Prevention & Control

Victor Hoe Chee Wai
MBBS, MPH (Malaya), MPH (Occupational Health) (Malaya), CMIA, OHD, CHRA
Lecturer
Occupational and Environmental Health Unit
Department of Social and Preventive Medicine

Objective

- To understand the
  - Principles of Prevention and Control methods
  - Personal Protective Equipment (PPE)
  - Emergency preparedness
  - Occupational Safety and
  - Accident Prevention at work

Content

- Principle of Prevention and Control
- Personal Protective Equipment (PPE)
  - Types of PPE
  - Respiratory Protection
- Emergency Preparedness
- Occupational Safety and
- Accident Prevention

Principle Prevention and Control

- Hazard Identification
- Exposure Assessment
- Risk Characterization
- Risk Matrix
- Control of hazards

What is Hazard?

- Source of potential harm

Anticipation of Hazards

- Anticipate potentially hazardous situations before they actually occur so that they can be prevented/avoided

Hazard Identification Methods

- Specialised techniques to identify hazards in the planning and design stage
  - HAZOP
    - HAZard and OPerability studies
  - FMEA
    - Failure Mode and Effect Analysis
  - HIRAC
    - Hazard Identification Risk Assessment Control

- Methods used to identify workplace hazards
  - Accident and sickness statistics
  - Investigations of accidents, sickness, complaints and near-miss.
  - Inspections,
  - Checklist,
  - Surveys,
  - Audits

Type of Hazards

- Chemicals
  - Dusts, fume, gases
- Physical
  - Noise, vibration, cuts, needle stick injury
- Biological
  - Viruses, bacteria, fungi
- Ergonomics
  - Overexertion, repetitive mechanical action
- Psychosocial
  - work demand, lack of support

Hazard rating

- FATALITY
  - results in death
- MAJOR
  - permanent disability or permanent health effect
- MINOR
  - limited and reversible health effects or damage
- NEGLIGIBLE
  - not causing disability

What is exposure?

- The time of contact with the substance

Exposure rating

- Very Likely
  - Exposure are excessive
- Likely
  - Exposure are not adequately controlled.
- Unlikely
  - Exposure are controlled and likely to remain so .
- Highly Unlikely
  - Exposure is negligible

What is Risk?

- likelihood of harm or undesired event occurring, and
- the consequences of its occurrence

Risk = Hazard X Exposure

Consequence Likelihood

Risk Assessment

- Is the overall process of estimating the magnitude of risk, and deciding whether or not the risk is tolerable or acceptable, taking into account any measures already in place

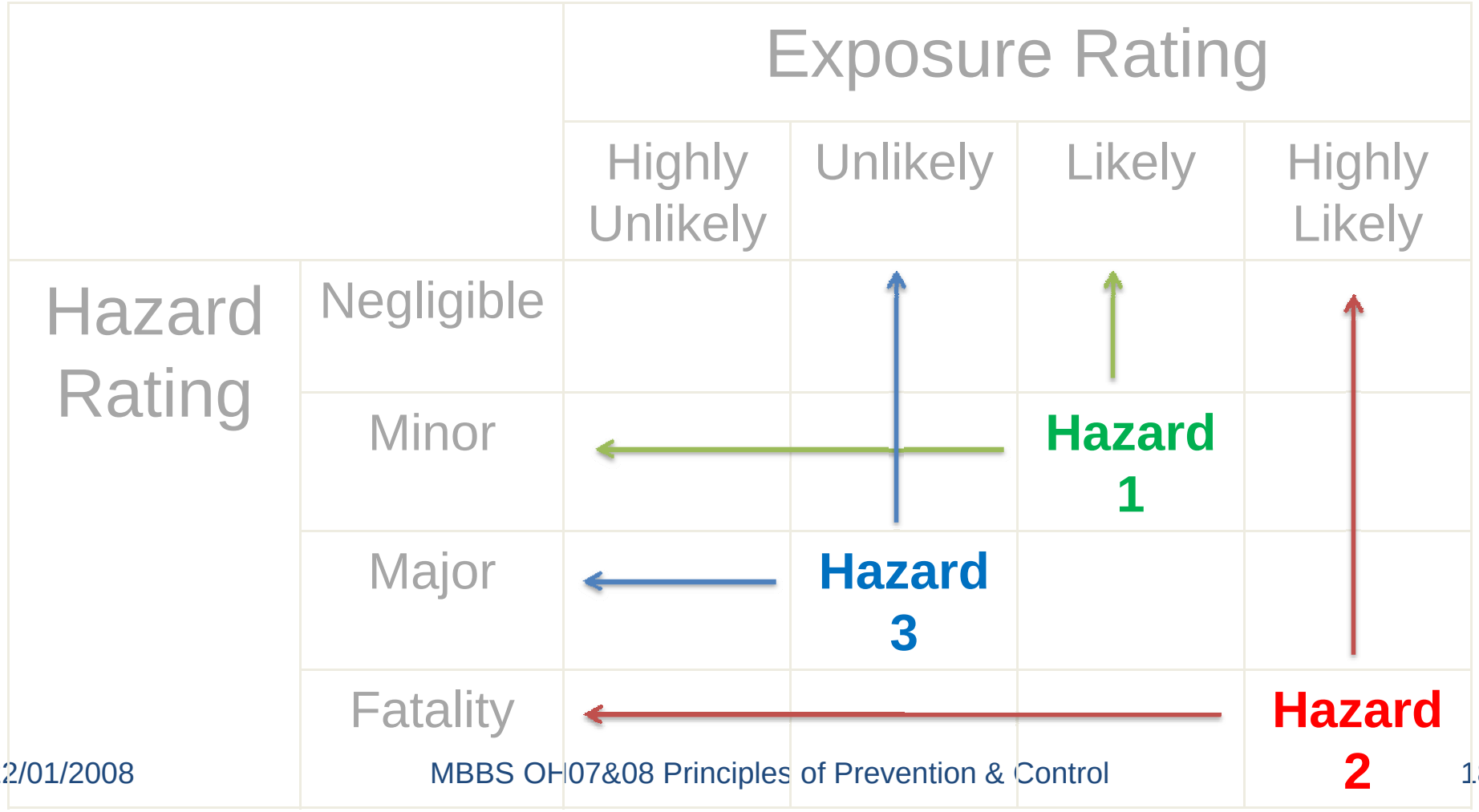
Risk Characterisation

- To integrate and summarise the hazard identification and exposure assessment in order to:
  - Develop a numerical risk estimate for the hazards assessed (Risk rating)
  - Present assumptions, uncertainties, and scientific judgement pertaining to the hazards assessed
  - Define significance of estimated risk

Risk Matrix

		Exposure Rating			
		Highly Unlikely	Unlikely	Likely	Highly Likely
Hazard Rating	Negligible	**Low**	**Low**	**Medium**	**Medium**
	Minor	**Low**	**Medium**	**Medium**	**High**
	Major	**Medium**	**Medium**	**High**	**High**
	Fatality	**Medium**	**High**	**High**	**High**

Risk Matrix



Hierarchy of controls

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal Protective Equipment (PPE)

Elimination

- The toxic substance which pose a hazard to the workers and/or the community should not be introduced or should be removed (eliminate).
  - Prohibit the use of
    - Asbestos containing materials,
    - Lead in petrol
    - Mercury in batteries

Substitution

- If the toxic substance that pose a danger to the workers and/or the community could not be removed then a less hazard (toxic?) substance should be introduced instead. (substitution)
  - Asbestos fibres with synthetic fibres
  - Lead is replace with other additives

Engineering Controls

- If the toxic there is no substitute for the toxic substance or it is too expensive then Engineering Controls should be introduced
  - Radioactive materials –
    - Uranium in reactors
    - X-ray

Administrative Controls

- If the engineering control could not adequately control the exposure to the toxic substance then the administration should introduce control measure to limit the exposure of the workers.

PPE

- This is the last resort for the control of exposure to the toxic substances, it should be used only when,
  - Effective work practices and/or engineering controls are not feasible to achieve the permissible exposure limit (PEL),
  - Controls are being instituted, and
  - During emergencies

Example of Engineering Controls

- Enclose work processes
  - Close-loop process system
- Confining/Isolation work operations
- Use mechanical assists
  - Pumps to transfer chemicals
- Guards
  - Mechanical
  - Electronic
- Ventilation systems

Ventilation Systems

- Purpose
  - Supply adequate oxygen
  - Prevent build up of airborne hazards
  - Maintain comfortable environment
    - Heat
    - Humidity

Types

- General Dilution ventilation
- Local exhaust ventilation (LEV)

General Dilution Ventilation

- Principle: Adds or remove air from work area by
  - Natural convection/Mechanical
  - Conditioning of air
    - Cooling or
    - Heating

Useful under the following conditions:

- Small quantity of airborne hazard
- Hazards released at uniform rate
- Sufficient distance between worker and source of hazard
- Hazards of low toxicity
- No need to filter before discharge into atmosphere
  - Non-toxic to the environment (DOE)

Components

- Fan
- Ducts
- Inlet-outlet,
- Heating/cooling,
- Filtration

Advantages

- Easy to install
  - No need qualified person to design
- Easy to operate
- Low maintenance
  - No need regular monitoring

Disadvantages

- Difficult to control exposure at source
- Large volumes of air moved
  - Cannot be used with highly toxic substances
  - The toxic substance will be spread all over the production area
- Can be costly - electricity

Local Exhaust Ventilation (LEV)

- Principles
  - Enclose source as much as possible
  - Captures contaminants close to source
  - Air withdrawn at high speed
  - Removal near 100% if the design of the LEV is properly done

Components

- Hood
- Fans
- Ducts
- Air cleaner

Hoods

UNIVERSITY OF MALAYA
KUALA LUMPUR

Duct

Motor & Fan

Air Cleaner

Advantages

- Requires less air flow
- Contaminant not spread all over workplace
- Can be very effective if design properly
- Can recover reusable materials

Disadvantages

- Difficult to design
  - Must be done by a trained Engineer
- Only effective close to source
- Expensive to maintain
  - Needs constant/regular inspection for full effectiveness
  - Need to be conducted by competent person

Administrative Controls

- Procedures that minimize exposures while operating production and control equipment
- Modification of work processes
  - Bottom loading Rack (to minimize Benzene Exposure)
- Controlling employees' exposure by scheduling production and workers' tasks, or both, in ways that minimize exposure levels
  - Conducting hazardous procedure during time where there are less workers.
  - Rotation of Role/Job to minimize boredom

SOP – standard operating procedure

- Stringent inspection and maintenance
- Good house-keeping procedures
- Close supervision
- Mandating that eating, drinking, smoking, chewing tobacco or gum, and applying cosmetics in regulated areas be prohibited
- Encouraging good hygiene

Personal Protective Equipment (PPE)

PPE

- Equipment and/or clothing that is worn to protect workers against or to minimize workplace risks.
- It should be the **LAST OPTION** when all other control measure could not reduce the hazard to below PEL or during Emergency

Why PPE Not Method of Choice

- The use of PPE does not reduce the hazard at the source
- If the PPE fails and the failure is not detected, the risk increases significantly.

- People may fail to wear PPE, particularly for that “one off, quick job” and take the attitude “it’ll be right”.
- People believe that they are **“SAFE”** when wearing PPE and may place themselves at a higher risk.
  - *(False sense of security)*

Important Note:

- Choosing PPE as the first option inappropriately shifts the responsibility from the employer to the employee.

Types of PPE

- Head protection
- Eye protection
- Face protection
- Hearing protection
- Protective clothing
- Hand protection
- Foot protection
- Respiratory protection

How to Select PPE

- Familiarize themselves with the potential hazards and the availability of PPE.
- Understand the criteria for selecting appropriate PPE that provides adequate level of protection against the risk present.

- Evaluate the selected PPE to ensure it
  - Fits properly,
  - Used appropriately, and
  - Does not create secondary health or safety risk.
- Environmental factor should also be taken into consideration
  - Heat
  - Humidity

Eye and Face PPE

Hazard Type	Hazard Type	Common related tasks
Impact	Flying objects such as large chips, fragments, particles, sand, and dirt.	Chipping, grinding, machining, masonry work, wood working, sawing, drilling, riveting, sanding, etc.
Heat	Anything emitting extreme heat.	Furnace operations, pouring, casting, hot dipping, welding, etc.
Chemicals	Splash, fumes, vapors, and irritating mists.	Acid and chemical handling, degreasing, plating, and working with blood.
Dust	Harmful dust.	Woodworking, buffing, and general dusty conditions.
Optical Radiation	Radiant energy, glare, and intense light	Welding, torch-cutting, -brazing, -soldering, and laser work.

Hearing PPE

Corded Reusable
Ear Plugs With Storage
NRR 25 dB

Disposable Ear Plugs
NRR 29 dB

General Purpose
Ear Muffs
NRR 23 dB

Derating the NRR by 50% before estimating workplace protection
NRR – Noise Reduction Rating

Hand PPE

- Acid – Acetic, Citric, Phosphoric, HCL
  - Butyl Rubber
- Caustic – Sodium Hydroxide
  - Neoprene
- Crude Oil
  - Nitrile or Neoprene
- Diesel, Heating Oil and Lubrication
  - Nitrile Rubber

Respiratory PPE

- Protection against
  - Particulates
  - Vapour
  - Mist
  - Gases
  - Oxygen deficiency

Operating principle

- Purified Air
- Supplied Air

Air Purifying Respirators

- Particulates
  - Filters
- Gas / Vapour
  - Canister
  - Cartridge
- Powered
- Non-powered

- N – Non oil resistance
  - If no oil particles are present in the work environment, use a filter of any series (i.e., N-, R-, or P-series).
- R – Resistance to oil
  - If oil particles (e.g., lubricants, cutting fluids, glycerine, etc.) are present, use an R- or P-series filter. Note: N-series filters cannot be used if oil particles are present.
- P – Oil Proof
  - If oil particles are present and the filter is to be used for more than one work shift, use only a P-series filter.

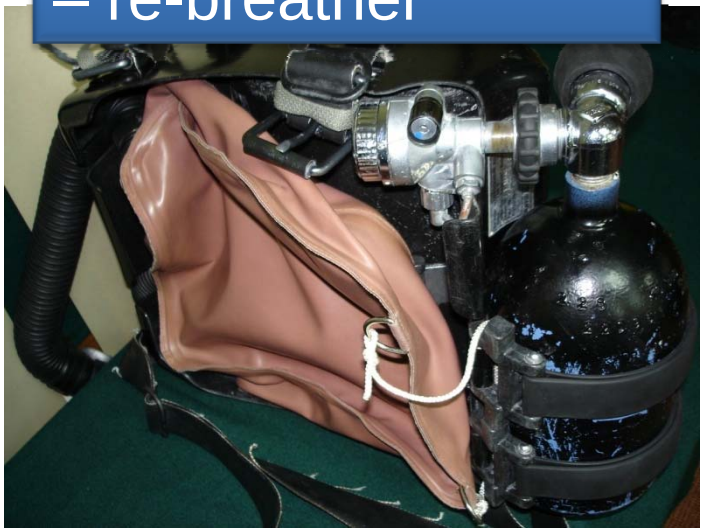
Supplied Air Respirator

- Air hose/Air line
- Self Contained Breathing Apparatus (SCBA)
  - Positive / negative pressure in face piece
  - Demand and continuous flow
  - Contain compress air
- Used where there is lack of oxygen or during an emergency

- SCBA – Self Contain Breathing Apparatus
  - Use in cases of emergency
  - Contain compress air

- SCUBA – Self Contain Underwater Breathing Apparatus
  - Use in diving – commercial and recreational
  - Most of the time contain compress air
  - For deeper dive where there is posibility of Oxygen and Nitrogen Narcosis - uses of other gas mixture – e.g. Oxygen and Helium
  - Can also contain pure oxygen for military use

contain pure oxygen – re-breather



Use of PPE

- Select the RIGHT PPE for the type of Hazard
- Fit Test to ensure proper fitting
- Medical Check-up
- Training
- Fit Check before each usage
- Storage/Discard

UNIVERSITY OF MALAYA
KUALA LUMPUR

Selection of Respiratory PPE

Respiratory Hazard	Dust Mask	Half Face	Full Face	Supplied Air
Asbestos		HEPA		
NORM		HEPA		
Benzene		OV		
Chlorine				X
H2S				X
Lead		HEPA	HEPA	X
Metal Fumes		FUME		X
Non-Asbestos	X	Dust		
Silica		HEPA		

Example of Recommendation of PPE

- Substance: Ethylene Oxide
- Up to 5 ppm:
  - (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern or
  - (APF = 50) Any self-contained breathing apparatus with a full facepiece or
  - (APF = 50) Any supplied-air respirator with a full facepiece
- **APF** – Assigned Protection Factors

- Emergency or planned entry into unknown concentrations or **IDLH** conditions:
  - (APF = 10,000) Any self-contained breathing apparatus (SBCA) that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or
  - (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

- Escape:
  - (APF = 50) Any air-purifying, full-face piece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern or
  - Any appropriate escape-type, self-contained breathing apparatus (SBCA)

Fit Test

- It is a process where the PPE, esp. respiratory PPE are subjected tested for proper fit with different individual before it is allocated to that individual
- Proper fit – there is no leakage of air

Fit Check

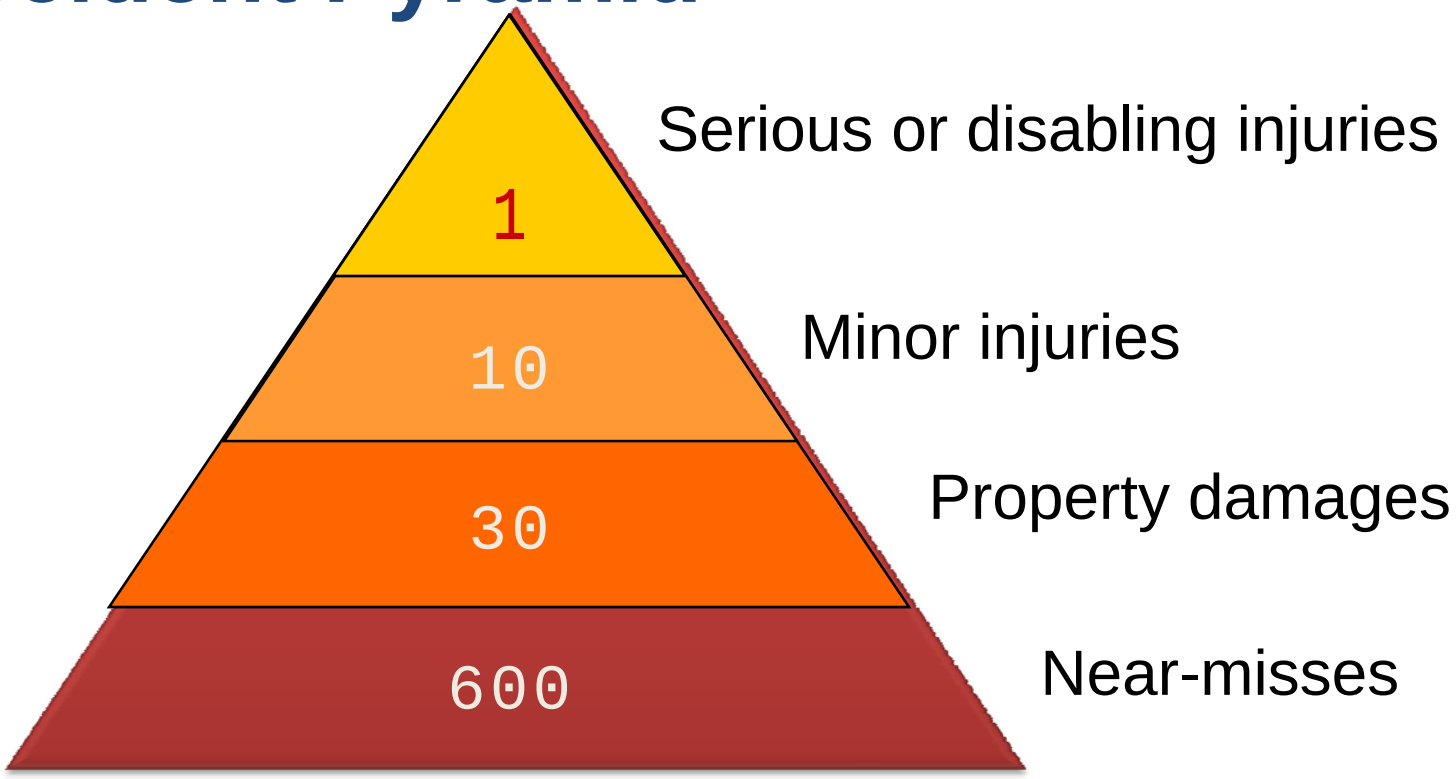
- It is a process during each use of the PPE, esp. respiratory PPE to check for proper fit
  - Positive pressure check
  - Negative pressure check

Occupational Safety & Accident Prevention

Definition

- Accidents
  - Unplanned event that interrupts the completion of an activity, and that may (or may not) include injury or property damage

Accident Pyramid



Source: Bird, F.E. et al. Practical Loss Control Leadership. Loganville, Georgia: Institute Publishing, 1989

- What are near misses?
  - Near misses are condition or situation when not correct will lead to accident
  - When we control or eliminate near misses it will reduce in the number of fatal accidents.
    - When you see a piece of banana skin on the floor you should remove it. The banana skin is a near miss, as if you have step on it you will fall.
    - The same goes for speeding – if you are speeding but was not involve in an accident, speeding is a near miss

Accident Causation

- Material
- Environment
- Task
- Management
- Personnel

Causes of accidents

- Unsafe Acts and Omissions
  - Inappropriate attitudes
  - Inappropriate knowledge
  - Inadequate skills
  - Inadequate supervision
  - Failure to do “something”
- Example
  - Not using PPE
  - Bypassing safety interlocks
  - Running on stairways
  - Recapping of needle
  - Inadequate job design
  - Awkward postures

Causes of Accident

- Unsafe Conditions
  - Materials,
  - Tools,
  - Workstation
  - Procedure,
  - Organisation,
  - Environment
- Example
  - Slippery floor
  - Missing machine guards
  - Poor workstation design
  - Overflowing containers
  - Cluttered hallways
  - Poor house keeping
  - Poor lighting

What is Occupational Safety?

- Control of accidental losses related to work activity
- Use professional management skills to reduce or eliminate all possible non-speculative risks in the operations
- Proactive approach – safety measures applied before accidents occur

Objectives of Accident Prevention

- Make work Environment safe
- Make the Job safe
- Make all workers Safety Conscious

Make work Environment Safe

- Workplace itself
  - Lighting, ventilation, electrical wiring, housekeeping
- Process
  - SOP, permit-to-work
- Equipment
  - Guarding, maintenance
- Materials used

Make the Job Safe

- Conduct Job Safety Analysis (JSA)
- Established Safe Operating Procedures
- Conduct Training

Make All Workers Safety Conscious

- Unsafe practices eliminated
- Safety training
  - Develop right attitudes
  - Doing things the right way
  - Keep equipment in good conditions
  - Use PPE and equipment correctly
- Supervision

Steps in Emergency Preparedness

- Anticipation of Emergency
- Emergency Procedures
  - How to account for all
  - Rescue and medical duties
  - Communication
- Training
- Drill

Anticipation of Emergency

- Internal Emergency
- External Emergency

Internal Emergency

- Identification and classification of hazards
  - Very Toxic Substances
  - Other Toxic Substances
  - Flammable substances
    - Flammable Gasses
    - Highly Flammable Liquids
    - Flammable Liquids
  - Explosive Substances
  - Oxidising Substances

Example

- Fire/Explosion
- Chemical spill/leak
- Violence – Amok
- Medical – CVA
- Bomb threat

External Emergencies

- Example
  - Floods
  - Earthquake
  - Landslides
  - Power failure
  - Fire/Explosion near the plan

For Hospital/Health Setting

- Anticipation of external emergency is relevant for the planning and the preparedness of the hospital/health services to response to such emergency
- Example
  - Major vehicle accidents
  - Infectious Disease outbreak
  - Floods
  - Terrorist Attack

Emergency Procedure

- It is a written procedure to be carried out during an emergency
  - Who can authorise an emergency evacuation?
  - Who can raise/trigger the alert?
  - Established escape routes
  - Who Operate to critical operations?
  - Who to conduct emergency shutdown?
  - Informing relevant authorities.

How to account for all?

- Employee accountability procedures
  - Supervisor's responsible to ensure all employees report to a predetermined designated assembly area
- Visitors accountability
  - The Security Personnel are usually in charge
  - Visitors should also know where to assemble
  - All visitors should registered with the security

Rescue and medical duties

- Specific rescue and medical duties assigned to designated personnel who are trained for the specific purpose.
- Usually each unit will have one designated personnel.
- Untrained personnel should not be involved in rescue operation as it will endanger the person's life.

Communication System

- Emergency Response Communication
  - Radio
  - Intercom
  - Telephone
- Types of alarm system
  - Visual Alarm
  - Audible Alarm

Training

- Special training to ensure safety in carrying out designated duties
  - Escape routes
  - First Aid
  - Emergency Rescue
- When to do training?
  - Plan/facilities initiated
  - Responsibilities changed
  - New employees hired/transferred

Drill

- Emergency response drill should be carried out at least once a year with the cooperation from Fire-Brigade
  - to familiarise the employees with the and
  - to test the emergency procedures.
- Some high risk operation may need to have drill more than once a year