COURSE GUIDE

EMT 523
ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

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First Printed 2021
ISBN: 978-978-058-098-8

CONTENTS **PAGE**

INTRODUCTION

In the last few years more and more attention has been placed on the environment and little wonder too, as global climates continue to change. While it was once disputed that the earth was getting hotter, it is now a known fact that global temperatures are rising, that there is a "green house effect" and that sea levels are rising. These issues are now so topical that they have been added to the primary school curriculum, and explained to even pupils in nursery schools. This is because various nations of the world have continued to experience extreme weather conditions with attendant loss of life and property; Hurricanes such as Katrina, Typhoons, Tsunamis in Japan, Floods in Lagos and Volcanic eruptions in Europe, which caused the close down of European Air Space, have ensured that the global climate and by extension the preservation of the environment remain topical issues to entire world. There is now no disputing that some action must be taken to preserve the earth.

There is a link between Occupational Health and Safety and the Environment. Often, the most acute environmental disasters are often linked with health and safety issues, either as a cause such as the Bhopal and Chernobyl disasters or as a consequence, the recent Earthquake and Tsunami in Fukushima, Japan resulting in damage to Dai-ichi nuclear power plant further threatening the environment. As man has continued to develop with increased industrialization more health and safety issues pertaining to the work place continue to occur.

Environmental Health and Occupational Health and Safety evolved as viable courses as the knowledge of both Environmental Health and Occupational Health and Safety has increased over the years. While Environmental Health issues affect everyone and may occur as a result of activities of industries, Occupational Health and Safety issues affect man in his Work Environment.

This course is designed to provide a basic knowledge of the environment to everyone, as it is obvious that we all require basic facts about both our work and home environments. However the course is of utmost importance for all those who intend to pursue a career in Environmental Sciences; as Environmental Health Officers, Environmental Conservation and Protection Officers, Architects, Engineers, Builders, Landscape Architects, Occupational Health Officers, Risk Officers, Compliance Officers, Health and Safety Technicians, Production Supervisors and Human Resource Specialists.
This Course Environmental Health and Safety is a two credit degree course.

There are two modules consisting of 20 Units altogether.
The first module deals with Environmental Management and Assessment; here you will learn of the various tools used in managing the environment and the second module deals with Health and Safety emphasizing the processes and tools used to ensure health and safety.

WHAT YOU WILL LEARN IN THIS COURSE

You will learn about Environmental management with particular reference to some of the management assessment tools.

You will learn about Occupational Health and Safety with particular reference to Health and Safety Processes, Assessment tools and Emergency preparedness including some Emergency and Safety procedures.

COURSE AIMS

This course aims at providing the basic knowledge in Environmental Management and Occupational Health and Safety by providing the basic concepts which can be expanded upon during the course of a career
Thus the aim of this course is to:

i. Explain the meaning of the Environment and Environmental management with particular reference to some of the management assessment tools.
ii. Explain the meaning of Occupational Health and Safety with particular reference to Health and Safety Processes, Assessment tools and Emergency preparedness.

COURSE OBJECTIVES

In order to achieve the course aims, there are some overall objectives set for the course. Besides, each module and each unit has their respective objectives which you and your facilitator must constantly refer to, so that no objective is skipped. All the modules and unit objectives are specifics of the course objectives. The course objectives are stated as follows:

i. Explain the meaning of the Environment and Environmental management
ii. Discuss various types of Environmental management tools; EIA, Strategic Environmental Assessment, Environmental Audit, Lifecycle Assessment and Clean technology
iii. State the strategies and techniques for each of these techniques.
iv. Explain the meaning of Occupational Health and Safety

v. Discuss the concepts of Accident Prevention and Emergency Preparedness
vi. Describe the process of drafting an Occupational health policy.

WORKING THROUGH THIS COURSE

This course contains some packages that you will be given at the beginning of the Semester: one of them is the course material. Your full participation in both the continuous assessment and the final written examination are two areas expected of you to fulfill at the end of the course. The 19 study units of the course packaged for you in modules are as shown below:

Module 1

Unit 1 Our Planet
Unit 2 The Need For Environmental Sustainability
Unit 3 Environmental Legislation
Unit 4 Environmental Management Systems
Unit 5 Environmental Impact Assessment (EIA)

Module 2

Unit 1 Strategic Environmental Assessment
Unit 2 Environmental Audit
Unit 3 Cost Benefit Analysis
Unit 4 Life Cycle Assessment
Unit 5 Clean Technology

Module 3

Unit 1 Environmental Risk Management
Unit 2 Sustainable Development
Unit 3 Health and Safety Policies in Industries and Work Environment
Unit 4 Strategies and Objectives
Unit 5 First Aid and Techniques

Module 4

Unit 1 Accidents: Classification, Causes and Costs
Unit 2 Fire and Fire Fighting
Unit 3 Health and Safety Audits and Management Tools
Unit 4 Health and Safety Plans Accidents: Case Studies

From all indications, you should be able to complete two credit units about 20 study units in a semester. Each unit is properly laid out with: Introduction to the unit, specific objectives, body of the unit, conclusion, summary, Tutor Marked Assignments and References.

COURSE MATERIAL

Major course materials of the course are as follows:

i. Course Guide: This is the blue print of the course and details the course.
ii. Study units: Each of these provides an overview of the content and number of units that will be covered in this course.
iii. Assignment files: These files contain challenging tutorial questions termed as Self-Assessed Exercises which enable you assess yourself and develop a better understanding of the topic and a Tutor –Marked Assignment (TMAs) which must be handed in to the Tutor and form part of your final grade.
iv. Presentation schedule: The modus operandis (e.g. time table, hours expected on each unit/ Module, assignment submission procedure ,how the course will be self tutored and the monitoring techniques by Noun will be in the information package of this schedule).

STUDY UNITS

Details of the study units have earlier been presented. It is spelt out in modules with corresponding units and titles. You will be expected to spend 2-3 hours studying a unit.

REFERENCES AND OTHER RESOURCES

Apart from this study unit, some reference materials are provided as additional reading materials to support your study. You may come across them in Noun library or elsewhere.

INSTRUCTIONAL MEDIA

As an open and distance learning University several and relevant multi-media that can make learning possible are available.

ASSIGNMENT FILE

This has been discussed later. It is mandatory to always turn in your assignments to any tutor assigned.

ASSESSMENT

You will be expected to complete at least ten assignments by the end of the course. Some of these will be in the form of a project and continuous assessment (CA). You will be expected to write a final examination in the course. The overall score in the course will be a sum of 40% of CA and 60% of written examination. You will be expected to have 50% in the CA and 50% in the written examination; anything short of this will count as failure.

TUTOR –MARKED ASSIGNMENT

The TMA is a continuous assessment component of your course. It accounts for 30% of the total score. You will be given four (4) TMAs to answer. Three of these must be answered before you are allowed to sit for the end of course examination. The TMAs would be given to you by your facilitator and returned after you have done the assignment. Assignment questions for the units in this course are contained in the assignment file. You will be able to complete your assignment from information and materials contained in your reading, references and study units. However, it is desirable in all degree level of education to demonstrate that you have read and researched more into your references, which will give you a wider view point and may provide you with a deeper understanding of the subject. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you can not complete your work on time, contact your facilitator before the assignment is due to discuss the possibility of an extension. Extension will not be granted after the due date unless there are exceptional circumstances.

FINAL EXAMINATION AND GRADING

The end of course examination for Environmental Health and Safety ESM 431will be for about 3 hours and it has a value of 70% of the total course work. The examination will consist of questions, which will reflect the type of self –testing, practice exercise and tutor –marked assignment problems you have previously encountered. All areas of the course will be assessed.

Use the time between finishing the last unit and sitting for the examination to revise the whole course. You might find it useful to review your self-tests, TMAs and comments on them before the examination. The end of course examination covers information from all parts of the course.

COURSE MARKING SCHEME

Assignment	**Marks**
Assignments 1-4	Four assignments, best three marks of the four count at 10% each- 30% of course marks.
End of course examination	70%
Total	100%

FACILITATORS/TUTORS AND TUTORIALS

There are 16 hours of tutorials provided in support of this course. You will be notified of the dates, times and location of these tutorials as well as the name and phone number of your facilitator, as soon as you are allocated a tutorial group. Your facilitator will mark and comment on your assignments, keep a close watch on your progress and any difficulties you might face and provide assistance to you during the course. You are expected to mail your Tutor Marked Assignment to your facilitator before the schedule date (at least two working days are required). They will be marked by your tutor and returned to you as soon as possible. Do not delay to contact your facilitator by telephone or e-mail if you need assistance. The following might be circumstances in which you would find assistance necessary, hence you would have to contact your facilitator if:

1 You do not understand any part of the study or the assigned readings.
2 You have difficulty with the self-tests
3 You have a question or problem with an assignment or with the grading of an assignment.

You should endeavour to attend the tutorials. This is the only chance to have face to face contact with your course facilitator and to ask questions which are answered instantly. You can raise any problem encountered in the course of your study. To gain much benefit from course tutorials prepare a question list before attending them. You will learn a lot from participating actively in discussions.

SUMMARY

Environmental Health and Safety is a course that intends to provide a basic concept of the discipline and is concerned with definitions, terms, tools and processes used in Environmental Health and Occupational Health and Safety. Upon completing this course, you will be equipped with the basic knowledge in Environmental Management and Occupational Health and Safety by the provision of the knowledge of

environmental management assessment tools and occupational health and safety Processes and Assessment tools.

In addition you will be able to answer the following questions:

a. What is meant by the term Environment and how does man affect his environment?
b. What is meant by the term Environmental management?
c. Discuss Four types of Environmental management tools.
d. State the strategies and techniques for EIA, Strategic Environmental Assessment, Environmental Audit, Lifecycle Assessment and Clean technology.
e. Explain the meaning of Occupational Health and Safety.
f. Discuss the concept of Accident and state the principles for Prevention Draft an Occupational health policy for Firm ABC a printing firm located in your region.

Of course, the list of questions that you can answer is not limited to the above list. To gain the most from this course you should endeavour to apply the principles you have learnt to your understanding of Environmental Health and Safety. I wish you success in the course and I hope that you will find it both interesting and useful.

MAIN COURSE

CONTENTS **PAGE**

MODULE 1

UNIT 1 OUR PLANET

CONTENTS

1.0 INTRODUCTION

In order to have an understanding of the concept of Environmental Health, one must understand: what the environment is, which normal processes occur in the environment , how man affects his environment and how the various effects of all the activities of man on his Environment ultimately affect him.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- define the concept environment and explain some of the natural processes that keep the earth stable
- explain some of the various activities of man currently degrading the planet.

3.0 MAIN CONTENT

3.1 Natural processes that keep the earth stable

Most people think 'the environment' is something "out there" that doesn't affect us. *The environment is where we live and consists of all*

the living and non-living things around us. The non-living (physical) part of the environment includes air, water, soil, minerals and climatic factors such as temperature and humidity. The living part consists of all micro-organisms, plants and animals (man inclusive). Everything we need to live is ultimately provided by our planet and its natural life support systems. If the environment is unable to provide those life support services, then people will suffer.

The next section lists some of the things we can't do without.

1. Stable Climate: A stable and comfortable climate is essential for human development
2. Protection from ultra-violet radiation our atmosphere, specifically the ozone layer, protects life against the most harmful ultraviolet radiation from the sun. Ultraviolet light can damage DNA in plants and animals. It is a cause of skin cancers, crop damage and can harm sea creatures
3. Provision of Fresh water: All the water we have on the Earth now is all the water we have ever had. Most of the Earth's water is in the oceans (97%) or locked away as ice. Freshwater is mostly stored underground as 'groundwater' (0.6%) and a very small proportion (0.01%) is in lakes, streams and rivers. Nature provides fresh water continuously, as rain or snow, as the melt-water from glaciers, and by releasing clear filtered water from springs. We tap into natural underground reservoirs of water which have been filtered through porous rocks when we get water from wells
4. Provision of Breathable air: Wind disperses pollution. Rain washes pollutants out of the air. Plants can trap and filter out pollutants. When plants photosynthesize (make sugar from carbon dioxide and water) they release oxygen. All of these things help to ensure that animals of all kinds can breathe.
5. Food webs: Food webs are the complex inter-relations of plants and animals which rely on each other for food. The start of it all is photosynthesis. Green algae and plants create their own stored fuel by using the energy from sunlight to turn carbon dioxide and water into simple sugars. This is the basis of the rest of life of the planet, as animals eat the plants or each other, and other organisms eat recently-alive things.
6. Fertile soils: In most land-based food webs, plants also need fertile soil, which is provided through the erosion of rocks, the rotting of recently-alive things, and the presence of microscopic living things which bind the soil together.
7. Food: We depend on nature for our food. There are around 270,000 plant species yet only 7,000 (less than 1%) have been used for food by humans.

8. Fuel: We use a lot of fuel including hydrocarbons e.g. coal, gas and oil. These sources are not renewable. Other sources of include wind and sunlight which are renewable.
9. Raw materials: We use raw materials for building, clothing, tools and equipment, dyes, books
10. Medicines: Plants and animals also provide us with medicines such as birth control drugs, antibiotics, cancer drugs, cardiac drugs, anti-malarial and analgesics.
11. Water recycling, disposal and clean up: Natural Cycles such as the carbon cycle, water cycle, nitrogen cycle, and phosphorus cycle play a part in neutralising and filtering waste and pollution. Over time,‘ natural’ substances break down – are digested or eaten by micro-organisms, worked on by water or light, rotted and absorbed in the planet-sized cycles which move carbon, water and many other materials around.
12. Soil: Soil is crucial to agriculture, the production of many raw materials (from plants and animals) and to the food webs which keep so many of the planet’s cycles functioning. Soil also plays an important role in storing water and slowing down the speed with which it flows back to the sea.
13. Biodiversity: Individual species and varieties provide us with resources: food, raw materials, and medicines.

3.2 Man’s Effect on his environment

Man has however had an effect which has degraded the environment and is affecting his own Health.

1. Climate

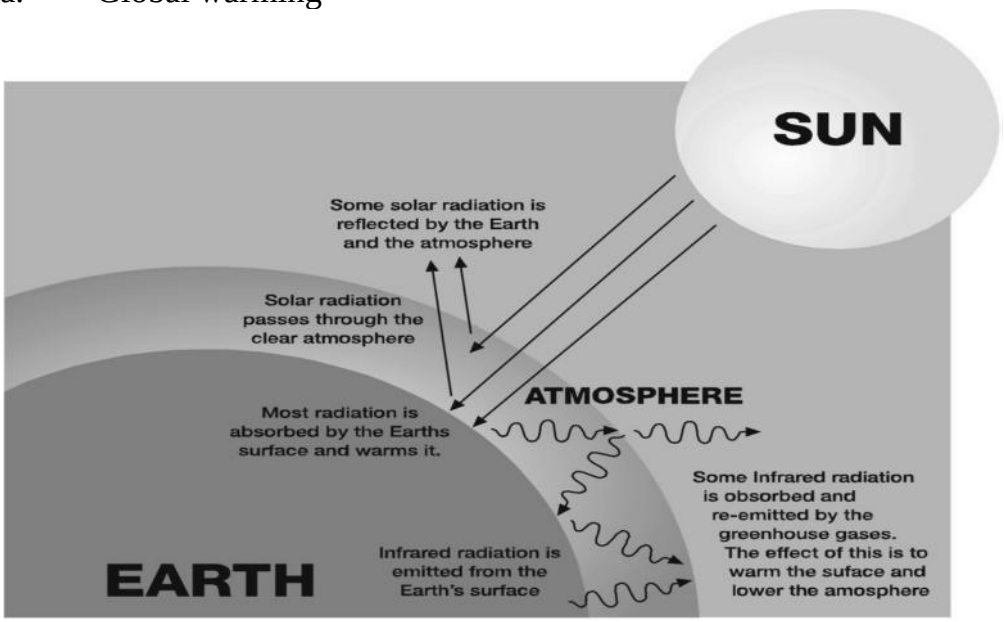
The major way in which we are having an impact on the climate is through adding greenhouse gases to the atmosphere. The greenhouse effect is a natural phenomenon, keeping the Earth warm and helping to support life. But we are adding greenhouse gases such as Carbon dioxide released when fossil fuels are burnt for energy , Methane (formed when plant and animal remains rot without oxygen being present – in rice fields, the stomachs of cows, rubbish dumps etc);Water vapour, Chloroflourocarbons(CFCs), Halogenated flourocarbons (HFCs) and other ‘halogenated’ gases (used as solvents, in dry cleaning, as refrigerants, in car air conditioning systems, as insulators in electrical applications),Nitrous oxide (also formed when fossil fuels are burnt, e.g. by cars), Ground-level ozone (a by-product formed when other types of air pollution react with sunlight).

This has resulted in more heat being trapped and the warming of the Earth. As well as adding more greenhouse gases to the atmosphere, we are making it harder for nature’s cycles to remove them. Carbon dioxide

is used by plants and when the plants die and decompose, it can be stored in the soil. Forests are being cut down and soils farmed so hard that they cannot store as much carbon. This is leading to a wide variety of changes in the climate, including more extreme weather like droughts, floods, and severe storms. We are also impacting on the climate by cutting down forests – which changes the pattern of rainfall.

Essential Climatic Terms

a. Global warming



The increased 'greenhouse gases' in the atmosphere, causes more heat being trapped on the Earth. This is causing overall temperatures to rise. The average surface temperature has increased by between 0.3 and 0.7 ^{o}C over the last century. The Earth is warming faster than at any time in the past 10,000 years resulting in Snow cover, glaciers and ice sheets being in retreat, a 40% drop in the amount of Arctic ice since the 1970s and the whole western Siberian sub-Arctic region has started to thaw for the first time since its formation, 11,000 years ago.

b. Climate change

The Earth is warming, and as a result the climate and sea levels are changing. What the weather will be like in the future is hard to predict, but it is likely to be more extreme (with more frequent severe storms, flash floods, heat waves and droughts, Tsunamis, reactivation of volcanos). The pattern of temperature and rain around the world will shift and people will need to adapt to different agriculture, and different ways of living their lives. Plants and animals will also be affected, migrating at different times of the year, to places which no longer have the same weather they would have expected.

c. Protection from radiation

The ozone layer has been damaged and has got very thin over some parts of the planet. The cause is the release of man-made chemicals like Chloro-Flouro-Carbons(CFCs), Halogenated Flouro Carbons (HFCs) and other 'halogenated' chemicals, which drift up to the upper atmosphere and destroy the ozone layer.

2. Fresh water

Man is polluting lakes, rivers and the underground natural reservoirs known as 'ground water'. Once polluted, it is extremely hard to clean up. Secondly, we are diverting and using water - often in a very wasteful way - making it unavailable downstream, where it would otherwise have been expected. Thirdly, we are draining marshes, cutting down forests and stopping rivers from using natural flood plains. This means that water passes through an area much faster than it would have done previously, rather than being stored up and gradually emerging later in the season.

3. Breathable air

Man is polluting the air and making pollutants which do not occur naturally. In cities, levels of air pollution often go above safe levels. Even in the countryside, where there is less pollution, pollutants created from things like traffic, high levels of pollution can be found as pollution is carried by the wind.

4. Food webs

We put many pressures on food webs (and the habitats and ecosystems of which they are a part). Pollution can harm living things and prevent them from reproducing. The physical destruction of habitats (forests, lakes and so on) means that other creatures which depend on those habitats for food or shelter can die out. As such creatures which depend on them for food suffer. Logging, draining, building, mining, quarrying and ploughing up for farming are some of the ways that we disrupt food webs.

5. Fertile soils

By taking away the covering and protection provided by plants, soil is left uncovered and can be washed or blown away. If the plants which grow in an area are removed each year, then the soil can become poor and thin, as the nutrients and organic matter are not replaced. The microscopic life of the soil is reduced, and the soil becomes less fertile and more easily eroded.

6. Food

Although 7,000 species have been used for food by humans over our history, today we use fewer than 20 species for most of our food. This

makes our own food supplies very vulnerable to changes - because of the lack of variety - if there is a big problem with one source of food, we don't have a lot to fall back on. On the other hand, rural communities in more than 60 countries get much of their protein from wild animal meat and fish. This makes them vulnerable if that source of protein shrinks, because of any of the reasons above.

The most important wild source of protein, globally, is fish. Nearly 70% of the world's fish stocks are fished at dangerously high levels - that is, more fish are taken out each year than are replaced by natural reproduction and growth, and fish are increasingly being caught before they are mature, so stocks are even lower in future years.

7. Fuel

When people depend on wood, use it at a faster rate than it can re-grow, and in a way which damages the forest as a whole, it means that the supply of fuel gets smaller over time.

8. Raw materials

When plants and animals are used at a faster rate than they can reproduce, then the overall stock of materials goes down. In addition, the ecosystems (food webs and habitats) which they are part of get damaged. We have a tendency to use minerals and metals very wastefully throwing them away into rubbish dumps, rather than reusing, repairing or recycling.

9. Medicines

We get a lot of our medicines from plants and animals. We might be missing out on more, for example by destroying rainforests and the plants and animals which live there, before we fully understand what other useful medicines we might get from them.

10. Waste recycling and disposal

Nature can absorb and process our 'natural' waste products - food waste and other plant and animal wastes can be composted, used as fertiliser or as food by other animals. But if there is too much of it at any one time or in any one place, nature's systems are overwhelmed. Too much sewage spread on land or draining into rivers can upset the balance, and certain types of algae rapidly increase, suffocating or poisoning other plants and animals. Too much carbon dioxide being released to the atmosphere means that nature's systems can't reabsorb it all, and the greenhouse effect becomes greater. Some kinds of wastes can't be processed by natural systems and build up in the food chain, eventually to levels where they poison animals or stop them from reproducing. These include chemicals like DDT (a pesticide) and PCBs (used as flame retardants and in electrical equipment), which are now banned.

11. Population

At the turn of the century the estimate was 6 billion. By the middle of this century it is estimated there will be almost 10 billion people utilizing the world's resources.

World population trends	
Year	**Total world population**
Pre-history - settled agriculture, c50,000 BC	10 million
AD1	300 million
1974	4 billion
1995	5.7 billion
1998	6 billion
2025	8.3 billion (UN median projection)
2050	9 - 9.8 billion

4.0 CONCLUSION

We can see that a lot of the resources of nature are not renewable, and even when they are, not at the level at which man is utilizing these resources. Thus in order to safe guard the future of present and future generations man will have to review his activities or risk destroying the earth.

5.0 SUMMARY

The environment is where we live and consists of all the living and non-living things around us. Some natural processes keep the earth stable by ensuring a stable climate, availability of fresh water, soil, provision of food, biodiversity, raw materials, medicine, clean up and disposal. These processes involve cycles like the carbon, nitrogen, phosphorus and water cycles with integral processes such as photosynthesis, respiration, and phagocytosis. Man's activities are currently destabilizing the earth resulting in climate change and global warming and depleting the earth of resources such as soil, biodiversity, raw materials and fresh water.

6.0 TUTOR-MARKED ASSIGNMENT

1. What is meant by the term Environment?
2. Discuss 5 ways by which nature keeps the environment stable and the negative impact man's activities have on them.

7.0 REFERENCES/FURTHER READING

Al Gore *Earth in the Balance*, Earth scan, London (2007).

DETR (1998) *Sustainable development: opportunities for change.*

Ghazi P. & Lewis R. *The Low Carbon diet* Short Books, London 2007.

Goodland & Ledoc (1987) *Ecological Modelling* Vol. 38.

Our Common Future *The World Commission on Environment and Development (1987)* Oxford University Press.

UNIT 2 THE NEED FOR ENVIRONMENTAL SUSTAINABILITY

CONTENTS

1.0 INTRODUCTION

We have seen in the previous unit that there is a need for man to review his present activities in order to ensure the earth is preserved for present and future generations. Thus while man tries to meet the needs of people on the planet today he should do so in a way which means that the planet can go on providing for the needs of future generations.

2.0 OBJECTIVES

By the end of this unit, you should be able to:

- discuss why there is a need for environmental sustainability
- discuss measures within your home or work place which will encourage environmental sustainability.

3.0 MAIN CONTENT

3.1 What are we doing to nature?

It has been observed that man is not meeting the needs of present generations as evidenced by:

- 1.5 billion people in developing countries having no access to clean water
- nearly 11 million young children dying each year from preventable illnesses
- increasing death rates in Sub-Saharan Africa
- high under 5 mortality rates
- high rates of adult and childhood illiteracy.

Man is also not staying within the planet's environmental limit's so as to be able to provide for future generations. Ecological Studies have shown that given the state of the environment, and the number of people on the planet, a sustainable fair share footprint would be 1.8 global hectares per person. The average actual footprint is 2.2 global hectares with7.3 million hectares of forest being lost without being replaced each year, and half of the world's wetlands having disappeared during the 20th century.

Waste and inequality

One way in which we could help to get back within environmental limits, and ensure more people's basic needs are met, is to be more efficient in how needs are met. When resources are used wastefully, environmental damage is done, with less good done on the 'benefit' side of the deal. More efficient use of resources means more 'benefit' for less 'damage'. Energy, food, consumer goods, water are wasted particularly in developed countries. This waste is much less in developing Nations were poverty is rampant.

Greenhouse gases build up in the atmosphere as a result of thousands of everyday and long-term decisions made by all of us, such as where we get our energy from and how much we use, how much we waste, what we do with our rubbish, how we get around, where we buy things from, the chemicals used to make everyday products as well as for specialist industrial use. To help nature help us, there are some things that we can all do, at work and at home. These include:

Energy

i. Use energy wisely: choose energy efficient appliances and light bulbs, use manual or hand-operated alternatives, don't leave appliances on stand-by - switch them off.
ii. Use alternative energy sources such as wind, solar, geo-thermal, biomass, wave-tidal.
iii. Avoid the use of ozone depleting substances ensure that all appliances especially those using ozone depleters such as CFCs are disposed of properly. Air conditioning and cooling systems, and fire-extinguishing systems, which often contain ozone-depleting substances should be disposed or maintained safely.
iv. Use public transport, walk or cycle.

Freshwater

We use water for: drinking, generating energy, agriculture, harvesting fish and seafood, running machinery, carrying waste, washing, cooking, recreation, and gardening.

It is important to conserve water in terms of:

- quantity - use water more efficiently, use water wisely, do not waste it
- quality - Reduce water pollution by avoiding disposal of sewage and solid waste in water, Don't tip paints, varnish, oil or other polluting substances down the drain
- regulate effluents from industries including agricultural industries
- regulate the use of artificial fertilizers and encourage the use of organic fertilizers.

Breathable air

i. Reduce your use of things which contribute to air pollution: drive less and keep your car well maintained. Use public transport, walk or cycle instead, avoids flying. Choose paint and other DIY products which have low levels of VOCs (volatile organic compounds). Don't burn garden waste and rubbish on a bonfire - recycle or compost it.
ii. Buy food and other goods which have been produced locally -this cuts down on the amount of transport.

Food webs and fertile soils, fuel, medicines and raw materials

Choose food and other products which have been produced in a 'sustainable' way such as foods produced using organic fertilizers, where soil is not over cultivated or unsuitable cultivation methods are not used, where large expanses of forests are not destroyed (deforestation) to make way for mechanized farming.

Biodiversity

Help provide places for wildlife, and rebuild natural soil fertility.

Waste Disposal

i. Reduce –reduce the amount of waste produced by ensuring unnecessary purchases.
ii. Reuse- Give products to other people who may find it useful ; donation of pre-loved (second hand) clothing , furniture , appliances or find alternative use for the same products.
iii. Recycle – Use products as raw materials for a different product such as the use of tyres as playground mats, the use of pure water sachets as raw materials for refuse bags.

Travel

Think twice before making a journey by car or plane. Use public transport, walk or cycle.

3.2 The Need for Environmental Sustainability

Being better informed about environmental matters, and reducing the environmental impact is not just in the long-term interests of the planet. It can bring short-term and direct benefits to all organizations (not just businesses).This is often called the 'business case' for environmental improvement. There are Cost savings (eco-efficiency) from using things more efficiently: Results in reduced wastage, reduced cost of labour and capital requirements, additional streams of income from waste products and reduced costs of disposal of by- products or waste products.

4.0 CONCLUSION

The little measures we take at home, at school, at play all reduce our impact on the Environment. These measures include walking instead of taking a bike or a car for short distances, carrying a water bottle around instead of buying drinks in disposable containers. Every little bit helps when put together globally.

5.0 SUMMARY

There is a need for man to review his present activities in order to ensure the earth is preserved for present and future generations. Decisions concerning where we get our energy from and how much we use, how much we waste and what we do with our rubbish, how we get around and where we buy things from, the chemicals used to make everyday products as well as for specialist industrial uses are important in terms of sustaining the environment.

6.0 TUTOR-MARKED ASSIGNMENT

As a Manger in a Printing factory situated in your region, Explain the possible impact your factory may have on the environment and discuss measures to encourage Environmental Sustainability.
(*Look at all the inputs of production energy, raw materials; paper from tree to paper, chemicals used, machinery, labor and transport)*

7.0 REFERENCES/FURTHER READING

DETR (1998) *Sustainable development: opportunities for change*, London DETR.

Ghazi P. & Lewis R (2007). *The Low Carbon diet*, London: Short Books.

Goodland & Ledoc (1987) *Ecological Modelling* Vol. 38

UNEP (1992) *Banking and the Environment*

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UNIT 3 ENVIRONMENTAL LEGISLATION

CONTENTS

1.0 INTRODUCTION

Once it was observed that there was a need to preserve the planet for present and future generations, it became necessary to establish environmental laws; standards by which individuals, organizations or nations would be judged by.

Before this, Environmental laws had been enmeshed with public health laws, which had evolved over time by experience and common sense. However as man has continued to develop, it became necessary to have laid down guide lines expressly developed to protect the environment.

2.0 OBJECTIVES

By the end of this section, you should be able to:

- define environmental legislation
- trace the history of environmental legislation in Nigeria and name the main agencies involved in Legislating the environment
- discuss the history of International Environmental Legislation with reference to some conventions and protocols.

3.0 MAIN CONTENT

3.1 Environmental Legislation

A law is generally defined as a way of regulating human behavior. For the purpose of law environment is defined along the terms of its physical components including air, water, space, land, plants and wildlife.

Environmental laws/ legislation is that law or legislation which relates primarily to the protection of the whole or part of the physical components of the environment. Laws which relate primarily to the public health or particular groups of individuals such as consumers or workers are covered under public health or occupational health laws.

Regulation of Environmental Protection can be achieved by the use of regulations. Regulation is the application of rules and procedures to achieve a measure of control over the activities of individuals and organizations.

These regulations may exert:

1. Anticipatory controls
    - Outright bans (e.g. Ban of CFCs)
    - Prohibition unless notified (e.g. use of certain nature reserve),
    - Prohibition unless registered (e.g. waste disposal),
    - Prohibition without licence (e.g. importation of chemicals)
2. Continuing Controls –continuous controls of activity such as control of factory premises by agencies such as NESREA, LASEPA, OGEPA

3.2 Environmental Standards

Effective environmental control requires standards which may be:

1. Target Standards: These are also called Environmental quality standards and are set by reference to particular targets and include:
    - emission standards- standardizes what is emitted
    - process standards- standardizes a whole or part of processes used
    - product standards- standardizes characteristics of the final product.
2. Source Standards: These are set by reference to the source Environmental legislation and policies are enacted to protect the health and safety of the general public from adverse interference with environmental resources arising from human and industrial activities. They prescribe minimum standards and grant statutory approvals/permits. Non- compliance with legislation may attract prosecution, imposition of fines and/or imprisonment.

3.3 Development of Environmental Legislation and Agencies in Nigeria

Prior to 1988, there were no laws to in force to regulate industrial pollution or hazardous waste. Existing environmental legislation only focussed on the protection and conservation of economically important natural resources (E.g. Oil Pipeline Act 1956, Forestry Act 1958, Mineral Oil (Safety) Regulations 1963, Oil in Navigable Waters Act 1968). Generous concessions were granted by Federal & State governments to business promoters to establish industries with little or no attention paid to the pollution generated from their operational activities. The Koko toxic waste incident of 1988, in which barrels of toxic waste were imported by a Business man, and dumped in Koko(Delta State), changed this trend and resulted in the FEPA Decree(now an Act) of 1988 and the creation of FEPA (Federal Environmental Protection Agency).

FEPA

FEPA was created by Decree 58 of 1988 as the overall body charged with the responsibility of protecting the environment in Nigeria in cooperation with Federal and State Ministries, Local Governments, statutory bodies.

Its functions include establishing and prescribing national guidelines, criteria and standards for:

a) Water quality
b) Air quality and atmospheric protection
c) Noise levels
d) Gaseous emissions and effluent limits
e) Ozone protection

The agency was empowered to monitor and control hazardous substances, supervise and enforce compliance.

National Policy on the Environment of 1998

A National Policy on the environment was promulgated in 1998.

The goals of the policy are:

- secure a quality of environment adequate for good health and well-being
- conserve & use environmental resources for the benefit of present & future generations
- restore, maintain and enhance the ecosystem
- raise public awareness and promote understanding of the environment
- collaboration with other countries and international agencies on environmental protection

Nigeria's Agenda 21

Nigeria's Agenda 21 Programme seeks to:

- integrate environment into development planning at all levels of government and the private sector
- commence a transition to sustainable development
- address sectoral priorities, plans, policies & strategies for the major sectors of the economy
- foster regional and global partnerships

National Environmental Standards and Regulations Enforcement Agency (NESREA)

In 1999 FEPA was scrapped and its functions taken over by the newly created Federal Ministry of Environment. In 2007 the National Assembly established the National Environmental Standards and Regulations Enforcement Agency (NESREA), a parastatal of the Ministry of Environment. NESREA Act repealed FEPA Act of 1988. NESREA now has the responsibility of enforcing environmental Laws, regulations and standards and deterring people, industries and organizations from polluting and degrading the environment.

NESREA's mandate includes the following:

- enforcement of environmental standards, regulations, rules, laws, policies and guidelines
- protection and development of the environment, biodiversity conservation and sustainable development in Nigeria
- liaison with relevant stakeholders within and outside Nigeria
- developing guidelines, regulations and standards on the environment other than in the oil & gas sector.

NESREA has powers to:

- prohibit processes and use of equipment or technology that undermine environmental quality
- conduct field follow-up of compliance with set standards and take procedures prescribed by law against any violator
- establish mobile courts to expeditiously dispense cases of violation of environmental regulation.

Other regulatory agencies include:

i. **State EPA's** such as OGEPA (Ogun State Environmental Protection Agency), RISEPA (Rivers State Environmental Protection Agency).
ii. **Department of Petroleum resources (DPR),** which enforces safety and environmental regulations in the oil & gas industry and ensures that operations conform to national and international industry practices and standards.

iii. **Standards Organization of Nigeria (SON)** implements, audits and certifies ISO 14000Standards in Nigeria. The ISO 14000 family addresses "Environmental Management". This means what the organization does to minimize harmful effects on the environment caused by its activities, and to achieve continual improvement of its environmental performance.

3.4 International Environmental Regulation

Following the Stockholm Conference in 1970, many countries established Ministries of Environment and environmental Legislation began to increase. There was also growing recognition that that pollution does not respect land borders and pollution from one country crosses to another. In addition phenomena such as the green house effect, global warming was identified. As such there was a need to develop international environmental legislation. This has resulted in the signing of various treaties under the umbrella of various international organisations such as the United Nations (UN).

The most common treaties called Conventions include:

- UN Law of the Sea (1986)
- UN Convention on Biological Diversity (1992)
- UN Framework Convention on Climate Change (1994)
- UN Convention to Combat Desertification (1997)
- Vienna Convention for the Protection of the Ozone Layer (1988)
- Stockholm Convention on Persistent Organic Pollutants (2001, 2004)
- Basel Convention on the Trans-boundary Movement of Hazardous Wastes
- Bamako Convention on the Ban of the Import into Africa and the Control of Tran boundary Movement and Management of Hazardous Wastes within Africa.

Subsidiary agreements called Protocols include:

- Montreal Protocol on Substances that deplete the Ozone Layer (1987)
- Cartagena Protocol on Bio-safety (2003)
- Kyoto Protocol to the Framework Convention on Climate Change (2004).

4.0 CONCLUSION

Environmental legislation is a fairly new and emerging field when compared to other aspects of law. It is still evolving In Nigeria and as such the agencies charged with this function are many and continue to evolve. Despite this, it is important to understand the basis for the

environmental laws and the agencies involve, as stiffer penalties are currently being applied for flaunting environmental laws or polluting the environment. Furthermore, there is a move to organize an International Legal system once the problems associated with the various conventions and protocols are ironed out.

6.0 SUMMARY

Environmental laws/ legislations are those laws or legislations which relate primarily to the protection of the whole or part of the physical components of the environment. Regulation is the application of rules and procedures to achieve a measure of control over the activities of individuals and organizations **.**These regulations may exert anticipatory control or continuing control.

Effective environmental control requires standards. FEPA was created by Decree 58 of 1988 and charged with the responsibility of protecting the environment. In 1999 FEPA was scrapped. In 2007 the National Assembly established the National Environmental Standards and Regulations Enforcement Agency (NESREA), a parastatal of the Ministry of Environment. Following the Stockholm Conference in 1970, many countries established Ministries of Environment and Environmental Legislation has increased.

SELF-ASSESSMENT EXERCISE

i. What incident necessitated environmental legislation in Nigeria and what was Government's response.
ii. List 3 agencies involved in Legislating the environment in Nigeria and discuss their functions.

6.0 TUTOR-MARKED ASSIGNMENT

Environmental legislation was introduced formally in Nigeria in 1988. As the Senior Special Assistant to the Commissioner of Environment in your state, Evaluate the present state of legislation, Discuss the impact (If any) this legislation has had on the environment and propose a plan for improving the impact.

7.0 REFERENCES/FURTHER READING

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Federal Environmental Protection Act of 1988, Lagos: Federal Government Press.

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UNIT 4 ENVIRONMENTAL MANAGEMENT SYSTEMS

CONTENTS

1.0 INTRODUCTION

In the previous units we looked at various environmental challenges and the laws which have evolved in order to contain these challenges and ensure environmental sustainability. In response to this; in order to control environmental performance and ensure regulatory compliance environmental management systems (EMSs) have been developed. The most prominent framework is the ISO14001, which requires verification and certification; however other frameworks also exist which do not require certification but have the same generic concepts as ISO 14001.

2.0 OBJECTIVES

By the end of this section, you should be able to:

- define EMS, explain the general characteristics and aims of an EMS
- explain the role of EMSs and identify the elements of an EMS
- identify the main elements of ISO 14001.

3.0 MAIN CONTENT

3.1 Definitions in EMS

Environmental Management systems are defined as *explicit sets of arrangements and processes designed to manage environmental issues and ensure that organizations environmental performance goals and objectives are achieved*.

EMS has also been defined as *part of an organisation's management system used to develop and implement its environmental policy and manage its environmental aspects.*

A management system is *a set of interrelated elements used to establish policy and objectives and to achieve those objectives.*

A management system includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources.

Thus EMSs are means by which organizations comply with environmental regulations and legislation and identify, minimize and manage their environmental impacts.
In order to implement an EMS organizations one must identify performance goals and objectives. To do this one needs to first identify environmental aspects.

Environmental aspects (also called environmental effects or impacts) are *substances which cause environmental impacts.*

Environmental aspects are defined as *an element of an organization's activities or products or services that interact with the environment.*

Environmental aspects can be divided into categories such as those we have seen in the previous units and include:

- Air pollution and odour
- Land pollution
- Water pollution including surface, ground, waste water
- Noise
- Use of natural resources
- Natural habitats

Aspects should be differentiated into aspects which can be directly controlled such as emissions, discharges, solid waste and aspects which can only be influenced such as selection of materials, customer consumption.

To set up a successful EMS, an organization must identify possible environmental aspects, separate controllable aspects from aspects that can be influenced, then identify aspects with significant impacts.

Environmental impacts are *any change in the environment whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services.*

Once the impact of the organizations products and services are established, one must determine which of them are significant, then set objectives and targets to address significant impacts over which the organization can have an impact.

3.2 Elements of EMS

An EMS will include the following main elements:

Planning (Plan)

- Establish an environmental policy

This commits an organization, and is defined as the overall intentions and direction of an organization related to its environmental performance as formally expressed by top management. The policy must commit to continual improvement, pollution prevention, and regulatory compliance and meet other organizational requirements.

- Identify and evaluate environmental aspects

This forms a baseline analysis for comparing set objectives and targets. It involves identification of aspects whether past, present or future, abnormal or normal, frequent or infrequent, controllable or those that can be influenced; significance evaluation based on data, experience, information to determine the significance of aspects. This helps to determine aspects which need control or improvement.

- Identify relevant legal and regulatory requirements

A procedure to ensure that the organization has access to applicable environmental and legal requirements and to determine how these requirements apply to its environmental aspects must be in place.

- Develop objectives and targets to control impacts

Management should formulate specific performance objectives, targets and goals. These objectives should be SMART

S- Specific
M- Measurable
A- Attainable
R- Relevant
T- Time bound

They should be documented and aimed at specific functions and levels in the organization. Technology, finance, operations, business and views of interested parties should be taken into account.

These objectives and targets may be classified as relating to:

1. Control - relating to operating parameters such as objectives and targets to meet laws and regulations

2. Improvement –based on goals and requirements of stakeholders , organizational vision and available technologies
3. Investigation into future improvements – involving research

To ensure interactions with the environment are controlled and improvements of environmental performance are made and maintained, there are four possible measures:

1. Prevention
2. Elimination
3. Reduction
4. Control

These four ways control and improve environmental impact in terms of preference with prevention being the best and control being the worst.

- Establish and maintain an environmental programme to achieve objectives and targets.

The environmental programme outlines how an organization intends to meet the objectives and targets that are set. It ensures that policy goals, objectives and targets are supported by strategy for implementation. It designates responsibility, plan, authority, control and time –scales.

Implementation and operation (Do)

- Organisation and responsibilities

The responsibilities that different organizational units and functions have within the EMS are key. Job descriptions need to be defined communicated and understood and specific environmental management structures should be built into existing ones.

Implementation of EMS including training, documentation, operational control and emergency preparedness and response requires that the competencies/ qualifications required should be clearly defined and documented.

Checking and Corrective action (Check)

- Monitoring of activities and record keeping

The monitoring and measurement techniques will depend on the significant environmental aspects, related objectives and targets. Measurements may be scientific e.g. sampling, metering or quantitative e.g. informed estimates.

- EMS audit procedures

Audits may be:

- internal- auditor is employee of organization being monitored
- external- auditor is independent second party from within the organization

- third party external audit – auditor is an independent party e.g. certifying agency.

Parameters such as the targets, regularity, personnel responsible, resources necessary, audit protocol, communication procedures, mechanism for corrective actions and preventive and prevention of reoccurrence should be clearly spelt out.

Management review (Act)
This takes place periodically to determine effectiveness, adequacy and suitability. Based on the review, recommendations are made and incorporated into the company policy. This may require formulation of new objectives and programme modification to achieve these objectives.

3.3 ISO 14000

During preparations for the 1992 UN Conference on Environment and Development which took place in Rio de Janeiro, Brazil the Business Council for Sustainable Development decided there was a need to develop international standards in environmental performance. Thus the International Standards Organisation (ISO) developed ISO 14001 from British Standards (BS) 7750.The ISO 14000 series covers standards in the field of environmental management tools and systems but excludes test methods for pollutants, limit value of pollutants, setting environmental performance levels, standardization of products.

ISO 14001 is an auditable standard for systems management and provides the framework for performance improvement, control and regulatory compliance as well as demonstrates commitment to customers and stakeholders. It is intended that the implementation of an environmental management system will result in improved environmental performance. Environmental performance are the measurable results of an organizations management of it's environmental aspects.

3.4 Elements of ISO 14001

ISO 14001 specifies the requirements for an EMS may be certified by a third party and includes:

- development of an environmental policy
- identification of environmental aspects
- establishment of relevant legal and regulatory requirements
- development of environmental objectives and targets
- establishment of an environmental programme
- implementation of an EMS including training, documentation, operational control and emergency preparedness and response

- monitoring and measurement of operational activities including record keeping
- EMS audit
- management review to determine the effectiveness and suitability of EMS

4.0 CONCLUSION

EMSs are prescribed options for responding to environmental challenges with ISO 14001 being the most prominent framework. However ISO 14001 is not a regulation, it is voluntary and not all organizations will aim to achieve ISO 14001 as a result of costs, intrusion and perceptions of added value which accompanies the certification and verification. However any organization can manage these challenges using the generic concepts embodied in ISO 14001.

5.0 SUMMARY

Environmental Management systems are explicit sets of arrangements and processes designed to manage environmental issues and ensure that organizations environmental performance goals and objectives are achieved. To set up a successful EMS, an organization must identify possible environmental aspects, separate controllable aspects from aspects that can be influenced, then identify aspects with significant impacts.

Once the impact of the organizations products and services established, determine which of them are significant. Set objectives and targets to address significant impacts over which the organization can have an impact.

SELF-ASSESSMENT EXERCISE

Set an objective and target with respect to energy consumption in a printing company and outline the key elements of the environmental management programme e.g. person responsible, tasks, deadlines.

6.0 TUTOR-MARKED ASSIGNMENT

Explain the elements of a generic EMS and identify its difference from the ISO 14001 EMS.

7.0 REFERENCES/FURTHER READING

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UNIT 5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

CONTENTS

1.0 INTRODUCTION

If an organization is actively seeking to attain the goals of improved environmental performance, it has been seen from the unit on environmental management systems that the best possible measure is prevention. The most effective tool is one that identifies the implication of an action and prevents it before the action takes place. This tool would allow the decision maker to be fully informed as to the possible consequences of a decision; whether or not an action should go ahead. The EIA takes on the role of the proactive assessment of the potential effects of a project or an action. EIA should identify potential problems and sort them out at a stage when plans can still be modified. Indeed EIA has a particularly useful role to play in the context of an EMS during the identification and evaluation of aspects.

2.0 OBJECTIVES

By the end of this section, you should be able to:

- define EIA
- review the history of the EIA Internationally and Nationally
- discuss EIA and identify projects which mandatorily require an EIA
- list the challenges to EIA in Nigeria.

3.0 MAIN CONTENT

3.1 Definition of EIA

Environmental Impact Assessment is a "pre project" anticipatory process.

The term "environmental impact assessment" describes a procedure that must be followed for certain types of project before they can be given "development consent". The procedure is a means of drawing together, in a systematic way, an assessment of a project's likely significant environmental effects. This helps to ensure that the importance of the predicted effects, and the scope of reducing them, is properly understood by the public and the relevant competent authority before it makes its decision.Thus Environmental Impact *Assessment is the process of identifying and evaluating the consequences of human actions on the environment and when appropriate mitigating these consequences.*

3.2 Origins of EIA

Environmental Impact Assessment originated from the USA in 1969. The US National Environmental Policy Act (NEPA) of 1969 was the first legislation to require an EIA. It initially applied to US Federal projects or projects where the Federal Government was directly involved but was later extended to private projects.

The aims were to minimise the long-term environmental effects of Federal actions, to specify society's right to a safe/healthy/aesthetic environment, to ensure the widest beneficial use of the environment without undesirable consequences, to preserve historic, cultural and natural heritage, to balance population and resources and to recycle scarce and natural resources.

The following factors are taken into consideration:

- the environmental impact of the proposed action
- any adverse environmental effects which cannot be avoided should the proposal be implemented
- alternatives to the proposed action
- the relationship between local short term uses of man's environment and the maintenance and enhancement of long term productivity
- any irreversible and irretrievable commitments of resources which would be involved if implemented.

The spread of EIA around the world

EIA spread to different countries following this time-line

- Canada (1973)
- Colombia (1974)
- Australia (1974)
- West Germany (1975)
- France (1976)
- Philippines (1977)
- European Commission Directive (1985)
- United Kingdom (1988)
- Kazakhstan (1991)
- Nigeria (1992)

By 1996 more than 100 countries had established EIA systems.

3.3 Development of EIA in Nigeria

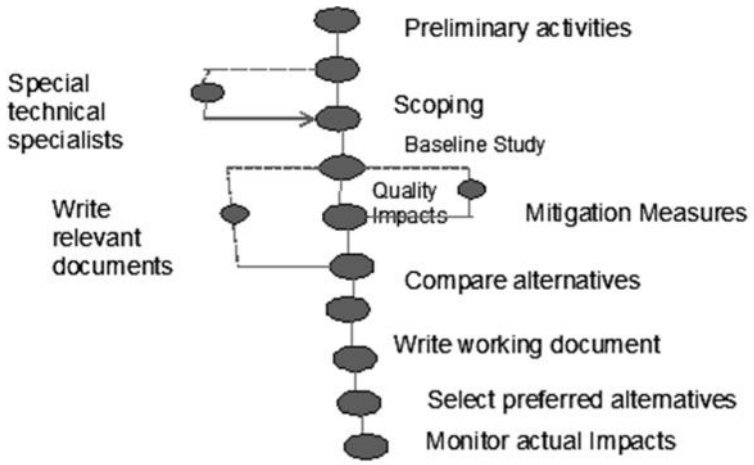
Prior to 1988, there were no laws to in force to regulate industrial pollution or hazardous waste as previously discussed. The Koko toxic waste incident (1988) led to the enactment of the FEPA Act of 1988.The Federal Environment Protection Agency (FEPA) was charged with the responsibility of protecting the environment in Nigeria. FEPA established and prescribed national guidelines, criteria and standards for: water quality, air quality and atmospheric protection, noise levels, gaseous emissions and effluent limits. The agency was also empowered to monitor and control hazardous substances, supervise and enforce compliance and the EIA was one of the tools FEPA utilized to do this. The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established by an Act of the National Assembly in 2007. The NESREA Act repealed FEPA Act of 1988. NESREA is now charged with the responsibility of enforcing environmental Laws, regulations and standards and deterring people, industries and organization from polluting and degrading the environment.

3.4 Principles & procedures of EIA Legislation

EIA principally affects new development projects and may be mandatory, discretionary or voluntary EIA. EIA seeks to compare various alternatives which are available for any project or programme. Each alternative will have economic costs and benefit as well as environmental impacts both adverse and beneficial. EIA is essentially a predictive process which is interdisciplinary in nature. The Project proponent/developer is the sole decision maker who commissions an EIA study of a project. In Nigeria, he employs an Environmental Consultant who acts as the Proponents Agent and Liaison Officer with EIA Division of the Federal Ministry of Environment, Abuja and

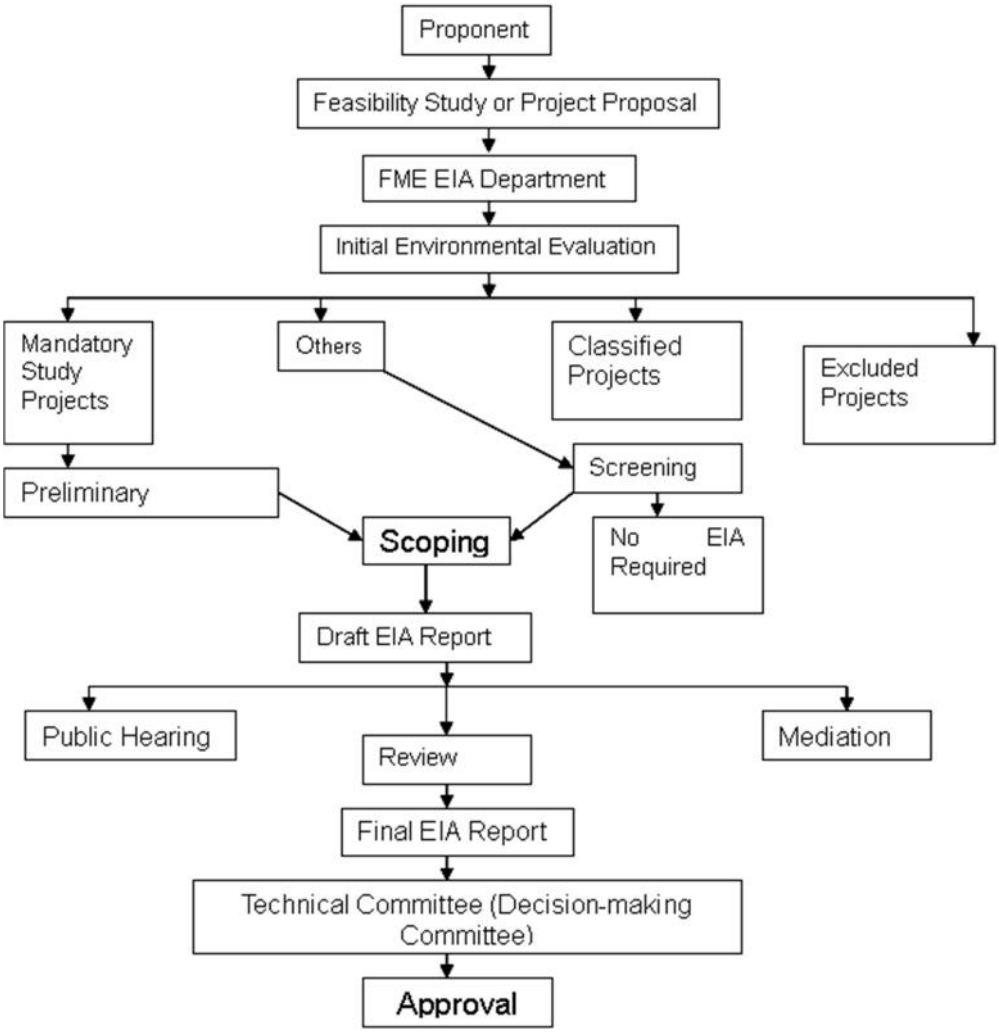
commences the study. EIA is a multidisciplinary exercise, the study team would comprise of:

- A Project Leader
- A Project Coordinator
- Environmental Scientists: *Experts in Chemistry, Biology (Botany, Zoology, Microbiology), Geology, Geography, Geographical Information Science,*
- Environmental Engineers, Planners and Architects
- Social Scientists: *Economics, Sociologists, Anthropologists, Archeologists.*
- Medical Scientists: *Doctors, Medical Statisticians, Medical Recorders, Public Health Scientists*
- Other relevant specialists depending on the type and nature of the project
- Proponent's Expert Representatives



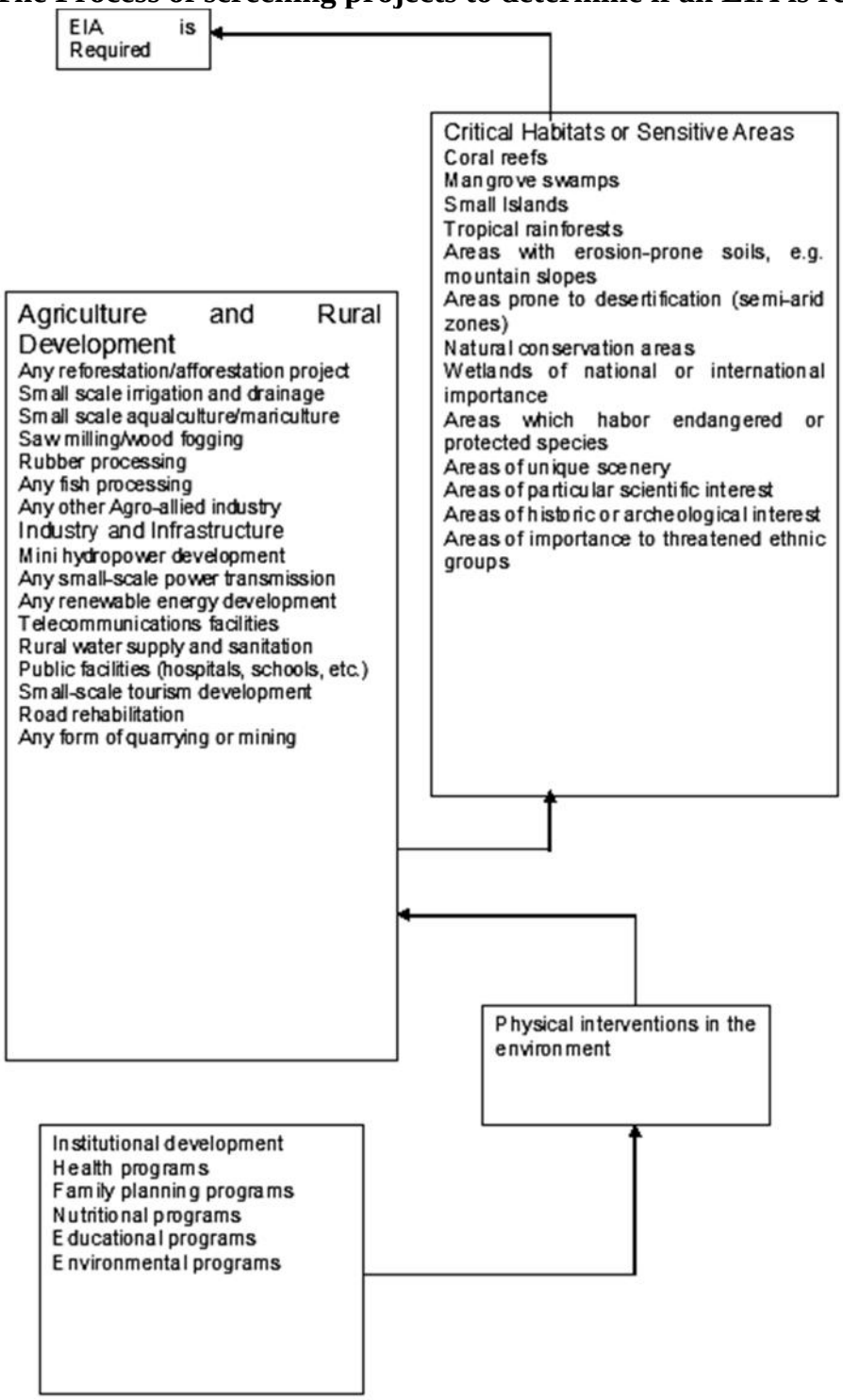
Activity Diagram for EIA

Nigerian EIA System



EIA law 1992. Federal Ministry of Environment. Federal Government Press, Lagos

The Process of screening projects to determine if an EIA is required



EIA law 1992 Federal Ministry of Environment. Federal Government Press, Lagos

Processes of EIA

a) Screening: Screening of all projects must take place. Screening aims to determine whether an EIA is required. Three categories of projects are defined:

- Category I projects – EIA is mandatory; large-scale activities within: - Agriculture (500 hectares or more), Airport (2500m or longer airstrip),Drainage and Irrigation (200 hectares or more),Land reclamation (50 hectares or more), Fisheries (land based acquaculture of 50 hectares or more),Forestry (50 hectares or more conversion), Industry - Chemical (100 tonnes/day), Petrochemical (all sizes), Non ferrous, non metallic, Iron and Steel, Ship yards, Pulp and paper, Infrastructure - Hospital, Industrial estate, Expressways, New township, Port, Pit Mining, Petroleum, Power generation and transmission, Quaries , Railways, Transportation, Resort and recreational development, Waste treatment and disposal (all waste disposal),Water supply
- Category II projects – Screening determines whether or not EIA is required.
- Category III projects – EIA is not required and EIS certificate will be issued.

Once it is determined that there is a need for an EIA, preliminary activities which comprise of writing a description of the proposed study commence. The result is a benchmark statement specifying the exact aims of the project.

b) Scoping: Impact identification i.e. scoping are identified and marked down for studying.An EIA exercise is intended to review the potential impacts of a proposed project on the following environmental factors:
   - Effects on water
   - Effects on air
   - Effects on land
   - Effects on flora & fauna
   - Effects on soil & geology
   - Effects on the climate
   - Effects on the landscape

c) Baseline study: Field-work at the Project site(s) would entail in-depth studies involving data gathering to constitute the "Baseline" research. This is a record of what existed in the area prior to action. Field-work involves physical data collection on project as well as literature search for useful existing information relevant to the project.

d) Prediction of "likely significant" impacts: This prediction relies heavily on the experience of the team of experts using previous knowledge or experience to predict positive or negative impacts on the environment. These impacts may be direct as a result of

the development itself or indirect as a result of but not due to the development itself.

e) Proposed mitigation measures: Measures are proposed to mitigate against negative impacts.

f) Public consultation: The Public Consultation process involves the mandatory newspaper publications in which the Ministry invites the public to read Draft copies of the EIA at designated centres throughout the States and Federal Capital Territory. The Ministry calls for comments and Public hearings are held to consider the entire EIA report. The stakeholders concerns and issues are discussed at this hearings and the feedback at the Public hearings is incorporated into the final EIA report.

g) Submission of EIA report: The reviewed and revised EIA report is submitted to the Federal Ministry of Environment for Scientific Review by independent experts.

h) Grant of consent by a competent authority: On the acceptance of the Final Report by the Ministry of Environment, an Environmental Impact Statement (EIS) is issued under the signature of the Honourable Minister of Environment signaling approval for the Project to commence.

i) Monitoring & Audit

3.5 Environmental Impact Assessment (EIA) Decree 86 of 1992

This is the principal legislation on EIA in Nigeria and introduced environmental considerations into development project planning and execution. There are Published EIA sectoral guidelines which outline project areas and sizes of projects requiring EIA and prescribed penal sanctions for non compliance.

Minimum content of an EIA

- A description of the proposed activity
- A description of the potential affected environment
- A description of practical activities
- An assessment of the likely or potential environment impacts of the proposed activity
- An identification and description of measures to mitigate the adverse environmental impacts
- A brief and non technical summary of the report

Challenges to EIA in Nigeria

- Policy inconsistency and environmental management not accorded political priority
- Poor environmental awareness within the business community
- Weak regulatory framework
- Weak organisational structure to enforce EIA system

- Manpower issues and technical competence
- Lack of funding
- Lack of coordination
- Multiple regulators at the Federal/State levels
- Public consultation rarely enforced
- Alternatives rarely considered
- Low quality reports

4.0 CONCLUSION

Although the role of EIA in environmental management cannot be overemphasized since it facilitates increased efficiency, reduced waste, reduced risk and improve stakeholder relationships, it has been seen that EIA is better incorporated at the planning stage , and that is not over when a project is up and running, as continuous monitoring and feedback must be part of the process.

As is often the case EIA may only be attempting to reduce impacts which could have been completely avoided if Strategic Environmental Assessments (SEAs) was utilized. This is because while EIA is focuses on the mitigation of impacts, SEA maintains a chosen level of environmental quality. Thus SEAs are currently replacing EAI's in the developed world.

5.0 SUMMARY

Environmental Impact Assessment is the process of identifying and evaluating the consequences of human actions on the environment and when appropriate mitigating these consequences. Environmental Impact Assessment originated from the USA in 1969. It is essentially a predictive process which is interdisciplinary in nature. Processes in EIA include Screening, Scoping, Conduction of baseline study, Prediction of "likely significant" impacts, Proposal of mitigation measures, Public consultation, Submission of EIA report, Grant of consent by a competent authority and Monitoring & Audit. EIAs are currently being replaced by SEAs in the developed world.

SELF-ASSESSMENT EXERCISE

List 10 category one projects that require a mandatory EIA in Nigeria

6.0 TUTOR-MARKED ASSIGNMENT

Define EIA and explain the process of EIA in Nigeria to your Finance Manager as the Environmental Officer of an Agricultural Plantation set

to begin a rubber plantation of 400 hectares requiring the settlement of 150 families.

7.0 REFERENCES/FURTHER READING

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MODULE 2

UNIT 1 STRATEGIC ENVIRONMENTAL ASSESSMENT

CONTENTS

1.0 INTRODUCTION

We have seen that the EIA process is usually applied in major development projects to ensure that likely environmental problems are anticipated and appropriate mitigation measures proposed before ***project*** commencement and throughout the ***project*** cycle. It however became obvious with the global environmental issues and an increased need for a sustainable development that the EIA process occurred too late in the planning process. Strategic Environmental assessment developed from the application of the tenets of the EIA process to actions including policies, plans and programmes.

2.0 OBJECTIVES

By the end of this unit, you should be able to:

- define strategic environmental assessment (SEA)
- explain the relationship between EIA and SEA
- describe the process of SEA and identify where it differs from EIA in Nigeria
- discuss the advantages and problem areas in SEA.

3.0 MAIN CONTENT

3.1 Definitions

SEA is defined by Therivel as "the formailsed, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan, programme and its alternatives, including the preparation of a written report on the findings of that evaluation, and using the findings in publicly accountable decision making".

Policies were defined by Glasson et al. as an inspiration and guidance for action. Plans were defined as sets of co-ordinated and timed objectives for the implementation of policy. Programmes are sets of projects in a particular area

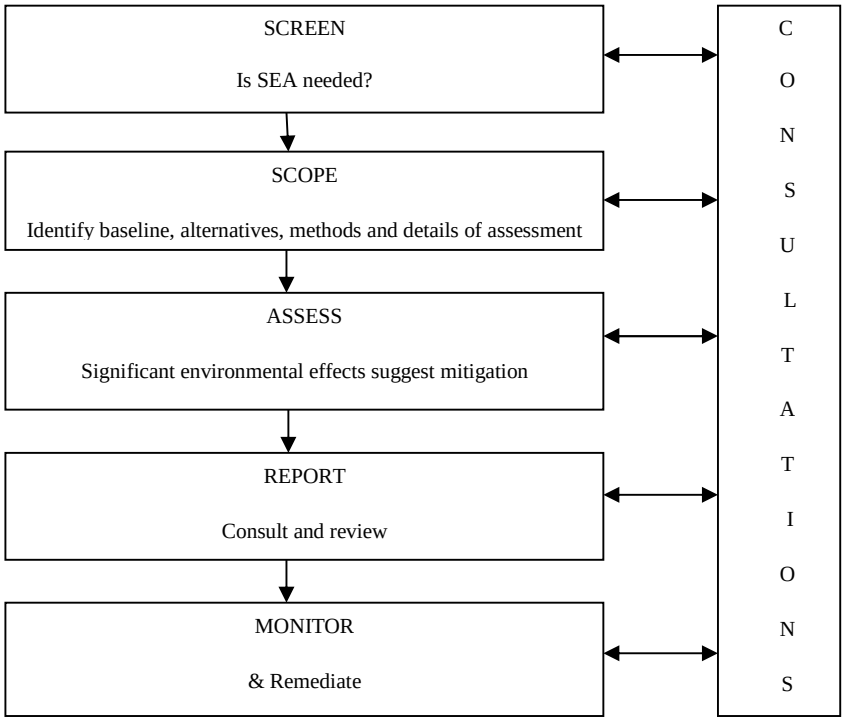
EIA	SEA
Actions are immediate, operational	Actions are strategic, visionary, conceptual
Detailed decisions to do with location, design, construction, operation of a project	Wide development options e.g. fiscal, regulatory, organizational, spatial
Short or medium timeline	Medium or long timeline
Reactive, mitigates negative impacts by design	Proactive, prevents negative impacts, promotes positive chances
Focus, methods and techniques specific. More structured.	Focus, methods and techniques change based on decision making level of practitioner
More specific assessment methods legal and industry requirements in assessment. Rigour more certain	Assessment based on professional judgements objective benchmarks and good practice. Rigour more uncertain
Uses more quantitative data	Uses more qualitative data
Less geared towards sustainable development due to methodology	More geared towards sustainable development Due to methodology

3.2 SEA Procedures

These procedures may be:

a. EIA based- structured and rigorous using specific steps
b. Non EIA based- less structured and less rigorous used for decision making and higher policy making

Stages of the SEA Process



3.3 Comparison of the EIA and SEA processes

	EIA	**SEA**
Screening	List method	2 methods used: list method definition method
Scoping	Baseline information detailed and extensive	Ongoing, depends on resources and purpose
Assessment	Based on specific methods, legal requirements and industry standards	Relies on professional judgement
Report	Environmental Statement (called EIA Report in Nigeria)	Environmental Report
Monitoring	Continuation of baseline surveys	Includes iterative feedback review measures for monitoring
Consultation	No Consultation in Nigeria only a Public hearing after Draft EIA report completed	Consultation starts at scoping all the way to findings

3.4 Advantages of SEA

a. Encourages consideration of environmental objectives during policy, plan and programme making for all organizations
b. Helps consultation between all stake holders
c. Enables formulation of standard mitigation measures
d. Encourages consideration of alternatives rejected in EIA
e. Helps in the location of the right sites for projects before EIA
f. Help effective analysis of cumulative effects of projects
g. Helps in the consideration of long term or delayed impacts

3.4.1 Problems areas in SEA

a. Long timelines and large geographical areas
b. Ensuring use of relevant baseline information
c. Limited information
d. Choice of right alternatives
e. Identification and assessment of cumulative effects
f. Difficulty in understanding concepts and methods by stakeholders
g. Use of SEA as a creative process in strategic decision making.

4.0 CONCLUSION

Strategic Environmental Assessment (SEA) is a process to ensure that significant environmental effects arising from *policies, plans* and *programmes* are identified, assessed, mitigated, communicated to decision- makers, monitored and that opportunities for public involvement are provided.

Strategic Environmental Assessment is a generic tool and has become important instrument to assist in achieving sustainable development in public planning and policy making in the developed nations. The SEA process informs planners, decision makers and affected public on the sustainability of strategic decisions. It also facilitates the search for the best alternative and ensures a democratic decision making process. This in turn leads to more cost and time effective Environmental Impact Analysis at the project level.

5.0 SUMMARY

SEA is the formalised, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan, programme and its alternatives, including the preparation of a written report on the findings of that evaluation, and using the findings in publicly accountable decision making. Although SEA evolved from EIA, SEA

procedures may be EIA based- structured and rigorous using specific steps or Non EIA based- less structured and less rigorous used for decision making and higher policy making. While EIA deals with detailed decisions to do with location, design, construction, operation of a project, SEA deals with wide development options e.g. fiscal, regulatory, organizational and spatial. The processes of SEA include screening, scoping, assessment, report production, monitoring and consultation.

SELF-ASSESSMENT EXERCISE

i. Define the term strategic environmental assessment (SEA)
ii. Compare and contrast the terms EIA and SEA

6.0 TUTOR-MARKED ASSIGNMENT

1. Define the term SEA.
2. Identify reasons why SEAs should be introduced in Nigeria and Mention possible problem areas.

(Note: identify and use as an example a plan, policy or project which has failed in your opinion and how SEA could have prevented this)

7.0 REFERENCES/FURTHER READING

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UNIT 2 ENVIRONMENTAL AUDIT

CONTENTS

1.0 INTRODUCTION

We have already encountered environmental audit as part of an Environmental management system. We saw how the audit is used to assess how well the EMS is conforming to the programme and how effective the EMS is in fulfilling the organization's environmental policy. In order for an organization to effectively manage or control it's environment, it has to be able to assess whether the systems already in place are effective.

In order to do this, the aim is to compare the prevailing conditions with baseline conditions or with set criteria. As we have already seen audits can be internal, external or third party audits. Environmental audits were adapted from Accounting Audits and usually lead to the identification of risks or of cost saving activities.

2.0 OBJECTIVES

By the end of this section, you should be able to:

- define environmental audit and explain the different types of environmental audits
- identify the advantages and costs associated with environmental audits
- outline the steps for carrying out an environmental audit.

3.0 MAIN CONTENT

Environmental Audit has been defined by the International Chamber of Commerce as A *management tool comprising a systematic documented and periodic and objective evaluation of how well environmental organization, management and equipment are performing with aim of helping to safeguard the environment by:*

- *Facilitating management control of environment practices*
- *Assessing compliance with company policies, which would include meeting regulatory requirements*

This definition means that audits can be used to

1. Verify compliance with environmental requirements
2. Evaluate the effectiveness of EMSs already in place
3. Assess risk from regulated or unregulated materials and practices

EMS management standards such as the ISO have definitions which refer specifically to the EMS thus the Environmental audit has been defined by ISO as *a systematic, independent and documented process for obtaining audit evidence and evaluating its objectivity to determine the extent to which the EMS audit criteria set up by the organization are fulfilled.*

Environmental auditing involves a series of activities set up by management to evaluate the environmental performance of organizations. Legislative compliance checks as well as an assessment of all aspects of the organization that may impact the environment are carried out. Environmental audit is a vital management tool that works as part of a process of continuous improvement. Audit was first used in the context of the environment in the U.S.A and developed from the audit procedure used for financial reporting.

3.1 Types of Environmental Audits

EAs are divided into three broad classes based on how specific is to a particular task, issue or activity. This is to suit needs of different organizations as a result of the aspect those organizations would want to consider.

***Liability Audits*:** Used to identify anything that may result in Liability include:

- Compliance audits- checks extent to which present and future regulations are complied with
- Environmental risk audits-to identify potential environmental risks as a result of processes and procedures

- Due diligence audits-liability audit carried out before purchase of new plants or equipments

The frequency of Liability Audit is put at 3months Frequency, Compliance audits done Quarterly by In-house Auditors; Biannually by External Auditors

***Managerial environment audits*:** focus on certain aspects of management

- EMS audits
- Policy audits
- Corporate audits
- The frequency of Management Audit is usually 4years in the Oil and Gas Industry (as recommended by Department of Petroleum Resources in the "Environmental Guidelines and Standards for the Petroleum Industry in Nigeria" – EGASPIN). The EU Regulations and ISO 14001 (International Organization for Standardization) recommend 3years cycle.

Activity audits: specific areas or activities audited and includes technical and management issues associated with area/ activity such as product audits, waste audits, energy audits.

3.2 Costs of Environmental Audits

These costs may be direct costs or hidden costs:

Direct costs

- Opportunity cost of management and staff time
- Cost of training internal auditors
- Cots of external auditors or verifiers
- Disruption during audit
- Cost of preparation and publishing of audit

Hidden costs

Costs of acting on the audit findings to correct breaches or irregularities.

3.3 Benefits of EA

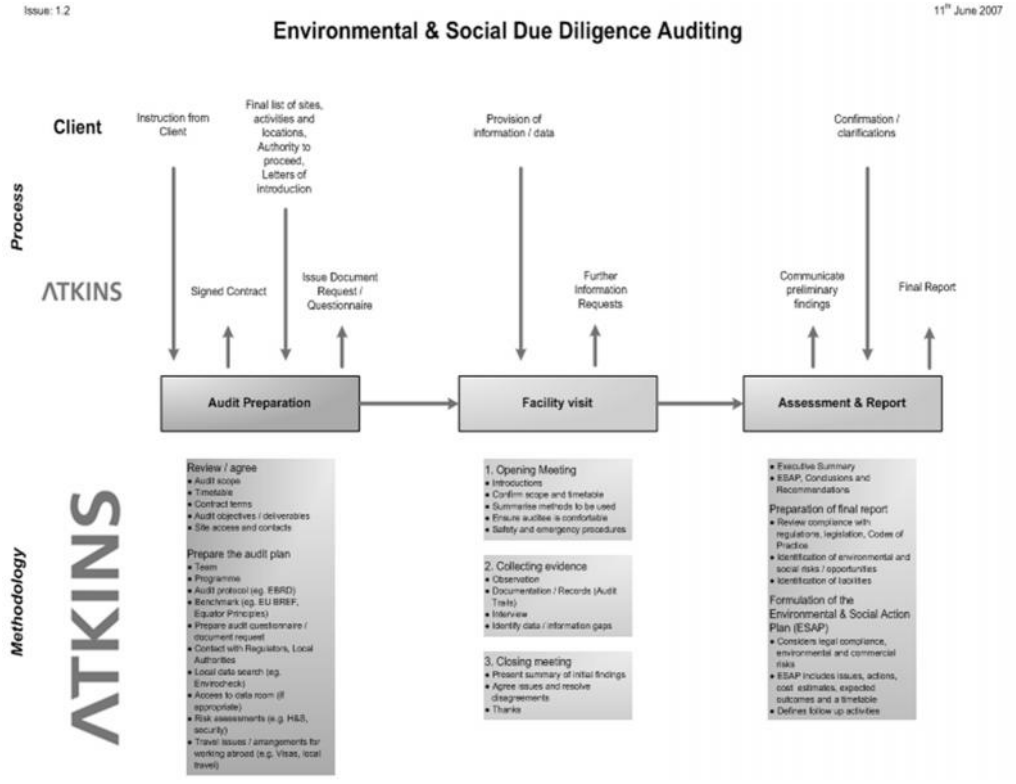
- Legal compliance: avoiding the cost of non compliance such as remediation and fines
- Reduced risk exposure, lower insurance premiums. Assured legal compliance, cheaper finance
- Stakeholder appeasement: Stakeholders are well informed and companies benefit from good will

- Improved community relations, improved media coverage, increased staff commitment
- Environmental efficiency: leading to reduced waste and reduced operating costs
- Improved materials efficiency, improved product quality

3.4 The Process of EAs

The Audit process consists of three phases
1. Audit Preparation-Planning and preparation
2. Facility visit -Audit proper
3. Assessment and report -Reporting and follow up

Each process is reviewed in the figure below.



An audit report should have the following features:

3.4.1 Important Elements of an audit report

- Accuracy (findings of fact must be validated and must be free from errors)
- Clarity (avoid jargons and technical terminologies)
- Conciseness (brevity and straight to the point)

- Timeliness (a draft should be prepared within a week of the audit being completed and the final report ready within 4-5 weeks of the closing meeting)
- Tone (report should be written in simple English without embellishments

An audit report should contain the following information

a) Contents list
b) Executive summary
c) Purpose & Scope of the audit
d) Discussion & analysis of the findings
e) Reference to items for corrective action
f) A list of actions & recommendations
g) The distribution list
h) Records of the audit programme
i) List of participants

Ideally, a quality environmental audit report should not be more than 25 pages

4.0 CONCLUSION

Although environmental audits evolved from Accounting, they have now become essential to all environmental programmes and projects.

5.0 SUMMARY

Environmental audit is a management tool comprising a systematic documented and periodic and objective evaluation of how well environmental organization, management and equipment are performing. EAs are divided into three broad classes Liability Audits, Managerial environment audits and Activity Audits. Costs of Environmental Audits may be direct costs or hidden costs. The Audit process consists of three phases: Audit Preparation-Planning and preparation, Facility visit -Audit proper and Assessment and report - Reporting and follow up.

SELF-ASSESSMENT EXERCISE

Define environmental audit and explain the different types of environmental audits.

6.0 TUTOR-MARKED ASSIGNMENT

You are the SHE officer of a printing company in one of the 6 geopolitical regions. You are required to plan an environmental audit for

your company. State how you would do this. What main elements would we expect form your report.

7.0 REFERENCES/FURTHER READING

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UNIT 3 COST BENEFIT ANALYSIS

CONTENTS

1.0 INTRODUCTION

Once an organization decides to run an environmental project or programme, it should assess the economic consequence of this programme. Thus the advantages (benefits) are compared to the disadvantages (costs) to assess how desirable the project is. Traditionally, while organizations are used to financial assessments and report to their shareholders, they must now also assess their environments and give the information obtained from this Cost benefit analysis (CBA) to their stakeholders. Thus the CBA has a vital role to play in environmental programmes.

2.0 OBJECTIVES

By the end of this section, you should be able to:

- define the CBA
- explain the main activities in the basic approach to CBA
- identify the importance of CBA as an EMS tool.

3.0 MAIN CONTENT

CBA is defined as *a broader project appraisal tool which provides a framework for measuring the economic costs and benefits of project on society (the stakeholder community) as a whole, including environmental effects, irrespective of whether they are captured in an investor's financial accounts.* Project appraisal can range anywhere between two extremes; from simple financial appraisal to complex full-scale social cost benefit appraisal. The choice of type of appraisal would

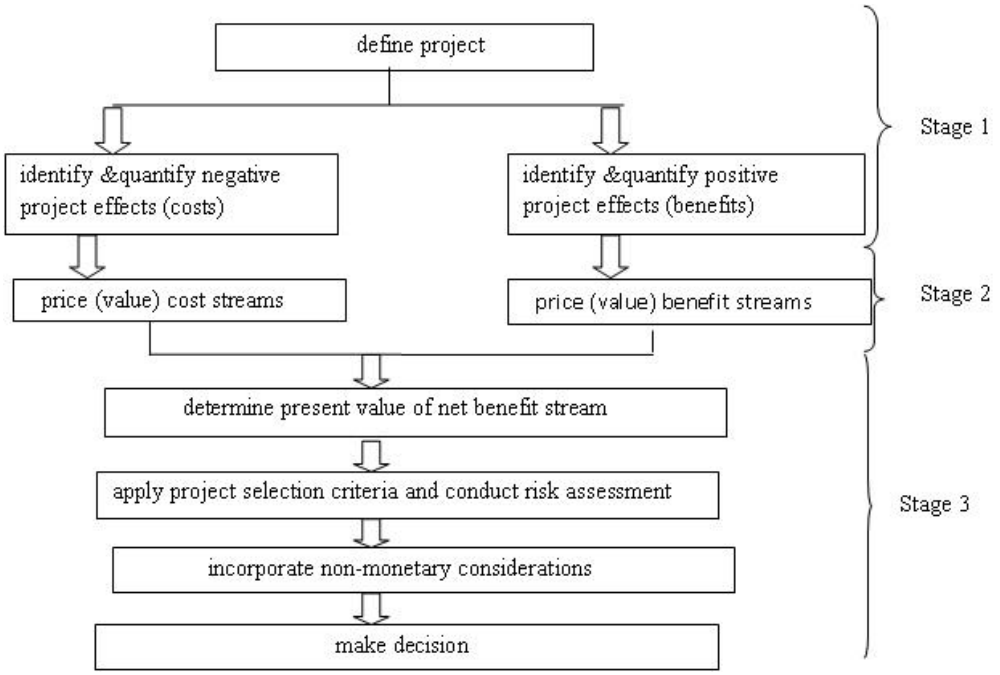
depend on the investor's objective. If the objective was to maximize share holder value then financial appraisal was the route. However an investor interested in addressing the concerns of all relevant stakeholders including environmental concerns then CBA is the route to go.

3.1 Methodology of CBA

CBA approach may be divided into three main activities or stages.

a. Identification of all parties affected by the project and quantifying of the impacts of the project on these parties.
b. Attaching an appropriate price tag to all economically relevant impacts
c. Discounting of all costs and benefits that occur in different time periods to determine the net benefit and make a decision on the relative economic project benefit.

Cost benefit analysis framework



3.2 Identify and quantify project effects

Costs are usually divided into

a. Capital or investment costs which are costs incurred at the set up of the project and may be referred to as non recurrent expenditure. This includes costs of land and property, infrastructure and equipment costs as well as installation costs.
b. Recurrent costs are those costs due to operation and maintenance and include energy costs, labour costs, material costs.

c. External or third party costs these may be the ascribed as a result of activities which adversely affect third parties such as water pollution by industry causing illness and all the costs associated with the illness.

Benefits may be:

- direct revenue earned from the project's output
- cost savings as a result of the project
- forgone or avoided external costs must also be included in a project's benefit streams.

In identifying ascribed costs or benefits the base situation is always used as a comparison since it is defined as the 'do nothing' case.

3.3 Value costs and Benefits

While tangible costs and benefits can be valued using market prices, environmental commodities do not have market prices but must be valued none the less. A range of valuation techniques have been developed and which attempt to measure either willingness- to- pay (for improvement in environmental quality) or willingness- to- accept (compensation for reduction in environmental quality). The techniques used to assess this fall into three groups.

1. Techniques using actual market prices

It is possible to value costs and benefits which can be priced whether the project effects can be seen or not. It uses the same valuation method as normal financial accounting methods used include

- Change in productivity- here a change in the environment results in a change in the ability to produce a commodity or increase the cost of producing it. An example is air pollution causing reduced farm production. The change in usual production can be evaluated. A dose response method is used such that you can predict the change in output per unit change in environmental quality.
- Preventive expenditure/Replacement Cost Approaches: Replacement cost approach uses the cost of repairing or replacing an asset affected by the environmental change as an estimate of the benefit of eliminating the negative environmental change. Preventive expenditure approach uses the expenditures as an estimate of the benefit of eliminating the negative environmental change.

2. Surrogate Market Approaches

The value of substitute goods in surrogate markets are used to value environmental goods and services. Surrogate market approaches include

- Property value approach- using price differentials between houses with different attributes including environmental attributes, the implicit values of the environmental attributes are determined and changes in the attributes can then be valued.
- Wage differential approach-Similar jobs in locations with different environmental conditions are valued, assuming that you need higher wages where increased level of pollution and greater risks to life and health exist. The changes in wage rates are used to determine the effect of the environmental changes.
- Travel cost approach- The value placed on a recreational activity is inferred from demand. These values are used to monetize changes in quality and /or quality of the recreational activity and its environmental components.

3. Survey Based Approaches

Where the market valuation methods- surrogate market techniques and market price techniques cannot be used, methods based on responses to surveys are used. Methods include

- Contingent valuation Method- Personal valuations of respondents' willingness to pay or willingness to accept compensation. The valuations are for changes in quality or quantity based on hypothetical and not real situations.
- Contingent rating-Choices are ranked on hypothetical situations on different goods including environmental attributes

3.4 Decision Making

Once the inputs and outputs are priced you need to make a decision. This involves comparing costs and benefits and applying a decision rule. However projects tend to run for a period of time, costs incurred today must be compared with benefits accruing in the future. Thus weighting to allow comparison for different points in time occurs to calculate the present value of the costs and benefits. This process is called discounting.

The criteria for 'discounted' project are

a. Net present value (NPV) method- This is the present value of estimated benefits net of costs. A project is accepted if the present value is greater than zero. A positive NPV means benefits outweigh costs and a negative NPV means that costs outweigh benefits.
b. Benefit- cost ratio method- This is the ratio of sum of the discounted net benefits (benefits-costs) to the discounted investment costs i.e. B/C. A project is accepted if B/C ratio is greater than 1. This implies that NPV is positive.

c. Internal Rate of Return (IRR) method- The internal rate of return is rate of discount at which discounted net benefits equal discounted investment costs. At this discount rate selected IRR rate the NPV is equal to zero. A project is acceptable if it's IRR is greater than the discount rate selected thus NPV is positive.

In addition to these 3 methods the non-monetary or unquantifiable effects are itemized and quantified as much as possible and determine to what extent they would affect the already determined NPV negatively or positively.

3.5 The Use of CBA in EMS

In attaining the environmental objectives and targets set by an EMS in line with the environmental policy of an organization, resources will need to committed. To ensure efficient use of these resources an appraisal of its costs and benefits will need to be undertaken i.e. a CBA.

Moreover if environmental effects are to be compared with tangible goods and services the means of comparing them in equivalent monetary units is the CBA.

4.0 CONCLUSION

CBA has an important role to play in determining the effects environmental projects or programmes. It's basic principles are in economics and accounting and by determining net costs to benefits a decision is made as to whether a programme or project should continue or not.

5.0 SUMMARY

CBA is as a broader project appraisal tool which provides a framework for measuring the economic costs and benefits of project on society as a whole, including environmental effects, irrespective of whether they are captured in an investor's financial accounts.

CBA approach may be divided into three main stages which are identification of all parties affected by the project and quantifying of the, attaching an appropriate price tag to all economically relevant impacts, discounting of all costs and benefits that occur in different time periods to determine the net benefit and make a decision on the relative economic project benefit.

The criteria for 'discounted' project are Net present value (NPV) method, Benefit- cost ratio method and the Internal Rate of Return (IRR) method.

CBA ensures efficient use of these resources and enables environmental effects to be compared with tangible goods and services by comparing them in equivalent monetary units.

SELF-ASSESSMENT EXERCISE

i. Define Cost Benefit Analysis.
ii. Identify the three main approaches to valuation of tangible costs utilized in CBA.

6.0 TUTOR-MARKED ASSIGNMENT

Explain the process of making a decision using the CBA and discuss how the three discounted project criteria are used in this context.

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UNIT 4 LIFE CYCLE ASSESSMENT

CONTENTS

1.0 INTRODUCTION

As concern has increased over the relationship between the economy and the environment various techniques have been developed to assess the effect of human and industrial activities on the environment. Life cycle assessment serves the function of taking the account of the environmental effects of a product or service through all of its life stages from raw material to final disposal of the product. It assesses all the relevant effects of the product from cradle-to-grave.

2.0 OBJECTIVES

At the end of this section, you should be able to:

- define life cycle assessment and give a brief history of its development
- explain the methodology of LCA
- list the uses of LCA.

3.0 MAIN CONTENT

As concern over Climate change increased in the late 60's and early 70' several projects evolved to quantify industry use of raw materials and energy. These were initially called *energy analysis* but their focus broadened to consider use of resources and waste production. The projects were now called *resource analysis.* One of the first resource analysis studies conducted for the Coca Cola Company to determine alternative container system with the lowest energy and natural resource consumption developed a process which analysed this from *cradle to grave* this process was called the *Resource and Environmental Profile Analysis (REPA).*This and other studies formed the basis for the life cycle inventory phase of LCA. Analysis of pollution problems caused

by industry as a result of smog in Los Angeles and Tokyo, acid rain in Scandinavia, global warming and ozone depletion resulted in the expansion of the use of methodology to calculate energy and resource consumption to analyse pollution to land water and air. This expanded analysis was called eco-balance and evolved to be part of the LCA.

The Society for Environmental Toxicology and Chemistry (SETAC) played a leading role in developing terms and methodology of LCA. They have developed a methodological framework and a code of practice for LCA to ensure consistent approach practice and reporting of LCAs. SETAC also had an important role in integrating impact assessment into LCA.

In 1993 however, since LCA was becoming a standard tool for making environmental claims, there was a need for standardization. The International Organisation for Standardisation evolved some standards in order to achieve this.

ISO 14040 Life Cycle Assessment: Principles and Framework
ISO 14041 Life Cycle Assessment: Life Cycle Inventory Analysis
ISO 14042 Life Cycle Assessment: Impact Assessment
ISO 14043 Life Cycle Assessment Interpretation
ISO 14048 Life Cycle data documentation format
ISO 14049 Life Cycle Assessment- Examples of application of ISO 1404 goal and scope definition and inventory analysis

LCA is defined by the ISO as the *compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.*

It has also been defined by the Society for Environmental Toxicology and Chemistry (SETAC) as *a process to evaluate the environmental burdens associated with a process, product or activity by identifying and quantifying energy and materials used and wastes released to the environment; and to identify and evaluate opportunities to affect environmental improvements. The assessment includes the entire life cycle of the product, process or activity, encompassing, extracting and processing raw materials; manufacturing, transportation and distribution; use, re-use, maintenance; recycling and final disposal.*

LCAs attempt to quantify the environmental burdens caused by industrial or product systems since the system generates the waste and not the product. A product system is a collection of operations connected by flows of intermediate products which perform one or more detailed functions. When describing a product system it must be done such that another practitioner can duplicate the inventory analysis. Thus

the scope of the LCA must clearly specify the functions of the system being studied. *The functional unit is a measure of the performance of the functional outputs of the product system*. A functional unit must be measurable as it forms the basis of the LCA.

After identifying the industrial/product system, you must draw the system boundary differentiating it from the system environment which is the source of all inputs and the receiver of all outputs. There are also usually sub-systems or unit processes which have the same characteristics as the industrial main system and should be enclosed within their own system boundary.

3.1 Methodology of LCA

There are four keys steps to the LCA as defined by ISO14000:

a. Define the goal and scope- decide what you want to achieve
b. Life cycle inventory analysis (LCI) –gather and process relevant data
c. Life cycle impact assessment- determine the main environmental impacts
d. Life cycle interpretation- evaluate their relative interpretation

Define the goal and scope

It is vital to identify exactly the purpose for carrying out the study i.e. *goal definition*. The goal of an LCA should unambiguously state the intended application, the reasons for carrying out the study and the intended audience. The goal defines what is to be accomplished by the LCA, how results will be used, what decisions will be based on the LCA output and if results will be used externally or internally. These answers affect the scope of the study. An example of a goal is the quantification of energy, raw materials, air emissions, effluents and solid wastes of a printing factory.

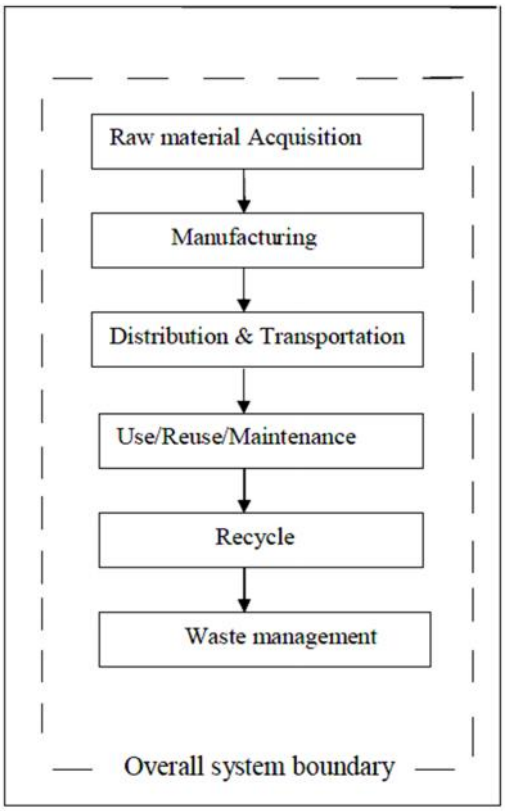
As resources are limited the researcher must decide the breadth and depth of the study based on the goal. The scope should be sufficiently well defined to ensure that the breadth and the details of the study are compatible and self sufficient to address the stated goal. Scoping will entail defining the *function* under study, the *system* which performs the function, the *boundaries* of this system, *data categories* needed to address the stated goal. Sometimes a detailed scoping pinpoints the main impacts of the system and based on the goal removes the need for a full LCA or leads to a reformulation of original decisions concerning the study.

- While there is no correct system, it is necessary to specify the system in a clear and transparent manner i.e. system

specification, in addition the LCA must cover the life cycle of the system from cradle to grave.

- The starting boundary at which the system is considered must be clearly stated, as must the boundaries at the end points of the system .Then the unit operations in between should be defined.

This is represented using a process tree

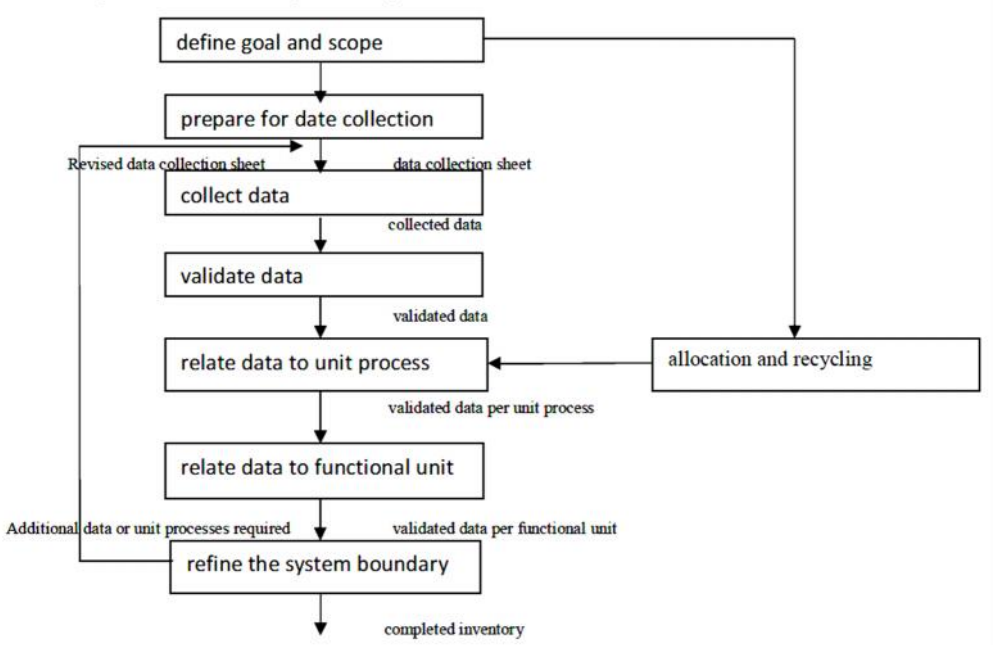


In addition to the main production process represented in the process tree, it is necessary to assess:

a. Energy which is a main industrial component. Thus the gross energy requirement which is the total energy resource extracted from the environment must be accounted for.
b. Ancillary materials which are inputs required for manufacturing but do not form part of the main product.

Sometimes there are various inter- linkages within the system and the system must then be represented as a network.

Life –Cycle inventory Analysis



Key steps in inventory analysis Source : ISO 14041

This phase tries to gather the information relating to all the inputs to the extended system including energy and ancillary materials, and all the environmental outputs associated with the various parts of the system.

- Prepare to collect data- determine type of data required i.e. primary data collected on site to be entered in a worksheet and secondary data obtained from literature, references, government and industry sources, websites, databases. Complete a data set ensuring data quality and proper allocation. Data quality is affected by age, whether it is aggregate, whether it is an estimate or actually measured and data completed. Allocation refers to the procedure where environmental burdens are apportioned between multiple inputs or outputs i.e. in a production unit with multiple products.
- Normalising - this is the expression of inputs and outputs to relative standard unit of throughput. This is because the quantity of input/output used /produced per unit process is a function of the mass going through the system at the point in time. The standard unit is called the functional unit.
- Computation – Data is entered into a computer model to calculate the inventory of the overall system. This produces data sets known as inventory tables.

LCA Impact Assessment

Once the inventory is generated, the results must be interpreted by assessing the environmental impact of the inputs/outputs identified by the inventory by following the steps below.

- Selection & definition of impact categories- categories selected of issues such as global climate change, acidification, and smog will depend on the goals and scope of the study.
- Assignment or classification- allocates the inventory data to the relevant issue categories. Some data (stressors) will impact a number of categories.
- Category Modelling- calculations are carried out to evaluate the relative significance of each stressor to the overall impact of the system being studied. e.g. using the Global Warming Potential GWP in CO_2 equivalents .

Substance	Amount (kg)	GWP in CO_2 equiv/kg @20 years	CO_2 eqiv/kg
CO_2	3.2	1	3.2
NO_2	0.15	290	43.5
Tetrachloromethane	0.0003	2000	0.6
Total GWP in CO_2 equivalents			47.3

- Assessment- This stage involves assessing the import of the impact on the system. This stage may be omitted but when carried should be done carefully using databases.
- Weighting- this is a subjective process and involves assigning relative weights or values to impacts. Weighting helps in decision making but is accused of being based on value judgements and politics not science. Relative weights used for ranking is based on societal value and preferences (determined by decision theory techniques) or monetary values (external damage cost estimates).

LCA Interpretation

Life cycle interpretation is determined by ISO to be a systematic procedure to identify, qualify, check, and evaluate information from the conclusions of the inventory analysis and/or impact assessment of a system, and to present them in order to meet the requirements of the application as described in the goal and scope of the study. It is also a process of communication…of the more technical phases of LCA…in a form which is both comprehensible and useful to the decision maker.'

ISO 14043 Interpretation involves a review to ensure a systematic and consistent process. In addition when comparing environmental impacts related to different options the checks must ensure the approach is consistent so comparison is meaningful. The report produced must State the objectives clearly, explain the scope, explain the system boundary and the reason for it's choice, show flow diagrams of important inputs,

outputs and products, describe the method used stating the value judgements and assumptions, data showing source and quality, conclusions drawn from study.

3.2 Uses of LCA

Internal Uses:

- Provides a comprehensive baseline of environmental information. These are determined during inventory and impact assessment components of LCA and are used in the EMS
- Optimizes reduction of environmental impact by identifying areas of maximum improvements with least resources
- Provides consumption and environmental loading data for product, process or activity comparisons
- Improves eco-design by providing information that will enhance (re)design of products, processes or activities
- Used as an EMS tool for analyzing environmental aspects since it identifies and quantifies energy and raw material usage, releases due to products, process or activities and assess environmental impact.
- Used as an EMS tool for continuous improvement as actual opportunities are identified and evaluated in the interpretation stage of LCA.

External Uses:

- Substantiation of environmental claims
- Help in formulating environmentally benign purchasing- ensure purchases with less impact
- Influence formulation of public policy
- Provide information for public education
- Encourage research and development by emphasizing gaps

4.0 CONCLUSION

Life cycle assessment is a useful tool in EMS during the preliminary environmental review, when identifying and evaluating which aspects are significant and when setting objectives and targets since it helps to identify maximum improvements with minimum resources and product, process and activity comparisons.

5.0 SUMMARY

LCA assesses all the relevant effects of the product from cradle-to-grave. It developed in the 1960 and early 70'from fuel cycle studies like energy analysis and resource analysis. The Society for Environmental Toxicology and Chemistry (SETAC) played a leading role in developing

terms and methodology of LCA while the International Organisation for Standardisation evolved its standards.

There are four keys steps to the LCA:
i. Definition of the goal and scope
ii. Life cycle inventory analysis (LCI)
iii. Life cycle impact assessment
iv. Life cycle interpretation

Life cycle assessment is a useful tool in EMS during the preliminary environmental review and for continuous improvement as actual opportunities are identified and evaluated in the interpretation stage of LCA.

SELF-ASSESSMENT EXERCISE

Explain the uses of LCA to an organization

6.0 TUTOR-MARKED ASSIGNMENT

You are the Environmental manager of a Printing Press located in one of the 6 Geo political zones. Explain the methodology you would use to conduct an LCA for your company.
(Note wood is organic and you would need to consider the impact of trees on the environment, where is your source of paper - import or local, are these sources sustainable)

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UNIT 10 CLEAN TECHNOLOGY

CONTENTS

1.0 INTRODUCTION

As man's population as well as his level of development has increased, so has his level of discharges to the environment with an accompanying cost to his environment and to public health. There is increasing pressure for all, especially businesses to reduce their discharges.

At the Earth Summit in Rio de Janeiro, in 1992, waste management was discussed with the aim of minimizing waste, maximizing environmental sound waste reuse, recycling and disposal as elimination is currently unrealistic. New technologies are currently evolving to reduce waste at the design phase.

While one can differentiate between technology which concentrates on prevention (clean technology- used to set objectives and target and establish an environmental management programme), and technology which is used as control (waste minimization-used in operational control) waste minimization and clean technology are often used synonymously, and we shall do the same in this section. Clean technology focuses on the prevention of waste and pollution, the minimization of energy consumption and conservation of raw materials.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define waste minimization, clean technology and cleaner products

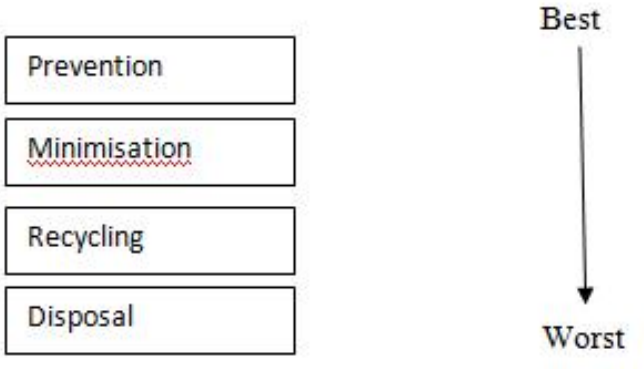
- describe the role of clean technology in managing waste
- list the benefits of clean technology
- explain the role of clean technology in EMS.

3.0 MAIN CONTENT

3.1 Development of Clean technology

Clean technology developed as a result of the realization that increasing demand for and use of non-renewable resources is unsustainable as result of depleted resources, increased by products of production and consumer waste. There was increased pressure to maximimise production efficiency and reduce waste. Waste management is not anew concept and many companies had used waste minimization measures e.g. reuse, recycle for years for financial reasons. The Science Advisory Board in America (1988) advocated the need to reduce or prevent pollution at source. In the EU the 1991 Framework directive on Waste contains an obligation to reduce waste by cleaner technologies, waste recovery and recycling.

Hierarchy of Waste management



The EU has developed various directives on waste resulting in a change in thinking from waste disposal to waste management and minimization

3.2 Definitions

Clean technology ***is the production of goods and services without*** *detectable environmental impact.* As this is unattainable the term cleaner technology is sometimes used.

Cleaner technology *is the design and manufacture of intrinsically clean products by intrinsically clean processes.*

Cleaner production *is the conceptual and procedural approach specific to production which demands that all phases in the life cycle of the a product or process should be addressed with the objective of prevention or minimization of short and long term risks to human health and the environment.*

Cleaner products *are products whose production has a conceptual and procedural approach which demands that all phases in the life cycle of the product should be addressed with the objective of prevention or minimization of short and long term risks to human health and the environment.*

Waste minimization *is concerned with improvements to existing activities; that is reduction of waste at source and with recycling.*

3.3 Benefits of Clean technology

i. Increased Profit as a result of a marketing edge leading to more sales, waste cost savings – cost of raw materials and reduced storage and disposal costs.
ii. Improved process efficiency as result of constant review of production process and technologies
iii. Reduced environmental liability due to reduced risks to the environment, health and safety.
iv. Reduced environmental impact as clean technologies usually focus on type, amount and how toxic the discharge is.
v. Improved Stakeholder relations since shareholders, staff, regulators have increased confidence in the organization

3.4 Important Elements in the implementation of clean technology

Total Organisational Commitment

Organisational commitment is important for implementation and must be demonstrated by:

- A statement of organisational policy
- A strategy for implementation with allocation of a manager
- Training of all staff

Barriers to organisational commitment include:

- Economic barriers due to insufficient resources
- Technical barriers due to lack of knowledge and expertise
- Regulatory barriers if regulations are cumbersome
- Cultural barriers due to lack of top management commitment, low awareness and poor communication.

- Resistance to change due to fear

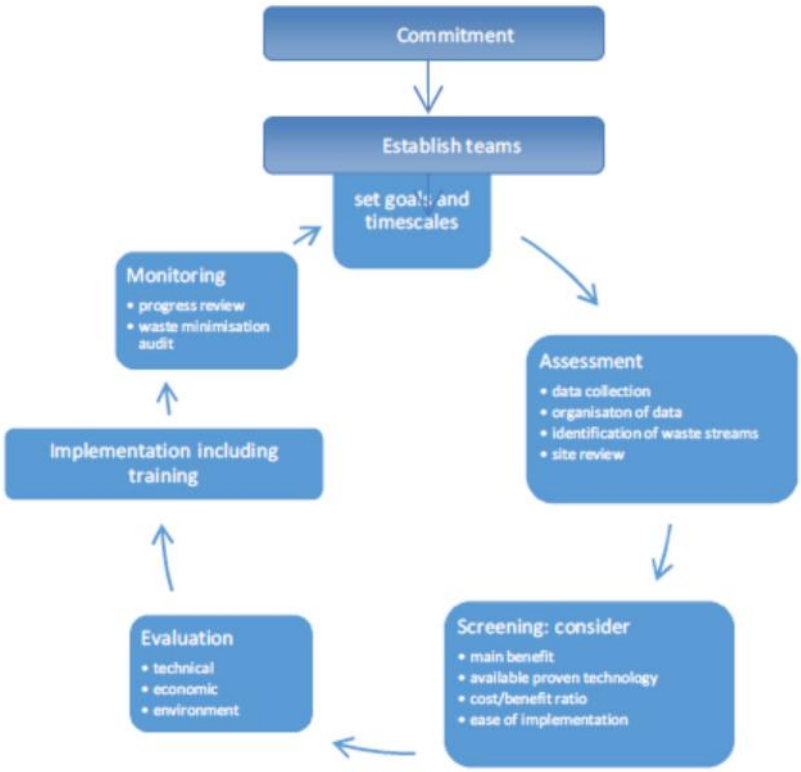
Clean technology and Waste minimization techniques

Waste minimization techniques consist of waste reduction at source (the better option) and recycling.

- Waste reduction at source
  a. Good Housekeeping i.e. good operating practice in existing activities such as
- Maintenance
- Training
- Control procedures
  b. Technological Changes which covers equipment and process modification
- Retrofitting where exiting equipment and processes are modified
- cleaner processes where processes are designed to minimize waste and pollution
  c. Input Material Changes is the replacement of potentially hazardous material inputs with less or preferably non-hazardous inputs reducing the impact.
  d. Product Changes involves altering the product to reduce waste in manufacture, use and disposal.
- Recycling
  a. Re-use within the same process as substitutes for virgin material inputs
  a. Re-use as raw material for another product
  b. Reclamation sort through waste and use as raw material or sell
- Treatment and Disposal

Treat all discharges as effectively as possible and dispose

3.5 Methodology of clean technology



Uses of Clean Technology in EMS

- Clean technology results in the quantification of inputs and outputs associated within an organization to establish a baseline
- Clean technology helps to identify areas where improvements are necessary
- Clean technology helps to identify possibilities for the redesign of products and processes thus reducing environmental impact the main aim of an EMS
- Clean technology helps to reduce waste, pollution, resource consumption thus minimizing environmental health and safety risks
- Clean technology helps in the identification of significant environmental aspects
- The process of clean technology is cyclical and similar to the EMS
- Clean technology can help to offer solutions for areas with problematic environmental implications.

4.0 CONCLUSION

Clean technology is an important tool in EMS. It has it's roots in waste management but focuses on the prevention of waste and pollution, the minimization of energy consumption and conservation of raw materials.

5.0 SUMMARY

Clean technology in the strictest terms is the production of goods and services without detectable environmental impact. Clean technology benefits the organization by increasing profit, improving process efficiency, reducing environmental liability, reducing environmental impact and improving stakeholder relations. Clean technology requires total organisational commitment and entails waste minimization at source and recycling methods.

SELF-ASSESSMENT EXERCISE

i. Define clean technology
ii. Define waste minimization
iii. Discuss the benefits of clean technology to an organization

6.0 TUTOR-MARKED ASSIGNMENT

As the environmental manger in a printing company in one of the 6 geopolitical zones introduce clean technology to your Board of Directors.

7.0 REFERENCES/FURTHER READING

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MODULE 4

UNIT 1 ACCIDENTS: CLASSIFICATION, CAUSES AND COSTS

CONTENTS

1.0 INTRODUCTION

Accidents are a common feature in industry particularly in the developing world. In fact some industries such as the mining industry are well known for accidents as evidenced by the Chilean Miners accident. Accidents result in losses to the workers and their families, the industry, as well as the nations. One thing is evident, a concerted effort must be made to reduce the number and the severity of accidents occurring worldwide since a majority of accidents are preventable. Factories Act of 1987 deals with the registration of factories, factory workers and professionals exposed to occupational hazards, the safety of workers and penalties for any breach of its provisions, notification of accidents and industrial diseases while the Employees' Compensation Act of 2011 deals with compensation and penalties**.**

2.0 OBJECTIVES

At the end of this unit you should be able to

- Define accidents and classify accidents
- Identify the causes of accidents
- List the costs of accidents
- Describe methods which are useful in the prevention of accidents.

3.0 MAIN CONTENT

3.1 Terms and definitions

The ILO defines an accident is *an incident which has given rise to injury, ill health or fatality*. It has also been defined by the WHO as *an unpremeditated event resulting in recognizable damage* and as *an occurrence in a sequence of events which usually produces unintended injury, death or property damage.*

Accidents do not just happen they occur as a result of unsafe acts or unsafe conditions or both. Prevention of accidents requires cooperation of all members of the entire organization.

An incident is a work-related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred.
An incident where no injury, ill health, or fatality occurs may also be referred to as a "near-miss", "near-hit", "close call" or "dangerous occurrence".

An emergency situation is a particular type of incident.

3.2 Classification of accidents

Accidents may be classified based on

3.2.1 The degree of danger to life and property.

It may be divided into four categories

- Minor: No loss of life
- Moderate: Injury but no loss of life and property
- Major: Loss of life
- Disaster: extensive loss of life/ property

3.2.2 Principal-cause and effect

- Fire and Explosions
- Electrical Accidents
- Chemical Accidents and Explosions
- Accidents with machines, plant, tools
- Falling Objects on the body
- Falling of persons in pits or from heights
- Accidents from civil works
- Human-made accidents
- Natural disasters

3.2.3 According to their place of occurrence

- Road Traffic Accidents
- Domestic accidents including drowning, burns , poisoning, falls, injuries, bites and injuries
- Industrial accidents ;these are further classified based on the industry involved such as agricultural accidents, fishing/trawler accidents, mining accidents, construction accidents, quarry accidents, aviation accidents, factory accidents e.t.c
- Railway accidents
- Violence including trauma, homicide, suicide and war

3.3 Causes of accidents

The causes of accidents are multi-factoral and are grouped under two main headings

a. Human factors
b. Environmental Factors

a. Human factors

Human factors have been adjudged to contribute to 85% of all accidents and include:

- Physical : the physical capability of the worker may be inadequate for the job e.g. visual acuity, hearing
- Physiological:
  a. Sex- females have less accidents than men
  b. Age- younger people and elderly people have more accidents
  c. Time – accidents are more common as the day end
  d. Experience- less experienced workers are more prone to accidents

e. Working hours- longer working hours are usually associated with more accidents

- Psychological – mental factors such as carelessness, inattentiveness, overconfidence, ignorance, emotional stress, lack of knowledge accident proneness.

b. Environmental Factors

- Mechanical failure

These are factors such as temperature, poor illumination, humidity, noise and unsafe machines

- Acts of nature: weather conditions such as hurricanes, floods

3.4 Costs of Industrial Accidents

These may be

- Costs to the worker

Direct costs- Costs of treatment, Morbidity, Disability, Mortality
Indirect costs- psychological stress, loss of livelihood

- Costs to the organization

Direct costs- Medical costs, Costs of rehabilitation, Compensation costs, Fines by regulatory authorities, Legal costs, Loss of trained manpower, absenteeism, disruption of production schedule

Indirect Costs- Poor public perception, Stake holder engagements such as strikes by unions, Blockades by surrounding communities

- Costs to family

Direct costs -Loss of family members, loss of livelihood
Indirect costs- stress to care giver, loss of income to care giver

- Costs to the community/ nation

Direct costs- loss of trained manpower, pressure on medical facilities
Accident Prevention
Studies have shown that as much as 98 % of accidents are preventable.

3.5 Principles of accident prevention

1. Adequate pre-placement examination
2. Adequate job training
3. Continuing education
4. Ensuring safe working environment

5. Establishing a safety department under a competent safety engineer
6. Period surveys/ risk assessment to identify hazards
7. Careful reporting, maintenance of records, review and publication

4.0 CONCLUSION

It is evident that a concerted effort must be made to reduce the number and the severity of accidents occurring worldwide since a majority of these accidents are preventable.

5.0 SUMMARY

An accident is an incident which has given rise to injury, ill health or fatality. Accidents do not just happen they occur as a result of unsafe acts or unsafe conditions or both. Accidents may be classified based on the degree of danger to life and property, principal-cause and effect, according to their place of occurrence. The causes of accidents are multi-factoral and are grouped under two main headings human factors and environmental factors. Costs of Industrial Accidents may be costs to the worker, costs to the organization, costs to the family, costs to the community/ nation. Studies have shown that as much as 98 % of accidents are preventable.

SELF ASSESSMENT EXERCISE

i. What is an accident?
ii. How do you classify accidents?

6.0 TUTOR MARKED ASSIGNMENT

1. Identify the causes of accidents
2. List the costs of accidents
3. Describe methods which are useful in the prevention of accidents

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UNIT 2 FIRE AND FIRE FIGHTING

CONTENTS

1.0 INTRODUCTION

Fire is rapid combustion resulting in release of heat and light of flame. Fire occurs in different situations domestic, agricultural, forestry, industry and may result in loss of life and property. Loss of life is due to poisonous gases and flames. Fire danger to life is given higher weight than fire hazard to property. More than 85% of fires are caused by electrical sparks or short circuits.

While most organisations aim to be insured against fires, the insurance is often not equal to the losses as some items are indeed irreplaceable thus it is more expedient that fires are minimised by adopting scientific engineering approach.

Aspects to be considered during design, construction and operation of organizations include safe escape of personnel, fire prevention, fire fighting and minimization of loss of life and property, safety of personnel from fire, gases and smoke, reducing spread of smoke and gases, emergency operations and first aid measures.

2.0 OBJECTIVES

At the end of this unit you should be able to

- Explain the fundamentals and elements of fire
- Identify the general fire prevention and Fire control measures

- List the different types of fires and identify the extinguishers useful for each type

3.0 MAIN CONTENT

3.1 Fundamentals and elements of fire

Fire is an active, rapid, burning (combustion) fast oxidation process accompanied by heat, light and poisonous gases/ smoke/carbon dioxide due to combustion. The flame is the luminous hot zone of fire. Fire starts at a hot spot and spreads along combustible material to neighbouring areas in the presence of combustible material, air and heat. Various materials differ in their ignition temperatures and fire characteristics. Combustion rate may be slow ; there is slow evolution of heat but not by light, rapid ; rapid evolution of heat accompanied by light , spontaneous absorption of atmospheric oxygen at ordinary temperature.

Elements of Fire

Fuel: combustible material, most fuels have a flash point at which they give up vapours.

Heat or Ignition and temperature: Combining oxygen with fuel vapours releases heat energy which in turn vaporises more fuel
Oxygen (Air): Oxygen combines with flammable vapours at a flash point causing burning.

Initiation of fires requires heat and hot spot, air and flammable material.

Causes of Fires

a. Lapses in Safety management: negligence, carelessness, poor housekeeping, poor wiring, gas leaks
b. Human error: negligence: lack of awareness/ training
c. Accident beyond human control

3.2 General Fire Prevention

Fire is probably the most serious danger which any organisation will ever have to face. It can break out almost anywhere and can affect everyone. "Prevention is better than cure".

Fire Prevention Regular fire prevention routines are one of the simplest and most efficient means of preventing fire. Fire prevention aims at not allowing the combination of the elements of fire.

- Safety documentation for plant/ equipment and for civil/ storage/ installation/ commissioning/ operation/ maintenance phases of the project
- Provision of fire fighting systems (1) permanent (2) portable
- Provisions for fire prevention at the civil design and works stage. Smoke and Carbon –monoxide alarms have been found to be very effective as means of early detection and control thus limiting fires and reducing loss of life and property. Fire doors play an important role in the precautionary system; their purpose is to contain the fire, and to prevent the spread of smoke and toxic gases, which can be lethal even in small quantities.
- Provisions in the electrical design and works- All Electrical work should be carried out by or supervised by certified personnel, avoid overloading electrical equipment, earth all equipment
- Organisation, awareness and training of personnel- The value of the nightly routine of switching off and unplugging electrical equipment (unless the equipment concerned is designed to run continuously cannot be overemphasized). It is essential that the fire alarm system and a pre-arranged plan specific for the evacuation of each building should be tested regularly. Heads of Units must ensure that fire drills are held based upon agreed on intervals following a risk assessment. Where appropriate some staff can undertake the extra duties of Fire Marshals/Officers. These must be specially trained and given specific duties in terms fire hazards or during a fire. Information concerning fire safety should be widely dispersed and staff trained where necessary.
  Ensure signage relating to fire safety such as the Fire Routine procedure, Fire exits, Fire assembly points are conspicuously placed.

- Precautions against fires, Housekeeping and Monitoring- Proper storage and handling of Flammable and explosive materials- liquids or gases, avoid use of inflammable material, develop check list and monitor regularly, Ensure all fire fighting equipment are checked, refilled and/ or serviced when due. More people die through inhaling smoke than through burns. Fire doors must therefore not be propped or wedged open; to prop open a fire door can cost lives if a fire breaks out. The Safety/Fire Officer should routinely assess for fire risks during monitoring.
- First aid facilities
- Insurance coverage during construction and operation

3.3 Fire Control

Fire extinguishing techniques

- Starvation: Removal of fuel
- Smothering: Reducing the amount of oxygen available by dilution or by introducing other inert media.
- Blanketing: Cutting off of fuel vapours mixing with oxygen by applying an external media such as the use of foam. It is valuable in extinction of fires of oils and other flammable liquids.
- Cooling: Reduces the temperature to one at which combustion cannot continue.
- Breaking of branched chain reaction: Dry chemical powder containing halogenated hydrocarbon reacts with the hydrocarbon molecule on fire.

Fire fighting systems

- Fire hydrants: Water systems. May be internal or external. Pump should be independent of other equipment within the premises.
- Portable Fire extinguishers -New extinguishers are 90% red and are distinguished by a colour panel

a. Red: Water. The extinguisher is of limited use can only be used for class A fires of wood, paper or organic material; works by cooling.
b. Green Panel: Foam. Cools and smothers fire. Suitable for Class B fire of fuel or liquid and class A fires. Do not use for electrical fires.
c. Black Panel: Carbon dioxide. Smothers fire. Good general purpose extinguisher. Good for class B fires
d. Blue Panel: Dry Powder. Smothers fire and is a good general purpose fire extinguisher. Useful for class A, class B and class C (flammable gasses).

- Buckets: filled with sand
- Hose reels
- Water spray systems may be high velocity or medium velocity
- Sprinkler systems: used mainly in stores or usually unoccupied buildings
- Foam system

3.4 Fire Routine Procedure

Each Head of Unit must ensure that all members of staff are instructed in the action to be taken should a fire break out. This is most

conveniently done by giving each member of staff written instructions in the form of a Fire Routine Procedure probably in the induction hand book. This Fire Routine procedure should also be placed at very visible sites where even visitor can easily site them. Visitors should be encouraged to view the notices. Staff should be encouraged to commit to memory the standard instructions in the Fire Routine Procedure; there will be no time to read these instructions in an emergency.

3.4.1 On Discovering a Fire

If a fire is discovered' the discoverer should:

- Raise the alarm: Operate the nearest fire alarm. If no fire alarm is provided, shout "Fire".
- Act Swiftly: Leave the building. Ensure that the nearest fire service is informed of the fire. Do not panic
- Do not take risks

Other measures

- Electric power supply and other fuel supplies switched off
- Use of portable fire extinguisher , water or sand for small fires if trained/ able/ allowed
- Activate automatic fire fighting system

3.4.2 On Hearing the Fire Alarm

On hearing the fire alarm, all staff must leave the building immediately by the nearest available exit, closing doors. Lifts must not be used.
It is essential that the means of escape from a building should function efficiently. Exit doors should be fastened so that they can be easily and immediately opened from the inside without the use of keys. Exit routes must not be obstructed or used as storage areas.

In addition, all fire/smoke doors should be closed when buildings are empty.

All personnel are well advised to become familiar with as many as possible of the exit and escape routes from the building in which they normally work.

All Staff should assemble at the Fire Assembly point and a head count taken.

3.5 Fire Fighting

Classes of Fire

Fire Class	Combustion Material involved	Fire extinguishing medium
Class A	Fires involving ordinary solid materials such as wood, coal, plastics, cloth, paper, rags, rubbish, construction and packaging material	Water or solution with high water content. Cooling and wetting of material quenches fire
Class B	Fires involving Flammable liquids/ vapours /solvents: Transformer oil, diesel oil, solvents, liquid, chemicals, lubricating oils, paints/varnishes/thinners, greases, contained, uncontained	Limiting air or oxygen supply, inhibiting fire, Dry chemicals, foam, Halon. Water is unsuitable
Class C	Fires involving live electrical equipment in energized state. If equipment is dead becomes class A or B	CO_2 gas , dry chemicals, water is unsuitable
Class D	Fires involving metals like magnesium, titanium	Normal extinguishing media unsuitable. Special chemicals and techniques used
Class E	Fires involving Flammable gases and fuels, hydrogen, ammonia, acetylene, LPG, petrol, Furnace oil	Starvation of fire is most useful. special methods, close inlet valve

Four types of fire extinguishers should be provided within the premises. The extinguishing media used are: water, carbon dioxide, foam and dry powder. The external appearance of each type of extinguisher is different and each carries its own instructions for use. In some buildings, hose reels are also provided. Fire blankets should be provided in many locations and should be used for smothering fires involving flammable liquids or burning clothing.

All personnel should know the location of the firefighting equipment in their area of work, to know on what type of fire each piece of equipment can be used and how each should be used. This is achieved by training.

Whenever firefighting equipment has been used, an immediate report must be made to the Safety Officer or to the Fire Safety Unit (If there is one) so that the equipment may be recharged or replaced.

In all buildings, particularly residences, protection of human life must take priority over fighting fires. The person discovering a fire must promptly initiate the emergency procedures listed above. Delay can be fatal as, once a fire is out of control, it can spread rapidly and cut off escape routes.

If allowed by the organisation, especially when trained, and without endangering personal safety, attempts can be made to contain and control a fire until the Fire Service arrives. It must be ensured that the correct type of fire extinguisher is used. The wrong choice can turn a minor incident into a major event. The Fire extinguisher is used according to manufacturer's instruction. It must be remembered to take a position between the fire and the exit so that the escape route cannot be cut off., ensure awareness of what is happening in the surrounding area and take account of limitations. The greatest hazards to fire fighters are the effects of asphyxiant, irritant and toxic gases, smoke and fumes generated from the combustion of plastics and other materials. Never attempt to fight a fire wearing a respirator or breathing apparatus. Never fight a Fire without anyone else's knowledge.

After a Fire

Even if a fire appears to have been successfully extinguished by staff, it will still be necessary to ask the Fire Service to check that the fire has not unknowingly spread, and that materials or the building fabric cannot reignite.

Unit heads must ensure that all fires within the building are recorded and reported to the Health and Safety officer or Manager

4.0 CONCLUSION

While Fire prevention is everyone's responsibility, Fire fighting should best be taken on by trained personnel. It would be in the best interest with a high risk for fires as a result of their Production processes to ensure fire training of every member of staff if feasible. Otherwise it is important for all staff m**e**mbers to be conversant with the Fire routine procedures and participate in fire drills.

5.0 SUMMARY

Fire is probably the most serious danger which any organisation will ever have to face. It can break out almost anywhere and can affect everyone. "Prevention is better than cure". Fire Control is achieved using Fire alarms, Smoke and Carbon –monoxide alarms, Fire extinguishers, Fire Doors, Fire Drills and Fire marshals. Ensure every employee is knowledgeable of the Fire Routine Procedure. On

discovery of a fire the discoverer should raise the alarm, act swiftly, do not take risks and do not panic Fire fighting should best be taken on by trained personnel.

SELF-ASSESSMENT EXERCISE

i. ABC Company is a Petrochemical Company situated in Delta State.
ii. List the different types of fires which can occur and identify the extinguishers useful for each type (Note different fires could occur in different departments)

6.0 TUTOR-MARKED ASSIGNMENT

As the safety officer in a printing press, develop the Fire safety segment of the induction manual.

7.0 REFERENCES/FURTHER READING

Jain, R.K. Sunil S.R. *Industrial Safety, Health and Environment Mangement Systems,* Khanna publishers, (2008) New Delhi, India.

www.ed.ac.uk/schools-departments/health-safety

UNIT 3 HEALTH AND SAFETY AUDITS AND MANAGEMENT TOOLS

CONTENTS

1.0 INTRODUCTION

We have already seen the use of audits in the environment. We know that an audit is a systematic, independent and documented process for obtaining "audit evidence", evaluating it objectively to determine the extent to which "audit criteria" are fulfilled. Independent does not mean just external as audits may be internal or external. In this section we shall be reviewing the use of audit in health and safety as a management tool.

2.0 OBJECTIVES

At the end of this unit you should be able to:

- Define Health and Safety Audit
- List the main elements evaluated during a Health and Safety Audit
- Identify the advantages and costs associated with Health and Safety audits
- Outline the steps for carrying out a Health and Safety audit

3.0 MAIN CONTENT

3.1 Definition

Health and Safety Audit is defined ***as the systematic evaluation of performance in health and safety to identify deviations from agreed standards***.

Arrangements to conduct periodic audits should be made in order to determine whether the OH&S management system and its elements are in place, adequate, and effective in protecting the safety and health of workers and preventing incidents.

To do this an audit policy and programme should be developed, which includes a designation of auditor competency, the audit scope, the frequency of audits, audit methodology and reporting.
Types of Audits

a. Walk through audits: Least expensive, evaluates unsafe conditions during construction, security, operation and maintenance
b. Intermediate audits: More detailed study and review of plant design and operations
c. Comprehensive audit: comprehensive consisting of
d. Envelope audit-civil works, electrical, stores, offices, canteens, security lighting e.t.c.
e. Functional audit-Organisational structure, training, responsibility, delegation e.t.c.
f. Safety facility audit-reviews risk

The Comprehensive audit is an evaluation of all of the organization's OH&S management system elements or a subset of these, as appropriate. The audit should cover:

a. HS policy;
b. Worker participation;
c. Responsibility and accountability;
d. Competence and training;
e. OH&S management system documentation;
f. Communication;
g. System planning, development and implementation;
h. Prevention and control measures;
i. Management of change;
j. Emergency prevention, preparedness and response;
k. Procurement;
l. Contracting;

m. Performance monitoring and measurement;
n. n) Investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance;
o. Audit;
p. Management review;
q. Preventive and corrective action;
r. Continual improvement; and
s. Any other audit criteria or elements that may be appropriate.

The audit conclusion should determine whether the implemented OH&S management system elements or a subset of these:

a. Are effective in meeting the organization's HS policy and objectives;
b. Are effective in promoting full worker participation;
c. Respond to the results of HS performance evaluation and previous audits;
d. Enable the organization to achieve compliance with relevant national laws and regulations; and
e. Fulfil the goals of continual improvement and best HS practice.

Audits should be conducted by competent persons internal or external to the organization who are independent of the activity being audited.

3.1.1 Internal audit

The organization shall ensure that internal audits of the OH&S management system are conducted at planned intervals to:

a) determine whether the OH&S management system:
- conforms to planned arrangements for OH&S management
- has been properly implemented and is maintained
- is effective in meeting the organization's policy and objectives;

b) provide information on the results of audits to management.

Audit programmes are 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 and address:

- the responsibilities, competencies, and requirements for planning and conducting audits, reporting results and retaining associated records
- 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.

3.2 Audit Procedure

a. Notification

Once an audit schedule is produced, Health and Safety officer consults with appropriate unit manager / faculty head to agree on the timing of the audits within the schedule.

b. Pre – Audit Meeting

A pre – audit meeting takes place with the unit manager / faculty head approximately 2 weeks before the actual audit. The purpose of this meeting is to

- Provide a general overview of the audit process and method
- Confirm subjects and areas to be audited
- Request material to be provided for the audit e.g. risk assessments or maintenance records
- Collect a copy of the unit / faculty safety plan where relevant
- Indicate other relevant personnel who may be required to assist during the audit process e.g. section leader
- Discuss outstanding issues from previous audits

c. Audit Interview and Verification

The audit itself is a 3-stage process consisting of an initial audit interview with the unit manager / faculty head, verification of the information provided and a final close – off meeting.

- The audit interview will be conducted using the audit questionnaire, which lists a series of questions covering all aspects of health and safety.
- Verification of the answers given will be made by reviewing the documentation requested and a random physical conditions check. This verification inspection also allows the auditors to gain a general view of the health and safety culture which exists in the department/division.

- The close – off meeting allows for the appropriate manager to be provided with a verbal report, highlighting strengths and opportunities for improvement. Corrective action, timescales and responsibilities will be agreed at this stage.

During audits, each performance indicator will be rated as a percentage of full compliance. This rating will be known as the compliance value. Compliance values given for each PI will be based on answers to a set of audit protocols relating specifically to that PI.

Overall compliance value for PI (%) and interpretation.

Compliance value	***Interpretation (all or some of the following may apply)***
0 - 10%	No controls in place. Significant risk to the organisation in terms of personal injury, civil or criminal litigation. Further action required immediately.
10 - 20%	Part controls exist. Risk to the organisation in terms of personal injury, civil or criminal litigation. Further action required within a short time period.
20 - 30%	Controls inadequate. Possible risk of personal injury and civil litigation. Unlikely risk of criminal litigation, but possible risk of improvement notice being served by the enforcing authorities. Further action required within a short time period.
30 - 40%	Controls not used. Possible risk of personal injury and civil litigation. Unlikely risk of criminal litigation, but possible risk of improvement notice being served by the enforcing authorities. Further action required within a medium time period.
40 - 50%	Irregular use of controls. Possible risk of personal injury and civil litigation. Unlikely risk of criminal litigation, and low risk of improvement notice being served by the enforcing authorities. Further action required within a medium time period.
50 - 60%	Additional training/measures required. Not complying with best practice. Possible risk of personal injury and civil litigation. Unlikely risk of criminal litigation, and low risk of improvement notice being served by the enforcing authorities. Further action required within a medium time period.
60 - 70%	Basic legal compliance. Unlikely risk of personal injury and civil litigation. Very unlikely that enforcing authorities would take action. Further action required, but

	should be programmed as part of the continuous improvement process.
70 - 80%	Significant controls. Unlikely risk of personal injury and civil litigation. Highly unlikely that enforcing authorities would take action. Further action required, but should be programmed as part of the continuous improvement process.
80 - 90%	Advanced control.. Unlikely risk of personal injury. If such injury occurred, it is unlikely that civil litigation would succeed. Negligible risk of action from enforcing authorities. Further action required, but should be programmed as part of the continuous improvement process.
90 - 100%	Optimum controls. Highly unlikely risk of personal injury. If such injury occurred, it is unlikely that civil litigation would succeed. If standard is maintained, no risk of action from enforcing authorities. No further action is required other than to maintain the exemplary standard being achieved in health and safety.

d. Audit Report

The audit report (paper copy) will be produced within 2 weeks of the audit taking place and will consist of 3 parts.

Part 1 is the Health and Safety Audit Summary Report which summarises the audit finding and gives the overall audit score as a percentage.

Part 2 is the Non Conformance/Observation Record which details the problems identified in the audit. A non conformance highlights areas where, in the opinion of the auditors, policy and/or health safety legislation/guidance or best practice is not being adhered to in a satisfactory manner. An observation highlights areas where improvements could be made and acts as a guide for future health and safety planning.

In allocating a non conformance or observation, auditors will take into account circumstances where managers have not dealt with health and safety issues arising from policy changes occurring at the time of the audit.

Part 3 is the Corrective Action Record which details the corrective action required, the responsible person and target date for implementation as agreed at the close - off meeting.

The draft audit report will be forwarded to the relevant unit manager / faculty head for an accuracy check before authorisation by the Chief Executive. Copies will be given to the manager concerned, Management and health and safety representatives.

Review Meeting

A review meeting will be held between the auditors and manager between 3 and 6 months after the audit (the timing of this meeting will obviously take into account when the audit took place during term time and college holidays). The purpose of this meeting is to determine the status of the corrective action required, review due dates and offer further assistance if necessary. Managers are requested to complete the Corrective Action Status Record for discussion at this meeting. The form will be copied to the Principal and the Health and Safety Adviser.

3.3 Costs of OH&S Audits

These costs may be direct costs or hidden costs

Direct costs

- Opportunity cost of management and staff time
- Cost of training internal auditors
- Cots of external auditors or verifiers
- Disruption during audit
- Cost of preparation and publishing of audit

Hidden costs

Costs of acting on the audit findings to correct breaches or irregularities.

3.3.1 Benefits of OH&S Audits

- Legal compliance: avoiding the cost of non compliance such as remediation and fines
- Reduced risk exposure, lower insurance premiums. Assured legal compliance, cheaper finance
- Stakeholder appeasement: Stakeholders are well informed and companies benefit from good will
- Improved community relations, improved media coverage, increased staff commitment

4.0 CONCLUSION

OH&S Audits are an essential component of OH&S management systems and ensure that all aspects of the system are efficient and effective. They are thus important in ensuring continuous improvement which is essential in OH&S systems.

5.0 SUMMARY

Health and Safety Audit is defined as the systematic evaluation of performance in health and safety to identify deviations from agreed standards. The audit includes an evaluation of the organization's OH&S management system elements or a subset of these, as appropriate. Audits should be conducted by competent persons internal or external to the organization who are independent of the activity being audited.
The Audit Procedure consists of notification, pre – audit meeting, audit interview and verification, audit report and the review meeting.

SELF-ASSESSMENT EXERCISE

i. Define Health and Safety Audit
ii. List the main elements evaluated during a Health and Safety Audit

6.0 TUTOR-MARKED ASSIGNMENT

As the Safety officer in a printing company in one of the 6 geo-political regions , explain the steps you would take to carry out an internal audit.

7.0 REFERENCES/FURTHER READING

Jain, R.K. Sunil S.R. *Industrial Safety, Health and Environment Mangement Systems*, Khanna publishers, (2008) New Delhi, India.

www.arberdeenshire.gov.uk/index.asp

Procedure number 7:1:10 Revision 2 Health and Safety Audit Cardonald College Glasgow

UNIT 4 HEALTH AND SAFETY PLANS ACCIDENTS: CASE STUDIES

CONTENTS

1.0 INTRODUCTION

Health and safety plan is the framework for preventing personal injuries and deaths. It is the responsibility to set out a policy which serves as a basis for the preparation of the health and safety plans

2.0 OBJECTIVES

At the end of the unit you should be able to:

- List the elements of a health and safety plan
- Use the template provided to prepare a health and safety plan

3.0 MAIN CONTENT

3.1 Outline for preparation of a health and safety plan

If the organisation is managing safety correctly then the creation of a formal safety plan should not entail a great deal of additional work and be merely a “tick-box” exercise, though it will create a more formal way of demonstrating compliance with legal requirements. For those who are essentially starting from scratch and who have very little in place in terms of a safety management system, the outline is a basis for a safety management framework and highlights the main hazards in the workplace that need to be adequately controlled. The plan includes an initial status review of the overall management system and a list of hazards that will be examined to check that adequate control for each of the hazards are in place.

3.1.1 Initial status review

As part of an annual plan, a review of the key safety arrangements should be carried out. This will ensure that systems and procedures are in place to effectively manage health and safety. This review covers

Policy- There is a need to check whether any changes have been made to the Safety Policy, or to draft one if none exists to carry out certain tasks. The initial review is a useful time to check the members of the safe ***Organising*** -To ensure that health and safety is managed effectively a team of people is needed ty team and to ensure that everybody is familiar and happy with their defined responsibilities.The initial status review gives the opportunity to check that adequate communication systems are in place.
Planning-A good idea of hazards existing in the workplace should be known. By using a hazard inventory form that lists common types of hazards in the workplace it is possible to create the more detailed part of the plan to supplement the initial status review. Examples of hazard inventories exist on the safety web pages. A regular annual review is worth conducting as it prompts a check that no new hazards have been introduced in the organization which have not been properly assessed.

Risk assessments need to be carried out. As part of the initial status review high risk activities should have been identified and risk assessments carried out or at least have been given priority when planning the risk assessment programme Organisations should set performance standards for the activities they carry out. As a minimum these should meet legal requirements Dates should be set for regular safety meetings, review sessions with the Head of Department, and times to circulate safety information (e.g. specific topic information). Try and set the sessions in advance so that they become part of the safety plan for the year and everybody is well aware in advance of the dates.

Monitoring-Two safety monitoring and inspection exercises should be done each year at a minimum. Introduce additional inspection/checks particularly if high risk activities are carried out. Spot checks and safety tours can also be carried out as deemed necessary. These can be built into the topics chosen in the second part of the safety plan document.
In previous plans check that any actions or recommendations made as part of the plan are being managed. It is likely that some items of your previous plan may not have been completed. These should be carried over into the next plan and progress monitored. Outstanding actions could include recommendations from accidents, FM maintenance and repair work, outstanding issues from previous inspection exercises, etc.

3.1.2 Core topics

The second part of the plan focuses on key safety topics that need to be assessed as part of the plan. The aim should be to check on the range of hazards across the year to ensure that the arrangements in place to control the risks associated with each topic are robust and appropriate, e.g. when looking at electrical safety and testing you may ask:

- Do you have an inventory of electrical equipment in the organisation?
- Do people tell the safety department when new equipment is purchased?
- Are new pieces of equipment visually checked prior to use?
- Are items clearly marked with test labels?

Ongoing development

The initial status review should be a permanent part of each plan developed. This will ensure that the management framework remains in place and that any changes to safety critical personnel, activities, premises changes etc. are captured and addressed.

The hazard topics listed on the plan will vary depending on the approach taken by the safety department. Once the relevant hazards have been identified some may choose to keep all the hazards listed on the plan and check all the relevant controls each year. This may be possible for smaller organisations. Larger organisations may not be able to do this and may decide to concentrate on their high risk activities one year and then look at lower risk issues the following year. Alternatively, larger organisations may want to look at all the hazards but just concentrate on particular issues each year, e.g. under Control of Substances hazardous to health(COSHH) one year an organisation may look at chemical container labeling; the next year they may check their arrangements for handling of chemical waste and the next year they may review the risk assessments of a few of the high priority activities involving toxic chemicals. Clearly, the more people are involved in monitoring the control measures, the more that can be covered and accomplished in any particular year. Whatever option is chosen, the aim should be to ensure that hazards have been identified, adequate controls have been introduced and that these are being used in a consistent manner.

Thus the essential elements of a health and safety plan are:

- OH&S Policy
- Safety organization at plant level with responsibilities
- Safe procedures for carrying out various activities

- Identification of hazards
- Procedure for obtaining permission to work for operations which may affect safety
- Accident reporting and investigation
- Plans and procedures to achieve objectives and targets set by management
- Feedback system for managerial review at prescribed frequency
- Appointment of competent persons for carrying out inspection, testing, certifying various equipments, structures and environment for carrying out jobs safely.
- Responsibilities of management , safety departments, unions and Staff are spelt out

3.2 Template Health and Safety Plan

This is the Health and Safety Policy Statement of
(name of company)…….
Our statement of general policy is: to provide adequate control of the health and safety risks arising from our work activities; to consult with our employees on matters affecting their health and safety; to provide and maintain safe plant and equipment; to ensure safe handling and use of substances; to provide information, instruction and supervision for employees; to ensure all employees are competent to do their tasks, and to give them adequate training; to prevent accidents and cases of work related ill health; to maintain safe and healthy working conditions; and to review and revise this policy as necessary at regular intervals.
Signed
(Employer)
Date Review date

Responsibilities

1. Overall and final responsibility for health and safety is that of…….....
2. Day- to- Day responsibility for ensuring this policy is put into practice is delegated to

……

3. To ensure health and safety standards are maintained/ improved, the following people have responsibility in the following areas

Name
Responsibility
……..
……..
……
……..
……..
……..

4. All employees have to:

- .Cooperate with supervisors and managers on health and safety matters;
- Not interfere with anything provided to safeguard their health and safety;
- Take reasonable care of their own health and safety; and
- report all health and safety concerns to an appropriate person mentioned inthis policy statement).

Health and safety risks arising from our work activities

1. Risk assessments will be undertaken by…….
2. The findings of the risk assessments will be reported to……
3. Action required to remove/control risks will be approved by…….
4. ……will be responsible for ensuring the action required is implemented.
5. ……. will check that the implemented actions have removed/reduced the risks.
6. Assessments will be reviewed every……or when the work activity changes, whichever is soonest.

Consultation with employees

1. Employee representative(s) are ……
2. Consultation with employees is provided by…….

Safe plant and equipment

1. ……..will be responsible for identifying all equipment/plant needing maintenance.
2. ……..will be responsible for ensuring effective maintenance procedures are drawn up.
3. …… will be responsible for ensuring that a dented maintenance implemented.
   Any problems found with plant/equipment should be reported to……..
4. ……will check that new plant and equipment meets health and safety standards before it is purchased.

Safe handling and use of substances

1. ……..will be responsible for identifying all substances which need a COSHH assessment.
2. ……will be responsible for undertaking COSHH assessments.
3. ……...will be responsible for ensuring that all actions identified in the assessments are implemented.
4. …….will be responsible for ensuring that all relevant employees are informed about the COSHH assessments.
5. …….will check that new substances can be used safely before they are purchased.
6. Assessments be reviewed every……, or when the work activity changes, whichever is soonest.

Information, instruction and supervision

1. The Health and Safety Law poster is displayed at/leaflets are issued by……
2. Health and safety advice is available from…….
3. Supervision of young workers/trainees will be arranged/undertaken/monitored by……
4. ……is responsible for ensuring that our employees working at locations under the control of other employers, are given relevant health and safety information.

Competency for tasks and training

1. Induction training will be provided for all employees by……
2. Job specific training will be provided by……
3. Specific jobs requiring special training are……
4. Training records are kept at/by……
5. Training will be identified, arranged and monitored by……

Accidents, first aid and work related ill health

Health surveillance is required for employees doing the following jobs…….....

Health surveillance will be arranged by……..

Health surveillance records will be kept by/at……
The first aid box(es) is/are kept at……..
The appointed person(s)/first aider(s) is/are……
All accidents and cases of work related ill health are to be recorded in the accident book. The book is kept by/at……
……
……is responsible for reporting accidents, diseases and dangerous occurrences to the enforcing authority

Monitoring

To check our working conditions, and ensure our safe working practices are being followed, we will……
……..
……...is responsible for investigating accidents.
…….is responsible for investigating work related causes of sickness absences.
……...is responsible for acting on investigation findings to prevent a recurrence.

Emergency procedures – fire and evacuation

…….is responsible for ensuring the fire risk assessment is undertaken and implemented.

Escape routes are checked by/every……..
Fire extinguishers are maintained and checked by/every……..
Alarms are tested by/every……
….
Emergency evacuation will be tested every……

Obtained from Health and Safety Executive

3.3 Accident case studies

We have already seen the causes of accidents and have identified health and safety plans as a means of avoiding some of them. None the less here are some accidents resulting in huge costs/ losses with a description of the technical/human failures. The

following case studies were obtained from Health and Safety Executive which keeps records of industrial accidents world-wide.

1. Accident summary Union Carbide India Ltd, Bhopal, India. 3rd December 1984

In the early hours of 3 December 1984 a relief valve on a storage tank containing highly toxic methyl isocyanate (MIC) lifted. A cloud of MIC gas was released which drifted onto nearby housing.

Prior to this, at 23.00 hrs on 2 December, an operator noticed the pressure inside the storage tank to be higher than normal but not outside the working pressure of the tank. At the same time a MIC leak was reported near the vent gas scrubber (VGS). At 00.15hrs a MIC release in the process area was reported. The pressure inside the storage tank was rising rapidly so the operator went outside to the tank. Rumbling sounds were heard from the tank and a screeching noise from the safety valve. Radiated heat could also be felt from the tank.

Attempts were made to switch on the VGS but this was not in operational mode.

Approximately 2,000 people died within a short period and tens of thousands were injured, overwhelming the emergency services. This was further compounded by the fact that the hospitals were unaware as to which gas was involved or what its effects were. The exact numbers of dead and injured are uncertain, as people have continued to die of the effects over a period of years.

The severity of this accident makes it the worst recorded within the chemical industry.

Failings in technical measures:

- The flare system was a critical element within the plant's protection system. However, this fact was not recognised as it was out of commission for some three months prior to the accident.
- Plant Modification / Change Procedures: HAZOP, identification of safety critical elements
- Hazards associated with runaway reactions in a chemical reactor are generally understood. However, such an occurrence within a storage tank had received little research.
- Reaction / Product Testing: laboratory testing

- The ingress of water caused an exothermic reaction with the process fluid. The exact point of ingress is uncertain though poor modification/maintenance practices may have contributed.
- Design Codes - Plant: ingress of unwanted material
- Maintenance Procedures: training and competence levels
- Plant Modification / Change Procedures: Hazard Operating Procedure Analysis (HAZOP)
- The decommissioning of the refrigeration system was one plant modification that contributed to the accident. Without this system the temperature within the tank was higher than the design temperature of 0°C.
- Plant Modification / Change Procedures: HAZOP, decommissioning procedures
- The emergency response from the company to the incident and from the local authority suggests that the emergency plan was ineffective. During the emergency operators hesitated when to use the siren system. No information was available regarding the hazardous nature of MIC and what medical actions should be taken.
- Emergency Response / Spill Control: site emergency plan, emergency operating procedures/training

2. Accident summary Warehouse fire

An automatic fire alarm operated in a warehouse storing various materials including oxidising materials, solvents and various other chemicals in drums. The fire alarm was transmitted to the local fire service. By the time the fire service arrived, flames were shooting through holes in the roof. An explosion then occurred which broke the glass in the site gatehouse.

15 minutes into the incident another explosion occurred in a store holding oxidising materials. This blew out a roller shutter door, which hit the wall of a building about 10m away. This was now a serious fire engulfing both the oxidising materials store and an acid pen area. Drums of solvents were beginning to explode in the intense heat. Some of these exploding drums were propelled several hundred feet into the air.

The fire also spread to the roof of a nearby building on the boundary of the site and after 30 minutes from the alarm being raised another offsite building 30m away was beginning to be endangered. Several explosions then occurred engulfing the front of this second building. A flying, burning solvent drum also crashed through the roof in the main store area, immediately starting another fire. The off-site emergency plan was progressively implemented during the course of the incident.

The Fire Brigade was advised of the broad generic basis of the materials involved in the fire, and a print out of stored materials was obtained. This list was too detailed for the needs of the emergency services. The resulting smoke from the fire contained a cocktail of eleven different chemicals including hydrogen chloride. Approximately 3,000 residents were evacuated from their homes.

Failings in technical measures:

- Lack of chemical segregation in the storage of a vast range of chemicals led to the extremely rapid and violent spread of the fire. Although the specific root cause of the fire has not been identified with a degree of certainty, a number of chemical routes to ignition in the event of spillage or exothermic reaction were present in the oxidising materials store where the fire started. The probable cause was leakage of a corrosive substance onto organic materials.
- Segregation of Hazardous Materials: incompatible substances
- The building was constructed in 1982 in accordance with the building regulations in force at the time. However, later HSE guidance suggests that a more substantial thermal barrier, such as a double brick wall, should have separated the store from the adjacent area containing drums of flammable liquids.
- Design Codes - Buildings / Structures: design of buildings to withstand plant excursions
- The drainage system on-site was adequate and able to cope with firewater run-off. Some minor pollution in the harbour did occur but this produced no obvious acute effects.
- Emergency Response / Spill Control: fire fighting

3. Contractor suffers electric shock after failure to isolate power supply

A self-employed contractor sustained 415-volt electric shock injuries from the bare electrical wires supplying an overhead travelling crane while working from a ‘cherry picker’ installing computer cabling. The defendant company failed to follow their procedures for safe isolation of the power supply to the crane.

Action
The company was prosecuted and fined £15 000.

Failings in technical measures

The Company should have

- carried out a risk assessment of the cabling activity that should have identified the hazard from the electrical wires;
- taken action to warn the contractor of the nearby presence of electrical wires; only allowed work when the power had been turned off

4. Fatal ATV overturn

A 14-year-old child on a work placement scheme with a company operating a commercial shoot was killed when the all-terrain vehicle (ATV) he was riding overturned. He had ridden the ATV into woods on his own to feed pheasants and was later found next to the overturned vehicle on sloping ground. He was not wearing a helmet, although this was not the cause of his death Action

- The company was prosecuted for failing to adequately assess the risks associated with using ATVs and for allowing its gamekeepers to use them without training.
- Magistrates also heard that the tyres on the ATV were inflated to different pressures, which could have made the bike less stable. The company pleaded guilty, was fined £35 000 and ordered to pay £25 000 costs.

Failings in technical measures

The company should have:

- made sure that people using such machines have been properly trained, are capable of remaining in control of the bike at all times, are capable of the task and are supervised;
- used personal protective equipment. Head protection is particularly essential, as is following the manufacturer's safety instructions, which advise specific age limits for different types of machine;
- carried out thorough risk assessment before a child or young person uses any machinery or equipment. Employers and users should be aware also that use of some work equipment by children is specifically prohibited. Even if the risk assessment indicates that the risk is low or can be controlled, adequate instructions and training should be given (appropriate to the physical and emotional maturity of the individual child or young person

4.0 CONCLUSION

Health and Safety plans are initiated by management, prepared by the safety department but require the input of all members of staff to be successful. In our case review we have seen that effective and efficient implementation of the health and safety plan may have ensured the avoidance of most of these accidents.

5.0 SUMMARY

Health and safety plan is the framework for preventing personal injuries and deaths. The plan includes an initial status review(Policy, Organising, Planning and Monitoring*)* of the overall management system and a list of hazards that will be examined to check that adequate control for each of the hazards are in place. Essential elements of a health and safety plan include the OH&S Policy, Safety organization at plant level with responsibilities, safe procedures for carrying out various activities and identification of hazards.

SELF-ASSESSMENT EXERCISE

i. List the elements of the OH&S plan.
ii. Explain the importance of two of these elements in the OH &S plan

6.0 TUTOR-MARKED ASSIGNMENT

As the safety officer of the company with the ware house fire use the safety template to write an OH&S plan that could have ensured avoiding the fire. (Ensure all the technical problems sited are covered).

7.0 REFERENCES/FURTHER READING

Accidents case studies http://www.hse.gov.uk/comah/stagtech/casesstudyind.htm

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P Lees, 'Loss prevention in the process industries – Hazard identification, assessment and control', Volume 3, Appendix 5, Butterworth Heinemann, London Jain, R.K. Sunil S.R.(2008) *Industrial Safety, Health and Environment Management Systems*, New Delhi, Khanna Publishers.