Guidelines

for Hazard Identification, Risk Assessment and Risk Control (HIRARC)

Department of Occupational Safety and Health
Ministry of Human Resources
Malaysia

2008

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Preface

In recent years, Hazard Identification, Risk Assessment and Risk Control (HIRARC) has become fundamental to the practice of planning, management and the operation of a business as a basic of risk management. The organizations that have carried out risk assessment at the work place have noted numerous changes in their working practice. Those who have already carried out risk assessment in their work, have reported positive changes in their working practice, they recognize substandard act and working condition as they develop and take necessary corrective action. Legislation requires that this process should be systematic and be recorded so that the results are reliable and the analysis complete. The risk assessment process should be continuous and should not be regarded as a one-off exercise.

In line with the Department approach of PREVENTIVE MEASURES as a way of enforcing the law on Occupational Safety and Health (OSH), it seems that HIRARC has became extremely important. With HIRARC, one will be able to identify hazard, analyze and assess its associated risk and then apply the suitable control measures

This Guideline is supposed to provide guidance on methodology of conducting HIRARC, it should be simple enough to be used by small and medium industries and should be versatile enough to be used by all in various economic sectors, either in the manufacturing sector, construction sectors or any other economic sectors.

The methodology of HIRARC as proposed in this Guidelines is intended for the assessment of physical hazards. Those who intend to assess health hazards in their workplaces, should make use of other risk assessment guidelines designed specifically for such purposes.

The Department would like to thank all the staff from Major Hazard Division for their effort and contribution in the preparation of this guideline.

Director General
Department of Occupational Safety and Health,
Malaysia

2008

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1.0 Purpose

The purpose of this guideline is to provide a systematic and objective approach to assessing hazards and their associated risks that will provide an objective measure of an identified hazard as well as provide a method to control the risk. It is one of the general duties as prescribed under the Occupational Safety and Health Act 1994 (Act 514) for the employer to provide a safe workplaces to their employees and other related person.

2.0 Term And Definitions

Hazard means a source or a situation with a potential for harm in terms of human injury or ill health, damage to property, damage to the environment or a combination of these.

Hazard control means the process of implementing measures to reduce the risk associated with a hazard.

Hierarchy of control means the established priority order for the types of measures to be used to control risks.

Hazard identification means the identification of undesired events that lead to the materialisation of the hazard and the mechanism by which those undesired events could occur.

Risk means a combination of the likelihood of an occurrence of a hazardous event with specified period or in specified circumstances and the severity of injury or damage to the health of people, property, environment or any combination of these caused by the event.

Risk assessment means the process of evaluating the risks to safety and health arising from hazards at work.

Risk management means the total procedure associated with identifying a hazard, assessing the risk, putting in place control measures, and reviewing the outcomes.

3.0 Basic Concepts

3.1 What is risk?

Risk is something that we as individuals live with on a day-to-day basis. People are constantly making decisions based on risk. Simple decision in daily life such as driving, crossing the road and money investment all imply an acceptance risk. Risk is the combination of the likelihood and severity of a specified hazardous event occurring. In mathematical term, risk can be calculated by the equation -

Risk = Likelihood x Severity

Where,

Likelihood is an event likely to occur within the specific period or in specified circumstances and,

Severity is outcome from an event such as severity of injury or health of people, or damage to property, or insult to environment, or any combination of those caused by the event.

4.0 Planning And Conducting Of HIRARC

4.1 Purpose of HIRARC

The purpose of HIRARC are as follows:-

a. to identify all the factors that may cause harm to employees and others (the hazards);

b. to consider what the chances are of that harm actually be falling anyone in the circumstances of a particular case and the possible severity that could come from it (the risks); and

c. to enable employers to plan, introduce and monitor preventive measures to ensure that the risks are adequately controlled at all times.

4.2 Planning of HIRARC Activities

HIRARC activities shall be plan and conducted –

a. for situation –

   i. where hazard appear to pose significant threat;
   ii. uncertain whether existing controls are adequate; or/and
   iii. before implementing corrective or preventive measures.

b. by organization intending to continuously improve OSH Management System.

It should be the duty of the employer to assign a trained personnel to lead a team of employees associated with one particular process or activity to conduct HIRARC.

4.3 Process of HIRARC

Process of HIRARC requires 4 simple steps -

a. classify work activities;

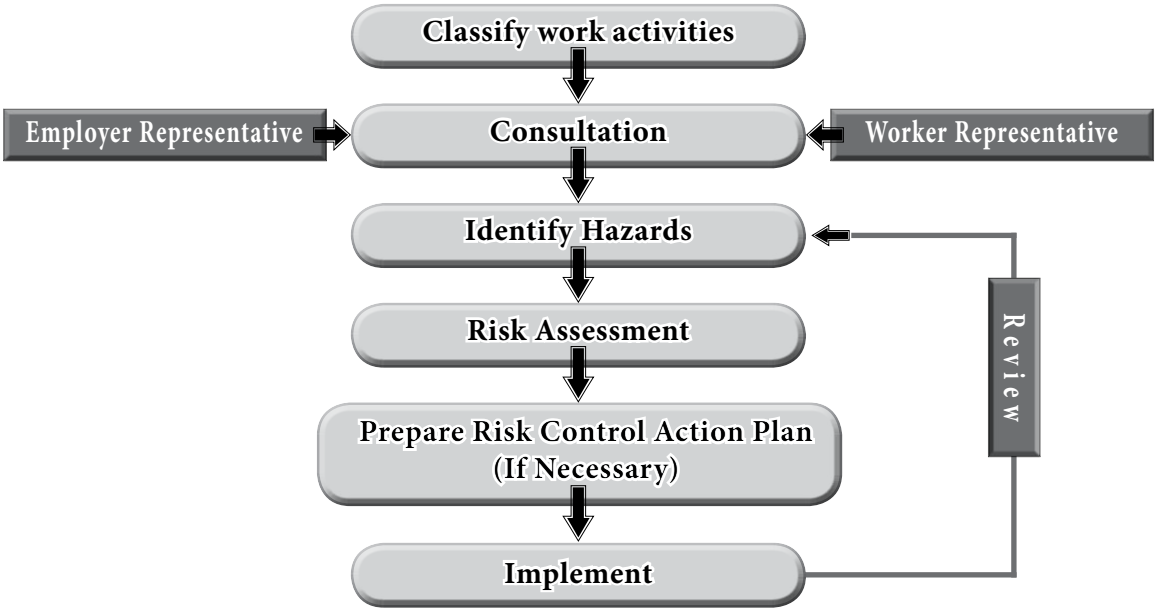
b. identify hazard;

c. conduct risk assessment (analyze and estimate risk from each hazard), by calculating or estimating -

   i. likelihood of occurrence, and
   ii. severity of hazard;

d. decide if risk is tolerable and apply control measures (if necessary).

Flowchart of HIRARC Process



4.3.1 Classify work activities

Classify work activities in accordance with their similarity, such as -

i. geographical or physical areas within/outside premises;
ii. stages in production/service process;
iii. not too big e.g. building a car;
iv. not too small e.g. fixing a nut; or
v. defined task e.g. loading, packing, mixing, fixing the door.

4.3.2 Hazard identification

The purpose of hazard identification is to highlight the critical operations of tasks, that is, those tasks posing significant risks to the health and safety of employees as well as highlighting those hazards pertaining to certain equipment due to energy sources, working conditions or activities performed. Hazards can be divided into three main groups, health hazards, safety hazards, and environmental hazards.

4.3.2.1 Health hazards

An occupational health hazard is any agent that can cause illness to an individual. A health hazard may produce serious and immediate (acute) affects, or may cause long-term (chronic) problems. All or part of the body may be affected. Someone with an occupational illness may not recognize the symptoms immediately. For example, noise-induced hearing loss is often difficult for the affected individual to detect until it is well advanced. Health

hazards include chemicals (such as battery acid and solvents), biological hazards (such as bacteria, viruses, dusts and molds), physical agents (energy sources strong enough to harm the body, such as electric currents, heat, light, vibration, noise and radiation) and work design (ergonomic) hazards.

4.3.2.2 Safety hazards

A safety hazard is any force strong enough to cause injury, or damage to property. An injury caused by a safety hazard is usually obvious. For example, a worker may be badly cut. Safety hazards cause harm when workplace controls are not adequate.

Some examples of safety hazards include, but are not limited to -

i. slipping/tripping hazards (such as wires run across floors);
ii. fire hazards (from flammable materials);
iii. moving parts of machinery, tools and equipment (such as pinch and nip points);
iv. work at height (such as work done on scaffolds);
v. ejection of material (such as from molding);
vi. pressure systems (such as steam boilers and pipes);
vii. vehicles (such as forklifts and trucks);
viii. lifting and other manual handling operations; and
ix. working alone.

4.3.2.3 Environmental hazards

An environmental hazard is a release to the environment that may cause harm or deleterious effects. An environmental release may not be obvious. For example, a worker who drains a glycol system and releases the liquid to a storm sewer may not be aware, of the effect on the environment. Environmental hazards cause harm when controls and work procedures are not followed.

4.3.2.4 Hazard identification technique

The employer shall develop a hazard identification and assessment methodology taking into account the following documents and information -

i. any hazardous occurrence investigation reports;
ii. first aid records and minor injury records;
iii. work place health protection programs;
iv. any results of work place inspections;
v. any employee complaints and comments;
vi. any government or employer reports, studies and tests concerning the health and safety of employees;
vii. any reports made under the regulation of Occupational Safety and Health Act,1994
viii. the record of hazardous substances; and
ix. any other relevant information.

4.3.2.5 The hazard identification and assessment methodology

The hazard identification and assessment methodology shall include -

a. Steps and time frame for identifying and assessing the hazards.

   One must define the steps for the identification of hazards and a time frame for this identification. The following information should be included -

   i. who will be responsible for the identification: for example, it may be the work place health and safety committee, or an individual or individuals appointed by the committee;
   ii. the way in which the identification reports are processed: for example, they may be compiled and processed by the commit tee, or by individuals appointed by the committee; and
   iii. the identification time frame: for example, the identification of hazards for workshop A must be completed in December, for workshop B in April and for workshop C in November.

b. The keeping of a record of the hazards.

   After having identified the hazards, one must establish and maintain an identification record, either in print or electronic format.

c. A time frame for reviewing and, if necessary, revising the methodology.

The date for the review of the identification: for example, the review of the identification method will be carried out every three years.

To complete hazard identification, one can use techniques to identify hazards. Some examples of techniques include, but are not limited to -

i. work place inspections;
ii. task safety analysis or job hazard analysis;
iii. preliminary investigations;
iv. potential accident factors;
v. failure analysis;
vi. accident and incident investigations.

It is in your interest to adopt your own process and your own identification techniques so that they match oner management procedures and the size of business. In fact, the identification method may vary depending on the size of the work place.

4.3.3 Analyze and estimate risk

Risk is the determination of likelihood and severity of the credible accident/event sequences in order to determine magnitude and to priorities identified hazards. It can be done by qualitative, quantitative or semi quantitative method.

A qualitative analysis uses words to describe the magnitude of potential severity and the likelihood that those severity will occur. These scales can be adapted or adjusted to suit the circumstances and different descriptions may be used for different risks. This method uses expert knowledge and experience to determine likelihood and severity category.

In semi-quantitative analysis, qualitative scales such as those described above are given values. The objective is to produce a more expanded ranking scale than is usually achieved in qualitative analysis, not to suggest realistic values for risk such as is attempted in quantitative analysis.

Quantitative analysis uses numerical values (rather than the descriptive scales used in qualitative and semi-quantitative analysis) for both severity and likelihood using data from a variety of sources such as past accident experience and from scientific research. Severity may be determined by modeling the outcomes of an event or set of events, or by extrapolation from experimental studies or past data. Severity may be expressed in terms of monetary, technical or human impact criteria, or any of the other criteria. The way in which severity and likelihood are expressed and the ways in which they are combined to provide a level of risk will vary according to the type of risk and the purpose for which the risk assessment output is to be used.

In this guidelines qualitative and semi quantitative method uses as an example.

4.3.3.1 Likelihood of an occurrence

This value is based on the likelihood of an event occurring. You may ask the question "How many times has this event happened in the past?" Assessing likelihood is based worker experience, analysis or measurement. Likelihood levels range from "most likely" to "inconceivable." For example, a small spill of bleach from a container when filling a spray bottle is most likely to occur during every shift. Alternatively, a leak of diesel fuel from a secure holding tank may be less probable.

Table A indicates likelihood using the following values -

LIKELIHOOD (L)	EXAMPLE	RATING
Most likely	The most likely result of the hazard / event being realized	5
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at sometime in future	3
Remote	Has not been known to occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

Table A

4.3.3.2 Severity of hazard

Severity can be divided into five categories. Severity are based upon an increasing level of severity to an individual's health, the environment, or to property. Table B indicates severity by using the following table:

SEVERITY (S)	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid type injury	1

Table B

4.3.3.3 Risk assessment

Risk can be presented in variety of ways to communicate the results of analysis to make decision on risk control. For risk analysis that uses likelihood and severity in qualitative method, presenting result in a risk matrix is a very effective way of communicating the distribution of the risk throughout a plant and area in a workplace.

Risk can be calculated using the following formula:

L x S = Relative **Risk**

L = Likelihood

S = Severity

An example of risk matrix (Table C) is shown below:

	Severity (S)				
Likelihood (L)	1	2	3	4	5
5	**5**	**10**	**15**	**20**	**25**
4	**4**	**8**	**12**	**16**	**20**
3	**3**	**6**	**9**	**12**	**15**
2	**2**	**4**	**6**	**8**	**10**
1	**1**	**2**	**3**	**4**	**5**

Table C

High
Medium
Low

To use this matrix, first find the severity column that best describes the outcome of risk. Then follow the likelihood row to find the description that best suits the likelihood that the severity will occur. The risk level is given in the box where the row and column meet.

The relative risk value can be used to prioritize necessary actions to effectively manage work place hazards. Table D determines priority based on the following ranges:

RISK	DESCRIPTION	ACTION
15 - 25	**HIGH**	A HIGH risk requires **immediate** action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.
5 - 12	**MEDIUM**	A MEDIUM risk requires a planned approach to controlling the hazard and applies temporary measure if required. Actions taken must be documented on the risk assessment form including date for completion.
1 - 4	**LOW**	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded.

Table D

Hazards assessed, as "High Risk" must have immediate actions, to resolve risk to life safety and or the environment. Individuals responsible for required action, including follow up must be clearly identified. A further detail risk assessment method may require such as quantitative risk assessment as means of determine suitable controls measures.

5.0 Control

Definition: Control is the elimination or inactivation of a hazard in a manner such that the hazard does not pose a risk to workers who have to enter into an area or work on equipment in the course of scheduled work.

Hazards should be controlled at their source (where the problem is created). The closer a control to the source of the hazard is the better. This method is often referred to as applying engineering controls. If this does not work, hazards can often be controlled along the path to the worker, between the source and the worker. This method can be referred to as applying administrative controls. If this is not possible, hazards must be controlled at the level of the worker through the use of personal protective equipment (PPE), although this is the least desirable control.

5.1 Selecting a suitable control

Selecting a control often involves –

a. evaluating and selecting short and long term controls;
b. implementing short-term measures to protect workers until permanent controls can be put in place; and
c. implementing long term controls when reasonably practicable.

For example, suppose a noise hazard is identified. Short-term controls might require workers to use hearing protection. Long term, permanent controls might remove or isolate the noise source.

5.2 Types of Control

5.2.1 At the source of the hazard

a. **Elimination** - Getting rid of a hazardous job, tool, process, machine or substance is perhaps the best way of protecting workers. For example, a salvage firm might decide to stop buying and cutting up scrapped bulk fuel tanks due to explosion hazards.

b. **Substitution** - Sometimes doing the same work in a less hazardous way is possible. For example, a hazardous chemical can be replaced with a less hazardous one. Controls must protect workers from any new hazards that are created.

5.2.2 Engineering control

a. **Redesign** - Jobs and processes can be reworked to make them safer. For example, containers can be made easier to hold and lift.

b. **Isolation** - If a hazard cannot be eliminated or replaced, it can some times be isolated, contained or otherwise kept away from workers. For example, an insulated and air-conditioned control room can protect operators from a toxic chemical.

c. **Automation** - Dangerous processes can be automated or mechanized. For example, computer-controlled robots can handle spot welding operations in car plants. Care must be taken to protect workers from robotic hazards.

d. **Barriers** - A hazard can be blocked before it reaches workers. For example, special curtains can prevent eye injuries from welding arc radiation. Proper equipment guarding will protect workers from con tacting moving parts.

e. **Absorption** - Baffles can block or absorb noise. Lockout systems can isolate energy sources during repair and maintenance. Usually, the further a control keeps a hazard away from workers, the more effective it is.

f. **Dilution** - Some hazards can be diluted or dissipated. For example, ventilation systems can dilute toxic gasses before they reach operators.

5.2.3 Administrative controls

a. **Safe work procedures** - Workers can be required to use standardized safety practices. The employer is expected to ensure that workers follow these practices. Work procedures must be periodically reviewed with workers and updated.

b. **Supervision and training** – Initial training on safe work procedures and refresher training should be offered. Appropriate supervision to assist workers in identifying possible hazards and evaluating work procedures.

c. **Job rotations** and other procedures can reduce the time that workers are exposed to a hazard. For example, workers can be rotated through jobs requiring repetitive tendon and muscle movements to prevent cumulative trauma injuries. Noisy processes can be scheduled when no one is in the workplace.

d. **Housekeeping, repair and maintenance programs** - Housekeeping includes cleaning, waste disposal and spill cleanup. Tools, equipment and machinery are less likely to cause injury if they are kept clean and well maintained.

e. **Hygiene** - Hygiene practices can reduce the risk of toxic materials being absorbed by workers or carried home to their families. Street clothing should be kept in separate lockers to avoid being contaminated by work clothing. Eating areas must be segregated from toxic hazards. Eating should be forbidden in toxic work areas. Where applicable, workers should be required to shower and change clothes at the end of the shift.

5.2.4 Personal protective equipment

Personal protective equipment (PPE) and clothing is used when other controls measures are not feasible and where additional protection is needed. Workers must be trained to use and maintain equipment properly. The employer and workers must understand the limitations of the personal protective equipment. The employer is expected to require workers to use their equipment whenever it is needed. Care must be taken to ensure that equipment is working properly. Otherwise, PPE may endanger a workers health by providing an illusion of protection.

5.3 Monitoring controls

The effectiveness of controls must be checked regularly. Evaluate and monitor hazard controls during inspections, routine maintenance, and other activities. Ask the following questions –

a. have the controls solved the problem?
b. is any risk to workers posed by the controls contained?
c. are all new hazards being identified?
d. are significant, new hazards appropriately controlled?
e. are accident reports being analyzed?
f. are any other measures required?

Document control activities to track their effectiveness, if necessary re-evaluate hazards and implement new control measures.

5.4 Safe work procedures

Through the completion of a Job Hazard Analysis, sometimes hazards are identified and cannot be eliminated or engineered out of a particular task. Safe Work Procedures are step by step instructions that allow workers to conduct their work safety when hazards are present. A Safe Work Procedure identifies the materials and equipment needed, and how and when to use them safety.

Safe Work Procedures are generally prepared for -

a. critical high risk jobs where accidents have or could result in severe injuries;
b. hazardous work where accidents occur frequently;
c. new or altered tasks have been introduced;
d. new equipment has been added to a process;
e. a job that requires many detailed tasks;

f. where two or more workers required for a job, and each must perform specific tasks simultaneously; and
g. specific tasks are done infrequently.

Safe Work Procedures must include:

a. regulatory requirements;
b. necessary personal protective equipment;
c. required training;
d. worker responsibilities;
e. specific sequence of steps to follow to complete the work safely;
f. required permits; and
g. emergency procedures.

An example of a task that requires the development of a safe work procedure is confined space entry. Individuals who must work within confined spaces must ensure that safe work procedures are developed and followed to maximize life safety.

5.5 Personal protective equipment (PPE)

Personal protective equipment means any equipment which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety and any additional accessory designed to meet that objective;

PPE is usually chosen to provide protection appropriate to each of type of hazard present. There are specifications for the types of PPE used for protecting an individual's head, eyes, footwear, limb and body, fire retardant clothing, respiratory, hearing, and personal flotation devices.

It may also include required apparel for example when traffic hazards are present high visible and distinguishable "vests must be worn"

6.0 Documenting HIRARC

6.1 Responsibility and accountability

Proper management of hazards sporadically identified in the workplace can be done through effective process. Ultimately, the individual or team who identified the hazard must ensure proper communication of the hazard to the appropriate workplace authority (manager, department head, or designated person). Each HIRARC must be fully documented. The HIRARC form must be completed by the HIRARC team and signed

by the in charge personnel of the area. Departments responsible for the hazards and their control are required to maintain all records of assessments for at least 3 years. (In some cases, legislative requirements will determine the minimum time to retain records).

The appropriate authority is responsible for ensuring that effective and timely controls are applied to the hazard and communicating the results back to the originator. Management or employer must endorse and approve the HIRARC results. Employer must communicate all HIRARC to employees, monitor the follow up action and keep the records. The HIRARC Form (see APPENDIX C) is an example to document the HIRARC process.

6.2 Documenting process

Instructions to team leader and persons conducting HIRARC -

a. complete HIRARC Form. It is recommended to use a single form for each work process;
b. record the names and designation of HIRAC team members;
c. outline the process workflow and indicate in the form under 'process/ location column;
e. list all activities (routine and non-routine) for each work process under the "Work Activity" column;
f. identify the hazards associated with each activity and record in "Hazard" column;
g. determine the effect of each hazard identified and record in "Effect" column;
h. record any existing hazard control measures;
i. determine likelihood (L) from Table A and severity (S) from Table B for each hazard. Assign P and C rating in respectively column. The existing control measures should be take into consideration while determine (L) and (S);
j. by using Risk Matrix (Table C and D) assign one risk and record in "Risk" column;
k. based on the risk assigned, recommend appropriate risk control measures (see Table D);
l. assign a suitable person to implement the recommended risk control and indicate the follow up action date and status;
m. repeat the HIRARC for other activities and process;
n. conduct another round of HIRARC after control measures have been implemented; and
o. review HIRARC for every three years or whenever there are changes in process or activities.

7.0 Consultation

If practicable, there must be consultation with the relevant health and safety representative(s) when identifying, assessing and controlling risks. Consulting directly with employees and drawing on their experience and knowledge is more effective in reducing risk.

8.0 Training

Information, instruction and training provide employees with the skills and knowledge to perform their work in a manner that is safe and without risks to health. It enables them to -

a. follow health and safety procedures;
b. use risk controls set in place for their protection; and
c. have an appreciation of the nature of the hazard; the risks associated with their use; and the reason why risk controls are used.

Managers, Supervisors Health and Safety Representatives and others who may be required to perform risk assessments by agreement with management shall be trained in hazard identification risk assessment and control methods. They must be trained in the risk assessment process and be familiar with -

i. the regulations associated with the hazard;
ii. have a practical understanding of the work hazards; and
iii. consult with the Health and Safety Representative.

APPENDIX A

Examples of Workplace Hazards

The Hazard Identification listed is to assist in the identification of hazards in the work place. This table provides some additional explanation of the meaning of the hazard classifications.

WORK ENVIRONMENT	
Adequate Access	Refers to adequate access to, from and within the workplace
Air Conditioning	Refers to uncontaminated air in the work space
Confined Spaces	Means enclosed work space where people do not normally work (defined in standards)
Temperature Extremes: a) Heat	This includes contact with hot objects, hyperthermia, fire (Not explosions)
b) Cold	This includes contact with cold objects and hypothermia
Lighting	Refers to adequate illumination for the particular work being done
Mental Stress	Includes bullying, workplace violence, shift work, excessive work loads
Dehydration	Adequate water supply for the individuals while working
ENERGY	
Electrical	Includes contact with exposed wires and contact with high voltage
Gravity	Includes falls, trips and slips of persons as well as objects falling, working at heights
Kinetic Energy: a) The body hitting objects b) Hit by moving objects c) Explosion d) Penetrating objects	 Hitting objects with part of the body Being hit by moving objects but excluding falling objects An explosion may also include heat as a hazard This includes all objects that can penetrate including needles
Vibration	Includes vibration to parts or to the whole body
Acoustic/Noise	Includes exposure to single, sudden sound or long term exposure
Pressure	Pressure in hydraulic and pneumatic systems
MECHANICAL	
Vehicles	Being caught between, struck by or against vehicles (includes fork lifts)
Mobile and Fixed Plant	Being caught between, struck by or against plant (defined in legislation)

Powered Equipment	Includes electrical or fuel powered equipment, tools and appliances
Non-Powered Equipment	Includes non-powered hand tools, appliances and equipment
MANUAL HANDLING	
Muscular Stress	
a) Lifting, carrying	Refers to muscular stress while lifting, carrying, or putting down objects
b) Other handling	Refers to muscular stress while handling objects other than above
c) Without handling	Refers to muscular stress with no objects being handled
d) Repetitive movement	Refers to repetitive movement and low muscular loading
Ergonomics	Includes fatigue, stress or errors due to workplace design
ANIMAL / INSECT	
Bites/ Stings	Includes bites and stings from animals and/or insects
BIOLOGICAL	
Biological /Microbiological	Includes bacterial, fungal, viral, parasitic or human/animal tissue/fluids blood products
CHEMICAL	Refers to single or long term contact with chemicals
Flammable	Refers to chemicals which burn
Corrosive	Refers to chemicals which will corrode tissue or metals
Toxic	Refers to chemicals which will poison a worker
Oxidizers	Refers to chemicals which will provide oxygen to a fire, or react readily
Compressed Gases	Refers to gases which under high pressure
IONIZING RADIATION	Refers to radioactive substances and radiation producing equipment like X-rays
OTHER RADIATION	
Laser	Refers to coherent low divergent electromagnetic radiation. the Helium-Neon lasers used in the undergraduate Physics labs, or the laser pointers
Ultraviolet	Refers to electromagnetic radiation from 180 nm to 400 nm
Infrared	Refers to electromagnetic radiation from 700 nm to 1 mm
Radiofrequency	Refers to electromagnetic radiation from 100 kHz to 300 MHz

Microwave	Refers to electromagnetic radiation from 0.3GHz to 300 GHz
Electromagnetic Field	Includes static magnetic fields and low frequencies from 0 to 100kHz. The NMR magnets used in research laboratories. ELF magnetic fields induce electric fields in the body which result in current flows and heating in biological tissue.
ENVIRONMENTAL	
Release Contamination	Atmosphere, sanitary sewer, storm sewer Ground water, fresh water, soil
MAJOR EVENT/ACTIVITY	
OTHER EVENT/ACTIVITY	Includes events such as sporting or public events on or off campus
NATURAL EVENT/ ACTIVITY	
Rain/Storm/Lightning/ Flooding	Preparation is the key to being able to address these issues
OTHER EVENT/ACTIVITY	
Working Alone	Loss of personal security, unable to communicate with emergency services
PROPERTY EVENT/ACTIVITY	
Structure Collapse	Loss of building
Structure Damage	Wall crumbling
System Component	Loss of monitoring system or suppression system
Water Damage	Plumbing leak,
Utility Disruption	Loss of essential services - gas, electricity, water

APPENDIX B

Checklist for Workplace Hazard Examples

EXAMPLES OF POTENTIALLY DAMAGING HAZARDS

WORK ENVIRONMENT

Adequate Access
Air Conditioning
Confined Spaces
Temperature Extremes (including skin contact)
Heat (inc. fire, flames)
Cold
Lighting
Mental Stress
Dehydration
Falls, trips, slips etc.
Falling objects
Working at Heights
Kinetic Energy
The body hitting objects
Hit by moving objects
Explosion
Penetrating objects
Vibration
Pressure – pneumatic, hydraulic
Acoustic/Noise

ENERGY

Electrical
Gravity

MECHANICAL

Vehicles
Mobile and Fixed Plant
Powered Equipment
Non-Powered Equipment

MANUAL HANDLING

Muscular Stress
Lifting, carrying
Other handling
Without handling
Repetitive movement
Ergonomics

CHEMICAL

Flammable
Toxic
Corrosive
Oxidizer
Compressed Gases

BIOLOGICAL

Microbiological
Animal tissue/fluids
Human tissue
Human Blood and fluids
Pathogenic
Zoonotic

ENVIRONMENTAL

Air Release
Sewer Release
Release to Property

PROPERTY

Structural Collapse
Structural Damage
Utility Failure
Utility Disruption
Water Damage

IONIZING RADIATION

Radioactive Materials

OTHER TYPES OF RADIATION

Laser
Ultraviolet
Infrared
Radiofrequency
Microwave
Electromagnetic Field

MAJOR EVENT

Student activities function
Public event
Violence
Hold up
Intoxicated students
Firearms / Weapons
Food Poisoning

NATURAL

Lightning
Rain
Storm
Flooding
Sun
Wind

ANIMAL / INSECT

Bites/ Stings
Research Animals

OTHER

Working Alone
Remote location

HIRARC Form

HIRARC FORM			
Company:		Conducted by: (Name, designation) Date: (from... to ...)	
Process / Location:			
Approved by: (Name, designation)			
Date:		Review Date:	Next Review Date:

1. Hazard Identification				2. Risk Analysis				3. Risk Control	
No.	Work Aktivity	Hazard	Which can cause/effect	Existing Risk Control (if any)	Likelihood	Severity	Risk	Recommended Control Measures	PIC (Due date/ status)
1									
2									
3									
4									
5									

APPENDIX D

Worked example

Scenario 1: Wood panel cutting process

A team of two workers operates a cross-cut saw machine. Their work includes loading wood panel onto the machine, cutting the wood and unloading the cut wood. They also need to repair and maintain the machine regularly as well as to change the blades of the machine. (Caution: This example may not be applicable to similar work in your workplace).

HIRARC FORM

Company:	2F Furniture Entp	Conducted by: (Name, designation)	Mr. S (Supervisor), Miss M & Mr. L (Operator)	
Process / Location:	Wood cutting/Panel Sect.		24 Jun 2007 to 28 July 2007	
Approved by: (Name, designation)	Mr. K (Manager)	Date: (from... to ...)		
Date:	25 Julai 2007	Review Date:	1.	2.

1. Hazard Identification				2. Risk Analysis				3. Risk Control	
No.	Work Aktivity	Hazard	Which can cause/effect	Existing Risk Control (if any)	Likelihood	Severity	Risk	Recommended Control Measures	PIC (Due date/ status)
1	Loading the machine with wood	Cutting blades	Cuts / first aid type injury	Safe work practice	4	1	4 (Low)	Use leather hand glove	Andy (26 July 2007) / completed
2	Operating the machine	Unguarded machine	Hand get caught into rotating parts / amputation	Safe work practice, daily pre-use check and regular maintenance	4	3	12 (Medium)	To Fix L-guard	Chia (26 Ogos 2007) / In progress
		Flying fragments	Serious cuts & eye injuries by flying fragments of blades that break during cutting	Warning signs; Training, Safety goggles	4	3	12 (Medium)	Use stronger blades; To Fix L-guard Install	Mutu (26 Ogos 2007) / completed
3	Unloading cut wood	Heavy load	Muscular strain / back pain	Manual lifting procedure	3	1	3 (Low)	Use mechanical lifter	Ali (20 Ogos 2007) / KIV
4	Repair and maintenance of the machine	Unguarde machine; unsafe work practise	Serious cuts from blade & getting cought in rotating parts if machine is accidentally started	Cover 'on button' Safe work practice	4	4	16 (High)	To make delay start button	Ahmad (18 Ogos 2007) / completed

Worked example

Scenario 2: Wall exterior plastering work

A group of three workers was instructed to do plastering work at exterior wall at first floor of the building. Their work includes erecting working platform, wall plastering with concrete and do clearing work. (Caution: This example may not be applicable to similar work in your workplace).

HIRARC FORM

Company:	3D Construction Eng. Entp.	Conducted by: (Name, designation)	Mr. B (Supervisor), Mr. S & Mr. R (Plasterer)	
Process / Location:	Plastering Work/Exterior Wall.	Date: (from... to ...)	24 Jun 2007 to 30 July 2007	
Approved by: (Name, designation)	Mr. J (Site Manager)			
Date:	25 Julai 2007	Review Date:	1.	2.

1. Hazard Identification				2. Risk Analysis				3. Risk Control	
No.	Work Aktivity	Hazard	Which can cause/effect	Existing Risk Control (if any)	Likelihood	Severity	Risk	Recommended Control Measures	PIC (Due date/ status)
1	Erect working platform	Unguarded floor	Head injury / fatal	Safety helmet, housekeeping	4	5	20 (High)	1) Fence upper floor exposed edges 2) Establish Safe Work Procedure use JSA	1) Muthu/ 20 Ogos 07 completed 2) Ravi/ 2 Sept 07 completed
2	Loading concrete onto platform	Uneven floor	Fall of person / broken leg	Housekeeping, safety shoes	4	3	12 (medium)	Put plank on floor, anti slip mat	Muthu/ 26 July 07 completed
		Heavy load	Muscular strain / Back pain	Manual lifting procedure	3	1	3 (low)	Use small container	Muthu/26 July 07 completed
3	Plastering	Defective platform	Fall from height / fatal	Safety belt	4	5	20 (High)	1) Install handrail 2) Use new plank as platform	Muthu/26 July 07 completed
		Hot weather	Dehydrate	Nil	3	1	3 (low)	Provide drinking facilities	Ahmad to purchase/ 26 July 07 in progress
4	Clearing unused material	Sharp object	Finger cut	Nil	3	1	3 (low)	Use leather glove, use tool	

APPENDIX E

Example of Hazard Identification Technique

A. Job Hazard Analysis

Definition

Job Hazard Analysis (JHA) breaks a job or task into specific steps, analyzes each step for specific hazards, develops safe work procedures to eliminate or reduce those hazards, and integrates safe work procedures into safety and health programs. JHAs must be developed for each job or task. Supervisors and workers must complete the JHA together.

Procedure

Basic Steps - Job Hazard Analysis is broken down into 6 major steps:

a. Select the job task to be analyzed.

Prioritize which job tasks to analyze. Those job tasks where accidents and injuries are occurring should be analyzed first. Look at job tasks where there is a potential for serious injury. Look at new job tasks, these are important if a new process requires the development of new procedures and job tasks

b. Identify the major sequence of steps for each step
(Specific job step Description).

Once a job task has been chosen, it must be broken down into logical steps. Limit the number of steps in a JHA to a manageable number. Most jobs can be described in ten or less steps. The job steps must be kept in their proper sequence to ensure a proper analysis. The opportunity to make recommendations will come later in the analysis.

c. Identify the potential hazards for each step (Hazard Identification)

Once the job steps have been chosen, the potential hazards for each step can be identified. Whatever can go wrong may go wrong! What are the potential hazards as a result of each task step? Is the worker exposed to hazardous chemicals? Is the worker subject to poor workstation design? There may only be one, or there may be a large number for each job step.

d. Determine preventative measures to protect against the hazards
(Required Precautions)

i. The most important aspect of the job hazard analysis is to determine preventive measures to control or eliminate the identified hazards. What actions must be taken to control or eliminate the hazard?

ii. Eliminate the Hazard - Substitute with less hazardous substance/ material

iii. Contain/Enclose the Hazard - Use a fume hood or proper shielding

iv. Revise Safe Work Procedures - Adding additional steps

v. Reduce Worker Exposure - This is the least effective option in most cases, but may have to be used when permanent work process change is impossible or impracticable. Examples of this option include job rotation, where worker exposure is reduced, and the provision of personal protective equipment (PPE) to workers.

e. Develop a worker-training program

Reformat the job hazard analysis into a training program to help the employee eliminate or reduce hazards.

f. Re-evaluation

Re-evaluate the job descriptions and modify the job hazard analysis' accordingly

B. Example - Job Hazard Analysis

a. Selecting Jobs for Analysis

A job hazard analysis can be performed for all jobs in the workplace, whether the job task is "special" (non-routine) or routine. Even one-step jobs—such as those in which only a button is pressed—can and perhaps should be analyzed by evaluating surrounding work conditions. To determine which jobs should be analyzed first, review your job injury and illness reports. Obviously, a job hazard analysis should be conducted first for jobs with the highest rates of disabling injuries and illnesses. Also, jobs where "close calls" or "near misses" have occurred should be given priority. Analyses of new jobs and jobs where changes have been made in processes and procedures should follow. Eventually, a job hazard analysis should be conducted and made available to employees for all jobs in the workplace.

b. Involve the Employee

Once you have selected a job for analysis, discuss the procedure with the employee performing the job and explain its purpose. Point out that you are studying the job itself, not checking on the employee's job performance. Involve the employee in all phases of the analysis—from reviewing the job steps and procedures to discussing potential hazards and recommended solutions. You also should talk to other workers who have performed the same job.

c. Conducting the Job Hazard Analysis

Before actually beginning the job hazard analysis, take a look at the general conditions under which the job is performed and develop a checklist. Below are some sample questions you might ask -

i. Are there materials on the floor that could trip a worker?

ii. Is lighting adequate?

iii. Are there any live electrical hazards at the jobsite?

iv. Are there any chemical, physical, biological, or radiation hazards associ ated with the job or likely to develop?

v. Are tools—including hand tools, machines, and equipment - in need of repair?

vi. Is there excessive noise in the work area, hindering worker communication or causing hearing loss?

vii. Are job procedures known and are they followed or modified?

viii. Are emergency exits clearly marked?

ix. Are trucks or motorized vehicles properly equipped with brakes, overhead guards, backup signals, horns, steering gear, and identification, as necessary?

x. Are all employees operating vehicles and equipment properly trained and authorized?

xi. Are employees wearing proper personal protective equipment for the jobs they are performing?

xii. Have any employees complained of headaches, breathing problems, dizziness, or strong odors?

xiii. Is ventilation adequate, especially in confined or enclosed spaces?

xiv. Have tests been made for oxygen deficiency and toxic fumes in confined spaces before entry?

xv. Are work stations and tools designed to prevent back and wrist injuries?

xvi. Are employees trained in the event of a fire, explosion, or toxic gas release?

Naturally this list is by no means complete as each worksite has its own requirements and environmental conditions. You should add your own questions to the list. Photographs, if appropriate, may be used in creating a more detailed analysis of the work environment.

d. Breaking the Job Down

Nearly every job can be broken down into job tasks or steps. In the first part of the job hazard analysis, list each step of the job in order of occurrence as you watch the employee performing the job. Be sure to record enough information to describe each job action, but do not make the breakdown too detailed. Later, go over the job steps with the employee.

e. Identifying Hazards

After you have recorded the job steps, next examine each step to determine the hazards that exist or that might occur. Ask yourself these kinds of questions:

i. Is the worker wearing personal protective clothing and equipment, including safety harnesses that are appropriate for the job?

ii. Are work positions, machinery, pits or holes, and hazardous operations adequately guarded?

iii. Are lockout procedures used for machinery deactivation during mainte nance procedures?

iv. Is the worker wearing clothing or jewelry that could get caught in the machinery or otherwise cause a hazard?

v. Are there fixed objects that may cause injury, such as sharp machine edges?

vi. Is the flow of work improperly organized (e.g., Is the worker required to make movements that are too rapid)?

vii. Can the worker get caught in or between machine parts?

viii. Can the worker be injured by reaching over moving machinery parts or materials?

ix. Is the worker at any time in an off-balance position?

x. Is the worker positioned to the machine in a way that is potentially dangerous?

xi. Is the worker required to make movements that could lead to or cause hand or foot injuries, or strain from lifting— the hazards of repetitive motions?

xii. Can the worker be struck by an object or lean against or strike a machine part or object?

xiii. Can the worker fall from one level to another?

xiv. Can the worker be injured from lifting or pulling objects, or from carrying heavy objects?

xv. Do environmental hazards—dust, chemicals, radiation, welding rays, heat, or excessive noise—result from the performance of the job?

Repeat the job observation as often as necessary until all hazards have been identified.

C. Worked example Job Hazard Analysis

Cleaning Inside Surface of Chemical Tank - Top Manhole Entry

STEP	HAZARD	REQUIREMENTS
1. Determine what is in the tank, what process is going on in the tank, and what hazards this can pose.	Improper oxygen level Chemical exposure - Gas, dust, vapor - irritant, toxic Liquid - irritant, toxic, corrosive, heated Solid - irritant, corrosive Moving blades/ equipment	Establish confined space entry procedures (Code of Practice for confine space). • Obtain work permit signed by safety, maintenance, and supervisors. • Test air by qualified person. • Ventilate to 19.5% -23.5% oxygen and less than 10% LEL of any flammable gas. Steaming inside of tank, flushing and draining, then ventilating, as previously described, may be required. • Provide appropriate respiratory equipment - SCBA or air line respirator. • Provide protective clothing for head, eyes, body, and feet. • Provide harness and lifeline. (Reference: .....). • Tanks should be cleaned from outside, if possible.
2. Select and train operators.	Operator with respiratory or heart problem; other physical limitation. Untrained operator - failure to perform task	• Examination by industrial physician for suitability to work. • Train operators. • Dry run. (Reference: .....).
3. Set up equipment	Hoses, cord, equipment - tripping hazards. Electrical - voltage too high, exposed conductors. Motors not locked out and tagged.	• Arrange hoses, cords, lines, and equipment in orderly fashion, with room to manoeuvre safely. • Use ground-fault circuit interrupter. • Lockout and tag mixing motor, if present.
4. Install ladder in tank.	Ladder slipping.	• Secure to manhole top or rigid structure.
5. Prepare to enter tank.	Gas or liquid in tank.	Empty tank through existing piping. • Review emergency procedures. • Open tank. • Check of jobsite by industrial hygienist or safety professional. • Install blanks in flanges in piping to tank (isolate tank). • Test atmosphere in tank by qualified person (long probe).

STEP	HAZARD	REQUIREMENTS
6. Place equipment at tank-entry position.	Trip or fall.	Use mechanical-handling equipment. • Provide guardrails around work positions at tank top. • Provide personal protective equipment for conditions found. (Reference:.....).
7. Enter tank.		• Provide outside helper to watch, instruct, and guide operator entering tank, with capability to lift operator from tank in emergency.
8. Cleaning tank.	Reaction to chemicals, causing mist or expulsion of air contaminant.	Provide protective clothing and equipment for all operators and helpers. • Provide lighting for tank (Class I, Div. 1). • Provide exhaust ventilation. • Provide air supply to interior of tank. • Frequent monitoring of air in tank. • Replace operator or provide rest periods. • Provide means of communication to get help, if needed. • Provide tow-man standby for any emergency.
9. Cleaning up.	Handling of equipment, causing injury.	Dry run. • Use material-handling equipment.

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