targeted : waste oillies, lead – Acid batteries, non-ferrous wastes
◊ The auction / sale of these materials to only authorised recyclers who are registered with the Ministry of Environment & Forests, Government of India.
◊ No trader can take such type of waste

10. Noise Pollution (Regulation & Control) Rules, 2000
Aiming to regulate and control noise from sources like, industrial activity, construction activity, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices, such that the prescribed Ambient Noise Levels are complied with.
◊ A loud speaker should not be used except after obtaining written permission from the authority
◊ If the noise level exceeds the ambient standards by 10d(B) A, complaint can be lodged to the authority.

Responsabilités for Manufacturers, users auctioners, dealers and importers of batteries
◊ Manufactures are to take initiatives to collect the spent batteries back
◊ Recyclers / re-processors of batteries need to register themselves with the MoEF
2.1 INTRODUCTION

A wide range of approvals & licenses are required before a large industrial project can be commissioned. Many projects have suffered inordinate delays resulting in cost over-runs. Sometimes the project even becomes unviable even at the time of commissioning. Interest burdens that require to be capitalized by itself, can be a cause for the project becoming unviable even before it is commissioned. Hence it is good to have an idea of the statutory procedures, approvals & licenses required for start up of a large industrial project.

Note: We have used CPWD recommendations for Tamil Nadu as the basis. This lesson is only a guide and is not intended to be inclusive or complete.

2.2 OBJECTIVE

Valuation profession requires the professional to assess large projects & buildings. Valuation requires that the Valuer is aware of statutory requirements for establishing a large project. Major deviations can have very significant influence on value of the asset. In this lesson we learn about various approvals & No-objection certificates required in the process of establishing a large project (industrial).

2.3 CONTENT

Any large project requires considerable planning. To ensure timely completion it is very necessary to have a good understanding of various requirements to be met at each stage of the project. We now look at various approvals & No-objection certificates (NOC) that need to be obtained as the project progresses.

(A) Project Feasibility/ Planning Stage

(A1.1) Zone & use - Govt Land: Land use plan approval for the plot is required from Local Body and Housing & Urban Development Body. The land use plan for land area is to be notified by H & UD Dept., after the same is approved by local body.

(A1.2) Land use - Change: First Approval for change in land use of the plot is required from local body. A notification calling for Public opinion is to be made where necessary. Approval for change in land use is to be granted by H & UD Dept. in writing and appropriate changes made in the plan.

(A1.4) Deviations: Relaxation in respect of density/ ground coverage/FAR/ setbacks/ height etc. prescribed in byelaws are required from the State Govt. H & UD Dept. may not possess any power of relaxation in these matters, except as provided by State Govt. rules.

(A1.5) Approval for Demolition: (A1.5) Approval for Demolition of any Existing Structure is required from the Corporation of the City or appropriate Local Body.
(A.2) Where the location is within 20 kms of existing or proposed Airport

No Objection Certificate (legal document) is required for height clearance of Buildings / Structures/ Masts from the Directorate of Air Traffic Management, Airport Authority of India (AAI), when the project lies within 20 kms. Radius of Air strips/funnel.

(A.3) Coastal Regulation Zone

No Objection Certificate is required when the land is near the coast/CRZ as construction is not allowed up to 500 meters from the high tide line of the sea or 100 m from the high tide line of river, creek etc. (See CRZ regulations for more details)

A4. Power Availability & Access:  Advice approvals from Electricity Transmission / Distribution Company in the area – regarding feasibility / availability of Power at the required voltage level and arrangements for power including provisions for – Sub-station, equipment, dedicated power lines.

(B) Commencement (pre-commencement) Stage

(B.1) Local Body Approvals

(B1.1) Approval is required from the local authority and Local body under the provisions of Local Building Byelaws, Master plan and Local Body Acts.

(B.2) Proximity to declared areas of ASI

Where the entire project site or part /s of it is within 300 meter radius from the declared boundary of any monument protected under Ancient Monument Act and is under the control of ASI, no Objection Certificate is required from the National Monument Authority (NMA) / Archaeological Survey of India (ASI).

(B.3) Tree Cutting / felling

Approval is required from the State Forest Department / Municipal Corporation when there is a proposal for tree cutting/felling and transplantation at the site.

(B.4) Notified heritage Buildings:

(Where the project or part thereof is likely to affect)

Approval is required from the Heritage Conservation Committee (HCC) or Appropriate Authority when the project has any link/ relation with any listed heritage building and precincts (as notified by Local Body from time to time) and within their jurisdiction.

(B.5) Where Project is proximate to or inside

RAILWAY AUTHORITY/PORTTRUST / DEFENCE establishment.

NOC is required from the Railway Authority/Chennai Port Trust / Defense Establishment when the project site is proximate as per notified guidelines.

(B.6) Road Cutting or Right of Way

NOC is required from the Road Owning Agency (D&UD Dept., PWD, NHAI, Local Body) when cutting of footpath or road or service lane or Right of way (ROW) is involved.
(B.7) Fire Safety
Approval / Fire Safety Certificate is required from Chief Fire Officer (CFO) State Fire & Rescue Services) for the proposals at layout plan stage as stipulated in the local building byelaws and National Building Code (NBC).

(B.8) Road Traffic Management
Approval from traffic police is required from the Jurisdictional Local Traffic Police Officer, where the proposal involves disruption of general traffic movement/circulation pattern temporarily or permanently during and after the construction of the project.

(B.9) Inflammable or hazardous Storages: PESO APPROVAL
Approval is required from the Director, PESO, in case of hazardous building or for storing of hazardous materials in the compound.

(B.10) Factory layout / buildings & Process
Approval from DISH
Approval & licenses from the Directorate of Industrial Safety & Health is required for every Factory under the Factories Act.

(B.12) Environment Clearance
NOC Is Required From Ministry Of Environment And Forests (MEF)/ State level expert committee for all building / construction projects having built up area more than 20,000 Esq. and area development projects/townships covering an area more than 50 hectare.

B13. Pollution Control Board Clearance
An NOC for establishing the Project / Industry in the area and layout plan including provisions for Air & Water pollution mitigation specifying the quantities/type of effluents likely to be generated is to be obtained for State Pollution control Board.

B14. Electrical Safety
All Electrical Installations have to conform to IE Act & Rules 2003 as amended. The State Chief Electrical Inspector or Central Electricity Authority as the case may be is the appropriate Authority for approving the design, layout and schematic of electrical installation in the project / industry.

All appropriate electrical drawings are to be approved and the installation proposal approved.

(C) Project Site Work - Progress Stage

(C.1) Building Plans Approval
Approval is required from the local body / authority(D & UD Dept.) for sanction of building plans/ building permit under the provisions of Building Byelaws, Master plan and Local Body Acts.

The local body forwards the proposals to the various other concerned authorities in the city as required for issue of case specific approvals.

(C.2) Conference Halls / auditorium with seating capacity of more than 50 persons to be used for public amusement
Approval/ NOC is required from DCP (Licensing) or Appropriate Authority for the proposal.
C.3) Electric Power Supply (temporary & permanent)
Approval is required from the Power distributing /supply agency for sanction of electrical load and requirement for the electrical substation and provision of transformers. The temporary connection for power supply needs to be obtained from the concerned authority before start of construction.

(C.4) Water Supply & Sewage disposal
Approval / NOC /assurance is required from the water supply agency for uninterrupted water supply. The temporary connection for water supply needs to be obtained from the concerned authority before start of construction.
Provision for sewage management should be approved.

(D) Ground water extraction
Permission is required from the Central Ground Water Authority (CGWA) to abstract ground water Permission to abstract ground water through any energized means i.e. for digging / installation of bore well water connection in the site for drinking water in a notified /non notified area for household/ industrial / infrastructure projects as per guidelines dated 15/11/ 2012 under Environmental Protection Act (EPA)(1986).

(D.2) Commencement of Work notice
Owner/applicant who has been granted building permit shall intimate the local Authority in writing before 7 days of starting of construction work at site in the prescribed form. An acknowledgement needs to be obtained from the Authority of this notice.

(D.3) Plinth Level Notice
Plinth Level Notice (information of completion of work up to plinth level in the prescribed Performa along with requisite documents, fee and charges mentioned therein) is required to be submitted by every owner/lessee to the local authority.

E. Completion & Trial Runs stage
(E) Completion Cum Occupancy Certificate
Completion-cum-Occupancy Certificate is required from H&UD authority before occupation of a building or part of a building for any purpose.

(E.2) Lifts (passenger & service lifts) NOC is required from the Lift Inspector of the State, before granting Completion-cum-Occupancy Certificate when lifts are installed in a building.

E3: Pollution Control Board Clearance
A clearance letter for commencement of operations is to be obtained from State Pollution Control Board for Air / Water pollution mitigation arrangements.

E4: Electrical Safety
Clearance for charging of transformer after inspection & approval of Electrical installation by the Chief Electrical Inspector, State..

5. General Safety
Clearance for starting from Directorate of Industrial Safety & Health (DISH)

6. Inflammable Storages
Inspection &Clearance for start from Director, PESO.
7. Steam Boilers
   Approval from Inspector of Boilers for light up & firing of boiler.

8. Other requirements
   Depending upon the type of Industry – approvals from specific authorities may
   be required.

2.4 REVISION POINTS
   1. Commission; 2. Project; 3. Pollution Control

2.5 INTEXT QUESTIONS
   1. List some statutory approvals and state its importance in any large Industrial
      project.
   2. List at least 5 approvals that are required at the planning stages of an
      Industrial Project.

2.6 SUMMARY
   In this lesson we look at the various approvals needed from Project Feasibility/
   Planning Stage, Commencement (pre-commencement) Stage, Project Site Work -
   Progress Stage to Completion & Trial Runs stage.

   We need to understand the importance of these requirements to ensure that
   project completion & commissioning take place in the target period.

2.7 TERMINAL EXERCISES
   1. What do you mean by local body approvals? Give 3 examples.
   2. List some approvals essential before start up or commissioning of a plant.

2.8 SUPPLEMENTARY MATERIALS
   1. https://www.epa.gov

2.9 ASSIGNMENTS
   1. During a visit to a factory study the various statutory approvals obtained by
      the Company and their validity.

2.10 SUGGESTED READINGS / REFERENCE BOOKS
   1. Suresh K. Dhameja, Environmental Engineering and Management,
   2. Guidelines for Environmental clearance of various projects, Dept. of
      Environment, Govt. of India.
   3. D.K. Asthana and Meera Asthana, Environment problems & solutions,
   5. Cunningham & William, Environmental Science: A global concern Tata
   6. Kaushick, Anubhua & Kaushik, C.P, Perspectives in Environmental Studies,

2.11 LEARNING ACTIVITIES
   1. Group discussion on during PCP days statutory approvals.

2.12 KEY WORDS
   1. Statutory; 2. Approvals; 3. Project
CASE STUDIES - MAJOR INDUSTRIAL DISASTERS

3.1 INTRODUCTION

There is growing awareness of risks and consequences of major industrial disasters. This is reflected in official statistics, mass media reports, and the appearance of new public institutions that address the problem. Industrial disasters & responses require much more attention than safety issues that need to be resolved. They reflect aspirations & expectations of society on technology, and environment concerns and about public opinion & therefore laws that get enacted.

3.2 OBJECTIVE

- To familiarise the student with some major industrial disasters in India. This is intended to sensitise the student on the need for strict implementation of Environment Regulations & Safety Practices. Valuers are encouraged to assess compliance to Environmental Regulations and provide for it in the Valuation matrix as a material influence on Value of the Asset.

3.3 CONTENT

It is very common & generally accepted stand point that Industrial Disasters are an “Act of God”, and they happen inspite of utmost care & due diligence on the part of Industry – occupier & professionals in charge of operations of a plant. However a close study of various disasters clearly establishes that apathy, ignorance, negligence and greed were also significant contributors to the occurrence. Professionals failed to apply due diligence and were mute witnesses to deteriorating safety features & practices over a period of time, culminating in an accident.

It is time to make a clear distinction between two types of industrial disasters – preventable & unforeseen. A vast majority of disasters that happened, can now be classified as preventable, in light of studies.

Accidents in Chemical process industries are a major threat to life and property. With the rapid development in science and technology, several new innovations have come up and Chemical process industries deal with thousands of new chemicals and several processes. Every day, there are innumerable minor accidents & near misses that go unreported. Nevertheless, it is a fact that growing awareness has resulted in more & more accidents getting reported and causes investigated and recorded. So it would be of great use if we could collate and categorize all the disasters, which occurred in the past, and learn useful lessons from analysis of causes of these disasters.

We learn best through our own experiences in different phases of our life. Mistakes could be catastrophic in a chemical plant, but it is a great opportunity to learn and design a safer plant in the future. We must learn from previous incidents and develop and design a safer plant, new procedures, practices and management systems for a safer and better future.
Each incident and analysis of its causes must result in organisational learning and reveal many hidden deficiencies on safety & operational practices. They can and should provide efficient tools for prevention of similar incidents in the future. Sharing of experience is a must, so that as an Industry and Country, we can leave behind a better tomorrow for our children. We now look at some major Industrial Disasters that have happened in our Country.

**BHOPAL TRAGEDY 1984**

One of the worst chemical disasters, in Industrial history, is perhaps the Bhopal Gas Leak tragedy.

The Bhopal disaster, or Bhopal gas tragedy, was a gas leak incident. It occurred on the night of 2–3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh. Over 500,000 people were exposed to methyl iso-cyanate (MIC) gas and other chemicals. The toxic substance made its way in and around the shantytowns located near the plant.

Estimates vary on the death toll. The official immediate death toll was 2,259. The government of Madhya Pradesh confirmed a total of 3,787 deaths related to the gas release. A government affidavit in 2006 stated the leak caused 558,125 injuries including 38,478 temporary partial injuries and approximately 3,900 severely and permanently disabling injuries.

The cause of the disaster remains under debate. The Indian government and local activists argue slack management and deferred maintenance created a situation where routine pipe maintenance caused a back flow of water into a MIC tank triggering the disaster. Union Carbide Corporation (UCC) contends water entered the tank through an act of sabotage.

In November 1984, most of the safety systems were not functioning and many valves and lines were in poor condition. In addition, several vent gas scrubbers had been out of service as well as the steam boiler, intended to clean the pipes. Another issue was that Tank 610 contained 42 tons of MIC, more than what safety rules allowed for.

During the night of 2–3 December 1984, water entered a side pipe that did not have its slip-blind plate and entered Tank E610 that contained 42 tons of MIC. A runaway reaction started, which was accelerated by contaminants, high temperatures and other factors. The reaction was speed up by the presence of iron from corroding non-stainless steel pipelines. The resulting exothermic reaction increased the temperature inside the tank to over 200 °C (392 °F) and raised the pressure. This forced the emergency venting of pressure from the MIC holding tank, releasing a large volume of toxic gases. About 30 metric tons of methyl isocyanate (MIC) escaped from the tank into the atmosphere in 45 to 60 minutes. The gases were blown in south-eastern direction over Bhopal.

The initial effects of exposure were coughing, severe eye irritation and a feeling of suffocation, burning in the respiratory tract, blepharospasm, breathlessness,
stomach pains and vomiting. People awakened by these symptoms fled away from the plant. Those who ran on foot, inhaled more than those who had a vehicle to ride. Owing to their height, children and other people of shorter stature inhaled higher concentrations. Thousands of people had died by the following morning.

Primary causes of deaths were choking, reflexogenic circulatory collapse and pulmonary oedema. Findings during autopsies revealed changes not only in the lungs but also cerebral oedema, tubular necrosis of the kidneys, fatty degeneration of the liver and necrotizing enteritis. The stillbirth rate increased by up to 300% and neonatal mortality rate by around 200%.

Initial investigation was conducted entirely by the Council of Scientific and Industrial Research (CSIR) and the Central Bureau of Investigation. Union Carbide organized a team of international medical experts, as well as supplies and equipment, to work with the local Bhopal medical community, and the UCC technical team began assessing the cause of the gas leak.

The health care system immediately became overloaded. Medical staffs were unprepared for the thousands of casualties. Doctors and hospitals were not aware of proper treatment methods for MIC gas inhalation.

**Long-term health effects**

Detailed data about the health effects are still not available. A total of 36 wards were marked by the authorities as being "gas affected," affecting a population of 520,000. Of these, 200,000 were below 15 years of age, and 3,000 were pregnant women. The official immediate death toll was 2,259, and in 1991, 3,928 deaths had been officially certified. The government of Madhya Pradesh confirmed a total of 3,787 deaths related to the gas release. Later, the affected area was expanded to include 700,000 citizens. A government affidavit in 2006 stated the leak caused 558,125 injuries including 38,478 temporary partial injuries and approximately 3,900 severely and permanently disabling injuries.

**A number of clinical studies have been conducted. Broadly the following health effects have been confirmed:**

- **Eyes:** Chronic conjunctivitis, scars on cornea, corneal opacities, early cataracts
- **Respiratory tracts:** Obstructive and/or restrictive disease, pulmonary fibrosis, aggravation of TB and chronic bronchitis
- **Neurological system:** Impairment of memory, finer motor skills, numbness etc.
- **Psychological problems:** Post traumatic stress disorder (PTSD)
- **Children's health:** Peri- and neonatal death rates increased. Failure to grow, intellectual impairment etc.

We don’t know as of date, effects of Bhopal Gas Leak, on female reproduction, chromosomal aberrations, cancer, immune deficiency, neurological disorders, post traumatic stress disorder (PTSD) and effects on children born after the disaster.
Indian Oil Corporation – Jaipur Oil Depot fire - 2009

The Jaipur oil depot fire broke out on 29 October 2009 at 7:30 PM (IST) at the Indian Oil Corporation (IOC) oil depot's giant tank holding 8,000 KL of oil, in Sitapura Industrial Area on the outskirts of Jaipur, Rajasthan, killing 12 people and injuring over 200. The oil depot is about 16 kilometres south of the city of Jaipur, and situated 5 KM from the Jaipur International Airport. The blaze continued to rage out of control for over a week after it started and during the period half a million people were evacuated from the area.

The incident occurred when petrol was being transferred from the Indian Oil Corporation’s oil depot to a pipeline. There were at least 40 IOC employees at the terminal, when it caught fire with an explosion. The Met department recorded a tremor measuring 2.3 on the Richter scale around the time the first explosion at 7:36 pm, which resulted in shattering of glass windows nearly 3 kilometres from the accident site.

The fire was a major disaster in terms of deaths, injury, loss of business, property and man-days, displacement of people, environmental impact in Jaipur. As per eyewitnesses having factories and hotels around Indian Oil’s Sitapura (Jaipur) Oil Terminal they felt presence of petrol vapour in the atmosphere around 4:00 p.m. on 29 October 2009. Within the next few hours the concentration of petrol vapour intensified making it difficult to breathe.

The Ayahs Hotel in the vicinity of the terminal asked all its guests to vacate the Hotel to avert any tragedy. Adjacent to the Terminal wall was the workshop of Morani Motors (P) Limited whereas per eyewitnesses the Cars parked on the roof top were thrown up in Air to about 10 feet and 35 new Hyundai cars were damaged.

The police, civil administration and fire emergency services were oblivious of the situation developing in Indian Oil Terminal, from 4.00 pm to 6.00 pm. Around 6.30 pm employees in the terminal panicked and reported the matter to nearby Sanganer Sadar Police Station. Within the next 30 minutes the local police chief and District Collector reached the site, along with GM, Indian Oil, but with no plan to deal with the situation. The nearby industries, which were running second shifts, were cautioned to vacate the area.

At 7:35 p.m. a huge ball of fire with loud explosion broke out engulfing the leaking petrol tank and other nearby petrol tanks with continuous fire with flames rising 30–35 m and visible from a 30 km radius. The traffic on adjacent National Highway No. 12 was stopped. This lead to a 20 km long traffic jam. The Jaipur International Airport is just 5 km away from the accident site.

Both the Army and experts from Mumbai were employed on 30 October 2009 to contain the fire. The district administration disconnected electricity and evacuated nearby areas to limit the damage. The fire still raged on 31 October 2009, in the Indian Oil Corporation Depot, at Jaipur.
The cause of fire was traced to a defective pipeline & leak. Fire & explosions released 50,000 kilolitres of diesel and petrol out of the storage tanks and aggravated the fire, at the IOC Depot.

The accident claimed 11 lives and seriously injured more than 150. The District Administration and Indian Oil Corporation had no disaster management plan to deal with this kind of calamity. The local fire officers were ill equipped to deal with fire accidents of this magnitude. A good disaster response plan complete with trained team could have saved lives & property. A high level enquiry team led by Mr. M.B. Lal and Oil Industry Safety Directorate (OISD) conducted a detailed study and submitted a report. Many of the recommendations have been accepted and are being implemented.

**BALCO, Korba – Thermal Power Plant Chimney Collapse - 2009**

The 2009 Korba chimney collapse occurred in the town of Korba in Chhattisgarh State on 23 September 2009. It was under construction, under contract for the Bharat Aluminium Co Ltd (BALCO). Construction had reached 240 m when the chimney collapsed on top of more than 100 workers who had been taking shelter from a thunderstorm. At least 45 deaths were recorded.

Plans specify a 275-metre chimney for the construction of a thermal power plant by BALCO, which is owned by Vedanta Resources. The incident happened during extreme weather conditions involving lightning and torrential rainfall. Workers sought shelter from the rain in a nearby store room, and a lightning strike at approximately 16:00 brought the chimney down on top of them.

A rescue attempt was initiated following the collapse. On-going rain obstructed efforts to retrieve the trapped workers. At least seven of the wounded were hospitalised.

An investigation has been initiated to determine the cause of the collapse. BALCO initially did not discuss the incident at length, stating only that "there is an accident and some people are injured"; claiming to be too busy with the rescue effort to make a longer statement. The state government believes that BALCO had been "overlooking security aspects".

In November 2009, the project manager from GDCL was arrested, as well as three officials from Vedanta Resources which manages BALCO. Later the National Institute of Technology (NIT) Raipur observed that the materials were of substandard quality and technically faulty in design. NIT also concluded that there was improper water curing and that soil at the site was not up to code. Additionally, supervision and monitoring was found to be negligent.

**New Delhi, Mayapuri – Radiation leak 2010**

In April 2010, the locality of Mayapuri was affected by a serious radiological accident. An AECL Gammacell 220 research irradiator owned by Delhi University since 1968, but unused since 1985, was sold at auction to a scrap metal dealer in Mayapuri on February 26, 2010. The radiation source arrived at a scrap yard in
Mayapuri during March, where it was dismantled by workers unaware of the hazardous nature of the device. The cobalt-60 source was cut into eleven pieces.

The smallest of the fragments was taken by one Mr. Ajay Jain who kept it in his wallet, two fragments were moved to a nearby shop, while the remaining eight remained in the scrap yard. Later all of the sources were recovered by mid-April and transported to the Aurora Atomic Power Station, where it was claimed that all radioactive material originally contained within the device was accounted for. The material remains in the custody of the Department of Atomic Energy.

Eight people were hospitalized as a result of radiation exposure, where one later died. Five patients suffered from the haematological form of the acute radiation syndrome and local cutaneous radiation injury as well. While four patients exposed to doses between 0.6 and 2.8 Gy survived with intensive or supportive treatment, the patient with the highest exposure of 3.1 Gy died due to acute respiratory distress syndrome and multi-organ failure on Day 16 after hospitalization.

The incident highlights the current gaps in the knowledge, infrastructure and legislation in handling radioactive materials. Medical institutions need to formulate individualized triage and management guidelines to immediately respond to future public radiological accidents.

**Concerns post-accident:** One of the main business at Mayapuri is the recycling of metal scraps and sale of salvage vehicle parts. Many traders from all over India come here to sell or purchase old auto parts. Many small workshops specialized in different metals are active in the Mayapuri area.

Safety of the scrap yards became a concern after the radiological accident that occurred in April 2010. The area is not equipped with radiation detectors, despite being a common practice in steel recycling factories in the US and in most of the European countries. The presence of toxic heavy metals and of harmful chemicals in the waste generated by these activities presents a direct menace for the health of several ten thousands of people living in the area.

**Mangalore Chemicals and Fertilizers Limited– 2000**

There was a chemical accident in the Urea Plant at M/s. Mangalore Chemicals and Fertilizers Limited, Panambur, Mangalore on 9.2.2000, An 8” dia high-pressure pipeline housing a wellolet was connected between autoclave (urea reactor) of 108MT capacity and the stripper to carry ammonium carbamate (Urea Solution). The pressure of pipe line was of the order of 141kg/cm2 and the temperature of 180 C. The Solution had contained 29% of ammonia, 18% carbon di oxide and 32% of urea.

On 9\textsuperscript{th} February 2000, a substantial quantity of ammonium carbamate solution leakage was noticed at the wellolet joint of the pipeline. A maintenance manager along with two operators, an engineer and two contract workmen were trying to plug the leakage by providing a proper clamping. In the process, the
weldolet joint gave way resulting in sudden release of pressurized hot ammonium carbamate solution. As a result, the personnel on the job were exposed to hot solution and toxic gas.

In the accident, 8 persons were affected. 2 persons died on the spot and the other two at the hospital amounting to death of 4 persons including the maintenance manager and an engineer.

Investigation conducted by the department under the guidance of an expert committee revealed that the weldolet used in the high pressure pipe line had high carbon content which is not suggested for that kind of a process. Maintenance Repair works was undertaken on line even after noticing the hazardous solution which amounts of non implementation of shutting down procedures. Further the high-pressure pipeline was not subjected to hydrostatic test, ultrasonic tests and examinations as required under relevant provisions of law for its soundness. The personnel who were on the job were not wearing any personal protective equipment in addition to non-adherence to work to permit system. Work Permit System was not enforced.

The expert committee investigated made the following recommendations to prevent any incident in future. It can be seen that many Standard Operating Procedures were not followed. Victims included Maintenance Manager, who should have been aware of the risks.

The pipeline, connected equipment and the accessories must be subjected to hydrostatic test as required under the relevant provision of law; Weldolet must be subjected to 100% examination to detect corrosion and the soundness; Maintenance/repair works shall not be undertaken on line, it shall be done only as per standard maintenance procedure drawn up before hand; Work Permit system shall be strictly adhered to along with suitable personal protective equipment;

Emergency plan shall be put to rigorous tests and practiced. The personnel including the contract workmen shall be put to rigorous training.

National Fertilisers Limited (NFL), Panipat - 1992

Eleven people died Aug. 26 when ammonia gas leaked from the fertilizer plant near Panipat. The plant previously won several safety awards.

The victims, all employees of NFL, were on maintenance duty near a pipeline pump when its suction valve reportedly burst and liquid ammonia escaped. Liquid ammonia burst out at the high pressure of 23 kg per sq cm, vaporising within seconds to form suffocating clouds of deadly gas. This hit and choked to death eleven persons and injured ten even as their colleagues sprung into action to diffuse the gas with water sprays.

IT WAS a routine job of replacing the defective safety valve of the spare ammonia feed pump at the 15-year-old urea plant of the National Fertilisers Limited (NFL) at Panipat. Around 11.00 am on August 26, eight employees climbed
the steps to the open-air ramp, which had been declared a "safe area" by the plant safety department, and began to replace the valve when the unthinkable happened.

The bush of the suction valve that stops the gas flow from the mainline, gave way. Liquid ammonia burst out at the high pressure of 23 kg per sq cm, vapourising within seconds to form suffocating clouds of deadly gas. This hit and choked to death eleven persons and injured ten even as their colleagues sprung into action to diffuse the gas with water sprays.

**Water Treatment Plant - Chlorine Gas Leak, Township, Jamshedpur - 2008**

There was a chlorine gas leak in the Tata Township on 27 May, 2008. People of Jamshedpur were caught unaware when they were exposed to a dense, pale green, pungent and poisonous gas, Chlorine. Jamshedpur Utilities and Services Company (Jusco), a subsidiary of Tata Steel, was in charge of operation of the water treatment plant. Chlorine gas leaked from an unused cylinder lying in the plant for about 10 years. By the next day, around 150 to 200 people had been hospitalised. The affected people also included company employees and their family members.

No deaths were reported. Tata Motors claimed that the chlorine leak has been plugged in good time. Residents who reported breathing difficulty were admitted to the Tata Motors hospital in Jamshedpur and treated.

Chlorine gas has strong oxidising properties. Its toxicity irritates the respiratory system. Severe continued exposure to the gas can be fatal.

A good emergency response system can mitigate injuries & loss of life.

**SPIC ammonia unit shut due to leakage problem - 2002**

Southern Petrochemical Industries Corporation (SPIC) at Tuticorin has been shut down due to a leakage in the pipeline. When the repair works were going on, a fatal accident occurred on October 1, company sources told *Business Line*.

Sources said that after the southern grid failure last month, technical problems arose in SPIC's plant, causing ammonia leakage in the pipeline. The plant was under shut down from September 27. While trying to do the repair work, Mr Thiraviyaraj, Joint Manager (Operations) slipped and fell. The gas mask he was wearing came off and he died of asphyxiation, it is learnt. It took more than 10 days to restart the plant.

None of the senior officials of the company was available for comment, and therefore, no estimate of the value of loss in production is readily available.

Earlier Tuticorin plant of SPIC had been shut down between May 1 and June 22, 2001, for a "routine turnaround maintenance", which caused a loss of production of 1.03 lakh tonnes of urea.

**3.4 REVISION POINTS**

1. Disaster
2. Power Plant
3. Radiation
3.5 INTEXT QUESTIONS
1. Write short notes on:
   a) Bhopal Gas Tragedy - UCIL
   b) Jaipur Oil Fire - IOCL
   c) Radiation Leak – Mayapuri, New Delhi
   d) Mangalore Chemicals & Fertilizer – Ammonia System - Accident case

3.6 SUMMARY
We look at the need for enforcement of Environmental regulations. We study some major industrial disasters in India like – UCIL - Bhopal Gas Tragedy, IOCL - Jaipur Oil Depot Fire, BALCO - Korba Chimney collapse, Radiation leak – Mayapuri, New Delhi, Accidents in Mangalore Chemicals & Fertilisers, TATA Water treatment plant, Jamshedpur & SPIC ammonia gas leak case to understand the seriousness of accidents, causes and need for strict enforcement of regulations.

3.7 TERMINAL EXERCISES
1. Explain the need for regulations on Environment Protection applicable to an Industry.

3.8 SUPPLEMENTARY MATERIALS
1. https://www.epa.gov>laws - regulations

3.9 ASSIGNMENTS
1. Deliberate on better Industrial practices – in the post Bhopal Gas Tragedy - that can help avoid such disasters.
2. Discuss How Jaipur oil depot fire outbreak in 2009 could have been averted?
3. Discuss role of valuer in prevention of Industrial disaster?
4. What is the role of Government and Industrialists in Public awareness on Dangers from hazardous material?

3.10 SUGGESTED READINGS / REFERENCE BOOKS
1. Dr. S. Maruthappa – Case study on Major Chemical Disasters- Symposium on Prevention of Industrial/Chemical Disasters at Bangalore
2. Workosh – Major Industrial Disasters in India, ENVIS-National Institute of Occupational Health, India

3.11 LEARNING ACTIVITIES
1. Group discussion on during on FCP days major Industrial Disasters.

3.12 KEY WORDS
1. Plant
2. Radiation
3. Project
LESSON - 4

LIQUID EFFLUENT TREATMENT – ZERO DISCHARGE

4.1 INTRODUCTION

Industrial processes often tend to generate pollutants in gaseous, particulate, liquid and solid forms. Of particular interest is the way in which liquid effluents are treated & disposed, as most industries use enormous quantities water as part of process. Liquid Effluent needs to be treated properly before being discharged to environment so that they do not cause any permanent damage. Hence Effluent treatment plants are an essential part of any Industry.

4.2 OBJECTIVE

In this lesson we learn about treatment of liquid effluents and methods of reducing / eliminating discharges that are toxic / harmful to environment. Most continuous process plants produce some liquid effluent that needs to be treated. These plants are very expensive, and need to be valued as part of essential assets.

4.3 CONTENT

Along with growth of Industry and Industrialization there has been a tremendous increase in pollution. Prosperity has come at a price. Most Industries have tried to discharge untreated effluents at some point of their history.

Major industries causing water pollution include: distilleries, sugar, textile, electroplating, pesticides, pharmaceuticals, pulp & paper mills, tanneries, dyes and dye intermediates, petro-chemicals, steel plants etc.

The Central & State Pollution Control Boardshave identified 24 areas in the country as critically polluted areas. These are: Bhadravati (Karnataka), Chembur (Maharashtra), Digboi (Assam), Govindgarh (Punjab), Greater Cochin (Kerala), Kala-Amb (Himachal Pradesh), Parwanoo (Himachal Pradesh), Korba (Madhya Pradesh), Manali (Tamil Nadu), North Arcot (Tamil Nadu), Pali (Rajasthan), Talcher (Orissa), Vapi (Gujarat), Visakhapatnam (Andhra Pradesh), Dhanbad (Bihar), Durgapur (West Bengal), Howrah (West Bengal), Jodhpur (Rajasthan), Nagda- Ratlam (Madhya Pradesh), Najafgarh Drain (Delhi), Patancheru Bollaram (Andhra Pradesh), Singrauli (Uttar Pradesh), Ankleshwar (Gujarat), Tarapur (Maharashtra).

It has become necessary to enact laws and force industries to implement wastewater treatment plants & zero discharge systems. The term zero discharge is loosely used to define no liquid discharge into the environment.

The concept of zero discharge necessarily means the following:
1. Recovery& recycling water/other materials from effluent water;
2. Reduce / eliminate discharge of polluting substances into the environment by any unauthorized methods.

As India progressed and Environmental Regulations began to be strictly implemented by State and Central Pollution Control Boards, the polluters were
penalized to an extent necessary to clean the environment that they polluted & encourage them to treat water. This concept was called Polluters Pay Policy. However this resulted in- pollute today pay if / when caught – policy - by many Industries. Self-regulation did not produce the desired results.

Realizing the difficulties in monitoring & regulating Industries in a permissive value system, PCB s began to insist on zero-discharge systems & real-time monitoring.

**Zero discharge – Features of a waste water treatment facility**

As with conventional wastewater treatment systems, zero discharge system also include primary treatment, secondary treatment and tertiary treatment. However, the main objective in a zero discharge treatment system is to see that

i) the processes utilized for waste water treatment does not generate any additional pollutants;

ii) production of waste is minimized by suitable selection of unit processes and adjusting operating parameters;

iii) as far as possible, pollutants in the wastewater are transferred to solid phase (sludge);

iv) sludge is stored or arranged to be in a secured landfill;

v) recovery & recycle of materials, especially water, is achieved.

Design of a good Zero discharge wastewater treatment begins in an analysis of physical & chemical characteristics – quantity & quality - of effluent water generated by the plant. This has to be followed by design of suitable primary, secondary and tertiary treatment processes. The treatment plant must be able to handle peak generation and provide for any planned expansion / increase in production of the plant.

**Design of a zero discharge system requires information / data on**

i) quality of the waste water to be treated;

ii) efficiency of the treatment system;

iii) ability of the treatment system to withstand variability in the quality of waste water being treated over short-time (shocks) and long-time basis;

iv) performance degradation of the machinery over a period of time;

v) operation and maintenance issues such as backwash and cleaning operations;

vi) mass-balance under different perceived operating conditions.

**Primary Treatment:** Primary treatment of waste water has to ensure that after primary treatment water is suitable for Reverse Osmosis process.

Secondary treatment consists of passing wastewater through a properly designed RO process.

Tertiary treatment is designed to treat the reject generated by RO, to recover water and, if possible, other useful materials. Often tertiary treatment includes a multi effect evaporator to evaporate reject water and produce sludge.
Since the concept of zero discharge system is to ensure essentially no discharge of pollutants into the environment, recovery of water gains primary importance. It achieves two purposes:

i) by reusing process water, utilization of natural water resources is minimized;

ii) reuse of recovered water enhances the capacity of the industry to efficiently utilize available water as well as control its quality to the required level.

**Primary Treatment**

The quality of wastewater determines the overall design of any zero discharge treatment system. Depending on wastewater quality, wastewater is subjected to suitable primary treatment which is normally meant to equalize influent, and to remove/reduce

i) suspended solids;

ii) oil & grease;

iii) biological (BOD) and chemical oxygen demand (COD);

iv) colour and odour;

v) toxic trace elements;

vi) total dissolved solids (TDS).

The food to microorganisms’ ratio (F/M), and biodegradability of organics in the wastewater, are some of the important parameters that influence the choice of anaerobic digestion and / or aerobic respiration.

As part of water treatment it may be necessary to adjust process pH, add necessary chemicals, and maintain dissolved oxygen concentration to achieve desired results.

**Primary Treatment Process:**

1. **Equalization**

   Controlling variability of influent characteristics is one of the important aspect in the design of a zero discharge system. As process efficiency down the line largely depends on the quality of wastewater received for treatment, designing an equalization system to absorb shocks is very important.

   Quality of wastewater may change slowly over a period of time or, there may be sudden changes. Sudden changes are hard to control and may pose significant threat to the treatment system. Variability in wastewater quality & quantity over a period of time should be considered at the design phase itself.

2. **Filtration**

   Filtration is designed to remove suspended solids, colour, and odour, as much as possible. Pressure Sand Filter (PSF) and Activated Carbon Filter (ACF) are normally utilized. Some of the design aspects that require attention are:
Mixers

Mixers mainly play the role of mixing necessary chemicals with waste water viz., acid/alkali for pH adjustment, flocculants for precipitation, anti-fouling agents for prevention of fouling etc., and bring about homogenization.

Like equalization, mixing is one of the important steps in a wastewater treatment facility. Incomplete mixing may pose significant threat to process stability, and in some cases to the equipment. Variability of mixing efficiency with time is one of the prime factors to consider in the design of a zero discharge system. Often it is possible to increase the overall performance of the waste water treatment system just by augmenting mixing efficiency in all the tanks. This also reduces power consumption.

Aeration

Aeration is forcing of atmospheric air through waste water to ensure that sufficient oxygen is available in the wastewater for sufficient time, for oxidation to occur. Aeration is an energy intensive process and it should be properly designed and actively monitored during operation, to ensure that BOD / COD levels are maintained as per stipulated levels.

Aeration plant design should provide for variation in BOD/COD demand, quantities generated etc. Tank size and geometry, flow characteristics, geometrical arrangement of diffusers, water column depth, mixing efficiency within the aeration basin should all be considered during the design of an aeration basin to ensure that uniformity in dissolved oxygen profile is maintained across the entire basin.

Anaerobic/Aerobic Digesters and Biodegradability of Organics

Bio-degradability of organics is a very complex subject and it is not intended to discuss this subject in this lesson. It should be remembered that even when the BOD/COD ratio and their levels are kept relatively constant, the nature of the chemical constituents that contribute to BOD may affect the performance of the anaerobic and aerobic treatment processes.

Any significant change in the composition of organics can destabilize the balance among microbial populations and upset the system performance.

Secondary Treatment System

The main purpose of secondary treatment is to recover reusable water (from permeate) and/or other useful materials (from reject).

RO System design should be able to

◊ Maximize recovery of water for recycling
◊ Minimal fouling of membrane
◊ Provide redundancy for down time due to cleaning and other maintenance purposes.
Design should be able to handle variations in feed quality & quantity. The RO system may adopt stage and pass configurations and employ by-passing, mixing and partial re-circulating techniques manage variations. At all times recovered water TDS should be maintained below the desired level.

The chemical composition of reject from the reverse osmosis system is subject to feed water quality and percentage of recovery achieved. The reject quality and quantity may vary from time to time; it is essential to equalize this before treating with an evaporator in the tertiary treatment process.

**Tertiary Treatment**

The objective of tertiary treatment is to recover water and segregate dissolved solids present in the reject obtained from reverse osmosis system.

Evaporation is achieved either by Solar Pond method or Evaporator. It may be necessary to purify these solids before reuse. Otherwise, the solids have to be disposed to secured landfill.

In Solar ponds, sludge generated from secondary treatment is stored in large ponds exposed to sun. Over a period natural evaporation reduces the sludge to dried mud. This method is slow and takes a lot of space.

Steam Evaporators can handle much higher total dissolved solids in its feed. Depending on the constituents of the feed, purity of solids recovered from an evaporator shall vary to a greater degree.

In an evaporator, the water in the effluent is evaporated using steam as a heating source. Low pressure is maintained to bring down boiling point so that less energy is utilized for boiling water. The generated water vapour is then condensed with a cooling medium for water recovery. The heat content of the vapour is transferred to the cooling medium and, therefore, vapour is condensed to water. The heat transferred to the cooling medium increases its temperature; therefore, with time, the vapour condensation diminishes. In order to maintain vapour condensation, it is necessary to reduce the temperature of cooling medium temperature using a cooling tower. Thus, in a single stage evaporation, the latent heat in the vapour is largely wasted to the environment. Since evaporation is an energy intensive process, employing single stage evaporator is not economical – and this shall increase operating costs.

**In order to utilize the latent heat of vapour, following mechanism is handled**

i) the evaporator is constructed with multiple stages (otherwise called as Multiple Effect Evaporator).

For the first calandria (first effect), externally supplied steam is the heating medium. Due to heating, water vapour is produced from the feed of the first effect. As the steam losses its heat to waste water, it condenses to water, which is recovered.
The vapour produced from wastewater is separated from liquid feed with the use of a vapour-liquid separator. Then, the vapour is compressed with the use of a Thermal Vapour Recompress or (TVR), which operates on the principle of a jet-pump. The TVR increases the vapour temperature by a few degree Celsius.

Then, this vapour serves as the heating medium for the second effect – where, again vapour is generated from the feed and the heating medium condenses to water, which is recovered.

For each stage, feed is obtained from its previous stage, which is nothing but the liquor remaining after evaporation. The same process is repeated for n-number of effects.

Thus, the steam requirement for treating a given volume of feed in a Multiple Effect Evaporator is reduced to a fraction.

4.4 REVISION POINTS
1. Liquid
2. Zero Discharge

4.5 INTEXT QUESTIONS
1. Briefly define liquid effluence and what are the major industries causing water pollution?
2. What are the features of a Zero discharge treatment system and what is the data required designing an efficient zero discharge system?
3. What is the Secondary treatment in a zero discharge system?

4.6 SUMMARY
Liquid effluent treatment stipulation & technology have evolved over the years. Degradation & failure of self-regulation has led to imposition of strict regulation & monitoring of Effluent treatment systems.

Liquid effluent treatment can be classified as primary treatment, secondary treatment & tertiary treatment. Primary treatment is designed to treat effluent in a manner that it is acceptable for RO treatment. Secondary treatment is generally RO process, that results in maximum possible recovery or water for recycling. Tertiary treatment is an effort to recover solids as much as possible and also include an evaporator.

4.7 TERMINAL EXERCISES
1. What is Primary treatment in a zero discharge system? Explain its various features.

4.8 SUPPLEMENTARY MATERIALS

4.9 ASSIGNMENTS
1. What is the Secondary treatment in a zero discharge system?
2. Explain tertiary treatment.
4.10 SUGGESTED READINGS / REFERENCE BOOKS

2. Guidelines for Environmental clearance of various projects, Dept. of Environment, Govt. of India.
3. D.K. Asthana and Meera Asthana, Environment problems & solutions,

4.11 LEARNING ACTIVITIES

1. Article by Sri. S. Eswaramoorthi, ECP Consulting

4.12 KEY WORDS

1. Zero discharge
2. Treatment
3. Pollution
Environmental Clearance

5.1 INTRODUCTION

Environmental Clearance is necessary for setting up certain projects. Any project that is started without this clearance can potentially be subject to inordinate delays or even cancellation.

5.2 OBJECTIVE

In this lesson we learn about Environmental Clearance.

5.3 CONTENT

Grant of Environmental Clearance (1994)

If the industrial unit comes under the specified project, then environmental clearance would be required from the Ministry of Environment and Forests for new projects as well as for Expansion / modernisation of existing projects if pollution load is increasing.

Who requires Environmental Clearance?

The following project categories are required to obtain environmental clearance:

- New Projects if investment is more than Rs. 100 crores
- Nuclear power plant and related projects, such as Heavy Water Plants, nuclear fuel complex, rare earths.
- River valley projects including hydro power, major irrigation projects and a combination, including flood control.
- Ports, harbours, air ports (except minore ports and harbours)
- Petroleum refineries including crue and Product pipelines.
- Chemical fertilizers
- Exploration for oil and gas and their production transportation and storage
- Synthetic Rubber
- Primary metallurgical industries
- Electric Arc Furnaces (Mini Steel Plants)
- Viscose staple fibre and filamentyarn
- Storage batteries integrated with the manufacture of oxides of lead and lead antimony alloy,
- Thermal power plants
- Pulp paper and newsprint
- Cement
- Any project proposed to be located within twenty five Km of reserved forests, Ecologically sensitive areas which may include National Parks, Sanctuaries, Biosphere Reserves,
- Critically polluted areas
- Or within fifty kms of inter-state boundary shall require environmental clearance from the Central Government
The following project categories, irrespective of the investment

- Pesticides
- Bulk drugs and pharmaceuticals
- Asbestos and asbestos products,
- All tourism projects between 200 – 500 meters of a High Tide Line and at locations with an elevation of more than 1,000 meters with investments of more than Rs. 5 crores.
- Mining projects (with leases of more than 5 hectares)
- Highway projects except projects relating to improvement work
- Petrochemical Complexes
- Tarred roads in the Himalayas and forest areas
- Distilleries
- Raw skins and hides
- Dyes
- Foundries
- Chlor-alkali industry
- Hydrocyanic Acid
- Electroplating
- Meta amine phenol
- Exemption: Small scale industrial units in project categories mentioned above, with investments less than Rs. 1 crore and which are on the reserved list, are exempted from environmental clearance.

For obtaining site clearance, application is to be submitted giving the location of the project along with requisite details, to the Ministry of Environment and Forests.

The Ministry of Environment and Forests will convey its decision about the suitability of the proposed site within a maximum period of 30 days.

Environmental Clearance can be taken for industrial estates.

The National Environment Tribunal Act, 1995

Objectives

- To provide for strict liability for damages arising out of any accident occurring while handling any hazardous substance
- To establish a National Environment Tribunal for granting relief and compensation
- The Tribunal may if it thinks fit, take up cases for claims for compensation suo moto (on its own)

5.4 REVISION POINTS

1. Clearance
2. Project
3. Environment
5.5 INTEXT QUESTIONS
1. What is meant by environmental clearance and why is it required? Which are the Government agencies that issue ECC?

5.6 SUMMARY
Environmental clearance is necessary for setting up certain projects. Any project that is started without this clearance can potentially be subject to inordinate delays or even cancellation.

5.7 TERMINAL EXERCISES
1. Name at least ten projects that require environmental clearance.

5.8 SUPPLEMENTARY MATERIALS
1. https://www.epa.gov/laws-regulations

5.9 ASSIGNMENTS
1. Name some industrial projects that require environmental clearance irrespective of its size or investment. Why is it so?

5.10 SUGGESTED READINGS / REFERENCE BOOKS
2. Guidelines for Environmental clearance of various projects, Dept. of Environment, Govt. of India.
3. D.K. Asthana and Meera Asthana, Environment problems & solutions,

5.11 LEARNING ACTIVITIES
1. Group discussion during PCP days Environmental clearance.

5.12 KEY WORDS
1. Environment
2. Clearance
3. Industrial project
6.1 INTRODUCTION

Risk Assessment based disaster mitigation plans in India, are a relatively new concept and can be said to be in evolution. Value of human life is still not considered seriously while arriving at best practices. In many cases, cost & profit motives outweigh human loss considerations, leading to a situation where human life is monetarily valued and factored into the economics. Class action suits in Courts, are still a novelty in India. However increasing awareness & amendments to Regulations and increasingly stricter administration & monitoring is leading to more & more Risk assessments & mitigation plans.

6.2 OBJECTIVE

An introduction to Quantitative risk assessment. A basic understanding of Risk assessment aspects can be of great help to the Valuer while assessing industrial plants. At a personal level, the Valuer can become aware of the risks involved, while on tour of the plant for purposes of study & assessment.

6.3 CONTENT

Brief history of QRA

Quantitative Risk Assessment can be defined as use of measurable, objective data to determine asset value, probability of loss, and associated risk(s) in various fields such as Environment, Finance, Occupational Health and Safety etc. However, in different countries the meaning attributed to QRA differs

Probabilistic risk assessment (PRA) is a systematic and comprehensive methodology to evaluate risks associated with complex engineered technological entity such as an airliner, a nuclear power plant or any other big industries and the effects of stressors on the environment

Probabilistic Safety Assessment (PSA) is an established technique to numerically quantify risk measures. It sets out to determine what undesired scenarios can occur, with which likelihood, and what the consequences could be.

The terms QRA (Quantitative Risk Assessment), PSA (Probabilistic Safety Assessment) and PRA (Probabilistic Risk Analysis) are used synonymously in different industries to describe various techniques for evaluating risk.

It is fair to say that the first documented QRA of the overall risk for an entire major hazard facility is perhaps WASH-1400, commissioned by the US Nuclear Regulatory Commission in 1975. This quantified the safety risks associated with the operation of all electricity generating nuclear power plants in the US.

Since there was a lot of Public concern associated with Nuclear devices of all kinds, The nuclear industry led the way, motivated by a desire to demonstrate that the actual risk was less than other industrial facilities and counter the public’s
perception that nuclear stations are very risky because the worst case consequences are potentially so catastrophic.

**Petrochemical industry:** Most petrochemical plants in those days caused extensive air pollution. Flaring was common, odors were all pervading, around any petro-chemical plant. Toxic effects of large chemical plant releases dispersed many miles and affected large numbers of people in local towns and cities.

One of the first major QRAs for petrochemical installations was at the highly industrial area of Canvey Island near London, in 1978. The UK’s offshore oil and gas industry came relatively late to formal QRA of overall risks, prompted by the Piper Alpha disaster in 1988 in which 167 workers lost their lives. The rail industry in the UK also started formal QRAs in the early 1990’s, against a background of train accidents, including the Clapham Junction crash in 1988 when three rush-hour trains collided, killing 34 people.

**Need for QRA**

Govt, Society and neighbourhood and all stake holders including workers in the plant need to be aware of the potential dangers associated with the plant. QRA provides insights into the nature of the facility that is being managed, to enable design a proper response plan, understand any limitations of the plan, worst case scenarios and issues that require further investigation.

History teaches us that practically all industries, have deliberately downplayed the dangers & have made efforts to 'prove' that calculated risk levels meet numerical risk acceptance criteria. Govt. & Industry have sprung to action only after some disaster takes place and there is public fury.

The response is always to prepare a Disaster Response Plan after the event. A good QRA can result in identifying most of the hazards / dangers lurking and document the same. Responses can be prepared over time to meet each contingency. In particular, the probabilistic approach of QRA can be extremely useful in demonstrating that a broad range of scenarios has been considered.

A robust, well-developed QRA can readily handle such questions and put the findings in the context of the total risk profile.

**QRA attempts to answer the questions:**

1. What can go wrong?
2. How often does it happen?
3. How bad are the consequences?
4. Is the risk acceptable?

Although QRA needs to be industry & plant specific, the broad approaches & methodology can remain the same. QRA techniques can be adapted to any situation industrial or otherwise.
**Risk criteria**

QRA must be capable of identifying risks (in measurable terms) to allow comparison with the risk criteria set by the regulator or the operator.

In cases where the industry is operational over a period of time, data must painstakingly collected about all accidents, near misses as applicable to the Industry rather than on individual plant basis. Probability of occurrences and scenario build up will have to be done on a scientific manner.

**Nature of the hazard**

Another aspect of QRA relates to analysing the impact of the hazardous event. A fire or explosion in a chemical plant or a train derailment or collision both have the potential to cause fatalities immediately, within seconds of the event. Nuclear releases however may cause latent health effects, the extent of which may not be known until many years later. For example, the Chernobyl nuclear accident in 1986 caused 31 immediate deaths, but by 1991 some 7,000 clean-up workers were believed to have died and some estimates of the eventual death toll are as high as 75,000 [Ref. 1]. Clearly, QRAs are sensitive to the models used to estimate the likelihood of fatality from the magnitude of the hazard.

**Dynamic or static conditions**

Unlike nuclear stations or chemical plants, which are located at a single site, trains can travel hundreds of miles through different local environments, picking up and putting down differing numbers of passengers. Rail industry QRAs are specifically designed to handle these transitory aspects.

There are other differences between industries as well, such as the way that fatalities are modeled during evacuation, or the extent to which frequencies and consequences are integrated into an overall risk picture, but what is evident is that the differences are not as great as one might first think – the level of detail and the focus of the analysis are shifted to enable QRA to help answer the specific questions unique to the industry.

**Similarities of QRA across Industries**

Basics & objectives of QRA remain the same irrespective of situation or Industry that requires to be assessed for Risk.

◊ QRA is a scientific approach using measurable results based on data statistical analysis and probabilistic projections
◊ QRA quantifies risk under different scenario
◊ Helps prepare risk mitigation plans
◊ Helps comparison of different options on risk mitigation plans
◊ Can prove that QRA can result in reduced risk

**Limitations**

QRA has its limitations. Even though QRA uses a lot of data & numbers, it should be kept in mind that there are many judgments throughout the analysis. All
judgments are subjective and to that extent obscure science. QRA practitioners should be aware of its limitations while offering solutions. They should make a sincere attempt to educate management on the limitations. Risk mitigation plans are built on imaginable scenarios and hence are subject to limitations of imagination.

CONCLUSION

It is fair to say that QRA is finding increasing acceptance even as the Practitioners & Industry in general are becoming more mature. Cost of disasters has increased enormously and in many cases can result in the closure of the plant for a long time if not permanently. Compensation in Rupees terms and personal liability of the Occupier are also very effective role in encouraging Industries to voluntarily take up QRA and emergency response plans. Nuclear industry is arguably taking an increasingly integrated approach to QRA, and there is more transparency in defining frequency and consequences of events.

Refineries & chemical plants, Railways are all placing increasing importance to QRA. Internationally, there is an increasing demand for QRA and the value it can add, especially on major design projects.

6.4 REVISION POINTS
1. Risk
2. Assessment
3. Quantitative risk

6.5 INTEXT QUESTIONS
1. Define QRA (Quantitative Risk Analysis), PSA (Probabilistic Safety Assessment) and PRA Probabilistic Risk Analysis
2. What is the need for QRA? Explain its relevance when compared to Disaster response plan.
3. What are QRA’s advantages and what are its limitations?

6.6 SUMMARY
QRA is a relatively new concept and been around for about 30 years. Nuclear and petrochemical industries, have taken the lead in QRA. Tools & techniques of QRA are applicable to all Industries and situations. Differences in the focus and level of detail of QRA in each industry arise from the need to understand the critical risk issues unique to the industry. QRA helps to make better risk-informed decisions, thus saving lives, protecting the environment, reducing economic loss and preserving the reputation of the Industry.

6.7 TERMINAL EXERCISES
1. Give a brief history of incidents that led to formation of QRA?
2. What are QRA’s advantages and what are its limitations?

6.8 SUPPLEMENTARY MATERIALS
1. https://www.epa.gov>laws – regulations
6.9 ASSIGNMENTS
1. Can QRA be standard across industries and locations? Explain.

6.10 SUGGESTED READINGS / REFERENCE BOOKS
1. TUV- http://www.risktec.tuv.com/knowledge-bank/technical-articles

6.11 LEARNING ACTIVITIES
1. Group discussion during PCP days Environmental clearance.

6.12 KEY WORDS
1. Risk
2. Assessment
3. Prevention
4. loss
7.1 INTRODUCTION

ISO Series Standards have been developed by the International Standards Organization for purposes of harmonizing the efforts of various Organizations, Governments and Countries to follow uniform approaches on practices of common global interest & benefit. ISO 14000 Standards seeks to encourage & establish best practices for firms to follow sustainable environment policy.

7.2 OBJECTIVE

- To familiarize the student with ISO 14000 series Standards for Environmental management. Certification under ISO 14000 series by an Industrial undertaking is an expression of commitment on Environment by the management. By assessing the quality of the implementation a Valuer can understand the value system of the Organisation. This can help the Valuer in arriving at a value conclusion.

7.3 CONTENT

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. ISO Standards do not themselves specify any details or permissible levels of pollutants. It is for Governments & Authorized bodies to specify rules, regulations, terms & conditions. ISO Standards merely provides a set of tools that may be used by an Organization to achieve excellence & establish a system for continual improvement.

ISO 14001:2015 and its supporting standards such as ISO 14006:2011 focus on environmental systems to achieve this. The other standards in the family focus on specific approaches such as audits, communications, labeling and life cycle analysis, as well as environmental challenges such as climate change.

ISO 14000 series of Standards include

- ISO 14001:2015 is the most popular standard of the ISO 14000 family, which also includes standards such as the following:
  - ISO 14004 - General guidelines on principles, systems and support techniques
  - ISO 14006 - Guidelines for incorporating eco-design
  - ISO 14015 - Environmental assessment of sites and organizations (EASO)
  - ISO 14020 - Environmental labels and declarations
ISO 14031 - Environmental performance evaluation
ISO 14040 - Life cycle assessment
ISO 14050 - Vocabulary
ISO 14063 - Environmental communication
ISO 14064 - Greenhouse gases

**Disclaimers:** Compliance to ISO Standards does not imply Statutory Compliance or excellence. ISO Standards are voluntary and generally Organizations are expected to require in their policy, stipulations that are better than or equal to, conditions as specified under respective laws. ISO shall not be held responsible for identifying or violation of any or all such patent rights, deviations, omissions & commissions that may be present in an organisation, merely because a Certification has been issued to the organisation.

**Background:** Achieving a balance between the environment, society and the economy is considered essential to meet the needs of the present without compromising the ability of future generations to meet their needs. Sustainable development as a goal is achieved by balancing the three pillars of sustainability.

Societal expectations for sustainable development, transparency and accountability have evolved with increasingly stringent legislation, growing pressures on the environment from pollution, inefficient use of resources, improper waste management, climate change, degradation of ecosystems and loss of biodiversity.

This has led organizations to adopt a systematic approach to environmental management by implementing environmental management systems with the aim of contributing to the environmental pillar of sustainability.

**Objective of an environmental management system**

The purpose of this International Standard is to provide organizations with a framework to protect the environment and respond to changing environmental conditions in balance with socio-economic needs. It specifies requirements that enable an organization to achieve the intended outcomes it sets for its environmental management system.

A systematic approach to environmental management can provide top management with information to build success over the long term and create options for contributing to sustainable development by:

- protecting the environment by preventing or mitigating adverse environmental impacts;
- mitigating the potential adverse effect of environmental conditions on the organization;
- assisting the organization in the fulfillment of compliance obligations;
- enhancing environmental performance;
- controlling or influencing the way the organization's products and services are designed, manufactured, distributed, consumed and disposed by using a life...
cycle perspective that can prevent environmental impacts from being unintentionally shifted elsewhere within the life cycle;
 ◦ achieving financial and operational benefits that can result from implementing environmentally sound alternatives that strengthen the organization’s market position;
 ◦ communicating environmental information to relevant interested parties.

This International Standard, like other International Standards, is not intended to increase or change an organization’s legal requirements.

Success factors

The success of an environmental management system depends on commitment from all levels and functions of the organization, led by top management. Organizations can leverage opportunities to prevent or mitigate adverse environmental impacts and enhance beneficial environmental impacts, particularly those with strategic and competitive implications. Top management can effectively address its risks and opportunities by integrating environmental management into the organization’s business processes, strategic direction and decision making, aligning them with other business priorities, and incorporating environmental governance into its overall management system.

Demonstration of successful implementation of this International Standard can be used to assure interested parties that an effective environmental management system is in place.

Adoption of this International Standard, however, will not in itself guarantee optimal environmental outcomes. Application of this International Standard can differ from one organization to another due to the context of the organization. Two organizations can carry out similar activities but can have different compliance obligations, commitments in their environmental policy, environmental technologies and environmental performance goals, yet both can conform to the requirements of this International Standard.

The level of detail and complexity of the environmental management system will vary depending on the context of the organization, the scope of its environmental management system, its compliance obligations, and the nature of its activities, products and services, including its environmental aspects and associated environmental impacts.

Plan-Do-Check-Act model

The basis for the approach underlying an environmental management system is founded on the concept of Plan-Do-Check-Act (PDCA). The PDCA model provides an iterative process used by organizations to achieve continual improvement. It can be applied to an environmental management system and to each of its individual elements.

It can be briefly described as follows
 ◦ **Plan:** establish environmental objectives and processes necessary to deliver results in accordance with the organization’s environmental policy.
◊ **Do:** implement the processes as planned.
◊ **Check:** monitor and measure processes against the environmental policy, including its commitments, environmental objectives and operating criteria, and report the results.
◊ **Act:** take actions to continually improve.

Figure 1 shows how the framework introduced in this International Standard could be integrated into a PDCA model, which can help new and existing users to understand the importance of a systems approach.

**Figure 1 — Relationship between PDCA and the framework in this International Standard**

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**Contents of this International Standard**

This International Standard conforms to ISO’s requirements for management system standards. These requirements include a high level structure, identical core text, and common terms with core definitions, designed to benefit users implementing multiple ISO management system standards.

An organization that wishes to demonstrate conformity with this International Standard can do so by:

◊ making a self-determination and self-declaration, or
◊ seeking confirmation of its conformance by parties having an interest in the organization, such as customers, or
◊ seeking confirmation of its self-declaration by a party external to the organization, or
◊ seeking certification/registration of its environmental management system by an external organization.
Scope

This International Standard specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance.

This International Standard helps an organization achieve the intended outcomes of its environmental management system, which provide value for the environment, the organization itself and interested parties. Consistent with the organization’s environmental policy, the intended outcomes of an environmental management system include:

- enhancement of environmental performance;
- fulfillment of compliance obligations;
- achievement of environmental objectives.

This International Standard is applicable to any organization, regardless of size, type and nature, and applies to the environmental aspects of its activities, products and services that the organization determines it can either control or influence considering a life cycle perspective. This International Standard does not state specific environmental performance criteria.

This International Standard can be used in whole or in part to systematically improve environmental management. Claims of conformity to this International Standard, however, are not acceptable unless all its requirements are incorporated into an organization’s environmental management system and fulfilled without exclusion.

7.4 REVISION POINTS

1. Environment
2. Organization
3. Complaint

7.5 INTEXT QUESTIONS

1. Write short note on ISO 14000? What is its relevance in business practice?
2. What are the basic standards in ISO 14000 series? Explain.
3. Explain PDCA model in ISO 14000 with illustration and example.

7.6 SUMMARY

The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. ISO Standards do not themselves specify any details or permissible levels of pollutants. The success of an environmental management system depends on commitment from all levels and functions of the organization, led by top management. The basis for the approach underlying an environmental management system is founded on the concept of Plan-Do-Check-Act (PDCA). The PDCA model provides an iterative process used by organizations to achieve continual improvement. This International Standard is applicable to any organization, regardless of size, type and nature, and applies to the environmental
aspects of its activities, products and services that the organization determines it can either control or influence considering a life cycle perspective. This International Standard does not state specific environmental performance criteria.

7.7 TERMINAL EXERCISES
1. What are the aims of an environmental management system?

7.8 SUPPLEMENTARY MATERIALS
1. https://www.epa.gov/laws – regulations

7.9 ASSIGNMENTS
1. Explain PDCA model in ISO 14000 with illustration and example.

7.10 SUGGESTED READINGS / REFERENCE BOOKS
1. ISO 14004, Environmental management systems — General guidelines on principles, systems and support techniques
2. ISO 14006, Environmental management systems — Guidelines for incorporating ecodesign
3. ISO 14031, Environmental management — Environmental performance evaluation — Guidelines
4. ISO 14044, Environmental management — Life cycle assessment — Requirements and guidelines
5. ISO 14063, Environmental management — Environmental communication — Guidelines and examples

7.11 LEARNING ACTIVITIES
1. Group discussion during PCP days Environmental clearance.

7.12 KEY WORDS
1. Environment
2. Management
3. Performance
8.1 INTRODUCTION

A separate set of Standards have been developed for purposes of Health & Safety at the workplace. This has been done to emphasize the need to focus on Health & Safety at the workplace as a separate subject different from general focus on Sustainable Environment. Thus it can be seen that Health & Safety at the Workplace is a sub-set of Environment protection practices.

Earlier there used to be an ISO Standard 18000 series in consonance with OHSAS 18001 Standard. However numeral 18000 Series has been allotted to another Standard by ISO. A new series ISO 45000 is being brought about that will be in consonance with OHSAS 18001. Thus ISO 45001 expected by 2018, will eventually replace OHSAS 18001.

8.2 OBJECTIVE

- To familiarize the student with International Standards on workplace safety – need for & objectives of the Standards.

8.3 CONTENT

Organizations of all kinds are increasingly concerned with achieving and demonstrating sound Occupational Health and Safety (OH&S) performance by controlling their OH&S risks, consistent with their OH&S policy and objectives. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures that foster good OH&S practices, and increased concern expressed by interested parties about OH&S issues.

Many organizations have undertaken OH&S “reviews” or “audits” to assess their OH&S performance. On their own, however, these “reviews” and “audits” may not be sufficient to provide an organization with the assurance that its performance not only meets, but will continue to meet, its legal and policy requirements. To be effective, they need to be conducted within a structured management system that is integrated within the organization.

The OHSAS Standards covering OH&S management are intended to provide organizations with the elements of an effective OH&S management system that can be integrated with other management requirements and help organizations achieve OH&S and economic objectives. These standards, like other International Standards, are not intended to be used to create non-tariff trade barriers or to increase or change an organization’s legal obligations.

This OHSAS Standard specifies requirements for an OH&S management system to enable an organization to develop and implement a policy and objectives that take into account legal requirements and information about OH&S risks. It is intended to apply to all types and sizes of organizations and to accommodate diverse geographical, cultural and social conditions.
The basis of the approach is shown in Figure 1. The success of the system depends on commitment from all levels and functions of the organization, and especially from top management. A system of this kind enables an organization to develop an OH&S policy, establish objectives and processes to achieve the policy commitments, take action as needed to improve its performance and demonstrate the conformity of the system to the requirements of this OHSAS Standard.

The overall aim of this OHSAS Standard is to support and promote good OH&S practices, in balance with socio-economic needs. There is an important distinction between this OHSAS Standard, which describes the requirements for an organization’s OH&S management system and can be used for certification/registration and/or self-declaration of an organization’s OH&S management system, and a non-certifiable guideline intended to provide generic assistance to an organization for establishing, implementing or improving an OH&S management system. OH&S management encompasses a full range of issues, including those with strategic and competitive implications.

Demonstration of successful implementation of this OHSAS Standard can be used by an organization to assure interested parties that an appropriate OH&S management system is in place.

Those organizations requiring more general guidance on a broad range of OH&S management system issues are referred to OHSAS 18002.

This OHSAS Standard is based on the methodology known as Plan-Do-Check-Act (PDCA). PDCA can be briefly described as follows.

◊ **Plan:** establish the objectives and processes necessary to deliver results in accordance with the organization’s OH&S policy.

◊ **Do:** implement the processes.

◊ **Check:** monitor and measure processes against OH&S policy, objectives, legal and other requirements, and report the results.

◊ **Act:** take actions to continually improve OH&S performance.
The level of detail and complexity of the OH&S management system, the extent of documentation and the resources devoted to it depend on a number of factors, such as the scope of the system, the size of an organization and the nature of its activities, products and services, and the organizational culture. This may be the case in particular for small and medium-sized enterprises.

**Requirements of Occupational health and safety management systems**

**Scope**

OHSAS Standard specifies requirements for an occupational health and safety (OH&S) management system, to enable an organization to control its OH&S risks and improve its OH&S performance. It does not state specific OH&S performance criteria, nor does it give detailed specifications for the design of a management system.

**This OHSAS Standard is helpful to any organization that wishes to**

◊ establish an OH&S management system to eliminate or minimize risks to personnel and other interested parties who could be exposed to OH&S hazards associated with its activities;

◊ implement, maintain and continually improve an OH&S management system;

◊ assure itself of its conformity with its stated OH&S policy;

◊ demonstrate conformity with this OHSAS Standard by:

◊ making a self-determination and self-declaration, or

◊ seeking confirmation of its conformance by parties having an interest in the organization, such as customers, or

◊ seeking confirmation of its self-declaration by a party external to the organization, or

◊ seeking certification/registration of its OH&S management system by an external organization.

All the requirements in this OHSAS Standard are intended to be incorporated into any OH&S management system. The extent of the application will depend on such factors as the OH&S policy of the organization, the nature of its activities and the risks and complexity of its operations.

This OHSAS Standard is intended to address occupational health and safety, and is not intended to address other health and safety areas such as employee wellbeing/wellness programs, product safety, property damage or environmental impacts.

**OH&S management system requirements**

**General**

The organization shall establish, document, implement, maintain and continually improve an OH&S management system in accordance with the requirements of the OHSAS Standard and determine how it will fulfill these requirements.

The organization shall define and document the scope of its OH&S management system.
OH&S policy

Top management shall define and authorize the organization’s OH&S policy and ensure that within the defined scope of its OH&S management system it:

◊ is appropriate to the nature and scale of the organization’s OH&S risks;
◊ includes a commitment to prevention of injury and ill health and continual improvement in OH&S management and OH&S performance;
◊ includes a commitment to at least comply with applicable legal requirements and with other requirements to which the organization subscribes that relate to its OH&S hazards;
◊ provides the framework for setting and reviewing OH&S objectives;
◊ is documented, implemented and maintained;
◊ is communicated to all persons working under the control of the organization with the intent that they are made aware of their individual OH&S obligations;
◊ is available to interested parties; and
◊ is reviewed periodically to ensure that it remains relevant and appropriate to the organization.

Planning

Hazard identification, risk assessment and determining controls

The organization shall establish, implement and maintain a procedure(s) for the ongoing hazard identification, risk assessment, and determination of necessary controls.

The procedure(s) for hazard identification and risk assessment shall take into account

◊ routine and non-routine activities;
◊ activities of all persons having access to the workplace (including contractors and visitors);
◊ human behaviour, capabilities and other human factors;
◊ identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of the organization within the workplace;
◊ hazards created in the vicinity of the workplace by work-related activities under the control of the organization; infrastructure, equipment and materials at the workplace, whether provided by the organization or others;
◊ changes or proposed changes in the organization, its activities, or materials;
◊ modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities;
◊ any applicable legal obligations relating to risk assessment and implementation of necessary controls (see also the NOTE to 3.12);
◊ the design of work areas, processes, installations, machinery/equipment, operating procedures and work organization, including their adaptation to human capabilities.
Methodology for hazard identification and risk assessment shall

◊ be defined with respect to its scope, nature and timing to ensure it is proactive rather than reactive; and
◊ provide for the identification, prioritization and documentation of risks, and the application of controls, as appropriate.

For the management of change, the organization shall identify the OH&S hazards and OH&S risks associated with changes in the organization, the OH&S management system, or its activities, prior to the introduction of such changes.

The organization shall ensure that the results of these assessments are considered when determining controls. When determining controls, or considering changes to existing controls, consideration shall be given to reducing the risks according to the following hierarchy:

◊ elimination;
◊ substitution;
◊ engineering controls;
◊ signage/warnings and/or administrative controls;
◊ personal protective equipment.

The organization shall document and keep the results of identification of hazards, risk assessments and determined controls up-to-date.

The organization shall ensure that the OH&S risks and determined controls are taken into account when establishing, implementing and maintaining its OH&S management system.

Legal and other requirements

The organization shall establish, implement and maintain a procedure(s) for identifying and accessing the legal and other OH&S requirements that are applicable to it.

The organization shall ensure that these applicable legal requirements and other requirements to which the organization subscribes are taken into account in establishing, implementing and maintaining its OH&S management system.

The organization shall keep this information up-to-date.

The organization shall communicate relevant information on legal and other requirements to persons working under the control of the organization, and other relevant interested parties.

Objectives and program(s)

The organization shall establish, implement and maintain documented OH&S objectives, at relevant functions and levels within the organization.

The objectives shall be measurable, where practicable, and consistent with the OH&S policy, including the commitments to the prevention of injury and ill health,
to compliance with applicable legal requirements and with other requirements to which the organization subscribes, and to continual improvement.

When establishing and reviewing its objectives, an organization shall take into account the legal requirements and other requirements to which the organization subscribes, and its OH&S risks. It shall also consider its technological options, its financial, operational and business requirements, and the views of relevant interested parties.

The organization shall establish, implement and maintain a program(s) for achieving its objectives. Program(s) shall include as a minimum:

◊ designation of responsibility and authority for achieving objectives at relevant functions and levels of the organization; and

◊ the means and time-frame by which the objectives are to be achieved.

The program(s) shall be reviewed at regular and planned intervals, and adjusted as necessary, to ensure that the objectives are achieved.

Implementation and operation

Resources, roles, responsibility, accountability and authority

Top management shall take ultimate responsibility for OH&S and the OH&S management system. Top management shall demonstrate its commitment by:

◊ ensuring the availability of resources essential to establish, implement, maintain and improve the OH&S management system; (Resources include human resources and specialized skills, organizational infrastructure, technology and financial resources).

◊ defining roles, allocating responsibilities and accountabilities, and delegating authorities, to facilitate effective OH&S management; roles, responsibilities, accountabilities, and authorities shall be documented and communicated.

◊ The organization shall appoint a member(s) of top management with specific responsibility for OH&S, irrespective of other responsibilities, and with defined roles and authority for:

◊ ensuring that the OH&S management system is established, implemented and maintained in accordance with this OHSAS Standard;

◊ ensuring that reports on the performance of the OH&S management system are presented to top management for review and used as a basis for improvement of the OH&S management system.

◊ The identity of the top management appointee shall be made available to all persons working under the control of the organization.

◊ All those with management responsibility shall demonstrate their commitment to the continual improvement of OH&S performance.

◊ The organization shall ensure that persons in the workplace take responsibility for aspects of OH&S over which they have control, including adherence to the organization’s applicable OH&S requirements.
Competence, training and awareness

The organization shall ensure that any person(s) under its control performing tasks that can impact on OH&S is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records.

The organization shall identify training needs associated with its OH&S risks and its OH&S management system. It shall provide training or take other action to meet these needs, evaluate the effectiveness of the training or action taken, and retain associated records.

The organization shall establish, implement and maintain a procedure(s) to make persons working under its control aware of:

◊ the OH&S consequences, actual or potential, of their work activities, their behaviour, and the OH&S benefits of improved personal performance;
◊ their roles and responsibilities and importance in achieving conformity to the OH&S policy and procedures and to the requirements of the OH&S management system, including emergency preparedness and response requirements;
◊ the potential consequences of departure from specified procedures.
◊ Training procedures shall take into account differing levels of: responsibility, ability, language skills and literacy; and risk.

Communication, participation and consultation

◊ Communication: With regard to its OH&S hazards and OH&S management system, the organization shall establish, implement and maintain a procedure(s) for:
◊ internal communication among the various levels and functions of the organization;
◊ communication with contractors and other visitors to the workplace;
◊ receiving, documenting and responding to relevant communications from external interested parties.

Participation and consultation: The organization shall establish, implement and maintain a procedure(s) for:

◊ the participation of workers by their:
◊ appropriate involvement in hazard identification, risk assessments and determination of controls;
◊ appropriate involvement in incident investigation, development and review of OH&S policies and objectives;
◊ Workers shall be informed about their participation arrangements, including who is their representative(s) on OH&S matters.
◊ consultation with contractors where there are changes that affect their OH&S.
The organization shall ensure that, when appropriate, relevant external interested parties are consulted about pertinent OH&S matters.

**Documentation:** Documentation is the foundation on which all Standards are built. It is necessary that a proper documentation system is developed & maintained for purposes of implementation & sustenance of OHSAS 18001.

The OH&S management system documentation shall include:

- the OH&S policy and objectives;
- description of the scope of the OH&S management system;
- description of the main elements of the OH&S management system and their interaction, and reference to related documents;
- documents, including records, required by this OHSAS Standard; and
- documents, including records, determined by the organization to be necessary to ensure the effective planning, operation and control of processes that relate to the management of its OH&S risks.

**Control of documents**

Documents required by the OH&S management system and by this OHSAS Standard shall be controlled. Records are a special type of document and shall be controlled appropriately.

The organization shall establish, implement and maintain a procedure(s) to:

- approve documents for adequacy prior to issue;
- review and update as necessary and re-approve documents;
- ensure that changes and the current revision status of documents are identified;
- ensure that relevant versions of applicable documents are available at points of use;
- ensure that documents remain legible and readily identifiable;
- ensure that documents of external origin determined by the organization to be necessary for the planning and operation of the OH&S management system are identified and their distribution controlled; and
- prevent the unintended use of obsolete documents and apply suitable identification to them if they are retained for any purpose.

**Operational control**

The organization shall determine those operations and activities that are associated with the identified hazard(s) where the implementation of controls is necessary to manage the OH&S risk(s). This shall include the management of change.

**For those operations and activities, the organization shall implement and maintain:**

- operational controls, as applicable to the organization and its activities; the organization shall integrate those operational controls into its overall OH&S management system;
- controls related to purchased goods, equipment and services;
controls related to contractors and other visitors to the workplace;
documented procedures, to cover situations where their absence could lead to deviations from the OH&S policy and the objectives;
stipulated operating criteria where their absence could lead to deviations from the OH&S policy and objectives.

**Emergency preparedness and response**

Emergency preparedness & response is a very important aspect of OSHAS 18001. Based on HAZOP studies a detailed list of potential emergency situations needs to be prepared. A detailed SOP for each situation has to be prepared and all concerned persons properly trained to respond to such emergencies.

Thus OSHAS stipulates that the organization shall establish, implement and maintain a procedure(s):

- to identify the potential for emergency situations;
- to respond to such emergency situations.

The organization shall respond to actual emergency situations and prevent or mitigate associated adverse OH&S consequences.

In planning its emergency response the organization shall take account of the needs of relevant interested parties, e.g. emergency services and neighbours.

The organization shall also periodically test its procedure(s) to respond to emergency situations, where practicable, involving relevant interested parties as appropriate.

The organization shall periodically review and, where necessary, revise its emergency preparedness and response procedure(s), in particular, after periodical testing and after the occurrence of emergency situations (see 4.5.3).

**CHECKING**

**Performance measurement and monitoring**

The organization shall establish, implement and maintain a procedure(s) to monitor and measure OH&S performance on a regular basis. This procedure(s) shall provide for:

- both qualitative and quantitative measures, appropriate to the needs of the organization; monitoring of the extent to which the organization’s OH&S objectives are met;
- monitoring the effectiveness of controls (for health as well as for safety);
- proactive measures of performance that monitor conformance with the OH&S programme(s), controls and operational criteria;
- reactive measures of performance that monitor ill health, incidents (including accidents, near-misses, etc.), and other historical evidence of deficient OH&S performance;
- recording of data and results of monitoring and measurement sufficient to facilitate subsequent corrective action and preventive action analysis.
If equipment is required to monitor or measure performance, the organization shall establish and maintain procedures for the calibration and maintenance of such equipment, as appropriate. Records of calibration and maintenance activities and results shall be retained.

**Evaluation of compliance**

Consistent with its commitment to compliance [see 4.2c]], the organization shall establish, implement and maintain a procedure(s) for periodically evaluating compliance with applicable legal requirements (see 4.3.2).

The organization shall keep records of the results of the periodic evaluations.

**NOTE:** The frequency of periodic evaluation may vary for differing legal requirements or any other requirements to which the organization subscribes.

The organization shall evaluate compliance with other requirements to which it subscribes (see 4.3.2). The organization may wish to combine this evaluation with the evaluation of legal compliance referred to in 4.5.2.1 or to establish a separate procedure(s).

**The organization shall keep records of the results of the periodic evaluations.**

**Incident investigation, nonconformity, corrective action and preventive action**

**Incident investigation**

The organization shall establish, implement and maintain a procedure(s) to record, investigate and analyse incidents in order to:

- determine underlying OH&S deficiencies and other factors that might be causing or contributing to the occurrence of incidents;
- identify the need for corrective action;
- identify opportunities for preventive action;
- identify opportunities for continual improvement;
- communicate the results of such investigations.

The investigations shall be performed in a timely manner.

Any identified need for corrective action or opportunities for preventive action shall be dealt with appropriately.

**The results of incident investigations shall be documented and maintained.**

**Nonconformity, corrective action and preventive action**

The organization shall establish, implement and maintain a procedure(s) for dealing with actual and potential nonconformity(ies) and for taking corrective action and preventive action. The procedure(s) shall define requirements for:

- identifying and correcting nonconformity(ies) and taking action(s) to mitigate their OH&S consequences;
- investigating nonconformity(ies), determining their cause(s) and taking actions in order to avoid their recurrence;
- evaluating the need for action(s) to prevent nonconformity(ies) and implementing appropriate actions designed to avoid their occurrence;
◊ recording and communicating the results of corrective action(s) and preventive action(s) taken; and reviewing the effectiveness of corrective action(s) and preventive action(s) taken.

◊ Where the corrective action and preventive action identifies new or changed hazards or the need for new or changed controls, the procedure shall require that the proposed actions shall be taken through a risk assessment prior to implementation.

◊ Any corrective action or preventive action taken to eliminate the causes of actual and potential non-conformity(ies) shall be appropriate to the magnitude of problems and commensurate with the OH&S risk(s) encountered.

◊ The organization shall ensure that any necessary changes arising from corrective action and preventive action are made to the OH&S management system documentation.

Control of records

The organization shall establish and maintain records as necessary to demonstrate conformity to the requirements of its OH&S management system and of this OHSAS Standard, and the results achieved.

The organization shall establish, implement and maintain a procedure(s) for the identification, storage, protection, retrieval, retention and disposal of records.

Records shall be and remain legible, identifiable and traceable.

Internal audit

The organization shall ensure that internal audits of the OH&S management system are conducted at planned intervals to determine whether the OH&S management system conforms to planned arrangements for OH&S management, including the requirements of this OHSAS Standard; and has been properly implemented and is maintained; and effective in meeting the organization’s policy and objectives. Provide information on the results of audits to management.

Audit program(s) shall be planned, established, implemented and maintained by the organization, based on the results of risk assessments of the organization’s activities, and the results of previous audits.

Audit procedure(s) shall be established, implemented and maintained that address: the responsibilities, competencies, and requirements for planning and conducting audits, reporting results and retaining associated records; and the determination of audit criteria, scope, frequency and methods. Selection of auditors and conduct of audits shall ensure objectivity and the impartiality of the audit process.

Management review

Top management shall review the organization’s OH&S management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. Reviews shall include assessing opportunities for improvement and the need for changes to the OH&S management system, including the OH&S policy and OH&S objectives. Records of the management reviews shall be retained.
Input to management reviews shall include:

- results of internal audits and evaluations of compliance with applicable legal requirements and with other requirements to which the organization subscribes;
- the results of participation and consultation (see 4.4.3);
- relevant communication(s) from external interested parties, including complaints;
- the OH&S performance of the organization;
- the extent to which objectives have been met;
- status of incident investigations, corrective actions and preventive actions;
- follow-up actions from previous management reviews;
- changing circumstances, including developments in legal and other requirements related to OH&S; and
- recommendations for improvement.

The outputs from management reviews shall be consistent with the organization’s commitment to continual improvement and shall include any decisions and actions related to possible changes to:

- OH&S performance;
- OH&S policy and objectives;
- resources; and
- other elements of the OH&S management system.

Relevant outputs from management review shall be made available for communication and consultation.

### 8.4 Revision Points

1. Safety
2. Assessment
3. Management

### 8.5 InText Questions

1. Write short note on OHSAS & explain its aims.
2. What is the scope of OHSAS standard.

### 8.6 Summary

The OHSAS Standards covering OH&S management are intended to provide organizations with the elements of an effective OH&S management system that can be integrated with other management requirements and help organizations achieve OH&S and economic objectives.

OH&S management system promotes a safe and healthy working environment by providing a framework that helps organizations to:

- Identify and control health and safety risks
- Reduce the potential for accidents
◊ Aid legal compliance
◊ Improve overall performance

The OHSAS 18000 standards provide organizations with the elements of an effective safety management system which can be integrated with other management systems and help organizations achieve better occupational health and safety performance and economic objectives.

OHSAS 18001 specifies requirements for an OH&S management system to help an organization develop and implement a policy and objectives, which take into account legal requirements and information about OH&S risks. It applies to all types and sizes of organizations and accommodates diverse geographical, cultural and social conditions.

OHSAS 18002 provides guidance for establishing, implementing or improving a management system which is based on OHSAS 18001 and demonstrating successful implementation of OHSAS 18001.

8.7 TERMINAL EXERCISES
1. Write short note on OH&S Policy.
2. Explain the implementation and Operational aspect of OH&S in an organisation.

8.8 SUPPLEMENTARY MATERIALS
1. https://www.epa.gov>laws – regulations

8.9 ASSIGNMENTS

8.10 SUGGESTED READINGS / REFERENCE BOOKS
1. OHSAS 18001 & 2, Occupational health and safety management systems
3. Proposed ISO 45000 series Standards

8.11 LEARNING ACTIVITIES
1. Group discussion on during PCP days occupational health and safety management.

8.12 KEY WORDS
1. Safety Management
2. Organisation
3. Environment