# HEALTH, SAFETY AND ENVIRONMENT (HSE) CULTURE IN BANGLADESH: CHALLENGES AND RECOMMENDATION

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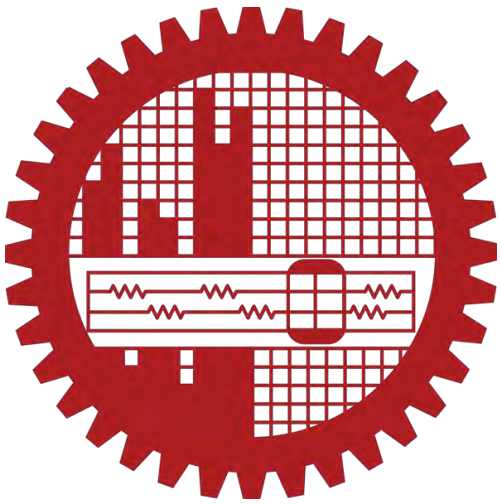
**MASTER OF ENGINEERING IN PETROLEUM ENGINEERING**



**DEPARTMENT OF PETROLEUM AND MINERAL RESOURCES ENGINEERING**
**BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY**
**DHAKA-1000, BANGLADESH**

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# HEALTH, SAFETY AND ENVIRONMENT (HSE) CULTURE IN BANGLADESH: CHALLENGES AND RECOMMENDATION

**A PROJECT**

**BY**

**MD. ENAMUL KIBRIA**

**SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENGINEERING IN PETROLEUM ENGINEERING**

**AT**

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**DHAKA-1000, BANGLADESH**

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## RECOMMENDATION OF THE BOARD OF EXAMINERS

The undersigned certify that they have read and recommend to the Department of Petroleum and Mineral Resources Engineering, a project entitled **"HEALTH, SAFETY AND ENVIRONMENT (HSE) CULTURE IN BANGLADESH: CHALLENGES AND RECOMMENDATION"** submitted by **MD. ENAMUL KIBRIA**, has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Master of Engineering in Petroleum Engineering.

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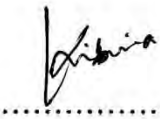
## DECLARATION

It is hereby declared that this project or any part of it has not been submitted elsewhere for the award of any degree or diploma.



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**Md. Enamul Kibria**

**DEDICATED**

To

My

Beloved

**Parents**

Invocation of who might be sources for the blessings of Allah in completion of this study

# ABSTRACT

With rapid growth of national economy and strong social needs, energy has become an important strategic resource for national development. Although Bangladesh government is making great efforts to develop sustainable energy such as nuclear, coal mining, hydro power, wind and solar power etc, undoubtedly, petroleum and natural gas still dominate the national energy demands.

Although technological improvements have reduced Petroleum and other industry related deaths, accidents are still too common. That's why health, safety, and the environment culture remain among the top priorities for oil and gas industries, reflecting an attitude of zero tolerance for accidents.

Petroleum (Drilling) activities can take place in diverse geological and geophysical settings, each posing unique type of challenges. However proper planning, hazard control, inspection, incident investigation and reporting can reduces the number of accidents approximately to zero.

Health, Safety and Environment (HSE) should be the first priority in petroleum and mining industry for ensuring incident free operation with profitable growth in the business. Industry without practicing HSE (regulation) is very dangerous for personnel, equipment, material, property and environment. To ensure safety (incident free operation) regular inspection of project plant, rig site and necessary control measure should always be carried out by trained manpower, HSE personnel along with concerned special authorities to meet the demand of Occupational Safety and Health Administration (OSHA) standard and regulation (or OSH). Physical inspection, incident investigation and reporting, emergency planning, hazard identification, hazard control, Lockout/ Tag out (LOTO), Manual Materials Handling (MMH), hazard analysis, job safety analysis, risk analysis, stop work condition and authorities, training, employee orientation, tool safety, toolbox talk, are essential element for maintaining safety of industries. That's why this paper about safety culture has prepared by working on all of those.

Attitudes, personal education and experience, organizational training, communication mechanism and so on, all of them affect the development of a safety culture in any organization. The environment in which people work and the systems and processes in the industry also influence the safety culture. Therefore, each industry needs to consider all of these aspects in developing and nurturing a safety culture that suits the organization and the individuals within it.

In any Petroleum project, concern authority need to maintain standard quality of implementation of the HSE programmed with due consideration to standing Safety rules and regulations. The project may be considered viable from the Health, Safety and Environmental point of view and therefore be considered for implementation by appropriate authorities. It has been recommended that, Health, Safety and Environmental clearance would be issued in favor of petroleum project for execution of the project as incident free operation in future.

The research and conclusions and recommendations of this report could provide useful organizational safety culture concept to promote safety performance and safety management in Bangladesh.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| API | American Petroleum Institute |
| ANSI | American National Standards Institute |
| BAPEX | Bangladesh Petroleum Exploration & Production Company Limited |
| BLS | Bureau of Labor Statistics |
| CSA | Canadian Safety Authority |
| CST | Construction Safety Training |
| CSE | Confined Space Entry |
| CPR | Cardiopulmonary Resuscitation |
| CHESM | Contractor Health, Environment, and Safety Management |
| EX | Excavation |
| GHS | Globally Harmonized System |
| GFCI | Ground-Fault Circuit Interrupter |
| HSE | Health, Safety and Environment |
| HSE | Health and Safety Executive |
| HazCom | Hazard Communication |
| HW | Hot Work |
| HA | Hazard analysis |
| HID | Hazard Identification |
| ICCA | International Council of Chemical Association |
| IADC | International Association of Drilling Contractors |
| IIPP | Injury and Illness Prevention Program |
| JHA | Job Hazard Analysis |
| JSA | Job Safety Analysis |
| L&R | Lifting and Rigging |
| LO/TO | Lockout/ Tag out |
| MSDS | Material Safety Data Sheet |
| MMH | Manual Materials Handling |
| MSD | Musculoskeletal Disorders |
| MORT | Management Oversight and Risk Tree |
| NEO | New Employee Orientation |
| NORM | Naturally Occurring Radioactive Material |
| NIOSH | National Institute for Occupational Safety and Health |
| NFPA | National Fire Protection Association |
| OSHA | Occupational Safety and Health Administration |
| OSH | Occupational Safety and Health |
| PPE | Personal Protective Equipment |
| PTS | Permanent Threshold Shift |
| PTW | Permit To Work |
| Parts Per Million | Parts Per Million |
| SCBA | Self-Contained Breathing Apparatus |
| SLM | Sound Level Meter |
| SIMOPS | Simultaneous Operation |
| WHMIS | Workplace Hazardous Materials Information System |
| W@H | Working At Height |

# Chapter-1: Introduction

## 1.1 Researching background and significance:

With rapid growth of national economy and strong social needs, energy has become an important strategic resource for national development. Although Bangladesh government is making great efforts to develop sustainable energy such as nuclear, coal mining, hydro power, wind and solar power etc, undoubtedly, petroleum and natural gas still dominate the national energy demands.

However, due to rapid industrialization in Bangladesh at Petroleum and other industrial sector, has characteristic of high risk, almost all companies should have a common view - safety first, apply high reliable equipment, adopt optimized hull structure design, and establish safety management regulations (Safety culture) to control and relief risk and danger from their regular operation. Although technological improvements and stricter safety regulations have reduced Petroleum and other industry related deaths, accidents are still too common. That's why health, safety, and the environment culture remain among the top priorities for oil and gas industries, reflecting an attitude of zero tolerance for accidents.

Health, Safety and Environment (HSE) is a key element of an organization to run its business smoothly. A higher number of incidents indicate to the organization's poor efficiency. For overcoming these organizational poor efficiency Health, Safety and Environment regulation become more stringent for oil and gas industry. It is very important to ensure that the organization follows the Health, safety and Environment regulations, arrange preventive measure and ensure incident free operation of the system to prevent incidental (accidental) damage. But in our country, there is a lack of safety regulatory board for controlling Health, Safety, and Environment issue or incident in Petroleum industry. That's why it is very essential to work for managing safety for building safety culture in Industries in our country for protecting People, Property (Natural resource), and Environment.

For controlling HSE related issue (Blow out, rig disaster, oil spill etc) as well as for safely extracting and Transporting oil and gas without incident, Bangladesh government should take initiative for established a safety regulatory Board under Ministry of Power, Energy and Mineral Resources (MPEMR) like Oil Industry Safety Directorate (OISD) for India which is under (Ministry of Petroleum and Natural Gas), [44]; Similarly Occupational Safety and Health Administration (OSHA) for U.S.A which is under (United States Department of Labor) , Occupational Safety and Health (OHS) for Canada, Health and Safety Executive (HSE) for U.K. If not possible to establish safety regulatory Board or until established our own safety regulatory board Bangladesh government as well as petroleum and other industrial organization can be used any one of OISD, OSHA, OSH, or HSE with some adjustment for our own culture and environment.

This project about safety culture have prepared by working on, Safety policy, Managing Safety, Managing safe work (MSW) standard, Job safety analysis, Hazards analysis and Hazards control, Risk analysis, Permit to work, Personal Protective Equipment, Heat Stress Management, Manual Handling, Material safety data sheet (MSDS), Motor Vehicle Safety, chemical safety, spill safety, Behavioral Base Safety (Safe act, Unsafe act), HSE policy, Stop Work Condition, hot work, confined space entry, lock out / tag out (LOTO), Excavation work (Ex), Working at height (W@H) Emergency Planning, Training, incident investigation and Reporting (investigation Model and Practical use) and case studies in Petroleum industries in Bangladesh. All of those will be applicable as a preventive and corrective

approach (control measure) that's help to building/ promoting HSE culture in Bangladesh and will ensure incident free operation in oil and gas sector. These will ultimately save life, money and property and also protect environment.

All of these factors can be incorporated into aspect of safety culture; an excellent safety culture can promote effectively safety performance with positive effect. An organization should create and sustain a good safety culture, especially in Petroleum industry, it can help organization and company to identify personnel behaviors and attitudes what are right, safety culture encourages to reward right behaviors and attitudes, because rewarding is more effective than punishing.[43];

An excellent safety culture can reduce accidents and keep on-site workers safe, finally establishing a more complete and mature system to achieve zero accident. The benefits of safety culture also include that enhancing operating discipline, promoting operating standards, increasing productivity and encouraging worker morale.[43];

Project goal would be such like that to eliminate all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from project activities. Everyone will be able to believe that work is never so urgent or important that they cannot take the time to do it safely and in an environmentally responsible manner. Also it will be help to implement high environmental standards for petroleum operations in order to ensure that companies actions today will not only provide the energy needed to drive economic growth and social well-being, but also secure a stable and healthy environment for tomorrow.

If an organization or company can deliver a good safety culture, it will need leadership and managers to actively diagnose issues and act to correct mistakes, and make supportive and collaborative function of a safety department to spread over broader organizational effectiveness.

This Project work will have seen as the first step towards building Health, Safety, and Environment (HSE) practice development which would be help to formulate guidelines for future hydrocarbon activities for Petroleum and other industry in a safe manner.

## 1.2 Objectives:

- To know who, how and to what extent will be affected during the petroleum activities because of Hazards
- To know what types of mitigation measures would be taken for protecting people, property, and environment
- To categorize problems in different ways such as the frequency of occurrence, degree of difficulty, monetary involvement, hazard level, risk analysis etc
- To make suggestions to be adopted for future activities

## 1.3 Outline of Methodology:

- The report was prepared on the basis of information collected from various project of chevron Bangladesh Limited and Sylhet Gas field Ltd
- Data collection include collection of project reports, working papers, site visit, interview of related personnel

- Problems was analyzed by considering human error, design error, or unforeseen natural factors, and whether same type of problems occurred recurrently
- Recommendations were made for building safety culture for concern authority (or organization) to avoid the health, safety and environment related problems in future.
- A public consultation process was maintained in the project area by consulting with the employee and the local community.
- Safety engineering case studies were prepared for the incidents. The idea getting from those case studies would be helpful or can be use as a guideline for future mitigation measures of health, safety and environmental (HSE) issues.

## 1.4 Researching scope defined:

The scope of this project is to collect and analyze accident cases and influential factor of accidents, find out root causes of accidents, summarize lessons learned from accident. Though these lessons learned, to get safety culture's influence factors. Based on these influence factors, associated with literature review and information collected to build an organizational safety culture concept, aiming on identify industrial safety culture aspects in working environment.

## 1.5 HSE Culture & its importance to organization:

Health, Safety and Environment (HSE) guide explains more about how the right approach can benefit company business. it involves creating organized efforts and procedures or a systematic approach for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances as well as complying with environmental regulations, such as managing waste or air emissions all the way to helping sites reduce the company's carbon footprint.

Organization should implement high environmental standards for petroleum operations in order to ensure that companies actions today will not only provide the energy needed to drive economic growth and social well-being, but also secure a stable and healthy environment for tomorrow. It also should be emphasized that the focus of the proposed work will be limited to Health, Safety, and Environment (HSE) practices gradual growth only to ensure incident free operation by pointing out the problems and remedial measure link to different area of Bangladesh.

Effective health, safety and environmental practices pay for themselves. They also improve company reputation with customers, the local community and company own employees, by eliminating all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from project activities. Everyone should believe that work is never so urgent or important that they cannot take the time to do it safely and in an environmentally responsible manner.

## 1.6 Definition of Safety:

Safety is the state of being "safe", the condition of being protected from harm or other non-desirable outcomes. Safety can also refer to the control of recognized hazards in order to achieve an acceptable level of risk. This can take the form of being protected from the event or from exposure to something that causes health, economical, or environmental losses. It can include protection of people or of possessions."

- "Safety means keeping personnel free from harm or danger. It means taking care not to fall or bump or run into things. It also means to avoid accidents or incident by being careful with what people are doing"
- Safety means denoting something designed to prevent injury or damage: a safety barrier a safety helmet
- It also means the condition of being protected from or unlikely to cause danger, risk, or injury: People should leave for their own safety; the survivors were airlifted to safety
- Safety can be seen as something that comes out of the organization that allows it to achieve its objectives (even in a high risk environment). In this way, safety is not something that is done to the organization, but comes out of it

The goals of health, safety and environment programs include to fostering a safe and healthy work environment. HSE may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment.

## 1.7 History of HSE management approach:

The first formal EHS or HSE management approach was introduced in 1985 by the chemical industry as a reaction to several catastrophic accidents (like the Seveso disaster and the Bhopal disaster). This worldwide voluntary initiative called "Responsible Care" is in place in about 50 countries and centrally coordinated by the International Council of Chemical Associations (ICCA). It involves eight fundamental features that ensure plant and product safety, occupational health and environmental protection but also try to demonstrate by image-building campaigns that the chemical industry acts in a responsible manner. Still, this initiative is restricted to the chemical industry.

Since the 1990s, general approaches to EHS or HSE management that may fit any type of organization can be found in international standards like ISO 14001 for environmental management and OHSAS 18001 for occupational health and safety management or the European Eco-Management and Audit Scheme (EMAS). In 1998, EHS or HSE guidelines were also created by the International Finance Corporation.

## 1.8 Why safety is important?

### 1.8.1 Petroleum incident in the world:

While technological improvements and stricter safety regulations have reduced Petroleum and Coal mining related deaths, accidents are still too common. That's why health, safety, and the environment remain among the top priorities for oil and gas companies, reflecting an attitude of zero tolerance for accidents. Some example of like these incident description are given below:

- The Piper Alpha disaster in the North Sea, UK, which killed 167 people in July 1988, is the deadliest offshore oil rig accident in history. Which destroys the entire facility causing an estimated loss of $1.4bn It was one of the biggest offshore oil platforms in the UK producing more than 300,000 barrels of crude a day. The disaster occurred due to gas leakage from one of the condensate pipes at the platform on 6 July 1988. The pressure safety valve of the corresponding condensate-injection pump was removed during the day as part the routine maintenance of the pump. The open condensate pipe was temporarily sealed with two blind flanges. The temporary disc cover, however, remained in place during shift-change in the

evening as maintenance work was not complete. The condensate-injection pump was not supposed to be switched on under any circumstances. But because of Communication errors however led the night crew staff at the platform to turn on the pump after the other pump tripped. It resulted in leakage of gas condensate from the two blind flanges causing gas ignition and serial explosions on the platform. Only 61 out of the 226 workers survived the disaster and it took close to three weeks to control the fire. At the time of the disaster the platform was managed by Occidental in block 15 of the UK Continental Shelf, about 120 miles north-east of Aberdeen.

- Alexander L. Kielland was a semi-submersible platform accommodating the workers of the bridge-linked Edda oil rig, in the Norwegian continental Shelf. The Platform, capsized in March 1980, killing 123 people
- The Ocean Ranger oil drilling rig disaster on 15 Feb 1982 in the North Atlantic Sea off the coast of Newfoundland, Canada, killed 84 crew members is one of the deadliest offshore oil rig accidents in history
- Glomar Java Sea Drillship disaster on 25 Oct 1983 in the South China Sea caused the death of 81 people
- Bohai 2 oil rig disaster in Nov 79, in the Gulf of Bohai off the coast of China, killed 72 out of 76 people
- Enchova Central Platform disaster (blowout) in Aug1984 in the Campos Basin, Brazil, killed 42 people
- The Mumbai High North disaster on 27 July 2005 in the Arabian Sea, killed 22 people. The accident caused significant oil spill and a production loss of about 120,000 barrels of oil and about 4.4 million cubic meters of gas a day
- Usumacinta Jack-up disaster, it occurred on the 23rd of Oct 2007 in the Gulf of Mexico, claimed 22 lives
- The C.P. Baker Drilling Barge disaster (blowout) in the Gulf of Mexico on 30 June 1964 resulted in the death of 21 people and injured 22 after fires and a explosion occurred on the drilling barge
- 20 th April 2010, the day is a nightmare disaster for world. In the U.S Gulf of Mexico, “Deepwater Horizon” drilling platform occurred a serious accident, and resulted in blowout and hull sunk fatality of 11 drilling workers. It was a Semi-submersible offshore oil drilling rig owned by Transocean, and leased to BP from 2001 until Sept 2013. In Sept 2009, The rig drilled the deepest oil well in history at a vertical depth (10,683 m) in the Tiber oil field at Keathley Canyon block 102, approximately (400 km) Southeast of Houston, in (1,259 m) of water. This is the most serious in the history of oil pollution. Unbelievably, 10 weeks after the accident, all famous experts around the world could not offer feasible way to solve the blowout. In the end, the entire accident caused to leak 5000 thousand barrels of crude oil is the largest oil spill in U.S. waters, and the cost is US $ 560 million.[39];
- Caspian Sea oil rig disaster on Plat from 10 on the Guneshli field offshore Azerbaijan is the worst offshore Disaster in history which killed at least 32 people. The incident happened on Friday, 4 December 2015. It is believed severe weather ruptured a gas line causing an explosion and huge fire that engulfed the platform. Around 60% of SOCAR’s (State oil company) oil production passes via the platform where the fire broke out; meaning that the company’s output will be hit

### 1.8.2 The world's worst coal mining disasters:

While technological improvements and stricter safety regulations have reduced coal mining related deaths, accidents are still too common. China, which produces more than one-third of annual global coal output, accounts for more than two-thirds of mining deaths around the world each year.

Most of the coal mine disasters around the world were caused by gas and coal dust explosions

- The Benxihu colliery disaster on 26 April 1942 in China killed 1,549 lives is the worst coal mining disaster ever
- The Courrieres mine disaster in March 1906 in France killed 1,099 people
- Mitsubishi Hojyo coal mine disaster, the deadliest mining accident in Japan, caused 687 deaths, in Dec 1914
- Laobaidong coal mine disaster is the second deadliest in China, occurred on 9 May 1960, killed 684 people.
- The Mitsui Miike coal mine explosion on 9 Nov1963 in Japan, killed 458 and injured 833 miners
- UK's Senghenydd Colliery disaster in 1913 killed 439 coal miners
- Coalbrook mine disaster with 435 deaths is the worst ever disaster in South Africa's mining history in 1960
- Wankie Colliery Disaster occurred on 6 June1972 in Rhodesia (now Zimbabwe) killed 426 people
- Dhanbad coal mine disaster occurred on bet 27 & 28 May (1965 &1975) in India, were killed 375 miners
- The Monongah Coal Mine Disaster is the largest disaster in the US that took 362 lives
- The 1866 Oaks coal mine disaster in the UK killed 388 people

### 1.8.3 Spill incident:

- As Iraqi forces retreated from Kuwait during the first Gulf War, they opened the valves of oil wells and pipelines in a bid to slow the onslaught of American troops. The result was the largest oil spill history has seen. Some 240 million gallons of crude oil flowed into the Persian Gulf. The resulting oil slick spanned an area just larger than the size of the island of Hawaii

- In June 1979, an oil well in the Bay of Campeche collapsed after a pressure buildup sparked an accidental explosion. Over the next 10 months about 140 million gallons of crude spouted into the Gulf of Mexico from the damaged oil well

- Nearly 88 million gallons of oil spilled from an oil well in Fergana Valley, one of Uzbekistans's most active energy- and oil-refining areas. While the spill didn't get much press at the time, it is the largest inland spill ever reported
- On 20 April 2010, while drilling at the Macondo Prospect (U.S Gulf of Mexico, "Deepwater Horizon"), an explosion on the rig caused by a blowout killed 11 people and ignited a fireball visible from 64 km away. The resulting fire could not be extinguished. This is the most serious in the history of oil pollution. In the last, the entire accident caused to leak 5000,000 barrels of crude oil is the largest oil spill in U.S. waters

A serious workplace injury or death changes lives forever – for families, friends, communities, and coworkers too. Human loss and suffering is immeasurable. Occupational injuries and illnesses can

provoke major crises for the families in which they occur. In addition to major financial burdens, they can impose substantial time demands on uninjured family members. Today, when many families are operating with very little free time, family resources may be stretched to the breaking point.

**The importance of safety in all aspects of our lives is quite obvious. There are a lot of reasons why and here are some.**

- **To avoid accidents.** Most of the time accidents happen due to recklessness and irresponsibility. People who don't follow the safety precautions always end up getting injured or worse, getting killed. Whether it's inside the house or in the workplace, exercising safety precautions is a must
- **To stay healthy.** Eating the right kind of food and doing exercise is also another safety measure. It keeps your body in shape and keeps you safe from unwanted sickness. Having a healthy body is a blessing. Not only does it save you from harmful diseases, but it also saves you from spending too much on medicines and hospital bills
- **To live a long life.** Responsible people are those who take care of themselves and of others because of the people who love them. It's not easy to lose a loved one, a friend or a family member. If you want to live a long life together with all the people you love, live your life safely
- **To prevent unexpected dilemmas from rising**. Planning is another essential part of being safe. A lot of times, accidents or troubles can be prevented with careful planning, organization and implementation
- To know who, how and to what extent will be affected during the petroleum activities because of Hazards.
- To know what types of mitigation measure would be taken for protecting people, property, and environment.
- To know the actual environmental condition of the proposed area (Before starting operation).
- To achieve a zero incident/accident goal.
- To treat with care all materials that may cause pollution.
- To identify improvement opportunity from the current practices.
- To categorize these problems in different ways such as the frequency of occurrence, degree of difficulty, monetary involvement, hazard level, risk analysis etc.
- To know the environmental impact on the surrounding people.
- To determine the change in livelihood.
- To determine the effect on agricultural, education, health etc.
- To make suggestions to be adopted for future activities.
- To prevent fatalities and injuries.
- To reduce damage to buildings, stock, and equipment.
- To protect the environment and the community.
- To suggest guidelines for selection and development of well sites, gas plant , gas plant extension for future exploration and development in light of the past experiences for ensuring incident free operation.

Companies that employ workers have an interest in keeping the workplace safe. Job-related injuries are something that responsible employers avoid. They take the time and use company resources to make sure that the people who come to work each day are safe.

They may offer on-the-job safety training or have safety procedures included in their company policies. In some workplaces, a person or a group of workers are designated as the company safety team. These people are responsible for ensuring that the premises are in compliance with safety regulations set out by law.

Not only does this make good sense from a moral standpoint, but it also makes good financial sense. If a worker is injured on the job, it costs the company in terms of lost man hours, increased insurance costs, workers' compensation premiums, and legal costs.

Productivity is lost when other workers have to stop doing their job to deal with the situation. Even after the injured worker has been sent home or taken to hospital, other employees may be distracted or need to take time off from work in the aftermath of the incident.

But in Bangladesh, there is a lack of proper safety regulations for controlling Health, Safety, and Environment (HSE) issue or incident in Petroleum industry (or other industry). That's why it is very essential to work for managing safety for building safety culture in Industries in our country for protecting People, Property (Natural resource), and Environment.

As Health, Safety and Environment (HSE) is a key element for an organization to run its business smoothly. Also as higher number of incidents indicates to the organization's poor efficiency. That's why to avoid such occurrences Health, Safety and Environment regulation need to be formulated. This is more stringent for oil and gas industry because of the nature of the business. For this reason it is very important to ensure that the organization follows the Health, Safety and Environment regulation (Like OSHA or OISD regulation), arrange preventive measure and ensure incident free operation of the system to prevent incidental (accidental) damage.

The **Occupational Safety and Health Administration** (**OSHA**) is an agency of the United States Department of Labor. Congress established the agency under the Occupational Safety and Health Act, OSHA's mission is to "assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance". The agency is also charged with enforcing a variety of whistleblower statutes and regulations.

## 1.9 Creating a Safety Culture:

### 1.9.1 Necessity of strong safety culture in the organization:

A company with a strong safety culture typically experiences few at-risk behaviors, consequently they also experience low incident rates, low turn-over, low absenteeism, and high productivity. They are usually companies who are extremely successful by excelling in all aspects of business and excellence.

Creating a safety culture takes time. It is frequently a multi-year process. A series of continuous process improvement steps can be followed to create a safety culture. Employer and employee commitment are hallmarks of a true safety culture where safety is an integral part of daily operations.

A company at the beginning of the road toward developing a safety culture may exhibit a level of safety awareness, consisting of safety posters and warning signs. As more time and commitment are devoted, a company will begin to address physical hazards and may develop safety recognition programs, create safety committees, and start incentive programs.

Developing strong safety cultures have the single greatest impact on incident reduction of any process. It is for this single reason that developing these cultures should be top priority for all managers and supervisors of any organization.

### 1.9.2 Supporting element for Building a safety culture:

Any process that brings all levels within the organization together to work on a common goal that everyone holds in high value will strengthen the organizational culture. Worker safety and health is a unique area that can do this. It is one of the few initiatives that offer significant benefits for the front-line work force.

1. **Obtain Top Management "Support"** - This is the very first step that needs to be accomplished. Top managers must be on board. If they are not, safety and health will compete against core business issues such as production and profitability, a battle that will almost always be lost. They need to understand the need for change and be willing to support it.
2. **Continue Building "Initiatives"** A compelling reason for the change must be spelled out to everyone. People have to understand WHY they are being asked to change what they normally do and what it will look like if they are successful.
3. **Build Trust -** Trusting is a critical part of accepting change and management needs to know that this is the bigger picture, outside of all the details. Trust will occur as different levels within the organization work together and begin to see success.
4. **Conduct Self Assessments/Bench Marking** - To get where people want to go, people must know where they are starting from. A variety of self-audit mechanisms can be employed to compare people site processes with other recognized models of excellence.
5. **Initial Training** of Management-Supervisory staff, Union Leadership (if present), and safety and health committee members, and a representative number of hourly employees. This may include both safety and health training and any needed management, team building, hazard recognition, or communication training, etc.
6. **Establish a Steering Committee** comprised of management, employees, union (if one exists), and safety staff. The purpose of this group is to facilitate, support, and direct the change processes.
7. **Develop Site Safety Vision**, key policies, goals, measures, and strategic and operational plans.
8. **Align the Organization** by establishing a shared vision of safety and health goals and objectives vs. production. Upper management must be willing to support by providing resources (time) and holding managers and supervisors accountable for doing the same.
9. **Define Specific Roles** and responsibilities for safety and health at all levels of the organization.
10. **Develop a System of Accountability** for all levels of the organization. Everyone must play by the same rules and be held accountable for their areas of responsibility.
11. **Develop Measures** and an ongoing measurement and feedback system. Examples include the number of hazards reported or corrected, numbers of inspections, number of equipment checks, JSA's, pre-start-up reviews conducted, etc.
12. **Develop Policies for Recognition**, rewards, incentives, and ceremonies. Again, reward employees for doing the right things and encourage participation in the upstream activities.
13. **Awareness Training and Kick-off** for all employees. It's not enough for a part of the organization to be involved and know about the change effort - the entire site needs to know and be involved in some manner (Awareness Training)
14. **Continually Measure** performance, **Communicate Results**, and **Celebrate Successes**. Publicizing results is very important to sustaining efforts and keeping everyone motivated.
15. **On-going Support** - Reinforcement, feedback, reassessment, mid-course corrections, and on-going training is vital to sustaining continuous improvement.

## 1.10 Safety culture and its impact on organization:

Safety cultures consist of shared beliefs, practices, and attitudes that exist at an establishment. Culture is the atmosphere created by those beliefs, attitudes, etc., which shape people behavior. An organizations safety culture is the result of a number of factors such as:

- Management and employee norms, assumptions and beliefs;
- Management and employee attitudes;
- Values, stories;
- Policies and procedures;
- Supervisor priorities, responsibilities and accountability;
- Production and bottom line pressures vs. quality issues;
- Actions or lack of action to correct unsafe behaviors;
- Employee training and motivation; and

Safety should become everyone's responsibility, not just the safety director's. Also should become a value of the organization and is an integral part of operations. Management and employees are committed and involved in preventing losses. Employee safety and doing something the right way takes precedence over short term production pressures. Simultaneously, production does not suffer but is enhanced due to the level of excellence developed within the organization.

## 1.11 Management Processes for Improvement safety culture:

- Define safety responsibilities for all levels of the organization, e.g., safety is a line management function
- Develop upstream measures, e.g., number of reports of hazards/suggestions, number of committee projects/successes, etc
- Align management and supervisors through establishing a shared vision of safety and health goals and objectives vs. production
- Implement a process that holds managers and supervisors accountable for visibly being involved, setting the proper example, and leading a positive change for health, safety and environment
- Evaluate and rebuild any incentives & disciplinary systems for safety and health as necessary
- Ensure the safety committee is functioning appropriately, e.g., membership, responsibilities/functions, authority, meeting management skills, etc
- Provide multiple paths for employees to bring suggestions, concerns, or problems forward. One mechanism should use the chain of command and ensure no repercussions. Hold supervisors and middle managers accountable for being responsive
- Develop a system that tracks and ensures the timeliness in hazard correction. Many sites have been successful in building this in with an already existing work order system
- Ensure reporting of injuries, first aids, and near misses. Educate employees on the incident pyramid and importance of reporting minor incidents. Prepare management for initial increase in incidents and rise in rates. This will occur if under-reporting exists in the organization. It will level off, then decline as the system changes take hold
- Evaluate and rebuild the incident investigation system as necessary to ensure that it is timely, complete, and effective. It should get to the root causes and avoid blaming workers

## 1.12 Employer Responsibilities to provide a safe workplace:

**Under the OSH law, employers have a responsibility to provide a safe workplace. This is a short summary of key employer responsibilities:**

- Provide a workplace free from serious recognized hazards and comply with standards, rules and regulations issued under the OSH Act
- Examine workplace conditions to make sure they conform to applicable standard (like OSHA standards)
- Make sure employees have and use safe tools and equipment and properly maintain this equipment
- Use color codes, posters, labels or signs to warn employees of potential hazards
- Establish or update operating procedures and communicate them so that employees follow safety and health requirements
- Employers must provide safety training in a language and vocabulary workers can understand
- Employers with hazardous chemicals in the workplace must develop and implement a written hazard communication program and train employees on the hazards they are exposed to and proper precautions (and a copy of safety data sheets must be readily available)
- Provide medical examinations and training when required by standards (like; OSHA standards.)
- Post, at a prominent location within the workplace, informing employees of their rights and responsibilities
- Report to the designated offices all work-related fatalities within 8 hours, and all work-related inpatient hospitalizations, all amputations and all losses of an eye within 24 hours
- Keep records of work-related injuries and illnesses
- Provide employees, former employees and their representatives access to the Log of Work-Related Injuries and Illnesses (OSHA Form 300)
- Provide access to employee medical records and exposure records to employees or their authorized representatives
- Provide to the OSHA compliance officer the names of authorized employee representatives who may be asked to accompany the compliance officer during an inspection
- Not discriminate against employees who exercise their rights under the Act
- Post OSHA citations at or near the work area involved. Each citation must remain posted until the violation has been corrected, or for three working days, whichever is longer. Post abatement verification documents or tags
- OSHA encourages all employers to adopt an Injury and Illness Prevention Program. Injury and Illness Prevention Programs, known by a variety of names, are universal interventions that can substantially reduce the number and severity of workplace injuries. Most successful Injury and Illness Prevention Programs are based on a common set of key elements. These include: management leadership, worker participation, hazard identification, hazard prevention and control, education and training, and program evaluation and improvement

Effective health, safety and environmental practices is about creating the kind of productive, efficient, and happy and inspiring workplace we all want to be part of a highly profitable company. These (HSE) practices also improve company reputation with customers, the local community and company own employees. So that Safety becomes a value of the organization and is an integral part of operations.

# Chapter-2: Managing Safety

## 2.1 Definition of Safety Management:

Managing Safety or Safety Management is an organizational function, which ensures that all safety risks have been identified, assessed and satisfactorily mitigated.

Safety management system is a term used to refer to a comprehensive business management system designed to manage safety elements in the workplace.

## 2.2 Basics requirements of an effective safety program:

The target of Health, Safety and Environment (HSE) is to protect employees, the public, the environment and to comply with applicable laws and protect the Company's reputation. HSE departments, of companies are responsible for environmental protection, occupational health and safety at work.

Industrial history has seen take a number of measures to protect employees from job related injuries or incidents. Included has been a wide variety of means such as training, awards, mandates, incentives, promotions and the list goes on forever. In pursuit of sound accident prevention methods, it becomes easy to lose sight of basics as we try to appeal to employees on what management thinks will gain their attention today and focus it on working accident free. But accident prevention is not complex, in fact, it's very simple. It is simply a business of "basics", and a rock-solid accident prevention program never needs to remove itself from those basic principles that have made it successful through-out the years. Presented here are the five basic areas of one such successful safety program and the mechanics that have provided for its implementation and follow-through. [41];

**To begin, we must first address the basics requirements of an effective safety program which will then direct us to our desired goals. [41];**

1. Policy-The company's commitment to safety
2. Accountability-Provide a safe work Environments
3. Training
4. Participation-Promote participation in the safety Effort
5. Compliance-Comply with all Legal Safety codes, Rules and regulations

### 2.2.1 Policy-The company's commitment to safety:

Safety is an important consideration in every decision and every business plan. It is an integral part of every position description. Goals of any safety program are both humanitarian and economic. As managers, it is main responsibility to send employees home to their families each day whole and healthy.

It is also true that a good safety record is clear evidence of good management. Accidents which result in injury, death, or loss of property are almost always preventable. It should be a company's policy to do everything reasonable to prevent injury to employees, damage to property, and to protect the corporation, the customer and all those come on the work sites. With this in mind, a company should establish a written statement of commitment to safety (policy). In the program under consideration here, the company's top line operating management made a commitment to accident prevention that extended down through the ranks and further developed an entire safety, manual that details their position

regarding all environmental, health, and safety matters as well as step by step procedures for most traditional tasks.

Once such a company safety policy (manual) has been established, and communicated, the remaining four basic requirements of managing an effective safety program can be addressed.

### 2.2.1.1 Supporting element for Building safety Policy:

Any process that brings all levels within the organization together to work on a common goal that everyone holds in high value will ensure by the organizational HSE policy. It is one of the most important initiatives that offer significant benefits for the front-line work force.

**(a) Obtain organizational Management "Support"** They need to understand the need for change and be willing to support it. Because losses due to incidents are bottom line costs to the organization, controlling these will more than pay for the needed changes (HSE policy).

**(b) Continue Building "Initiatives"** People have to understand WHY they are being asked to change what they normally do and what it will look like if they are successful.

**(c) Conduct Self Assessments** - To get where people want to go, people must know where they are starting from. A variety of self-audit mechanisms can be employed to compare people site processes and facilities with other recognized models of excellence.

**(d) Establish a Effective Committee** comprised of management, employees, and safety staff. The purpose of this group is to facilitate, support, and direct the needed change (policy).

**(e) Develop Policies for Recognition**, rewards, incentives, and ceremonies. Continually reevaluate these policies to ensure their effectiveness and to ensure that they do not become entitlement programs.

**(f) On-going Support** - Reinforcement, feedback, reassessment, mid-course corrections, and on-going training is vital to sustaining continuous improvement.

### 2.2.1.2 Example of effective HSE Policies:

Effective HSE Policies are very essential for any organization for ensuring incident free operation. There are 14 HSE policies will be applicable in the Petroleum and Mining industries. [7];

All of those HSE Policies are given below:-

1. Corporate HSE Policy,
2. Working Alone Policy ,
3. Health & Wellness Policy
4. Environmental Policy
5. Training Policy
6. Security Policy
7. P.P.E. Policy
8. Alcohol and Drug Policy
9. Land Transportation Policy
10. Safe Travel Policy
11. Smoking Policy
12. Right To Stop Work Policy
13. Quality Policy
14. Social Responsibility Policy

Creating a safety culture takes time. It is frequently a long time process. A series of continuous process improvement steps can be followed to create a safety culture. Employer and employee commitment are hallmarks of a true safety culture where safety is an integral part of daily operations.

**2.2.1.2.1 Scope of Drug and Alcohol policy:** The scope of the policy should encompass all full-time, part-time, and temporary employees of the company. Here is an example of one such policy:

The use, sale, transfer or possession of alcohol, drugs, controlled substances, drug paraphernalia or any combination thereof, on any company premises or work site (including company vehicles and any private vehicles parked on company premises or work sites) is grounds for discipline, up to and including, discharge from employment.

A company should vitally interest in the safety and well being of all its employees. As stated previously, it should be the company's policy to do all possible to provide a safe work site. To this end, it is necessary to put a policy in effect that specifically defines and prohibits contraband items.[41];

**2.2.1.2.2 Disciplinary action for entry upon company under the influence of drugs, or alcohol substances:** Entry upon company premises or being at work with drug paraphernalia or under the influence of alcohol, drugs, or controlled substances, or any combination thereof, is grounds for discipline, up to and including, discharge from employment. "under the influence" is defined for purposes of this policy as being unable to perform work in a safe and productive manner, being in a physical or mental condition which creates a risk to the safety and well-being of the individual, other employees, the public, or company property; or having any detectable level of alcohol, drugs or controlled substances, or any combination thereof, in the body.

Any employee's refusal to submit to a lawful security exam (e.g interview, lawful electronic devices), or to a search or inspection of his or her personal property located on company premises, worksites or facilities, or to a drug screening as outlined in the consent to Pre/Post-Employment Drug Screening from executed by any applicant/ employee is grounds for discipline, up to and including, discharge.

### 2.2.1.2.3 Sample Alcohol and Drug Policy:

In today's environment, it is felt that a contraband policy is necessary to define and reinforce existing work rules, employee expectations, and company practices. Along with a contraband policy, a consent form to allow for free and post employment physicals and a drug screening should be devised with the agreement of top management. The following wording gives an example of one of the types of forms in use: ABC Drilling Organization.

**Alcohol and Drug Policy:**

- No person is allowed to work under the influence of alcohol or drugs. Any person found to be under the influence of alcohol or drugs will be removed from the job site. Individuals will be reported to their crew supervisor for evaluation. Confirmation of alcohol or drug influence will receive disciplinary action of minimum two weeks suspension for first offense and termination for reoccurrence. Countries might apply stricter penalties.
- The unauthorized possession of illegal drugs, firearms, explosives, weapons and hazardous substances or articles, are not permitted on company premises, including Company owned or leased vehicles, aircraft or vessels.

- Alcohol possession or consumption is strictly prohibited on all air; land and marine vehicles, vessels or boats involved in companies operation.
- Alcohol consumption is strictly prohibited during work hours on all companies operations.
- Alcohol and drug testing may be conducted for pre-placement, at random, periodically, post accident and/or for reasonable suspicion, if and as the law permits, on any company's crew, facility or worksite. While an employee has the right to refuse an administered test, Company reserves the right, if and as the law permits, to suspend or terminate and remove an employee from the work location based on their refusal.
- Laws pertaining to drug and alcohol testing and enforcement may vary in different countries but whatever they may be the company will follow such laws.

**Some other's also included with this policy:**

- The unauthorized possession of illegal drugs, firearms, explosives, weapons and hazardous substances or articles, are not permitted on the premises of company, (Crew 432) nor in any Company owned or leased vehicles, aircraft or vessels. Any infringement will result in termination.
- It is dangerous to take illegal or any other drugs, which have not been prescribed by a doctor and such behavior is not permitted on the part of any member of personnel at whatever time and under whatever circumstances, immediate action will be taken against anyone found in possession of any illegal drugs.
- The Consumption of licensed alcohol will not be allowed Offshore.
- Contravention of the above rule may lead to termination
- Alcohol possession or consumption is strictly prohibited during work hours on all companies (Crew 432) operations. No member of personnel is authorized to be under the influence of alcohol or drugs during working hours.
- Disciplinary action will be taken against any personnel who violate this policy.
- If people are taking prescribed medication which may affect their performance at work MUST need to inform their Supervisor.
- No drug & alcohol is allowed (carrying, selling or taking). [7];

### 2.2.1.2.4 Pre-/Post-employment physicals examination including drug screening for employment process:

CONSENT TO PRE-/POST-EMPLOYMENT PHYSICALS EXAMINATION INCLUDING DRUG SCREENING

I understand that I may be required to take a pre-employment physical examination which is a part of ABC Drilling Company's pre-employment screening process and which helps ABC to evaluate my eligibility for employment. I understand and agree that if the examination is given, one of the requirements for employment is a satisfactory result on the pre-employment physical examination.

I further understand that ABC has a policy prohibiting the possession and /or use of illegal and unauthorized drugs, controlled substance, and alcohol in its workplaces. The policy has been explained to me, and I understand its contents and agreed to abide by everything contained therein in the event I am hired by ABC.

I understand that the physical examination that I am agreeing to undergo may include the collection of a blood , urine and/or breath sample to be submitted for testing. I understand the test(s) which may take place on the sample(s) shall be for the purpose of determining whether I am currently, or have in the

recent past, used alcohol, drugs, or other controlled substance. In that regard, I agree to make known to ABC any prescription medicine which I may be taking or have taking or have taken in the three months prior to my pre-employment physical examination. I understand that any positive result from any such test(s) which, in the opinion of ABC, indicates my inability to satisfactorily perform the job for which I am applying, may preclude my employment. I voluntarily consent to release of the test(s) results to those officials who make employment decisions for ABC.

If hired by ABC, I further give my voluntary consent to other physical examinations at any time upon request by ABC which may include but not be limited to the collection of blood, urine, and/or breath sample to be submitted for testing. I understand the test(s) which may take place on the sample(s) shall be for the purpose of determining whether I am currently, or have in the recent past, used alcohol, drugs, or other controlled substances. I understand that any positive result for such test(s) which, in the opinion of ABC, indicates my inability to perform the job which I they may be performing at the time, may result in my immediate discharge from the employment of ABC. I voluntarily consent to release of the test(s) results to those officials who make employment decisions for ABC. I also understand that my refusal to cooperate in a ABC investigation involving suspected drug/alcohol use by an employee or my refusal to undergo a physical examination, including, but not limited to drug testing, as requested by ABC may result in discipline, up to and including, discharge from employment with ABC.

I further agree to hold ABC, its agents, directors, officers and employees harmless from any and all liability in connection with any physical testing, including, but not limited to, testing for drug, controlled substances, and/or alcohol content in my urine, blood, or breath.[41];

Date: ----------Signature: ----------

Printed Name: ----------

### 2.2.2 Accountability-Provide a safe work Environments:

**A**ccountability also begins with management. The company's safety policy, program and mechanics for implementation can be communicated downward through the ranks to the lowest level in the organization. In this chain of communication and commitment, the program is only as strong as weakest link. Since a program's strength goes to its weakest link, it then becomes imperative that every employee be totally committed to accident prevention.

Accountability for a safe rig site also lies with the hands, the Tool-pushers and operator's Representative. Toolpushers should be accountable to their Drilling Superintendent to provide a safe, clean drilling rig, safe and well maintained hazard free equipment, materials, and trained employees. Each Toolpusher's safety performances should be monitored by drilling Superintendent who's safety performance in turn should be monitored by the Manager over him. The majority of personal injuries are caused by an employee committing an unsafe act. An employee who works safely follows the safety requirements set by his employer. These requirements provide direction to be desired goals, and further informs employees on how they personally are held accountable.

**The following are fourteen (14) general principles to which employees can be held accountable:**

(1) Person's primary responsibility as an employee is to perform his/her duties in safe manner in order to prevent injury to himself/herself or his co-workers. Adequate rest, exercise and proper diet will enhance person health and level of awareness which is necessary in avoiding accidental injury.

(2). Know the contents of company safety manual and maintain an active interest in company's safety program.
(3) Be alert to all hazardous conditions.
(4) Correct hazards whenever possible.
(5) Inform personnel coming on duty of hazards.
(6) When working alone, notify another person of companies work location, and always try to anticipate any hazards that may encounter.
(7) Use the proper tools for the type of work to be performed.
(8) Use the correct protective equipment for the work are doing in the workplace.
(9) Never attempt to lift or move a heavy object (alone) that is beyond physical capability to do so in safe manner.
(10) Be careful, when moving about the work area, area, to avoid slipping, tripping or falling. Be especially careful when weather or other conditions create or aggravate hazardous situations.
(12) Never defeat the function of a safety device unless approved by toolpusher.
(13) Do not use makeshifts of any kind that could conceivable compromise safety.
(14) Look out for other employees whose actions might cause accidents.

### 2.2.3 Training:

**As part of safety training, each employee should be required to read the safety manual and sign a statement agreeing to abide by everything contained therein.**

Safety training is an important part of overall job training. Toolpushers have the responsibility in seeing that employees read the manual and know the safe way to perform their responsibilities. Every employee has primary responsibility for their own personal safety and well being. They should also be trained that they have a duty to follow workers and the company to perform work in safety manner that will not endanger others or cause property damage or material loss or environmental damage.

No program can be complete without training to ensure the optimum use of safety rules and regulation in the industry. Training should cover according to the standard requirement. It should be provide to employee or staff in a appropriate language and vocabulary so that they will be able to understand, about workplace hazards, methods to prevent them, and standards (i.e osha) that apply to their workplace.

Training can be done on an individual basis or in group meetings. Training programs should emphasize the major goals of the program and reinforce the fact that engineering controls have been considered as the primary prevention strategy. It is not good enough to tell someone to wear PPE just because management requires it. It should be consider as a last option according to the informed of the hazards.

Workers and their supervisors will require training in when, where, why, and how to use the equipment to achieve the necessary level of protection. The workers to be trained include those who are exposed on a regular basis and others who might be exposed on an occasional basis, for example, in emergencies or when temporary work is performed in dangerous areas. The training needs and methods for all these workers are essentially the same.

In the model program has many certain points of specific procedures insides the safety manual that deals with increasing safe drilling operations or other petroleum and mining operation.

### 2.2.3.1 Training for a successful safety program:

Employee education and training on how to conduct their work safely helps to minimize the risk of exposure and is a critical element of any complete workplace health and safety program. Especially for managing safety, training must cover not only how to do the job safely but also ensure that workers understand the hazards and risks of their job, and control measure. The scope of the training depends on the size and complexity of the worksite and the hazards involved. As an example, it is recognize(s)able, that Chevron Bangladesh limited and Geokinetic International already maintain incident free operation in our country, they believed that successful jobs start with safety. They are willing to undergo any safety training deemed necessary for ensuring incident free operation. Without safety program incident free operation is impossible. A successful safety program includes training in the following areas:

- Tool Safety (Hand Tools, Power Tools, and Non-Sparking Tool)
- Manual Handling
- Heat Stress Management
- Incident Investigation and Reporting
- Emergency Management
- Chemical Safety
- MSDS
- Inspection
- Blood borne Pathogens
- Confined Space Hazards & control measure
- Electrical Hazards
- Fall Protection
- Fire Protection/Extinguisher
- First Aid and CPR
- Hazard Communication (HazCom) and control measure
- Hearing Conservation
- Vehicle Operation
- Scaffolding
- Proper Electrical Safety
- Crane Operation
- Use of Anchors and Guywires
- Use of wooden, metal and plastic (fiberglass) portable ladders.
- Hydrogen Sulfide Safety (H2S)
- Lockout/Tagout (LO/TO)
- Personal Protective Equipment (PPE)
- Respiratory Protection
- Substance Abuse Awareness (Drug & Alcohol Awareness)
- Trenching and Excavation
- Welding, Cutting & Brazing (Hot Work) and so on. [6];

### 2.2.4 Participation-Promote participation in the safety Effort:

To be successful, a safety program must have the active participation of everyone. Each employee must constantly remind themselves and their fellow employees of their safety responsibility, and by example, demonstrate their own personal commitment to the safety effort: most importantly, this includes management. When an employee perceives that conducting oneself in a certain manner results in recognition or reward, then count on that behavior being demonstrated, be it good or bed! The participation requirement informs all employees that no one is excluded.

**Here are twelve (12) key ways safety is promoted:**

a. Safety is promoted through each employee's personal involvement in the program. This includes every employee from the president to the Floorhand.
b. Safety is promoted through crew meetings.
c. Safety is promoted through correct work procedures.
d. Safety is promoted through rig inspections.
e. Safety is promoted through discussion with the operator's personnel on the rig site.
f. Safety is promoted through various types of training.
g. Safety is promoted through good accident investigation.
h. Safety is promoted through a safety award program.
i. Safety is promoted through each employee learning the contents of the safety manual.
j. Safety is promoted through participation in the International Association of Drilling contractor (IADC).
k. Safety is promoted through a rig safety poster program.
l. Safety is promoted through compliancy by the company and each employee with all applicable local, state, and federal laws and regulations.[41];

Poor health and safety leads to illness and accidents and significant costs for company business. Excessive energy consumption doesn't just harm the environment; it hurts company profits, too.

Effective health, safety and environmental practices pay for themselves. They also improve company reputation with customers, the local community and company own employees.

Everyone in the workplace should have a duty and a responsibility to do whatever they can to keep the working environment safe. Employers need to know and understand the safety regulations that pertain to their industry and make sure that their premises are up to a model (free of obstacle). Workers can do their part by understanding the procedures the company wants them to follow on the job and following them. If they see or encounter something that is out of the ordinary, there should be a procedure in place so that it can be reported to management and deal with promptly. Managers should deal with employee concerns about safety issues in an appropriate manner.

#### 2.2.4.1 Management Processes for improving safety effort:

- Define safety responsibilities for all levels of the organization, e.g., safety is a line management function.
- Develop upstream measures, e.g., number of reports of hazards/suggestions, number of committee projects/successes, etc.
- Align management and supervisors through establishing a shared vision of safety and health goals and objectives vs. production.

- Implement a process that holds managers and supervisors accountable for visibly being involved, setting the proper example, and leading a positive change for health, safety and environment
- Evaluate and rebuild any incentives & disciplinary systems for safety and health as necessary.
- Ensure the safety committee is functioning appropriately, e.g., membership, responsibilities/functions, authority, meeting management skills, etc.
- Provide multiple paths for employees to bring suggestions, concerns, or problems forward. One mechanism should use the chain of command and ensure no repercussions. Hold supervisors and middle managers accountable for being responsive.
- Develop a system that tracks and ensures the timeliness in hazard correction. Many sites have been successful in building this in with an already existing work order system.
- Ensure reporting of injuries, first aids, and near misses. Educate employees on the incident pyramid and importance of reporting minor incidents. Prepare management for initial increase in incidents and rise in rates. This will occur if under-reporting exists in the organization. It will level off, then decline as the system changes take hold.

Evaluate and rebuild the incident investigation system as necessary to ensure that it is timely, complete, and effective. It should get to the root causes and avoid

### 2.2.5 Compliance-Comply with all Legal Safety codes, Rules and regulations:

It is our duty as employees to be good community neighbors as well as law abiding citizens. To this end company must always insure that their operations do not abridge the rights of company's neighbors or the community. It should be the intention of a company, and must always be the intention of each employee, to comply with company work rules and all applicable safety regulations. Everyone must constantly be an alert to see that each phase of work is in compliance with the work rules, as well as applicable local, state and federal requirements. It is mandatory that we as drilling contractors maintain proper environmental, health and safety conditions on every worksite. Each employee should not only be expected to comply but, in addition, it should be each employee's duty to report to their supervisor at once any unsafe condition or practice which come to their attention.

This requires all who have this legal responsibility to be proactive in managing their safety, health and welfare responsibilities and deal with them in a systematic way. This section should help organizations to improve their safety and health performance by providing advice on how safety and health should be managed, and in the process help them to comply with their legal requirements.

Absolute compliance throws on companies safety program, should explicitly remember that as quick as they are to denounce an employee's mistake in non-compliance, company should even react more quickly to praise an employee's action in compliance. Recognition is one of the most powerful motivators know to mankind.

Every business has legal responsibilities to ensure the health and safety of employees and other people, and to protect the environment. But the right approach isn't about doing the minimum required to comply with the legal requirements. It can also benefit companies business.

From an environmental standpoint, it involves creating a systematic approach to complying with environmental regulations, such as managing waste or air emissions all the way to helping sites reduce the company's carbon footprint.

Successful HSE programs also include measures to address ergonomics, air quality, and other aspects of workplace safety that could affect the health and well-being of employees and the overall community.

Effective health, safety and environmental practices pay for themselves. They also improve company reputation with customers, the local community and company own employees. Health, Environment and Safety (HSE) guide explains more about how the right approach can benefit company business.

Regulatory requirements play an important role in both approaches and consequently, HSE managers must identify and understand relevant HSE regulations, the implications of which must be communicated to top management (the board of directors) so the company can implement suitable measures.

## 2.3 Supporting components for HSE Program:

Once the five basics of the safety program (Policy, Accountability, Training, Participation, Compliance) are agreed upon and reduced to writing, implementation of individual program support components become extremely important. These components make up the day to day activities on which management of the safety program exists.

### 2.3.1 Employee Understands of his job:

To ensure that employees understand what is expected of them, each position from Toolpusher to floorman has a position description which lists the daily required duties as well as the routine maintenance schedules for each tour, trip and month. These are a published post of the Environmental, Health, and safety manual.

### 2.3.2 Managers (managers including Principal Investigators) are responsible to:

- Ensure that environmental, health and safety obligations are carried out by everyone working in their operations.
- Communicate to their employees and visitors that health and safety and concern for the environment are top priorities on the Berkeley company and that everyone shares in the obligation to perform work in a safe, healthful, environmentally protective manner.
- Analyze work procedures to identify hazards; ensure measures are implemented to eliminate or control those hazards.
- Ensure workplace hazards and environmental, health and safety-related policies and procedures are communicated to employees and visitors.
- Ensure safe operating procedures are in place and are observed.
- Ensure individuals working in their operations have the proper safety equipment and personal protective equipment to perform their work safely.
- Inform employees of the availability of a medical surveillance program on company to assist them in the case of potentially hazardous exposures or injuries.
- Encourage prompt reporting of health and safety concerns without fear of reprisal.
- Curtail or stop work being carried out under their authority if they reasonably believe that continuation of the work poses an imminent danger to health or safety. Upon directing that work be curtailed or stopped, if the situation cannot be corrected immediately, the Manager must notify 1) Director under whose responsibility the work is being performed, and 2) HSE.

- Ensure that self-assessment inspections are performed regularly, that records are retained and that deficiencies identified in any inspection (self-assessment or HSE) are addressed.

**2.3.3 Supervisors are responsibilities for:** Supervisors (one who supervises particular work unit) are uniquely positioned through direct daily employee contact to respond to employee needs, problems, and satisfaction. Supervisors are the direct link between management and the work force and can be most effective in developing job training, safety attitudes, safe working methods and identifying unsafe acts.

Supervisors are responsible for a great deal of what goes on day to day in the workplace; it's not just a position that solely assigns tasks. Supervisors must ensure a safe and healthful workplace for employees. Employees must be able to report unsafe or unhealthful workplace conditions or hazards to supervisor without fear of reprisal.

**The following is a list of primary responsibilities that supervisors have in the area of occupational safety and health for all employees under their supervision.**

- Conduct Orientation and Training of Employees
- Carry out policies passed down a hierarchy from the level above
- Plan short-range action-steps to carry out goals set by the level above
- Organized the work group
- Assign jobs to subordinates
- Delegate projects to subordinate
- Direct tasks, jobs and projects and also ensure quality assurance.
- Correct Unsafe Conditions
- Enforce rules and Safe work Practices
- Lead and motivate subordinates
- Establish incentive and reward programs and recognize employees for a job well done.
- Develop group cohesiveness
- Promote employees Quick Return to work
- Solve routine daily problems
- Control or evaluate performance of subordinates and makes recommendations for improvement.
- Discipline subordinates and also documenting disciplinary actions.
- Carryout departmental work as well as the planning, controlling, scheduling, organizing, leading, etc
- Prevent Unhealthful workplace conditions or hazards
- Investigate Workplace Accidents

### 2.3.4 Responsibilities of Individuals (All Employees, Staff, Visitors and Guests):

**Every employee, or other person authorized to conduct activities at the work area is responsible to:**

- Comply with applicable health, safety and environmental, laws and regulations, Company policy and accepted safe work practices.
- Observe health, safety and environmental related signs, posters, warning signals and written directions.

- Be familiar with the emergency plan, the emergency assembly area and emergency coordinators for their building, and participate in emergency drills.
- Learn about potential hazards associated with their work and work area; know where information on these hazards is kept for their review; and use this information when needed.
- Follow safe operating procedures and Material Safety Data Sheet (MSDS) guidance applicable to work performed, if the work involves hazardous materials.
- Follow procedures and observe precautions for the use of special materials (such as carcinogens or biohazards), as detailed in the use authorization or other operating procedures.
- Use personal protective equipment and engineering controls (e.g., fume hoods) appropriate to their work.
- Stop their work if they reasonably believe continuation of the work poses an imminent danger to health or safety, and immediately notify a supervisor in the chain of authority over the work.
- Report all unsafe conditions to their supervisor or safety committee as soon as is reasonably possible.
- Warn co-workers about defective equipment and other hazards.
- Participate in health and safety training and tool box talk applicable to their work situation.
- Participate in required inspection and monitoring programs.

The position description, along with maintenance requirements serves two purposes:
(1) It leis each employee knows exactly what their job entails, plus,
(2) Provides an excellent maintenance program which is standardized throughout the company for all equipment.

**2.3.5 Responsibilities of the Office of Health & Safety:** H&S Office is responsible for tracking developments in health, safety and welfare and determining requirements that apply to the organization.

H&S Office guides employers and employees to information relating to health, safety and welfare. For example, The Occupational Safety and Health Administration (OSHA) is an agency of the United States Department of Labor. Congress established the agency under the Occupational Safety and Health Act, OSHA's mission is to "assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance". The agency is also charged with enforcing a variety of whistleblower statutes and regulations, [9]. Similarly, Health and Safety Executive (HSE) in UK, work for aims to reduce work-related death, injury and ill health. For Canada its name is Occupational Safety and Health (OHS).

**Program Development:** HSE (office) is responsible to develop and oversee programs to be implemented by the organization to meet legal requirements and environmental, health and safety policies adopted by the company, both by the Office of the President and the company administration. HSE programs in development or in operation include:

- **Hazard Communication** The Injury and Illness Prevention Program contains provisions that satisfy hazard communication requirements. Training is available from HSE upon request.
- **Emergency Response and Training** HSE is responsibilities for coordinating the development of local emergency response and training plans by Training center and administrative units. Copies submitted by concern departments of emergency response and training plans are maintained in HSE.

- **Hazardous Waste Minimization Program** HSE has developed a hazardous waste minimization program which includes educating department, employee and staff on waste minimization, facilitating the exchange of surplus chemicals, and assisting company hazardous materials users in finding ways of minimizing hazardous wastes.
- **Toxic Gas** HSE is required to develop, and assist departments in implementing, a written program to ensure the safe use and handling of toxic gases on company.
- **Environmental Permits** Assist in completion of environmental permits pertaining to air and water quality protection.
- **Fire Prevention** Inspect company facilities to identify and eliminate fire hazards, such as improper storage of flammable, electrical fire hazards and blocked hallways or exits.
- **Hazardous Spill Response** Upon request, provide assistance in hazardous material spill clean up; preparing written reports about reportable releases and notifying appropriate agencies about reportable spills.
- **Noise Monitoring and Hearing Conservation** Conduct noise surveys to determine exposure; refer individuals, as warranted, to the Hearing Conservation Program (jointly operated by HSE and the Occupational Health Program).
- **Hazardous Chemical, Radioactive and Medical Waste Management** Provide prompt, safe, cost effective and legal waste management services to chemical, radioactive, and medical waste generators. This includes:

    - Compliance Assistance
    - Waste Pick-Up
    - Hazardous Chemical
    - Material Reuse
    - Transportation
    - Disposal Tracking

- **Plan Review and Construction Inspection** , review and approve/deny plans for new construction and renovation and conduct construction inspections to assure compliance with applicable Fire Code requirement.
- **Respiratory Protection** Perform fit tests (operated by HSE and the Occupational Health Program) to ensure proper protection for those individuals who need respirators; provide training in the use and care of respirators; perform workplace airborne hazard assessments; and perform air monitoring to verify respiratory protection.
- **Sanitation** Inspect company facilities to assure sanitary provision of foods on company; sample and analyze drinking water; monitor swimming facilities for general safety hazards and adequate filtration and disinfection processes.

### 2.3.6 Employee's understanding of the safety program:

Each employee is required to read the safety manual and acknowledge by their signature that they have read and understand the safety program, that they are aware of where it is kept on their worksite, and agree to study it in detail and become familiar with the information provided therein. They agree to follow and abide by all of the safety manual's rules and requirements and to report immediately any unsafe practice, accident, or question to their supervisor. The following is a very doable work rule policy.

### 2.3.6.1 Work Rules:

In general all employees are expected to report for their work in an alert mental and sufficient physical condition and in time to be prepared to assume the responsibilities of their jobs at their scheduled starting times. They are also expected to perform any assigned work promptly, safely and efficiently; to use company time, tools and equipment carefully and productively; to deal continuously and honestly with the company, its associates, customers and their fellow employees; and to conduct themselves at all times so that they reflect credit upon themselves and their company.

Employees are subject to all company rules of conduct while they are on any company worksite, or in any other place where they are engaged in performing their job assignment. Supplements to the work rules and examples of misconduct may be posted or issued as necessary. The company will also apply disciplinary action up to and including discharge for other valid reasons.

**Examples of misconduct which generally results in discharge for a single violation:**

a. Failure to read the safety manual and sign the statement agreeing to abide by everything contained therein.
b. Sleeping on duty.
c. Possession or use of intoxicants, narcotics or barbiturates on company property at any time. Reporting for work or being on duty when tested positive on a drug screen.
d. Possession of firearms, other weapons or explosives on company property unless authorized by President or vice President.
e. Unauthorized possession of a camera on company.
f. Smoking in areas designated as “No Smoking”.
g. Unauthorized removal, theft, conversion or use of company property, materials, facilities or equipment or of any items or property of other employees.
h. Fighting on company property at any time, or in any other place while engaged in performing the job assignment or off company premises while wearing any insignia of the company.
i. Willful, knowing, reckless, or negligent abuse, damage or destruction of company property, materials, facilities or equipment.
j. Giving false information which would materially affect the performance of duties, other employees or the company’s operation. Falsification of time records, personal records, or other company records.
k. Providing company data in respect to confidential information or other matters in connection with employment or company business to anyone not authorized by the president or vice president, i.e misuse of information from company records.
l. Failure or refusal to perform assigned duties.
m. Failure to observe and abide by safety rules and commonly recognized safe working practices.

Example of misconduct which generally results in disciplinary action less than discharge for a single violation:-

a. Failure to report for work as scheduled or notified, excepting only for good and sufficient cause shown.
b. Inattention to or neglect of duties.
c. Failure to report immediately to supervisor any personal injury.

d. Use of abusive language or otherwise violating rules of good conduct in relation with supervisors, fellow workers, and the public.
e. Solicitation on company premises, including drilling sites, is prohibited in all working and non-working areas during an employee's working time or the working time of the employee solicited. Distribution on company premises, including drilling site, of any and all literature is prohibited during working and non-working time in all working areas and in all non-working areas during an employee's working time. Furthermore, non-employees are not allowed to solicit or distribute literature on company premises at any time. For purposes of this rule, working time is defined as that time during which an employee is expected to be performing or her assigned job duties, but does not include lunch time, break time, or before or after work.
f. Distribution of literature, written or printed, on company property without permission.
g. Failure to conduct personal affairs off company premises so as to avoid involving or reflecting unfavorably on the company.
h. Failure to inform a supervisor of the taking of necessary medication that might affect an employee's mental or physical alertness.
i. Gambling in any form on company property.
j. Failure to observe properly posted signs and to take appropriate action or precaution as is indicated.

Workers want to do their jobs in a safe environment so that they can concentrate on doing the best job possible. Responsible employers understand that a safe workplace improves the company's bottom line.[41];

# Chapter-3: Hazard Communication & Control

## 3.1 Definition of hazard:

A condition or action that has the potential for an unplanned release of, or unwanted contact with, an energy source that may result in harm or injury to people, property or the environment.

A hazard is a situation that poses a level of threat to life, health, property, or environment. Most hazards are potential, with only a theoretical risk of harm; however, once a hazard becomes "active", it can create an emergency. It is any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work.

**3.1.1 Examples of hazards:** Workplace hazards can come from a wide range of sources. General examples include any substance, material, process, practice, etc that has the ability to cause harm or adverse health effect to a person under certain conditions. See Table 1.

**Table 1: Examples of Hazards and Their Effects**

| Workplace Hazard | Example of Hazard | Example of Harm Caused |
|---|---|---|
| Drilling of well | Pressure | Blowout |
| Source of Energy | Electricity | Shock, electrocution |
| Process | Welding | Metal fume fever |
| Practice | Hard rock mining | Silicosis |

## 3.2 Designing a Hazard communication program:

A safe working environment does not occur by chance. It requires everyone's close attention and open communication between management and employees about the Hazards. Every employee at Drilling Co. should thoroughly receive information and training about workplace hazards, methods to prevent them, and standards (OSHA) that apply to their workplace.

The following eleven step outline would be assistance in designing a Hazard communication (Employee Training Plan) program:

1. Introducing the OSHA Hazard Communication Standard, 29CFR1910.1200.[9];
2. Introducing Company Hazards Communication Plan.
3. Introducing Hazardous Materials List.
4. Introducing MSDS-Material safety data sheet.
5. Identify permanent location of MSDS files.
6. Identify company personnel with responsibility for administering Hazards communication plan.
7. Identify company personnel capable of evaluating hazards.
8. Explain procurement procedures of MSDS.
9. Explain emergency procedures.
10. Explain hazardous materials labeling procedure.
11. Explain and have signed the employee training acknowledgement form.

So people should know the hazards. Evaluate the hazards at the worksite. Many companies within the oil and gas industry use the Job Safety Analysis (JSA) & Hazard analysis (HA) process to identify hazards and find solutions.

### 3.3 Hazards Classification:

There are many types of hazards - chemical, ergonomic, physical, and psychosocial, to name a few - which can cause harm or adverse effects in the workplace. It necessary to find out resources on specific hazards and their control, including identification, risk assessment and inspections, to keep workplace healthy and safe

Physical hazards are substances or activities that threaten physical safety. They are the most common and are present in most workplaces at one time or another. These include unsafe conditions that can cause injury, illness and death.

Hazards can be found in every workplace, and can come from a wide range of sources.

### 3.4 Hazard Identification:

#### 3.4.1 Definition of Hazard Identification Tool:


**Fig-3.1 Hazard Identification Tool (Chevron worldwide), [6];**

- A visual aid that helps people focus on hazard identification
- A tool that helps to people for identifying hazards based on energy source identification
- A simple method to help employee or people complete daily activities and tasks safely and reliably
- A tool which easily integrates with existing hazard assessment methodologies such as JSA, SPSA, HA, JHA, PHA, THA, TIF, JLA, e.t.c

**3.5 Hazardous Energy source identification:** List of Hazardous Energy source are given below:

1) Gravity
2) Motion
3) Mechanical
4) Electrical
5) Pressure
6) Temperature
7) Chemical
8) Biological
9) Radiation
10) Sound

**3.5.1 Gravity:** The force caused by the attraction of all other masses to the mass of the earth. People defined gravity as a force that attracts all objects to the surface of the earth.

Gravitational force is present all the time. People can expect an object to fall pretty much all the time if it is located at some elevation to the surface.

**Gravitational potential energy** is the energy related to the mass of an object and its distance from the earth (or ground). The heavier an object is, and the further it is from the ground, the greater its gravitational potential energy. For example, a 1 kilogram (kg) weight held 2 metres above the ground will have greater gravitational potential energy then a 1 kg held 1 metre above the ground.

**Example:** A falling object, a body tripping or falling , drop an object – a pen, a tennis ball, a suspended load, a tool on a scaffolding etc.

**3.5.2 Motion:** Motion is another energy source which is present pretty much all the time in all the industry. For example, vehicles moving at a construction site, movement of a vessels in offshore operations, a load being moved from one location to another, and we have people moving around us, as well as our own movement which could be a potential hazard.

There are some examples of motion which may not necessarily be evident at first sight. Wind is an example of motion which could be hazardous. For example a strong wind definitely poses a hazard during crane operation.

**Example:-** Vehicle, equipment movement, body positioning: lifting

**3.5.3 Mechanical:** The energy of the components of a mechanical system, i.e. rotation, vibration, motion, etc. within otherwise stationary piece of equipment/machinery. A subset of the energy of motion is mechanical energy.

**Mechanical energy** is the energy contained in an item under tension. For instance, a spring that is compressed or coiled will have stored energy which will be released in the form of movement when the spring expands. The release of mechanical energy may result in an individual being crushed or struck by the object.

**Example:** A rotating shaft of a motor, or rotating disc of a grinder or a conveyer belt. Rotating equipment, compressed springs, drive belts. There is also a less evident example of a mechanical energy - compressed spring. It is not moving but it has a potential to move and release its stored energy.

**3.5.4 Electrical:** The flow of electron is called electricity. Electrical energy is very common all around us. There is equipment which generates, stores, transfers or consumes electrical energy. Since we use this energy source every day and it is very easy to become complacent regarding safe use of electricity.

All electrical systems have the potential to cause harm. The voltage of the electricity and the available electrical current in regular businesses and company premises has enough power to cause death by electrocution. Even changing a light bulb without unplugging the lamp can be hazardous because coming in contact with the "hot", "energized" or "live" part of the socket could kill a person. So person should learn to work safely with electricity.

**Effect of electrical hazards:** The human body conducts electricity. Even low currents may cause severe health effects. Spasms, burns, muscle paralysis, or death can result depending on the amount of the current flowing through the body, the route it takes, and the duration of exposure.

**Example:** Power line, transformers, static charge, lightning, energized equipment, wiring, batteries, turbine generators, various electrical appliances e.t.c.

**3.5.5 Pressure:** Energy applied by a liquid or gas which has been compressed or is under a vacuum. Pressure may not be as common an energy source as some of the others mention above, but if there is an unwanted contact or uncontrolled release of pressure the consequences can be quite serious.

**Hydraulic potential energy** is the energy stored within a pressurized liquid. When under pressure, the fluid can be used to move heavy objects, machinery, or equipment. Examples include: automotive car lifts, injection moulding machines, power presses, and the braking system in cars. When hydraulic energy is released in an uncontrolled manner, individuals may be crushed or struck by moving machinery, equipment or other items.

**Pneumatic potential energy** is the energy stored within pressurized air. Like hydraulic energy, when under pressure, air can be used to move heavy objects and power equipment. Examples include spraying devices, power washers, or machinery. When pneumatic energy is released in an uncontrolled manner, individuals may be crushed or struck by moving machinery, equipment or other items.

**Compressed gas and equipment:** Hazards associated with compressed gases include oxygen displacement, fires, explosions, and toxic gas exposures, as well as the physical hazards associated with high pressure systems. Special storage, use, and handling precautions are necessary in order to control these hazards.


**Fig-3.2 compressed gas and equipment - OSHA Safety and Health Topics, [9];**


**Fig-3.3 Pressure vessel [21];**

Generally, a pressure vessel is a storage tank or vessel that has been designed to operate at pressures above 15 p.s.i.g. Recent inspections of pressure vessels have shown in the world that there are a considerable number of cracked and damaged vessels in workplaces. Cracked and damaged vessels can

result in leakage or rupture failures. Potential health and safety hazards of leaking vessels include poisonings, suffocations, fires, and explosion hazards. Rupture failures can be much more catastrophic and can cause considerable damage to life and property. The safe design, installation, operation, and maintenance of pressure vessels in accordance with the appropriate codes and standards are essential to worker safety and health. [21];

Probably the most readily identifiable types of pressurized equipment will be pressure piping, gas bottles and air compressors. There are also hydraulic systems in every vehicle. At the process facilities pressure is present all the time. Process piping, LPG storage, pressurized process equipment, etc.

**Example:** Pressure piping, compressed gas cylinders, tanks, hoses e.t.c.

**3.5.6 Temperature:** The measurement of differences in the thermal energy of objects or the environment, which the human body senses as either heat or cold .Temperature is either heat or cold which can cause harm to human or damage equipment.

Cases when extreme temperature can damage equipment include: water left in piping below freezing temperature will burst the pipe; or malfunctioning cooling system of an engine leading to overheating.
Energy source are open flames, sparks, etc that can potentially be ignition sources, They may not necessarily have a high temperature to cause harm to a human or damage to an equipment but if they occur in the area where flammable mixture can be present the consequences could be disastrous.
**Example:** Open flame and ignition sources, hot or cold surface, extreme weather conditions e.t.c.

**3.5.7 Chemical:** The energy present in chemicals that inherently, or through reaction, has the potential to create a physical or health hazards to people, equipment, or the environment. Chemical energy might be the most broad energy source.

Chemical energy is the energy released when a substance undergoes a chemical reaction. The energy is normally released as heat, but could be released in other forms, such as pressure. A common result of a hazardous chemical reaction is fire or explosion.
For organization, being an oil company, the presence of flammable vapors at the work place is a major concern. Apart from being an exposure issue, a flammable vapor coupled with presence of an ignition source can lead to disastrous consequences, such as explosions, fires and more importantly injuries.

Another example of chemical energy is the lack of chemical Oxygen. It occurs when inert gases are introduced for purging equipment or extinguishing fires. Nitrogen or certain types of clean extinguishing agents displace oxygen which makes it dangerous for humans.

**Example:-** Flammable vapors, toxic compounds, corrosives, welding fumes, dusts e.t.c

**3.5.8 Biological:** Living organisms that can present a hazard . “Biological” energy as a potential for hazard from living organisms, such as bacteria, mammals, insects, etc . It may not be perceived as an energy source, but it fits the model very well and aids in identifying possible hazards.

Biological energy is probably more critical for food processing and food serving facilities, as well as medical facilities. Nevertheless it plays an important role at other workplaces as well. For example, the face-piece of a respiratory equipment which is not cleaned after people used it, may allow bacterial growth. Improper washing of hands before eating, and after going to the restroom, can spread disease. Snake bites is a concern and should be considered during work planning.

Contact can result in anything from the common cold to rabies or hepatitis.
Bacteria = skin infection, strep throat, pneumonia
Viruses = common cold, hepatitis, HIV
Humans = vector for bacteria and viruses
Insects = poisonous stings or bites from spiders, bees, wasps or scorpions
Reptiles = venomous bites from snakes
Plants = poison ivy or poison oak

**Example:** Animals, bacteria, viruses, insects, blood-borne pathogens, improperly handled food, contaminated water

**3.5.9 Radiation:** Radiation energy is energy from electromagnetic sources. This energy covers all radiation from visible light, lasers, microwave, infra red, ultraviolet, and X-rays. Radiation energy can cause health effects ranging from skin and eye damage (lasers and UV light) to cancer (X-rays). Different wavelengths of electromagnetic radiation cause different types of effects on people.

**Fig- 3.4 Radiation Hazards (Chevron worldwide), [58];**

The energy emitted from radioactive elements, or sources, and naturally occurring radioactive materials.

**Example:** Welding arc, X-rays, solar rays, microwaves, naturally occurring radioactive material (NORM) scale, Gamma rays, Alpha particles, Beta particles, Neutrons. X rays refer to a kind of electromagnetic radiation generated when a strong electron beam bombards metal inside a glass tube.

### 3.5.9.1 Protection from UV radiation:

UV radiation is invisible and therefore does not stimulate the natural defenses of the eyes. Workers must use eye and skin protection while working with UV radiation sources which present the potential of eye harmful exposure. The selection of eye protection depends on the type and intensity of the UV source. UV radiation is easily absorbed in a variety of materials. Shielding is usually easy to design. Mercury lamps and metal halide lamps have an outer glass cover to stop UV radiation, and are designed such that if the outer glass is broken, the lamp ceases to function.

### 3.5.10 Sound:

**Fig-3.5 Noise Hazards and control - Chevron worldwide [6];**

### 3.5.10.1 Sound-Noise basic Information:

**Sound:** Sound is what we hear. Noise is unwanted sound. The difference between sound and noise depends upon the listener and the circumstances. Rock music can be pleasurable sound to one person and an annoying noise to another. In either case, it can be hazardous to a person's hearing if the sound is loud and if he or she is exposed long and often enough.

Sound is produced by vibrating objects and reaches the listener's ears as waves in the air or other media. When an object vibrates, it causes slight changes in air pressure. These air pressure changes travel as waves through the air and produce sound. Sound is used for communication, notification, detecting danger, etc.

Noise is one of the most common workplace health hazards. In heavy industrial and manufacturing environments, as well as in farms, cafeterias, permanent hearing loss is the main health concern.

Need to look at two aspects of sound: noise and difficulty of communication.

Noise - is any unwanted sound which can be produced by equipment, such as pile compactors, pumps, compressors, pressure relief, etc. For any noise above 85 dB hearing protection is required. The effect of excessive noise is long term and leads to permanent hearing loss.

**3.5.10.2 Noise:** Noise-related hearing loss has been listed as one of the most prevalent occupational health concerns in the industry for many years. Thousands of workers every year suffer from preventable hearing loss due to high workplace noise levels. Since 2004, the Bureau of Labor Statistics (BLS) has reported that nearly 125,000 workers have suffered significant, permanent hearing loss. In 2009 alone, BLS reported more than 21,000 hearing loss cases.

Exposure to high levels of noise can cause permanent hearing loss. Neither surgery nor a hearing aid can help correct this type of hearing loss. Short term exposure to loud noise can also cause a temporary change in hearing or a ringing in people ears (tinnitus). These short-term problems may go away within a few minutes or hours after leaving the noisy area. However, repeated exposures to loud noise can lead to permanent tinnitus and/or hearing loss.

Loud noise can also create physical and psychological stress, reduce productivity, interfere with communication and concentration, and contribute to workplace accidents and injuries by making it difficult to hear warning signals. Noise-induced hearing loss limits people ability to hear high frequency sounds, understand speech, and seriously impairs their ability to communicate. The effects of hearing loss can be profound, as hearing loss can interfere with person ability to enjoy socializing with friends, playing with person (your) children or grandchildren, or participating in other social activities person (you) enjoy, and can lead to psychological and social isolation.

**Example:-** Impact noise, vibration, high-pressure relief, equipment noise

### 3.5.10.3 Noise control for maintaining recommendation Noise level:

The National Institute for Occupational Safety and Health (NIOSH) has recommended that all worker exposures to noise should be controlled below a level equivalent to 85 dBA for eight hours to minimize occupational noise induced hearing loss.

In 1981, OSHA implemented new requirements to protect all workers in general industry (e.g. the manufacturing and the service sectors) for employers to implement a Hearing Conservation Program where workers are exposed to a time weighted average noise level of 85 dBA or higher over an 8 hour work shift. Hearing Conservation Programs require employers to measure noise levels, provide free annual hearing exams and free hearing protection, provide training, and conduct evaluations of the adequacy of the hearing protectors in use unless changes to tools, equipment and schedules are made so that they are less noisy and worker exposure to noise is less than the 85 Dba. [17];

### 3.5.10.4 Noise - Auditory Effects:

**Health effects caused by exposure to noise:** Noise exposure can cause two kinds of health effects. These effects are non-auditory effects and auditory effects. Non-auditory effects include stress, related physiological and behavioural effects, and safety concerns. Auditory effects include hearing impairment resulting from excessive noise exposure. Noise-induced permanent hearing loss is the main concern related to occupational noise exposure.

### 3.5.10.5 The main auditory effects include:

**Permanent hearing loss:** Permanent hearing loss, also known as permanent threshold shift (PTS), progresses constantly as noise exposure continues month after month and year after year. The hearing impairment is noticeable only when it is substantial enough to interfere with routine activities. At this stage, a permanent and irreversible hearing damage has occurred. Noise-induced hearing damage cannot be cured by medical treatment and worsens as noise exposure continues.

When noise exposure stops, the person does not regain the lost hearing sensitivity. As the employee ages, hearing may worsen as "age-related hearing loss" adds to the existing noise-induced hearing loss.

**3.5.10.6 A noise survey:** As a first step in dealing with noise, workplaces need to identify areas or operations where excessive exposure to noise occurs. If there is a noise problem in a workplace, then a noise assessment or survey should be undertaken to determine the sources of noise, the amount of noise, who is exposed and for how long.

A noise survey takes noise measurements throughout an entire plant or section to identify noisy areas. Noise surveys provide very useful information which enables us to identify:

- Areas where employees are likely to be exposed to harmful levels of noise and personal dosimetry may be needed.
- Machines and equipment which generate harmful levels of noise.
- Employees who might be exposed to unacceptable noise levels.
- Noise control options to reduce noise exposure.

Noise survey is conducted in areas where noise exposure is likely to be hazardous. Noise level refers to the level of sound. A noise survey involves measuring noise level at selected locations throughout an entire plant or sections to identify noisy areas. This is usually done with a sound level meter (SLM). A reasonably accurate sketch showing the locations of workers and noisy machines is drawn. Noise level measurements are taken at a suitable number of positions around the area and are marked on the sketch. The more measurements taken, the more accurate the survey is. A noise map can be produced by

drawing lines on the sketch between points of equal sound level. Noise survey maps, like that in Figure, provide very useful information by clearly identifying areas where there are noise hazards.

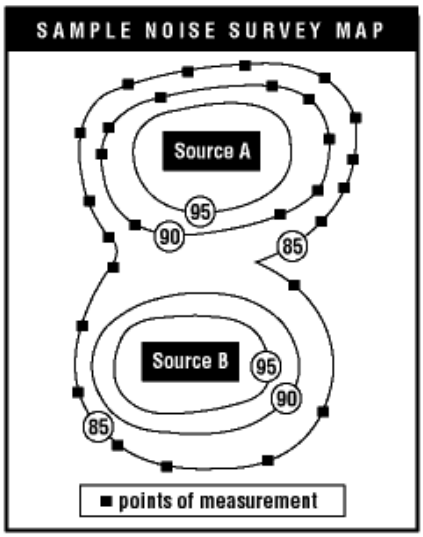



**Fig - 3.6 Noise surveys [17];**

The sound level meter (SLM) must be calibrated before and after each use. The manual gives the calibration procedure. To take measurements, the SLM is held at arm's length at the ear height for those exposed to the noise. [17]

### 3.5.10.7 What can be done to reduce the hazard from noise?

Noise controls are the first line of defense against excessive noise exposure. The use of these controls should aim to reduce the hazardous exposure to the point where the risk to hearing is eliminated or minimized. With the reduction of even a few decibels, the hazard to hearing is reduced, communication is improved, and noise-related annoyance is reduced. There are several ways to control and reduce worker exposure to noise in a workplace.

**Engineering controls** that reduce sound exposure levels are available and technologically feasible for most noise sources. Engineering controls involve modifying or replacing equipment, or making related physical changes at the noise source or along the transmission path to reduce the noise level at the worker's ear.

Noise control solution requires audiometric testing (hearing tests), hearing conservation program, and provision of hearing protectors. Examples of inexpensive, effective engineering controls include some of the following:

- Choose low-noise tools and machinery.
- Maintain and lubricate machinery and equipment (e.g., oil bearings).
- Place a barrier between the noise source and employee (e.g., sound walls or curtains).
- Enclose or isolate the noise source.

**Administrative controls** are changes in the workplace that reduce or eliminate the worker exposure to noise. Examples include:

- Operating noisy machines during shifts when fewer people are exposed.

- Limiting the amount of time a person spends at a noise source.
- Providing quiet areas where workers can gain relief from hazardous noise sources (e.g., construct a sound proof room where workers' hearing can recover – depending upon their individual noise level and duration of exposure, and time spent in the quiet area).
- Restricting worker presence to a suitable distance away from noisy equipment.

  Controlling noise exposure through distance is often an effective, yet simple and inexpensive administrative control. This control may be applicable when workers will present but not actually working with a noise source or equipment. Increasing the distance between the noise source and the worker, reduces their exposure. [17];

**3.6 Goal of identification of hazards:** Overall, the goal is to find and record possible hazards that may be present in the workplace. To be sure that all hazards will found:

- Look at all aspects of the work.
- Include non-routine activities such as maintenance, repair, or cleaning.
- Look at accident / incident / near-miss records.
- Include people who work "off site" either at home, on other job sites, drivers, with clients, out sides etc.
- Look at the way the work is organized or "done"
- Look at foreseeable unusual conditions (for example: possible impact on hazard control procedures that may be unavailable in an emergency situation, power outage, etc.).
- Examine risks to visitors or the public.

### 3.7 Series of events or decisions that should be considered:

| | | |
|---|---|---|
| Having identified the hazards, the possible major impacts of each should be itemized, such as:<br>• Sequential events (for example, a fire after an explosion).<br>• Evacuation.<br>• Casualties.<br>• Damage to plant infrastructure.<br>• Loss of vital records/documents.<br>• Damage to equipment.<br>• Disruption of work. | Based on these events, the required actions need to be determined. For example:<br>• Declare emergency.<br>• Sound the alert.<br>• Evacuate danger zone.<br>• Close main shutoffs.<br>• Call for external aid.<br>• Initiate rescue operations.<br>• Attend to casualties.<br>• Fight fire. | In the final consideration there should have a list and the location of resources needed:<br>• Medical supplies.<br>• Auxiliary communication equipment.<br>• Power generators.<br>• Respirators.<br>• Chemical and radiation detection equipment.<br>• Mobile equipment.<br>• Emergency protective clothing.<br>• Firefighting equipment.<br>• Ambulance.<br>• Rescue equipment. |

**3.8 Hazard class:** Hazard classes are a way of grouping together products that have similar properties. Most of the hazard classes are common to Globally Harmonized System (GHS) and will be used worldwide by all countries that have adopted GHS. Some hazard classes are specific to WHMIS2015. [16]

List of Hazard Classes are:

**Physical Hazards**

- Flammable gases
- Flammable aerosols
- Oxidizing gases
- Gases under pressure
- Flammable liquids
- Flammable solids
- Self-reactive substances and mixtures
- Pyrophoric liquids
- Pyrophoric solids
- Self-heating substances and mixtures
- Substances and mixtures which, in contact with water, emit flammable gases
- Oxidizing liquids & Oxidizing solids
- Organic peroxides
- Corrosive to metals
- Combustible dusts
- Simple asphyxiants
- Pyrophoric gases
- Physical hazards not otherwise classified

**Health Hazards**

- Acute toxicity
- Skin corrosion/irritation
- Serious eye damage/eye irritation
- Respiratory or skin sensitization
- Germ cell mutagenicity
- Carcinogenicity
- Reproductive toxicity
- Specific target organ toxicity – single exposure
- Specific target organ toxicity – repeated exposure
- Aspiration hazard
- Biohazardous infectious materials
- Health hazards not otherwise classified

**3.9 Safety Hazards Associated with Oil and Gas Extraction Activities:** Safety and health hazards and dangerous conditions that can result in fatalities for oil and gas workers include:

Oil and gas well drilling and servicing activities involve many different types of equipment and materials. Recognizing and controlling hazards is critical to preventing injuries and deaths. Several of these hazards are highlighted below. [10]

- Vehicle Collisions (Vehicle Accidents )
- Struck-By/ Caught-In/ Caught-Between
- Explosions and Fires
- Falls
- Chemical Exposures
- Confined Spaces
- Ergonomic Hazards
- High Pressure Lines and Equipment
- Electrical and Other Hazardous Energy
- Machine Hazards
- Planning and Prevention

### 3.9.1 Vehicle Collisions:

Workers and equipment are required to be transported to and from well sites. Wells are often located in remote areas, and require traveling long distances to get to the sites. Highway vehicle crashes are the leading cause of oil and gas extraction worker fatalities. Roughly 4 of every 10 workers killed on the job in this industry are killed as a result of a highway vehicle incident.

- Work Zone Traffic Safety.
- Fatal Facts, Report on a fatality attributable to a vehicle hazard.

**Fig-3.7 Vehicle Collisions [47];**

### 3.9.2 Struck-By/ Caught-In/ Caught-Between:

Three of every five on-site fatalities in the oil and gas extraction industry are the result of struck-by/caught -in/caught-between hazards. Workers might be exposed to struck-by/caught-in/caught-between hazards from multiple sources, including moving vehicles or equipment, falling equipment, and high-pressure lines. The following OSHA and NIOSH documents provide guidance on recognizing and controlling these hazards:

**Fig- 3.8 Struck-By/ Caught-In/ Caught-Between [10];**

- Crane, Derrick, and Hoist Safety: Addresses hazards, controls, and standards associated with cranes, derricks, and hoists.
- Struck-By : Covers struck-by hazards in the oil and gas industry.

**3.9.3 Explosions and Fires:** Workers in the oil and gas industries may face the risk of fire and explosion due to ignition of flammable vapors or gases. Flammable gases, such as well gases, vapors, and hydrogen sulfide, can be released from wells, trucks, production equipment or surface equipment such as tanks and shale shakers. Ignition sources can include static, electrical energy sources, open flames, lightning, cigarettes, cutting and welding tools, hot surfaces, and frictional heat.

**3.9.4 Confined Spaces:** Workers are often required to enter confined spaces such as petroleum and other storage tanks, mud pits, reserve pits and other excavated areas, sand storage containers, and other confined spaces around a wellhead. Safety hazards associated with confined space include ignition of flammable vapors or gases. Health hazards include asphyxiation and exposure to hazardous chemicals. Confined spaces that contain or have the potential to contain a serious atmospheric hazard must be classified as permit-required confined spaces, tested prior to entry, and continuously monitored.

**3.9.5 Ergonomic Hazards:** Oil and gas workers might be exposed to ergonomics-related injury risks, such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures, and performing the same or similar tasks repetitively. Risk factors and the resulting injuries can be minimized, in many cases, eliminated through interventions such as pre-task planning, use of the right tools, proper placement of materials, education of workers about the risk, and early recognition and reporting of injury signs and symptoms.

### 3.9.5.1 Definition of Manual handling:

Manual Materials Handling (MMH) means moving or handling things by lifting, lowering, pushing, pulling, carrying, holding, or restraining. MMH is also the most common cause of occupational fatigue, low back pain and lower back injuries.

Materials handling involves many activities, including the movement, protection, storage, and control of products throughout the manufacturing, distribution, consumption and disposal processes.

### 3.9.5.2 Manual handling risk factors and musculoskeletal disorders:

Manual handling operations involve the transporting or supporting of a load, including the lifting, lowering, pushing, pulling, carrying or moving of a load, protection, storage, and control of products throughout the manufacturing, distribution, consumption and disposal processes by the hands or through the application of bodily force. When the work exceeds a worker's physical capabilities, however, serious injuries can result. There are several risk factors that make manual handling of loads hazardous and increase the risk of injury. Particularly, for back pain, these can be grouped into five main categories: the load; the task; the environment; organizational and psychosocial factors; and individual and lifestyle factors. Risk assessment methods will have been developed to provide comprehensive information about the complex interactions of risk factors associated with the handling of loads.

### 3.9.5.2.1 Multiple risk factors:

There are a number of risk factors that may make manual handling of loads hazardous and increase the risk of musculoskeletal injury. Whilst each of these risk factors may independently contribute to the development of musculoskeletal disorders, the risk is greater if several risk factors are present at the same time. Examples of risk factors within the five major risk factor categories are:

**(a) The load:**

- heavy, bulky or unwieldy;
- difficult to grasp;
- unstable or likely to move unpredictably (like animals);
- harmful, e.g. sharp, hot;
- too large for the handler to see over or around.

**(b) The task:**

- holding loads away from the body;
- awkward and static postures, e.g., working with hands above shoulder level, sitting;
- applying high forces, e.g., lifting, carrying, pulling, pushing and using tools;
- long carrying distances;
- Repetitive movements, especially if they involve the same joints and muscle groups, and if they involve high force exertions.

**(c) The work environment:**

- limited space;
- vibration and its intensity;
- cold or excessive heat;
- dirty, slippery floor;
- poor lighting conditions;
- noisy workplaces;
- gusts of wind or other strong air movements.

**(d) Organizational and psychosocial factors:**

- demanding work, lack of control over the tasks performed and low levels of autonomy;
- low job satisfaction;
- repetitive, monotonous work, at a high pace;
- lack of support from colleagues, supervisors and managers;
- prolonged work without the opportunity to rest and recover.

**(e) Individual and lifestyle factors:**

- medical history;
- physical capabilities;
- age;
- smoking;
- acute trauma;
- pregnancy;
- lack of work experience, training or familiarity with the job.

The conditions where company workers are working can also contribute to hazards of MMH and result in injuries, for example:

- Walking surfaces that are uneven, sloping, wet, icy, slippery, unsteady, etc.
- Differences in floor levels or walking surfaces.
- Poor housekeeping that causes slip, trip and fall hazards.
- Inadequate lighting.
- Cold or very hot and humid working conditions.
- Strong wind or gusty conditions.
- Working at high pace.
- Movement is restricted because of clothing or personal protective equipment.

- Space is small or posture is constrained or both.
- Use elevating platforms to avoid overhead reaching.

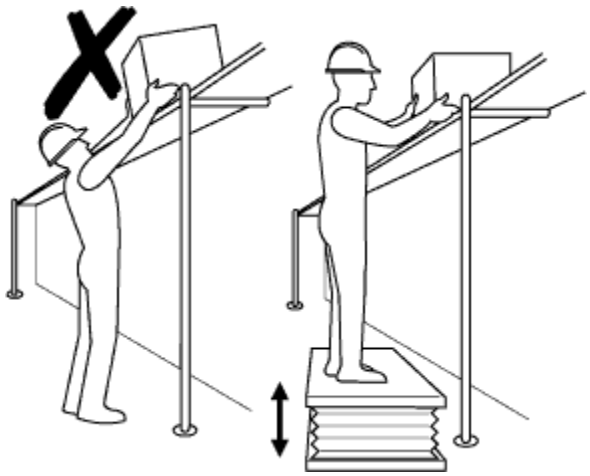


**Fig- 3.9 Using elevating platforms to avoid overhead reaching [46];**

### 3.9.5.3 Factors contribute to back injury during Manual Materials Handling (MMH):

Work-related factors include the weight of the load lifted, the range of the lift, the location of the load in relation to the body, the size and shape of the load, distance and duration the load is carried, and the number and frequency of lifts performed. Excessive bending and twisting also increase the risk for back injury.

For most workers, lifting loads over **20 kilograms** results in an increased number and severity of back injuries. While the weight of the load is the most obvious factor, it is not the only one that determines the risk of injury. The location of the load is also important. A load lifted far from the body imposes more stress on the back than the same load lifted close to the body. Lifting a bulky object also forces a worker into an awkward and potentially unbalanced position. The preferred range for lifting is between knee and waist height. Lifting above and below this range is more hazardous. [6];

How often the worker performs MMH tasks, and for how long, are extremely important factors. Frequently repeated and long-lasting tasks are the most tiring and therefore the most likely to cause back injury. Workers need rest breaks in preventing excessive fatigue. Frequency and duration of rest breaks are important factors to be considered.

Poor layout of the workplace also increases the risk for injury. For example, shelving that is too deep, too high or too low causes unnecessary bending or stretching. Lack of space to move freely increases the need for twisting and bending.

Tasks that involve manual handling exceeding the worker's physical capacity and a poor workplace layout are the most common causes of back injuries. Physical capability includes elements such as gender, physical size, age, pregnancy and any previous injury.

Training is a very important component to back injury prevention. Workers must be educated about correct lifting techniques for the tasks they do. New employees, those changing jobs, or those returning to work need to know the correct techniques and the dangers of not lifting correctly before beginning their job tasks.

### 3.9.5.4 Guidelines for lifting:

- Store bags at waist height
- People should not bend over and try to lift the bag all at once

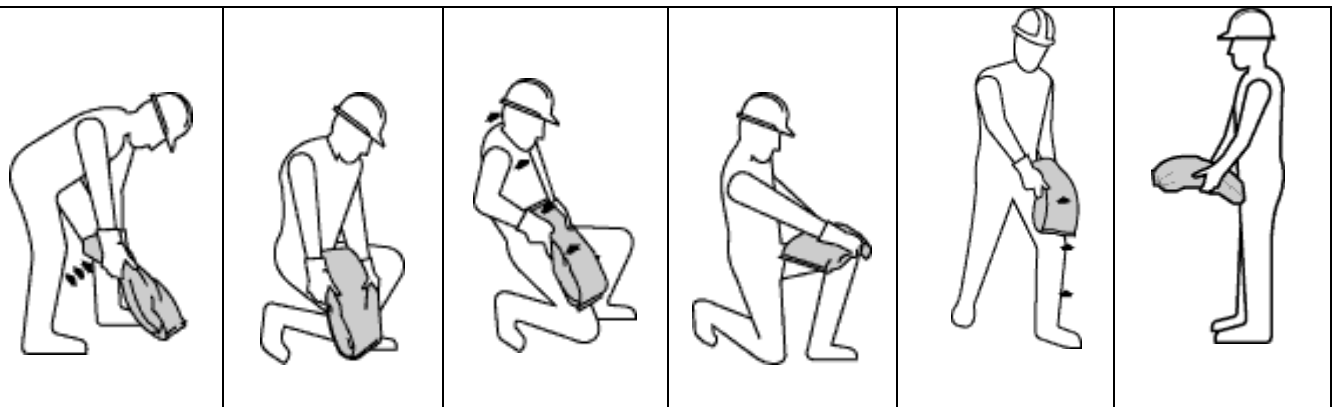
**Fig-3.10 Good lifting technique [46];**

**Fig-3.11 Bed lifting technique (bend over) [46];**

### 3.9.5.4.1 General tips for lifting:

- Prepare for the lift by warming up the muscles.
- Stand close to the load and facing the way intend to move.
- Use a wide stance to gain balance.
- Ensure a good grip on the load.
- Keep arms straight.
- Tighten abdominal muscles.
- Tuck chin into the chest.
- Initiate the lift with body weight.
- Lift the load close to the body and also centre to the body as possible.
- Lift smoothly without jerking.
- Avoid twisting and side bending while lifting.
- Avoid carrying loads with only one hand.
- Do not lift if people are not convinced that people can handle the load safely.

### 3.9.5.4.2 Heavy objects lifting procedure from ground level:



| Step-1 | Step-2 | Step-3 | Step-4 | Step-5 | Step-6 |
|---|---|---|---|---|---|

**Fig-3.12 Heavy objects lifting (Step: 1-6), [46];**

**Step-1:** Raise bag upright
**Step-2:** Put one knee against bag
**Step-3:** Pull bag up the leg
**Step-4:** Rest bag on edge of knee of the other leg
**Step-5:** Stand upright
**Step-6:** Carry the load with people back in upright position

**3.9.5.4.3 Tips for lifting compact load:** A compact load can be lifted between the knees. When lifting, remember to:

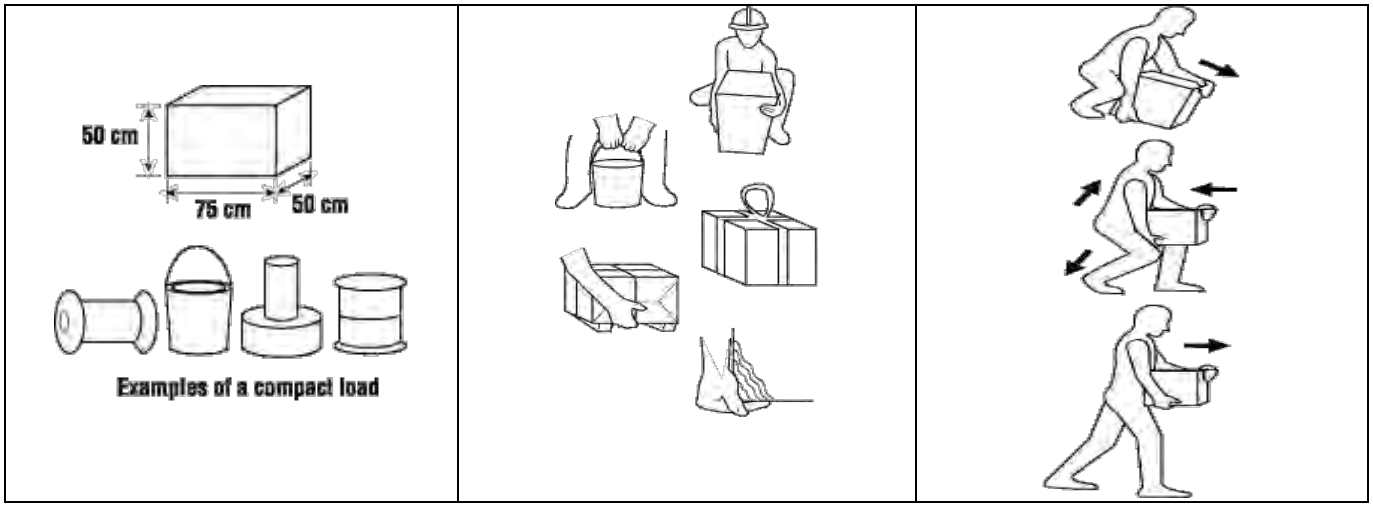



**Fig-3.13 lifting compact load [46];**

**3.9.5.5 General technique for putting a load down:** Avoid unloading a bag from the shoulder directly to floor level. Use an intermediate platform or get help from a coworker.

- Take a wide stance with one foot in front of the other.
- Keep the load close to the body.
- Keep the back straight.
- Avoid jerky releases.
- To lower object, bend knees - not back.

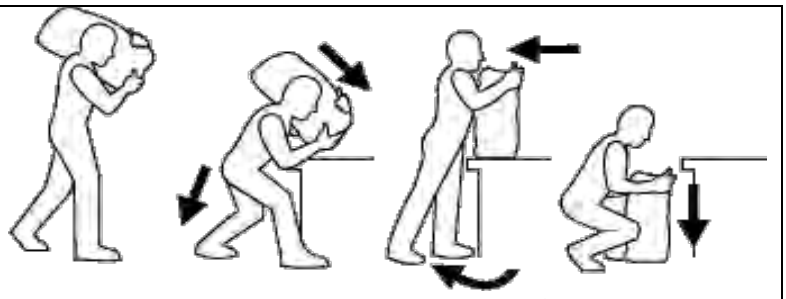


**Fig-3.14 lowering the bag [46];**

### 3.9.5.6 Technique for reducing stressful body movements in MMH:

It is important that the design of MMH allows the worker to do tasks without excessive bending and twisting. These body motions are particularly dangerous and can cause back injury even when not combined with handling loads.

- Provide all materials at a work level that is adjusted to the worker's body size.
- Eliminate deep shelves to avoid bending.
- Ensure sufficient space for the entire body to turn.
- Locate objects within easy reach.
- Ensure that there is a clear and easy access to the load.
- Use slings and hooks to move loads without handles.
- Balance contents of containers.
- Use rigid containers.
- Change the shape of the load so the load can be handled close to the body.

**3.9.5.7 Manual handling risk assessment:** Given the risks associated with many manual handling tasks, employers are required to assess the risks and ensure the health and safety of their employees. The weight of the object, the hold on the object and the position of its centre of gravity are important issues when assessing the risk of injury from manual handling tasks. A poor work environment, (e.g. the space available to perform handling tasks, temperature, humidity, etc.) can compromise muscle efficiency and may lead to vascular and neurological damage of the musculoskeletal system. Workers with cold hands may exert greater forces than normal, affecting muscles, soft tissues and joints. It is important to be aware that individuals differ in their susceptibility to musculoskeletal injury.

Under the EU Council Directive 90/269/EEC, employers are required to avoid the need for manual handling of loads by workers. Where this is not possible employers must assess the risks associated with manual handling in the workplace, and act to safeguard the safety and health of their employees and others who may be at risk. A Risk assessment involves a systematic and thorough evaluation of the hazards in the workplace and the likelihood that these could cause harm to an individual. On the findings of the risk assessment, it can then be decided whether sufficient precautions have been taken to prevent injuries occurring, or whether further action is necessary. The benefits of a good risk assessment are that they can help reduce the costs to businesses from lost output, compensation claims and higher insurance premiums.

The starting point for a risk assessment in small and medium sized enterprises is to observe the work environment and work tasks. The use of a simplified checklist to identify potential hazards can be of great benefit in ensuring that all risk factors are identified. It is important that employees are involved in this process as they are the 'experts' when it comes to identify hazards in their workplace. Some examples of suitable risk assessments can be found on national and international health and safety at work websites. For example, the checklist for the prevention of manual handling risks on the EU-OSHA website. The checklist allows assessing the risks related to manual handling and examines risk factors related to:

- the weight and specific characteristics of the load
- the task and organization of work
- workplace layout and equipment
- work environment
- Individual capacity (age, sex), skills and training level.

### 3.9.5.7.1 Risk Factor when the load is too heavy:

The regulations set no specific requirements such as weight limits; the ergonomic approach shows clearly that such requirements are based on too simple a view of the problem. However this guidance does offer numerical guidelines, which take into account weight, repetition and location of lift as a means of identifying activities, which involve risk. In using the guideline weight in figure (a) ; The assessor should take account of the nature of the work activities and have an appreciation of what realistic improvements can be put in place to avoid or reduce risk. In some situations it may not be possible to use a mechanical aid; in such circumstances other interventions should be considered. When assessing manual handling activities it is important to keep in mind that weight is not the only factor that needs to be considered. As detailed in this guidance other factors that should be considered include repetition, individual capacity, posture and the work environment.

The Guideline weights can be used to determine if the load is too heavy. Working outside these guidelines is likely to increase the risk of injury.

In Figure (15) each box contains a guideline weight for lifting and lowering in that zone. As people can see the guideline weights are reduced if handling is done with the arms extended, or at high or low levels, as this is where injuries are most likely to occur.

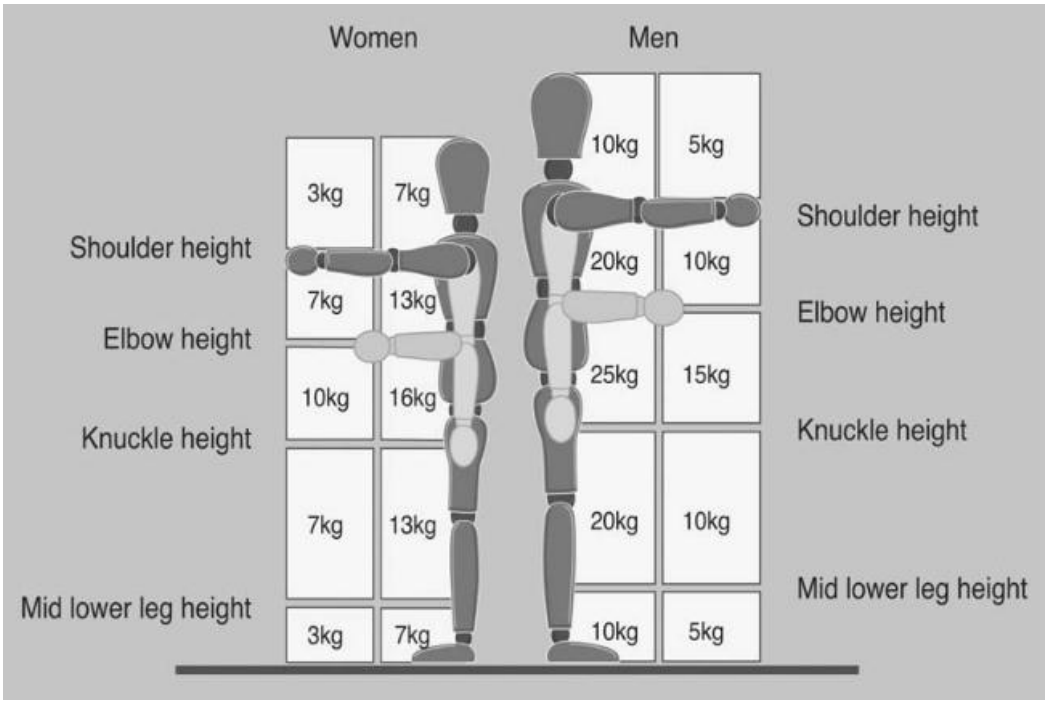



**Fig-3.15 Guideline weight for lifting and lowering Used by Kind Permission of the Health and Safety Executive [40];**

Observe the work activity people (are) assessing and compare it to the diagram. Decide which box the lifter's hand pass through when moving the load. Then, assess the load weight being handled. If the load weight is less than the figure given in the box, the operation is within the guidelines. If the load weight is greater than the figure in the box than there is an increased risk of injury .If the lifter's hands enters more than one box during the operation, then the smallest weight figure applies.

**Example:** A man is lifting a load weight of 40 kg, the man is lifting it close to his body and he lifts the load from floor level to knuckle height. In looking at the Guideline weights it is evident that the lifter's hands enter more than one box during the operation, therefore the smallest weight figure applies. In this case the smallest weight is 10 kg. Therefore the conclusion is that there is an increased risk of injury as the load weight is greater than the guideline figure. It is important to look at the activity in more detail to identify what control measure can be put in place to avoid or reduce the risk of injury.[40];

### 3.9.5.8 The Prevention of manual handling related injuries:

One approach to the prevention of work-related musculoskeletal disorders is through the health and safety guidelines and directives. Under EU legislation, each employer must undertake a suitable and sufficient risk assessment of those manual handling operations that pose a risk to an individual and take appropriate steps to prevent the risk of injury. Whilst training programmes are of crucial importance to injury prevention, they are not on their own, a suitable substitute for a lack of mechanical aids, inappropriate loads and poor working conditions.

Many MSDs from manual handling can be prevented, or greatly reduced by complying with existing health and safety regulations and following guidance on good practice. However, effective prevention measures are considered to include: designing and organizing tasks to avoid manual handling, or at least to reduce it; the use of automation and lifting aids, organizing manual handling tasks in a safer way (e.g.

dividing the load into smaller items, and ensuring appropriate rest breaks), and providing information and training to workers about the tasks, the use of equipment and correct handling techniques.

**3.9.6 High Pressure Lines and Equipment:** Workers might be exposed to hazards from compressed gases or from high-pressure lines. Internal erosion of lines might result in leaks or line bursts, exposing workers to high-pressure hazards from compressed gases or from high-pressure lines. If connections securing high-pressure lines fail, struck-by hazards might be created. The following OSHA documents provide guidance on recognizing and controlling these hazards:

**Fig-3.16 High Pressure Lines and Equipment, [10];**

- Compressed Gas and Equipment.
- Pressure Vessels.

**3.9.7 Electrical and Other Hazardous Energy:** Workers might be exposed to uncontrolled electrical, mechanical, hydraulic, or other sources of hazardous energy if equipment is not designed, installed, and maintained properly. Further, administrative controls such as operating procedures must be developed and implemented to ensure safe operations. The following OSHA and NIOSH documents provide guidance on recognizing and controlling these hazards:

- Control of Hazardous Energy (Lockout/Tagout).
- Hazardous Energy
- Lockout/Tagout.
- Electrical Safety.

**Fig-3.17 Hazardous Energy (Pressure), [10];**

### 3.9.8 Machine Hazards:

Oil and gas extraction workers may be exposed to a wide variety of rotating wellhead equipment, including top drives and Kelly drives, drawworks, pumps, compressors, catheads, hoist blocks, belt wheels, and conveyors, and might be injured if they are struck by or caught between unguarded machines. The following documents provide guidance on recognizing and controlling these hazards:

- **Barrier Guard for Drawworks Drum at Oil Drilling Sites:** Describe the need for barrier guards for drawworks drums to prevent caught-between hazards at oil drilling sites.
- **Caught-Between:** Need to discuss with employee about sources of caught-between hazards at oil and gas drilling sites.
- **Machine Guarding:** Need to discuss with employee about principles of machine guarding in the oil and gas industry and associated OSHA standards.
- **Machine Safety:** Lists NIOSH publications and current research into occupational machine safety.

## 3.10 Planning and Prevention of identified hazards:

For process-specific and task-specific hazards and controls, identifies common hazards and possible solutions to reduce incidents that could lead to injuries or deaths. Each drilling and servicing company should have its own safety program:

- For knowing hazards. Evaluating the hazards at the worksite. Many companies within the oil and gas industry use the Job Safety Analysis process (also referred to as a JSA, Job Hazard Analysis, or JHA) to identify hazards and find solutions.
- Establish ways to protect workers, including developing and implementing safe practices for:
    - Confined space; excavations
    - Chemical handling; exposure
    - Chemical storage
    - Electrical work
    - Emergency response
    - Equipment/machine hazards
    - Fall protection
    - Fire protection
    - Hot work, welding, flame cutting operations
    - Personal protective equipment use
    - Power sources (lockout/tagout provisions, safe distance from power lines)
    - Working in the heat, long shifts
- Provide personal protective equipment (PPE). When engineering controls alone cannot protect worker overexposure to chemicals, noise, or other hazards, the employer must provide PPE.
- Communicate the hazards, and train workers.
- Have a plan for contractor safety and training.

### 3.11 Worker Rights for safe workplace environment:

Workers have the right to:

- Working conditions that do not pose a risk of serious harm.
- Receive information and training (in a language and vocabulary they understand) about workplace hazards, methods to prevent them, and standards (OSHA) that apply to their workplace.
- Review records of work-related injuries and illnesses.
- Get copies of test results that find and measure hazards.
- File a complaint asking to inspect their workplace if they believe there is a serious hazard or that their employer is not following (OSHA's) rules. Organization will keep all identities confidential.
- Exercise their rights under the law without retaliation or discrimination. [14];

The health and safety of every employee is of great importance to any company. It follows that the company policy and the hazard communication standard issued by the Occupational Safety and Health Administration, should produce a reasonable effort to identify any hazard in the workplace and to inform all employees who may come in contact with them of the nature of the hazard.

In developing HSE culture in the industries (Petroleum and other industries) not only require of the federal standard (like OSHA Standard), but also looking to it as a means to add the safety program (all necessary safeguards) in the organization. As workers have a right to a safe workplace, that's why employers requires the law to provide their employees a safe and healthy workplaces.

**3.12 Electrical Safety:** Electricity is the most useful energy source which is used in almost all organization. The voltage of the electricity and the available electrical current in regular businesses and homes has enough power to cause death by electrocution. Even changing a light bulb without unplugging the lamp can be hazardous because coming in contact with the "hot", "energized" or "live" part of the socket could kill a person. That's why people need to know (learn), how to work safely with electricity.

**3.12.1 Definition of electricity:** The flow of electron (Through a conductor) is called electricity. It is one of the most important sources of energy. Electrical power allows people heat and light their homes. Electricity is also vital to the operation of many industries.

Electricity occurs naturally in the world and is also artificially created by human beings. An example of electricity occurring in nature is lightning. An example of man-made electricity is the creation of electricity at a power plant by means of a large turbine and a generator.

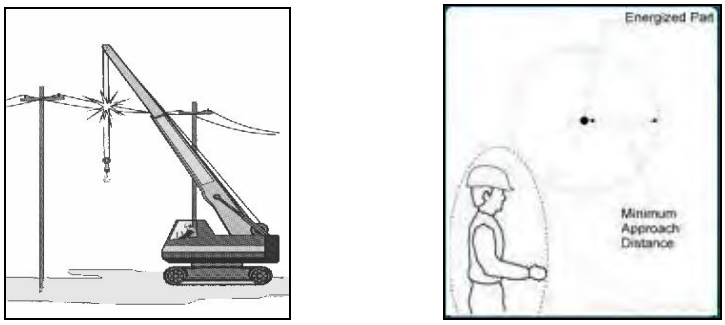
**3.12.2 Electrical energy and its Potentiality:** Electrical energy is the most common form of energy used in workplaces. It can be available live through power lines or it can also be stored, for example, in batteries or capacitors. Electricity can harm people in one of three ways:

1. By electrical shock.
2. By secondary injury.
3. By exposure to an electrical arc.

All electrical systems have the potential to cause harm. The voltage of the electricity and the available electrical current in regular businesses and homes has enough power to cause death by electrocution.

**Fig-3.18 Electrical Hazards [48];**

Electrician or operator who needs to work near electrical conductor should measure the distance to electrical wires and maintain minimum clearance distances according to safety regulations.




**(a)** **(b)**

**Fig-3.19 Minimum approach distance from energized part [59];**

**3.12.3 Types of injuries result from electrical currents:** People are injured when they become part of the electrical circuit. Humans are more conductive than the earth (the ground we stand on) which means if there is no other easy path, electricity will try to flow through our bodies.

There are four main types of injuries: electrocution (fatal), electric shock, burns, and falls. These injuries can happen in various ways:

- Direct contact with exposed energized conductors or circuit parts. When electrical current travels through our bodies, it can interfere with the normal electrical signals between the brain and our muscles (e.g., heart may stop beating properly, breathing may stop, or muscles may spasm).
- When the electricity arcs (jumps, or "arcs") from an exposed energized conductor or circuit part (e.g., overhead power lines) through a gas (such as air) to a person who is grounded (that would provide an alternative route to the ground for the electrical current).
- Thermal burns including burns from heat generated by an electric arc, and flame burns from materials that catch on fire from heating or ignition by electrical currents or an electric arc flash. Contact burns from being shocked can burn internal tissues while leaving only very small injuries on the outside of the skin.
- Thermal burns from the heat radiated from an electric arc flash. Ultraviolet (UV) and infrared (IR) light emitted from the arc flash can also cause damage to the eyes.
- An arc blast can include a potential pressure wave released from an arc flash. This wave can cause physical injuries, collapse people lungs, or create noise that can damage hearing.
- Muscle contractions, or a startle reaction, can cause a person to fall from a ladder, scaffold or aerial bucket. The fall can cause serious injuries.

**3.12.4 Electric Shock:** The human body conducts electricity. Even low currents may cause severe health effects. Spasms, burns, muscle paralysis, or death can result depending on the amount of the current flowing through the body, the route it takes, and the duration of exposure. Example: Death can result from an electrical shock of more than 120 Ma current.

### 3.12.5 Completion of Circuit through the Body:

- If a person touches a live conductor, current may flow through the body to the ground and cause a shock.
- Increased electrical contact with the ground increases the risk of shock.
- Avoid standing in water, on wet surfaces, or working with wet hands or wearing sweaty garments.
- Small shocks could surprise people and cause to slip and fall, possibly from a high place.

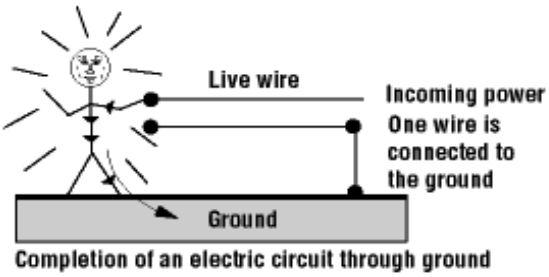



**Fig-3.20 Completion of an electric circuit through the body [18];**

**3.12.6 Responsibility of people in case of electrical shock:** People should do the following activity in case of electrical shock:-

- Call for medical help.
- People should not touch the victim with their "bare hands" until he or she is away from the live electrical source.
- Turn off the power at the fuse box or circuit breaker panel if an appliance or electrical equipment is the electrical source or, if people can do it safely, turn off the appliance or electrical equipment and unplug it. Just turning off the equipment is not sufficient.
- If the electricity cannot be turned off and the victim is still in contact with the electrical source, decide if you must move the victim or push the wire away from the victim (call for emergency help if the wire is a high voltage power line).
- Insulate yourself if you must move a victim away from a live contact - wear dry gloves or cover your hands with cloth and stand on dry insulating material like cardboard, wood or clothes. Ensure you have good footing and will not slip or fall when trying to move the victim.
- Use a dry piece of wood, broom or other dry, insulating object or material to move the wire or power source away from the victim or push the victim off the live electrical source.
- People should not move the victim if there is a possibility of neck or spinal injuries (from a fall, for example) unless it is absolutely necessary.
- Give artificial respiration if the victim is not breathing.
- Give CPR if the victim's heart has stopped (In that case person must be trained in CPR).
- Cover burns with a sterile dressing. There may be a burn where the power source touched the victim and in the area where the electricity left the body (to ground). On the surface electrical burns may not look serious but deeper in the tissue the burn can be severe.

- Keep the victim comfortable, warm and at rest, and monitor breathing.

**3.12.7 Power Tools Safety:** Because power tools are so common in construction, workers are constantly exposed to a variety of hazards. Every tool that makes their job easy and efficient may one day be the cause of a tragic accident. It is good to be reminded of common-sense safety practices. [18];

### 3.12.8 Portable Tool Use with Extension Cords:

- Another potential hazard is using extension cords with portable tools. In construction, these cords suffer a lot of wear and tear. Often, the damage is only to the insulation, exposing energized conductors. When a person handling the damaged cord contacts the exposed wires while holding a metal tool case or contacting a conductive surface, serious electrical shock can result, causing a fall, physical injury, or death. [18];
- Since neither insulation nor grounding protects people from these conditions, use other protective measures. One acceptable method would be a ground-fault circuit interrupter (GFCI).

**Fig-3.21 Frac tank bonding and grounding, [49];**

### 3.12.9 General safety tips for working with or near electricity:

- Inspect portable cord-and-plug connected equipment, extension cords, power bars, and electrical fittings for damage or wear before each use. Repair or replace damaged equipment immediately.
- Always tape extension cords to walls or floors when necessary. Nails and staples can damage extension cords causing fire and shock hazards.
- Use extension cords or equipment that is rated for the level of amperage or wattage that people are using.
- Always use the correct size fuse. Replacing a fuse with one of a larger size can cause excessive currents in the wiring and possibly start a fire.
- Always use ladders made with non-conductive side rails (e.g., fibreglass) when working with or near electricity or power lines.
- Place halogen lights away from combustible materials such as cloths or curtains. Halogen lamps can become very hot and may be a fire hazard.
- Risk of electric shock is greater in areas that are wet or damp. Install Ground Fault Circuit Interrupters (GFCIs) as they will interrupt the electrical circuit before a current sufficient to cause death or serious injury occurs.
- Know where the panel and circuit breakers are located in case of an emergency.
- Label all circuit breakers and fuse boxes clearly. Each switch should be positively identified as to which outlet or appliance it is for.
- Do not use outlets or cords that have exposed wiring.
- Do not block access to panels and circuit breakers or fuse boxes.
- Do not touch a person or electrical apparatus in the event of an electrical accident. Always disconnect the power source first. [18];

### 3.12.10 Responsibility of people if he thinks he is too close to overhead power lines:

People should not work close to power lines. Recommended distances vary by jurisdiction and/or utility companies. Company should check with both jurisdiction and electrical utility company when working, driving, parking, or storing materials closer than 15 m (49 feet) to overhead power lines.

- If people must be close to power lines, people must first call electrical utility company and they will assist according to necessary.
- If companies vehicle comes into contact with a power line:
    - Do not get out of company vehicle.
    - Call 911 and local utility service for help.
    - Wait for the electrical utility company people to come and they will tell the concern people when it is safe to get out of company vehicle.
    - Never try to rescue another person if he or she is not trained to do so.
    - If people must leave the vehicle (e.g., vehicle catches on fire), exit by jumping as far as possible - at least 45 to 60 cm (1.5 to 2 feet). Never touch the vehicle or equipment and the ground at the same time. Need to keep people feet, legs, and arms close to the body.
    - People should keep feet together (touching), and move away by shuffling the feet. Never let feet separate or may be shocked or electrocuted.
    - Shuffle at least 10 meters away from vehicle before take a normal step. Do not enter an electrical power substation, or other marked areas.

**3.12.11 Grounding and its requirement:** The term "ground" refers to a conductive body, usually the earth. "Grounding" a tool or electrical system means intentionally creating a low-resistance path to the earth. When properly done, current from a short or from lightning follows this path, thus preventing the buildup of voltages that would otherwise result in electrical shock, injury and even death

There are two kinds of grounds; both are required by the OSHA construction standard:

- System or Service Ground: In this type of ground, a wire called "the neutral conductor" is grounded at the transformer, and again at the service entrance to the building. This is primarily designed to protect machines, tools, and insulation against damage.
- Equipment Ground: This is intended to offer enhanced protection to the workers themselves. If a malfunction causes the metal frame of a tool to become energized, the equipment ground provides another path for the current to flow through the tool to the ground. [18];


**Fig-3.22 Electrical Incidents-Text Version of Grounding Animation, [18];**

View these images (Bad and Good –above Fig)

**Grounding Requirements:**

- Ground all electrical systems.
- The path to ground from circuits, equipment, and enclosures must be permanent and continuous.
- Ground all supports and enclosures for conductors.
- Ground all metal enclosures for service equipment.
- Ground all exposed, non-current-carrying metal parts of fixed equipment.
- Ground exposed, non-current-carrying metal parts of tools and equipment connected by cord and plug.

## 3.12.12 Methods of Grounding Equipment:

- Ground all fixed equipment with an equipment grounding conductor that is in the same raceway, cable, or cord, or that runs with or encloses the circuit conductors (except for DC circuits only).
- Conductors used for grounding fixed or moveable equipment, including bonding conductors for assuring electrical continuity, must be able to safely carry any fault current that may be imposed on them.
- Electrodes must be free from nonconductive coatings, such as paint or enamel, and if practicable, must be embedded below permanent moisture level.

The image labeled "Bad" demonstrates an example of improper grounding. In this image a construction worker wearing a hard hat is using an electric saw to cut lumber. The image shows the cord to his saw is not completely plugged in. As a result, as the worker uses his saw, the electricity flowing through the cord also flows through his body.

The image labeled "Good" demonstrates an example of proper grounding. In this image a construction worker wearing a hard hat is using an electric saw to cut lumber. The image shows the cord to his saw completely plugged in. As the worker uses his saw, the electric current is properly controlled, keeping him from being injured.

## 3.12.13 Use of Ground Fault Circuit Interrupter (GFCI):

A Class A Ground Fault Circuit Interrupter (GFCI) works by detecting any loss of electrical current in a circuit (e.g., it will trip at a maximum of 6mA). When a loss is detected, the GFCI turns the electricity off before severe injuries or electrocution can occur. A painful non-fatal shock may occur during the time that it takes for the GFCI to cut off the electricity so it is important to use the GFCI as an extra protective measure rather than a replacement for safe work practices.

A GFCI Circuit Breaker can be installed on some circuit breaker electrical panels to protect an entire branch circuit.

## 3.12.14 Checklist for basic electrical safety:

**Inspect Cords and Plugs**

- Check extension cords and plugs daily. Do not use, and discard if worn or damaged. Have any extension cord that feels more than comfortably warm checked by an electrician.

**Eliminate Octopus Connections**

- Do not plug several items into one outlet.
- Pull the plug, not the cord.
- Do not disconnect power supply by pulling or jerking the cord from the outlet. Pulling the cord causes wear and may cause a shock.

**Never Use Extension Cords as Permanent Wiring**

- Use extension cords only to temporarily supply power to an area that does not have a power outlet.
- Keep extension cords away from heat, water and oil. They can damage the insulation and cause a shock.
- Do not allow vehicles to pass over unprotected extension cords. Extension cords should be put in protective wire way, conduit, pipe or protected by placing planks alongside them.

## 3.13 Chemical Safety:

### 3.13.1 Chemical Hazards and its effect:

The energy present in chemicals that inherently, or through reaction, has the potential to create a physical or health hazards to people, equipment, plant or the environment. Chemical energy might be the most broad energy source. It is the energy released when a substance undergoes a chemical reaction. The energy is normally released as heat, but could be released in other forms, such as pressure. A common result of a hazardous chemical reaction is fire or explosion. That's why, for performing any activity related with chemical, need to read out the Material Safety Data Sheet at first. It is a document that contains information on the potential health effects of exposure and how to work safely with the material it is written about. It is an essential starting point to a health and safety program. It contains hazard evaluations on the use, storage, handling, and emergency procedures all related to the material.

For an oil and gas company, the presence of flammable vapors at the work place is a major concern. Apart from being an exposure issue, a flammable vapor coupled with presence of an ignition source can lead to disastrous consequences, such as explosions, fires and more importantly injuries.

**3.13.2 Example of chemical:** Flammable vapors, toxic compounds, corrosives, welding fumes, dusts, Sulfuric acid, Methane, Drilling Mud, Hydraulic Fracturing fluid, Corrosives dusts toxic compounds, welding fumes, e.t.c

### 3.13.3 Hazardous Chemicals:

Workers, who use hazardous chemicals during work processes, especially during hydraulic fracturing, might be exposed to hazardous byproducts of oil and gas drilling. The degree of potential hazard depends on individual chemical properties and toxicity, but possible hazards include chemical burns from caustic substances and inhalation of toxic vapors. All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately. Establishing effective engineering controls and work practices can reduce potential worker overexposures.


**Fig-3.23 Hazardous Chemicals [10];**

As common result of a hazardous chemical reaction is fire or explosion. That's why, for performing any activity related with chemical, need to locate chemical supply lines to the system and close and lockout the valves. Where possible, bleed lines and/or cap ends to remove chemicals from the system.

### 3.13.4 Chemical Inventory:

Determine which chemicals are used in the workplace and whether material safety data sheets are available. Find out whether actual and potential sources of chemical exposure are properly controlled. Make sure that all workers have received training in handling chemicals. Check that all chemicals are labeled with pertinent information (such as handling, storage, and waste disposal) according to Workplace Hazardous Materials Information System (WHMIS) requirements.

### 3.13.5 Respiratory Protection for chemical:

Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors, and sprays. These hazards may cause cancer, lung impairment, diseases, or death.

Respirators protect the user in two basic ways. The first is by the removal of contaminants from the air. Respirators of this type include particulate respirators, which filter out airborne particles, and air-purifying respirators with cartridges/canisters which filter out chemicals and gases. Other respirators protect by supplying clean respirable air from another source. Respirators that fall into this category include airline respirators, which use compressed air from a remote source, and self-contained breathing apparatus (SCBA), which include their own air supply. [34];

**Fig-3.24 Respiratory Protection [34];**

**3.13.6 Employer Responsibility about chemical Hazard:** According to OSHA requirement employers should ensure the safety of all employees in the work environment. Necessary protection must be provided whenever need to protect against chemical, environmental, hazards.

- Provide personal protective equipment (PPE). When engineering controls alone cannot protect worker overexposure to chemicals, or other hazards, the employer must provide PPE.
- Employers should responsible for labelling or relabelling products in the workplace, as directed in occupational health and safety legislation.
- Clearly label all chemicals and materials. Check the material safety data sheet (MSDS) or safety data sheet (SDS) for storage and handling instructions. If necessary need to contact with the manufacturer for more information.
- Check material safety data sheets (MSDSs) or safety data sheets (SDSs) for recommendations regarding PPE (gloves, respirator, etc.) when working with chemicals and materials.
- Provide workers access to Safety Data Sheets (SDSs) on silica sand and other hazardous chemicals they are exposed to during hydraulic fracturing operations or other chemical related activities.
- Provide training and information to workers about the hazards of silica and other chemicals used in the workplace.
- Before deciding to replace a chemical/substance with another, consider all the implications and potential risks of the new material.
- Eliminate the use of the hazardous chemical or material if possible or take necessary control measure.
- Treat drilling fluids to chemically reduce corrosion failures.
- Employer should Highlights potential asphyxiation and toxic chemical exposure hazards in confined spaces on drilling rigs to the employee who directly involve with that activity.
- Confined spaces that contain or have the potential to contain a serious atmospheric hazard (chemical hazards) must be classified as permit-required confined spaces, tested prior to entry, and continuously monitored.

### 3.13.6.1 Employee Responsibility about chemical Hazard:

- Use proper personal protective equipment when working with chemicals.
- Sometimes employees should responsible for labelling or relabelling products in the workplace, as directed in occupational health and safety legislation.
- Use designated containers for mixing certain chemicals.
- In case of oxygen deficiency: take precautions to ensure own safety before attempting rescue (e.g. wear appropriate protective equipment).
- Take precautions to prevent a fire (e.g. remove sources of ignition).
- Stop or reduce leak if safe to do so.
- For accidental release measures of methane, eliminate heat and ignition sources such as sparks, open flames, hot surfaces and static discharge. Post "No Smoking" signs.
- Always secure (e.g. chain) cylinders in an upright position to a wall, rack or other solid structure.
- Always wear insulated protective clothing, if contact with refrigerated gas is possible.
- If the oxygen content of the air is below acceptable limits, wear a NIOSH approved self-contained breathing apparatus (SCBA) or supplied air respirator.
- First aiders should avoid direct contact. Wear chemical protective gloves, if necessary.

- Ensure in the workplace there have equipment and supplies for flushing, neutralizing, and cleaning spilled chemicals, acid and electrolyte solutions nearby.
- Follow the manufacturer's guidelines regarding suitable glove material.
- Minimize potential for environmental damage (e.g., do not pour chemicals down the drain, on the ground, into storm sewers; recycle or compost trash as much as possible; etc.).
- Do not throw away unwanted chemicals into the general garbage or into bodies of water which could contaminate streams, irrigation or drinking water.

**3.13.7 Significance of signal word:** A signal word is a prompt that alerts people about the degree or level of hazard of the product. There are only two signal words used: "**Danger**" or "**Warning**". "Danger" is used for high risk hazards, while "Warning" is used for less severe hazards. If a signal word is assigned to a hazard class and category, it must be shown on the label, and listed Hazards Identification of the Safety Data Sheet (SDS).

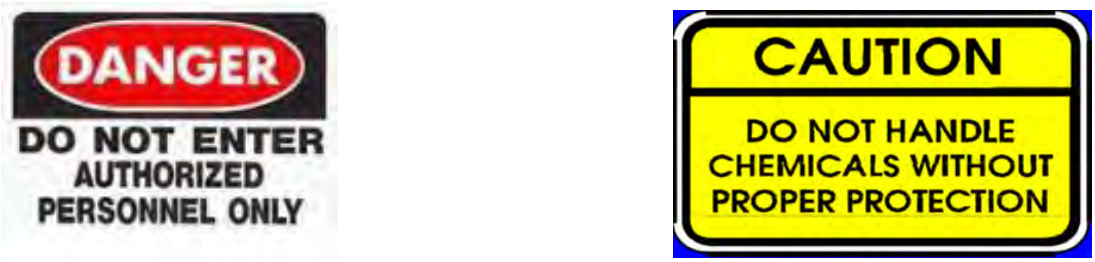



**Fig- 3.25 Example of Signal word Sign "Danger" or "Warning" [6];**

**3.13.8 Importance of chemical labeling:** Labels are important because they are the first alert there may be hazards associated with using the product. The labels also tell what precautions to take when using the product. In addition, labels also inform the person that there is a Material Safety Data Sheet (MSDS) available which contains more detailed information on the product. Employers and sometimes employees are all responsible for labelling or relabelling products in the workplace, as directed in occupational health and safety legislation.

**3.13.8.1 Example of chemical Labeling:** Pipes and reaction vessels may be marked in other ways such a colour coding, or placards. However, it is the employer's duty to train workers how to recognize and interpret the markings used in the individual workplace.

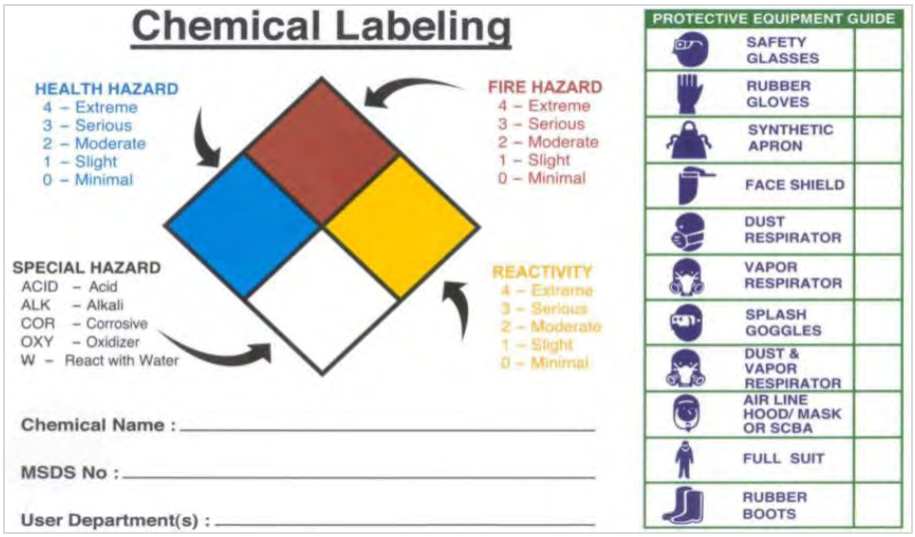



**Fig- 3.26 Example of Chevron's In-house Chemical Label, [6];**

### 3.13.8.2 WHMIS symbols (for chemical) and their meaning:

| Class A - Compressed Gas | Symbols (for chemical) |
|---|---|
| • Contents under high pressure.<br>• Cylinder may explode or burst when heated, dropped or damaged. |  |

| Class B - Flammable and Combustible Material | Symbols (for chemical) |
|---|---|
| • May catch fire when exposed to heat, spark or flame.<br>• May burst into flames. |  |

| Class C - Oxidizing Material | Symbols (for chemical) |
|---|---|
| • May cause fire or explosion when in contact with wood, fuels or other combustible material. |  |

| Class D, Division 1 - Poisonous and Infectious Material: Immediate and serious toxic effects | Symbols (for chemical) |
|---|---|
| • Poisonous substance.<br>• A single exposure may be fatal or cause serious or permanent damage to health. |  |

| Class D, Division 2 - Poisonous and Infectious Material: Other toxic effects | Symbols (for chemical) |
|---|---|
| • Poisonous substance.<br>• May cause irritation. | |

| | |
|---|---|
| • Repeated exposure may cause cancer, birth defects, or other permanent damage. |  |

| Class D, Division 3 - Poisonous and Infectious Material: Biohazardous infectious materials | Symbols (for chemical) |
|---|---|
| • May cause disease or serious illness.<br>• Drastic exposures may result in death. |  |

| Class E - Corrosive Material | Symbols (for chemical) |
|---|---|
| • Can cause burns to eyes, skin or respiratory system. |  |

| Class F - Dangerously Reactive Material | Symbols (for chemical) |
|---|---|
| • May react violently causing explosion, fire or release of toxic gases, when exposed to light, heat, vibration or extreme temperatures. |  |

**Fig- 3.27 Symbols for chemical Hazard Class -WHMIS classification Controlled Product symbols for chemical [16];**

### 3.13.8.3 Pictogram for hazardous chemical product:

Pictograms are graphic images that immediately show the user of a hazardous product what type of hazard is present. With a quick glance, it can see, for example, that the product is flammable, or if it might be a health hazard.

The graphic below shows hazard pictograms. The bold type is the name given to the pictogram; the words in the brackets describe the hazard.

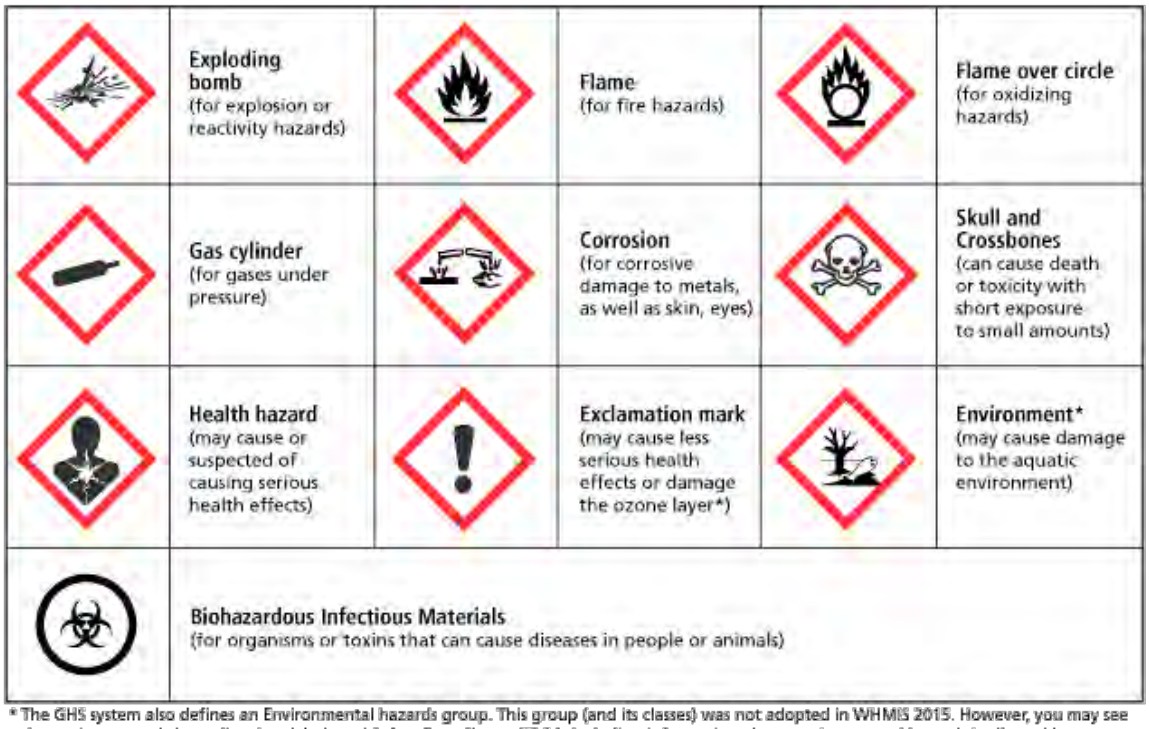



**Fig-3.28 Hazard pictograms-GHS system Environmental hazards group which was not adopted in WHMIS 2015. [15];**

### 3.13.9 Globally Harmonized System (GHS):

GHS stands for the Globally Harmonized System of Classification and Labeling of Chemicals. GHS defines and classifies the hazards of chemical products, and communicates health and safety information on labels and safety data sheets). The goal is that the same set of rules for classifying hazards, and the same format and content for labels and safety data sheets (SDS) will be adopted and used around the world. An international team of hazard communication experts developed GHS.

#### 3.13.9.1 Benefits of using Globally Harmonized System (GHS):

Currently many different countries have different systems for classification and labelling of chemical products. In addition, several different systems can exist even within the same country. This situation has been expensive for governments to regulate and enforce, costly for companies who have to comply with many different systems, and confusing for workers who need to understand the hazards of a chemical in order to work safely.

GHS promises to deliver several distinct benefits. Among them are:

- Promoting regulatory efficiency.
- Facilitating trade.
- Easing compliance.
- Reducing costs.
- Providing improved consistent hazard information.
- Encouraging the safe transport, handling and use of chemicals.
- Promoting better emergency response to chemical incidents.
- Reducing the need for animal testing.

**Safety Data Sheets (SDS)** - The GHS SDS has 16 sections in a set order, and minimum information is prescribed.

### 3.13.10 Material Safety Data Sheet (MSDS):

A Material Safety Data Sheet (MSDS) is a document that contains information on the potential hazards of health, fire, reactivity and environmental exposure and how to work safely with the chemical product or material are written about. It is an essential starting point for the development of a complete health and safety program. It also contains information on the use, storage, handling and emergency procedures all related to the hazards of the material. The MSDS contains much more information about the material than the label. MSDSs are prepared by the supplier or manufacturer of the material. It is intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.

MATERIAL SAFETY DATA SHEET

ADDRESS:
Heat and Light Resources
d/b/a HeatCell
PO Box 1033
Jane Lew, WV 26378
(304) 326-2624

DATE: 01/02/00
PREPARED BY: Dr. Charles Simon
EMERGENCY TELEPHONE NUMBER: CHEMTREC 800-424-9300

NFPA HAZARD CLASSIFICATIONS
H = HEALTH
F = FLAMMABILITY
R = REACTIVITY
INF = NOT FOUND
H = 1
F = 1
R = 1

I. IDENTIFICATION

LABEL NAME: FOOD WARMER
TRADE OR PRODUCT NAME: EcoFuel™ XB/HeatCell
FDA NO:
CAS NO: Diethylene Glycol CAS 00111-46-6

II. FIRE, EXPLOSION AND REACTIVITY DATA

FLASH POINT (METHOD): 246°F (104°C) Cleveland Open Cup
EXTINGUISHING MEDIA: DRY CHEMICAL, FOAM OR $CO_2$
DOT HAZARD CLASSIFICATION: NOT REQUIRED

0 = LEAST
1 = SLIGHT
2 = MODERATE
3 = HIGH
4 = EXTREME

SPECIAL FIRE FIGHTING PROCEDURES: NONE
UNUSUAL FIRE AND EXPLOSION HAZARDS: UNKNOWN, Believed to be relatively safe.

HAZARDOUS COMBUSTIBLE OR DECOMPOSITION PRODUCTS:
Product consists of hydrocarbon component stabilized by tightly packed fiber wool to give an essentially non-spillable mass. The components are contained in a metal can with a metal lid. The mass is not ignitable at room temperature. To ignite, apply flame directly to glass fiber(s). Can produce carbon monoxide and some irritants under some burning conditions. Glass fibers caused cancer in animals through unnatural routes of exposure (surgical implantation), but it is not associated with cancer by inhalation. Use of glass fibers has not been shown to cause cancer in humans. If ingestion of glass fibers occur, observe individual for several days to ensure that intestinal blockage does not occur. It is not recommended to induce vomiting if ingested.

STABILITY: Stable CONDITIONS TO AVOID: Excessive Heat. MATERIALS TO AVOID: Strong Oxidizers.
HAZARDOUS POLYMERIZATION PRODUCTS: NA Will not occur.

III. PHYSICAL DATA

ODOR, APPEARANCE AND PHYSICAL STATE:
Slightly opaque colorless liquid with subtle petroleum solvent odor

BOILING POINT: 433°F 223°C
MELTING POINT: NA
SPECIFIC GRAVITY (H2O = 1 lb): 1.117 @ 68°F (20°C)
EVAPORATION RATE: < 1 (Butyl Acetate = 1)
VAPOR PRESSURE (mm Hg): < 1@20°C, DEG = 0.01
SOLUBILITY IN WATER: Partially Miscible
VAPOR DENSITY (AIR = 1): > 1

IV. PROTECTION INFORMATION

RESPIRATORY: Use MSHA or NIOSH respirator for handling vapor or mist.
VENTILATION: Always use with Good ventilation.
EYE: Safety glasses for working with vapors or mists.
SKIN: Protective gloves or clothing generally not needed.
OTHER PROTECTIVE DEVICES AND PROCEDURES: Generally not required. Avoid prolonged breathing of mist. Wash hands after handling. Wash soiled work clothing frequently.

V. OCCUPATIONAL EXPOSURE LIMIT

THRESHOLD LIMIT VALUE (TLV): NF
OSHA PERMISSIBLE EXPOSURE LIMIT (PEL): NF
HAS THE SUBSTANCE BEEN LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN IN THE ANNUAL REPORT OR CARCINOGENS PUBLISHED BY NTP, BY THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, OR BY OSHA? YES ☐ NO ☒

**Fig-3.29 Example of Material Safety Data Sheet (MSDS) (Google image of MSDS Sheet)**

### 3.13.10.1 Importance of understanding MSDS:

Traditionally the intended readers of MSDSs were occupational hygienists and safety professionals. Now the audience also includes employers, supervisors, doctors, emergency responders and workers. To ensure that MSDS users can quickly find the information that they need, the information should be in an easy-to-read format and written in a clear, precise and understandable manner.

For most people who work with controlled products, there are some sections that are more important than others. it should always read the name of the chemical, know the hazards, understand safe handling and storage instructions, as well as understand what to do in an emergency.

### 3.13.11 SDS contains the following information:

The Hazardous Products Regulations specifies the sections and content for the SDS, as follows:

| **(ANSI, GHS) standards** | | |
|---|---|---|
| | **SDS Section and Heading** | **Specific Information Elements** |
| **1** | Identification | • Product identifier (e.g. Product name)<br>• Other means of identification (e.g. product family, synonyms, etc.)<br>• Recommended use<br>• Restrictions on use<br>• Supplier identifier<br>  o Name, full address and phone number(s)<br>• Emergency telephone number and any restrictions on the use of that number, if applicable |
| **2** | Hazard identification | • Hazard classification (class, category) of substance or mixture or a description of the identified hazard for Physical or Health Hazards Not Otherwise Classified<br>• Label elements:<br>  o Symbol (image) or the name of the symbol (e.g., flame, skull and crossbones)<br>  o Signal word<br>  o Hazard statement(s)<br>  o Precautionary statement(s)<br>• Other hazards which do not result in classification (e.g., molten metal hazard) |
| **3** | Composition/Information on ingredients | • When a hazardous product is a material or substance:<br>  o Chemical name<br>  o Common name and synonyms<br>  o Chemical Abstract Service (CAS) registry number and any unique identifiers<br>  o Chemical name of impurities, stabilizing solvents and/or additives |

| | | |
|---|---|---|
| | | • For each material or substance in a mixture that is classified in a health hazard class:<br>  ○ Chemical name<br>  ○ Common name and synonyms<br>  ○ CAS registry number and any unique identifiers<br>  ○ Concentration |
| **4** | First-aid measures | • First-aid measures by route of exposure:<br>  ○ Inhalation<br>  ○ Skin contact<br>  ○ Eye contact<br>  ○ Ingestion<br>• Most important symptoms and effects (acute or delayed)<br>• Immediate medical attention and special treatment, if necessary |
| **5** | Fire-fighting measures | • Suitable extinguishing media<br>• Unsuitable extinguishing media<br>• Specific hazards arising from the hazardous product (e.g., hazardous combustion products)<br>• Special protective equipment and precautions for fire-fighters |
| **6** | Accidental release measures | • Personal precautions, protective equipment and emergency procedures<br>• Methods and materials for containment and cleaning up |
| **7** | Handling and storage | • Precautions for safe handling<br>• Conditions for safe storage (including incompatible materials) |
| **8** | Exposure controls/ Personal protection | • Control parameters, including occupational exposure guidelines or biological exposure limits and the source of those values<br>• Appropriate engineering controls<br>• Individual protection measures (e.g. personal protective equipment) |
| **9** | Physical and chemical properties | • Appearance (physical state, colour, etc.)<br>• Odour<br>• Odour threshold<br>• pH<br>• Melting point/Freezing point<br>• Initial boiling point/boiling range<br>• Flash point<br>• Evaporation rate<br>• Flammability (solid; gas)<br>• Lower flammable/explosive limit |

| | | |
|---|---|---|
| | | • Upper flammable/explosive limit<br>• Vapour pressure<br>• Vapour density<br>• Relative density<br>• Solubility<br>• Partition coefficient - n-octanol/water<br>• Auto-ignition temperature<br>• Decomposition temperature<br>• Viscosity |
| **10** | Stability and reactivity | • Reactivity<br>• Chemical stability<br>• Possibility of hazardous reactions<br>• Conditions to avoid (e.g., static discharge, shock, or vibration)<br>• Incompatible materials<br>• Hazardous decomposition products |
| **11** | Toxicological information | Concise but complete description of the various toxic health effects and the data used to identify those effects, including:<br>• Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact)<br>• Symptoms related to the physical, chemical and toxicological characteristics<br>• Delayed and immediate effects, and chronic effects from short-term and long-term exposure<br>• Numerical measures of toxicity |
| **12** | Ecological information | • Ecotoxicity<br>• Persistence and degradability<br>• Bioaccumulative potential<br>• Mobility in soil<br>• Other adverse effects |
| **13** | Disposal considerations | Information on safe handling for disposal and methods of disposal, including any contaminated packaging |
| **14** | Transport information | • UN number<br>• UN proper shipping name<br>• Transport hazard class(es)<br>• Packing group<br>• Environmental hazards<br>• Transport in bulk, if applicable<br>• Special precautions |
| **15** | Regulatory information | Safety, health and environmental regulations specific to the product |

| | | |
|---|---|---|
| **16** | Other information | Date of the latest revision of the SDS |

The ANSI/GHS MSDS standard format is organized in an order that answers the following five basic questions:

- what is the material
- what information needs to be known immediately
- what should be done in cases of emergency situations
- how can hazardous situations be prevented from occurring
- what other useful information is there on this material

## 3.14 Heat Stress Management:

### 3.14.1 Definition of Heat stress:

"Heat stress" is the " overall heat load to which a worker may be exposed from the combined contributions of metabolic heat, environmental factors (i.e., air temperature, humidity, air movement, and radiant heat), and clothing requirements." Metabolic heat is the heat produced by the body through chemical processes, exercise, hormone activity, digestion, etc.

Heat may come from many sources. For example:

- In outdoor occupations, such as Gas pipeline constructions industry, Petroleum industry, seismic activity, Drilling activity, open-pit mining, chemical plants, refining, asbestos removal, and hazardous waste site activities road repair and agriculture, summer sunshine is the main source of heat.

Most people feel comfortable when the air temperature is between 20°C and 27°C and when the relative humidity ranges from 35 to 60%. When air temperature or humidity is higher, people feel uncomfortable. Such situations do not cause harm as long as the body can adjust and cope with the additional heat. Very hot environments can leading to a variety of serious and possibly fatal. [23];

### 3.14.2 Factors leading to Heat Stress:

- High temperature and humidity;
- Direct sun or heat;
- Limited air movement;
- Physical exertion;
- Poor physical condition
- Some medicines; and
- Inadequate tolerance for hot workplaces

### 3.14.3 Types of Heat disorders and health effects: Heat exposure causes the following illnesses:

(1) Heat Stroke

(2) Heat Exhaustion

(3) Heat Cramps

(4) Heat Rashes

(5) Heat syncope

**Heat stroke** is the most serious type of heat illness or acute illness caused by overexposure to heat. Signs of heat stroke include body temperature often greater than 41°C, and complete or partial loss of consciousness.

Symptoms of Heat Stroke may include:

- Dry, hot skin with no sweating
- Mental confusion or losing consciousness
- Seizures or convulsions.
- High body temperature (usually over 105F) and
- Mental dysfunction.

Heat stroke requires immediate first aid and medical attention. Delayed treatment may result in death.

**Heat exhaustion** results when the body loses large amounts of fluid (body water and salt) by sweating during work in hot environments. The skin becomes cool and clammy.

Symptoms of heat exhaustion may start suddenly, and include:

- Nausea or irritability.
- Dizziness.
- Muscle cramps or weakness.
- Feeling faint.
- Weakness and moist skin;
- Confusion
- visual disturbances,
- Palpitations,
- Upset stomach or vomiting.
- Headache.
- Fatigue.
- Thirst.
- Heavy sweating.
- Diarrhea,
- Breathlessness
- High body temperature.
- Tingling and numbness of extremities after exposure to a hot environment.

Heat exhaustion may quickly develop into heat stroke. Recovery occurs after resting in a cool area and consuming cool drinks (e.g., water, clear juice, or a sports drink).

**Heat cramps** are sharp pains in the muscles that may occur alone or be combined with one of the other heat stress disorders. The cause is salt imbalance resulting from the failure to replace salt lost with sweat. Cramps most often occur when people drink large amounts of water without sufficient salt (electrolyte) replacement.

**It's a** Painful and often incapacitating cramps in muscles. The muscles used in doing the work are most susceptible. Heat cramps are caused by depletion of salt in the body as a result of heavy sweating, and ingestion of water without replacing salt.

**Heat rashes** (prickly heat or milliaria) are tiny red spots on the face, neck, back, chest and thighs ( on the skin) caused by a hot and moist environment. The spots are the result of inflammation caused when the ducts of sweat glands become plugged. This painful rash reduces the body's ability to sweat and to tolerate heat.

**Heat syncope** is heat-induced dizziness; fainting and temporary loss of consciousness induced by temporarily insufficient flow of blood to the brain while a person is standing. It occurs mostly among unacclimatized people. It is caused by the loss of body fluids through sweating, and by lowered blood pressure due to pooling of blood in the legs. Recovery is rapid after rest in a cool area.

### 3.14.4 Humidex / (Humidex Rating and Work):

Humidex is a measure of how hot we feel. It is an equivalent scale intended for the general public to express the combined effects of warm temperatures and humidity. It provides a number that describes how hot people feel, much in the same way the equivalent chill temperature, or "wind chill factor," describes how cold people feel. Humidex is used as a measure of perceived heat that results from the combined effect of excessive humidity and high temperature.

Environmental department of the country should use humidex ratings to inform the general public when conditions of heat and humidity are possibly uncomfortable.

**Table 2**

| Humidex Range | Degree of Comfort |
|---|---|
| 20-29 | Comfortable |
| 30-39 | some discomfort |
| 40-45 | great discomfort; avoid exertion |
| above 45 | dangerous; heat stroke possible |

### 3.14.4.1 Importance of humidity:

The body attempts to maintain a constant internal temperature of 37°C at all times. In hot weather, the body produces sweat, which cools the body as it evaporates. As the humidity or the moisture content in the air increases, sweat does not evaporate as readily. Sweat evaporation stops entirely when the relative humidity reaches about 90 percent. Under these circumstances, the body temperature rises and may cause illness.

### 3.14.4.2 Recommended Actions Based on the Humidex Reading:

Table-3

| Humidex 1 – Moderate physical work, unacclimatized worker, OR Heavy physical work, acclimatized worker | Response | Humidex 2 – Moderate physical work, acclimatized worker, OR Light physical work, unacclimatized worker |
|---|---|---|
| 25 - 29 | • supply water to workers on an "as needed" basis | 32 - 35 |
| 30 - 33 | • post Heat Stress Alert notice<br>• encourage workers to drink extra water<br>• start recording hourly temperature and relative humidity | 36 - 39 |
| 34 - 37 | • post Heat Stress Warning notice<br>• notify workers that they need to drink extra water<br>• ensure workers are trained to recognize symptoms | 40 - 42 |
| 38 - 39 | • work with 15 minutes relief per hour can continue<br>• provide adequate cool (10 - 15°C) water<br>• at least 1 cup (240 mL) of water every 20 minutes<br>• workers with symptoms should seek medical attention | 43 - 44 |
| 40 - 41 | • work with 30 minutes relief per hour can continue in addition to the provisions listed previously | 45 - 46* |
| 42 - 44 | • if feasible, work with 45 minutes relief per hour can continue in addition to the provisions listed above | 47 - 49 |
| [illegible] | • only medically supervised work can continue | [illegible] |

Source: Occupational Health Clinics for Ontario Workers (OHCOW) – "Humidex Based Heat Response Plan"

When the humidex rating is in the 40 - 45°C range, most people would it uncomfortable. However, many kinds of work must be restricted when the humidex is above 45°C. [20];

### 3.14.5 Control measures for heat disorders and health effects:

**Possible heat disorders may face by the people because of heat expose, all of those are given below:**

- Heat Stroke
- Heat Exhaustion
- Heat Cramps
- Heat Rashes

**Control measures to reduce the effects of heat are given below:**

The risk of heat-related illnesses can be reduced by:

- Engineering controls to provide a cooler workplace.
- Safe work practices to reduce worker exposure.
- Training employees to recognize and prevent heat illnesses.

**3.14.5.1 Engineering Controls:** Engineering controls are the most effective means of reducing excessive heat exposure. The examples which follow illustrate some engineering approaches to reducing heat exposure.

- **Heat produced by the body**: Automation and mechanization of tasks minimize the need for heavy physical work and the resulting buildup of body heat.
- **Insulating Hot Surfaces**: Insulation reduces the heat exchange between the source of heat and the work environment.
- **Shielding**: Shields stop radiated heat from reaching work stations.
- **Ventilation and Air Conditioning**: Ventilation, localized air conditioning, and cooled observation booths are commonly used to provide cool work stations.

| Engineering controls | Actions |
|---|---|
| Reduce body heat production | Mechanize tasks. |
| Stop exposure to radiated heat from hot objects | Insulate hot surfaces. Use reflective shields, aprons, remote controls. |
| Reduce convective heat gain | Lower air temperature. Increase air speed if air temperature below 35°C. Increase ventilation. Provide cool observation booths. |
| Increase sweat evaporation | Reduce humidity. Use a fan to increase air speed (movement). |

### 3.14.5.2 Administrative or work practice controls to offset heat effects

- Acclimatize workers
- Replace fluids
- Reduce the physical demands
- Provide recovery areas
- Reschedule hot jobs
- Monitor workers

| Administrative controls | Actions |
|---|---|
| Acclimatization | Allow sufficient acclimatization period before full workload. |
| Duration of work | Shorten exposure time and use frequent rest breaks. |
| Rest area | Provide cool (air-conditioned) rest-areas. |
| Water | Provide cool drinking water. |
| Pace of Work | If practical, allow workers to set their own pace of work. |
| First aid and medical care | Define emergency procedures. Assign one person trained in first aid to each work shift. Train workers in recognition of symptoms of heat exposure. |

### 3.14.5.3 Personal Protection:

Ordinary clothing provides some protection from heat radiated by surrounding hot surfaces. Specially designed heat-protective clothing should be available for working in extremely hot conditions. In hot and humid workplaces, light clothing allows maximum skin exposure and efficient body cooling by sweat evaporation.

**Following personal protective equipment is effective in minimizing heat stress:**

- Reflective clothing
- Wetted clothing
- Water-cooled garments.

| Methods of Control | Actions |
|---|---|
| **Clothing** | Wear loose clothing that permits sweat evaporation but stops radiant heat. Use cooled protective clothing for extreme conditions. |

### 3.14.6 Balancing Heat by Human body:

The healthy human body maintains its internal temperature around 37°C. Variations, usually of less than 1°C, occur with the time of the day, level of physical activity or emotional state. A change of body temperature of more than 1°C occurs only during illness or when environmental conditions are more than the body's ability to cope with extreme heat.

As the environment warms-up, the body tends to warm-up as well. The body's internal "thermostat" maintains a constant inner body temperature by pumping more blood to the skin and by increasing sweat production. In this way, the body increases the rate of heat loss to balance the heat burden. In a very hot environment, the rate of "heat gain" is more than the rate of "heat loss" and the body temperature begins to rise. A rise in the body temperature results in heat illnesses.

When the body is unable to cool itself by sweating, several heat-induced illnesses such as heat stress or heat exhaustion and the more severe heat stroke can occur, and can result in death.

### 3.14.7 Preventing Heat Stress:

health impact can be significantly reduced by allowing workers to self-pace their work; providing safe drinking water and regular breaks throughout the day; and awareness of heat stress symptoms. The real danger is when the work is externally paced (e.g. by machinery), as workers will push themselves beyond the safe limit and become at risk of developing heat disorders. At most risk is workers who are poorly hydrated, unacclimatized, or physically unfit.

People should Know signs/symptoms of heat-related illnesses; monitoring self physical condition’s and coworkers; Block out direct sun or other heat sources; Use cooling fans/air-conditioning; rest regularly; Drink lots of water; about 1 cup every 15 minutes; Wear lightweight, light colored, loose-fitting clothes; Avoid alcohol, caffeinated drinks, or heavy meals. [6];

**3.14.8 First aid steps for heat exhaustion and heat stroke:** First aid for heat exhaustion includes:

- Get medical aid. Stay with the person until help arrives.
- Move to a cooler, shaded location.
- Remove as many clothes as possible (including socks and shoes).
- Apply cool, wet cloths or ice to head, face or neck. Spray with cool water.
- Encourage the person to drink water, clear juice, or a sports drink.

Heat exhaustion may quickly develop into heat stroke. Symptoms of heat stroke include:

- Hot, dry skin or profuse sweating.
- Confusion.
- Loss of consciousness.
- Seizures.
- Very high body temperature.

First aid for heat stroke includes:

- **Call 911 immediately (or local emergency number) at once**. Heat stroke is a medical emergency.
- Stay with the person until help arrives.
- Move to a cooler, shaded location.
- Remove as many clothes as possible (including socks and shoes).
- Wet the person's skin and clothing with cool water.
- Apply cold, wet cloths or ice to head, face, neck, armpits, and groin.
- Do not try to force the person to drink liquids.

**While waiting for help to arrive:** Need to Move the worker to a cool, shaded area; Loosen or remove heavy clothing; Provide cool drinking water; Fan and mist the person with water.

## 3.15 Hazard Control:

### 3.15.1 Designing hazard control Method:

Before thinking about what control measures are needed, first responsible person (HSE) need to know whether there are health and safety problems in company workplace, and if so, what they are. Once recognize a hazard, and then HSE Person should determine which measure will correct the problem most effectively. Generally, there are five major categories of control measures: elimination, substitution, engineering controls, administrative controls and personal protective equipment. Eliminating a hazard means removing it completely; substitution is replacing one hazardous agent or work process with a less dangerous one. An engineering control may mean changing a piece of machinery (for example, using proper machine guards) or a work process to reduce exposure to a hazard; working a limited number of hours in a hazardous area is an example of an administrative control (for example, job rotation); and personal protective equipment (PPE) includes ear and eye protection, respirators, and protective clothing etc.

### 3.15.2 Goals of Hazard control:

All workplace hazards (chemical, physical, etc.) can be controlled by a variety of methods. The goal of controlling hazards is to prevent workers from being exposed to occupational hazards. Some methods of hazard control are more efficient than others, but a combination of methods usually provides a safer workplace than relying on only one method. Some methods of control are cheaper than others but may not provide the most effective way to reduce exposures.

### 3.15.3 Hazard control program:

A hazard control program consists of all steps necessary to protect workers from exposure to a substance or system, the training and the procedures required to monitor worker exposure and their health to hazards such as chemicals , materials or substance, or other types of hazards such as noise and vibration. A written workplace hazard control program should be used to control the exposure and how these controls will be monitored for effectiveness.

Controlling occupational hazards is the best way to protect workers from exposures. Occupational hazards can be controlled using a number of strategies. All of the control methods described in this chapter is based on the same idea: workers should not be exposed to workplace hazards.

Some control methods are better than others, but no single method of control can completely protect workers from hazards. If a hazard cannot be completely eliminated, then a combination of methods should be used to reduce hazards to “safe” levels (levels that will not place workers' health at risk). Some methods of control cost less than others but may not reduce hazards effectively.

### 3.15.4 Selecting an appropriate control method:

Selecting an appropriate control is not always easy. It often involves doing a risk assessment to evaluate and prioritize the hazards and risks. In addition, both "normal" and any potential or unusual situations must be studied. Each program should be specially designed to suit the needs of the individual workplace. Hence, no two programs will be exactly alike.

Choosing a control method may involve:

- Evaluating and selecting temporary and permanent controls.
- Implementing temporary measures until permanent (engineering) controls can be put in place.
- Implementing permanent controls when reasonably practicable.

For example, in the case of a noise hazard, temporary measures might require workers to use hearing protection. Long term, permanent controls might use engineering methods to remove or isolate the noise source.

In situations where there is not a clear way to control a hazard, or if legislation does not impose a limit or guideline, in that cases it should seek guidance from occupational health professionals such as an occupational hygienist or safety professional about what would be the "best practice" or "standard practice" when working in that situation.


**Fig-3.30 There is not a fine line between Safe and Unsafe, [58];**

A legal limit or guideline (such as an exposure limit) should never be viewed as a line between "safe" and "unsafe". The best approach is to always keep exposures or the risk of a hazard as low as possible.

### 3.15.5 Hazard control methods:

Hazard control methods are often grouped into the following categories:

- Elimination (including substitution).
- Engineering controls.
- Administrative controls.
- Personal protective equipment

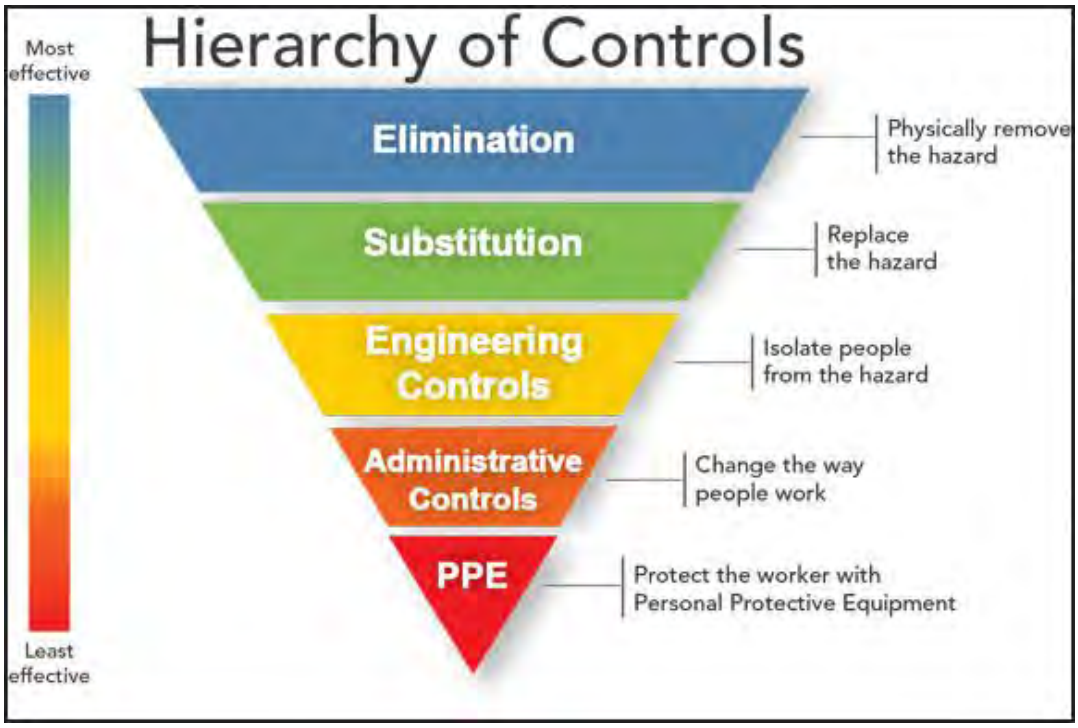



**Fig-3.31 Hierarchy of Controls (Most effective-Least effective), [50];**

The main ways to control a hazard include:

- **Elimination (including substitution)**: Elimination of a specific hazard or hazardous work process, or preventing it from entering the workplace, is the most effective method of control.

- **Engineering Controls**:

  Where feasible and appropriate, the first and best strategy is to control the hazard at its source. Engineering controls do this, unlike other controls that generally focus on the employee exposed to the hazard. The basic concept is that the work environment and the job itself should be designed to eliminate hazards or reduce exposure to hazards.

  **Engineering control** includes designs or modifications to plants, equipment, ventilation systems, and processes that reduce the source of exposure.

- **Administrative Controls:**

  controls that alter the way the work is done, including timing of work, policies and other rules, and **work practices** such as standards and operating procedures (including training, housekeeping, and equipment maintenance, and personal hygiene practices).

  Administrative Controls Includes exercise, breaks and rotation of workers. These types of controls are normally used in conjunction with other controls.

- **Personal Protective Equipment**: Equipment worn by individuals to reduce exposure such as contact with chemicals or exposure to noise.

Personal Protective Equipment (PPE) is a supplementary method of control via clothing or equipment when hazard exposure cannot be engineered completely out, and when other forms of control cannot provide sufficient additional protection. It should be remember, that, PPE is the last level of control!

These methods are also known as the "hierarchy of control" because they should be considered in the order presented (it is always best to try to eliminate the hazard first, etc).

### 3.15.6 Controls are usually placed:

1. At the source (where the hazard "comes from").
2. Along the path (where the hazard "travels").
3. At the worker.

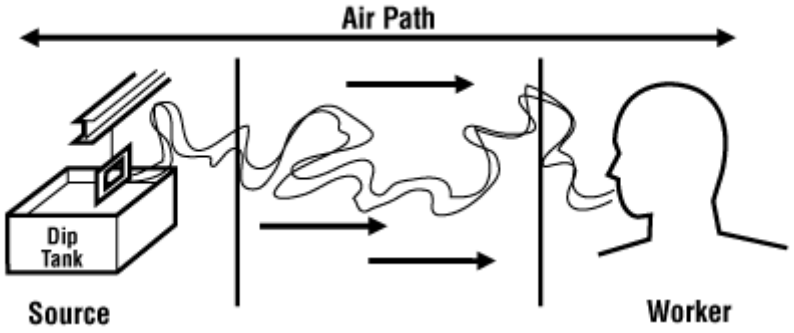



**Fig-3.32 Ways to control a hazard [58];**

Control at the source and control along the path are sometimes also known as engineering controls.

### 3.15.7 Useful Definition:

**Elimination:** Elimination is the process of removing the hazard from the workplace. It is the most effective way to control a risk because the hazard is no longer present. It is the preferred way to control a hazard and should be used whenever possible**.**

**Substitution:** Substitution occurs when a new chemical or substance that is less hazardous is used instead of another chemical. The goal, obviously, is to choose a new chemical that is less hazardous than the original.

The table below provides some examples:

**Table - 4**

**Substitution of chemical or substance that is less hazardous instead of another chemical.**

| **Instead Of:** | **Consider:** |
|---|---|
| carbon tetrachloride (causes liver damage, cancer) | 1,1,1-tri chloroethane, dichloromethane |
| organic solvents (causes various effects on body) | water-detergent solutions |
| sandstone grinding wheels (causes severe respiratory illness due to silica) | synthetic grinding wheels such as aluminum oxide |

However, people should make sure that the substitute chemical or substance is not causing any harmful effects, and to control and monitor exposures to make sure that the replacement chemical or substance is below occupational exposure limits.

Another type of substitution includes using the same chemical but to use it in a different form. For example, a dry, dusty powder may be a significant inhalation hazard but if this material can be purchased and used as pellets or crystals, there may be less dust in the air and therefore less exposure.

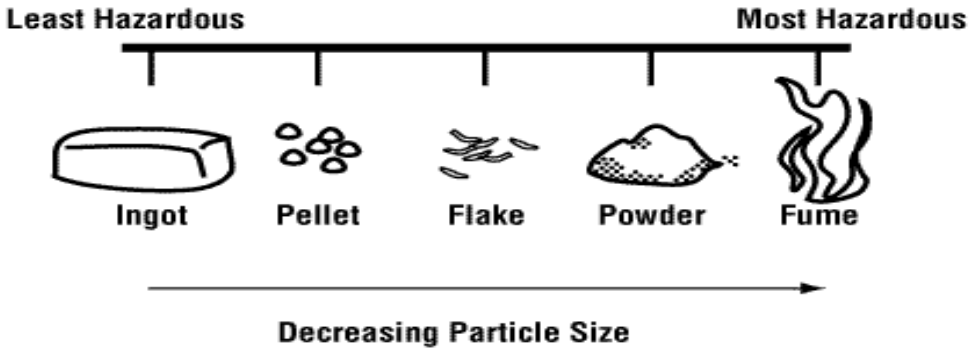



**Fig-3.33 Substitution:-Same chemical but in a different form (less exposure-less hazardous)[58];**

Before deciding to replace a chemical/substance with another, consider all the implications and potential risks of the new material.

### 3.15.8 Elimination as hazard control method:

### 3.15.8.1 Eliminate hazards at the “development stage”:

It is important to consider worker health and safety when work processes are still in the planning stages. For example, when purchasing machines, safety should be the first concern, not cost. Machines should conform to national safety standards; they should be designed with the correct guard on them to eliminate the danger of a worker getting caught in the machine while using it. Machines that are not produced with the proper guards on them may cost less to purchase, but cost more in terms of accidents, loss of production, compensation, etc. Unfortunately, many used machines that do not meet safety standards are exported to developing countries, causing workers to pay the price with accidents, hearing loss from noise, etc.

Eliminating a specific hazard is the most effective method of control. It is easier to eliminate hazards while a work process is still in the development stages.

### 3.15.9 Engineering controls as hazard control method:

There are a number of common control measures which are called “engineering controls”. These include enclosure, isolation and ventilation.

Engineering controls are methods that are built into the design of a plant, equipment or process to minimize the hazard. Engineering controls will be a very reliable way to control worker exposures as long as the controls are designed, used and maintained properly. The basic types of engineering controls would be:

- Process control.
- Enclosure and/or isolation of emission source.
- Ventilation.

**3.15.9.1 Process Control:** Process control involves changing the way a job activity or process will have done to reduce the risk. Monitoring should be maintained before and as well as after the change is implemented to make sure the changes did result in lower exposures.

Examples of process changes include to:

- Use wet methods rather than dry when drilling or grinding. "Wet method" means that water is sprayed over a dusty surface to keep dust levels down or material is mixed with water to prevent dust from being created.
- Use automation - the less workers have to handle or use the materials, the less potential there is for exposure.
- Use mechanical transportation rather than manual methods.

#### 3.15.9.2 Enclosure and Isolation:

These methods aim to keep the chemical "in" and the worker "out" (or vice versa).

If a hazardous substance or work process cannot be eliminated or substituted, then need to enclosing it so workers may not exposed to the hazard would be the next best method of control. Many hazards can be controlled by partially or totally enclosing the work process. Highly toxic materials that can be released

into the air should be totally enclosed, usually by using a mechanical handling device or a closed glove system that can be operated from the outside.

**Machine guarding** is one kind of enclosure that prevents workers from coming into contact with dangerous parts of machines. Workers should receive training on how to use guarded machines safely. Some of the areas of a machine that can injure people are: the point of operation (which is the area on a machine where work is actually being performed); pinch-points; sharp areas, such as blades; exposed electrical components, which can cause electrical shock or burns; presses, which can crush; rotating parts; flying chips and sparks.

**Designing machine guards:**

Guards can often be built at Company workplace at low cost. Here are some helpful points for designing and building machine guards.

- Complete enclosure is preferable to a partial enclosure. A partial guard should be avoided.
- Guards should fit the danger areas as closely as possible.
- Guards should leave the operation easy to see.

Before working with any machine, need to think: "How can this machine be made safer to operate?"

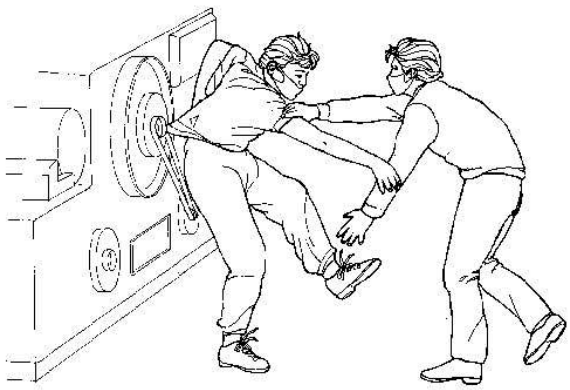


**Fig-3.34 Unguarded machines may hazardous [55];**

An enclosure keeps a selected hazard "physically" away from the worker.

**Isolation:** Isolation can be an effective method of control if a hazardous job can be moved to a part of the workplace where fewer people will be exposed, or if a job can be changed to a shift when fewer people are exposed (such as a weekend or midnight shift).

It is also important to limit the length of time and the amount of a substance(s) to which workers are exposed if they must work in the hazardous area. For example, dust-producing work should be isolated from other work areas to prevent other workers from being exposed. At the same time, workers in the dusty areas must be protected and restricted to only a short time working in those areas.

Isolation places the hazardous process "geographically" away from the majority of the workers. Common isolation techniques need to create a contaminant-free booth either around the equipment or around the employee workstations.

### 3.15.9.3 Ventilation:

Ventilation is a method of control that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly.

Ventilation in the workplace can be used for two reasons: (1) to prevent the work environment from being too hot, cold, dry or humid; (2) to prevent contaminants in the air from getting into the area where workers breathe. Generally there are two categories of ventilation: local exhaust ventilation and general ventilation. Whatever the type, ventilation should be used together with other methods of control.

Local exhaust ventilation is very adaptable to almost all chemicals and operations. It removes the contaminant at the source so it cannot disperse into the work space and it generally uses lower exhaust rates than general ventilation (general ventilation usually exchanges air in the entire room).

Local exhaust ventilation is an effective means of controlling hazardous exposures but should be used when other methods (such as elimination or substitution) are not possible.

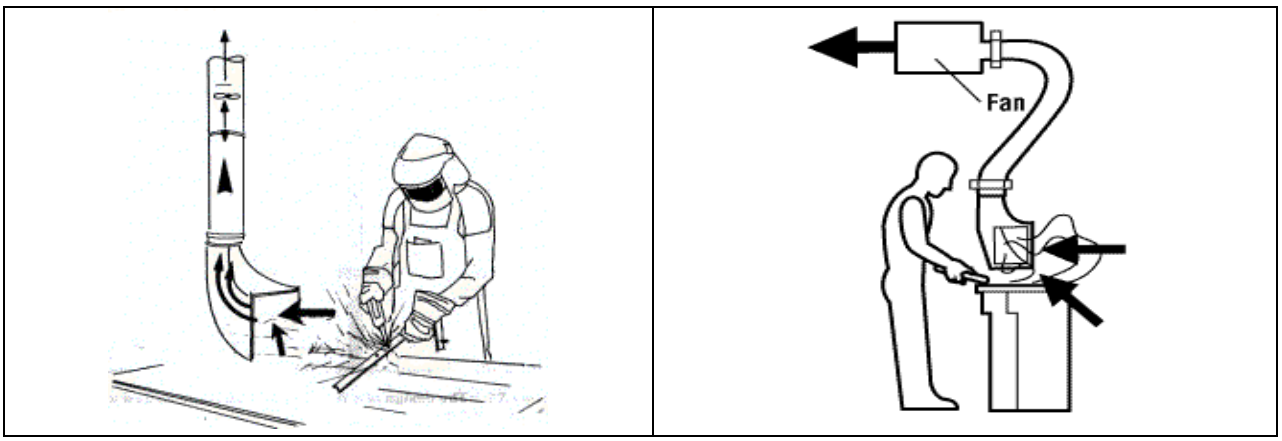



**Fig-3.35 Local exhaust ventilation [57];**

**Local exhaust ventilation** usually uses suction, based on the principle of a vacuum cleaner, to remove pollutants from the air.

Exhaust ventilation can also include the use of flexible piping. The end of the pipe that draws in the contaminants (the inlet) must be placed as close as possible to the source of the hazard in order to be effective. Flexible piping is often used to draw welding fumes away from the worker and to draw away contaminants in work areas that are hard to reach.

General ventilation, which is generally used for keeping the workplace comfortable, is one of the least effective methods of controlling hazards but one of the most commonly used. The purpose of any general ventilation system is to remove contaminated air and replace it with “fresh” air. This system does not really remove hazardous agents from the air; it simply reduces the amounts in the air to levels that are considered “safe” for breathing. The effectiveness of a general ventilation system depends on several things, including: how quickly the hazardous agent is being released into the air; how much and how quickly fresh air is coming in; and how the contaminated air is being removed. [19];

General ventilation can be used for keeping the workplace comfortable, and local exhaust ventilation for removing air pollutants. General ventilation is one of the least effective methods of controlling hazards.

The design of a ventilation system is very important and must match the particular process and chemical or contaminant in use. In many cases, the ventilation system is not effective because of poor design, lack of servicing, etc. Expert guidance should be sought. It is a very effective control measure but only if it is designed, tested, and maintained properly.

### 3.15.10 Administrative controls as hazard control method:

controls limiting the amount of time workers spend at a hazardous job can be used together with other methods of control (i.e Engineering control) to reduce exposure to hazards.

Administrative controls limit workers' exposures by scheduling shorter work times in contaminant areas or by implementing other "rules". These control measures have many limitations because the hazard itself is not actually removed or reduced. Administrative controls are not generally favored because they can be difficult to implement, maintain and may not a reliable way to reduce exposure.

Some examples of administrative controls include:

- Changing work schedules (for example, two people may be able to work for four hours each at a job instead of one person working for eight hours at that job);
- Giving workers longer rest periods or shorter work shifts to reduce exposure time;

### 3.15.11 Personal protective equipment (PPE) as a hazard control method:

Personal protective equipment (PPE) is the least effective method of controlling occupational hazards and should be used only when other methods cannot control hazards sufficiently. PPE can be uncomfortable, can decrease work performance and can create new health and safety hazards. For example, ear protectors can prevent people from hearing warning signals, respirators can make it harder to breathe, earplugs may cause infection, and leaky gloves can trap hazardous chemicals against the skin.

The type of PPE person need to use depends on the hazard, how exposure can affect person body, and how long they will be exposed. Unfortunately, workers are often given the wrong PPE, such as a dust respirator when the hazard is a fume or vapour.

**Fig- 3.36 PPE Using practice during the work [56];**

### 3.15.12 Hazard Reporting by Employee (Hazard control by maintaining reporting):

The immediate hazard reporting process would allows employees to report hazardous conditions or practices as they will notice. This procedure allows for prompt reporting and subsequent corrective action without waiting for the next round of regular inspections.

Hazards can be reported verbally or by filling a simple form available at bulletin boards or other conspicuous places. The following is an example of such a form.

| **Hazard Report Form – Example** | |
|---|---|
| Name: | Date: |
| Location: | |
| Equipment: | |
| Description of the hazard: | |
| Suggested corrective action: | |
| Signature: | |
| Supervisor's remarks: | |
| Corrective action taken: | |
| Signature of Supervisor: | Date: |

# Chapter-4: Safety Tool

## 4. 1 Meaning of Safety Tool:

Safety tool can be used daily to promote organizational safety culture. These tools (Permit, JSA, Risk Matrix etc) are also intended to facilitate health and safety discussions on the job site as well as indoor place (HSE related Meeting). Various Safety tool may used in the industry, those tools would play an important role on Health, Safety, and Environment culture of any organization in many ways. They help to ensure, efficient use of tools, material & equipment, encouraging safe work practice, growing personal responsibility & authority, managing safe work, maintain communication between Management and employee, etc.

## 4.2 Name of various Safety Tool:

Most useful safety tools are given below:

(1) Risk Assessment Matrix
(2) Job Safety Analysis (JSA)
(3) Hazard Analysis (HA)
(4) Permit To Work (PTW)
(5) Inspections
(6) Tool Box Talk
(7) Personal Protective Equipment (PPE)
(8) Audit / Safety Audit

### 4.2.1 Risk Assessment Matrix:

**4.2.1.1 Definition of risk:** Risk is the chance or probability that a person would be harmed or experience an adverse health effect if exposed to a hazard. It may also apply to situations with property or equipment loss.

For example: The risk of developing cancer from smoking cigarettes could be expressed as "cigarette smokers are 12 times (for example) more likely to die of lung cancer than non-smokers". These risks are expressed as a probability or likelihood of developing a disease or getting injured, whereas hazards refer to the possible consequences (e.g., lung cancer, emphysema and heart disease from cigarette smoking).

Factors that influence the degree of risk include:

- How much a person is exposed to a hazardous thing or condition,
- How the person is exposed (e.g., breathing in a vapour, skin contact), and
- How severe are the effects under the conditions of exposure.

### 4.2.1.2 What workers are at risk?

All outdoor workers potentially exposed to the sun's ultraviolet radiation are at risk, including:

- oilfield workers
- pipeline workers
- maintenance workers
- brick masons

- surveyors
- loggers
- open-pit miners
- landscapers
- sailors
- construction workers
- railroad track workers

### 4.2.1.3 Examples of high risk activities:

| High risk activities can involve risks from a variety of sources such as those below: | The risk from natural hazards is not the same across the country but the list would include: |
|---|---|
| • At heights.<br>• In confined spaces (such as tanks).<br>• With electricity.<br>• With hazardous substances or materials.<br>• With hazardous equipment such as firearms.<br>• With materials at great pressure.<br>• With the public, where there is a potential for violence. | • Floods.<br>• Earthquakes.<br>• Tornadoes.<br>• Other severe wind storms.<br>• Severe extremes in temperature (cold or hot).<br>• Pandemic diseases like influenza. |

The possibility of one event triggering others must be considered. An explosion may start a fire and cause structural failure while an earthquake might initiate many of the technological events listed above.

**4.2.1.4 Definition of a risk assessment:** Risk assessment is the process where:

- Identify hazards.
- Analyze or evaluate the risk associated with that hazard.
- Determine appropriate ways to eliminate or control the hazard.

In practical terms, a risk assessment is a thorough look at workplace to identify those things, situations, processes, etc that may cause harm, particularly to people, property or the environment. After identification is made, it should evaluate how likely and severe the risk is, and then decides what measures should be in place to effectively prevent or control the harm from happening.

### 4.2.1.5 Hazard and Risk Analysis:

Based upon the information from the work or workplace condition, perform a hazard and risk analysis of how workers will be interacting with the system. This analysis should be outline where possible hazards present, and what the associated risk of each hazard exists.

The hazard and risk analysis should be outlining all situations where a worker would be exposed to hazards. Examples include:

- A hydraulic hose releases pressurized fluid when it is removed for maintenance purposes.
- A barrier or guard has been removed or by-passed.

- A press cycles accidentally while a worker is changing a die.
- An injection moulding machine gate closes while a worker is in it.
- A robot moves while a worker is trying to program it.

### 4.2.1.6 Risk Assessment for evaluating the risk of the task:

Before any task will perform, conduct a risk assessment to evaluate the risk of the task. The risk assessment should take into account the following:

- Time it takes to complete the task
- The worker may come into contact with
- Route of potential exposure
- Susceptibility of the worker.
- Environment in which the task is carried out.

Appropriate strategies such as waste management, use of personal protective equipment and hand hygiene would then need to be select to reduce the risk of exposure and other control measure.

### 4.2.1.7 Importance of risk assessment:

Risk assessments are very important as they form an integral part of a good occupational health and safety management plan. They help to:

- Create awareness of hazards and risks.
- Identify who may be at risk (employees, cleaners, visitors, contractors, the public, etc).
- Determine if existing control measures are adequate or if more should be done.
- Prevent injuries or illnesses by taking initiatives at the design or planning stage.
- Prioritize hazards and control measures.

The aim of the risk assessment process is to remove a hazard or reduce the level of its risk by adding precautions or control measures, as necessary. By doing so, there would be created a safer and healthier workplace.

### 4.2.1.8 Ways of risk assessment:

Assessments should be done by a competent team of individuals who have a good working knowledge of the workplace (such as Supervisor, HSE Engineer). Staff should be involved always include supervisors and workers who work with the process under review as they are the most familiar with the operation. In general, to do an assessment, it should:

- Identify hazards.
- Evaluate the likelihood of an injury or illness occurring, and its severity.
- Consider normal operational situations as well as non-standard events such as shutdowns, power outages, emergencies, etc.
- Review all available health and safety information about the hazard such as MSDSs, manufacturers literature, information from reputable organizations, results of testing, etc.
- Identify actions necessary to eliminate or control the risk.

- Monitor and evaluate to confirm the risk is controlled.
- Keep any documentation or records that may be necessary. Documentation may include detailing the process used to assess the risk, outlining any evaluations, or detailing how conclusions were made.

By determining the level of risk associated with the hazard, the employer and the joint health and safety committee can decide whether a control program is required. [25];

### 4.2.1.9 Rank or prioritize the risks:

Ranking or prioritizing hazards is one way to help determine which hazard is the most serious and thus which hazard to control first. Priority is usually established by taking into account the employee exposure and the potential for accident, injury or illness. By assigning a priority to the hazards, there should creating a ranking or an action list. The following factors play an important role:

- Percentage of workforce exposed.
- Frequency of exposure.
- Degree of harm likely to result from the exposure.
- Probability of occurrence.

There is no one simple or single way to determine the level of risk. Ranking hazards requires the knowledge of the workplace activities, urgency of situations, and most importantly, objective judgments.

### 4.2.1.10 Risk Assessment:

- Solutions/control measures would intended to either eliminate the risk of the job (task) or reduce it to an acceptable level.
- Using the HA (hazard analysis) Risk Assessment Matrix, each step in an HA need to assesse for the risk that remains after taking the listed control measures into account.
- The matrix need to used to determine the potential severity and the likelihood of the remaining risk for each step in the HA, which can leads to a risk ranking code of Low, Medium or High (L, M, H).
- Additional control measures may be required as indicated by the risk ranking codes.
- Identify extra control measures for Medium risk activity.
- Must not allow continuing job with High risk. Split the task into pieces to reduce the risk level.
- In all cases, the HA Team shall verify that identified control measures exist and be effective. Job cannot proceed without verification.

### 4.2.1.11 Hazard analysis Risk Assessment Matrix (Chevron-worldwide):-

**Table - 5 Risk Assessment Matrix (sample)**

| Potential Severity by Category | | | Likelihood of Occurrence | | |
|---|---|---|---|---|---|
| **Personal Injury** | **Environment** | **Cost of Incident** | **Improbable** (Not Known To Have Occurred) | **Occasional** (Annual Occurrence) | **Frequent** (Weekly Occurrence) |
| **Level 1** First Aid | **Minor** Level 1 incidents | < $100,000 | **L** | **L** | **M** |
| **Level 2** LTI/Recordable Injury | **Medium** Level 2 incidents | $100,000 to $500,000 | **L** | **M** | **H** |
| **Level 3** Fatality/Permanent Disability/Multiple Recordable Injury | **Major** Level 3 incidents | > $500,000 | **M** | **H** | **H** |

| Code | Meaning |
|---|---|
| **L** | Acceptable, but additional controls should be considered if cost effective. |
| **M** | Should only proceed with appropriate authorization after additional controls are implemented. |
| **H** | Do Not Proceed. Task must be redefined or further control measures must be put in place to reduce risk. The controls must be reassessed prior to the task commencing. |

### 4.2.1.12 Methods of ranking or prioritizing risks:

One option may use a table similar to the following as established by the British Standards Organization:

**Table 6**
**Risk Assessment by the British Standards Organization**

| Likelihood of Harm | Severity of Harm | | |
|---|---|---|---|
| | **Slight Harm** | **Moderate Harm** | **Extreme Harm** |
| Very unlikely | Very low risk | Very low risk | High risk |
| Unlikely | Very low risk | Medium risk | Very high risk |
| Likely | Low risk | High risk | Very high risk |
| Very likely | Low risk | Very high risk | Very high risk |

These categorizations and the resulting asymmetry of the matrix arise from the examples of harm and likelihood illustrated the HES Standard. Organizations should adjust the design and size of the matrix to suit their needs. [33];

#### 4.2.1.12.1 Definitions for Likelihood of Harm:

**Very Likely** – Typically experienced at least once every six months by an individual.

**Likely** – Typically experienced once every five years by an individual.

**Unlikely** – Typically experienced once during the working lifetime of an individual.

**Very unlikely** – Less than 1% chance of being experienced by an individual during their working lifetime.

#### 4.2.1.12.2 Definitions for Severity of Harm:

**Potential severity of harm** – When establishing potential severity of harm, information about the relevant work activity should be considered, together with:

a) Part(s) of the body likely to be affected.

b) Nature of the harm, ranging from slight to extremely harmful:

1. Slightly harmful (e.g., superficial injuries; minor cuts and bruises; eye irritation from dust; nuisance and irritation; ill-health leading to temporary discomfort)

2. harmful (e.g., lacerations; burns; concussion; serious sprains; minor fractures; deafness; dermatitis; asthma; work-related upper limb disorders; ill-health)

3. extremely harmful (e.g., amputations; major fractures; poisonings; multiple injuries; fatal injuries; occupational cancer; other severely life shortening diseases; acute fatal diseases). [33];

#### 4.2.1.12.3 Definition for Risk Level: Tolerability Guidance on necessary action and time scale:

**Very low**: These risks are considered acceptable. No further action is necessary other than to ensure that the controls are maintained.

**Low**: No additional controls are required unless they can be implemented at very low cost (in terms of time, money, and effort). Actions to further reduce these risks are assigned low priority.

**Medium**: Consideration should be as to whether the risks can be lowered, where applicable, to a tolerable level and preferably to an acceptable level, but the costs of additional risk reduction measures should be taken into account.

**High**: Substantial efforts should be made to reduce the risk. Risk reduction measures should be implemented urgently within a defined time period and it might be necessary to consider suspending or restricting the activity, until this has been completed. Considerable resources might have to be allocated to additional control measures. Arrangements should be made to ensure that controls are maintained, particularly if the risk levels are associated with extremely harmful consequences and very harmful consequences.

**Very high**: These risk are unacceptable. Substantial improvements in risk control measures are necessary so that the risk is reduced to a tolerable or acceptable level. The work activity should be halted until risk controls are implemented that reduces the risk so that it is no longer very high. If it is not possible to reduce the risk, the work should remain prohibited. [33];

### 4.2.1.13 Example of Risk Ranking:

**Working on a Scaffold**

- While working on a properly built scaffold, basically it is LOW risk.
- If a Top Rail is missing due to structural obstruction, it becomes MEDIUM risk.
  - Additional precaution e.g. Safety Harness and lanyard is required, full time supervision also need
  - Work team Leader must sign (initials) in the 5th column of the Hazard analysis (HA) to ensure the additional precaution for the job step is understood and to be taken
  - Careful while assigning 'M' level, it should not become the Accepted Practice; always use the risk matrix to determine the level of risk.
- Should multiple rails be missing or there is no suitable overhead anchor point to connect the lanyard, it would then become HIGH risk.
  - HIGH risk job cannot be continued
  - Break the task down, e.g. consider other options such as use of a Man-Lifter; or determine other mitigation measure to reduce the risk level, e.g. introduce use of a suitable safety cable.

### 4.2.1.14 Sample risk assessment form:

The following is a sample risk assessment form. Be sure to customize it for needs at workplace.

| **Sample Risk Assessment Form** | |
|---|---|
| Name of person doing assessment: | |
| Date: | |
| Activity / Procedure being assessed: | |
| Known or expected hazards associated with the activity: | |
| The risk of injury and its severity likely to arise from these hazards: | |
| Who is at risk? | |
| Measure to be taken to reduce the level of risk: | |

| | |
|---|---|
| Training prerequisites: | |
| Level of risk remaining: | |
| Action to be taken in an emergency: | |
| References, if any: | |
| Signature of Assessor: | |

### 4.2.2 Job Safety Analysis (JSA):

**4.2.2.1 Definition of JSA:** Job safety analysis (JSA), also known as "job hazard analysis", is the first step in developing the correct procedure. In this analysis, each task of a specific job is examined to identify hazards and to determine the safest way to do the job. Job safety analysis involves the following steps:

1. Select the job (Brief Job description)

2. Identify the hazards.

3. Define preventive measures.

4. Safety Equipment Required

The analysis should be conducted on all critical tasks or jobs as a first priority. Critical jobs include:

- Those where frequent accidents and injuries occur.
- Those where severe accidents and injuries occur.
- Those with a potential for severe injuries.
- New or modified jobs.
- Infrequently performed jobs, such as maintenance.

**4.2.2.2 Purpose of the onsite JSA:** A Job Safety Analysis (JSA) shall be performed onsite prior to the initiation of work.

**The purpose of the onsite JSA is to**:

- Involve the work team to make sure that the people doing the work understand the tasks, hazards and mitigations
- Address on-site conditions on the day of the work
- Verify that work team has proper skill level and tools

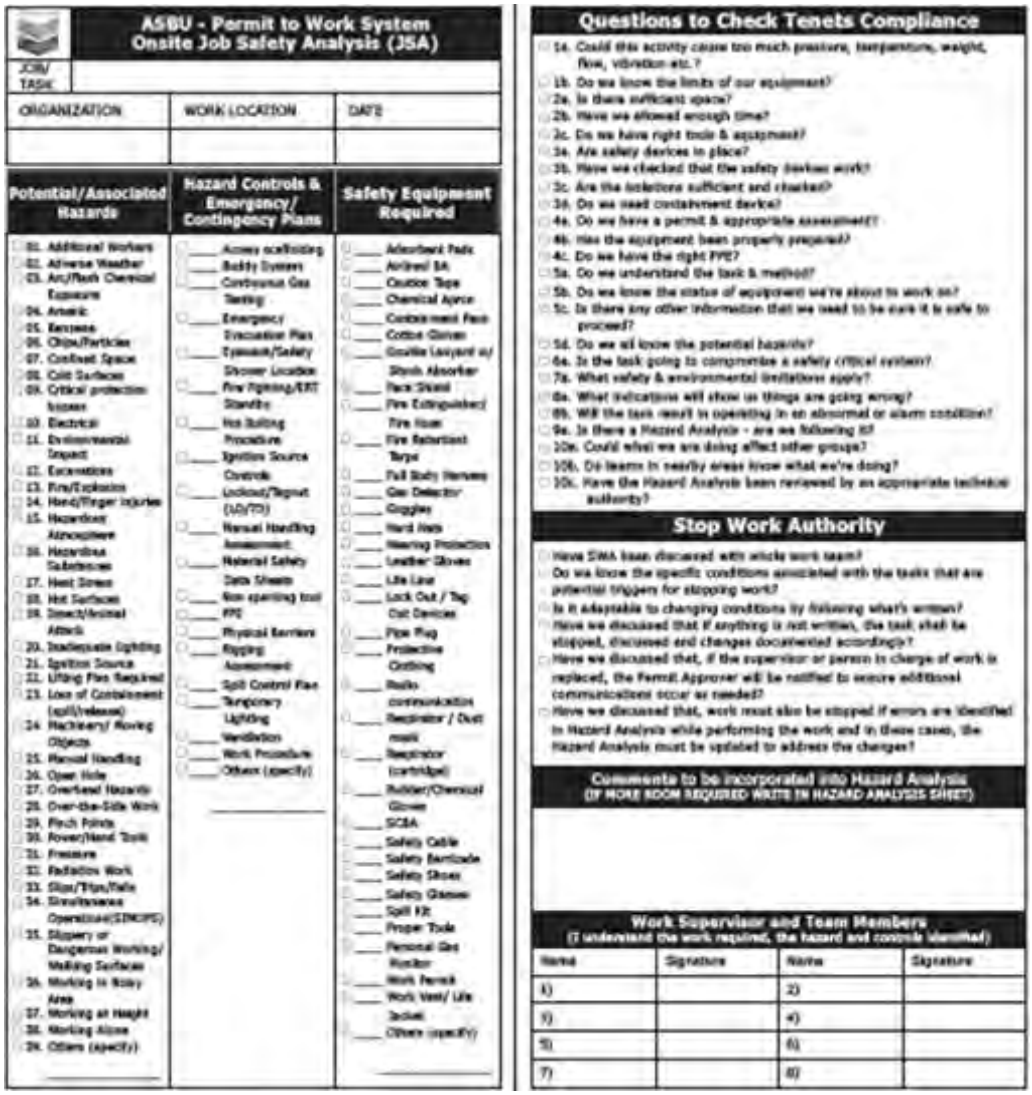
Other factors:

- It should be developed in the language appropriate for the entire work crew (sometimes multiple languages and / or verbal translation may be needed).
- It may be kept as a reference for future similar operations.

**4.2.2.3 Reason for Practicing Job Safety Analysis (JSA):** Job safety analysis is generally carried out by observing a worker doing the job. Members of the joint health and safety committee should participate in this process. The reason for the exercise must be clearly explained to the worker, emphasizing that the job, not the individual, is being studied. Another approach, useful in the analysis of infrequently-performed or new jobs, is group discussion.

A work procedure may consist of more than one specific task. In such cases, each separate task should be analyzed to complete a job safety analysis for that procedure. The final version of the correct work procedure should be presented in a narrative style format that outlines the correct way to do the job in a step-by-step outline. The steps are described in positive terms, pointing out the reasons why they are to be done in this way. Reference may be made to applicable rules and regulations and to the personal protective equipment required, if any. Employees who carry out the tasks should be consulted in developing the procedure.

**4.2.2.4 Content of JSA:**



ASBU - Permit to Work System
Onsite Job Safety Analysis (JSA)

JOB/ TASK

| ORGANIZATION | WORK LOCATION | DATE |
|---|---|---|
| | | |

| Potential/Associated Hazards | Hazard Controls & Emergency/ Contingency Plans | Safety Equipment Required |
|---|---|---|
| 01. Additional Workers<br>02. Adverse Weather<br>03. Arc/Flash Chemical Exposure<br>04. Arsenic<br>05. Benzene<br>06. Chips/Particles<br>07. Confined Space<br>08. Cold Surfaces<br>09. Critical protection losses<br>10. Electrical<br>11. Environmental Impact<br>12. Excavations<br>13. Fire/Explosion<br>14. Hand/Finger Injuries<br>15. Hazardous Atmosphere<br>16. Hazardous Substances<br>17. Heat Stress<br>18. Hot Surfaces<br>19. Insects/Animal Attack<br>20. Inadequate Lighting<br>21. Ignition Source<br>22. Lifting Plan Required<br>23. Loss of Containment (spill/release)<br>24. Machinery/ Moving Objects<br>25. Manual Handling<br>26. Open Hole<br>27. Overhead Hazards<br>28. Over-the-Side Work<br>29. Pinch Points<br>30. Power/Hand Tools<br>31. Pressure<br>32. Radiation Work<br>33. Slips/Trips/Falls<br>34. Simultaneous Operations(SIMOPS)<br>35. Slippery or Dangerous Working/ Walking Surfaces<br>36. Working in Noisy Area<br>37. Working at Height<br>38. Working Alone<br>39. Others (specify) | Access scaffolding<br>Buddy System<br>Continuous Gas Testing<br>Emergency Evacuation Plan<br>Eyewash/Safety Shower Location<br>Fire Fighting/ERT Standby<br>Hot Bolting Procedure<br>Ignition Source Controls<br>Lockout/Tagout (LO/TO)<br>Manual Handling Assessment<br>Material Safety Data Sheets<br>Non-sparking tool<br>PPE<br>Physical Barriers<br>Rigging Assessment<br>Spill Control Plan<br>Temporary Lighting<br>Ventilation<br>Work Procedure<br>Others (specify) | Adsorbent Pads<br>Airlined BA<br>Caution Tape<br>Chemical Apron<br>Containment Pans<br>Cotton Gloves<br>Double Lanyard w/ Shock Absorber<br>Face Shield<br>Fire Extinguisher/ Fire Hose<br>Fire Retardant Tarps<br>Full Body Harness<br>Gas Detector<br>Goggles<br>Hard Hats<br>Hearing Protection<br>Leather Gloves<br>Life Line<br>Lock Out / Tag Out Devices<br>Pipe Plug<br>Protective Clothing<br>Radio communication<br>Respirator / Dust mask<br>Respirator (cartridge)<br>Rubber/Chemical Gloves<br>SCBA<br>Safety Cable<br>Safety Barricade<br>Safety Shoes<br>Safety Glasses<br>Spill Kit<br>Proper Tools<br>Personal Gas Monitor<br>Work Permit<br>Work Vest/ Life Jacket<br>Others (specify) |

**Questions to Check Tenets Compliance**

1a. Could this activity cause too much pressure, temperature, weight, flow, vibration etc.?
1b. Do we know the limits of our equipment?
2a. Is there sufficient space?
2b. Have we allowed enough time?
3c. Do we have right tools & equipment?
3a. Are safety devices in place?
3b. Have we checked that the safety devices work?
3c. Are the isolations sufficient and marked?
3d. Do we need containment device?
4a. Do we have a permit & appropriate assessment(s)?
4b. Has the equipment been properly prepared?
4c. Do we have the right PPE?
5a. Do we understand the task & method?
5b. Do we know the status of equipment we're about to work on?
5c. Is there any other information that we need to be sure it is safe to proceed?
5d. Do we all know the potential hazards?
6a. Is the task going to compromise a safety critical system?
7a. What safety & environmental limitations apply?
8a. What indications will show us things are going wrong?
8b. Will the task result in operating in an abnormal or alarm condition?
9a. Is there a Hazard Analysis - are we following it?
10a. Could what we are doing affect other groups?
10b. Do teams in nearby areas know what we're doing?
10c. Have the Hazard Analysis been reviewed by an appropriate technical authority?

**Stop Work Authority**

Have SIMA been discussed with whole work team?
Do we know the specific conditions associated with the tasks that are potential triggers for stopping work?
Is it adaptable to changing conditions by following what's written?
Have we discussed that if anything is not written, the task shall be stopped, discussed and changes documented accordingly?
Have we discussed that, if the supervisor or person in charge of work is replaced, the Permit Approver will be notified to ensure additional communications occur as needed?
Have we discussed that, work must also be stopped if errors are identified in Hazard Analysis while performing the work and in these cases, the Hazard Analysis must be updated to address the changes?

**Comments to be incorporated into Hazard Analysis**
(IF MORE ROOM REQUIRED WRITE IN HAZARD ANALYSIS SHEET)

**Work Supervisor and Team Members**
(I understand the work required, the hazard and controls identified)

| Name | Signature | Name | Signature |
|---|---|---|---|
| 1) | | 2) | |
| 3) | | 4) | |
| 5) | | 6) | |
| 7) | | 8) | |

**Fig- 4.1 JSA from (chevron Bangladesh sample form), [5];**

- Job description
- Potential/ Associated Hazards
- Hazard Controls & Emergency/ Contingency Plans
- Safety Equipment Required
- Questions to Check company Compliance
- Stop Work condition
- Additional comments
- Signature

### 4.2.2.5 JSA practicing Procedure:

Everyone involved in implementing a job or task should be present when the JSA is written. The JSA should be reviewed, approved, and signed by the supervisor before the task is started. Understanding every job step is very important, whenever a job step changes or a new step is introduced, the JSA must be reviewed and updated.

To start the JSA Process, select the job or task to be performed. JSA is need for any job that has hazards or potential hazards. Also it is needed for an uncommon or seldom-performed job

Forms or worksheets may vary from company to company but the idea remains the same. Identify all hazards, complete all necessary steps, and maintain safe work procedures before starting the job.

### 4.2.2.6 Job Site Safety:

Drilling Co. should takes safety on the job site very seriously. They should have policy to provide a safe and healthy work environment for everyone, and company compliance should be match by safety standards set by OSH or other international standard such OGP or OSHA. There also should have both nominated and awarded the “Best of the Best” Award by the company for “Outstanding Contribution to Safety Achievement”. [11];

**Fig - 4.2 Job Site Safety - Basic Drilling Co. [11];**

A safe working environment does not occur by chance. It requires everyone’s close attention and open communication between management and employees. Every employee at drilling co. is thoroughly trained in safety procedures. Everyone should obligated to know and abide by the safety requirements and standards for their area, or, job. [11];

Its need to understand that each and every drilling job is different. Prior to each job that will start, need to do a complete analysis of all safety plans that need to be implemented. This will provides employee with the ability to identify any potential problems that may come across and how to prepare for them.

### 4.2.2.7 Benefits of practicing JSA:

The JSA will be a very effective means of helping reduce incidents, accidents, and injuries in the workplace. It would be an excellent tool to use during new employee orientations and training and can also be used to investigate "near misses" and accidents. As JSA is used for investigation purpose that's why it is need to keep in documentation from 6 months to 3 years.

The reasons for completing a JSA at worksite in the company are to encourage teamwork (especially with new employees), to involve everyone performing the job in the process, and to elevate awareness.

A key element of any effective safety program is the Job Safety Analysis (JSA). So people should know the hazards evaluate the hazards at the worksite in the Job safety analysis process. Many companies within the oil and gas industry use the Job Safety Analysis process (also referred to as a JSA, Job Hazard Analysis, or JHA) to identify hazards and find solutions.

### 4.2.3 Hazard Analysis:

A safe working environment does not occur by chance. It requires everyone's close attention and open communication between management and employees about the Hazards. So people should know the hazards. Evaluate the hazards at the worksite. Many companies within the oil and gas industry use the Hazard analysis (HA) process to identify hazards and find solutions.

A Hazard Analysis (HA) involves five (5) steps:

1. Identifying the job (task)
2. Forming the HA team (for simple tasks, this may be one person)
3. Breaking down the job (task) into steps
4. Identifying potential hazards with energy sources
5. Developing solutions/control measures to mitigate the identified hazards with risk assessment

### 4.2.3.1 Example of Hazard Analysis:

| Permit to Work System<br>**Planning Phase Hazard Analysis** | | | PERMIT NUMBER |
|---|---|---|---|
| | | | |
| JOB/TASK | ORGANIZATION | WORK LOCATION | DATE |
| **Manually Cleaning the Floor & Skid** | | Process Area | |
| Required PPE: | Basic PPE, rubber gloves, cotton gloves, ear plugs (if required) & respirator/Dust mask (if required) | | |
| Required Tools/ Equipment | Bucket, spade, half cut drum, hand tools etc. | | |

| # | MAJOR STEPS OF THE JOB/TASK | ENERGY SOURCES – POTENTIAL/ ASSOCIATED HAZARDS | SOLUTIONS/CONTROL MEASURES | Risk Ranking Code (see Last Page) | Initial for 'M' Level Risk |
|---|---|---|---|---|---|
| 1. | Prepared necessary materials at worksite & Open gratings of the skid / drain line. | **Motion**: Back injury may occur while lifting gratings<br>**Mechanical**: Pinch Point in between grating & structure<br>Sound: Sound (while pump running)<br>**Gravity + Motion**: slip-trip-fall while moving gratings | Follow manual lifting technique (not more than 15 kg each person)<br>Use cotton gloves & keep eyes on task<br>Use ear plugs<br>Keep eyes on path, hold firmly | L | |
| 2. | Manually collect sludge into the bucket / half cut drum & transfer to storage drum. | **Motion**: Ergo risk due to repetitive body bending<br>**Chemical**: Skin contact of sludge & bad Smell<br>**Biological**: Snakes & bugs may present inside the skid | Avoid repetitive body bending & take periodic break<br>Use rubber gloves, rubber boot & dust mask (if required use 3M organic vapor respirator)<br>Make noise & be vigilant prior to start the job | L | |
| 3. | Floor cleaning with degreaser (if required) | **Chemical**: Skin contact | Use rubber gloves; Follow MSDS | L | |
| 4. | Assemble gratings as before it was. | **Motion**: Back injury may occur while lifting gratings<br>**Mechanical**: Pinch Point in between grating & structure<br>**Gravity + Motion**: slip-trip-fall while moving gratings | Follow manual lifting technique (not more than 15 kg each person)<br>Use cotton gloves & keep eyes on task<br>Keep eyes on path, hold firmly | L | |
| 5. | | | | | |

***The risk associated with this job has been evaluated with the work team and reduced to an acceptable level.***

**Signature (Department Supervisor)** _____

**Job Planning Team Members – List any additional on separate sheet**

(I as **Work Team Leader** and We as team member participated in the Hazard Analysis carried out for this work and confirmed the hazard controls are sufficient for the proposed work)

Date: _____

| Name | Position | Signature |
|---|---|---|
| 1) | **Work Team Leader** | |
| 2) | | |
| 3) | | |
| 4) | | |
| 5) | | |
| 6) | | |

| Potential Severity by Category | | | Likelihood of Occurrence | | |
|---|---|---|---|---|---|
| **Personal Injury** | **Environment** | **Cost of Incident** | **Improbable** (Not Known To Have Occurred) | **Occasional** (Annual Occurrence) | **Frequent** (Weekly Occurrence) |
| **Level 1** First Aid | **Minor** Level 1 incidents | **< $ 100,000** | **L** | | **M** |
| **Level 2** LTI/Recordable Injury | **Medium** Level 2 incidents | **$ 100,000 to $ 500,000** | **L** | **M** | **H** |
| **Level 3** Fatality/Permanent Disability/Multiple Recordable Injury | **Major** Level 3 incidents | **> $ 500,000** | **M** | **H** | **H** |

| Code | Meaning |
|---|---|
| L | Control measures are acceptable. Additional controls should be considered if cost-effective. |
| M | Additional control measures are required. Should only proceed with appropriate authorization after additional controls are implemented. |
| H | Do not proceed. Remaining risk is imminent or potential severity is unacceptable with current control measures. Task shall be redefined or further control measures shall be put in place to reduce risk. Controls shall be reassessed prior to the task commencing. |


## Hazard Identification Tools

### Hazard

A condition or action that has the potential for an **unplanned release** of, or **unwanted contact** with, an energy source that may result in harm or injury to people, property, or the environment.

### Hierarchy of Controls

1. Remove the energy source
2. Prevent the release of energy
3. Protect from the release
4. Use Stop Work Authority

## Energy Sources

**Gravity**
The force caused by the attraction of all other masses to the mass of the earth.
*Examples:* ***falling object, collapsing roof, and a body tripping or falling***

**Motion**
The change in position of objects or substances.
***Examples:*** *vehicle, vessel, or equipment movement; flowing water; wind; and body positioning when lifting, straining, or bending*

**Mechanical**
The energy of the components of a mechanical system, i.e., rotation, vibration, or motion within an otherwise stationary piece of equipment or machinery.
***Examples:*** *rotating equipment, compressed springs, drive belts, conveyors, and motors*

**Electrical**
The presence and flow of an electric charge.
***Examples:*** *power lines, transformers, static charges, lightning, energized equipment, wiring, and batteries*

**Pressure**
Energy applied by a liquid or gas that has been compressed or is under a vacuum.
***Examples:*** *pressure piping, compressed cylinders, control lines, vessels, tanks, hoses, and pneumatic and hydraulic equipment*

**Temperature**
The measurement of differences in the thermal energy of objects or the environment, which the human body senses as either heat or cold.
***Examples:*** *open flame; ignition sources; hot or cold surfaces, liquids, or gases; steam; friction; and general environmental and weather conditions*

**Chemical**
The energy present in chemicals that inherently, or through reaction, has the potential to create a physical or health hazard to people, equipment, or the environment.
***Examples:*** *flammable vapors, reactive hazards, carcinogens or other toxic compounds, corrosives, pyrophorics, combustibles, oxygen-deficient atmospheres, welding fumes, and dusts*

**Biological**
Living organisms that can present a hazard.
***Examples:*** *animals, bacteria, viruses, insects, blood-borne pathogens, improperly handled food, and contaminated water*

**Radiation**
The energy emitted from radioactive elements or sources and naturally occurring radioactive materials *(NORM)*.
***Examples:*** *lighting issues, welding arcs, solar rays, microwaves, lasers, X-rays, and NORM scale*

**Sound**
Sound is produced when a force causes an object or substance to vibrate and the energy is transferred through the substance in waves.
***Examples:*** *equipment noise, impact noise, vibration, high-pressure release, and the impact of noise to communication*

**Fig- 4.3 Planning Phase Hazard Analysis, Chevron Bangladesh Sample Form, [5];**

### 4.2.4 Permit to Work (PTW):

**4.2.4.1 Definition of Permit to Work:** A Permit to Work (PTW) is a written authorization to perform a work within Company operational control.

### 4.2.4.2 Permit to work requirement depends on:

Permit to work requirement depends on type of work (i.e Hot work, Confined space work), Hazards of work, location of work (i.e Gas process area, fuel tank area), Risk of work, which means, whenever work is conducted that may adversely affect on the following:

- Health,
- Environment,
- Safety,
- Efficiency, or
- Reliability of associated personnel or an asset.

PTW is not intended for low-risk activities in low exposure locations/settings.

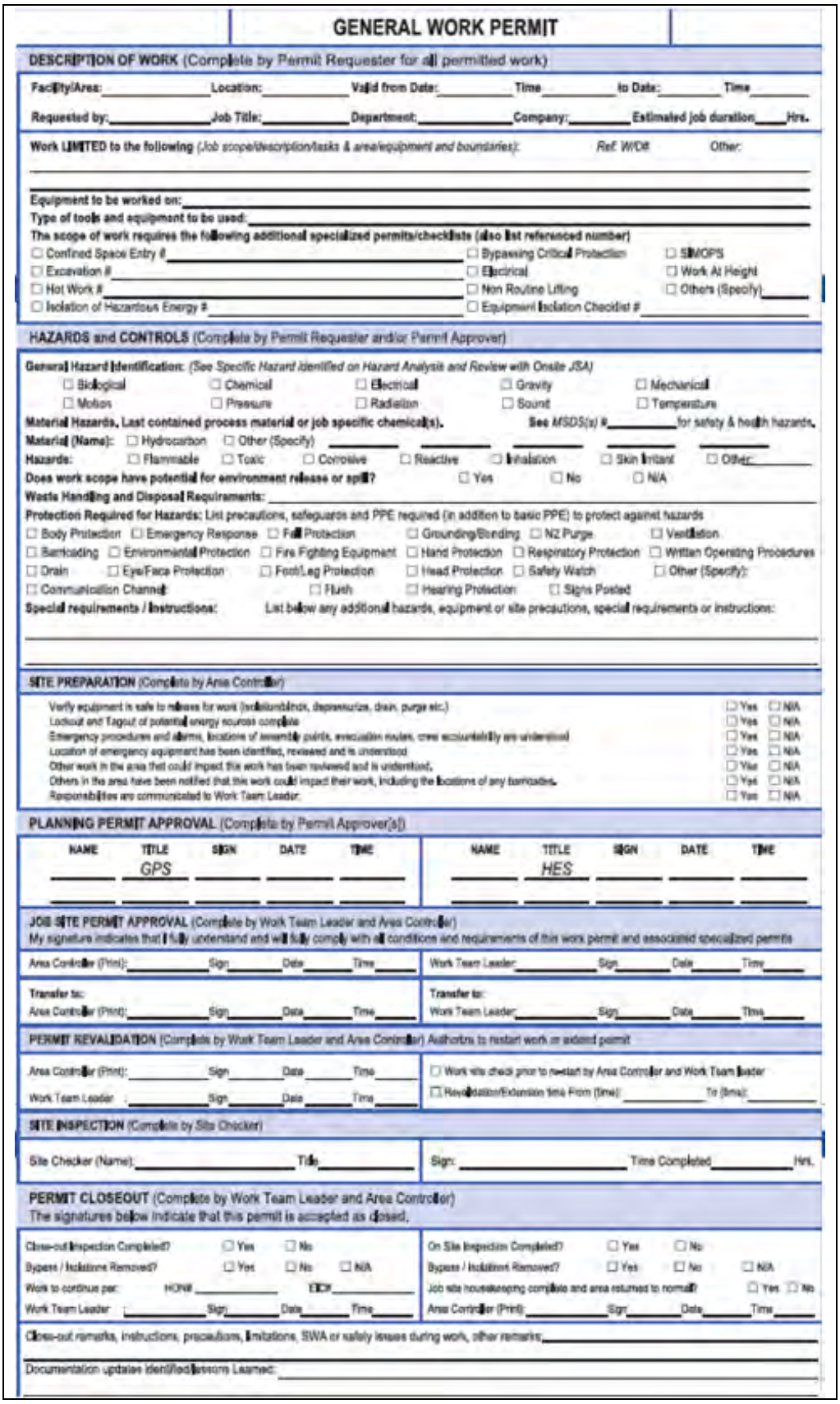
### 4.2.4.3 Permit to work standard requirements:

1. Personnel assigned responsibilities in the Permit to Work roles shall be trained and competent.
2. Hazard analysis shall be performed when planning the work and a Job Safety Analysis (JSA) shall be performed on site with the work crew prior to the initiation of work. Reference: Global Upstream – Hazard Analysis Procedure.
3. The Permit to work (PTW) standard shall clearly indicate roles and responsibilities on how a permit is:
    1) Prepared
    2) Approved/Released
    3) Monitored/Verified
    4) Handled for changes in conditions
    5) Completed and closed out
4. Individuals shall not self-issue a permit
5. Permit to work documentation shall be available at the work site, and retained after work is completed as required by local regulation, Company policy, or for a minimum of six months, whichever is greater. [5];

### 4.2.4.4 Duration of Permit to work:

- In general, Permit to Work approval shall be issued for a single shift, typically a 12-hour period.
- If necessary, the Permit Approver can issue a Permit to Work for a longer period of time but not to exceed 18 hours in total. This should only be done after careful consideration of other ongoing activities, personnel involved, etc.

### 4.2.4.5 Example of Permit to work form:



GENERAL WORK PERMIT

DESCRIPTION OF WORK (Complete by Permit Requester for all permitted work)

Facility/Area: Location: Valid from Date: Time to Date: Time

Requested by: Job Title: Department: Company: Estimated job duration: Hrs.

Work LIMITED to the following (Job scope/description/tasks & area/equipment and boundaries): Ref. WD#: Other:

Equipment to be worked on:

Type of tools and equipment to be used:

The scope of work requires the following additional specialized permits/checklists (also list referenced number)

☐ Confined Space Entry # ☐ Bypassing Critical Protection ☐ SIMOPS

☐ Excavation # ☐ Electrical ☐ Work At Height

☐ Hot Work # ☐ Non Routine Lifting ☐ Others (Specify):

☐ Isolation of Hazardous Energy # ☐ Equipment Isolation Checklist #

HAZARDS and CONTROLS (Complete by Permit Requester and/or Permit Approver)

General Hazard Identification: (See Specific Hazard identified on Hazard Analysis and Review with Onsite JSA)

☐ Biological ☐ Chemical ☐ Electrical ☐ Gravity ☐ Mechanical

☐ Motion ☐ Pressure ☐ Radiation ☐ Sound ☐ Temperature

Material Hazards. Last contained process material or job specific chemical(s). See MSDS(s) # for safety & health hazards.

Material (Name): ☐ Hydrocarbon ☐ Other (Specify)

Hazards: ☐ Flammable ☐ Toxic ☐ Corrosive ☐ Reactive ☐ Inhalation ☐ Skin Irritant ☐ Other:

Does work scope have potential for environment release or spill? ☐ Yes ☐ No ☐ N/A

Waste Handling and Disposal Requirements:

Protection Required for Hazards: List precautions, safeguards and PPE required (in addition to basic PPE) to protect against hazards

☐ Body Protection ☐ Emergency Response ☐ Fall Protection ☐ Grounding/Bonding ☐ N2 Purge ☐ Ventilation

☐ Barricading ☐ Environmental Protection ☐ Fire Fighting Equipment ☐ Hand Protection ☐ Respiratory Protection ☐ Written Operating Procedures

☐ Drain ☐ Eye/Face Protection ☐ Foot/Leg Protection ☐ Head Protection ☐ Safety Watch ☐ Other (Specify):

☐ Communication Channel: ☐ Flush ☐ Hearing Protection ☐ Signs Posted

Special requirements / Instructions: List below any additional hazards, equipment or site precautions, special requirements or instructions:

SITE PREPARATION (Complete by Area Controller)

| | |
|---|---|
| Verify equipment is safe to release for work (isolation/blinds, depressurize, drain, purge etc.) | ☐ Yes ☐ N/A |
| Lockout and Tagout of potential energy sources complete | ☐ Yes ☐ N/A |
| Emergency procedures and alarms, locations of assembly points, evacuation routes, crew accountability are understood | ☐ Yes ☐ N/A |
| Location of emergency equipment has been identified, reviewed and is understood | ☐ Yes ☐ N/A |
| Other work in the area that could impact this work has been reviewed and is understood. | ☐ Yes ☐ N/A |
| Others in the area have been notified that this work could impact their work, including the locations of any barricades. | ☐ Yes ☐ N/A |
| Responsibilities are communicated to Work Team Leader. | ☐ Yes ☐ N/A |

PLANNING PERMIT APPROVAL (Complete by Permit Approver(s))

| NAME | TITLE | SIGN | DATE | TIME | NAME | TITLE | SIGN | DATE | TIME |
|---|---|---|---|---|---|---|---|---|---|
| | GPS | | | | | HES | | | |

JOB SITE PERMIT APPROVAL (Complete by Work Team Leader and Area Controller)

My signature indicates that I fully understand and will fully comply with all conditions and requirements of this work permit and associated specialized permits

Area Controller (Print): Sign: Date: Time: | Work Team Leader: Sign: Date: Time:

Transfer to: Area Controller (Print): Sign: Date: Time: | Transfer to: Work Team Leader: Sign: Date: Time:

PERMIT REVALIDATION (Complete by Work Team Leader and Area Controller) Authorize to restart work or extend permit

Area Controller (Print): Sign: Date: Time: | ☐ Work site check prior to restart by Area Controller and Work Team Leader

Work Team Leader: Sign: Date: Time: | ☐ Revalidation/Extension time From (time): To (time):

SITE INSPECTION (Complete by Site Checker)

Site Checker (Name): Title | Sign: Time Completed: Hrs.

PERMIT CLOSEOUT (Complete by Work Team Leader and Area Controller)

The signatures below indicate that this permit is accepted as closed.

Close-out Inspection Completed? ☐ Yes ☐ No | On Site Inspection Completed? ☐ Yes ☐ No

Bypass / Isolations Removed? ☐ Yes ☐ No ☐ N/A | Bypass / Isolations Removed? ☐ Yes ☐ No ☐ N/A

Work to continue per: HOW: EDC: | Job site housekeeping complete and area returned to normal? ☐ Yes ☐ No

Work Team Leader: Sign: Date: Time: | Area Controller (Print): Sign: Date: Time:

Close-out remarks, instructions, precautions, limitations, SWA or safety issues during work, other remarks:

Documentation updates identified/Lessons Learned:

**Fig- 4.4 Permit to work form (Sample Form-Chevron South Asia Business unit), [5];**

### 4.2.4.6 Person involved and Roles within Permit to work Systems:

**Permit User:** Individuals performing the work scope defined in the permit.
**Permit Approver:** Approver of a permit: Competent individual who has been trained and authorized by the company to review, where applicable sign and approve relevant forms.
**Work Team Leader:** Person in charge of the work: Competent individual who is responsible for the safe execution of work. The role of the designated leader may vary among several people, depending on the work specified.
**Area Controller:** Competent individual who is responsible for the equipment in the area where the work is to be performed.
**Site Checker:** A competent individual who is assigned responsibility to verify work-site activities are in compliance with permit conditions during normal activities.

### 4.2.4.7 Type of work that required Permit to work:

A Permit to Work will be required for the following activities:

- **(1) General Work Permit:** For performing any Construction work, especially for cold work, or when work is perform above 2 Meter's height this permit is required.
- **(2) Hot Work Permit:** when employee is operating outside of normal working environment, for performing any Open flame (welding, cutting) or close flame hot work (generator sets), in that cases this permit is required.
- **(3) Confined Space Entry Permit: For** avoiding any confined space related hazards or for controlling confined space related hazards this permit required.
- **(4) Excavation Permit:** For avoiding any contact with buried services (cable, wire, pipeline) and to prevent excavation collapse this permit required.
- **(5) Isolation of Hazardous Energy work Permit:** Where isolation of the energy source is required for ensuring incident free operation by maintaining zero energy state, this permit is required.
- **(6) Energized Electrical Work permit:** For avoiding any energized electrical work related hazards or for controlling those hazards this permit required.

Permit to Work (PTW) is intended for high - risk activities in high exposure locations/settings. Also for any other work activities if authority think that permit to work is required.

#### 4.2.4.7.1 General Work Permit:

The general work permit system is a means for the authority (Supervisor or designated personnel) to control work performed by personnel who may be exposed to special hazards.

- It is a job planning tool used to manage risks associated with work in hydrocarbon processing areas, construction projects, and other work areas.
- The General Work Permit is the starting point for the permit to work system and will accompany other safe work permits, such as hot work, confined space entry, and excavation.

The concept of General Work Permit may be implemented effectively in many industries including many oil & gas industry, General industry, Shipping Industry e.t.c**,** [5];

**4.2.4.7.2 Hot Work Permit:** A permit issued in addition to a Permit to Work to grant the Company and/or contractor employees permission to perform hot work.

### 4.2.4.7.2.1 Definition of hot work:

- Working with ignition sources near flammable materials is referred to as "hot work." Welding and cutting are examples of hot work. Fires are often the result of the "quick five minute" job in areas not intended for welding or cutting. Getting a hot work permit before performing hot work is just one of steps involved in a hot work management program that helps to reduce the risk of starting a fire by welding or cutting in areas where there are flammable or combustible materials.

- Any work activities that introduce a potential ignition source of any kind to the jobsite in a Classified Area (Where Flammable or combustible material present).

Hot work is any work that involves burning, welding, using fire- or spark-producing tools, or that produces a source of ignition. Welding and cutting operations are common to drilling and servicing operations.

**Examples of hot work:** Welding, brazing, cutting, grinding or chipping, Soldering, Spark-producing tools, performing abrasion blasting, using high-pressure hydro-jet, using electric resistance heaters etc.

### 4.2.4.7.2.2 Hot work and its effect:

Hot work operations can be very dangerous, especially in areas where flammable or combustible materials may present. Each year there are many examples of explosions and fires that devastate Petroleum and mining industries, general industry, homeowners, business owners, families, communities and environment. The one thing these disasters have in common is the failure to follow proper hot work procedures. Adhering to the elements of hot work as outlined in several different OSHA Standards saves lives, property, environment and jobs.

Ensuring fire safety in the performance of hot-work (welding, cutting, and brazing) operations during construction, destruction, renovation, or maintenance activities is a critical component of fire prevention. Proper management and control of hot-work operations can be achieved through implementation of a site-specific hot-work program.

### 4.2.4.7.2.3 Substitution of hot work for minimizing hot work hazards:

People may be able to substitute hot work with other methods. Below are some examples:

| **Instead of:** | **Use:** |
|---|---|
| Saw or torch cutting | Manual hydraulic shears |
| Welding | Mechanical bolting |
| Sweat soldering | Screwed or flanged pipe |
| Torch of radial saw cutting | Mechanical pipe cutter |

### 4.2.4.7.2.4 Hot work management program:

Hot work management programs need to put in place to control or eliminate hot work hazards and their risks. Programs should include the development of policies, procedures, and the assignment of responsibilities and accountabilities for all aspects of hot work. A program should include:

1. **Policie**s

a. Where hot work is permitted
b. When hot work is permitted
c. Who authorizes hot work

2. **Procedures**

a. What must be assessed before permitting/performing hot work in an area or on a process piece of equipment or area
b. What would do to prepare an area for hot work
c. What need to do if hot work cannot be avoided in a particularly hazardous area
d. What hot work tools be required
e. How to obtain a hot work permit, when permit be required, and who can administer them

3. **Training**

a. Employees, supervisors, maintenance individuals, fire wardens, trained fire watch individuals, and contractors all have different roles, and must be trained accordingly on Hot Work Standard.

4. **Communications**

a. Posting procedures
b. Posting policies
c. Posting signs in areas that are/may prohibited from having hot work performed in them

**4.2.4.7.2.5 Hot work procedure:** HSE Person would be responsible; to make sure people is following company hot work procedure. Employees who will perform the hot work job need to consider the follow items:

- Make sure that all equipment is in good operating order before work starts.
- Inspect the work area thoroughly before starting the work. Look for combustible materials in structures (partitions, walls, ceilings).
- Combustible floors must be kept wet with water or covered with fire resistant blankets or damp sand.
- Use water only if electrical circuits have been de-energized to prevent electrical shock.
- Remove any spilled grease, oil, or other combustible liquid from the workplace.
- Move all flammable and combustible materials away from the work area.
- If combustibles cannot be moved, cover them with fire resistant blankets or shields. Protect gas lines and equipment from falling sparks, hot materials and objects.

- Secure, isolate, and vent pressurized vessels, piping and equipment as needed before beginning hot work.
- Inspect the area following work to ensure that wall surfaces, studs, wires or dirt have not heated up.
- Post a trained fire watcher within the work area during welding, including during breaks, and for at least 30-60 minutes after work has stopped. Depending on the work done, the area may need to be monitored for longer (up to 3 hours) after the end of the hot work.
- Eliminate explosive atmospheres (e.g., vapours or combustible dust) or do not allow hot work. Shut down any process that produces combustible atmospheres, and continuously monitor the area for accumulation of combustible gases before, during, and after hot work.
- If possible, schedule hot work during shutdown periods.
- Comply with the required legislation and standards applicable to your workplace. [2];

### 4.2.4.7.2.6 Extinguishing Media:

Extinguishing media are agents which can put out fires involving the material. Common extinguishing agents are water, carbon dioxide, dry chemical, "alcohol" foam, and halogenated gases (Halons). It is important to know which extinguishers can be used so they can be made available at the worksite. It is also important to know which agents cannot be used since an incorrect extinguisher may not work or may create a more hazardous situation. If several materials are involved in a fire, an extinguisher effective for all of the materials should be used and before using the fire extinguishers it is very important to make sure that it is inspected and located along commonly travelled routes, and close to possible ignition sources.

**4.2.4.7.2.7 Importance's of "non-sparking" tools:** Non-sparking tools provide protection against fires and explosions in environments where there may a concern about sparks igniting flammable solvents, vapors, liquids, dusts or residues. There are many standards and recommendations that have been published by OSHA (Occupational Health and Safety Administration) and NFPA (National Fire Protection Association) that advise the use of non-sparking tools in hazardous environments. [13];

### 4.2.4.7.3 Confined Space Entry Permit:

A permit used by the permit approver to grant personnel permission to perform entry into a confined space. This permit only allows entry into the confined space. Work activities in the confined space may require additional permits

### 4.2.4.7.3.1 Definition of confined space and Confined Space Entry:

Generally speaking, a confined space is an enclosed or partially enclosed space that:

- is not primarily designed or intended for human occupancy
- has a restricted entrance or exit by way of location, size or means
- Can represent a risk for the health and safety of anyone who enters, due to one or more of the following factors:
    - its design, construction, location or atmosphere
    - the materials or substances in it
    - work activities being carried out in it, or the
    - mechanical, process and safety hazards present

Confined space that may have one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress. [1];

**Example of confined space:** Confined spaces include but are not limited to, silos, vats, pits, hoppers, utility vaults, tanks, tunnels, sewers, pipes, vessels, access shafts, truck or rail tank cars, aircraft wings, equipment housings, ductwork, hoppers, boilers, manholes, vaults, manure pits and storage bins. Ditches and trenches may also be a confined space when access or egress is limited.

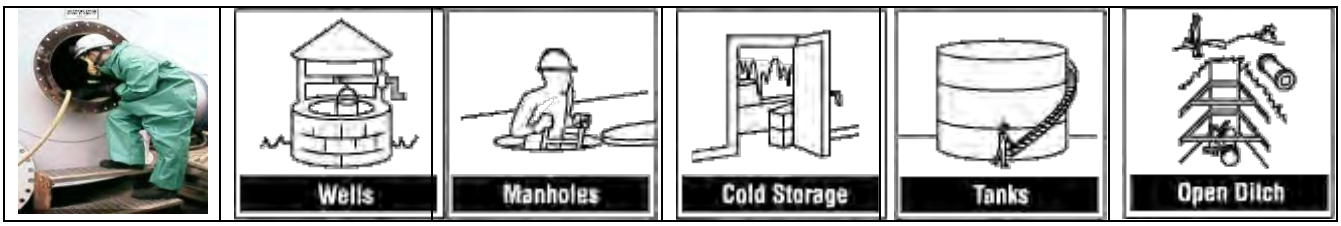



**Fig- 4.5 Confined space (Confined Space-Program) [51];**

**Space Entry:** The act of passing any major portion of the body (e.g., head, legs) through an opening to a confined space. Entry is considered to have occurred as soon as the body part breaks the plane of the opening.

### 4.2.4.7.3.2 Confined Space Hazardous Space:

Many workers are injured and killed each year while working in confined spaces. An estimated 60% of the fatalities are rescuers. A confined space can be more hazardous than regular workspaces for many reasons. To effectively control the risks associated with working in a confined space, a Confined Space Hazard Assessment and Control Program should be implemented for any workplace. Before putting together this program, make sure to review the specific regulations that apply to the workplace. All Petroleum company (other industry) should have regulations dealing with confined space entry. [1];

If the confined space cannot be made safe for the worker by taking precautions then workers should not enter the confined space until it is made safe to enter by additional means.

### 4.2.4.7.3.3 Potential Confined Space Hazards and energy source:

All hazards found in a regular workspace can also be found in a confined space. However, they can be even more hazardous in a confined space than in a regular worksite.

- Gravity: Engulfment, entrapment, fall potential
- Motion: Body posture
- Mechanical: The structural integrity, rotating equipment
- Electrical: Electrocution
- Pressure: Pressurized fluid
- Temperature: Heat stress, steam
- Chemical:
  - Gases & Vapors: Benzene, carbon monoxide, oxygen deficiency, welding fumes
  - Liquids: Hydrocarbons, sulfuric acids

    - Solids: Dust
- Biological: Insects, bacteria
- Radiation: Naturally-occurring radioactive materials (NORM)
- Sound: Noise, echo

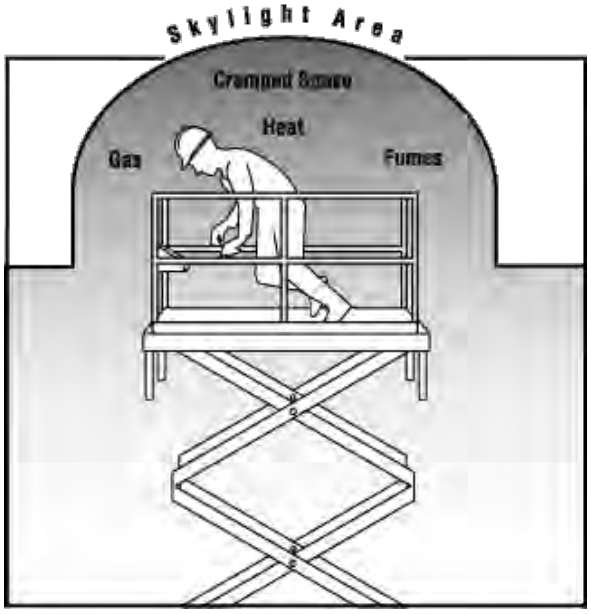



**Fig- 4.6 Hazards in confined spaces [51];**

### 4.2.4.7.3.4 Confined Space Hazard Assessment and Control Program:

To manage the risks associated with working in confined spaces, a Confined Space Hazard Assessment and Control Program should be developed and implemented. A Confined Space Hazard Assessment and Control Program, specific for the work being conducted, should be written for work in each and every confined space.

A Confined Space Hazard Assessment and Control Program should include the following:

- Description of roles and responsibilities of each person or party (e.g., employer, supervisor, workers, attendant, and emergency response team).
- Advice on how to identify confined spaces.
- The identification and assessment of all potential hazards that may exist at the beginning of the work as well as those that may develop because of the work activities.
- A plan to eliminate or control all identified hazards.
- Training program for all the workers those will enter into the confined spaces.
- The establishment of an entry permits system for each entry into a confined space.
- Development of an emergency plan complete with training and equipment in case an unforeseen situation occurs.
- An emergency response system.
- Program review whenever there is a change in circumstances or at least annually, to identify program weaknesses and make any necessary changes to the program.
- Record and documentation control

### 4.2.4.7.3.5 Entry Permit System for confined space entry:

An Entry Permit is an administrative tool used to document the completion of a hazard assessment for each confined space entry. Someone fully trained and experienced in confined space work should complete the Entry Permit. Before entering a confined space, an entry permit should be written. It should contain at least the following information:

- The length of time the permit is valid for.
- The name(s) of the worker(s) that are authorized to enter the confined space.
- The name(s) of the attendant(s) (safety watch) and/or supervisor.
- The location and description of the confined space.
- The work that is to be done in the confined space.
- Possible hazards that may be encountered inside and outside the space.
- Possible hazards that may develop during the work activity.
- The date and time of entry into the confined space and the anticipated time of exit.
- The details of any atmospheric testing done of the confined space - when, where, results, date monitoring equipment was last calibrated. Ideally, calibration would be done just before each use. If this is not possible, follow the equipment manufacturer's guidelines for frequency of calibration.
- Hazard control measures, including the use of mechanical ventilation and other protective equipment needed and any other precautions that will be followed by every worker who is going to enter the confined space.
- Means of communication between the persons working in the confined space and the attendant.
- Emergency plan, and the protective equipment and emergency equipment to be used by any person who takes part in a rescue or responds to other emergency situations in the confined space
- A signature of a worker who did the confined space air testing. The signature on the permit would indicate that adequate precautions are being taken to control the anticipated hazards.
- Authorization signature by the supervisor certifying that the space has been properly evaluated, prepared, and it is safe for entry and work.

The entry permit should be posted at the confined space and remain so until the work is completed. The employer should keep a copy of the completed permit on file. [1];

### 4.2.4.7.3.6 Confined Space Hazard control and work arrangement:

There should be warning signs to prevent unauthorized entry to the confined space. Anyone working in a confined space must be constantly alert for any changing conditions within the confined space. In the event of an alarm from monitoring equipment or any other indication of danger, workers should immediately leave the confined space.

Another worker, the attendant (also known as the Safety Watch or Standby), must be present outside the confined space and continuously monitors the workers inside the confined space.

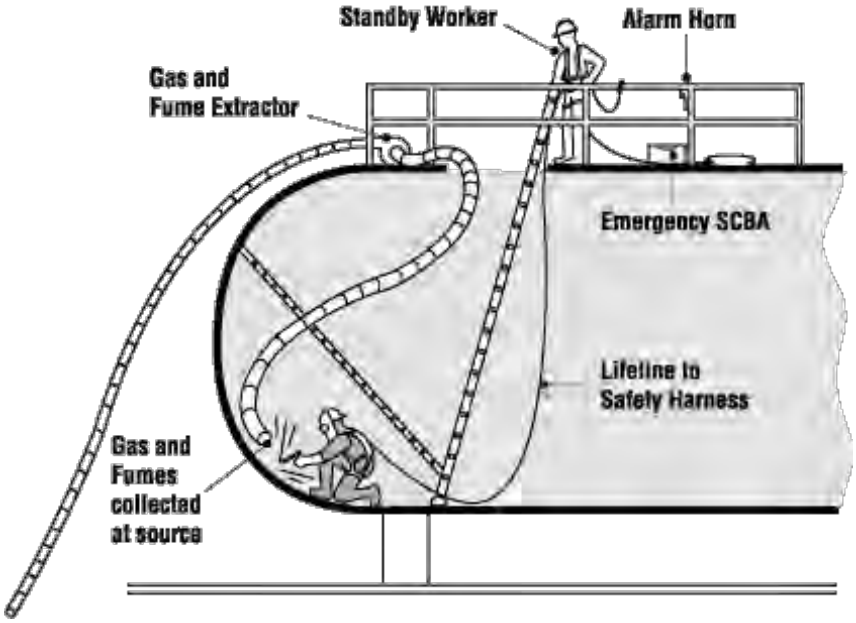



**Fig- 4.7 Confined Space Hazard Control and work arrangement (example) [51];**

The Safety Watch would be responsible for the following duties:

- Understands the nature of the hazards that may be found inside the particular confined space and can recognize signs, symptoms and behavioral effects that workers in the confined space could experience.
- Monitors the confined space and surrounding area and is on the lookout for dangerous conditions.
- Remains outside the confined space and does no other work which may interfere with their primary duty of monitoring the workers inside the confined space.
- Maintains constant two-way communication with the workers in the confined space.
- Orders the immediate evacuation if a potential hazard, not already controlled for, is detected.
- Calls for emergency assistance immediately if an emergency develops.
- Is immediately available to provide non-entry emergency assistance when needed.
- Can provide entry rescue only after the most stringent precautions are taken and another Safety Watch is immediately available.

If worker leave a confined space for a short time (for example, coffee break, getting additional material for their work.), the confined space should be re-tested before the worker re-enters. If the confined space has been continuously monitored by equipment that can show the details of the atmosphere during the time absent from the confined space and this information can be seen from outside the confined space, it can be re-entered without retesting. If there is not continuous air monitoring then the hazard assessment needs to be repeated.

No confined space should be closed off until it has been verified that no person is inside it.

After exiting the confined space, the time of exit should be noted on the entry permit.

### 4.2.4.7.3.7 Confined Space Emergency situation and control:

If a situation arises where there is a hazardous condition and the worker cannot leave or is unable to leave the confined space, rescue procedures should begin immediately.

The Safety Watch should be qualified in confined spaces rescue procedures and will be available immediately outside the confined space to provide emergency assistance if needed. The Safety Watch also should be familiar with the structural design of the confined space. The Safety Watch must be maintaining constant communication with the worker inside the confined space and will:

- Have an alarm for calling for help.
- Have all required rescue equipment (for example, safety harnesses, lifting equipment, a lifeline) immediately available and be trained in its use.
- Hold a basic first aid certificate.
- Can do Cardiopulmonary Resuscitation (CPR).

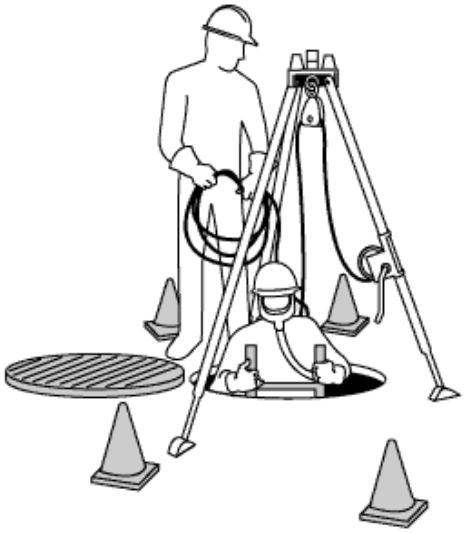


**Fig- 4.8 Safety equipment arrangement (with self contained breathing apparatus) [51];**

- The detailed plan for emergency response to an injury or other emergency within the confined space should be described in detail in the Confined Space Hazard Assessment and Control Program.
- Rescue the victims from outside of the confined space, if possible. No other worker should enter a confined space to attempt a rescue unless that worker is fully trained in the rescue procedures and is wearing the appropriate personal protective equipment. More than 60% of deaths in confined spaces are would-be rescuers, who are not fully trained and adequately equipped.
- Another worker qualified in confined spaces rescue procedures must be present outside the confined space before the first rescuer enters the confined space. Do not use the same air as the confined space workers are rescuing. Wear SCBA (self contained breathing apparatus) or supplied air respirator with an escape bottle.
- A rescue plan and the rescue personnel and equipment for each confined space entry must be in place to rescue personnel who may be in difficulty.
- A rescue plan shall be in place for each entry based on rescue need.

**Fig- 4.9 Critical Emergency Rescue equipment (Chevron South Asia Business unit) [1];**

**4.2.4.7.3.8 Training importance for working safely in confined spaces:** Appropriate training is extremely important to working safely in confined spaces. Hands-on training should be an essential part of the confined space training.

Every worker who enters a confined space must be fully trained on the following:

- Recognition and identification of potential hazards associated with the confined spaces where people will be entered.
- Evaluation and control procedures for the identified or potential hazards.
- Set-up, use and limitations of all equipment such as emergency equipment, ventilation equipment (blowers), hazardous energy control, isolation and lockout equipment, and air quality monitors (e.g., Oxygen/combustible meters) that will be used while in the confined space.
- Set-up, use and limitations of all personal protective equipment (e.g., full-body harness, respirators) which the worker will be using while in the confined space.
- All safe work procedures for entering the confined space as outlined in the employer's Confined Space Hazard Assessment Program.
- Procedures to follow in the event of a situation developing that could present additional risk to the worker or an emergency.
- The specific work to be done while in the confined space.
- To work in a manner that will not endanger lives.

Workers with emergency rescue responsibilities will need additional specialized training. All confined space training should include some hands-on training with the safety equipment including the personal protective equipment and safety harnesses. Rescue procedures should be practiced frequently so there is a high level of proficiency. Employers should keep records of all confined spaces training including refresher courses. [1];

**4.2.4.7.4 Excavation Permit:** Excavation Permit is required for any excavation work more than 6 inch depth. Also for avoiding any contact with buried services (cable, wire, and pipeline) and to prevent excavation collapse this permit required.

**4.2.4.7.4.1 Excavation and its support system**: Any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal. Employer need to protect personnel who may enter excavations by using support systems (e.g., shoring, bracing, sloping, benching, and shields). Design and construct the excavation support system using competent trained persons.

**4.2.4.7.4.2 Day-lighting:** In the context of excavation, the process of safely exposing the underground utility to precisely locate and identify it. Day-lighting is done with hand tools, vacuum excavation or other means that cannot damage the utility.

**4.2.4.7.5 Isolation of Hazardous Energy Permit:** A separate document attached to a Permit to Work specifying the control measures necessary to carry out the isolation of hazardous energy work safely.

**Isolation:** The process that segregates the hazardous energy or toxic substance from the recipient. This may be achieved by a number of methods such as blinding, electrical isolation or positive physical isolation.

**Zero Energy State:** The maximum protection against unexpected movement or activation of equipment or machinery, release of stored pressure, or flow of liquid or gas when maintenance or repair is performed.

### 4.2.4.7.5.1 Definition of Hazardous energy:

Hazardous energy is defined as: "any electrical, mechanical, pneumatic, chemical, nuclear, thermal, gravitational, or other energy that can harm people" Some energy sources are obvious, such as electricity, heat in a furnace, or something that might fall. Others may be hidden hazards such as air pressure in a system or a tightly wound spring.

In this document, the term energy refers to anything that can provide power to a system to allow it to perform work. The term system refers to machinery, equipment, and/or processes.

Energy sources (like-electrical, mechanical, hydraulic, chemical e.t.c) used in machines and equipment can be hazardous to workers. During the servicing and maintenance of machines and equipment, the unexpected startup or release of stored energy can result in serious injury or death to workers.

### 4.2.4.7.5.2 Harmful effects of hazardous energy:

When workers servicing or maintaining machines or equipment in that case they may be seriously injured or killed if hazardous energy is not properly controlled. Injuries resulting from the failure to control hazardous energy during maintenance activities can be serious or fatal! Injuries may include electrocution, burns, crushing, cutting, lacerating, amputating, or fracturing body parts, and others.

Electricians, machine operators, and laborers are among the 3 million workers who service equipment routinely and face the greatest risk of injury.

### 4.2.4.7.5.3 Control of hazardous energy:

Failure to control hazardous energy accounts for nearly 10 percent of the serious accidents in many industries. Lockout/Tagout describes the practices and procedures necessary to disable machinery or equipment to prevent hazardous energy release. The Control of Hazardous Energy (Lockout/ Tagout) for petroleum industry or general industry outlines measures for controlling different types of hazardous energy. The LOTO standard establishes the employer's responsibility to protect workers from hazardous energy. Employers should also required to train each worker to ensure that they know, understand, and be able to follow the applicable provisions of the hazardous energy control procedures:

- Proper lockout/tagout (LOTO) practices and procedures safeguard workers from the release of hazardous energy. The OSHA standard for The Control of Hazardous Energy (Lockout/Tagout) for general industry, outlines specific action and procedures for addressing and controlling hazardous energy during servicing and maintenance of machines and equipment. Employers are also required to train each worker to ensure that they know, understand, and are able to follow the applicable provisions of the hazardous energy control procedures. Workers must be trained in the purpose and function of the energy control program and have the knowledge and skills required for the safe application, usage and removal of the energy control devices.
- All employees who may work in an area where energy control procedure(s) may utilized need to be instructed in the purpose and use of the energy control procedure(s), especially prohibition against attempting to restart or reenergize machines or other equipment that are locked or tagged out.
- All employees who are authorized to lockout machines or equipment and perform the service and maintenance operations need to be trained in recognition of applicable hazardous energy sources in the workplace, the type and magnitude of energy found in the workplace, and the means and methods of isolating and/or controlling the energy.
- Specific procedures and limitations relating to tagout systems where they may allowed.
- Retraining of all employees to maintain proficiency or introduce new or changed control methods.

Workers have a right to a safe workplace. The law requires employers to provide their employees with safe and healthful workplaces. [12];

### 4.2.4.7.5.4 Purpose of a hazardous energy control program:

In most cases, equipment or systems will have safety devices built in. These safety devices include barrier guards and safeguarding devices to help protect workers during normal operations. However, during maintenance or repairs, these devices may have to be removed or by-passed. In these situations, a hazardous energy control program is needed.

A hazardous energy control program can be use to maintain worker safety by preventing:

- Unintended release of stored energy.
- Unintended start-up.
- Unintended motion.
- Contact with a hazard when guards are removed or safety devices have been by-passed or removed.

**4.2.4.7.5.5 Hazardous Energy Control Program:** Hazardous energy control programs involve 5 steps:

**1. Gather Information:** Begin by gathering documentation from the manufacturer or designer of the system about:

- Where energy isolating devices may located and procedures for their use.
- Step-by-step procedures for servicing or maintaining the system.
- How to safely address malfunctions, jams, misfeeds, or other planned and unplanned interruptions in operations.
- How to install, move, and remove any or all parts of the system safely.

**2. Perform a Task Analysis:** When performing the task identification, at a minimum, consider the following categories:

- Machine/process set-up & unexpected start-up.
- All modes of operation and also fault-finding and troubleshooting.
- Emergency stoppages and restart.
- Planned & Unplanned maintenance and repair.

**3. Perform a Hazard and Risk Analysis:** The hazard and risk analysis will outline all situations where a worker could be exposed to hazards. Examples include:

- A press cycles accidentally while a worker is changing a die.
- An injection moulding machine gate closes while a worker is in it.
- A robot moves while a worker is trying to program it.

**4. Implement Controls:** The controls required will follow what hazards and risks were identified during the analysis and assessment. For example, identify what types of hazardous energy are present in a system that needs to be controlled, and what types of energy-isolating and de-energizing devices are required.

**5. Communication, including Training:** Communicate and train appropriate staff on how the program works, their role in the program, and what their responsibilities are.

### 4.2.4.7.5.6 Lockout/Tag out:

Lockout and Tag out is more than putting a lock on a switch, it consist of comprehensive step-by-step processes that involve communication, coordination, and training. Lockout is one way to control hazardous energy.

In practice, lockout is the isolation of energy from the system (a machine, equipment, or process) which physically locks the system in a safe mode. The energy-isolating device can be a manually operated disconnects switch, a circuit breaker, a line valve, or a block. In most cases, these devices will have loops or tabs which can be locked to a stationary item in a safe position (de-energized position). The locking device (or lockout device) can be any device that has the ability to secure the energy-isolating device in a safe position.

Tag out is a labeling process that is always used when lockout is required. The process of tagging out a system involves attaching or using an indicator (usually a standardized label) that includes the following information:

- Why the lockout/tag out is required (repair, maintenance, etc.).
- Time of application of the lock/tag.
- The name of the authorized person who attached the tag and lock to the system.

### 4.2.4.7.5.7 Lockout procedures and work instructions contain:

The written lockout procedures will identify what needs to be done, when it needs to be done, what tools are available to do it, who is supposed to do it, and who needs to be notified.

The document should specify:

- The actual specific machine, equipment, or process shutdown and isolation process.
- How and where the lockout devices are installed.
- How stored energy is controlled and subsequently de-energized.
- How the isolation can be verified.

Work instructions will identify how the lockout process is to be carried out in a step-by-step manner including how stored energy is controlled and de-energized, how isolation can be verified, and how and where lockout devices are installed. Work instructions are machine, equipment or process specific and include pictures or images of what is being described.

Proper lockout/tagout (LOTO) practices and procedures safeguard workers from hazardous energy releases when they are servicing or maintaining machines or equipment. Lockout/Tagout describes the practices and procedures necessary to disable machinery or equipment to prevent hazardous energy release by ensuring zero energy state on system.

### 4.2.4.7.5.8 Steps of a lockout/tag out program include:

1) **Prepare for shutdown:** The authorized person will identify which sources of energy may present and must be controlled; and more importantly, identify what method of control will be used.
2) **Notify all affected employees:** The authorized person will communicate the following information to notify affected persons:

- What is going to be locked/tagged out.
- Why it is going to be locked/tagged out.
- For approximately how long will the system be unavailable.
- Who is responsible for the lockout/tag out.
- Who to contact for more information.

3) **Equipment Shutdown:** Equipment shutdown involves ensuring controls are in the off position, and verifying that all moving parts such as flywheels, gears, and spindles have come to a complete stop.

4) **Isolation of system from hazardous energy:** The exact written instructions should be specific for Isolation hazardous energy for the system need to be follow

- **Electrical energy:** Switch electrical disconnects to the off position. Visually verify that the breaker connections are in the off position. Lock the disconnects into the off position.
- **Hydraulic and Pneumatic potential energy:** Set the valves in the closed position and lock them into place. Bleed off the energy by opening the pressure relief valves, then closing the airlines.

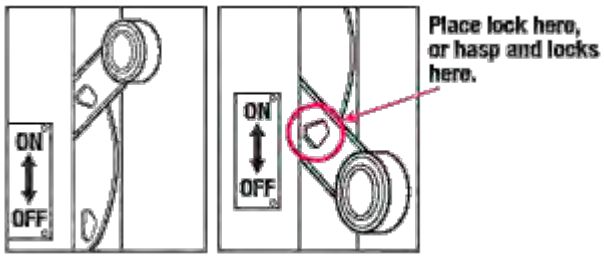



**Fig- 4.10 Electrical lockout [54];**

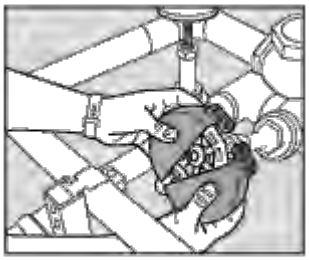


**Fig- 4.11 Hydraulic and Pneumatic lockout [54];**

5) **Dissipation of residual or stored energy:** In general, following examples include:

- Mechanical potential energy - Carefully release energy from springs that may still be compressed. If this is not possible, use blocks to hold the parts that may move if the energy is released
- Gravitational potential energy - If feasible, lower the part to a height where falling is impossible. If this is not possible, contact the manufacturer for guidance.
- Chemical energy - If available, bleed lines and/or cap ends to remove chemicals from the system.

6) **Lockout/Tag out:**

When the system's energy sources are locked out, there should have specific guidelines that must be followed to ensure that the lock cannot be removed, and the system cannot be inadvertently operated.

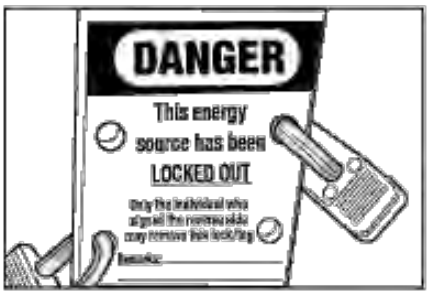



**Fig- 4.12 Example of multiple locks on a lockout tag [54];**

7) **Verify Isolation:** Verify that the system is properly locked out before beginning any work. Verification can take place in several ways: Following are some example:

- The machine, equipment, or process controls (push buttons, switches) are engaged or activated and the result is observed. No result means isolation is verified. Return controls to safe position (off).

- Visual inspection of: Electrical connections to ensure they are open.
- Testing of the equipment: Check temperature gauges to ensure thermal energy has been discharged.

Choose the method that will best ensure that the energy to the system has been isolated without creating other hazards during the verification.

8) **Perform Maintenance or Service Activity:** Complete the activity that required the lockout process to be started.
9) **Remove Lockout/Tag out devices:** To remove locks and tags from a system that is now ready to be put back into service, the following general procedure can be used:

- Inspect the work area to ensure all tools and items have been removed.
- Confirm that all employees and persons are safely located away from hazardous areas.
- Verify that controls are in a neutral position.
- Remove devices and re-energize machine.
- Notify affected employees that servicing is completed. [3];

### 4.2.4.7.5.9 Person's responsibility for the lockout program (Who is responsible):

Each party in the workplace has a responsibility in the lockout program. In general:

**Management is responsible for:**

- Drafting, periodically reviewing, and updating the written program.
- Identifying the employees, machines, equipment, and processes included in the program.
- Providing the necessary protective equipment, hardware and appliances.
- Monitoring and measuring conformance with the program.

**Supervisors are responsible for:**

- Distributing protective equipment, hardware, and any appliance; and ensuring its proper use by employees.
- Ensuring that equipment-specific procedures are established for the machines, equipment and processes in their area.
- Ensuring that only properly trained employees perform service or maintenance that require lockout.
- Ensuring that employees under their supervision follow the established lockout procedures where required.

**Employees are responsible for:**

- Assisting in the development of equipment-specific procedures.
- Following the procedures that have been developed.
- Reporting any problems associated with those procedures, the equipment, or the process of locking and tagging out. [12];

### 4.2.5 Shop, Yard and Rig and plant Inspections:

**4.2.5.1 Purpose of inspections:** As an essential part of a health and safety program, workplaces should be inspected. Inspections are important as they allow employer to:

- listen to the concerns of workers and supervisors
- gain further understanding of jobs and tasks
- identify existing and potential hazards
- determine underlying causes of hazards
- monitor hazard controls (personal protective equipment, engineering controls, policies, procedures)
- recommend corrective action

### 4.2.5.2 Importance of workplace inspections:

Workplace inspections help prevent injuries and illnesses. Through critical examination of the workplace, inspections identify and record hazards for corrective action. Joint occupational health and safety committees can help plan, conduct, report and monitor inspections. Regular workplace inspections are an important part of the overall occupational health and safety program. This provides a system of multiple self-checks that identifies non-compliance and provides immediate continued training by ensuring corrective measures are taken.

Workplace inspections help to identify existing hazards so that appropriate corrective action can be taken. Health and safety legislation requires workplace inspections as a proactive action to ensure workplace health and safety.

**4.2.5.3 Plan for inspections:** Planning is essential for an effective inspection.

**(a) Aspects to Examine:**

Every inspection must examine who, what, where, when and how. Pay particular attention to items most likely to develop unsafe or unhealthy conditions because of stress, wear, impact, vibration, heat, corrosion, chemical reaction or misuse. Inspect the entire workplace area each time. Include areas where no work is done regularly, such as parking lots, rest areas, office storage areas and locker rooms.

**(b) Workplace Elements:** Look at all workplace elements - the environment, the equipment and the process. The environment includes such hazards as noise, vibration, lighting, temperature, and ventilation. Equipment includes materials, tools and apparatus for producing a product or a service. The process involves how the worker interacts with the other elements in a series of tasks or operations.

**(c) Chemical Inventory:** Determine which chemicals are used in the workplace and whether material safety data sheets are available. Find out whether actual and potential sources of chemical exposure are properly controlled. Make sure that all workers have received training in handling chemicals. Check that all chemicals are labelled with pertinent information (such as handling, storage, and waste disposal) according to Workplace Hazardous Materials Information System (WHMIS) requirements.

**(d) Inspection:** Supervisors and workers continually conduct ongoing inspections as part of their job responsibilities. Such inspections identify hazardous conditions and either correct them immediately or

report them for corrective action. The frequency of these inspections varies with the amount and conditions of equipment use. Daily checks by users assure that the equipment meets minimum acceptable safety requirements.

Engineers, maintenance personnel, occupational hygienists, health and safety professionals, supervisors or managers, qualified insurance loss control personnel, and by Toolpushers and Drilling Superintendents may be a part of the inspection team or they may be called upon to help with certain aspects of the inspection, or to help explain equipment or processes.

### 4.2.5.4 Observation:

Supervisors and workers are responsible for reporting and taking action on unsafe conditions and acts as they are encountered. Records of previous accidents and the potential for serious accidents and injuries are factors need to be included when determining if more frequent inspections are needed. Look for deviations from accepted work practices. Use statements such as, "a worker was observed operating a machine without a guard." Do not use information derived from inspections for disciplinary measures.

Some common poor work practices include:

- using machinery or tools without authority
- operating at unsafe speeds or in other violation of safe work practice
- removing guards or other safety devices, or rendering them ineffective
- using defective tools or equipment or using tools or equipment in unsafe ways
- using hands or body instead of tools or push sticks
- overloading, crowding, or failing to balance materials or handling materials in other unsafe ways, including improper lifting
- repairing or adjusting equipment that is in motion, under pressure, or electrically charged
- failing to use or maintain, or improperly using, personal protective equipment or safety devices
- creating unsafe, unsanitary, or unhealthy conditions by improper personal hygiene, by using compressed air for cleaning clothes, by poor housekeeping, or by smoking in unauthorized areas
- standing or working under suspended loads, scaffolds, shafts, or open hatches

State exactly what has been detected and accurately identify its location.

Assign a priority level to the hazards observed to indicate the urgency of the corrective action required. For example:

A = Major--requires immediate action

B = Serious--requires short-term action

C = Minor--requires long-term action

Make management aware of the problems in a concise, factual way.

Take immediate action as needed. When permanent correction takes time, take any temporary measures that can applicable.

After each listed hazard, specify the recommended corrective action and establish a definite correction date. Each inspection team member should review for accuracy, clarity and thoroughness.

### 4.2.5.5 Checklist for General Inspection (Workplace Housekeeping):

Inspection is the only way to check for deficiencies in the program so that changes can be made. The documents on workplace inspection checklists provide a general guide.

Use the following checklist as a general workplace guide.

**(a) Spill Control**:

- Are all spills wiped up quickly?
- Are procedures followed as indicated on the material safety data sheet?
- Are spill absorbents used for greasy, oily, flammable or toxic materials?
- Are used rags and absorbents disposed of promptly and safely?
- Is a spill area surrounded by a barrier to prevent a spill from spreading?

**(b) Equipment and Machinery Maintenance:**

- Is equipment in good working order, with all necessary guards or safety features operational or in place?
- Is equipment damaged or outdated?
- Are tools and machinery inspected regularly for wear or leaks?
- Is equipment repaired promptly?
- Are drip pans or absorbent materials used if leaks cannot be stopped at the source?
- Is a machine that splashes oil fitted with a screen or splash guard?
- Are machines and tools cleaned regularly?

**(c) Floors and Other Areas:**

- Are floors clean and clear of waste?
- Are signs posted to warn of wet floors?
- Are floors in good condition?
- Are there holes, worn or loose planks or carpet sticking up?
- Is anti-slip flooring used where spills, moisture or grease are likely?
- Are there protruding objects such as nails, sharp corners, open cabinet drawers, trailing electrical wires?
- Are personal items, such as clothing and lunch boxes, in assigned lockers or storage areas?
- Is the work area congested?
- Are floors well-drained?

**(d) Aisles and Stairways:**

- Are aisles unobstructed and clearly marked?
- Are mirrors installed at blind corners?
- Are aisles wide enough to accommodate workers and equipment comfortably?
- Are safe loading practices used with hand and power trucks, skids, or pallets?
- Is the workplace lighting adequate? Are stairs well lit?
- Are stairs covered with an anti-slip tread? Are faulty stair treads repaired?

**(e) Waste Disposal:**

- Are there adequate number of containers?
- Are there separate and approved containers for toxic and flammable waste?
- Are waste containers located where the waste is produced?
- Are waste containers emptied regularly?
- Are toxic and flammable waste chemicals handled properly?

**(f) Storage:**

- Are storage areas safe and accessible?
- Is material stacked securely, blocked or interlocked if possible?
- Are materials stored in areas that do not obstruct stairs, fire escapes, exits or firefighting equipment?
- Are materials stored in areas that do not interfere with workers or the flow of materials?
- Are bins or racks provided where material cannot be piled?
- Are all storage areas clearly marked?
- Do workers understand material storage and handling procedures?

**(g) Fire Prevention:**

- Are combustible and flammable materials present only in the quantities needed for the job at hand?
- Are combustible and flammable materials kept in safety cans during use?
- Are hazardous materials stored in approved containers and away from ignition sources?
- Are sprinkler heads clear of stored material?
- Are fire extinguishers inspected and located along commonly travelled routes, and close to possible ignition sources?
- Are oily or greasy rags placed in metal containers and disposed of regularly?

**4.2.5.6 Platform inspection:** Keep a log of all inspections and repairs. Report any concerns and repair before use.

Inspect the platform at beginning of each shift for:

- overall frame condition,
- uncontrolled motion,
- loose connections or missing fasteners,
- improper adjustments,
- cracked welds,
- broken or fraying wire ropes,
- damaged electrical wires, or hydraulic or pneumatic lines,
- inefficient brakes,
- poor tire condition and pressure,
- missing load capacity postings,
- broken safety devices (horns, emergency controls, gates, fall protection, etc.).

Inspections are also required on an annual or "hours of use" basis, for that purpose need to use manufacturers guidelines or standards.

### 4.2.5.7 Powered hand tools inspection procedure:

- Inspect tools for any damage prior to each use.
- Check the handle and body casing of the tool for cracks or other damage.
- If the tool has auxiliary or double handles, check to see that they installed securely.
- Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- Check for damaged switches and ones with faulty trigger locks.
- Inspect the plug for cracks and for missing, loose or faulty prongs.

**For defective tool, people should do the following:**

- If a tool is defective, remove it from service, and tag it clearly "Out of service for repair".
- Replace damaged equipment immediately - do not use defective tools "temporarily".
- Have tools repaired by a qualified person - do not attempt field repairs.

**Inspection of powered hand tools:**

- Inspect tools for any damage prior to each use.
- Check the handle and body casing of the tool for cracks or other damage.
- Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- Check for damaged switches and ones with faulty trigger locks.
- Inspect the plug for cracks and for missing, loose or faulty prongs.

### 4.2.5.8 Sample Inspection List:

Date: _____ Location/Department: _____

| **Yes = Satisfactory** | | **No = Unsatisfactory, needs attention** | | | |
|---|---|---|---|---|---|
| **Yes** | **No** | **Safe Work Practices** | **Yes** | **No** | **Fire Protection** |
| | | Use of machine guards<br>Proper manual lifting<br>Smoking only in safe, designated areas<br>Proper use of air hoses<br>No horseplay Other: _____ | | | Fire extinguishers<br>Proper type/location<br>Storage of flammable materials<br>Other: _____ |
| | | Use of Personal Protective Equipment | | | Tools and Machinery |
| | | Eye/face protection<br>Footwear<br>Gloves<br>Protective clothing | | | Lawn mowers<br>Power tools<br>Hand tools<br>Machine guarding |

| | | | | | |
|---|---|---|---|---|---|
| | | Head protection<br>Aprons<br>Respirators<br>Other: _____ | | | Belts, pulleys, gears, shafts<br>Oiling, cleaning, adjusting<br>Maintenance, oil leakage<br>Other: _____ |
| | | Housekeeping | | | First aid |
| | | Proper storage areas<br>Proper storage of flammable material (oily/greasy rags, etc.)<br>Proper disposal of waste<br>Floors (clean, dry, uncluttered)<br>Maintenance of yards, parking lots | | | First aid kits in rooms/vehicles<br>Trained first aid providers<br>Emergency numbers posted<br>All injuries reported<br>Other: _____ |
| | | Electrical Safety | | | Other: _____ |
| | | Machines grounding/GFI<br>Electrical cords<br>Electrical outlets<br>Other: _____ | | | SDS/Labels<br>Dust/vapour/fume control<br>Safe use of ladders/scaffolds<br>New processes or procedures carried out<br>Other: _____ |

Notes: _____

During the actual inspection, both work conditions and procedures should be observed. If a hazard that poses an immediate threat is discovered, preventive action must be taken right away, not after the inspection. Notes are made, specifying details of the hazard, including its exact location. When completing the inspection report, it is a good idea to classify each hazard by degree of possible consequences (for example: A = major, B = serious, C = minor). In this way, priorities for remedial action are established.

### 4.2.5.9 Sample Workplace Inspection Report (content-form):

Location:_____ Department/Areas covered: _____

Date of Inspection: _____ Time of Inspection: _____

| Item (Location) | Hazards Observed | Repeat item Yes/No | Priority | Recommended Action | Responsible Person | Action Taken | Date |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| Analysis and comments: | | | | | | | |

**Priority Codes:** A - do immediately; B - do within 3 days; C - do within 2 weeks; D - other

Corrective action should be taken immediately, with the emphasis on engineering controls, management failures, or need for worker education, whatever apply.

### 4.2.5.10 Inspections before site selection:

Once a bottom hole target has been selected, the site inspection will be made to select suitable site in the proposed area. At that time the following matters should be considered:

- Access to site
- Existing utilities
- Proximity of habitation
- Environmental consideration (EIA study)
- Size and shape of site
- Proximity to roads and railways
- Cost including site purchase (or lease), site preparation

### 4.2.5.11 Inspecting the Rig:

Perform a complete inspection of the rig before operating. The driller and/or rig superintendent/ toolpusher / manager should walk around the entire rig and inspect for missing or loose pins and bolts, equipment guards, adequate guard railings, proper line and cable placement, and unclear walkways. [10];

**Potential Hazards:**

- Falling from the rig.
- Tripping on power cords and hoses.
- Slipping and falling on slick walking services.

**Fig- 4.13 Inspecting the rig, [53];**

**Fig- 4.14 Inspecting rig equipment [53];**

**Possible Solutions:**

- Use proper fall protection.
- Keep all cords and hoses orderly and clear of walking spaces.
- Clear and clean all walkways and walking surfaces of slipping hazards

### 4.2.5.12 Inspections for ensuring incident free operation:

- Conduct a pre-job inspection to identify, then eliminate or correct hazardous work surfaces.
- Conduct a pre-job inspection to identify, then eliminate or correct hazardous work surfaces.
- Use proper equipment inspection techniques to include hammer unions
- Conduct a post-job inspection to identify, then eliminate or correct hazardous work surfaces.
- inspection to ensure cleanup is complete
- Perform the inspection while the engine is off and then again when the engine is on. Engine off checks helps to find any obvious problems and correct them before starting the engine and possibly harming others.
- After weather changes, conduct inspections for new hazards.
- Ensure that workers know how to perform regular maintenance and inspection of their PPE.
- Ensure that workers can identify potential problems or defects with their PPE during the pre-use inspection or while wearing/using.
- Keep a log of inspections and related items or repairs.

### 4.2.6 Tool Box Talk:

Toolbox is described as short, informal training conducted at a worksite by technically competent persons for the benefit of a work team, so that every work team member able to understand work related hazard, control and mitigation measure. Maintaining Toolbox talk at worksite is very important, which will help to ensure incident free operation. Chevron Bangladesh and Geokinetics international company maintain toolbox everyday in their operational areas. They maintain the rule for toolbox talk that is **No Toolbox Talk, No Work.** The potential applications for tool box talks are endless.

### 4.2.6.1 Definition of Tool Box Talk:

A Tool Box Talk is a short safety talk, which should be given by Managers, Supervisors, Safety Officers or Safety Representatives. Numbers of people attending each talk depend on individual work group and to hold it in a place where they will start the work or in a place where they will feel comfortable.

Running effective toolbox meetings can be a challenge. To help make it easier, need to follow toolbox meeting guides to provide a simple, clear format for conducting effective toolbox talks. These guides include information on specific construction safety topics that should help encourage safe work practices.

Toolbox talks are a great way of implementing company own training programmed at place of work. It is suitable for all levels of staff members, including those with literacy or language issues. If a person is struggling to get to grips with a particular topic, in that case consider a one-to-one tutorial. Health and Safety culture must be executed from the top, but must be understood at every level.

### 4.2.6.2 Aim and objective:

The aim of a Tool Box Talk is to highlight specific hazards in the workplace. The objective should be to raise the awareness of the employees and inform them of the control measures put in place to prevent workplace accidents. Tool Box Talks should be designed so that it will easily understood by workers with either literacy or language difficulties or so should be visual and interactive where possible.

### 4.2.6.3 Purpose of Tool Box Talk:

To give company workers, supervisors, and Department Heads a means of communicating health, safety, and environmental initiatives as well as accident/incident "Lessons Learned" and expressing concerns, obtaining information, and resolving issues related to safety in the workplace.

### 4.2.6.4 Scope of Tool Box Talk:

This policy applies to all workers, department, staff, and contractor employees of the company and anyone who wished to initiate the "purpose" of this policy.

### 4.2.6.5 Guidelines for Toolbox Talk:

Supervisor or Department Heads will ensure that workers attending these tool box meeting sign an attendance sheet as a proof of attendance.

A copy of the tool box talk will be sent to Department of Health Safety & Environment and the original (copy) kept on file with the supervisor.

The tool box talk meetings should be held at the same time, and if possible, at the work place on regular basis. An agenda for the tool box talk meeting should contain the following:-

- Review of minutes of the previous meetings, including status on any concerns raised;
- Review of incidents reported since the last meeting, including status of corrective action recommended and / or taken.
- Comments and concerns of workers; and
- Presentation of the weekly/ monthly safety topic.

### 4.2.6.6 Tool Box Talk Presenter Quality:

Toolbox talk is often described as short, informal training conducted at a worksite by technically competent persons for the benefit of a work team. The presenter must explain in detail the contents of each Tool Box Talk and relate the hazards highlighted to their own operation. Keep it straightforward and simple. Focus on just a important key points in the Tool Box talk. Encourage questions. Remind the participants that there is no such thing as a silly question. Everyone learns when one person asks a question. Find ways to involve members of the group. It will keep their interest and it will help them to remember what presenter has been discussing. Ask them for examples of hazards and safeguards related to the topic.

To evaluate how well the talk is progressing, encourage interaction with the attendees and finally to check the level of understanding, summaries the talk by having a quick question and answer session.

### 4.2.6.7 Basic information about Tool Box Talks:

### 4.2.6.7.1 Meaning of Tool Box Talk:

Tool box talks, tailgate meetings, safety time-outs, crew briefings – the names vary by industry. But no matter what people call them or what industry are in, don't assume that work site supervisors or crew leaders embrace (include) the need for these gatherings or even understand what people are asking them to pass on to employees.

When I was new to the workforce, my supervisor would gather us around the machine shop and deliver a quick safety talk. (Actually, it went more like "be careful while set up.") Then he would pass out the work assignments and give everyone their tool list. We called them tool box talks because there was always a tool box nearby and someone was always leaning on it. When I visited construction sites with my mentor, these talks were held around the tailgate of the site supervisor's pick-up truck. Whether it was around the tailgate or by the tool box, these talks were basically the same thing: informal safety meetings between the supervisor and employees.

### 4.2.6.7.2 Person conducting Tool box Talk:

Toolbox talk is often described as short, informal training conducted at a worksite by technically competent persons or person with direct supervision over the employees or HSE concern person for the benefit of a work team. If the safety manager comes along and speaks – however briefly – it gives the impression that the safety manager, not the supervisor, is responsible for safety.

### 4.2.6.7.3 Topics covered in toolbox:

Topics should be specific to company work environment. They should be topical and varied to cover:

- Accident trends
- Job-specific training requirements
- Specifics related to the equipment and/or tools that the employee group will be using.

Generic topics aren't usually effective because the employee can't relate the information to a specific job task. The topic needs to be not just specific but relevant to the employee. There's no need to talk about sailing safety to employees in an assembly plant.

### 4.2.6.7.4 Making Tool Box Talk Effective:

The effectiveness of tool box talks is determined by

- How topical the subject is
- The relevance of the topic to the job at hand
- How easy it is for employees to understand the talk

Opening a work session or taking time during a regular work shift to discuss safety topics associated with the task at hand can be very effective in keeping job safety fresh in the employee's mind.

### 4.2.6.7.5 How often conducting tool box talk?

People can deliver tool box talks at predetermined intervals, say every morning before starting the job or before starting the job at each shift. This gives the supervisor time to get together with the crew. It also reinforces the fact that the supervisor is responsible for safety. Toolbox talks are informal, but their regularity will reinforce a commitment to a safe work environment.

Tool box talks should also be flexible enough to be used to address new and timely issues, such as changes to equipment or processes. For example, people might want to use talks to introduce new or different PPE when introducing new chemicals to the worksite.

### 4.2.6.7.6 Tool Box Talk conducting period (How Long?):

Tool box talks should be short and to the point. In my experience, it's best to limit them to no more than 10 to 15 minutes. Paradoxically, shorter talks usually require the most preparation. It takes a lot of time and effort to distill the essential information and present it in an engaging way.

The meeting need only be 10-15 minutes long but must:-

1. Start on time;
2. Stay strictly to safety topics;
3. Be conducted in an orderly manner following a prepared agenda;
4. Allow for worker contributions; and
5. Have minutes taken and communicated (Question & Answer session).

### 4.2.6.7.7 Person attending in Tool Box Talk (Who should attend?):

Every employee who reports to the person conducting the talk should attend. Thi may make it necessary to schedule multiple sessions so that the supervisor can reach crews that are in different work areas, have different work assignments and/or use different equipment.

### 4.2.6.7.8 Attendance Should Be Documented:

Employee should use the form in Tool box talks and need to be documented. Company can then use the materials to document compliance with various training requirements. For example, tool box talk attendance sheets can help prove that HSE Concern person or work supervisor delivered requisite training under the OSHA Hazard Communication Standard.

### 4.2.6.8 Toolbox meeting checklist:

Choose a safety topic:

- Choose a topic relevant to the work the crew is doing

Be Prepared

- Inspect the jobsite for hazards related to crew work topic
- Read over the material employee plan to cover
- Make sure crew are familiar with any regulations, guidelines and company rules related to the day's topic.
- Review reports of recent accidents on the site, including "near misses"

Get the crew actively involved in the meeting

- Choose a real-life example to talk about
- Invite the crew to ask questions and make suggestions related to the topic
- Respond to questions that presenter can answer, and offer to find answers presenter don't know
- Allow time at the end of the meeting for question and suggestions on any safety issue
- Ask the crew for feedback about the meeting

- Involve the crew in preparing for and / or leading future safety meetings

Follow up

- Look into complaints, concerns, and suggestions that the crew brought up
- Report back to the crew to let them know what will be done
- Keep good records of each toolbox meeting

Show that company takes safety seriously

It takes more than a good toolbox meeting to create a safety work environment.

- Encourage safe work practices
- Set an excellent safety example for others
- Invite crew members to come to HSE Toolbox Presenter any time with safety problems and suggestions

### 4.2.6.9 Sample Tool Box Talk Meeting attendance Sheet:-

**Toolbox Meeting Attendance Sheet**

Project: ……Address:……

Employer:…….Supervisor:……

Date:……Time:…… Shift: …….

Number in crew:…… Number Attending: ……

Other safety issues or suggestions made by crew members:

……
……
……

Record of those attending:

| Name: (please print) | Signature: | Company: |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |

Manager's remarks:……..

Manager:…… Supervisor: ……..

(Signature) (Signature)

**4.2.6.10 Example of Toolbox Talk at Bibiyana Gas Field (Chevron contractor-Shamolima company)**


**Fig- 4.15 Tool Box Talk conducted by HES Specialist at Bibiyana Gas Plant with Shamolima Company (Chevron contractor)**

## 4.2.7 Personal Protective Equipment (PPE):

### 4.2.7.1 Definition of Personal Protective Equipment (PPP):

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Personal protective equipment is clothing or devices worn to help isolate a person from direct exposure to a hazardous material or situation. PPE is used to reduce or minimize the exposure or contact to physical, chemical, ergonomic, or biological agents. A hazard cannot be eliminated by PPE, but the risk of injury can be reduced.

Example of PPE:- Personal protective equipment may include items such as gloves, masks, safety glasses(with side shields) and shoes, earplugs or muffs, hard hats, respirators, or coveralls, aprons ,vests and full body suits, fall protection, lab coats, as well as head, eye and foot protection.

### 4.2.7.2 Role of personal protective equipment (PPE):

(1) Hazards exist in every workplace so strategies to protect workers are essential. The priority should be the elimination and control of hazards at their source or along the path between the source and the worker. Many methods are available, and the most appropriate one to the specific situation should be used.

(2) Controlling a hazard at its source should be the first choice because this method will eliminate it from the workplace altogether or isolate it from the worker. This approach may require substitution of a material with nonhazardous ones, isolation of hazards, addition of safety features to existing equipment,

redesign of the work processes, or purchase of new equipment. When the hazard cannot be removed or controlled adequately**.**

(3) Personal Protective Equipment (PPE) may be used if the work process is to continue.

(4) It will be the final item on the list for a very good reason. Personal protective equipment should never be the only method used to reduce exposure except under very specific circumstances because PPE may "fail" (stop protecting the worker) with little or no warning. For example: "breakthrough" can occur with gloves, clothing, and respirator cartridges.

(5) No matter which type of PPE will used, would be the essential to have a complete PPE program in place in the organization.

(6) PPE should be considered as the last level of protection when all other methods are not available or possible.

### 4.2.7.3 When is the best time to provide protection from hazards?

When hazards are identified, it is useful to consider general principles of control, which can be thought of as two basic categories: "pre-contact" or "point-of-contact."

**Pre-contact:** Pre-contact control be the first and most important method because it prevents the hazard from reaching the worker. Pre-contact control can be achieved by providing protection to the worker with local exhaust ventilation, machine guarding, better housekeeping, and safe work practices.

Where pre-contact controls are not practical, feasible, or totally effective then point-of-contact controls must be used.

**Point-of-contact:** The point-of-contact control will be important but secondary because it cannot eliminate the hazard. It only manages the hazard at the point of contact with the worker. This form of control is primarily accomplished through personal protective equipment. It is to be used when pre-contact controls are not totally effective.

### 4.2.7.4 When should PPE be used?

PPE is used to reduce or minimize the exposure or contact to physical, chemical, ergonomic, or biological agents. A hazard cannot be eliminated by PPE, but the risk of injury can be reduced.

PPE should only be used:

- as an interim (short term) measure before controls are implemented;
- where pre-contact control technology is not available;
- where pre-contact controls are inadequate;
- during activities such as maintenance, clean up, and repair where pre-contact controls are not feasible or effective;
- During emergency situations.

### 4.2.7.5 Proper use of personal protective equipment:

For ensuring the proper use of personal protective equipment, All personal protective equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. It should fit well and be comfortable to wear, encouraging worker use. If the personal protective equipment does not fit properly, it can make the difference between being safely covered or dangerously exposed. When engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment to their workers and ensure its proper use. Employers are also required to train each worker before providing personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

**4.2.7.6 Design a PPE program:** A PPE program must be comprehensive. It requires commitment and active participation at the planning, development, and implementation stages from all levels: senior management, supervisors, and workers. A good PPE program consists of these essential elements:

a) workplace survey
b) selection of appropriate controls
c) selection of appropriate PPE
d) fitting
e) training
f) management support
g) maintenance
h) auditing of the program

**4.2.7.7 Head protection:** If people are at risk for head injury at workplace, people should wear the appropriate head protection.

- If head protection is required, need to establish a complete safety protection program including selection, fit testing, training, maintenance and inspection.
- People should choose the correct headwear for the job.
- Classes of headwear can include:
    - Type 1 - protection from impact and penetration at the crown (top) and
    - Type 2 - protection from impact, penetration at the crown (top) and laterally (sides)
    - Each type also available in the following classes:
        - Class E (20 000 V electrical rating) - non-conducting material (electrical trades)
        - Class G (2200 V electrical rating) - non-conducting material (general trades)
        - Class C (no electrical rating). [24];

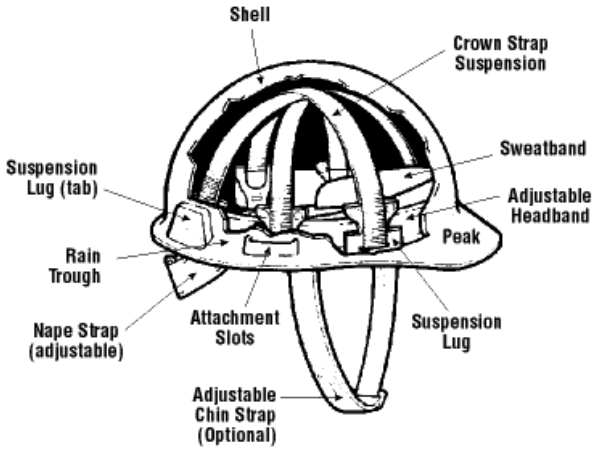



**Fig- 4.16 Headwear [24];**

- Headwear would consists of a shell and the suspension. These work together as a system and both need regular inspection and maintenance.
- Should not transport headwear in rear windows of vehicles. Heat and UV light can damage the material, making it brittle and less protective.
- Inspect headwear before each use.
- Always will need to check with the manufacturer when adding or using accessories (non-metallic stickers, tape, bandanas, hankerchiefs, etc.). [24];

**Fig- 4.17 Hard hat with the peak at the back [24];**

**4.2.7.7.1 Suspension of headwear:** The suspension system is as important as the shell. It holds the shell away from the head and acts as a shock-absorber. It also holds the shell in place on the head and allows air to flow freely.

- Adjust headband size so that headwear will stay on when the wearer is bending over, but not so tight that it leaves a mark on the forehead.
- Need to ensure that the suspension is in good condition. The main purpose of the suspension is to absorb energy.
- Look closely for cracked or torn adjustment slots, frayed material or other signs of wear.
- Should not put anything between the suspension and the shell. There must be a clearance inside the headwear while it is being worn. In case of a blow to the head, that space helps absorb the shock.
- Should not use a suspension made by one manufacturer with products made by another manufacturer.
- Should not change or alter any of the suspension, liner or shell.

### 4.2.7.8 Eye and face protection:

**Fig- 4.18 Eye protection (Source-OSHA News Release, 13 March 2015)**

Thousands of people are blinded each year from work-related eye injuries that could have been prevented with the proper selection and use of eye and face protection. Eye injuries alone cost more than $300 million per year in lost production time, medical expenses, and worker compensation.

Employer should require to ensure the safety of all employees in the work environment. Eye and face protection must be provided whenever necessary to protect against chemical, environmental, radiological or mechanical irritants and hazards.

**Face Protection:** Face protection should be provide an effective barrier to protect a worker's eyes, nose or mouth from coming into contact with sprays or aerosolized body fluids. There should be different types and combinations of face protection, such as a mask with safety glasses, goggles, face shield (with safety glasses or goggles), or a mask with an attached visor (and safety glasses or goggles).

### 4.2.7.8.1 Safety Glasses and Face Protectors:

**Recognition of safety glasses:**

**Lenses**: The certified safety glasses should have plastic polycarbonate lenses. They should stronger than regular lenses, are impact-resistant, and come in prescription and non-prescription (plano or zero-power lens) forms.

**Markings on safety glasses**: The manufacturer or supplier logo should have marked (or etched) on all approved safety lenses, frames (front and temple), removable side shields, and other parts of the glasses, goggles, or helmets.

**Frames**: Safety frames should stronger than street-wear frames and are often heat resistant. The design should be such like that to prevent lenses from being push into the eyes. [26];

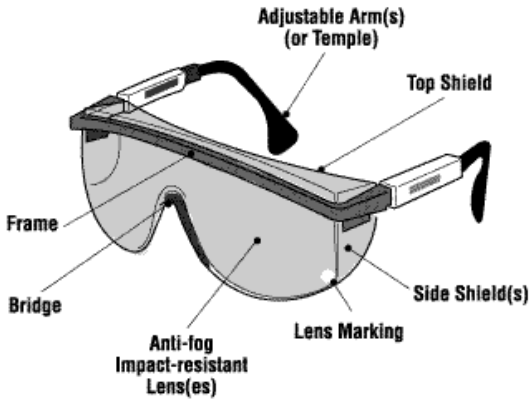



**Fig- 4.19 Safety Glasses [26];**

**4.2.7.9 Hearing protection devices (HPDs) & conservation program**: Earmuffs and Plugs, are considered an acceptable but less desirable option to control exposures to noise and are generally used during the time necessary to implement engineering or administrative controls, when such controls are not feasible, or when worker's hearing tests indicate significant hearing damage.

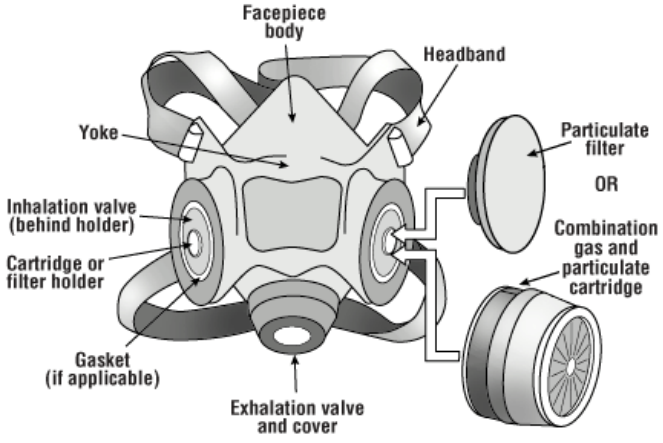
An effective hearing conservation program must be implemented by employers in general industry or Petroleum industry, whenever worker noise exposure is equal to or greater than 85 dBA for an 8 hour exposure or in the construction industry. This program strives to prevent initial occupational hearing loss, preserve and protect remaining hearing, and equip workers with the knowledge and hearing protection devices necessary to protect them. Key elements of an effective hearing conservation program include:

- Workplace noise sampling including personal noise monitoring which identifies which employees are at risk from hazardous levels of noise.
- Informing workers at risk from hazardous levels of noise exposure.
- Training and information that ensures the workers are aware of the hazard from excessive noise exposures and how to properly use the protective equipment that has been provided.
- Data management of and worker access to records regarding monitoring and noise sampling.

Each of these elements is critical to ensure that workers are being protected where noise levels are unable to be reduced below the OSHA required levels.

**4.2.7.10 Respiratory Protection:** Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors, and sprays. These hazards may cause cancer, lung impairment, diseases, or death. Respirators protect the user in two basic ways. The first is by the removal of contaminants from the air. Respirators of this type include particulate respirators, which filter out airborne particles, and air-purifying respirators with cartridges/canisters which filter out chemicals and gases. Other respirators protect by supplying clean respirable air from another source. Respirators that fall into this category include airline respirators, which use compressed air from a remote source, and self-contained breathing apparatus (SCBA), which include their own air supply.

Respiratory protection will be needed when ventilation system not sufficient to remove welding fumes or when there is risk of oxygen deficiency. Select and use respirators in compliance with company workplace regulation. [27];




The basic parts of a typical half-facepiece respirator are shown.
Two common options are illustrated on the right.
Both sides of the respirator would take the same type of filter or cartridge.

**Fig-4.20 Sample Half-face Respirator [27];**

### 4.2.7.10.1 When should a respirator be used?

Workers should use respirators for protection from contaminants in the air only if other hazard control methods are not practical or possible under the circumstances. Respirators should not be the first choice for respiratory protection in workplaces. They should only be used:

- when following the "hierarchy of control" is not possible (elimination, substitution, engineering or administrative controls)
- while engineering controls are being installed or repaired
- when emergencies or other temporary situations arise (e.g., maintenance operations)

### 4.2.7.10.2 Procedures for selecting and operating respiratory protective equipment:

Employers should have a written respirator program that describes the proper procedures for selecting and operating respiratory protective equipment. The correct use of a respirator is just as important as selecting the proper respirator. Parts of the respirator program deal with finding out what hazards are present and how much protection that the workers will need. Other parts should describe how to wear and look after the respirator.

Without a complete respiratory protection program, people will probably not receive the best protection from a respirator even if it is the correct choice for a specific job. A respiratory protection program should include several components such as:

| | |
|---|---|
| • hazard identification and control<br>• exposure assessment<br>• respirator selection<br>• respirator fit-testing<br>• training program<br>• inspection and record keeping | • cleaning and sanitizing respirators<br>• repairing and maintaining respirators<br>• proper storage of respirators<br>• health surveillance<br>• standard operating procedures (available in written form)<br>• program evaluation. |

A physician should examine the medical and psychological fitness of workers. This should be done before they will assigned to work in areas where respirators may be required. The workers must be physically fit to carry out the work while wearing respiratory equipment. They must also be psychologically comfortable (e.g., not claustrophobic) about wearing respirators.

### 4.2.7.11 Gloves:

The use of gloves does not replace the need for hand hygiene. Gloves often create a moist environment that facilitates the growth of microorganisms. Hands should be properly washed before the gloves are put on and after the gloves are removed. Hand hygiene is also needed before and after the replacement of gloves during a procedure or in between tasks.

Gloves are for single-patient and single-procedure use only. Only disposable gloves should be used in the prevention of disease transmission.

### 4.2.7.11.1 Skin and hand protection:

Since there are many hazards, hand protection can be provided in a variety of ways: finger guards, cots and thimbles, hand pads, mitts, and gloves.

- Choose hand protection that adequately protects from the hazard(s) of a specific job and adequately meets the specific tasks involved in the job (such as flexibility or dexterity).
- Follow the manufacturer's instructions for care, decontamination, and maintenance of gloves.
- Ensure the gloves fit properly.
- Ensure all exposed skin is covered by gloves. Gloves should be long enough so that there is no gap between the glove and sleeve.
- Do not wear gloves with metal parts near electrical equipment.
- Do not use worn or torn gloves.
- Clean gloves as instructed by the supplier.
- Inspect and test gloves for defects before using.
- Test all rubber or synthetic gloves for leaks by inflating them (see figures below).

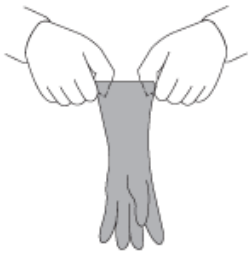
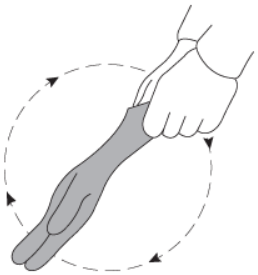
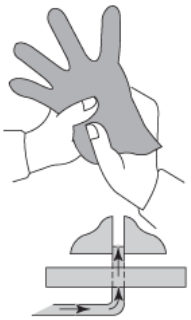
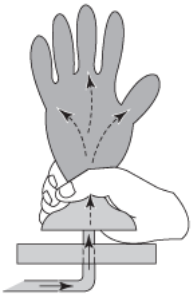
| | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| Fig- 4.21 (a) | Fig- 4.21 (b) | Fig- 4.21 (c) | Fig- 4.21 (d) | Fig- 4.21 (e) |

**Fig- 4.21 Rubber or Synthetic gloves test for leaks by inflating (CCOHS database CHEMINFO)**

### 4.2.7.12 Protective Clothing:

Wear loose clothing that permits sweat evaporation but stops radiant heat. Use cooled protective clothing for extreme conditions.

### Safety tips for using protective clothing:

**DO**

- Wear clothing made from heavyweight, tightly woven, 100% wool or cotton to protect from UV radiation, hot metal, sparks and open flames. Flame retardant treatments become less effective with repeated laundering.
- Keep clothing clean and free of oils, greases and combustible contaminants.

**DO NOT**

- Do not wear rings or other jewellery.
- Do not wear clothing made from synthetic or synthetic blends. The synthetic fabric can burn vigorously, melt and produce bad skin burns.

### 4.2.7.13 Why is foot comfort important?

There are two major categories of work-related foot injuries. The first category includes foot injuries from punctures, crushing, sprains, and lacerations. The second group of injuries includes those resulting from slips, trips and falls. Slips and falls do not always result in a foot injury but lack of attention to foot safety plays an important role in their occurrence.

These two categories of foot injuries, however, do not exhaust the whole range of foot problems at work. Although these may not be considered as occupational injuries in the strictest sense, they can have serious consequences for health and safety at the workplace. They cause discomfort, pain and fatigue. Fatigue sets up the worker for further injuries affecting the muscles and joints. Also, a worker who is tired and suffering pain is less alert and more likely to act unsafely. An accident or incident of any kind may result.

Working on a hard floor has the impact of a hammer, pounding the heel at every step. Slippery floors are hazardous for slips and falls that can result in sprained ankles or broken foot bones.

**4.2.7.13.1 Protection Code (markings) for safety shoe:** An "internal protection code" must have in the safety shoe. This code will be permanently marked on the outside or inside of at least one shoe/boot.

**Protection Code**

| **Position:** | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Mark:** | 1 | P | M | E | X |

Position:

1 – Level of toe protection (1 for Grade 1, 2 for Grade 2, 0 if not)

2 -- Presence of puncture-resistant sole (P if present, 0 if not)

3 -- Presence of metatarsal protection (M if present, 0 if not)

4 -- Type of electrical protection (E if shock resistant, S if static dissipative, C if conductive, 0 if no protection)

5 -- Chainsaw protection (X if present, 0 if not)

### 4.2.7.14 Fall Protection:

**Body Belts, Harnesses, and Lanyards:** If people are at risk for falling two meters or more at workplace, in that case should wear the appropriate fall protection equipment.

If fall protection is required, establish a complete fall protection program if one is not in place. The program should include training workers, selecting, fitting, and inspecting the equipment.

### 4.2.7.14.1 Safety tips for fall protective equipment:

- Inspect equipment before each use.
- Replace defective equipment. If there is any doubt about the safety of the equipment, do not use it and refer questionable defects to the supervisor.
- Replace any equipment, including ropes, involved in a fall. Refer any questionable defects to your supervisor or check with the manufacturer.
- Every piece of fall arrest equipment should be inspected and certified at least yearly or more often by a trained and competent person. Keep written records of inspections and approvals.
- It is advisable to use energy absorbers if the arresting forces of the lanyard alone can cause injury.
- Follow the manufacturer's instructions about:
    - the purpose of the device,
    - hazard warnings,
    - instructions and limitations on use,
    - the stretch distance of the harness,
    - instructions for fitting and adjusting,
    - recommendations for care (cleaning, maintenance, and storage) and inspection,
    - the purpose and function of the fall arrest indicator,
    - a warning if a fall occurs or inspection reveals an unsafe condition that the device be taken out of service until it will have been determined safe for use or destroyed, and
    - Instructions for proper application, use, and connecting to full body harness of any evacuation device.

### 4.2.7.14.2 Important of fall protection:

Falls are among the most common causes of serious work related injuries and deaths. Employers must set up the work place to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls.

### 4.2.7.14.3 Necessary step to reduce falls from height:

Employers must set up the work place to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls. OSHA requires that fall protection be provided at elevations of six feet in the construction industry operations**.** In addition, OSHA requires that fall protection be provided when working over dangerous equipment and machinery, regardless of the fall distance. [4];

To prevent employees from being injured from falls, employers must:

- Guard every floor hole into which a worker can accidentally walk (using a railing and toe-board or a floor hole cover).
- Provide a guard rail and toe-board around every elevated open sided platform, floor or runway.
- Regardless of height, if a worker can fall into or onto dangerous machines or equipment (such as a vat or acid or a conveyor belt) employers must provide guardrails and toe-boards to prevent workers from falling and getting injured.
- Other means of fall protection that may be required on certain jobs include safety and harness and line, safety nets, stair railings and hand rails. [4];

OSHA requires employers to:

- Provide working conditions that are free of known dangers.
- Keep floors in work areas in a clean and, so far as possible, a dry condition.
- Select and provide required personal protective equipment at no cost to workers.

Train workers about job hazards in a language that they can understand.

### 4.2.7.14.4 Personal Fall Arrest Systems:

A personal fall arrest system is one option of protection that OSHA requires for workers on construction sites who are exposed to vertical drops of 6 feet or more.

a) Attachment Location
b) Body Harness
c) Vertical Lifeline/Lanyard
d) Webbing
e) Anchorages
f) Horizontal Lifeline
g) Connectors
h) Using Fall Arrest Systems Safely

**a) Attachment Location :** The attachment of the body harness must be located in the center of the wearer's back, near the shoulder level,

**Fig-4.22 Attachment**

**Fig- 4.23 Body Harness [52];**

**Fig- 4.24 Vertical Lifeline/Lanyard [52];**

**b) Body Harness:**

Body harnesses are designed to minimize stress forces on an employee's body in the event of a fall, while providing sufficient freedom of movement to allow work to be performed.

- Do not use body harnesses to hoist materials.
- Body belts are not acceptable as part of a personal fall arrest system, because they impose a danger of internal injuries when stopping a fall.

**c) Vertical Lifeline/Lanyard:**

Vertical lifelines or lanyards must have a minimum breaking strength of 5,000 pounds, and be protected against being cut or abraded.

Self-retracting vertical lifelines and lanyards that automatically limit free fall distance to 2 feet or less must be capable of sustaining a minimum tensile load of 3,000 pounds when in the fully extended position.

**d) Webbing:** Webbing are the ropes and straps used in lifelines, lanyards, and strength components of body harnesses. The webbing must be made from synthetic fibers.

**Fig- 4.25 Webbing [52];**

**Fig- 4.26 Anchorages [52]**

**Fig- 4.27 Horizontal Lifeline [52];**

**e) Anchorages:** Anchorages used for attachment of personal fall arrest equipment must be independent of any anchorage being used to support or suspend platforms, and capable of supporting at least 5,000 pounds per employee attached, or must be designed and used as follows:

- As part of a complete personal fall arrest system which maintains a safety factor of at least two.
- Under the supervision of a qualified person.

**f) Horizontal Lifeline:** Horizontal lifelines are to be designed, installed, and used under the supervision of a qualified person, and as part of a complete personal fall arrest system which maintains a safety factor of at least two.

**g) Connectors:** Connectors, including D-rings and snaphooks, must be made from drop-forged, pressed or formed steel or equivalent materials. They must have a corrosion-resistant finish, with smooth surfaces and edges to prevent damage to connecting parts of the system.

**Fig- 4.28 Connector [52];**

**Fig- 4.29 D-Rings [52];**

**Fig-4.30 Snaphooks [52];**

**D-Rings:** D-Rings must have a minimum tensile strength of 5,000 pounds, and be proof-tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or becoming permanently deformed.

**Snaphooks:** Snaphooks must have a minimum tensile strength of 5,000 pounds, and be proof-tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or becoming permanently deformed.

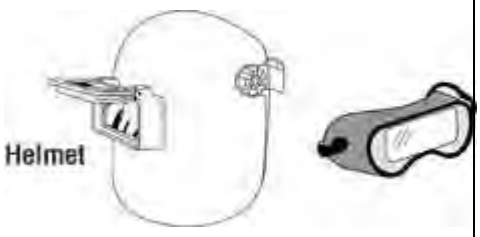
**h) Using Fall Arrest Systems Safely:**

**Fig- 4.31 The worker is protected by a properly constructed fall arrest system [52]**;

- Ensure that personal fall arrest systems will, when stopping a fall:
  - Limit maximum arresting force to 1,800 pounds.
  - Be rigged such that an employee can neither free fall more than 6 feet nor contact any lower level.
  - Bring an employee to a complete stop and limit maximum deceleration distance to 3½ feet.
- Have sufficient strength to withstand twice the potential impact energy of a worker free falling a distance of 6 feet,
- Remove systems and components from service immediately if they have been subjected to fall impact, until inspected by a competent person and deemed undamaged and suitable for use.
- Do not attach fall arrest systems to guardrail systems or hoists. [4];

### 4.2.7.15 Welding - Personal Protective Equipment and Clothing:

The chart below summarizes the types of personal protective equipment that can be used when welding.

| **Welding - Personal Protective Equipment** | | | |
|---|---|---|---|
| **Body Part** | **Equipment** | **Illustration** | **Reason** |
| Eyes and face | Welding helmet, hand shield, or goggles |   | Protects from:<br>• radiation<br>• hot slag, sparks<br>• intense light<br>• irritation and chemical burns<br>Wear fire resistant head coverings under the helmet where appropriate |
| Lungs (breathing) | Respirators |  | Protects against:<br>• fumes and oxides |

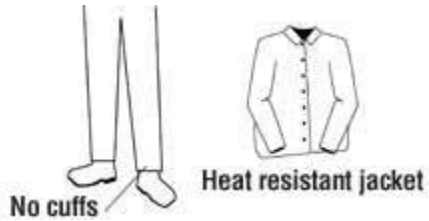
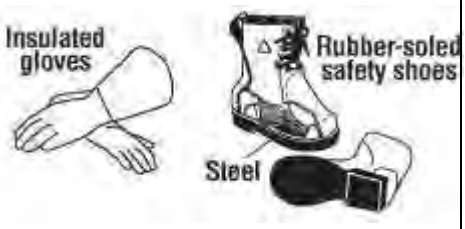
| | | | |
|---|---|---|---|
| Exposed skin (other than feet, hands, and head) | Fire/Flame resistant clothing and aprons |  | Protects against:<br>• heat, fires<br>• burns<br><br>Pants should not have cuffs, shirts should have flaps over pockets or be taped closed |
| Ears – hearing | Ear muffs, ear plugs |  | Protects against:<br>• noise<br><br>Use fire resistant ear plugs where sparks or splatter may enter the ear. |
| Feet and hands | Boots, gloves |  | Protects against:<br>• electric shock<br>• heat<br>• burns<br>• fires |

**Fig- 4.32 Welding - Personal Protective Equipment [45];**

### 4.2.7.15.1 Importance's of eye protection:

Eye injury can occur from the intense light and radiation that a welding arc can produce. Eye injury can also occur from hot slag that can fly off from the weld during cooling, chipping or grinding.

- Protect people eyes from welding light by wearing a welder's helmet fitted with a filter shade that is suitable for the type of welding people are doing.
- Always wear safety glasses with side shields or goggles when chipping or grinding a work piece if you are not wearing a welding helmet.

The following operations require full face protection from either a welding helmet or a hand shield:

- arc welding,
- plasma arc cutting, gouging or welding, and
- air carbon arc cutting.

For gas cutting, welding, or brazing, the intensity of the light is much less than from arc welding, cutting or gouging processes. Lighter shade filter lenses can be used with goggles in place of a helmet.

### 4.2.7.16 Using Seat Belt and Motor Vehicle safety:


**Fig- 4.33 Seat Belt & Motor vehicle safety (Behavior Based Safety Observation Card-South Asia Business unit of Chevron)**

According to the Bureau of Labor Statistics (PDF), more than 1,766 deaths a year result from occupational transportation incidents. That number is more than 38 percent of the 4,547 annual numbers of fatalities from occupational injuries. Fatal transportation incidents were lower by 10 percent in 2013, but still accounted for about 2 out of every 5 fatal work injuries in 2013. That's why for reducing transportation incidents, driver should be complete Defensive driving training. On the other hand in the vehicle there should have an Auditory signal if the seat belt is not buckled.

### 4.2.8 Audit / Safety Audit:

### 4.2.8.1 Definition of safety Audit:-

- Generally, a safety audit is a structured process whereby information is collected relating to the efficiency, effectiveness, and reliability of the total health and safety management system of a company. Safety audits are conducted in compliance with legislation, and are used as a guide for designing plans for corrective actions within a health and safety program.
- Safety auditing is a core safety management activity, providing a means of identifying potential problems before they have an impact on safety.

How often health and safety audits and inspections should be carried out in the company workplace for ensuring the highest safety standards should determine by employer and maintained throughout for ensuring incident free operation.

**4.2.8.2 Objective of Safety Audit:** Safety audits are conducted in order to assess the degree of compliance with the applicable safety regulatory requirements and with the procedural provisions of a Safety Management System. They are intended to provide assurance of the safety management functions, including staffing, compliance with applicable regulations, levels of competency and training.

### 4.2.8.3 Benefit of Safety Audit:

A safety audit examines and determines whether or not a company's daily activities and processes conform to their planned health and safety arrangements as well as government laws. An audit further identifies whether or not the planned arrangements are implemented effectively, and are suitable to achieve the organization's or company's health and safety policy objectives. Often it is a failure in health and safety management that results in a serious incident. Safety audits assist in identifying failures within a system, process, or program and the information gathered helps to determine the best course of corrective action.

Safety audits are beneficial because they:

- Promote constant review of systems to ensure that they do not become weakened by habit
- Facilitate planned improvements to programs, policies, and procedures
- Help to identify weaknesses in human resources departments
- Help to demonstrate management's dedication to employee health and safety

An audit may include one or more components of the total system, such as safety policy, change management, operating procedure, emergency procedures, etc. The aim is to disclose the strengths and weaknesses, to identify areas of non-tolerable risk and devise rectification measures. The outcome of the audit will be a report, followed by an action plan prepared by the audited personnel (organization) and approved by the regulator/supervisory authority. The implementation of the agreed safety improvement measures shall be monitored by the supervisory authority.

Often audits are integrated, i.e. they include not only safety but also other business processes and performance areas, such as quality, capacity, cost efficiency etc.

### 4.2.8.4 Techniques for gathering audit information:

The conduct of the actual audit is essentially a process of inspection or fact-finding. Information from almost any source may be reviewed as part of the audit. The techniques for gathering the information include:

- Review of documentation;
- Interviews with staff;
- Observations by the audit team.

### 4.2.8.5 Health and Safety audit involve:

An audit of the company health and safety management systems identifies whether the safety systems are operating effectively, or whether they need to be more efficient.

An audit may be an independent event or part of an ongoing program. In addition, audits:

- can focus on a particular activity (e.g. how hazardous substances are controlled);
- can focus on a particular part of the organization (e.g. the packing area); or
- May address the overall performance of the health and safety management system.

An audit of an HSE management system will address areas such as:

- planning;
- HSE responsibilities;
- organizational structure;
- consultation arrangements;
- implementation of all procedures and activities;
- hazard identification, assessment and control;
- training and competence;
- measurement, reporting and evaluation; and
- Review of the HSE system and its overall performance.

### 4.2.8.6 Audit conducting Procedure:

At first need to choose the area to audit, then need to complete the following step:-

**Step 1: Answer a group of questions in a particular sequence.**

Base on the audit questions around law and standards. Firstly, Audit Company documented safety procedures to ensure they are compliant. Secondly, audit the level of compliance to these safety procedures in the actual workplace by doing an inspection of the way things are carried out by the employees.

**Step 2: Write an audit report.**

The report must list all the issues that were alerted to in step 1. These are called 'audit findings'.

Use the audit report to identify the risks and assess the level of those risks.

**Step 3: Develop an action plan to correct them.**

Priorities the risk controls that would be apply to those risks using the hierarchy of control to develop an action plan. This action plan should then be communicated to employees with the relevant training.

### 4.2.8.7 Feature of Safety audit:

**(a) Pre-Job Reviews:** Pre-job activities to verify scope of work. Identification , effective management and control of short service employees.

- Pre-Mobilization Review
    - Workforce competency and certification
    - Equipment inspection and certification
- New Contractor Orientation program
    - Be familiar with Company HES expectations, processes and procedures
- Site Specific Orientation
    - If applicable where the job site holds unique hazards

**(b) Work-in-Progress:** Work-in-progress activities to reinforce expectations and monitor compliance to requirements

- Contractors are engaged throughout the work
- Interim Performance Reviews
    - Contract Owner engages Contractor Management Representative
    - At least twice a year and when significant events occur
- Field Inspections
    - Provide snapshot observations to verify work is conducted safely according to expectations and agreed plan
    - Initial inspection within 3 months after mobilization

- Management Field Visit
    - Owner company & Contractor
- Joint Safety Meetings
- Tailgate/Toolbox meetings
    - Prior to starting work, every shift

- Contractor HES Forum

**(c) End of Contract Evaluation:** Periodic evaluation of contractor HES performance and assessment of the Contractor HSE Management program.

- Formal review of contractor's HES performance
    - Within 4 weeks after the completion of contract
- Feedback to contractor CHESM Database
- Capture and share best practices and lessons learned
- Participants
    - Contract Owner
    - Contractor Management
    - Supply Chain Representative
    - HSE Representatives: owner company and contractor
    - Onsite Representative: owner company and contractor

### 4.2.8.8 Goal of a health and safety audit:

The goal of a health and safety audit is to assist in the continuous improvement of the company's HSE procedures. The audit should:

- identify the risks and the levels of those risks within the workplace;
- identify strengths and weaknesses in the company safety procedures;
- assess whether safety procedures be legally compliant;
- compare current documentation and practices against best practice and legal obligations;
- recommend improvements in the company safety procedures;
- ensure that there adequate resources available to manage HSE issues; and
- Ensure that the resources devoted to health and safety would be utilized effectively

# Chapter-5: Training

## 5.1 Benefit's of Training:

Training is the backbone of any system, especially for managing safety. For management to lead, for personnel to analyze the worksite for hazards, and for hazards to be eliminated or controlled, everyone involved with any kind of petroleum activities must be trained. The scope of the training depends on the size and complexity of the worksite and the hazards involved.

Employee education and training on how to conduct their work safely helps to minimize the risk of exposure and is a critical element of any complete workplace health and safety program. Training must cover not only how to do the job safely but it must also ensure that workers understand the hazards and risks of their job. It must also provide them with information on how to protect themselves and co-workers.

Worker training should be an essential part of any petroleum companies for ensuring incident free operation. Workers need to know how to work safely with the products they use. They also need to know how to protect other workers such as by posting signs (e.g., "Wet - Slippery Floor") and reporting any unusual conditions.

## 5.2 Designing a training program:

The objective of training is to implement health and safety procedures into specific job practices and to raise awareness and skill levels to an acceptable standard.

Communicate and train appropriate staff on how works need to complete, their role in the work, and what their responsibilities are.

### 5.2.1(a) Who Needs Training?

- Target new hires, contract workers, employees who wear PPE and workers in high risk areas. Managers and supervisors should also be included in the training plan.
- Manager training should emphasize their important role in visibly supporting the safety and health program and setting a good example.
- Supervisor training should cover company policies and procedures, hazard detection and control, accident investigation, handling of emergencies, and how to train and reinforce training.
- Long-term workers who have job changes as a result of new processes or materials.
- The entire workforce needs periodic refresher training in responding to emergencies.

### 5.2.1 (b) Occasions when employee training be required are:

- Commencement of employment.
- Reassignment or transfer to a new job.
- Introduction of new equipment, processes, or procedures.
- Refresher, annual, or periodic education and training to ensure skills and knowledge.
- Inadequate performance.

### 5.2.2 Designing Safety Training for supervisors:

Occupational Health and Safety Training also should outline suggested training for supervisors. According to the Canadian Safety authority standard (CSA Standard Z100-13), which states that a supervisor "should be competent (i.e., have adequate knowledge, training, and experience) on all processes and tasks over which he or she will be exercising authority. Organizations should be defined what constitutes an acceptable combination of knowledge, training, and experience in relation to the supervision of others performing tasks." Topics that have to be included in supervisor training include:

- Roles and responsibilities - legal and corporate.
- Internal responsibility system.
- Hazard identification, hazard control, risk assessment.
- Emergency procedures.
- Incident investigation.
- Conducting planned inspections.
- Auditing skills.
- Planned task observation.
- Communication skills.
- Motivation and discipline.
- Managing troubled employees.
- Off the job safety.
- Problem solving skills.
- First aid.
- WHMIS/chemical safety.
- Industrial hygiene and medical surveillance programs.
- Duty to accommodate.

### 5.2.3 (a) When providing training, an instructor should:

- Receive training in how to instruct.
- Prepare an orderly plan for instruction.
- Explain reasons why each step must be done in a certain way.

### 5.2.3 (b) All instructors should:

- Plan the session beforehand; break the job down into steps; have training aids available.
- Explain what is to be done.
- Describe all the hazards and protective measures.
- Demonstrate each step, stress key points, and answer any questions.
- Have the employee carry out each step, correct errors, and compliment good performance.
- Check frequently after the employee is working independently to ensure correct performance.

Documented correct work procedures are very important in job skills training.

## 5.3 Conducting training (Method):

No program can be complete without training to ensure the optimum use of safety rules and regulation in the industry. Training should cover according to the standard requirement. It should be provide to employee or staff in a appropriate language and vocabulary so that they will be able to understand, about workplace hazards, methods to prevent them, and standards (i.e osha) that apply to their workplace.

Training can be done on an individual basis or in group meetings. Training programs should emphasize the major goals of the program and reinforce the fact that engineering controls have been considered as the primary prevention strategy. It is not good enough to tell someone to wear PPE just because management requires it. It should be consider as a last option according to the informed of the hazards.

Workers and their supervisors will require training in when, where, why, and how to use the equipment to achieve the necessary level of protection. The workers to be trained include those who are exposed on a regular basis and others who might be exposed on an occasional basis, for example, in emergencies or when temporary work is performed in dangerous areas. The training needs and methods for all these workers are essentially the same.

**5.3.1 Conduct training for PPE Program:** No program can be complete without training to ensure the optimum use of PPE. Training should cover how to fit and wear PPE, how to adjust it for maximum protection, and how to care for it.

Training can be done on an individual basis or in group meetings. Training programs should emphasize the major goals of the program and reinforce the fact that engineering controls have been considered as the primary prevention strategy. It is not good enough to tell someone to wear a respirator just because management and/or legislation requires it. If the respirator is intended to prevent lung disorders, the workers should be informed of the hazards.

Workers and their supervisors will require training in when, where, why, and how to use the equipment to achieve the necessary level of protection. The workers to be trained include those who are exposed on a regular basis and others who might be exposed on an occasional basis, for example, in emergencies or when temporary work is performed in dangerous areas. The training needs and methods for all these workers are essentially the same.

Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

1. Training required for clothing or gloves. This includes:

- what are the hazards of skin contact with the chemical,

- what are limitations of the gloves,
- what could happen and what to do if the gloves fail, and
- When to dispose of or to decontaminate gloves.

Various factors like the thickness of the material, manufacturing methods, and product quality control can have a significant effect on these properties.

## 5.4 Employer Responsibility about Training:

Workers have a right to a safe workplace. The law requires employers to provide their employees with safe and healthful workplaces, and for that, purpose employers must provide training and information to workers in a manner and language that the worker understands.

Employers must:

- Prepare and implement a written hazard communication program.
- Provide training and information about hazards, hazards of silica and other chemicals used in the workplace.
- Provide workers access to Safety Data Sheets (SDSs) on silica sand and other hazardous chemicals they are exposed to during hydraulic fracturing operations
- Provide information and training (in a language and vocabulary they understand) about workplace hazards, methods to prevent them, and standards (eg.OSHA) that apply to their workplace.
- Provide & Implement injury awareness training (such as dropped objects, working from heights)
- Retraining of all employees to maintain proficiency or introduce new or changed control methods.
- Describes the practices and procedures necessary by training to disable machinery or equipment to prevent the release of hazardous energy.
- Do not permit employees on location without hydrogen Sulfide safety training. (Employees may be permitted on location for specific Hydrogen Sulfide training purposes that does not include general rig training.)
- Have a plan for contractor safety training.
- Providing health and safety training (Indoor & outdoor).
- Provide first aid training to the employee.
- Ensuring that employees receive training or certification as required.
- Set up and promote programs to improve employee training and education.
- Training and education of employees about the operating procedures as well as other necessary workplace training (including WHMIS).
- Training about stress management, time management, work/life balance, etc.
- Support for performance of tasks (e.g. on-the job training, training programs, work instructions, etc.)
- Communicate and train appropriate staff on how the Training program works, their role in the program, and what their responsibilities are.
- Preparing and training for emergency response for incidents such as spills, fire or employee injury.
- Training employees to recognize and prevent heat illnesses.
- Always provide training on how to choose the right tool for the job, how to correctly use each tool, and how to identify when tools need repair.

- Make a commitment to fulfil the violence prevention training needs of different levels of personnel within the organization.
- Make sure staff have the training, skills and resources they need.
- Provide adequate driver training, for the driver, those who are driving the vehicle.
- Provide Confined Space Entry Training for all the workers Who will need to enter into the confined spaces.
- Provide training and information to workers about the hazards of silica and other chemicals
- If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.
- If fall protection is required, establish a complete fall protection program if one is not in place. The program should include training workers, selecting, fitting, and inspecting the equipment.
- If foot protection is required, set up a complete foot safety protection program including selection, fit testing, training, maintenance and inspection.
- If head protection is required, establish a complete safety protection program including selection, fit testing, training, maintenance and inspection.
- All personnel working in an area where concentrations of Hydrogen Sulfide may exceed the 10 Parts Per Million (PPM) should be provided with training before beginning work assignments.
- Verify that all users, supervisors, selectors, buyers, and storekeepers are trained.
- Ensure that education programs are ongoing.

### 5.4.1 Employers responsibility about language use for training:

Provide training and information to workers about the workplace hazards. For ensuring incident free operation employers must provide training and information to workers in a manner and language that the worker understand. Also employers must consider the following:

- Prepare and implement a written hazard communication program.
- Provide training and information on workplace hazards and other chemicals used in the workplace and control measure.
- Provide workers access to Safety Data Sheets (SDSs) and other hazardous chemicals they are exposed to during the work.

**Consider medical monitoring for workers who are exposed to hazards.**

## 5.5 Employee Responsibility on Training:

- People should ask supervisor for training, if he or she has not done so already.
- Employee should understand potential hazards, and control measure.
- Employee should know the roles and responsibilities.
- Employee should familiar with safety regulations, standard requirement, and safe work practices and procedure.

## 5.6 Auditing the Training Program for improvement:

Active monitoring at job site, and good planning and training programs for workers are the best ways to prevent injury and death.

Auditing the Program for following reasons:

- Check frequently after the employee is working independently to ensure correct performance.
- Review and compare production and safety performance records.
- Review the program at least annually.

## 5.7 Education and training should cover following information:

- All procedures that must be followed in an emergency that involves the hazardous product.
- The information on the Safety Data Sheet (SDS) and what that information means.
- The information on both the supplier label and workplace label (MSDS), and what that information means.
- Any other procedures required when the product is in a pipe, piping system, vessel, tank car, etc.
- The procedure to follow if the hazardous product may be present in the air and a worker may be exposed.
- Make the worker aware of the hazards of MMH
- Demonstrate ways of avoiding unnecessary stress
- Training program should cover information that explains when and what PPE should be worn, and why it should be worn.
- Training should cover how to fit and wear PPE, how to adjust it for maximum protection, and how to care for it.

## 5.8 A good training program should:

- Make the worker aware of the hazards and control measure.
- Demonstrate ways of avoiding unnecessary stress
- Teach the worker to handle materials safely.
- Teach employee on how the work will have done safely.
- Make understand them, what could happen and what to do if the PPE fail.

## 5.9 Training Evaluation (Chevron Training Course Evaluation):

Soon after the Training & orientation sessions, employees should be assessed on their understanding of the items discussed. In this way, both the quality of training and the level of understanding can be evaluated.

## (a) CST Training Course Evaluation:-

### CST PARTICIPANT'S TRAINING COURSE EVALUATION

**Course Name:** **Date :** **Venue :**

Participant's Name (optional) : **Trainer's Name :**

| | | Strongly Disagree | | | | | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | Select your Level of understanding before class started | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Q2 | Select your Level of understanding after class completed | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

| | | 1 Poor | 2 Fair | 3 Good | 4 Very Good | 5 Excellent | N/A |
|---|---|---|---|---|---|---|---|
| **Administration** | | | | | | | |
| Q1 | Center's Administrator is able to provide adequate information of courses | | | | | | |
| Q2 | Center's Administrative staff was able to support requests | | | | | | |
| **Facilities** | | | | | | | |
| Q1 | Overall service of center's staff (guards, receptionist, janitors, etc.) | | | | | | |
| Q2 | Maps/Direction signs are adequate and clear | | | | | | |
| Q3 | Classroom facilities promotes a good learning environment | | | | | | |
| **Course Content: Knowledge and Skill** | | | | | | | |
| Q1 | Materials provided were clear and useful during training session | | | | | | |
| Q2 | The course content covered most of the topics you expected to find | | | | | | |
| Q3 | Objectives of the course were clearly identified at the start of training | | | | | | |
| Q4 | Identified objectives of the course were met | | | | | | |
| Q5 | Class activities enhanced knowledge and understanding | | | | | | |
| Q6 | Knowledge/Skills learned can be applied to my current job | | | | | | |
| Q7 | Knowledge/Skills taught could change my attitude to/behavior at work | | | | | | |
| Q8 | Post training field evaluation will help to measure knowledge/skill acquired during the training | | | | | | |
| Q9 | Briefly describe below the 1-2 most significant topics you have learnt from this class: | | | | | | |

| | | 1 Poor | 2 Fair | 3 Good | 4 Very Good | 5 Excellent | N/A |
|---|---|---|---|---|---|---|---|
| **The Instructor(s):** | | | | | | | |
| Q1 | Adequately explained course objectives and delivered accordingly | | | | | | |
| Q2 | Displayed a thorough knowledge & understanding of the subject matter | | | | | | |
| Q3 | Was well-prepared and was able to answer participants' questions | | | | | | |
| Q4 | Was able to maintain training schedule and provide scheduled breaks | | | | | | |
| Q5 | Multimedia (audio/video) are appropriate and improved understanding | | | | | | |
| Q6 | Presentation was well-organized and presentation was clear | | | | | | |
| Q7 | Instructor(s) worked to ensure class participation during training | | | | | | |

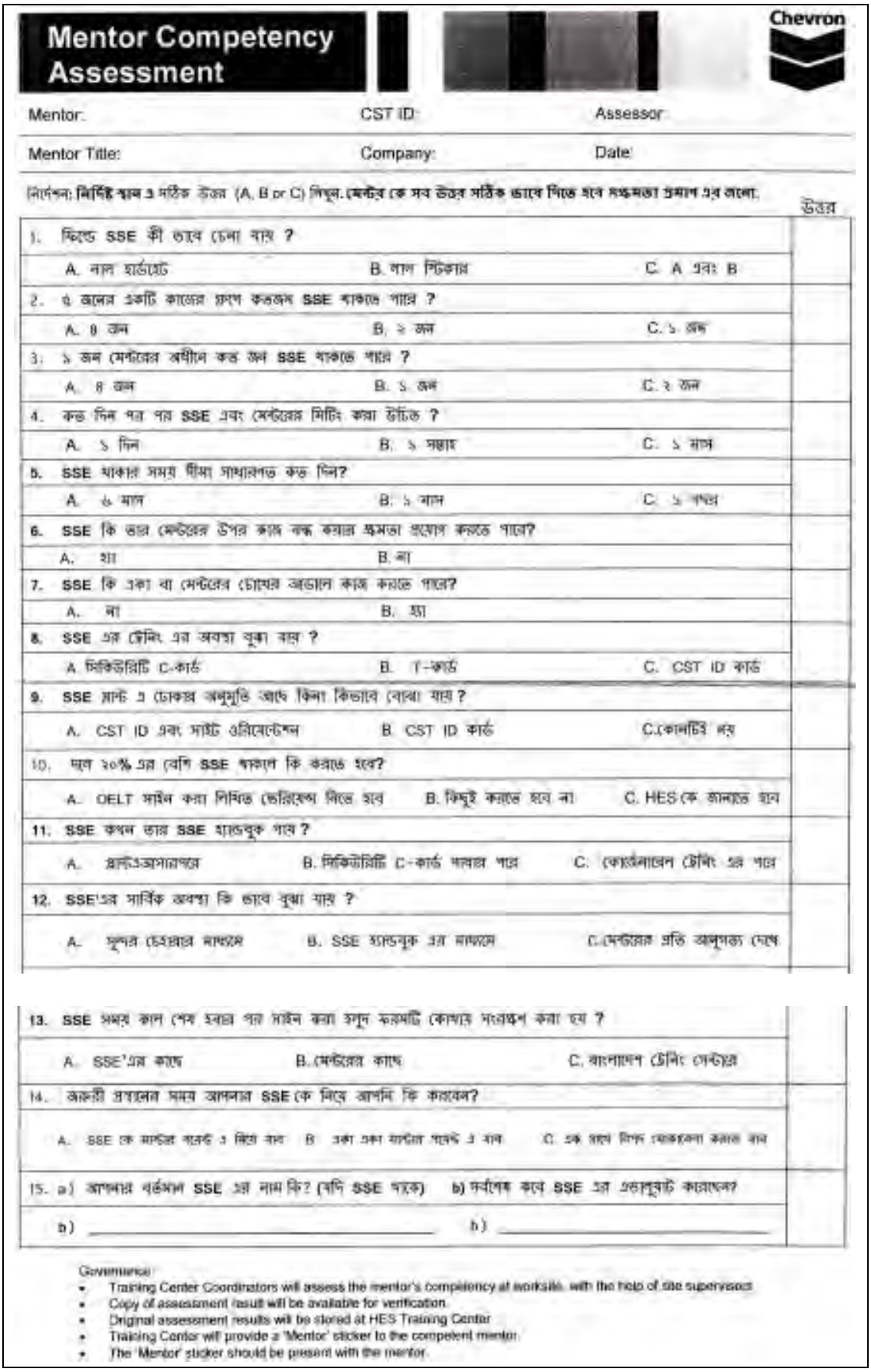
| | | Too Short | About Right | Too Long |
|---|---|---|---|---|
| **Course Timing:** | | | | |
| Q1 | Time alloted for course was | | | |

**Comments:**

**Participant: Please complete this form after the program and submit it to our trainer**

**Fig-5.1 Training Course Evaluation form (Bangladesh HES Training center)**

**(b) Mentor Competency Assessment form:**



**Mentor Competency Assessment**

Chevron

Mentor: CST ID: Assessor:

Mentor Title: Company: Date:

নির্দেশনা: **নির্দিষ্ট স্থানে** সঠিক উত্তর (A, B or C) লিখুন. **মেন্টর কে সব উত্তর সঠিক ভাবে দিতে হবে দক্ষতা প্রমাণ এর জন্যে.**

| | উত্তর |
|---|---|
| 1. কিভাবে SSE কী ভাবে চেনা যায় ? | |
| A. লাল হার্ডহ্যাট B. লাল স্টিকার C. A এবং B | |
| 2. ৬ জনের একটি কাজের গ্রুপে কতজন SSE থাকতে পারে ? | |
| A. ৪ জন B. ২ জন C. ১ জন | |
| 3. ১ জন মেন্টরের অধীনে কত জন SSE থাকতে পারে ? | |
| A. ৪ জন B. ১ জন C. ২ জন | |
| 4. কত দিন পর পর SSE এবং মেন্টরের মিটিং করা উচিত ? | |
| A. ১ দিন B. ১ সপ্তাহ C. ১ মাস | |
| 5. SSE থাকার সময় সীমা সাধারণত কত দিন? | |
| A. ৬ মাস B. ১ মাস C. ১ পক্ষ | |
| 6. SSE কি তার মেন্টরের উপর কাজ বন্ধ করার ক্ষমতা প্রয়োগ করতে পারে? | |
| A. হ্যা B. না | |
| 7. SSE কি একা বা মেন্টরের চোখের আড়ালে কাজ করতে পারে? | |
| A. না B. হ্যা | |
| 8. SSE এর ট্রেনিং এর অবস্থা বুঝা যায় ? | |
| A. সিকিউরিটি C-কার্ড B. T-কার্ড C. CST ID কার্ড | |
| 9. SSE সাইট এ ঢোকার অনুমতি আছে কিনা কিভাবে বোঝা যায় ? | |
| A. CST ID এবং সাইট ওরিয়েন্টেশন B. CST ID কার্ড C.কোনটিই নয় | |
| 10. মূল ২০% এর বেশি SSE থাকলে কি করতে হবে? | |
| A. OELT সাইন করা নিশ্চিত ভেরিফেশন দিতে হবে B. কিছুই করতে হবে না C. HES কে জানাতে হবে | |
| 11. SSE কখন তার SSE হ্যান্ডবুক পাবে ? | |
| A. প্লান্টএ আসার পরে B. সিকিউরিটি C-কার্ড পাওয়ার পরে C. কোর্সনাল ট্রেনিং এর পরে | |
| 12. SSE'এর সার্বিক অবস্থা কি ভাবে বুঝা যায় ? | |
| A. সুপার ভেইজার মাধ্যমে B. SSE হ্যান্ডবুক এর মাধ্যমে C.মেন্টরের প্রতি আনুগত্য দেখে | |
| 13. SSE সময় কাজ শেষ হবার পর সাইন করা ফরমটি কোথায় সংরক্ষণ করা হয় ? | |
| A. SSE'এর কাছে B.মেন্টরের কাছে C. বাংলাদেশ ট্রেনিং সেন্টারে | |
| 14. জরুরী প্রস্থানের সময় আপনার SSE কে নিয়ে আপনি কি করবেন? | |
| A. SSE কে মাস্টার মেরেট এ নিয়ে যাব B. একা একা মাস্টার মেরেট এ যাব C. এক স্থানে নিশ্চিত অপেক্ষা করতে বলব | |
| 15. a) আপনার বর্তমান SSE এর নাম কি? (যদি SSE থাকে) b) সর্বশেষ কবে SSE এর এসাসমেন্ট করেছেন? | |
| b) _____ b) _____ | |

Governance:

- Training Center Coordinators will assess the mentor's competency at worksite, with the help of site supervisors
- Copy of assessment result will be available for verification
- Original assessment results will be stored at HES Training Center
- Training Center will provide a 'Mentor' sticker to the competent mentor.
- The 'Mentor' sticker should be present with the mentor.

**Fig-5.2 Mentor Competency Assessment form (Bangladesh HES Training center)**

## (c) HES Daily Core Assessment Form:-

**HES Daily Core Assessment**

**Name** _____ **Date of Issue** _____
**Assessment Date** _____ **CST ID** _____ **Score** _____ **%**

**Questions**

1. **What is Operational Discipline ?**

   a. Always do your business safe way .
   b. Complete every task, the right way, every time

2. **Which statement is true for PPE. ?**

   a. PPE eliminates the hazard
   b. PPE is an option
   c. PPE is only the last line of defense between hazard and worker
   d. All of the above

3. **What should you do first during an emergency ?**
   a. Report to muster point
   b. Evacuate the location
   c. Secure the workplace
   d. Read the station bill

4. **What is the Chevron first key principle ?**
   a. Do it safely or not at all
   b. There is always time to do it safely
   c. Every task, safe way, every time
   d. Do it right or not at all

5. **What is the color of Hot work Permit? –1**

   a. ☐ Blue
   b. ☐ Brown
   c. ☐ Red
   d. ☐ Green

6. **How many permit to work forms are used in Chevron Bangladesh? –1**
   a. ☐ 7
   b. ☐ 5
   c. ☐ 6
   d. ☐ 3

7. **SWA is not applicable on supervisor. –1**
   a. ☐ True
   b. ☐ False

8. **Ergonomics means designing the job to fit the worker, instead of forcing the worker to fit the job.1**
   a. ☐ True
   b. ☐ False

9. **For Ladder safety which rule should be maintain by us ?**
   a ☐ 3P rule
   b ☐ 3 Point contact rule
   c ☐ 3 ft rule horizontal
   d ☐ None of the above

13. **Which one is the Hazard identification tool ? Select the right (proper) one .**

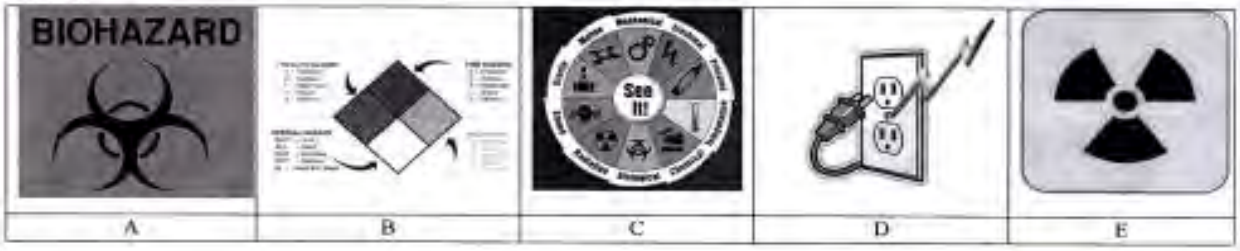



**Fig-5.3 HES Daily Core Assessment Form (Bangladesh HES Training center)**

**5.10 Training for ensuring incident free operation in Chevron Bangladesh & Geokinetic Int Ltd:**

Chevron Bangladesh Ltd & Geokinetic International believes that successful jobs start with safety. They are willing to undergo any safety training deemed necessary for ensuring incident free operation. Without safety program incident free operation is impossible. For management to lead, for personnel to analyze the worksite for hazards, and for hazards to be eliminated or controlled, everyone involved with any kind of petroleum activities must be trained.

A successful safety program includes training in the following areas:

- Construction Safety Training (CST-1,2,3)
- Supervisory Training
- Trenching and Excavation (EX)
- Hot Work (HW)
- Crane Operation (Lifting and Rigging or L&R)
- Fall Protection (working at height or W@H)
- Proper Electrical Safety
- Permit to work (PTW)
- Isolation of hazardous Energy ((Lockout/Tagout (LO/TO))
- Confined Space Entry(CSE)
- SIMOPS (Simultaneous operation)
- BCP (Bypass Critical Protection)
- QGT Training (Qualified Gas Tester)
- Confined Space Hazards
- Electrical Hazards
- Fire Protection/Extinguisher (Fire Watch & Fire Fighting Training)
- First Aid and CPR and Blood borne Pathogens
- Hazard Communication (HazCom)
- Hearing Conservation
- Vehicle Operation (Defensive Driving)
- Scaffolding
- Use of Anchors and Guywires
- Use of wooden, metal and plastic (fiberglass) portable ladders.
- Hydrogen Sulfide Safety (H2S)
- Personal Protective Equipment (PPE)
- Respiratory Protection
- Substance Abuse Awareness (Drug & Alcohol Awareness)
- Welding, Cutting & Brazing (Hot Work)
- Tool Safety (Hand Tools, Power Tools, and Non-Sparking Tool)
- Manual Handling
- Heat Stress Management
- Incident Investigation and Reporting
- Emergency Management
- Chemical Safety and so on

### 5.10.1 Sample example of indoor Training:-

**Fig-5.4 Indoor Training (Chevron contractor employee)**

### 5.10.2 (a) Sample example of outdoor Training (seismic GPS operation):-


**Fig-5.5 Outdoor Training (Seismic GPS operation, crew-432) [7];**

### 5.10.2 (b) Sample example of outdoor Training (Seismic drilling):

**Fig-5.6 Outdoor Training (Seismic drilling, crew-432) [7];**

### 5.10.2 (c) Sample example of outdoor Training (Fire Blanket using):


**Fig-5.7 Outdoor Training (Fire Blanket using Practice, crew-432) [7];**

### 5.10.2 (d) Sample example of outdoor Training (Explosive Handling):

**Fig-5.8 Outdoor Training (Explosive Handling, crew-432) [7];**

## 5.11 Recommendation's of Safety Training for every individual:

Health and safety is not just an extra part of an employee's job: it is an integral, full-time component of each individual's responsibilities. Individual's or Worker safety awareness Training must necessary for injury prevention during all phases of drilling, servicing or other petroleum operations. Procedures and processes must include safety meetings, Job Safety Analyses, and general and task-specific training etc.

- Communication and periodic drills must be required to ensure adequate performance of training when the plan must be implemented.
- Retraining of all employees to maintain proficiency or introduce new or changed control methods.
- Employees, supervisors, maintenance individuals, fire wardens, trained fire watch individuals, and contractors all have different roles, and must be trained accordingly

Training is the backbone for ensuring incident free operation. For management to lead, for personnel to analyze the worksite for hazards, and for hazards to be eliminated or controlled, everyone involved must be trained. The scope of the training depends on the size and complexity of the worksite and the hazards involved.

**5.12 HSE orientation (Facility orientation):** HSE orientation or Facility orientation is part of employee training program. Every employee must need to attend orientation or induction program. It is the first step in welcoming new hires to the company and familiarize new employees with the companies' facilities, its organizational structure, its policies and procedures, safety requirement, employer expectation, etc

### 5.12.1 Definition of employee orientation:

Orientation (sometimes called an induction) is the process of introducing new, inexperienced, and transferred workers to the organization, their supervisors, co-workers, work areas, and jobs, and especially to health and safety. Providing training and extra assistance during the initial period of employment is critical, regardless of the age of the employee, as they are not familiar with the hazards of the job or the workplace.

During this phase, each worker develops the knowledge, skills, and abilities that are necessary to work in a safe and healthy manner. While training (or refresher training) is always important, training should always be provided when employees are:

- transferred to jobs or work areas they are unfamiliar with
- returning from an extended period away from work
- who are new to the work force

Not all training can or should be done on the first day. Time the orientation sessions to best match the needs of the workplace and the work done, but be sure all areas are covered.

**5.12.2 Objective (Purpose) of employee orientation:** The New Employee Orientation (NEO) Program is the first step in welcoming new hires to the company. Its main objective is to familiarize new employees with the companies' facilities, its organizational structure, its policies and procedures, and to enable them to get a better understanding of their benefits and the various benefits options available to eligible new employees**.** In addition, the orientation provides detailed information about Human Resources, Health Safety and Environment and company Police. The objective of the session is to provide new employees with all the pertinent information they need to begin working at the company and to familiarize them with company policies and procedures.

Employee orientation and training are elements that are key to preventing accidents. Hazardous situations can be avoided or made less hazardous, if employees receive appropriate training and instruction. It is imperative that new employees and all employees, who are being assigned potentially hazardous tasks for the first time, be given adequate training.

Supervisors are the key personnel in both production and occupational safety and health. They are responsible for actions taken within their area of influence and are held accountable by company for the results within their area. Supervisors are responsible to ensure that work procedures are followed in a manner compatible with the safety and health of employees.

### 5.12.3 Benefits of employee orientation:

"One of the processes described in the HSE plan is the HSE introduction and orientation. Organizing this for new employees at the start of their job is a legal requirement. It is important that new people are informed about their rights and obligations in terms of HSE that they are aware of possible risks, that they know how to protect themselves, what to do in case of problems, incident, emergency etc.

New employees often report feeling completely overwhelmed the first few days on the job. One purpose of company orientation program is to provide the employee with limited and organized information to make the job seem more manageable and the environment more comfortable.

Some employees are given documents to read and are left primarily alone the first few days. This approach fails to establish expectations or enthusiasm about the new job because of the boring and tedious nature. Company challenge is to create an exciting, rewarding, and manageable first few days for all new employees.

**5.12.4 Importance of employee orientation:** Health and safety education should start with employee orientation when an employee joins the organization or is transferred to a new job. It has been found that inexperienced workers, in general, are involved in accidents at a higher rate than others. While experience can only be gained through time, both health and safety education and job skills training can be used to improve this record. Orientation sessions normally cover such items as explanation of the function of the work unit, organizational relationships, administrative arrangements, and miscellaneous policies and rules.

Items related to health and safety that should be included are:-

- Emergency procedures.
- Location of first aid stations.
- Health and safety responsibilities, including those specified by legislation.
- Reporting of injuries, unsafe conditions and acts.
- Use of personal protective equipment.
- Right to refuse hazardous work.
- Hazards, including those outside own work area.
- Reasons for each health and safety rule.

A new employee can be expected to absorb only a certain amount of information in the first few days. A brochure outlining the points covered in the orientation sessions is useful as a handout to employees. It also serves as a checklist for the person conducting the orientation. A buddy system is a useful follow-up to the initial orientation. This system allows for on-the-job reinforcement of the information presented to the new employee. This process also promotes the safety awareness of the experienced workers who are the "buddies".

New, inexperienced or transferred employees should be encouraged to ask questions at any time when doubt exists as to correct procedures. The new employee orientation may include a set of questions, such as the following:

- What are the hazards of the job?
- Is job safety training available?
- What safety equipment do I need to do my job?
- Do I need to wear personal protective equipment (PPE)? Will I receive training on how to use the PPE?
- What do I do in case of fire or another emergency?
- Where do I find fire extinguishers, first aid kits, first aid rooms and emergency assistance?
- What are my responsibilities regarding health and safety?
- If I notice something wrong, to whom should I report?
- Who is responsible for answering safety-related questions?
- What do I do if I get injured or have an accident?

Soon after the orientation sessions, employees should be assessed on their understanding of the items discussed. In this way, both the quality of training and the level of understanding can be evaluated.

### 5.12.5 Employee Orientation Training Guidelines:

New employees suffer significantly higher accident rates then their work group average. As work forces expand, accident rates increase. This vulnerable group must receive appropriate levels of supervision training to minimize the risks of accidents.

Employees, when they first arrive at a job site, are eager to please, and may pretend to understand material or instructions in order to create a good impression. A planned orientation process is essential to ensure that the employee becomes knowledgeable and competent as soon as possible. An orientation program must respond to the workers need to know basic information about the job. The following general topics must be addressed:

- company objectives
- job description (including limitations and authority)
- performance expectations
- wages, hours, benefits and pay period etc.
- training plan
- safety

The orientation program must recognize that workers new to the job suffer from information overload. Written material, demonstrations and hands-on practice must support verbal communication and instruction.

### 5.12.6 Facility Orientation at Bibiyana Gas Plant / BYGP Gas Plant orientation modules:

The orientation module presented in Bibiyana gas plant are given below:-

**In facility orientation:** Key topic are given below

**In facility orientation:** Key topic are given below

- Introduce Muster point ( A,B,C,D,E)
- Smoking zone
- Emergency Procedure
- T-card system
- Basic PPE
- Person in charge (PIC)
- Prohibited item
- Drug and alcohol policy
- Incident investigation
- Driving safety.

**Alarm:** BYGP has two alarm sounds. One for Fire, another for Gas leak.

Fire Alarm: Warble with **red** beacon

Gas Release Alarm :- with **blue** beacon.

- Evacuation
    - Situation beyond control
    - Announcement.
    - Everybody will Evacuate
- Prohibited Items in the Process Areas:
    - Matches / lighters
    - Mobile phone / music players
    - Camera
    - Fire eye may activate with flash
    - Need hot work permit to take
    - photograph in the process area
    - Any other non-intrinsically safe devices

- **Site Specific Hazards:** Snakes, monkeys, heavy vehicle movements, Crain lifting, Excavated area, Hydro Test (Pressure ) going on hazards activity .
- **Gas wells:** Gas wells are situated in two different locations one is at zone -7 in south pad , other one is located in north pad .
- **Pig Receiving :** Pig receiving activity also observed by me some day before that was Pig receiving activity of 20 inch pipe line ( Second Pig ) west pad to south pad. Now it is waiting for hydro test .
- **Gate Pass:** A gate pass must be issued for personal items like Laptop, camera etc.
- **Safety Statistics:** Last DAFW case was occurred in 2006. TRIR-0; DAFWIR-0.

**Speed limits for vehicles:**

- From BYGP to LGED Road 10 km/hour
- From LGED Road to Highway road 30 km/hr
- South pad to north pad link-road 30 km/hr
- For highway 70 km/hour. [30];

### 5.12.7 Contractor Organization Safety Orientation:

Contractors are expected to provide a formal orientation to new employees before they start work. Orientation should cover company policies, programs, procedures, and rules. Contractor orientations are verified by the company during formal audits.

### 5.12.8 Sample orientation checklist:

Below is a sample orientation checklist. Be sure to customize it for your workplace.

| **EMPLOYEE ORIENTATION CHECKLIST** | | | |
|---|---|---|---|
| **Areas to be Covered** | **Description** | **Completed** | |
| | | Yes | No |
| Company Safety Rules | Explain safety rules that are specific to company. | | |
| Company Policies | Explain the health, safety and environment policies of company. | | |
| Previous Training | Ask the employee if she/he has taken any safety training. | | |
| Training | Provide any necessary safety, environmental, compliance or policy/procedural training. | | |
| Health Safety and Environment | Inform the health and safety specialist that a new employee has joined the company who will need safety training. Arrange for this training and education to occur. | | |
| Potential hazards | Tour the work areas and facility and discuss associated work area hazards and safe work practices. | | |
| Emergency Procedures | Show and explain how to use emergency eyewashes and showers, first aid kits, fire blankets, fire extinguishers, fire exits and fire alarm pull boxes, as applicable. Demonstrate the evacuation procedures. | | |
| Toxic Products | Identify workspaces where hazardous materials are used, stored or disposed. Provide training as necessary. | | |
| Smoking area | Explain smoking is permitted to the designated area only. | | |
| Emergency Notification Form | Have employee complete the Emergency Notification form. Keep a copy for company files and send a copy to Emergency Coordinator. | | |
| MSDS for chemical | Provide education about WHMIS. Identify the location of the Material Safety Data Sheets (MSDSs). Review the MSDSs for all hazardous materials to be used by the employee. Explain hazardous material labelling requirements. Conduct job specific training. | | |
| Emergency Evacuation | Review the company's Emergency Evacuation Plan and explain the evacuation signals and procedures, point out proper exit routes and the designated assembly area for employee. | | |
| Personal Protective | Review the PPE program if the employee will be required to wear | | |

| | | | |
|---|---|---|---|
| Equipment (PPE) | protective equipment. Issue appropriate personal protective equipment (PPE) that must be worn as required by the work being performed. | | |
| In Case of Injury or Illness | Review the reporting procedures in the event of an injury and/or accident. | | |
| Health and Safety Committee | Supply a copy of the facility telephone list with names of the Health and Safety Committee members highlighted. Identify the location of the safety bulletin board. Explain how the employee can participate in the health and safety process (e.g., report hazards) | | |
| General Rights and Responsibilities | Explain worker rights and responsibilities as granted by legislation. | | |
| Emergency Contact | Provide a list of names, addresses, phone numbers and fax numbers of the persons who must be contacted in case of emergency. | | |
| Document | Maintain a record of the orientation. | | |

Employee Name: ……

Date: ……..  Supervisor's Signature: …….

# Chapter-6: Emergency Planning and Spill control

## 6.1 What is Emergency Planning?

Emergency is an undesired / unexpected event which suddenly happens and could cause

- Harm to People
- Damage to Property
- Affect to Environment

An emergency plan promotes safety awareness and shows the organization's commitment to the safety of workers, but lack plan could lead to severe losses such as multiple casualties and possible financial collapse of the organization.

## 6.2 Types of Emergency:

- Gas Leak
- Fire/Explosion
- Spills
- Medical
- Natural Disaster
- Bomb Threat
- Vehicle Accident

**6.3 Objectives of an emergency plan:** The objectives or purposes of the plan; that is, to reduce human injury and damage to property and environment in an emergency. An emergency plan specifies procedures for handling sudden or unexpected situations.

The objective is to be prepared to:

- Prevent fatalities and injuries.
- Reduce damage to buildings, stock, and equipment.
- Protect the environment and the community.
- Accelerate the resumption of normal operations.

Development of the plan begins with a vulnerability assessment. The results of the study will show:

- How likely a situation is to occur.
- What means are available to stop or prevent the situation.
- What is necessary for a given situation.

From this analysis, appropriate emergency procedures can be established.

At the planning stage, it is important that several groups be asked to participate. Among these groups, the health and safety committee can provide valuable input and a means of wider worker involvement, so that Emergency situation will be managed efficiently. By this way organization or company will reduce human injury and damage to property and environment in an emergency.

## 6.4 Significance of an emergency plan:

A definite plan to deal with major emergencies is an important element of Health, Environment and safety programs. Besides the major benefit of providing guidance during an emergency, developing the plan has other advantages. Concern people may discover unrecognized hazardous conditions that would aggravate an emergency situation and people can work to eliminate them. The planning process may bring to light deficiencies, such as the lack of resources (equipment, trained personnel, supplies), or items that can be rectified before an emergency occurs. In addition an emergency plan promotes safety awareness and shows the organization's commitment to the safety of workers.

The lack of an emergency plan could lead to severe losses such as multiple casualties and possible financial collapse of the organization.

An attitude of "it can't happen here" may be present. People may not be willing to take the time and effort to examine the problem. However, emergency planning is an important part of company operation.

## 6.5 Factors affecting emergency planning:

Many factors determine what procedures are needed in an emergency, such as:

- Nature of emergency.
- Degree of emergency.
- Size of organization.
- Capabilities of the organization in an emergency situation.
- Immediacy of outside aid.
- Physical layout of the premises.

Natural hazards, such as floods or severe storms, often provide prior warning. The plan should take advantage of such warnings with, for example, instructions on sand bagging, removal of equipment to needed locations, providing alternate sources of power, light or water, extra equipment, and relocation of personnel with special skills. Phased states of alert allow such measures to be initiated in an orderly manner.

The evacuation order is of greatest importance in alerting staff. To avoid confusion, only one type of signal should be used for the evacuation order. Commonly used for this purpose are sirens, fire bells, whistles, flashing lights, paging system announcements, or word-of-mouth in noisy environments. The all-clear signal is less important since time is not such an urgent concern. The followings are "musts":

- Identify evacuation routes, alternate means of escape, make these known to all staff; keep the routes unobstructed.
- Specify safe locations for staff to gather for head counts to ensure that everyone has left the danger zone. Assign individuals to assist employees with disabilities.
- Carry out treatment of the injured and search for the missing simultaneously with efforts to contain the emergency.
- Provide alternate sources of medical aid when normal facilities may be in the danger zone.
- Ensure the safety of all staff (and/or the general public) first, then deal with the fire or other situation.

**6.6 Emergency plan includes:** The emergency plan includes:

- All possible emergencies, consequences, required actions, written procedures, and the resources available.
- Detailed lists of personnel including their home telephone numbers, their duties and responsibilities.
- Floor plans.
- Large scale maps showing evacuation routes and service conduits (such as gas and water lines).

Since a sizable document will likely result, the plan should provide staff members with written instructions about their particular emergency duties.

A specific plan to deal with major emergencies is an important element of Health, Environment and safety (HSE) programs where concern should be, people will discover unrecognized hazardous conditions that would be responsible for an emergency situation and can work to eliminate them.

### 6.6.1 (a) EMERGENCY PROCEDURE (Base camp Layout plan-Block -13):

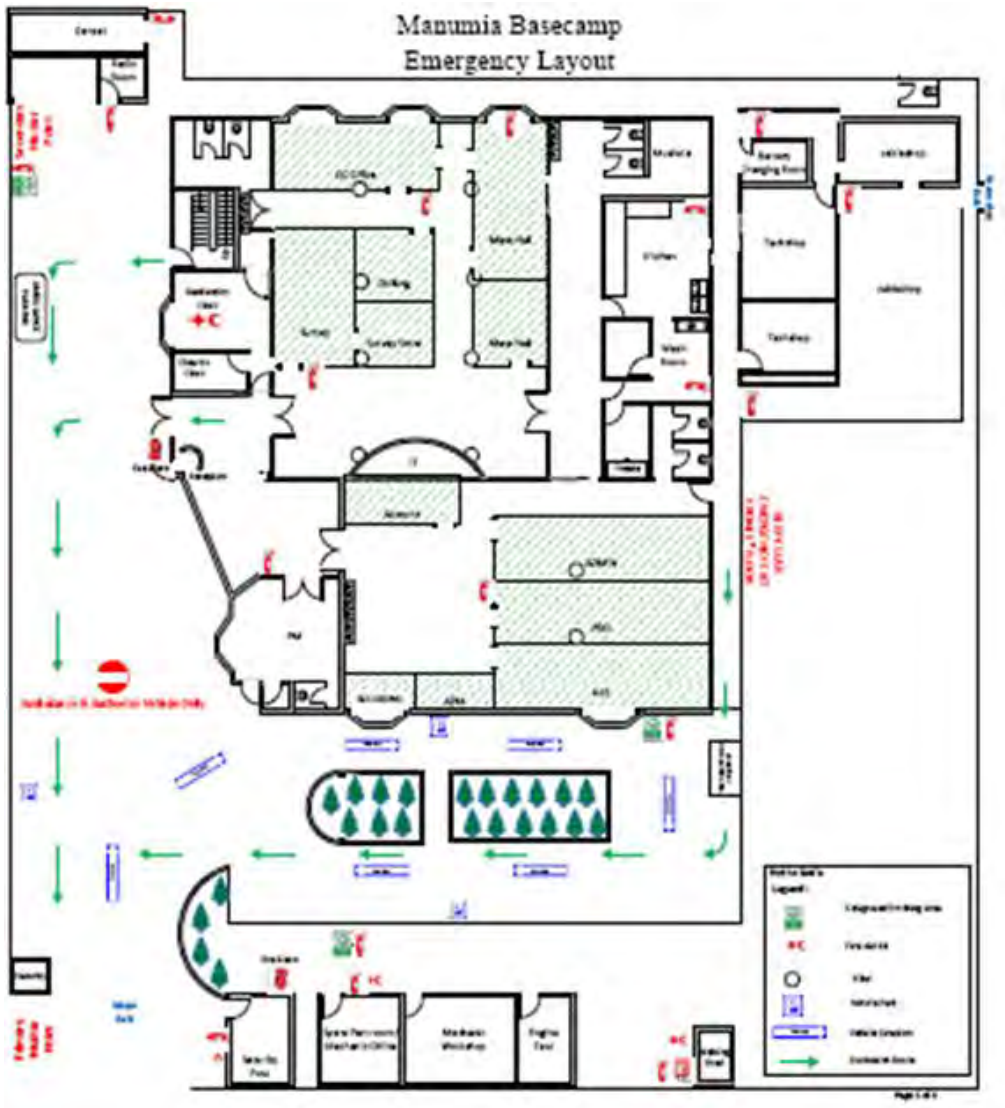



**Fig- 6.1 Base camp Emergency Layout plan (Crew-432, 3D Seismic Survey,**

**(Monumia Community center)**

### 6.6.1 (b) Emergency Procedure (Fly Camp Layout Plan-Block -13):

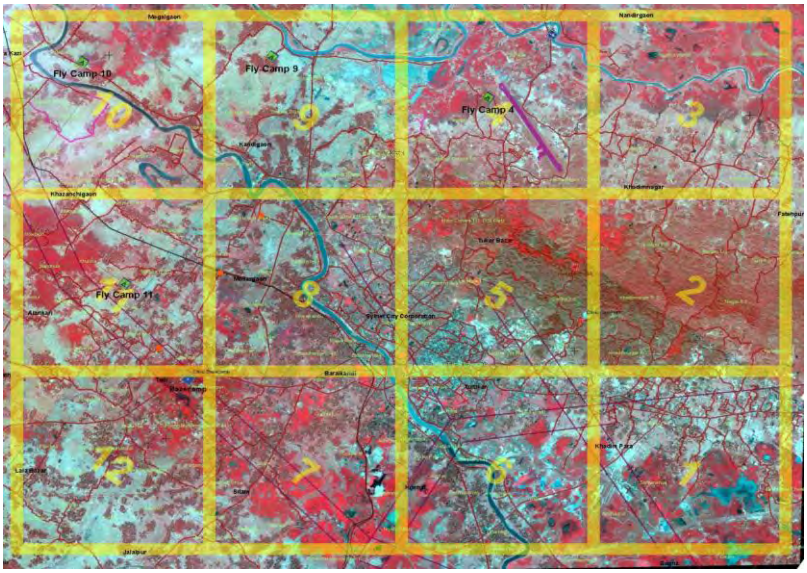



**Fig- 6.2 Fly Camp Emergency Layout plan (Crew-432, 3D Seismic Survey, Jalalabad Gas plant Extension Project)**

### 6.6.1 (c) Sample Emergency Layout Plan (SIMOPS Zone):

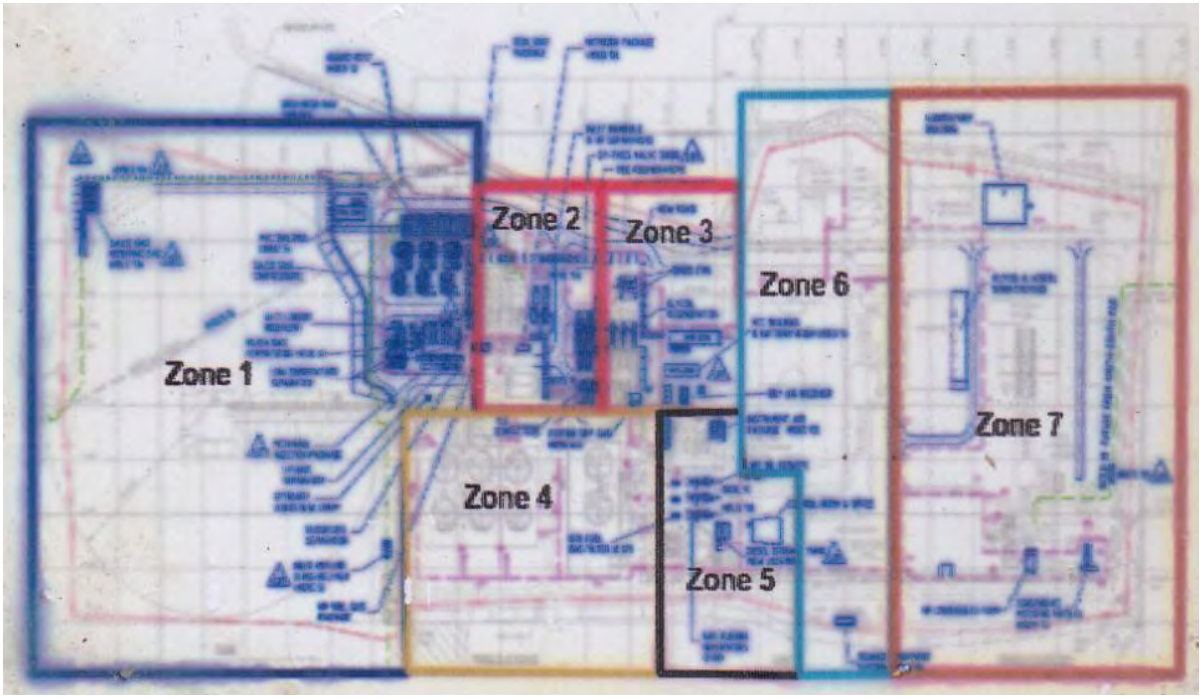



**Fig- 6.3 Plant Emergency Layout Plan (SIMOPS Zone - Bibiyana Gas Plant)**

**Zone-1:** Main Construction area, Sales gas compressor, liquid recovery, Flash gas compressor, Flash gas separator, Fuel gas system, cooler, Sales gas package.

**Zone-2:** Core process area-inlet manifold, individual separation trains (train 1-6), TEG regeneration system, new TEG contractor.

**Zone-3:** Core process area- DRIZO unit, Dry gas manifold, regeneration system, TEG contractor, MCC building & Battery room, Diesel Storage, By-pass valve skid etc.

**Zone-4:** Tank farm area- condensate storage area, dirty & clean produced water storage, LP gas separator, condensate shipping pump, Foam storage, water re-injection pump.

**Zone-5:** Control room area- Fire water & Jockey pump, Raw water pump, Fire water storage, control room, Gas Turbine generator, Lube oil tank, Generator, Air compressor etc.

**Zone-6:** Accommodation area- including Main gate, Security barrack, communication tower, Office building, LQ, Football field, Sewage Treatment unit.

**Zone-7:** Wellhead area- including Laboratory, Incinerator, Ware house, Glycol & Lube oil, drum storage, wellhead, WHCP, Test and Production manifold, Test Separator, Drain vessel, HP condensate pump, condensate metering, Sales gas metering, instrument air package, Dry air receiver etc.

### 6.6.2 Organizational or Employer responsibility on emergency:

One individual should be appointed and trained to act as Emergency Coordinator as well as a "back-up" coordinator. However, personnel on site during an emergency are key in ensuring that prompt and efficient action is taken to minimize loss.

Specific duties, responsibilities, authority, and resources must be clearly defined. Among the responsibilities that must be assigned are:

- Reporting the emergency.
- Activating the emergency plan.
- Assuming overall command.
- Establishing communication.
- Alerting staff.
- Ordering evacuation.
- Alerting external agencies.
- Confirming evacuation is complete.
- Alerting outside population of possible risk.
- Requesting external aid.
- Coordinating activities of various groups.
- Advising relatives of casualties.
- Providing medical aid.
- Ensuring emergency shut offs are closed.
- Sounding the all-clear.
- Advising media.

Sufficient alternates for each responsible position must be named to ensure that someone with authority is available onsite at all times.

External organizations that may be available to assist (with varying response times) include:

- Fire departments.
- Mobile rescue squads.
- Ambulance services.
- Police departments.
- Telephone companies.

- Hospitals.
- Utility companies.
- Industrial neighbours.
- Government agencies.

These organizations should be contacted in the planning stages to discuss each of their roles during an emergency. Mutual aid with other industrial facilities in the area should be explored.

Pre-planned coordination is necessary to avoid conflicting responsibilities. For example, the police, fire department, ambulance service, rescue squad, company fire brigade, and the first aid team may be on the scene simultaneously. A pre-determined chain of command in such a situation is required to avoid organizational difficulties. Under certain circumstances, an outside agency may assume command.

### 6.7 Series of events or decisions that should be considered:

Having identified the hazards, the possible major impacts of each should be itemized, such as:

- Sequential events (for example, a fire after an explosion).
- Evacuation.
- Casualties.
- Damage to plant infrastructure.
- Loss of vital records/documents.
- Damage to equipment.
- Disruption of work.

Based on these events, the required actions are determined. For example:

- Declare emergency.
- Sound the alert.
- Evacuate danger zone.
- Close main shutoffs.
- Call for external aid.
- Initiate rescue operations.
- Attend to casualties.
- Fight fire.

The final consideration is a list and the location of resources needed:

- Medical supplies.
- Auxiliary communication equipment.
- Power generators.
- Respirators.
- Chemical and radiation detection equipment.
- Mobile equipment.
- Emergency protective clothing.
- Fire fighting equipment.
- Ambulance.
- Rescue equipment.

- Trained personnel.

**6.8 Emergency procedures and it's establishment:** Emergency procedures are plans for dealing with emergencies such as fires, explosions, major releases of hazardous materials, violent occurrences, or natural hazards. When such events occur, the urgent need for rapid decisions, shortage of time, lack of resources, and trained personnel can lead to chaos and Overcome the Emergency situation.

The objective of the plan is to prevent or minimize fatalities, injuries, and damage. The organization and procedures for handling these sudden and unexpected situations must be clearly defined.

The development of the plan follows a logical sequence.

- Compile a list of possible hazards or scenarios (for example: fires, explosions, flood, gas leak, blow out).
- Identify the possible major consequences of each (for example: casualties, damage).
- Determine the required countermeasures (for example: evacuation, rescue, fire fighting).
- Inventory the resources needed to carry out the planned actions (for example: medical supplies, rescue equipment, training personnel).
- Based on these considerations, establish the necessary emergency organization and procedures.

Communication, training, and periodic drills are required to ensure adequate performance when the plan must be implemented.

## 6.9 Establishment of medical aid and first aid programs:

First aid facilities and the provision of medical aid is generally prescribed under health and safety department concern or workers' compensation program. The program must include the following information:

- Location of first aid stations and medical facilities.
- Identification of first aid attendants.
- Identification of other staff trained in first aid.
- Policy on pre-employment and follow-up medical examinations.
- Procedures for transporting injured employees to outside medical facilities.
- Provision of first aid training.
- Procedure for recording injuries and illnesses.

A policy on return to work after a lost-time accident might appropriately be included in this section of the program.

In general, if injured workers are offered alternative employment:

- The work should be suitable and productive.
- The worker's physician must agree that such employment will not harm the worker or slow down the recovery.
- The worker will pose no threat to other workers.
- The policy is applied to off-the-job injuries as well.

Once the health and safety program has been set in place and the program appears to be running smoothly, effort is still required to maintain enthusiasm and interest.

### 6.10 Employees' Responsibility during the emergency:

- Secure the workplace if safe to do so.
- Evacuate from location of emergency
- Rush but do not run
- Gather at the designated muster point
- Follow on scene commander's command

Do not return to work until all clear is given by Person-in-Charge

It might be worthwhile to mention in this section that, in an emergency, people should secure their workplace before evacuating the area providing if it is safe to do so. But Personnel in the immediate location of an emergency (e.g. gas release, fire) may not be able to safely secure their workplace before evacuating the site.

**Fig- 6.4 Muster point feature (Bibiyana gas plant, Nabiganj, Habiganj)**

### 6.11 Emergency Response – Key Factors:

- Emergency: It can happen here
- What can go wrong?
- Know Procedures, Know your Roles as per Station Bill
- Know your Emergency Safety Equipment
- Recognize your Limits - Response/ Evacuation
- Drills & Practices

Emergency Don't Have to be Disaster

### 6.12 Testing and Revision of emergency planning:

Completing a comprehensive plan for handling emergencies is a major step toward preventing disasters. Exercises and drills may (must) be conducted to practice all or critical portions (such as evacuation) of the plan. A thorough and immediate review after each exercise, drill, or after an actual emergency will point out areas that require improvement then company should be maintain communication, training, and

periodic drills to ensure adequate performance when the plan must be implemented. Knowledge of individual responsibilities must be evaluated through paper tests or interviews.

At the planning stage, it is important that several groups need to be asked to participate. Among these groups, the health and safety committee must provide valuable input and a means of wider worker involvement. Appropriate municipal officials should also be consulted as control may be exercised by the local government during major emergencies and additional resources must be available. Communication, training and periodic drills will ensure adequate performance if the plan must be carried out. Periodic drills must be maintained for ensuring adequate performance for controlling emergency situation when actual one (if any) will occurs.

The plan should be revised when shortcomings have become known, and should be reviewed at least annually. Company key personnel must be responsible changes in plant infrastructure, processes, materials used and for updating the emergency plan according to necessary.

## 6.13 Spill Safety or Spill Control

### 6.13.1 Chemical Spills handling procedure:

This chapter provides valuable information for chemical industries (Oil & Gas) in the event of a chemical spill. Topics include how to control, contain and clean up spills or leaks, tips to prevent spills, and the contents of a spill kit. Also included is a list of emergency numbers to fill in that applicators should have in case of a chemical spill.

The inability to respond properly to such an emergency—no matter how minor the problem-could seriously endanger public health and environmental quality.

All users of hazardous chemicals must be familiar with the laws and guidelines governing chemical spills. All chemical wastes, including spilled material, must be disposed of in accordance with company, country, and local laws.

The suggested guidelines in the event of a hazardous chemical spill are included under the "**Three C"** program: **Control** the spill, **Contain** the spill, and **Clean up** the spill.

First and foremost, do not expose individual to the spilled chemical; put on personal protective equipment, including chemical-resistant gloves, before attempting to control the spill. Also, do not attempt to rescue someone in an unknown environment without first properly protecting yourself, or you may be another victim.

An accidental spill can happen at any time. However, before attempting to control any spill, put on personal protective equipment. By acting quickly to control the flow of the material being spilled the less damage it can cause.

**(a) Control the Spill:** The best way to control spills is to stop them before they happen. Regularly cleaning and maintaining machines and equipment is one way. Another is to use drip pans and guards where possible spills might occur. When spills do occur, it is important to clean them up immediately. Absorbent materials are useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

Act quickly—the sooner the spill is controlled the less damage it can cause. Immediate steps should be taken to control the flow of the material being spilled, regardless of the source. However, stopping larger leaks or spills may not be so simple.

**(b) Get Help:** If the spill is large or dangerous, have someone get help. Do not leave the site unattended. The first contact to make in an emergency is the HSE Department than county emergency management office, which can provide or coordinate assistance and regulatory compliance. The office can be contacted by dialing 911 or checking the blue pages in a telephone directory. Have someone alert the country and local police if the spill occurs on a public highway.

Be sure to have the product label and material safety data sheet (MSDS) available. In certain cases, the fire department may need to be alerted, but be sure to caution them not to wash down the spill until advised to do so. In serious situations, contacting public health officials and the hospital emergency room may be necessary.

**(c) Isolate the Area:** Rope off the contaminated area; keep people at least 30 feet away from the spill. Avoid contact with any drift or fumes that may be released. Do not use road flares if suspect the leaking material is flammable. At times, evacuating people that are downwind from the spill may be necessary.

Do not leave the spill site until someone relieves you. Someone should be present at the spill site continuously until the danger is removed, the chemical is cleaned up, and the area is decontaminated.

**(d) Contain the Spill or Leak:** At the same time the leak is being controlled, contain the spilled material in as small an area as possible and keep it from spreading. In some situations, a shovel or power equipment may be needed to construct a dam.

Liquid spills can be further contained by spreading absorbent materials such as fine sand, absorbing pad, vermiculite, clay, or pet litter over the entire spill. However, a word of caution is needed here. Avoid using sawdust or sweeping compounds if the material is a strong oxidizer (check the label or MSDS) because such a combination presents a possible fire hazard.

In addition, spill kits contain non selective, universal sorbents packed in porous fabric pillows. These pillows and "tubes" can be placed directly on the spill or used to dike around the spill area. Waste disposal also is simplified since the contaminated pillows can be placed into heavy-duty disposal bags without loss of waste material.

The most important point to remember is do not get any spilled material into any body of water, including storm sewers or drains, no matter how small the spill. If the chemical does contaminate a stream, pond, or any other waterway, contact the Department of Environmental Protection, immediately. Discharge of chemical substances into waterways also must be reported to the countries environmental Department under the authority of the Clean Water Act.

**Contain the spill in as small an area as possible.**

| **(e) Emergency Phone Numbers** | |
|---|---|
| 911 or Local Emergency Planning Office<br>Local Police<br>Country Police<br>Fire Company<br>Ambulance<br>Local Hospital<br>Poison Control Center<br>Department of Environmental Protection | _____<br>_____<br>_____<br>_____<br>_____<br>_____<br>……<br>_____ |
| **If the spill gets into a water source:** | |
| Department of Agriculture<br>Department of Environmental Protection<br>Fish and Boat Commission<br>Environmental Protection Agency | _____<br>_____<br>_____<br>_____ |
| **For technical assistance:** | |
| Emergency Number from product label<br>Other concern office | _____ |
| **Other:** | |
| _____<br>_____<br>_____ | _____<br>_____<br>_____ |

**(f) Clean up the Spill:**

Be sure to wear protective equipment when cleaning up any spill. If absorbent material has not yet been used to control the spill, it must now be spread over the contaminated area. Then sweep it up and place in a steel or fiber drum lined with a heavy-duty plastic bag. Keep adding the absorbent to the spilled area until all the liquid is absorbed.

Once the spill has been cleaned up, decontaminating or neutralizing the area may be necessary. Then add fresh absorbent material to soak up should be swept up and placed in a plastic bag or drum for disposal. Repeat this procedure as needed to ensure that the area has been thoroughly decontaminated.

Remove absorbent since all saturated materials take on the properties of the chemicals they have absorbed and are then classified as hazardous waste. Disposal of all hazardous wastes generated by the

cleanup must be done in strict accordance with countries Environmental Conservation and Recovery Act laws.

**(g) Soil Contamination:**

The only effective way to decontaminate soil saturated with a hazardous chemical is to remove the top 2 to 3 inches of soil. This contaminated soil must be disposed of at a proper disposal site. The decontaminated area should be covered again properly.

**(h) Prevent Spills:**

The best way to handle a spill is to prevent it from happening. Evaluate company's methods for storing, mixing, loading, and transporting chemical to identify areas for additional precautions and modifications.

**(i) Storing Chemical Safely:**

Select a storage site to minimize the potential for runoff and contamination of surface water or groundwater in case of a spill or leak. The floor in the storage area should have an impermeable surface that is free of cracks. Check containers regularly for leaks, tears, or corrosion. Keep a spill kit at the storage area.

**(j) Transportation Safety:**

Vehicle operators should be trained in basic emergency response procedures. Have product labels and MSDSs in the vehicle. Secure chemical containers from moving during transit. Regularly inspect sprayer tanks, fittings, lines, booms, and nozzles. Each vehicle transporting chemical should contain a spill kit.

### 6.13.2 Spill kit information:

All the previously mentioned areas include a spill kit, which should be available wherever chemical are stored or handled. A spill kit can be purchased or easily assembled and should contain the following items:

- Telephone numbers for emergency assistance
- Personal protective clothing and equipment (gloves, footwear, and apron that are chemically resistant; disposable coveralls; protective eyewear; and a respirator)
- Containment to confine the leak or spill to a small area
- Absorbent materials, such as spill pillows, absorbent clay etc
- Plastic cover for spills
- "Caution tape" to isolate the area
- A shovel, broom, and dustpan
- Heavy duty disposal bags with ties
- Duct tape—a universal tool
- Sturdy plastic container that will hold the entire volume of the largest chemical container being handled and that can be tightly closed; can also be used to store the contents of the spill kitA permanent marker to write the name of the spilled pesticide on the container

### 6.13.3 Spill Control (Ask Question):

- Are all spills wiped up quickly?
- Is anti-slip flooring used where spills, moisture or grease are likely?
- Are procedures followed as indicated on the material safety data sheet?
- Are spill absorbents used for greasy, oily, flammable or toxic materials?
- Are used rags and absorbents disposed of promptly and safely?
- Is a spill area surrounded by a barrier to prevent a spill from spreading?

### 6.13.4 Spill safety activities:

- Make provisions to contain spilled flammable liquids.
- Use absorbent materials to clean up and prevent the spill from spreading.
- Clean up spilled oil, grease, fuel and other slipping and fire hazards immediately.
- Reduce spills by using dip pans.
- Follow manufacturer's recommendations regarding the type of absorbent material to use if the product is spilt.
- When cleaning, drain excess fluid into appropriate waste containers. Treat the absorbent and liquid mixture in the same way you would safely handle the liquid.
- Use a funnel to prevent fuel spillage on the engine when refuelling. Fuel up outdoors, then wipe up all spills.
- Do not spill any fuel on equipment. If do, wipe up and allow any residue to dry before starting the engine.
- Clean up spills promptly according to procedures, using personal protective equipment (PPE) where necessary.
- Remove any spilled grease, oil, or other combustible liquid.
- Place oily rags in a covered metal container.
- Dispose of absorbent according to local environmental requirements.
- Remove all spillage of flammable liquids from equipment, cellars, rig floor, and ground area adjacent to the wellhead.
- Use extreme care to avoid spilling or splashing the sulfuric acid solution. It can destroy clothing and burn the eyes and skin.
- Neutralize spilled or splashed sulfuric acid solution with a baking soda (sodium bicarbonate) solution, and rinse the spill area with clean water.
- Follow safety recommendations of fuel supplier during fuel delivery. Report fuel spills in accordance with regulations.
- Preparing and training for emergency response for incidents such as spills, fire or employee injury.
- Have equipment and supplies for flushing, neutralizing, and cleaning spilled chemicals, acid and electrolyte solutions nearby.

# Chapter-7: Accident and Incident Investigation

## 7.1 Definition of accident and near miss:

The term "accident" can be defined as an unplanned event that interrupts the completion of an activity, and that may (or may not) include injury or environmental or property damage.

A near miss usually refers to an unexpected event that did not cause injury or damage this time but had the potential. "Near miss" or "dangerous occurrence" are also terms for an event that could have caused harm but did not.

## 7.2 Benefit of Accident/Incident prevention Program:

Zero incidents in and of itself is both a goal and a reward. Company should not overlook that an additional reward to the employee for working accident free is that there exists no pain, suffering or against on the part of either himself or his family members. In addition to the humanitarian aspect, there are also positive economic aspects to the employee. If no accident is sustained, the employee sustains no economic loss by forfeiting wages for workers compensation. Further, there is no loss of company benefits and lastly, no loss to the employee of any monetary awards the company may have set up in its safety program.

An accident free work environment also has real rewards (paybacks) for the employer. First of all, it like at the humanitarian aspect again, but at this stage through the employer's eyes. When accidents do not occur, employees want to work for the employer. They make their family and friends aware of this very positive situation and the company gains a considerably enhanced image from all those with whom it comes in contact. Its reputation as a employee-conscious employer creates a favorable reception from both those inside and outside the organization. Secondly, the economic payback is over-whelming with insurance and litigation costs escalating astronomically, anywhere that costs can be controlled becomes a focal point for the manager's attention.

The paybacks for an employer-created effective accident prevention program are so great that no smart employer would anymore be without such an effort than they would be without their marketing, accounting or operational arms.

**Accident prevention cuts liability, which cuts costs, which improves the bottom line.**

**7.3 Necessity of investigation:** When accidents are investigated, the emphasis should be concentrated on finding the root cause of the accident rather than the investigation procedure itself so people can prevent it from happening again. The purpose is to find facts that can lead to actions, not to find fault. Always look for deeper causes. Do not simply record the steps of the event.

Reasons to investigate a workplace accident include:

- most importantly, to find out the cause of accidents and to prevent similar accidents in the future
- to fulfill any legal requirements
- to determine the cost of an accident
- to determine compliance with applicable safety regulations
- to process workers' compensation claims

Incidents that involve no injury or property damage should still be investigated to determine the hazards that should be corrected. The same principles apply to a quick inquiry of a minor incident and to the more formal investigation of a serious event.

## 7.4 Person involve at Accident investigating team:

Ideally, an investigation would be conducted by someone experienced in accident causation, experienced in investigative techniques, fully knowledgeable of the work processes, procedures, persons, and industrial relations environment of a particular situation.

Some jurisdictions provide guidance such as requiring that it must be conducted jointly, with both management and labour represented, or that the investigators must be knowledgeable about the work processes involved.

In most cases, the supervisor should help investigate the event. Other members of the team can include:

- employees with knowledge of the work
- safety officer
- health and safety committee
- union representative, if applicable
- employees with experience in investigations
- "outside" expert
- representative from local government

It is noted that the immediate supervisor be on the team. Advantage is that this person is likely to know most about the work and persons involved and the current conditions. Furthermore, the supervisor can usually take immediate remedial action

## 7.5 Root causes of an accident:

It is necessary to examine some underlying factors in a chain of events that ends in an accident.

- Was the worker distracted? If yes, why was the worker distracted?
- Was a safe work procedure being followed? If not, why not?
- Were safety devices in order? If not, why not?
- Was the worker trained? If not, why not?

An inquiry that answers these and related questions will probably reveal conditions that are more open to correction than attempts to prevent "carelessness".

## 7.6 Steps involved in investigating an accident:

The accident investigation process involves the following steps:

- Report the accident occurrence to a designated person within the organization
- Provide first aid and medical care to injured person(s) and prevent further injuries or damage
- Investigate the accident Accident Causation Models:-
- Many models of accident causation have been p
- Identify the causes

- Report the findings
- Develop a plan for corrective action
- Implement the plan
- Evaluate the effectiveness of the corrective action
- Make changes for continuous improvement

As little time as possible should be lost between the moment of an accident or near miss and the beginning of the investigation. In this way, one is most likely to be able to observe the conditions as they were at the time, prevent disturbance of evidence, and identify witnesses. The tools that members of the investigating team may need (pencil, paper, camera, film, camera flash, tape measure, etc.) should be immediately available so that no time is wasted.

### 7.7 Accident investigation process:

When accidents are investigated, the focus should be placed on finding the root cause of the accident so people can prevent it from happening again. The purpose is to find facts that can lead to actions, not to find fault.

### 7.7.1 Cause & Effect (Fishbone Diagram):

The Ishikawa Diagram, also known as the Fishbone Diagram or the Cause-and-Effect Diagram, is a tool used for systematically identifying and presenting all the possible cause of a particular problem in graphical format. The possible causes are presented at various levels of detail in connected branches, with the level of detail increasing as the branch goes outward i.e., an outer branch is a cause of the inner branch it is attach to. Thus, the outermost branches usually indicate the root cause of the problem. [43];

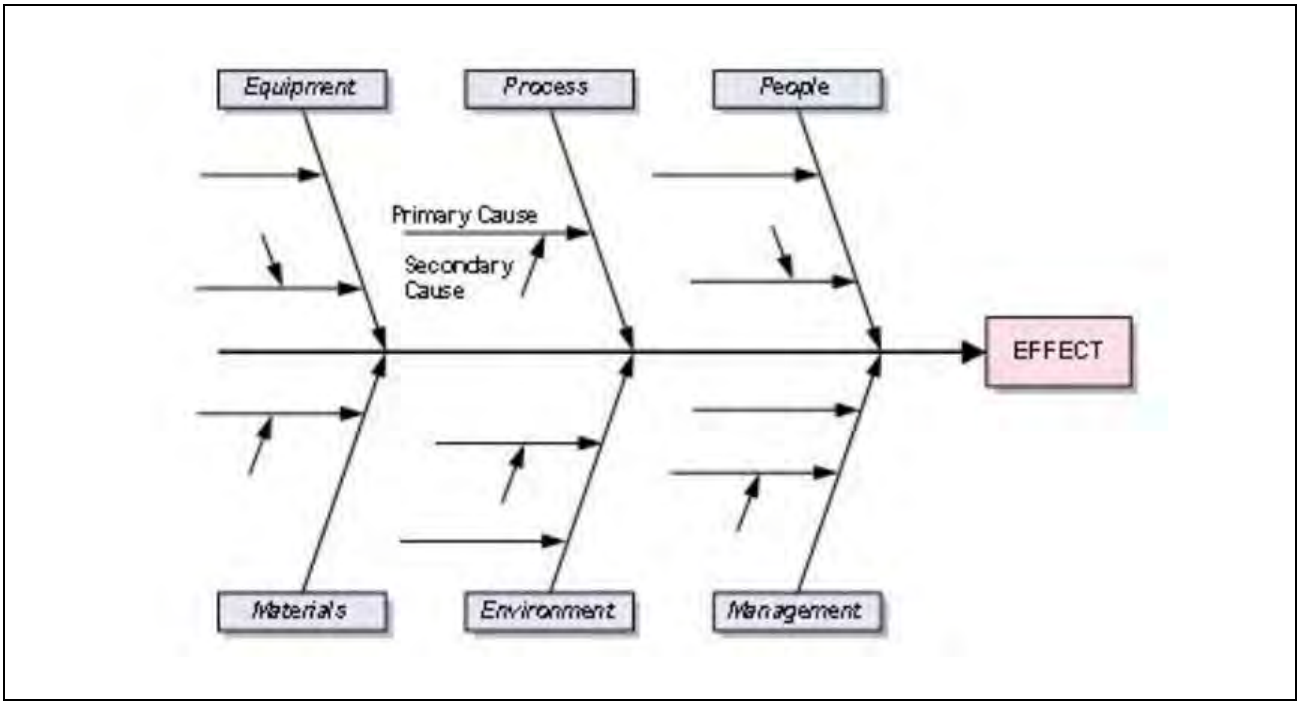



**Fig-7.1 Cause & Effect Diagram, [43];**

### 7.7.2 Heinrich's domino theory (sophisticated Management Oversight and Risk Tree (MORT):

Proposed, ranging from Heinrich's domino theory to the sophisticated Management Oversight and Risk Tree (MORT). [38];

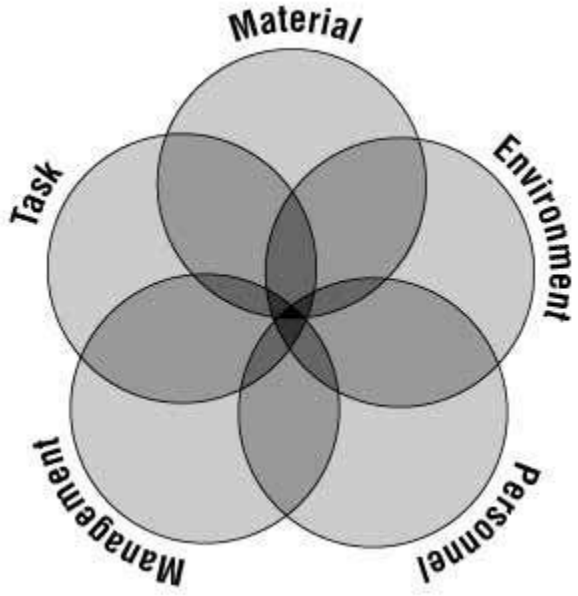



**Fig- 7.2 Simple Model to illustrate the Causes of Accidents. [38];**

The simple model shown in Figure -7.2 attempts to illustrate that the causes of any accident can be grouped into five categories - task, material, environment, personnel, and management. When this model is used, possible causes in each category should be investigated. Each category is examined more closely below. Remember that these are sample questions only: no attempt has been made to develop a comprehensive checklist.

**(a) Task:** Here the actual work procedure being used at the time of the accident is explored. Members of the accident investigation team will look for answers to questions such as:

- Was a safe work procedure used?
- Had conditions changed to make the normal procedure unsafe?
- Were the appropriate tools and materials available?
- Were they used?
- Were safety devices working properly?
- Was lockout used when necessary?

For most of these questions, an important follow-up question is "If not, why not?"

**(b) Material:** To seek out possible causes resulting from the equipment and materials used, investigators might ask:

- Was there an equipment failure?
- What caused it to fail?
- Was the machinery poorly designed?
- Were hazardous substances involved?
- Were they clearly identified?

- Was a less hazardous alternative substance possible and available?
- Was the raw material substandard in some way?
- Should personal protective equipment (PPE) have been used?
- Was the PPE used?
- Were users of PPE properly trained?

Again, each time the answer reveals an unsafe condition, the investigator must ask **why** this situation was allowed to exist.

**(c) Environment:** The physical environment, and especially sudden changes to that environment, are factors that need to be identified. The situation at the time of the accident is what is important, not what the "usual" conditions were. For example, accident investigators may want to know:

- What were the weather conditions?
- Was poor housekeeping a problem?
- Was it too hot or too cold?
- Was noise a problem?
- Was there adequate light?
- Were toxic or hazardous gases, dusts, or fumes present?

**(d) Personnel:** The physical and mental condition of those individuals directly involved in the event must be explored. The purpose for investigating the accident is not to establish blame against someone but the inquiry will not be complete unless personal characteristics are considered. Some factors will remain essentially constant while others may vary from day to day:

- Were workers experienced in the work being done?
- Had they been adequately trained?
- Can they physically do the work?
- What was the status of their health?
- Were they tired?
- Were they under stress (work or personal)?

**(e) Management:** Management holds the legal responsibility for the safety of the workplace and therefore the role of supervisors and higher management and the role or presence of management systems must always be considered in an accident investigation. Failures of management systems are often found to be direct or indirect factors in accidents. Ask questions such as:

- Were safety rules communicated to and understood by all employees?
- Were written procedures and orientation available?
- Were they being enforced?
- Was there adequate supervision?
- Were workers trained to do the work?
- Had hazards been previously identified?
- Had procedures been developed to overcome them?
- Were unsafe conditions corrected?
- Was regular maintenance of equipment carried out?
- Were regular safety inspections carried out?

This model of accident investigations provides a guide for uncovering all possible causes and reduces the likelihood of looking at facts in isolation. Again it should be emphasized that the above sample questions do not make up a complete checklist, but are examples only. [38];

### 7.7.3 "Swiss Cheese" Model:

The **Swiss Cheese Model** of accident causation is a model used in risk analysis and risk management, including, engineering, aviation, healthcare, and as the principle behind layered security, as used in computer security and defense in depth. It likens (compare) human systems to multiple slices of Swiss cheese, stacked side by side, in which the risk of a threat becoming a reality is mitigated by the differing layers and types of defenses which are "layered" behind each other. Therefore, in theory, lapses and weaknesses in one defense do not allow a risk to materialize, since other defenses also exist, to prevent a single point of weakness. The model was originally formally propounded by Dante Orlandella and James T. Reason of the University of Manchester, and has since gained widespread acceptance. It is sometimes called the Cumulative act effect. [37];

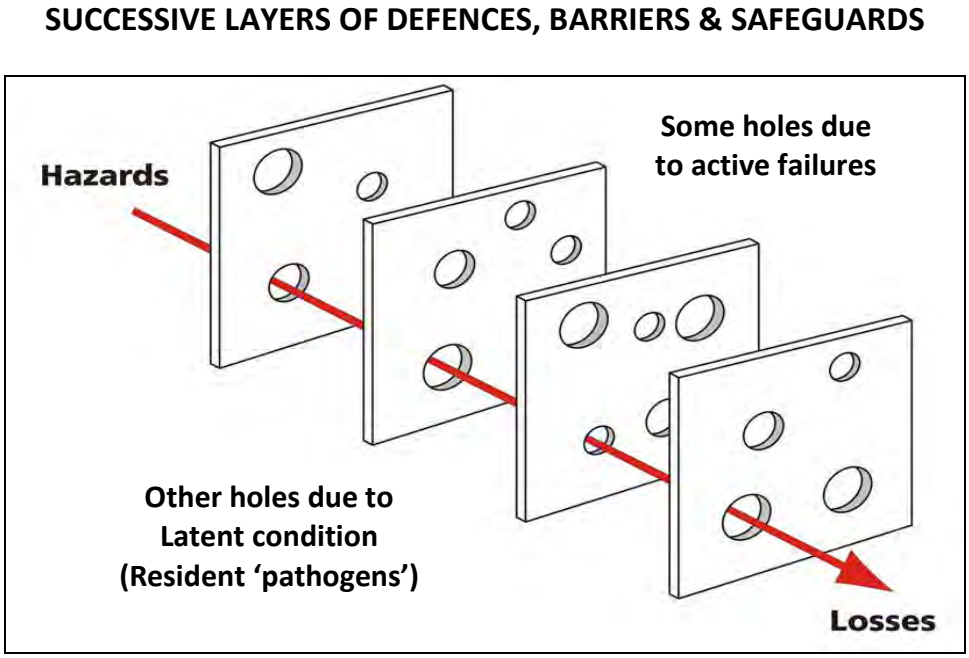



**Fig -7.3 Reason's Swiss Cheese Model (Modified from Reason, 2008 p.102). [36];**

The Swiss cheese model of accident causation illustrates that, although many layers of defense lie between hazards and accidents, there are flaws (a break/ a gap/ a defect) in each layer that, if aligned, can allow the accident to occur.

**Failure domains:**

Reason hypothesized that most accidents can be traced to one or more of four failure domains: organizational influences, supervision, preconditions and specific acts. Preconditions for unsafe acts include fatigued air crew or improper communications practices. Unsafe supervision encompasses for example, pairing inexperienced pilots on a night flight in to known adverse weather. Organizational influences encompass such things as reduction in expenditure (cost) on pilot training in times of financial austerity.

**Holes and slices:**

In the Swiss Cheese model, an organization's defenses against failure are modeled as a series of barriers, represented as slices of cheese. The holes in the slices represent weaknesses in individual parts of the system and are continually varying in size and position across the slices. The system produces failures when a hole in each slice momentarily aligns, permitting (in Reason's words) "a trajectory of accident opportunity", so that a hazard passes through holes in all of the slices, leading to failure. [35];

**Active and latent failures:**

The Swiss Cheese model includes both active and latent failures. Active failures encompass the unsafe acts that can be directly linked to an accident, such as (in the case of aircraft accidents) pilot error. Latent failures include contributory factors that may lie dormant for days, weeks, or months until they contribute to the accident. Latent failures span the first three domains of failure in Reason's model

Reason's early work in the field of psychological error mechanisms was important in this discussion on complexity of accident causation. By analyzing routine working faults and accidents, he developed models of human error mechanisms. Reason pointed out to address the issue of two kinds of errors: active errors and latent error, the kinds of errors tended to lie dormant in the system largely undetected until they combined with other factors to breach system defenses. Reason considered that accidents were not solely due to individual operator error (active errors) but lay in the wider systemic organizational factors (latent conditions) in the upper levels of the organization (Reason, J., 1990). Reason's model is commonly known as the "Swiss Cheese" Model. [37];

## 7.8 Facts collection procedure:

The steps in accident investigation are simple: the accident investigators gather information, analyze it, draw conclusions, and make recommendations. Although the procedures are straightforward, each step can have its pitfalls. As mentioned above, an open mind is necessary in accident investigation: preconceived notions may result in some wrong paths being followed while leaving some significant facts uncovered. All possible causes should be considered. Making notes of ideas as they occur is a good practice but conclusions should not be drawn until all the information is gathered.

**(a) Injured workers(s):** The most important immediate tasks--rescue operations, medical treatment of the injured, and prevention of further injuries--have priority and others must not interfere with these activities. When these matters are under control, the investigators can start their work.

**(b) Physical Evidence:** Before attempting to gather information, examine the site for a quick overview, take steps to preserve evidence, and identify all witnesses. In some jurisdictions, an accident site must not be disturbed without prior approval from appropriate government officials such as the coroner, inspector, or police. Physical evidence is probably the most non-controversial information available. Based on investigators knowledge of the work process, may want to check items such as:

- positions of injured workers
- equipment being used
- materials or chemicals being used
- safety devices in use
- position of appropriate guards
- position of controls of machinery

- damage to equipment
- housekeeping of area
- weather conditions
- lighting levels
- noise levels
- time of day

It may want to take photographs before anything is moved, both of the general area and specific items. Later careful study of these may reveal conditions or observations missed previously. Sketches of the accident scene based on measurements taken may also help in subsequent analysis and will clarify any written reports. Even if photographs are taken, written notes about the location of these items at the accident scene should be prepared.

**(c) Background Information:** A third, and often an overlooked source of information, can be found in documents such as technical data sheets, health and safety committee minutes, inspection reports, company policies, maintenance reports, past accident reports, formalized safe-work procedures, and training reports. Any pertinent information should be studied to see what might have happened, and what changes might be recommended to prevent recurrence of similar accidents. .

**(d) Recommendations should be made:** The most important final step is to come up with a set of well-considered recommendations designed to prevent recurrences of similar accidents. Once investigators are knowledgeable about the work processes involved and the overall situation of the organization, it should not be too difficult to come up with realistic recommendations. Recommendations should:

- be specific
- be constructive
- get at root causes
- identify contributing factors

Resist the temptation to make only general recommendations to save time and effort.

**7.9 Effect of human error on accident investigation:** Failing to point out human failings that contributed to an accident will not only downgrade the quality of the investigation. Furthermore, it will also allow future accidents to happen from similar causes because they have not been addressed.

However never make recommendations about disciplining anyone who may be at fault. Any disciplinary steps should be done within the normal personnel procedures.

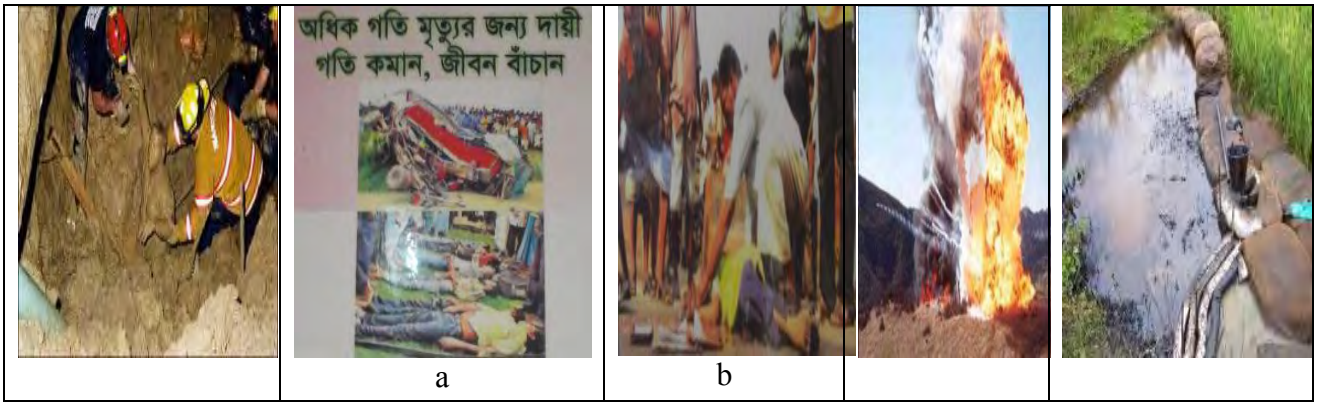
## 7.10 Reporting Procedure and investigation/Incident Investigation & Reporting (II&R):

### 7.10.1 Why Investigate Incidents?

- Identify Root Causes.
- Prevent Recurrence / Improve Profitability.
- Determine Facts, Avoid Blame.
- Look for Trends & Systemic Issues.
- Learn & Share Lessons.
- Meet Legal / Company Requirements – OE.

### 7.10.2 Which incident needs to investigate?

- Injury / Fatality
- Fire
- Lost Profit Opportunity (LPO)
  - Production Loss
  - Cost
  - Business Interruption
  - Equipment Breakdown (Critical)
- Release / Permit Violations
- Legal Liability
- Media Attention




a b

**Fig -7.4 Example of incident (a & b)-Accident research center display board, Buet.ac.bd. [6];**

### 7.10.3 Chevron Upstream's Investigation Methodology: Two types:-

(1) Five Why Method
(2) Why Tree Method.

**Example of sample incident**

**Five Why** shall be used for:

- Level 1 incidents/near misses

**Why Tree** shall be used for:

- All level 3 incidents/near misses
- Level 2 incidents/near misses.

**Near miss definition:** A near miss is any unplanned event having a potential but unrealized consequence for injury/illness or damage to property, the environment, the company's reputation or financial performance.

**Examples:-** Someone trips over a pallet, but doesn't fall, A nonfunctioning safety device etc.

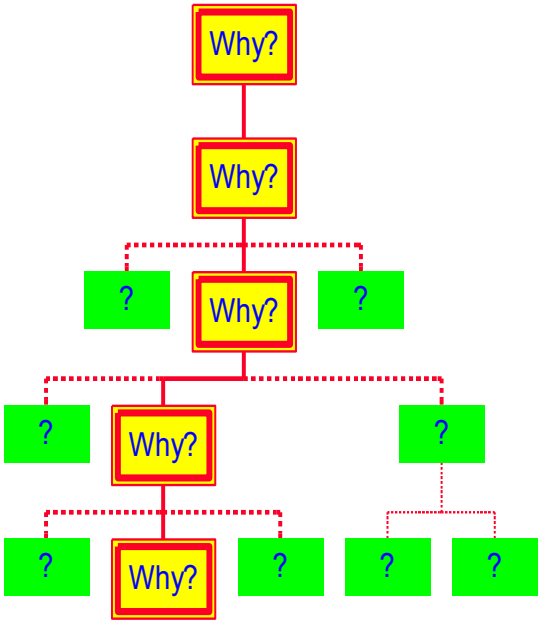



**Fig -7.5 Five Why Method & Why Tree Method for incident Investigation (chevron world-wide)**

## 7.11 Accidents/incidents reporting system and action plan:

Occupational health and safety legislation requires that specific injuries and certain categories of accidents/incidents must be reported. There may be minimum legal requirements for their investigation. The health and safety program should specify:

- What is to be reported
- To whom it will be reported.
- How it is reported.
- Which incidents are investigated
- Who will investigate them
- What forms are used
- What training investigators will receive
- What records are to be kept
- What summaries and statistics are to be developed
- How often reports are prepared.

Accidents and incidents are investigated so that measures can be taken to prevent a recurrence of similar events.

Assign a priority level to the hazards observed to indicate the urgency of the corrective action required. For example:

A = Major--requires immediate action

B = Serious--requires short-term action

C = Minor--requires long-term action

Make management aware of the problems in a concise, factual way

# Chapter-8: Case Studies

## 8.1 HSE engineering case studies:

Personal injuries, property or Environmental damage or destroyed occur frequently from unsafe practices, defective products, machines, equipment while walking at worksite, on the job, from unsafe work practice, unsafe facilities or from a number of hazardous conditions and other unsafe conditions. HSE Engineer is the concern people who work to protect people, property and the environment by identifying and eliminating hazards through engineering design or control measure (Administrative control, Substitution, use of PPE).

Within the engineering field HES Engineering is the special one that enclose or coordinate with many disciplines, such as mechanical engineering, structural engineering, civil engineering, electrical engineering, process engineering, environmental engineering, fire protection, product safety, system safety, ergonomics/ human factors and other.

HES Engineers or safety Engineer recognize that each human being has his/ her own physical and mental capabilities or qualities which come into play when operating a machine, working on the job, using a tools, or equipment, driving a vehicle, operating a crane or using a product.
Many contributing cause or factors as like as heat stress, noise, illness, lake of state of mind, fatigue, inattentiveness, adverse environmental condition or distractions make the human being an unreliable "system" when it comes to recognizing and avoiding hazardous conditions. Eliminating the hazard altogether or providing a safety device is therefore a much more reliable approach to preventing injuries.

The case studies included in this paper fall within a number of areas such as machinery, construction, occupational safety, overload the circuit, unsafe practices, power tools, facility safety and product design. [42];

## 8.2 Case Study:-1

**Type of Incident:** Fire Incident

**Type of Process:** Post Weld Heat Treatment

**Type of Equipment:** Thermocouple and flow line

**Incident Description**: BIX Company was performing Post Weld Heat Treatment on a section of 8" flow line pipe at Pipe Rack #10. The pipe was on the ground on sections of wooden supports. It was heated to working temperature of $610^0$, held for the prescribed time and cooled. While this cooling phase was taking place (approximately 2 hours after commencement of procedure), security personnel on duty noticed that the wooden support under the pipe and nearest to the treated section was smouldering. They immediately extinguished it and informed the supervisor on duty.

There was no damage to flow line pipe or surrounding area.

**Five Why's: It means five reasons why this incident occurred/happened?**

1. Why did the wooden support ignite?
2. Why did No. 1 happen?
3. Why did No. 2 happen?
4. Why did No. 3 happen?
5. Why did No. 4 happen?

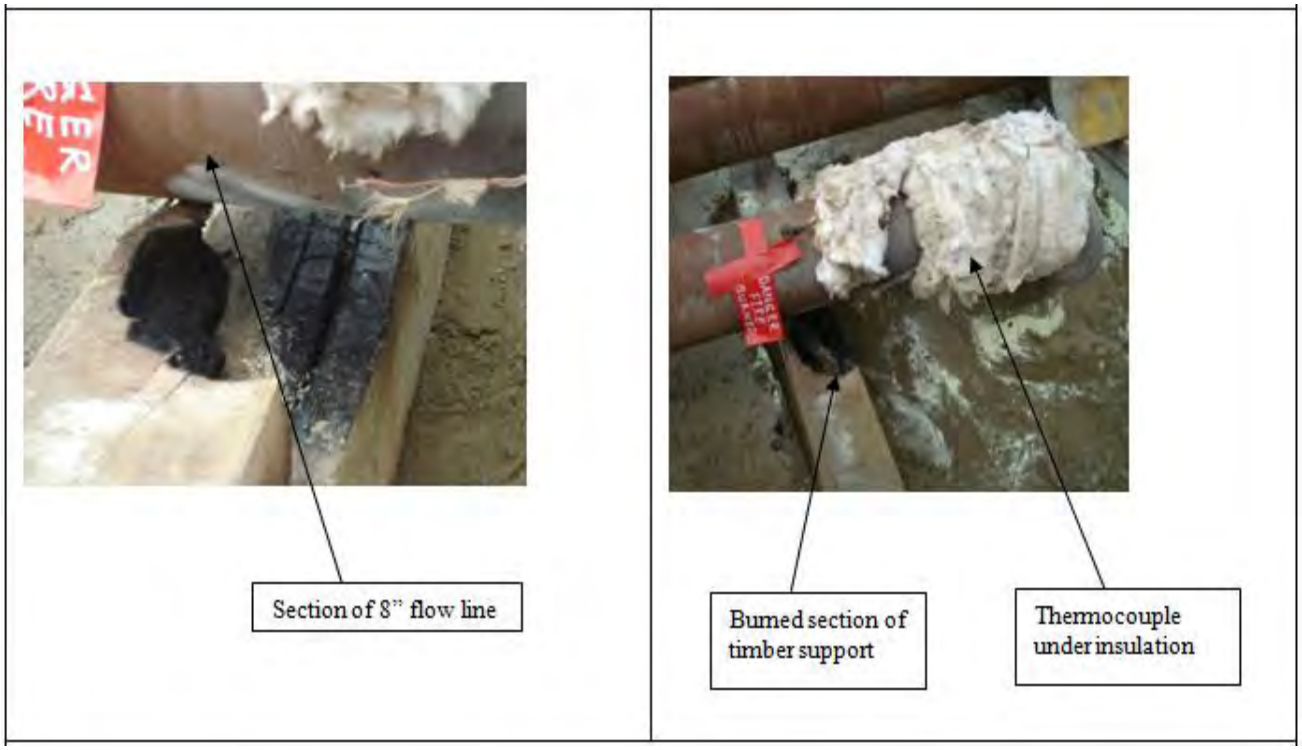



**Fig- 8.1 Post Weld Heat Treatment (Fire Incident)**

- **Reason-1:-** The wooden support was too close to the heating point
- **Reason-2:-** The workers didn't follow the instructions in the JSA
- **Reason-3:-** It was not convenient and would have taken extra time and effort
- **Reason-4:-** They decided to short cut the system
- **Reason-5:-** Supervision of the job was inadequate

**Root Cause(s):** Causes of the incident were

- The JSA was not followed
- Procedures was not followed and
- Safe Work Practices was not maintain
- The procedure was not adequately supervised

**Corrective Action(s):** List of actions that will be taken to eliminate the Root Cause of the incident:

- The workers did not comply with the instructions listed in the JSA. This to be discussed with the contractor supervisor.
- Supervisor will ensure that conditions/instructions set out in the JSA are followed (Owner: BIX)
- Educate BIX in the importance of accountability by the HSE concern person (Owner HSE )
- Always need to follow safe work practices and procedures by the all employees, and Supervisor is the responsible person for ensuring or maintaining those practices and procedures in the work place.

**Long Term Measures:** Discuss with all personnel the potential consequences of failure to follow procedure and also describe what changes in policy, procedure, or equipment are recommended if there any.

## 8.3 Case study-2

**Incident Type: -** Falling Incident, PMWG
**Platong :** Falling Incident

**Operation:** Erect Scaffolding under Cellar Deck (above water), PMWG

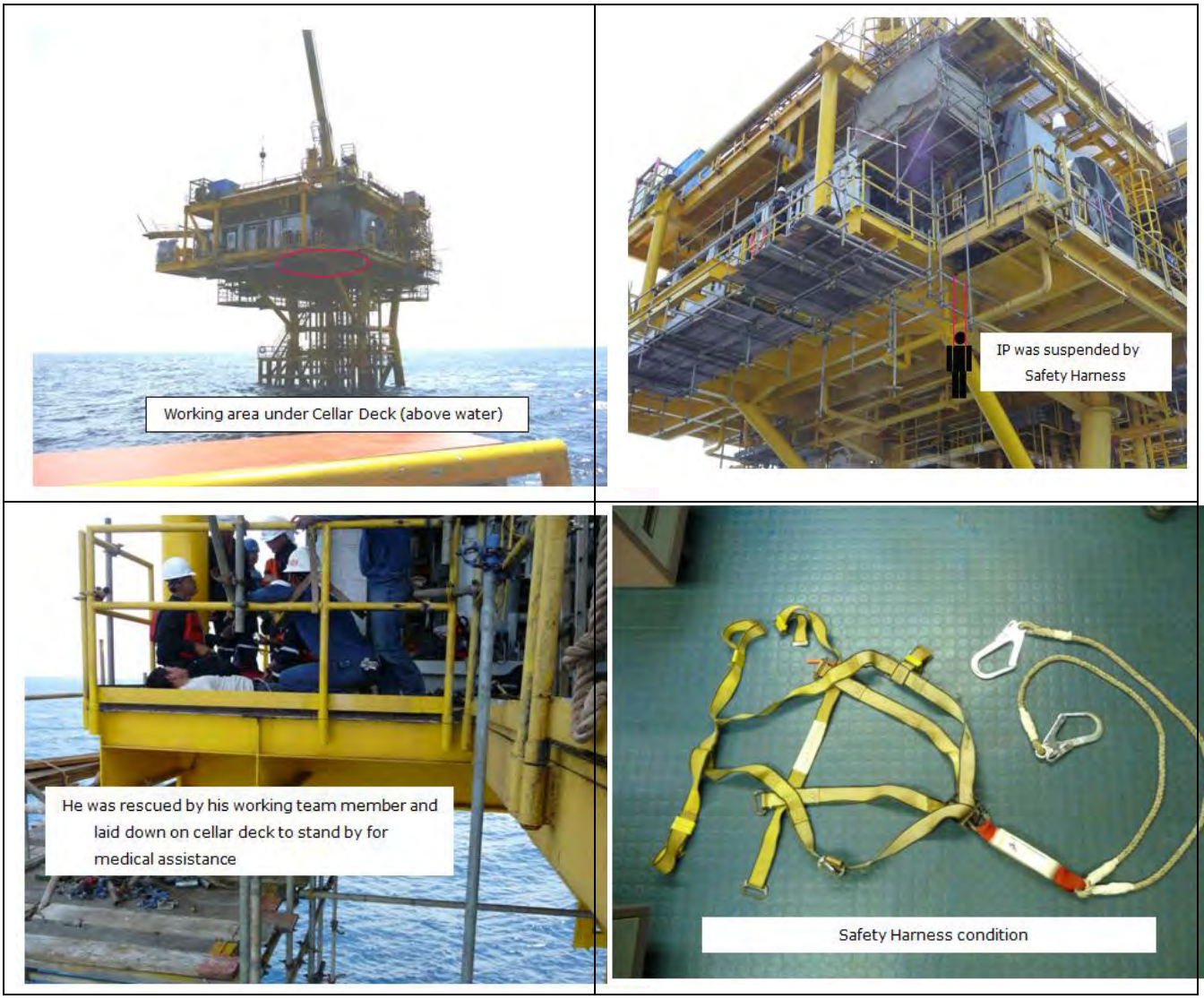



**Fig - 8.2 Falling Incident, PMWG**

### What Happened

- **0930 hrs:** It was reported that a FE Fitter fell down from Scaffolding Structure and suspended by Safety Harness while he was erecting the scaffolding under Cellar Deck (above water) at the South-West side of PMWG. He was rescued by his working team member and laid down on cellar deck to stand by for medical assistance. He was unconscious.
- **0945 hrs:** Emergency Team comprises of FEOCC (Platong), Platong HESS, Platong Medic, FE Supervisor and Platong Crane Leader departed from PLLQ by MV. Uni-Express 58 to PMWG.
- **1030 hrs:** Emergency Team on board PMWG. Platong Medic observed the IP condition. IP was conscious and well response to the Medic's questions, observed normal general physical conditions.
- **1105 hrs:** Transfer the IP back to PLLQ by stretcher (on Personal Basket)
- **1200 hrs:** Arrived at PLLQ and IP was rest on sick bay of medical obse

## 8.4 Case Study:-3

**Type of Incident: Near Miss**

[8]

**Type of Process: Scaffold erecting job at construction site**

**Type of Equipment: Safety Harness**

**Incident Description**: During the pre-use check of a full body safety harness, it was observed that the leg strap had a straight end instead of a double backed and stitched end, as the chest strap is constructed (see photo).

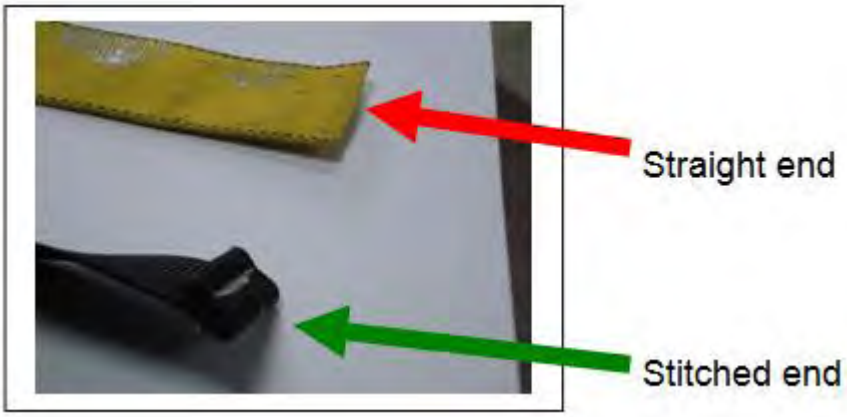



**Fig- 8.3 (a) Harness wearing procedure (Wrong way and Right way)-BYGP Project.**

Upon further checking it was discovered that if the buckle was turned so the loose end of the strap was underneath the leg strap, it could slip completely through the buckle, negating it's protective properties.

Retaining buckle inserted incorrectly, i.e. live end of webbing strap underneath the leg strap

Right way, live end of the leg strap located on the outside.

**Fig- 8.3 (b) Harness wearing procedures (Wrong way and Right way) - BYGP Project.**

**Like this situation may happen to the organization if employee not follow the following work at height (W@H) standard instruction.**

- The manufacturer's full body safety harness donning procedure is not followed
- The personnel are not trained on the manufacturer's donning procedure
- The user of fall protection does not follow the manufacturer's donning procedure

**What may go wrong?**

- Performer can easily make a mistake and put the webbing strap downwards
- The leg strap can pull out of the buckle
- The performer may come out of the harness leg straps

**Lessons Learned / Action Plan:**

- Always follow the manufacturer's procedures
- Ensure performers are trained on the procedures and demonstrate competency of personal fall arrest system (PFAS)
- Ensure performer inspects and complete functional test of all PASF components prior to use

**Essential Operation could be Violated:**

- Always operate in a safe and controlled condition
- Always follow safe work practices and procedures
- Always address abnormal conditions

## 8.5 Case Study:-4

**Type of Incident: Personal Injury - Dog bite to delivery driver outside the fence**

**Incident Description:** A delivery driver was bitten by a dog at gas plant fence area while he was outside the pocket gate. The dog was coming toward him during that time the injured person attracted the dog and his right thigh muscle was bitten by the dog. The patient was brought to the First Aid room where he got First Aid Treatment from the medic. Later, he was transferred to a local medical facility for follow up.

**Fig- 8.4 Dog bite to delivery driver outside the fence (BYGP).** [6];

## 8.6 Case Study:-5

**Type of Incident:** Personal Injury-Person crushed his finger while it was caught in the rack and pinion gear of a rotating cement mixer

**Type of Process:** Cement Mixing by rotating cement mixer.

**Type of Equipment:** Rotating cement mixer

**Incident Description**: At Spur Line Project construction site near Line Break Valve (LBV) Station - 1, one contractor injured his finger while it was caught in the rack and pinion gear of a rotating cement mixer. At the end of the day, after shutting down engine, the engine and drum continued to rotate due to inertia; the injured person, he decided to clean the drum without the drum coming to a stop. The Person's right hand glove got caught in between the rack and pinion gear of the mixer pulling his hand into the mechanism. Further study shows that the drum moves less than 10 second due to inertia after stopping the engine.

**Five Why's: It means five reasons why this incident occurred/happened?**

1. Why did the personal injury occur?
2. Why did No. 1 happen?
3. Why did No. 2 happen?
4. Why did No. 3 happen?
5. Why did No. 4 happen?


**Fig- 8.5 Cement mixing by rotating cement mixer (Personal Injury of JB Plant) [6];**

- **Reason-1:-** Injured Person decided to clean the drum without the drum coming to a stop from running position.
- **Reason-2:-** The workers didn't follow the instructions in the JSA
- **Reason-3:-** Person did not operate in a safe and controlled condition.
- **Reason-4:-** Injured Person decided to short cut the system
- **Reason-5:-** Injured Person's lack of knowledge about mechanical hazard and its potentiality.

**Root Cause(s):**

Causes of the incident were

- The JSA was not followed
- Procedures was not followed and
- Safe Work Practices was not maintaining as person maintain the short cut the system.
- Lack of awareness about mechanical hazard and it's consequence in case of incident

**Corrective Action(s):** List of actions that will be taken to eliminate the Root Cause of the incident:

- Educate the employee about the Hazard and the potentiality of the Hazard by the Safety Trainer or HSE concern person (Owner HSE )
- The workers did not comply with the instructions listed in the JSA. This to be discussed with the contractor company authority (manager, supervisor or HSE Person).
- Supervisor will ensure that instructions set out in the Job Safety Analysis are followed
- Always need to follow safe work practices and procedures by the all employees, and Supervisor is the responsible person for ensuring or maintaining those practices and procedures in the work place.

**Long Term Measures:**

Discuss with all personnel the potential consequences of failure to follow safe work practice and procedure.

## 8.7 Case Study-6

**Type of Incident:** Personal Injury
**Type of Equipment:** Vehicle
**Business Unit:** 3D Seismic

**Incident Description**: On the date of incident at afternoon Company Driver Mr. Rubel went to project area to pick up and drop the laborers.

The following five laborers (all are fictitious name) rushed to the vehicle and boarded on hurriedly:
1. Laborer Lukman (Front Seat)
2. Laborer Masuk Ahmed (Back Seat)
3. Laborer Md. Salam (Back Seat)
4. Laborer Md. Abdulla (Back Seat)
5. Laborer Md. Saiful (Back Seat)

Though there were three seat belts at the back seat, company person Mr. Imam of said to the laborers that if the driver allows so that five person can go in one vehicle. As there were hurried actions by the laborers while they were boarding on the vehicle, the driver was angry and after going a little distance he said one laborer from the back seat to get down from the vehicle. As the laborers did not agree, the driver stopped the vehicle and got down from the vehicle. He then opened the right rear door and pulled laborer Masuk by his hand/clothes out of the vehicle. Many laborers were going by walking down the street who witnessed the incidence and told all the laborers inside the vehicle to get down and go by walking. So the laborers inside the vehicle got down and started walking.

Then the driver Rubel went back to the project area again to pick up other laborers, but this time he took five laborers in his vehicle. When his vehicle was passing by the laborers who were going by walking they saw five passengers inside the vehicle. They stopped the vehicle and asked driver Rubel that why he was carrying five passengers now. About twenty (20) laborers stopped the vehicle and they were agitated. They called Muktadir of that company to the spot and complained. Muktadir requested driver Rubel to beg apology for his misdeeds. Driver Rubel begged apology to the gathered laborers and the incident ended there for the day. Driver Rubel went to drop the passengers of his vehicle.

Next day in the toolbox meeting at project area the issue was raised by the laborers and management came to know about it and took strict action against the driver Rubel.

**Five Why's: It means five reasons why this incident occurred/ happened?**

1. Why did the above incident happen?
2. Why did "1" happen?
3. Why did "2" happen?
4. Why did "3" happen?
5. Why did "4" happen?

- **Reason-1:** In the first trip, the driver didn't agree to carry more than approved numbers of passengers on his vehicle, and he pulled one of the passengers out of his vehicle, but in the second trip he allowed more than allowed numbers of passengers in his vehicle.

- **Reason-2:** The laborers were in a hurry to go back to their respective homes, thus they rushed and more than allowed number of laborers almost by force boarded on the vehicle.
- **Reason-3:** Driver's attitude and way of dealing with the laborers inside his vehicle was not as per proper customs and etiquettes.
- **Reason-4:** As one of the vehicles went out of order that day, there was shortage of vehicles. So all labors in the project site were in a hurry to reach home with shortage number of vehicles which made them tend to violate the procedures.
- **Reason-5:** The driver has not made any communication with his supervisor when he saw that the proper procedures were not being followed i.e. more number of passengers were boarding on the vehicle than the number of seat belts were available.

  Driver Rubel lacks the required standard to be maintained in conduct and behavior with the laborers while they are on board his vehicle. Driver was needed to follow the standard procedures in dealing with the situation.

**Root Cause(S):** Root Causes of the incident were:

- Laborers eagerness to go back homes hurriedly at the end of day's work.
- Driver Rubel's inability to deal with the situation i.e. not following the procedures. And using physical force.

**Corrective Action(S):** List of actions that will be taken to eliminate the Root Cause of the incident.

- Laborers should be assured that all of them would be lifted by vehicle immediately after the end of the work. More number of vehicles should be assigned to project area.
- Driver Rubel had been terminated. All the drivers have to be consistently alerted, motivated to always follow the procedures.

**8.8 Corrective measures to mitigate the hazard:** The corrective measures that can be taken to mitigate the hazard or control the hazard in order of priority are:

1. Engineering control including design or modifications to plants, equipment, ventilation system, and processes that reduces the sources of exposure.

   Engineering design need to be considered as a first priority to eliminate the hazard from the workplace, ie consider mechanical handling (such as crane, hydraulic lift, chain hoist) instead of manual lifting for heavy load, eliminate sharp edges on a product by taking necessary step, or eliminating pinch points in equipment or machinery or any other system.

2. Providing safety device is very effective control measure when the hazard cannot be eliminate, ie guards placed over moving chain, gear, sprocket , belt, spring, moving fan or any other dangerous areas of machines, tools, equipment or products.
3. In conjunction with safety device, warning and special procedures are the last resort when there are no viable design alternatives or safety devices.
4. Terminate the system: If it is very high risk activities and if there is no any control measure to reduce the risk from higher level, then the system need to terminate.

# Chapter-9: Conclusions and Recommendations

## 9.1 Conclusion:

The safety (accident prevention) program that is described here has five basic steps. These are given below:

- **Step-1**: top line operating management made a commitment (policy) to increase safety awareness and saw that their position was disseminated downward throughout the organization.
- **Step-2**: accountability for safe work sites and practices was put in place and non-responsiveness was not negotiable.
- **Step-3**: management took on the responsibility of training employees to work safely and employees accepted the responsibility for both themselves and their co-workers.
- **Step-4**: participation in every aspect of the safety program became a goal that was required from top to bottom in the organization.
- **Step-5**: all levels in the company were made aware of the necessary element of compliance with all applicable local, state and federal regulations thereby insuring that the steps for compliance were in place.

The five "basic" steps those already mentioned above were supplemented by support components. These included:

1. Position descriptions for each job on the work site.
2. The requirement of employees to read the safety manual prior to starting work.
3. A set of work rules providing parameters of employee conduct.
4. A contraband policy.
5. A hazard communication plan that includes additional training.
6. Inspections by qualified in-house safety personnel, qualified insurance loss control personnel, Toolpushers and Drilling Superintendents.
7. An awards program.

In addition to these seven supporting components, a totally separate program of environmental compliance was developed, with a detailed chemical reporting and waste management plan for yards and drill sites. This will continue to raise employee's safety consciousness and further enhance accident prevention efforts.

Another solid performance measure has been the positive response received from customers as the program's effectiveness is seen from their view-point of reduced liability. Finally, the single most important key to the program was the very first basic step mentioned, that of top line operating management's commitment to accident prevention. It is the most fundamental element for success and therefore the most necessary.

**9.2 Recommendations:** In order to develop the Health, Safety and Environment (HSE) culture in the industries in Bangladesh, Following recommendations should be follow:

- Safety should become everyone's responsibility, not just the safety director's. It becomes a value of the organization and is an integral part of operations
- The company's safety policy, program and mechanics for implementation must be communicated downward through the ranks to the lowest level in the organization

- ✪ The goals of health, safety and environment programs should include to fostering a safe and healthy work environment
- ✪ Everyone in the organization (workplace) should have a duty and a responsibility to do whatever they can to keep the working environment safe
- ✪ Each employee should required to read the safety manual and acknowledge by their signature
- ✪ Management and employees must be committed and involved in preventing losses
- ✪ HSE managers must identify and understand relevant HSE regulations, the implications of which must be communicated to top management (the board of directors) so the organization (company) will be able to implement suitable measures.
- ✪ Related professionals should be given extensive training national and international.
- ✪ Safety Orientation meeting/ training must be conducted for new hire and for contractor personnel
- ✪ Controlling occupational hazards would be the best way to protect workers from exposures. Occupational hazards should be controlled using a number of strategies by the company. Some control methods are better than others, but no single method of control can completely protect workers from hazards. If a hazard cannot be completely eliminated, then a combination of methods should be used by the organization to reduce hazards to "safe" levels (levels that will not place workers' health at risk).
- ✪ Personal protective equipment, such as respirators, protective suits and ear muffs, hand glove, safety shoe must be thought of as providing a back-up for other techniques (engineering control) that are designed to control hazards at the source.
- ✪ Providing the truly safe work environment is a never ending objective for employer and employee alike. That's why the best Injury and Illness Prevention Programs (incident investigation & prevention and share) should be consider and involve every level of the organization, instilling a safety culture that reduces accidents for workers and improves the bottom line for managers. When injury and illness prevention are part of the organization and a way of life, everyone wins.
- ✪ Safety for people, communities and the environment as well as for natural's resources should be taken as a priority basis on every project by the company. Company also should be committed to providing Health & Safety Services and Support as well as assisting with implementing dynamic and robust HSE programs ( like-Job Safety Analysis, Hazard analysis, Risk Analysis e.t.c ), cultivating an organizational and proactive culture committed to superior HSE performance.
- ✪ Completing a comprehensive plan for handling emergencies is a major step toward preventing disasters. Exercises and drills must be conducted to practice all or critical portions (such as evacuation) of the plan. A thorough and immediate review after each exercise, drill, or after an actual emergency must be point out areas that require improvement then company should be maintain communication, training, and periodic drills to ensure adequate performance when the plan must be implemented. Knowledge of individual responsibilities must be evaluated through paper tests or interviews.
- ✪ At the planning stage, it is important that several groups need to be asked to participate for emergency planning. Among these groups, the health and safety committee must provide valuable input and a means of wider worker involvement. Appropriate municipal officials should also be consulted as control may be exercised by the local government during major emergencies and additional resources must be available. Periodic drills must be maintained for ensuring adequate performance for controlling emergency situation when actual one (if any) will occurs.
- ✪ The plan should be revised when shortcomings have become known, and should be reviewed at least annually. Company key personnel must be responsible changes in plant infrastructure, processes, materials used and for updating the emergency plan according to necessary.

- ✪ Organization (employer) must take responsibility for establishing Lockout/ Tag out (LOTO) standard (also, review and update) in their area of operation to protect workers from hazardous energy by ensuring zero energy state on system. Employers are also required to train each worker for ensuring that they know, understand, purpose and function of the energy control program and will have the knowledge and skills required for the safe application, usage and removal of the energy control devices.
- ✪ Employer must establish Hot work standard, if hot work it necessary in the organization, and be ensuring (aware) that this standard will protect people, property (natural resource), and environment.
- ✪ Hot work areas must always be monitored for flammable gases before hot work is performed, and for that purpose at least one well-trained fire watch must be posted in each hot work area. Who must be trained in using fire-extinguishing equipment, including "hands on" practice with training fires . Also they must be trained in the facility's emergency procedures (i.e., sounding an alarm, evacuation routes, etc.) as outlined in the plant's written emergency response plan.
- ✪ The risk level of the Musculoskeletal Disorders (MSDs) of the loading and unloading worker probability must be reduced by providing a continuous training and sharing knowledge. There is no evidence to support use of advice or training in working techniques with or without lifting equipment for preventing back pain or consequent disability.
- ✪ Every individual must be learn how to prevent manual material handling (MMH) injuries from workplace by developing the skills needed to identify and control risk factors associated with work.
- ✪ Workers who often required to entering confined spaces such as petroleum and other storage tanks, mud pits, reserve pits and other excavated areas, sand storage containers, and other confined spaces around a wellhead must be trained on confined space entry standard.
- ✪ Confined spaces that contain or have the potential to contain a serious atmospheric hazard must be classified as permit-required confined spaces, tested prior to entry, and continuously monitored. According to OSHA and NIOSH documents Petroleum Company should provide guidance on recognizing and controlling all hazards.
- ✪ To effectively control the risks associated with working in a confined space, a Confined Space Hazard Assessment and Control Program must be implemented for any workplace. Before putting together this program, make sure to review the specific regulations that apply to the workplace. All Petroleum company must have regulations dealing with confined space entry.
- ✪ Workers with emergency rescue responsibilities must need additional specialized training. All confined space training should include some hands-on training with the safety equipment including the personal protective equipment and safety harnesses. Rescue procedures should be practiced frequently so there would be a high level of proficiency. Employers must keep records of all confined spaces training including refresher courses.
- ✪ Employees and employers must be take responsibility to work together to establish safe working procedures (Refer to the Hand and Portable Tool Information Sheet). If company don't have Tool safety policy in place could face fines from OSHA and endure a possible lawsuit.
- ✪ According to OSHA (Occupational Health and Safety Administration) and NFPA (National Fire Protection Association) standards, recommendations and advice for non-sparking tools need to be use for protection against fires and explosions in environments where there is a concern about sparks igniting flammable solvents, vapors, liquids, dusts or residues.
- ✪ Employee (People) should not rely on PPE alone for the protection against hazards. As PPE does not reduce the hazard itself nor does it guarantee for permanent or total protection, but if accident happen in that case just reduce the severity. Using PPE is only one element in a complete safety

program that would use a variety of strategies to maintain a safe and healthy occupational environment. Need to Use PPE in conjunction with Engineering Control, Administrative Control, and Safe Work Practices.

- ✪ Employer must required to provide workers with appropriate PPE
- ✪ It's all workers' responsibility to use PPE at all time during work; PPE is a must, not an option.
- ✪ The risk of spills in the oil and gas and also other chemical industries rises many planning and policy issues, that's why, it is very important to develop policy and planning by the organization, aimed at reducing the likelihood of oil spills, chemical spill, providing effective emergency response, and facilitating recovery.
- ✪ Knowing how to handle accidental chemical spills and leaks safely is as important as knowing how to use the material correctly. Individuals using or distributing hazardous chemicals must be responsible to protect the public and the environment.
- ✪ Discharge of chemical substances into waterways also must be reported to the countries environmental Department under the authority of the Clean Water Act.
- ✪ Disposal of all hazardous wastes generated by the cleanup must be done in strict accordance with countries Environmental Conservation and Recovery Act laws.
- ✪ Vehicle operators must be trained in basic emergency response procedures and must have product labels and MSDSs in the vehicle for transporting any type of chemical.
- ✪ Toolbox talk should often describe as short, informal training conducted at a worksite by technically competent persons for the benefit of a work team.
- ✪ Toolbox talk must be used to share safety information. Toolbox Talk requires preparation, active participation, and follow-up, but it should stimulate attention to everyone's health and safety.
- ✪ End tool box talk meeting on a positive note by summing up the key points that are outlined on presenter copy of the talk, along with any further action that will be taken as a result of the safety meeting. Remember to thank the participants for their involvement.
- ✪ It is recommended that toolbox talk must be perform before starting the job at work location regularly and also the series of Tool Box Talks relevant to company operation need to be delivered during Safety Week and repeated as necessary in accordance with the relevance of the risk to company work location.
- ✪ Safety orientations should provide an awareness level understanding of work hazards and may not fulfill training requirements, as prescribed by regulations, industry or company standards
- ✪ Supervisors are the key personnel in both production and occupational safety and health. They must be responsible for actions taken within their area of influence and held accountable by company for the results within their area.
- ✪ Supervisors must be responsible to ensure that work procedures will followed in a manner compatible with the safety and health of employees.
- ✪ Soon after the orientation sessions, employees should be assessed on their understanding of the items discussed. In this way, both the quality of training and the level of understanding can be evaluated.
- ✪ Challenge should be taken by the company to create an exciting, rewarding, and manageable first few days for all new employees.
- ✪ Employees, supervisors, maintenance individuals, fire wardens, trained fire watch individuals, and contractors all have different roles, and must be trained accordingly
- ✪ Training is the backbone for ensuring incident free operation. For management to lead, for personnel to analyze the worksite for hazards, and for hazards to be eliminated or controlled, everyone involved must be trained. The scope of the training must be determined by size and complexity of the worksite and the hazards involved.

- For controlling HSE related issue (Blow out, rig disaster, oil spill etc) as well as for safely extracting and Transporting oil and gas without incident, Bangladesh government should take initiative for established a safety regulatory Board under Ministry of Power, Energy and Mineral Resources (MPEMR) like Oil Industry Safety Directorate (OISD) for India which is under (Ministry of Petroleum and Natural Gas), Similarly Occupational Safety and Health Administration (OSHA) for U.S.A which is under (United States Department of Labor) , Occupational Safety and Health (OHS) for Canada, Health and Safety Executive (HSE) for U.K. If not possible to establish safety regulatory Board or until established our own safety regulatory board Bangladesh government as well as petroleum and other industrial organization can be used any one of OISD, OSHA, OSH, or HSE with some adjustment for our own culture and environment as well as geological and geophysical settings

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