UNIT-I

INTRODUCTION TO THE DEVELOPMENT OF INDUSTRIAL SAFETY AND MANAGEMENT

History and development of Industrial safety:

Industrial safety in the United States as we know it today did not begin to take shape until the early 20th century. Before that, many risked their lives daily going to work in industrial settings that included mines, construction, mills and manufacturing. In today's world, work safety statistics are usually measured by the number of injuries or deaths that take place yearly. Prior to 1900 these type of statistics are hard to come by, in part because it appeared that no one cared enough to make tracking on-the-job injuries and deaths a priority.

19th Century Bleakness:

There is little doubt that workers faced new and unprecedented dangers when the industrial revolution arrived on U.S. shores. American entrepreneurs developed labor-saving devices and machinery that, albeit profitable and highly productive, were often very dangerous. Workplace accidents did not impact the bottom line, since the only legal recourse for victims was suing the company. Those that went to court rarely won their case, and thus made work safety an unprofitable venture for many industrialists of the timeMining, train transportation and manufacturing were probably the most hazardous occupations of the time, and workers responded by taking out insurance policies to cover themselves in the case of a death or an accident, or by leaving a job altogether. This resulted in companies paying higher wages for jobs that were deemed more dangerous.

Public Efforts Lead to Improvements:

Federal safety regulation traces its birth to the creation of the Food and Drug Administration (FDA), and the Bureau of Mines, both which occurred prior to the United States' entry into World War I. Thanks in part to news coverage, the efforts of labor unions and some more progressive business men, the issue of work safety came to the forefront.

Unions representing trainmen campaigned for equipment improvements to ensure train and freight cart safety, and in 1910 the Bureau of Mines was established to identify new ways to make mines safer after a series of dangerous mine explosions.

Workman's Compensation is Born:

Congress passed a federal employers' liability law in 1908 that made it more expensive for companies to have an accident on their books. The law applied to railroad workers in interstate commerce, and made it harder for companies to claim that the employee was partially responsible for an injury. Thanks to the new law, worker injuries that once cost companies $200 to resolve now cost almost $2,000.

In 1910, the state of New York created a workmen's compensation law that forced companies to automatically compensate for workplace injuries (eliminating the need for families to take corporations to court). By 1921, 43 more states had followed New York's lead and established their own compensation laws.

Employers Take Action:

Compensation laws and other liability costs suddenly made workplace injuries an expensive proposition for many employers. What followed was a slow but steady increase in workplace safety. Large firms in railroading, mining and manufacturing suddenly became interested in safety. Manufacturing companies began to work to create safer equipment, and managers in many industries began getting tasked with identifying workplace dangers. In mining and construction, for instance, workers began to wear safety glasses and hard hats.

In 1913 the National Safety Council was formed by a group of business owners to pool shared knowledge, and to apply the information gathered through national agencies like the Bureau of Mines.

Between World Wars I and II accidents in the workplace declined at an uneven rate, and it should be noted that during times of economic boom safety law enforcement tended to take a back seat.

Post World War II to the Present:

The Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration were established in 1970. In addition worker's unions became more powerful than ever after World War II, and made work safety a priority.

Safety in the workplace remains a top concern for most U.S. industries---which must follow OSHA rules as well as rules and regulations established by other safety councils within specific industries. Workplace injury has steadily declined since World War I, and today meticulous records are kept of every injury, illness or fatality that occurs in a workplace.

IMPLEMENTATION OF FACTORIES ACT:

The Factories Act, 1948 (Act No. 63 of 1948), as amended by the Factories (Amendment) Act, 1987 (Act 20 of 1987), served to assist in formulating national policies in India with respect to occupational safety and health in factories and docks in India. It dealt with various problems concerning safety, health, efficiency and well-being of the persons at work places. It was replaced by the Occupational Safety, Health and Working Conditions Code, 2020.

The Act is administered by the Ministry of Labour and Employment in India through its Directorate General Factory Advice Service & Labour Institutes (DGFASLI) and by the State Governments through their factory inspectorates. DGFASLI advises the Central and State

Governments on administration of the Factories Act and coordinating the factory inspection services in the States.

The Act is applicable to any factory using power & employing 10 or more workers and if not using power, employing 20 or more workers on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so carried on, or whereon twenty or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on without the aid of power, or is ordinarily so carried on; but this does not include a mine, or a mobile unit belonging to the armed forces of the union, a railway running shed or a hotel, restaurant or eating place.

SAFETY AND PRODUCTIVITY:

In the world of manufacturing and construction, safety, quality, and productivity are inextricably linked. It's impossible to sacrifice one without sacrificing the others. When organizations put better care into maintaining their safety, quality, and productivity, they are also better able to serve their customers and protect their employees. Let's explore the relationship between these three important pillars of a strong, sustainable business.

The Three Pillars: Safety, Quality, and Productivity

Too often, businesses will see safety, quality, and productivity as interfering with each other, while they actually operate in concert. Organizations must not think of safety as a nuisance, but rather as an incredibly important component to business success.

Safety improves quality and productivity. When operations are unsafe, they aren't well-managed. Employees will not be motivated nor mindful, and employee churn will be far greater. Quality and productivity both suffer when employees are under stress, unsatisfied, or unable to complete their mission. But when businesses are safe, it frees up employees to focus on their quality and their productivity. The safer the organization is, the less frequently the organization will experience large scale disruption.

Quality improves safety and productivity. Safety is a measure of conscientiousness and proactiveness. High quality work means better results and better products. The higher quality the work, the fewer re-works are needed, and the greater overall productivity is. When quality is high for a business, it can be assumed that standards for the business are generally high, including safety equipment, safety software, and safety processes.

Productivity improves safety and quality. Carelessness is often what begets safety issues. With the appropriate (and productive) safety processes, safety can be improved, and quality can be improved as well. The more productive employees are, the less likely they are to cut corners on things like safety processes. The more productive they are, the more likely they are to put extra attention into the quality of their work.

As you can see, all three of these pillars really rely upon each other to improve upon the organization's outcomes. When one pillar falls, the others follow. But when one pillar is strong, it strengthens the entire business. Companies need to take a look at their safety, quality, and productivity, so they can explore where they may be falling short, and where their business may be destabilized.

Traditional Barriers to Safety, Quality, and Productivity

It's easy to see that safety improves business outcomes. Dangerous operations lead to lost time, injured employees, and a loss of morale. Nevertheless, many organizations fear that additional safety processes can take time and money. While true, it's time and money well spent; it's better to spend a small amount for preventative care than a large amount for an emergency.

In terms of quality, the primary issue is often expediency. Companies may feel they have to choose between fast, cheap, or high-quality. When companies are forced to reduce costs (cheap) and produce quickly (fast) they need to sacrifice quality. But sacrificing quality actually ends up driving up time and costs; unsatisfied customers demand reworks, which can often be upwards of three times the original budget.

Finally, productivity must never be seen to be at odds with safety or quality. Organizations may feel that safety and productivity are mutually exclusive, and that it's difficult to maintain a productive office with increased regulation and safety processes. However, the opposite is true; it's impossible for employees to remain productive in a dangerous environment.

Creating a Solid Foundation for Your Organization

How can businesses create a solid foundation for safety, quality, and productivity? It begins with company culture. Employers need to foster a company culture that values all these things, and it all begins with safety. Safety is essential to a business. A business can always improve upon the quality of its products and the productivity of its employees. But a business that is dangerous and unsafe can establish a negative reputation that will follow it forever.

In addition to company culture, employers should embrace new business processes and business technology. Safety management software can be used to improve upon incident reporting and provide better real-time visibility, making it easier for companies to ensure that their employees are following enhanced safety protocols, and that any safety issues are being properly and expediently addressed.It isn't always easy for an employer to improve their organization from the ground up, especially if it requires sweeping or structural changes. But when it comes to safety, it's critical. Learn how Anvl can help you gain real-time visibility and ensure process compliance to identify defects early and gain valuable data insights to drive continuous improvement.

SAFETY ORGANIZATIONS:

World Safety Organization National Office for India established since 2016. Our operational principles are fully aligned with the World Safety Organization Management Center in USA. WSO Management Center has dedicated Representatives in the United Nations in New York, Geneva and Vienna.

We are operating this office under the rules, regulation and bylaws of the WSO Management Center in the US.

Our goals are to make awareness each and every individual in the field of Occupational Health, Safety & Environmental

Our aim is to provide enhanced health and safety information together with a pragmatic approach in developing solutions, which enables employers and organizations to maintain the health, safety and welfare of all employees and members of the public, who may be at risk from their activities or undertakings.

WSO National Office for India has a team of national and international occupational safety health and environment professionals who have academic knowledge and many years of practical experience in risk management and loss prevention controls fields.

The World Safety Organization (WSO) was founded in 1975 as a result of an international conference, organized by the Safety Organization of the Philippines Inc. (SOPI), in Manila, Philippines. There were over 1,ooo delegates from over 20 countries represented at that conference (Thailand, USA, Japan, Australia, China, Iran, Singapore, Spain, Nigeria, Sweden, Iraq, Turkey, Yugoslavia, Papua New Quinea, Philippines, Hong Kong, and others). On that occasion the conference delegates agreed on the need for an international exchange of information, programs, new research methods, and data, in the areas of safety, environment, and all associated fields.

Dr. Emiliano Camarillo, one of the SOPI's board members, was the Chairman of the above conference and later was confirmed as the first WSO President-Director General. The charter members of the WSO Board of Directors were representatives from all continents.

1975

In 1975 the WSO was incorporated as a not-for-profit, non-governmental, non-religious, civic entity in the Philippines, and started to work with safety professionals around the world on the promotion of the organization, development of programs, etc. Conferences, seminars, congresses, and small classes/courses were given through the years in the Pacific Rim Countries. The purpose of the organization was to protect people, property, resources, and the environment; to promote safety; and, of course, to work toward the goal to "Make Safety a Way of Life."

During the first 10 years of the operation, approximately 7,000 WSO individual memberships were awarded. There were no services/benefits provided at that time for the WSO members. A single issue of the World Safety Journal was published in 1984 for attendees of the conference held in Manila, Philippines. Based on the information provided by Dr. Camarillo, there were no "renewals of membership" requested from the WSO members. Funds for the office operation were provided from the successful conferences and seminars.

1985

In 1985 Dr. Glenn E. Hudson, at that time a private consultant (loss control) and a retiree from the U.S. military service after 28 plus years, participated at the Asian Safety Educational Conference organized in Manila, Philippines. During that visit the WSO Board of Directors nominated Dr. Hudson, and later confirmed him, as a Chairman of the WSO Certification Board.

The first WSO Certification Board was established in 1975, but only the general program outline was completed under the pro-term chairmanship of Dr. Frederic Baldwin.

In 1985 the WSO Certification Board was fully established under the leadership of Dr. Hudson as the Chairman of the WSO Certification Board, incorporated as the Missouri not-for-profit corporation.

When the WSO certification program was transferred to the U.S.A., the complete operation of the WSO had to be brought up to standards of other professional organizations as they exist in industrialized countries. Membership brochures were designed and published, members of the certification board were appointed and confirmed, certification standards and requirements were designed, and the certification program was completed and presented to the professionals and practitioners in the fields of safety, environment, security, public health, transportation, construction, and all of the allied disciplines which the WSO brings together. The WSO Certification programs are being periodically reviewed and updated to incorporate all of the changing needs of the safety, environmental, and occupational community.

To further increase promotion of the WSO program and to achieve better contact with the new members, the WSO began to publish the WSO News-Letter, WSO Tech-Letter, and the World Safety Journal.

1986

During the 1986 conference in Manila, Philippines, Dr. Camarillo, who wished to retire, nominated Dr. Hudson to the position of the Vice President-Deputy Director General. Dr. Hudson would take over the leadership of the organization in 1987 during the 4th World Safety and Accident Prevention Congress, which was held in Anaheim, California.

WSO World Management Center was established in the U.S.A. to assist with the administrative management of the organization under the leadership of the Chief Executive Officer.

1987

In 1987 the WSO received the Consultative Status, Category II (non-governmental), with the Economic and Social Council of the United Nations. At that time, 157 Missions of the United Nations were awarded Honorary Membership in the WSO for their support of the WSO programs.

In 1987 the first WSO Division was established in the transportation safety field, comprised of the Maritime, Highway, Rail, and Aviation Committees. At present, there are three WSO Divisions, several committees, numerous chapters, and national offices throughout the world.

1988

To insure the undisturbed continuity of programs and unified leadership, the complete administration of the organization was moved to the U.S.A., first to Doniphan, Missouri, and then in 1988 to Warrensburg, Missouri. As there was not enough support for the international administration in the rural area of Southeast Missouri, Warrensburg, with its proximity to Kansas City, was selected.

Programs developed in the following years, including member networking, promotion of new programs, support in establishment of new safety groups, international and national conferences, chapters and divisions/committees, and national offices.

1989

In 1989 the new WSO Board of Directors was confirmed and the Board's first meeting was in Warrensburg, Missouri, during the WSO Regional Conference for Americas. At that time Dr. Hudson accepted another term of the presidency of the WSO, but a change was included in the WSO By-Laws and Constitution to limit the re-appointment of the WSO President-Director General to three consecutive terms. Some other changes were confirmed as well. Possibly the most important change was the change of operation in the Philippines to the WSO Philippine Islands Chapter. There was no apparent benefit to keep the operation in the Philippines as part of the administrative body, as the economical, political, and staffing problems would be eliminated by changing the operation into the operation of the Chapter. More recently, the WSO Philippine Island Chapter was re-assigned as the WSO International Office for the Philippines.

1990 to present

There are now several thousands of national and international companies, corporations, and other entities, which have received the WSO Honorary Membership for the support they provide for their employees by paying their WSO dues. There are also several organizations holding the "WSO Organizational Membership" in the WSO, which, together with the "WSO Institutional Membership," brings to the WSO universities and research institutes, national

and international associations, societies, organizations, and covers additional scores of members.

WSO-sponsored programs are the International Accrediting Commission for Safety and Environmental Education and Training, Inc., and the World Institute for Safety Education and Research.

The WSO has set up offices, recruited personnel, and provides facilities to pool technological and methodological knowledge in the health, safety, environmental, and accident prevention fields worldwide in order to share this wealth of information.

The WSO is undergoing a strong growth period. With individual referrals and recommendations from the WSO members, there is a continuous growth of the membership and a pool of professionals seeking the WSO certifications. One of the latest WSO programs is directed toward professionals seeking the WSO certifications, and toward the new generations of the professionals and practitioners of safety and accident prevention: the students of the safety and environmental programs of various universities in the U.S.A and other countries.

The WSO's purpose is to internationalize all safety fields including occupational and environmental safety & health, accident prevention movement, etc., and to disseminate throughout the world the practices, skills, arts, and technologies of the safety and accident prevention fields.

CODE OF ETHICS

Members of the WSO, by virtue of their acceptance of membership in the WSO, are bound to the following Code of Ethics regarding their activities associated with the WSO:

Members must be responsible for ethical and professional conduct in relationships with clients, employers, associates, and the public.

Members must be responsible for professional competence in performance of all their professional activities.

Members must be responsible for the protection of professional interest, reputation, and good name of any deserving WSO member or member of other professional organization involved in safety or associated disciplines.

Members must be dedicated to professional development of new members in the safety profession and associated disciplines.

Members must be responsible for their complete sincerity in professional service to the world.

Members must be responsible for continuing improvement and development of professional competencies in safety and associated disciplines.

Members must be responsible for their professional efforts to support the WSO motto, "Making Safety a Way of Life…Worldwide."

Any individual, member, officer, employee, or representative of any outside agency/organization may file a complaint against any member, officer, or employee of the WSO. Once a complaint has been filed, a thorough and confidential investigation will be completed by the Ethics Committee Chairman. If the charges are found to be true, the punishment shall range from:

- Informal counseling by a member of the WSO Executive Action Committee;
- Formal counseling by a member of the WSO Executive Action Committee;
- Written letter of Admonition placed in the member's file for one year;
- Written letter of Counseling placed in the member's file for one year;
- Written letter of Reprimand placed in the member's file for one year;
- Written letter of Reprimand placed permanently in the member's file;
- Individual being placed on a formal probation that could result in removal from the WSO and suspension and/or revocation of membership and credential privileges;
- Permanent disbarment from the roles of WSO and revocation of credentials.

SAFETY COMMITTEES AND STRUCTURE:

Safety committees range in size and structure based on the organization's number of employees, worksites and hazards present, but certain arrangements have been found to be more effective. According to a 2008 study published in the journal New Solutions (Vol. 18, No. 4), organizations that had safety committees made up of more hourly workers than managers had lower injury and illness rates. Researchers also found that organizations with a higher percentage of their workforce on safety committees had better rates.

The Maine Department of Labor states that ideal safety committees have representation from all departments and shifts, as well as from both management and the labor force.

Ben Bloom is safety consultant principal for Minnesota OSHA. Bloom said many organizations that participate in the Minnesota STAR (MNSTAR) program – which recognizes organizations with safety and health systems that go above and beyond OSHA requirements – have multiple safety committees. Some organizations assign a committee to each area in the facility, such as the warehouse, production area and offices. Having multiple committees is a great way to involve more workers in an organization's safety and health efforts, but clear guidelines or a centralized committee must be established to help prevent potential overlap, Bloom said.

Effective task delegation by a centralized committee allows a subcommittee to allocate more time and effort to a specific workplace problem. Dave Ferkul, workplace safety consultation supervisor for Minnesota OSHA, spoke of a nursing home that established multiple subcommittees to address specific issues related to staff and resident safety. One subcommittee focused on safe patient-handling equipment, and for fresh ideas they visited

other nursing homes to seek out examples of alternative equipment. The subcommittee reported its findings to the central safety committee, with upper management present, and a resulting investment in new equipment reduced workplace injuries, Ferkul said.

Committee leaders and member participation

An effective committee leader can facilitate a meeting without dominating it or allowing someone else to do so, Ferkul said. Instead of dictating how a discussion should proceed – which is not conducive to member participation and feedback – committee chairs should focus on encouraging participation among all members, he added.

Effective committee heads also should establish basic ground rules and ensure meetings do not get out of control. Rick Long, safety lead of the Dillard, OR-based Roseburg Forest Products' Dillard Plywood Division, described how his company used detailed agendas and time limits to turn around its approach to committee meetings.

In the late 1990s, safety committee meetings at the company usually became shouting matches between labor and management representatives, and would sometimes last four or more hours, Long said. In 1999, the company's approach to safety committees evolved: Overly lengthy, unstructured meetings were replaced by streamlined meetings lasting one hour or less. Safety committee chairs were voted in by hourly employees and given control over each meeting's agenda. Committee members also began voting on a written charter and flow-chart featuring each member and their responsibilities.

"Basically, we learned how to use agendas, how to stay on track and stay on time," Long said. "If there was an outstanding issue we couldn't agree on, we learned to 'put them in the parking lot' and revisit [at] the next meeting."

As a result, he said, employees and management feel they have equal say when it comes to safety, he said. "Everyone has a voice and is allowed to speak it, as long as they do it respectfully."

Enthusiasm:

Safety committees may struggle with maintaining member enthusiasm over time. Tim Morse, professor emeritus for the University of Connecticut Health Center in Farmington, recommends the following techniques to prevent or address committee member burnout:

- Rotate the committee's focus among a variety of topics, such as ergonomics for a period of time, followed by chemical hazard reduction, and so on.
- Bring in new committee members when the committee becomes stale. Also, periodically invite non-committee front-line workers to participate in a meeting and discuss any day-to-day hazards they encounter.
- Invite safety committees from similar organizations to visit and help identify hazards.

Management support:

Tim Morse, professor emeritus for the University of Connecticut Health Center in Farmington, co-authored a report published in 2013 in the American Journal of Industrial Medicine (Vol. 56, No. 2) that looked at common characteristics of effective safety committees. Researchers found that committees that made a meaningful impact on workplace safety had clear and visible upper management support. This allowed committees to secure funding or support to quickly address a safety hazard, another key trait of effective committees, Morse said. In addition, "larger committees are generally beneficial for both detecting problems and getting reality-based solutions," he said.

Management participation in meetings is important for the committee to make realistic decisions and recommendations, Ferkul said. Committee members need to see that their recommendations have an effect on workplace safety, and if too many are too costly or are never used, committee members' enthusiasm may decrease, he said.

Uncommunicative or unsupportive management reduces the effectiveness of committees, Bloom said. He remembers one worksite with a safety committee that did not receive updates from management on whether an identified safety hazard was being addressed. Management actually was making changes based on the recommendations, but lack of communication made the safety committee members feel as though their efforts were not valued, he said.

When employees see that safety is important to management, this can have a positive effect on their own safety values, said Ryan Nosan, state program administrative director for Minnesota OSHA. Management also can help stagnant safety committees make a turnaround.

"Effective support from upper management goes a long way," Nosan said. "Seeing management in attendance and active participants in the safety committee's activities is a powerful tool."

Committees and safety culture:

Safety professionals can benefit in many ways from the information generated from a committee containing front-line employees. However, Hurliman advised against safety professionals taking too active of a role. "[That] takes away the creativity of the group," he said. "You really want to let [employees] step forward." Instead, he said, safety professionals should behave more as a coach and resource to the group.

Nosan recalled a worksite that initiated a committee-led behavior-based safety program. A safety supervisor attended the meetings to help coordinate management support, but otherwise the committee was entirely employee-led. The enthusiasm of the group led to significant ergonomics-related changes throughout the facility, he said.

For safety professionals struggling to establish a safety culture at their organization, safety committees can help, Hurliman said.

"Employee involvement is how employers can get their safety cultures to be bought into. How they really make a lasting impact in safety and health is by getting people involved," he said. "Some of the things I have seen safety committees do have been just incredible, because the employer is allowing the employees to start driving aspects of the safety programs. Once that happens, I tell employers, 'Hang on, you're going for a ride. They're going to take you to places you didn't believe you could get to.'"

Selection of state safety committee requirements:

The table below is a selection of states that, at press time, require some type of safety committee, and a summary of the state's requirements. Please view the associated links for more detailed information on a state's requirements.

In addition to this list, states not included may have mandatory safety committee requirements for certain industries, sectors or organizations using specific work processes. These states also may offer incentives such as reduced workers' compensation premiums or reduced violation penalties.

To ensure your organization is compliant with your state's safety committee requirements, contact your Department of Labor, local OSHA office, workers' compensation board or other applicable agency.

ROLE OF GOVT. IN INDUSTRIAL SAFETY:

There are plenty of good reasons why any business would want to maintain a safe workplace. Other than the basic human desire to avoid pain and suffering, workplace accidents can destroy your business!

Thousands of Americans are killed each year in on-the-job accidents, and many more suffer work-related disabilities or contract occupational illnesses. Some of the high monetary costs attached to workplace accidents include:

- the inability to meet your obligations to customers
- wages paid to sick and disabled workers
- wages paid to substitute employees
- damaged equipment repair costs
- insurance claims
- workers' compensation claims
- administrative and recordkeeping costs

In addition, while both humanitarian desires and economic good sense have encouraged employers to create and maintain safer and healthier working conditions, employees, unions, and government agencies have applied pressure for greater efforts.

Federal Occupational Safety and Health Administration (OSHA) regulations govern workplace safety and no matter what business you are in, you should know and comply with the rules that apply to that business. General rules apply to just about any business and fines and penalties for violations can be severe!

Once you understand the government's role in regulating workplace safety, familiarize yourself with major workplace safety issues, including newer types of risks, such as workplace automation hazards, AIDS and biohazards, that your business may have to deal with.

With the necessary knowledge of your responsibilities and the safety issues involved, you can then access available resources to develop and document a safety program and train your employees to avoid workplace accidents.

The Occupational Safety and Health Act (OSHA)

Your legal obligations to provide a safe work environment for your employees arise primarily from a federal law known as the Occupational Safety and Health Act (OSH Act). OSHA was enacted in 1970 to address the uneven patchwork of state laws regarding workplace safety, and to respond to the growing number of serious injuries and deaths occurring in the workplace. OSHA is administered by the Department of Labor under the direction of the Assistant Secretary of Labor for Occupational Safety and Health.

Absent an accident, a small business owner isn't likely to be visited by federal health and safety inspectors very often, if at all. Unfortunately, if an accident does occur and you're found to be in violation of applicable safety rules, the consequences of the accident can be compounded. Not only must you bear the consequences of the accident (such as being unable to meet your obligations to customers), you may also have to pay government fines and other costs. So, it's worthwhile to have a general understanding of the legal underpinning of the safety standards that apply to almost every employer:

- **All** businesses have a duty to comply with some general rules under what's called a general duty clause.
- **All** businesses must also comply with industry-specific requirements and guidelines, known collectively as OSHA standards.

State safety regulation: Although your safety obligations originate directly at the federal level, states have the right to develop their own standards under a federally approved state plan. The standards under a state plan may differ from federal OSHA regulations, but must be at least as effective as the federal standards. Some states have established and administer their own state plans for workplace safety. If your business is in a state that has a state plan, you must comply with it. If your state does not have a state plan, you must comply with federal OSHA laws. For more information about these plans, contact your particular state labor department.

Are You an Employer Subject to OSHA?

The Occupational Safety and Health Act is a comprehensive law — it covers most employers. Unless you are **sure** your business is exempt, you should assume that the law applies to you.

Generally, if you have employees, you are probably covered by OSHA. If you have none, you usually aren't covered, although in some cases businesses who use workers such as independent contractors are still subject to OSHA.

Specifically an employer under the Act is a person engaged in a business affecting commerce who has employees, but does not include the United States or any state or political subdivision of a State. You are probably subject to OSHA requirements if you:

- are in control of the actions of your employee
- have power over the employee
- are able to fire the employee

Some of the usual indications of an employment relationship, such as who pays the employee, are **not** part of the definition of an employer under OSHA. There are special circumstances if you are one of multiple employers or if you have workers other than employees.

Employers Exempt From the Act

There are some very specific exemptions to employers covered by the Act. The following employers are **not covered** by the OSH Act:

- self-employed persons
- farms at which only immediate members of the farmer's family are employed
- those whose working conditions are regulated by other federal agencies under other federal statutes (This includes most employment in mining, nuclear energy and nuclear weapons manufacture, and many segments of the transportation industries.)
- persons who employ others in their own homes to perform domestic services such as housecleaning and child care
- churches and nonsecular church activities
- states and political subdivisions (although some state plans cover public employees)
- employers not engaged in interstate commerce

UNIT II

Accident Preventions and Protective Equipment's

Accident Preventions, Protective Equipment's and the Acts:

Personal protective equipment, Survey the plant for locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Fire fighting equipment, Accident reporting, Investigations, Industrial psychology in accident prevention, Safety trials.

PERSONAL PROTECTIVE EQUIPMENT:

This section explains your obligations for providing personal protective equipment (PPE) to employees and different types of PPE available.

Personal Protective Equipment (PPE) is equipment that will protect the user against health or safety risks at work, this can include items such as

- safety helmets
- ear protection
- high visibility clothing
- safety footwear and safety harnesses
- thermal, weather and waterproof clothing
- respiratory protective equipment (RPE).

As an employer, it is important that you understand your responsibilities and take steps to keep your workers and members of the public safe.

You will need to know what PPE you need to provide and what training you need to provide to employeesto ensure that they use it correctly.

As an employee, you will need to understand your responsibilities for the use, storage and maintenance ofyour own PPE.

1. PPE legislation
2. When do I need to provide PPE
3. Training, maintenance and storage of PPE
4. Types of PPE
5. PPE and corona virus (COVID-19)

1.PPE legislation

The Personal Protective Equipment at Work Regulations 1992 seeks to ensure that where risks cannot becontrolled by other means PPE should be correctly identified and put into use.

Under the requirements of The Health and Safety at Work Act 1974 (external site), Employees will not be charged with or contribute to the provision and maintenance of PPE. If there is a need for PPE items they must be provided free of charge by the employer. The regulations do not apply where requirements are detailed in other regulations such as respirators in The Control of Substances Hazardous to Health Regulations 2002 (COSHH). Many other regulations have specific requirements for the

provision,maintenance and the use of PPE. Such as the regulations dealing with asbestos, noise or ionising radiation. This ensures that specific hazardsand their controls are dealt with by specific regulations.

Duties of employees regarding PPE

The Personal Protective Equipment at Work Regulations 1992 place duties on employees to takereasonable steps to ensure that the PPE provided is properly used.

The Regulations also place the following duties on employees.

- PPE must be worn and used in accordance with the instructions provided to them
- Employees must make sure that PPE is returned to the provided accommodation after use(unless the employee takes the PPE away from the workplace e.g. footwear or clothing).
- PPE should be returned to the appropriate storage unit (if applicable) after use, unless theemployee takes their PPE home, for example footwear or clothing.
- PPE must be visually examined before use.
- Any loss or obvious defect must be immediately reported to their line manager.
- Employees must take reasonable care of any PPE provided to them and not carry out anymaintenance unless trained and authorized.

2.When do I need to provide PPE

PPE should always be your last resort to manage workplace risks. This is a legal requirement.

While risk assessing work activities you need to think of different control measures before moving to ask employees to wear PPE. When deciding what precaution that you are going to introduce in the workplace you can work through the 'hierarchy of controls'. It aims to minimize or prevent workplace hazards.

2.1.Hierarchy of controls

The controls in the hierarchy are in order of decreasing effectiveness, you should always follow this order.

1. Elimination - Physically remove the hazard, for example use a mechanical aid instead of manual handling.
2. Substitution - Replace the hazard with something less dangerous, for example by using aless hazardous chemical.
3. Engineering Controls - Isolate the employees from the hazard, such as noise zones or barriers.
4. Administrative Controls - Change or train the way people work, for example by reducing the exposure to vibration by rotating employees.
5. PPE - Protect the worker with personal protective equipment.

These are some of the reasons why PPE must be considered as a last resort.

- PPE only protects the person wearing it, whereas measures controlling the risk at source

protectseveryone in the workplace.

- It is hard to assess the level of protection provided by PPE because it depends on how it fits theindividual and if it is maintained and used correctly.
- PPE may restrict the user to some extent by limiting mobility or visibility, or by requiringadditional weight to be carried. Thus creating additional hazards.

2.2.Assessing and choosing PPE

The need for PPE must be identified through Risk Assessment; it should not be a one size fits all approach. The protective equipment should be personal to the individual user and be suitable and fit for purpose.

All personal protective equipment must be 'C E' Marked (external site). The C E mark signifies that the PPE satisfies certain basic/minimum safety requirements. To establish if your employees need to wear PPE you can carry out a risk assessment. Training, maintenance and storage of PPE

3.Information, Instruction and Training (IIT) on PPE usage

When PPE is provided it's required that all employees receive the correct information, instructions and training on its use and show how the equipment should be maintained,cleaned and disposed of.

The extent of the information, instruction and training will vary with the complexity and the performance of the kit, for example a full breathing apparatus will require more training to useproperly than a disposable face mask.

In addition to initial training, refresher training may be required from time to time.

Supervisor checks on the use of the PPE may help determine when refresher training is needed.

You can use this form to create a record of the induction and training programme for staff whoare new to their job.

3.1.What should PPE information and instruction cover?

1. The risks present and why PPE is needed.
2. The operation (including a demonstration), performance and limitations of the equipment.
3. Use and storage (including how to put it on, how to adjust it and remove it).
4. Any testing requirements before use.
5. Any user maintenance that can be carried out (e.g. hygiene, cleaning, procedures).
6. Factors that can affect the performance of the equipment (e.g. working conditions personal factors, defects and damage).
7. How to recognise defects in PPE and arrangements for reporting them.
8. Where to get replacement PPE.

3.2.Maintaining PPE

An effective system of maintenance of PPE is essential to make sure the equipment continues to provide the degree of protection for which it is designed for. Therefore the manufacturer's maintenance schedule (including recommended replacement periods and shelve life) must alwaysbe followed.

Maintenance may include, cleaning, examination, replacement, repair and testing. The user may be able to carry out simple maintenance but more intricate repairs must be carried out by a competent person.

3.3.Storage of PPE

You need to ensure that adequate storage facilities are provided when PPE is not in use unless the employee can take the PPE away from the workplace (e.g. footwear or clothing).

The storage should be adequate to protect the PPE from contamination, loss, damage, or sunlight. Where PPE may become contaminated during use you will need to provide storage that is separated from any other storage provided for ordinary clothing.

4.TYPES OF PPE:

Respiratory Protective Equipment (RPE)

RPE is designed to protect the individual wearer from various hazardous substances in their workplace. There are two types of respiratory equipment.

1. Filters contaminated air or cleans it before it is breathed in.
2. Supplies clean air from an independent source.

RPE may be required for working with large amounts of

- gases, vapours
- dusts, powders
- welding
- grinders, cutter and saw use.

Face masks rely on a good seal against the face, if there are gaps in the face mask then contaminated air, dust, gases and vapors may be breathed into the lungs. For this reason it is very important your mask fits properly and is used correctly every time you use it.

Facial hair, stubble and beards make it impossible to get a good seal on the face.

For this reason you need to be clean shaven to allow a good seal around the face and prevent any leaks of contaminated air into the lungs.

There are reasons that employees may have a beard for example, religious reasons. If that is the case there are alternative options that could be introduced, such as a full hood covering the head and the face.

4.1.Face fit testing of RPE

The RPE should have a tight-fitting face piece, you need to ensure the user has the correct device. For this reason the initial selection of RPE should include fit-testing. A competent face fit tester should carry out these assessments.

You will need to repeat the face fit testing if there are changes. For example if the model or size of the face piece changes or if there are significant changes to the user's facial characteristics. There are two forms of face fit testing.

- Qualitative fit testing is suitable for disposable filter face pieces and half masks. This can be done as a simple pass/fail based on the user's subjective assessment of the fit and leakage and this method is not suitable for full face masks.
- Quantitative fit testing provides a numerical measure of the fit known as a fit factor. This test requires special equipment and it is more complicated to carry out. This method is recommended for full face masks. Quantitative risk assessment is a more in-depth assessment of the risk.

4.2.Hearing protection

There are three types of hearing protection.

- Earmuffs/defenders that completely cover the ear.
- Ear plugs that are inserted into the ear canal.
- Semi inserts (also called canal caps) which cover the entrance of the ear canal.

Hearing protection must be worn by anyone who is likely to be exposed to noise at or above the Exposure Action Level set by The Control of Noise at Work Regulations 2005.

4.3.Head protection

There are three widely used types of head protection.

- Industrial safety helmets (hard hats) which are designed to protect against materials falling from a height or swinging objects.
- Industrial scalp protectors (bump caps) which are designed to protect from knocking against stationary objects.
- Caps/hair nets which protect against entanglement.
- Tasks where head protection may be required include
- construction
- building repair
- work in excavations or tunnels
- work with bolt driving tools
- driving motorcycles.

Turban-wearing Sikhs are exempt from wearing head protection on construction sites by virtue of The Employment Act 1989 as amended by Section 6 of the Deregulation Act 2015 (external site).

4.4.Eye protection

There are several types of eye protection.

- Safety spectacles: these are similar to regular glasses but have a tougher lens, they can include side shields for additional protection.
- Eye shield: a frame-less one piece molded lens often worn over prescription glasses.
- Safety goggles: these are made of flexible plastic frames and an elastic headband.
- Face shields: heavier and bulkier than other types of eye protection, face shields protect the face, but do not fully enclose the eye so do not protect against dust, gases, fumes and mists.

Tasks where eye protection may be used include

- handling hazardous substances where there is a risk of splashes
- working with power driven tools where materials are likely to be propelled
- welding operations
- working with lasers
- using gas or vapour under pressure.

4.5.Foot protection

There are a number of types of safety footwear.

- Safety boots or shoes, normally have steel toe caps but can have other safety features (e.g. steel mid soles, slip resistant soles, insulation against the heat and cold.

- Wellington boot can also have steel toe caps.
- Anti-static and conductive footwear, these protect against static electricity.
- Tasks where foot protection may be required include
- construction
- demolition
- building repair
- manual handling where the risk of heavy objects falling on the feet
- working in extremely hot or cold environments
- working with chemicals and forestry.

Where there is a risk of slipping that cannot be avoided or controlled by other measures, attention must be given to slip resistant soles and replaced before the tread pattern is worn.

4.6.Hand and arm protection

Hand and arm protection comes in a variety of forms.

- Gloves or gauntlets (leather, latex, nitrile, plastic coated, chain mail, etc).
- Wrist cuff armlets (e.g. used in glass cutting and handling).
- Tasks where hand and arm protection may be required include
- manual handling of abrasive, sharp or pointed objects
- working with vibrating equipment such as pneumatic drills and chainsaws
- construction and outdoor work
- working with chemicals and hazardous substances such as body fluids
- working in hot or cold materials or temperatures.

In order to eliminate the risk of ill health through exposure to latex a number of organisations have phased out the use of latex gloves and replaced them with nitrile.

4.7.Body protection

Types of body protection include

- overalls, aprons and coveralls (protection against hazardous substances)
- clothing for hot, cold or bad weather
- clothing to protect against machinery
- high visibility (jackets, trousers and vests)
- harnesses
- life jackets.

Tasks where body protection may be required include

- working with hazardous substances
- working next to the highway or areas with moving transport and vehicles (e.g. construction sites)
- outdoor, forestry and ground maintenance work.

5.PPE and coronavirus (COVID-19)

There are few workplaces outside of health and social care that will require extra PPE to protect against COVID-19 but it is important to remember that work tasks that required PPE before COVID-19, will still require that same level of use and protection for workers. Your risk assessments should reflect this and include any extra protection required to protect workers from the risk of transmission of COVID-19.

Guidance on use of PPE in health and social care settings can be found on the HPS website. The HPS website also gives Guidance on protection in non-health care setting.

Face coverings

Face coverings are not PPE as they do not protect the wearer. They are intended to protect others. Further information can be found on the Scottish Government's Coronavirus (COVID-19): general guidance for safer workplaces.

Preventing the spread of infection

Coronavirus will live for some time on surfaces, including on PPE, so you need to be aware of how to use and dispose of it correctly.

You can use these resources to remind employees how to

- put on and take off PPE correctly (for non-aerosol generating procedures) posters and videos from GOV.UK
- use disposable respirators correctly video and poster from the Health and Safety Executive.

Handwashing

Good hand hygiene is essential to help stop the spread of COVID-19. Watch this video on how to wash your hands.

Survey the Plants for Location

Plant location refers to the choice of the region where men, materials, money, machinery and equipment are brought together for setting up a business or factory. A plant is a place where the cost of the product is kept to low in order to maximize gains. Identifying an ideal location is very crucial, it should always maximize the net advantage, must minimize the unit cost of production and distribution. Plant location decisions are very important because once the plant is located at a particular site then the organization has to face the pros and cons of that initial decision.

Factors affecting the plant location:

Decisions regarding selecting a location need a balance of several factors. These are divided into primary factors and secondary factors; here both the factors can influence the business inthe long run.

Primary factors:

Availability of raw materials

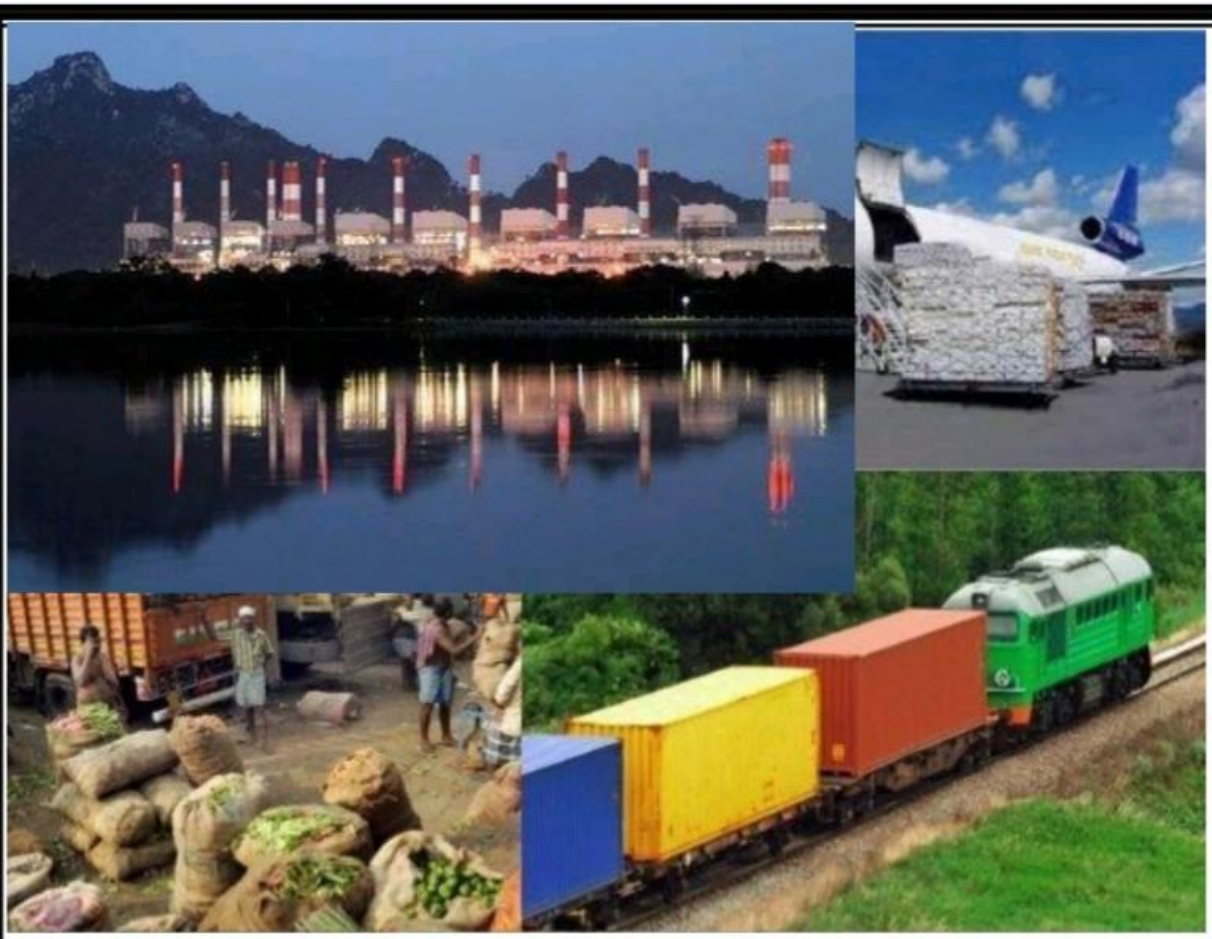
Availability of raw materials is the most important factor in plant location decisions. Usually, manufacturing units where there is the conversion of raw materials into finished goods is the maintask then such organizations should be located in a place where the raw materials availability is maximum and cheap.

Nearness to the market

Nearness of market for the finished goods not only reduces the transportation costs, but it can render quick services to the customers. If the plant is located far away from the markets then thechances of spoiling and breakage become high during transport. If the industry is nearer to the market then it can grasp the market share by offering quick services.

Availability of labor

Another most important factor which influences the plant location decisions is the availability of labor. The combination of the adequate number of labor with suitable skills and reasonable labor wages can highly benefit the firm. However, labor-intensive firms should select the plant location which is nearer to the source of manpower.



Transport facilities

In order to bring the raw materials to the firm or to carrying the finished goods to the market, transport facilities are very important. Depending on the size of the finished goods or raw materials a suitable transportation is necessary such as roads, water, rail, and air. Here the transportation costs highly increase the cost of production, such organizations can not completewith the rival firms. Here the point considered is transportation costs must be kept low.

Availability of fuel and power

Unavailability of fuel and power is the major drawback in selecting a location for firms. Fuel and power are necessary for all most all the manufacturing units, so locating firms nearer to the coal beds and power industries can highly reduce the wastage of efforts, money and time due to the unavailability of fuel and power.

Availability of water

Depending on the nature of the plant firms should give importance to the locations where water isavailable.

For example, power plants where use water to produce power should be located near the water bodies.

Secondary factors:

Suitability of climate:

Climate is really an influencing factor for industries such as agriculture, leather, and textile, etc. For such industries extreme humid or dry conditions are not suitable for plant location. Climate can affect the labor efficiency and productivity.

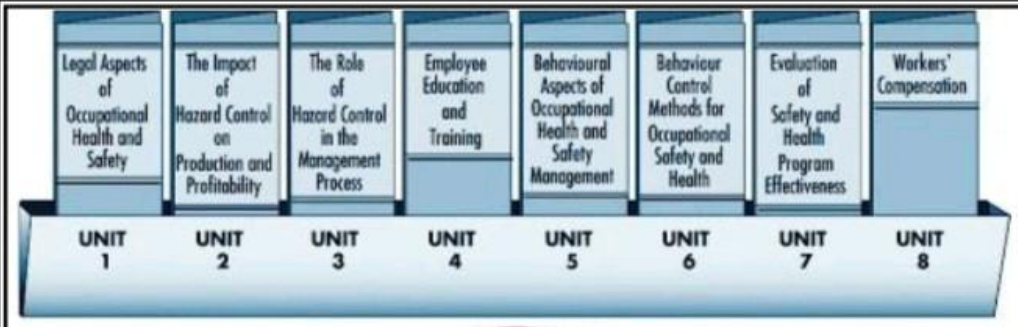
Government policies

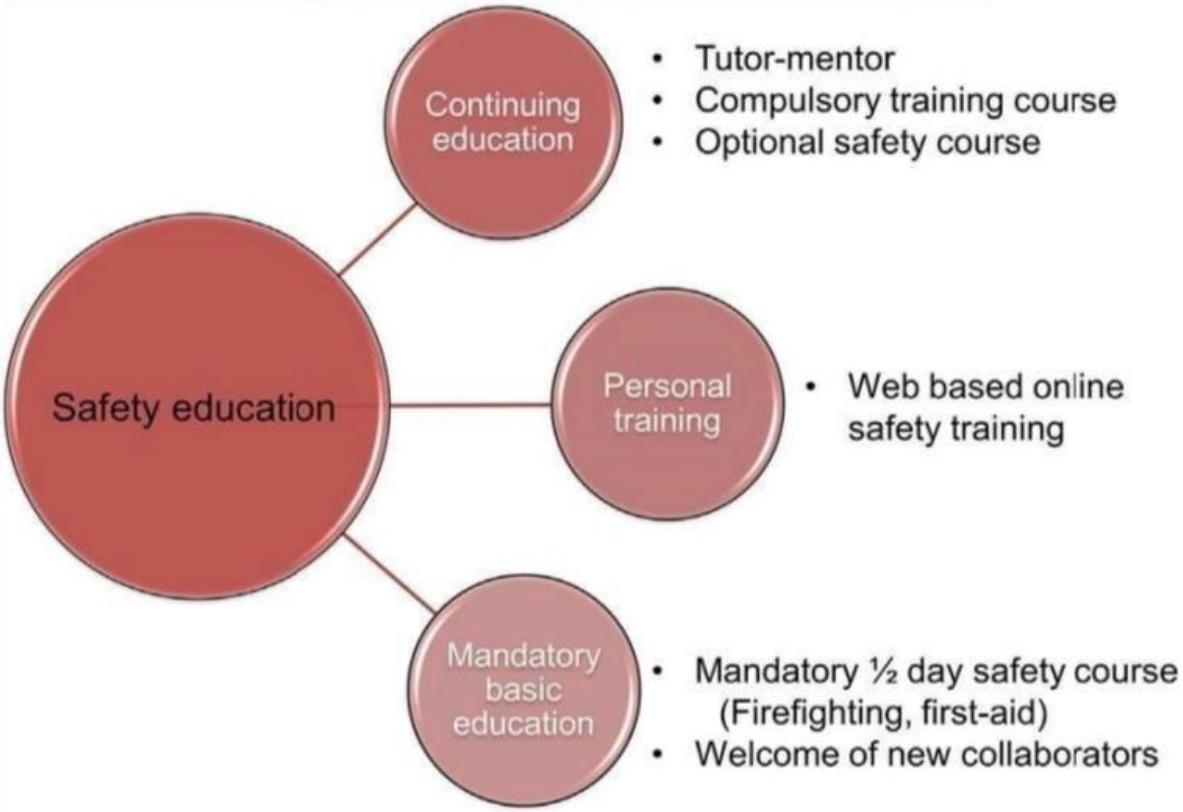
While selecting a location for the plant, it is very important to know the local existed Government policies such as licensing policies, institutional finance, Government subsidies, Government benefits associated with establishing a unit in the urban areas or rural areas, etc.

Availability of finance

Finance is the most important factor for the smooth running of any business; it should not be far away from the plant location. However, in the case of decisions regarding plant location, it is the secondary important factor because financial needs can be fulfilled easily if the firm is running

smoothly. But it should be located nearer to the areas to get the working capital and other financial needs easily.





Competition between states

In order to attract the investment and large scale industries various states offer subsidies, benefits, and sales tax exemptions to the new units. However, the incentives may not be big but it can help the firms during its startup stages.

Availability of facilities:

Availability of basic facilities such as schools, hospitals, housing and recreation clubs, etc can motivate the workers to stick to the jobs. On the other hand, these facilities must be provided by the organization, but here most of the employees give preference to work in the locations where all these benefits/facilities are available outside also. So while selecting plant location,

organizations must give preference to the location where it is suitable for providing other facilitiesalso.

Disposal of waste

Disposal of waste is a major problem particularly for industries such as chemical, sugar, and leather, etc. So that the selected plant location should have provision for the disposal of waste.

Education and training in safety:

Safety training and education creates consciousness and develops alertness to safety. Safety education develops safety –mindedness while training helps apply acquired safety knowledge to the specific job or task or procedure.

Just as safety engineering is the most effective way of preventing environmental causes, safety education is the most effective tool in the preventive of human causes of accidents. Through adequate safety instructions, personnel gain useful knowledge and develop safe attitudes.

Education and Training

Education and training are important tools for informing workers and managers about workplacehazards and controls so they can work more safely and be more productive. Another role of education and training, however, is to provide workers and managers with a greater understanding of the safety and health program itself, so that they can contribute to its development and implementation.

Education and training provides employers, managers, supervisors, and workers with:

- Knowledge and skills needed to do their work safely and avoid creating hazards that could place themselves or others at risk.
- Awareness and understanding of workplace hazards and how to identify, report, and control them.
- Specialized training, when their work involves unique hazards.

Additional training may be needed depending on the roles assigned to employers or individual managers, supervisors, and workers. For example, employers, managers, and supervisors may need specific training to ensure that they can fulfill their roles in providing leadership, direction, and resources for the safety and health program. Workers assigned specific roles in the program (e.g., incident investigation team members) may need training to ensure their full participation inthose functions.

Effective training and education can be provided outside a formal classroom setting. Peer-to-peer training, on-the-job training, and worksite demonstrations can be effective in conveyingsafety concepts, ensuring understanding of hazards and their controls, and promoting good work practices.

Action item 1: Provide program awareness training

Action Item 2: Train employers, managers and supervisors on their roles in the program Action item 3: Train workers on their specific roles in the safety and health program Action item 4: Train workers on hazard identification and controls

Action item 1: Provide program awareness training

Managers, supervisors, and workers all need to understand the program's structure, plans, and procedures. Having this knowledge ensures that everyone can fully participate in developing,implementing, and improving the program.

How to accomplish it

- Provide training to all managers, supervisors, workers, and contractor, subcontractor, and temporaryagency workers on:
  - Safety and health policies, goals, and procedures
  - Functions of the safety and health program
  - Whom to contact with questions or concerns about the program (including contact information)
  - How to report hazards, injuries, illnesses, and close calls/near misses
  - What to do in an emergency
  - The employer's responsibilities under the program
  - Workers' rights under the Occupational Safety and Health Act
- Provide information on the safety and health hazards of the workplace and the controls for those hazards.
- Ensure that training is provided in the language(s) and at a literacy level that all workers can understand.
- Emphasize that the program can only work when everyone is involved and feels comfortable discussingconcerns; making suggestions; and reporting injuries, incidents, and hazards.
- Confirm, as part of the training, that all workers have the right to report injuries, incidents, hazards, and concerns and to fully participate in the program without fear of retaliation.

Action item 2: Train employers, managers, and supervisors on their roles in the program

Employers, managers, and supervisors are responsible for workers' safety, yet sometimes have little training on safety-related concepts and techniques. They may benefit from specific trainingthat allows them to fulfill their leadership roles in the program.

How to accomplish it

- Reinforce employers, managers, and supervisors' knowledge of their responsibilities under the Occupational Safety and Health Act and the workers' rights guaranteed by the Act.
- Train employers, managers, and supervisors on procedures for responding to workers' reports

of injuries, illnesses, and incidents, including ways to avoid discouraging reporting.

- Instruct employers, managers, and supervisors on fundamental concepts and techniques for recognizing hazards and methods of controlling them, including the hierarchy of controls (see "Hazard Prevention andControl").Instruct employers, managers, and supervisors on incident investigation techniques, including root cause analysis.

Action item 3: Train workers on their specific roles in the safety and healthprogram

Additional training may be needed to ensure that workers can incorporate any assigned safety andhealth responsibilities into their daily routines and activities.

How to accomplish it

- Instruct workers on how to report injuries, illnesses, incidents, and concerns. If a computerized reporting systemis used, ensure that all employees have the basic computer skills and computer access sufficient to submit an effective report.
- Instruct workers assigned specific roles within the safety and health program on how they should carryout those responsibilities, including:
  - Hazard recognition and controls (see action item 4)
  - Participation in incident investigations
  - Program evaluation and improvement
- Provide opportunities for workers to ask questions and provide feedback during and after the training.
- As the program evolves, institute a more formal process for determining the training needs of workers responsible for developing, implementing, and maintaining the program.

Action item 4: Train workers on hazard identification and controls

Providing workers with an understanding of hazard recognition and control and actively involving them in the process can help to eliminate hazards before an incident occurs.

How to accomplish it

- Train workers on techniques for identifying hazards, such as job hazard analysis.
- Train workers so they understand and can recognize the hazards they may encounter in their own jobs, as well as more general work-related hazards.
- Instruct workers on concepts and techniques for controlling hazards, including the hierarchy of controls and its importance.
- Train workers on the proper use of work practice and administrative controls.
- Train workers on when and how to wear required personal protective equipment.
- Provide additional training, as necessary, when a change in facilities, equipment, processes, materials, or work organization could increase hazards, and whenever a worker is assigned a new task.

Prevention causes and cost of accident:

The domino effect theory: in a sequential combination of five factors (social environment, human error, unsafe acts, **accident**, **injury**), each of the factors alone will not **cause** an **accident** so that removing any one would be effective in **accident prevention**; however, each of the factors can be depicted as a "domino"

Accidents in Industries: Causes, Prevention and Proneness:

Economic Aspects (Cost) of Accidents:

An accident can be very costly to the injured employee as well as to the employer of the concern.There are definite costs associated with the accident, e.g., direct and measurable costs and indirect, i.e., somewhat intangible but nevertheless real costs.

(i) Compensation insurance, including Payment, and Overhead costs.

(ii) Uncompensated wage losses of the injured employee,

(iii) Cost of medical care and hospitalization.

Indirect costs of an accident they associate:

(i) Costs of damage to equipment, materials and plant.
(ii) Costs of wages paid for time lost by workers not injured.
(iii) Costs of wages paid to the injured worker.
(iv) Costs of safety engineers, supervisors and staff in investigating, recording and reporting ofaccidents and its causes.

(v) Costs of replacing the injured employee.
(vi) Cost of lowered production by the substitute worker.
(vii) Cost of delays in production due to accident.
(viii) Cost of reduction in efficiency of the injured worker when he joins the concern after getting recovered.

Causes of Accidents:

An accident is an unplanned incident and for each such incident there is usually a specific cause or causes if one could but discover them.

Accident may be caused due to:

Technical causes or unsafe conditions reflect deficiencies in plant, equipment, tools, materials handling system, general work environment, etc. Human causes or unsafe acts by the person concerned are due to his ignorance or forgetfulness, carelessness, day-dreaming, etc. It has beenestimated that there are four accidents caused by human causes to everyone that is caused by technical causes.

Mechanical Causes or Factors:

Unsafe mechanical design or construction.

2. Hazardous arrangement (piling, over-loading etc.)

3. Improper machine guarding.

4. Unsafe apparel.

5. Defective agencies or devices.

6. Improper material handling.
7. Broken safety guards.

8. Protruding nails.

9. Leaking acid valve.

10. Untested boilers or pressure vessels.

Environmental Factors:

Environmental factors indicate improper physical and atmospheric surrounding conditions of workwhich indirectly promote the occurrence of accidents.

Environmental factors include:

1. Too low a temperature to cause shivering.

2. Too high a temperature to cause headache and sweating.

3. Too high a humidity (in textile industry) to cause uncomforted, fatigue and drowsiness (especially when the atmosphere is also hot).

4. Defective and inadequate illumination causing eyestrain, glares, shadows, etc.

5. Presence of dust, fumes and smokes (e.g., in foundary or welding shop) and lack of proper ventilation.

6. High speed of work because of huge work load.

7. More number of working hours and over and above them the tendency of the employer to insist for over-time work.

8. Inadequate rest pauses or breaks between the working hours.

9. Noise, bad odour and flash coming from the nearby machinery, equipment or processes.

10. Poor housekeeping.

Personal Factors:

1.Age.2. Health3. Number of dependents.4. Financial position.5. Home environment.6. Lack of knowledge and skill.7. Improper attitude towards work.8. Incorrect machine habits.9. Carelessness and recklessness.10. Day-dreaming and un-attentiveness.11. Fatigue.12. Emotional un-stability, e.g., jealousy, revengefulness, etc.13. High anxiety level.14. Mental wordiness.15. Unnecessary exposures to risk.16. Non-use of safety devices.17. Working at unsafe speeds.18. Improper use of tools.

ACCIDENT PREVENTION:

Accident prevention is highly essential in an industry, in order to:

(i) Prevent injury to and premature death of employees.

(ii) Reduce operating and production costs.

(iii) Have good employer-employee relations.

(iv) High up the morale of employees.

Above all, prevention of accidents is a true humanitarian concern.

Housekeeping:

The Housekeeping department takes pride in keeping the hotel clean and comfortable, so as to create a 'Home away from home'. The aim of all accommodation establishment is to provide their customers with clean, attractive, comfortable and welcoming surrounding that offer value for money. Nothing sends a stronger message than cleanliness in a hospitality operation. No level of service, friendliness or glamour can equal the sensation a guest has upon entering a spotless, tidy and conveniently arranged room. Both management and guest consider the keeping of the place clean and in a good order a necessity for a hotel to command a fair price and get repeat business.

ROLE OF HOUSEKEEPING DEPARTMENT

Housekeeping plays a very important role in hospitality industry such as:-

- To achieve the maximum possible efficiency in ensuring the care and comfort of guests and in thesmooth running of the department.
- To establish a welcoming atmosphere and ensure courteous, reliable service from all staff of the department.
- To ensure a high standards of cleanliness and general upkeep in all areas for which the department is responsible.
- To provide linen in rooms, restaurants, banquet hall, conference venues, health clubs, and so on, as well as maintain an inventory for the same.

FIRST AID:

It is impossible to predict when will an accident happen in the workplace. However, it is the employer's duty to do everything in their power to prevent accidents and provide access to first aid to their employees and everybody who frequents their workplace.

The **5 main aims of first aid** are:

1. preserve life
2. prevent the escalation of the illness or injury
3. promote recovery
4. pain relief
5. protect the unconscious.

1. Preserve life – while the first aider is the person who has the certificate for the first aid, they are not medical professionals. They can do their best to make sure the patient is given the basic care and they can help treat minor injuries like cuts and scrapes that don't need routine or emergency attention.

However, in case of severe situations that are a threat to the patient's life, they do not focus on providing care but on preserving life long enough until the ambulance arrives

2. **Prevent the escalation** – again, the efforts of the first aiders are directed toward prolonging the time the patient has until the ambulance arrives. If the patient is bleeding profusely, the first aider will not stitch the wound, but they will do their best to stop the bleeding until the ambulance arrives. In that way, they will prevent further complications and health deterioration.

3. **Pain relief** – this is done only if it is in any way possible and it doesn't present a risk to the patient. Some pain relief medications can be dangerous in case a person is bleeding. Therefore, if not sure if the pain medication is appropriate, it is better to ask the medical experts first.

4. **Protect the unconscious** – one of the important factors in administering first aid is protection and safety for both the patient and the first aider. Moreover, this extends to the people who are nearby, as well. Protecting the unconscious can mean removing them from a dangerous situation, like fire, flooded space or road with traffic.

5. **Promote recovery** – every action that a first aider takes should be in the direction of helping the person who has suffered an injury or sudden illness get better.

Promoting the recovery usually means using the first aid kit. It is packed with supplies that are necessary for the first aider to be able to help the person in need. You can understand that the time of providing the first aid is crucial. If your first aid is not well-stocked or it is not there at all – thatis a big problem.

Firefighting equipments:

- Fire Extinguishers.
- Smoke Detectors.
- Fire Alarm Systems.
- Fire Suit.
- Fire Extinguisher Cylinders.
- Fire Sprinklers.
- Fire Hydrants.
- Fire Safety Service.

Accident Reporting:

Purpose

An accident reporting and investigation plan prescribes methods and practices for reporting and investigating accidents that can be read and understood by all managers, supervisors, and employees. No matter how conscientious the safety efforts are, accidents are going to happen sometimes due to human or system error.

This written Accident Reporting and Investigation Plan is intended to demonstrate The University of Mary Washington's compliance with the requirements in 29 CFR 1904 by:

- prescribing methods and practices for reporting and investigating accidents, and providing a means to deal with workplace accidents in a standardized way.

In addition it is the policy of the University to comply with all workers' compensation laws and regulations. The requirements of this plan apply to all operations and departments at the University.

AdministrativeDuties

The University of Mary Washington's Workman's Compensation Coordinator, is responsible for developing and maintaining and reporting First Records of Injury to Virginia State Department of Risk

Management.

This function is shared by the Human Resource office and the PublicSafety Department, Office of Occupational Health and Safety. They are both responsible for the OSHA 300A report as well as compensatory reports for the employee and have full authority to make necessary decisions to ensure the success of this plan. They are also qualified, by appropriate training and experience to commensurate with the complexity of the plan, to administer or oversee our accident reporting and investigation program and conduct the required investigations and incident evaluations.

All employee accidents are reviewed by a committee of university representatives from all trades, skills and professions for adequate recommendations and remediations.This written Accident Reporting and Investigation Plan is kept at the following locations Fairfax House and the Public Safety office at Brent Hall.

Accident Reporting Procedures:

Employees injured on the job are to report the injury to their supervisor as soon as possible after the incident/accident. Near miss accidents or incidents (when an employee nearly has an accident but is able to avoid it) should be reported as well. All accidents and incidents should be reported for prevention purposes.

The supervisor must immediately notify Human Resources Department and the Public Safety Department when an incident/accident occurs.

If they are not available a report should be forwarded for there review and the supervisor shall conduct an investigation and interview

Accident Investigation Procedures

Thorough investigation of all accidents will lead to identification of accident causes and help:

- reduce economic losses from injuries and lost productive time;
- determine why accidents occur, where they happen, and any trends that might be developing;
- employees develop an awareness of workplace problems and hazards;
- identify areas for process improvement to increase safety and productivity;
- note areas where training information or methods need to be improved; and
- suggest a focus for safety program development.

For all accident investigations, the Safety Department or designate will perform the following duties:

- Conduct the accident investigation at the scene of the injury as soon after the injury as safely possible.
- Ask the employee involved in the accident and any witnesses, in separate interviews, to tell in their own words exactly what happened.
- Repeat the employee's version of the event back to him/her and allow the employee to make any correctionsor additions.
- After the employee has given his/her description of the event, ask appropriate questions that focus on causes.
- When finished, remind the employee the investigation was to determine the cause and possible corrective action that can eliminate the cause (s) of the accident.
- Complete an accident investigation report with the employee and review data with employee for accuracy. This will provide information to put into database format.

The accident investigation report is used to:

- track and report injuries on a monthly basis;
- group injuries by type, cause, body part affected, time of day, and process involved;
- determine if any trends in injury occurrence exist and graph those trends if possible;
- identify any equipment, materials, or environmental factors that seem to be commonly involved ininjury incidents;
- discuss the possible solutions to the problems identified with the safety team and superiors; and
- proceed with improvements to reduce the likelihood of future injuries.

Injury/MedicalIssues

If a workplace accident results in injury or illness requiring hospitalization of three or more employees or a fatality of one or more employee, the University's Workman's Compensation Coordinator will report the incident within eight hours by phone or in person to the nearest VOSH office.

If an injured person is taken to a doctor, a statement from the doctor will be attached to the Accident Report form.

Record-keeping

The University of Mary Washington's Workmen Compensation Coordinator is responsible for maintaining the following records and documentation:

- OSHA 300A log of injuries and illnesses
- Accident investigation reports
- *Employer's Accident Report*

The University of Mary Washington Safety Department is responsible for maintaining the following records and documentation:

- Training records
- Investigation and Interviews

Training

This plan is an internal document guiding the action and behaviors of employees, so they need to know about it. To communicate the new accident reporting and investigation plan, all employees are given a thorough explanation as to why the new plan was prepared and how individuals may be affected by it.

The information and requirements of this written plan are presented to employees during new hire orientation or as the plan is reviewed and modified but at least annually.

Program Evaluation

The accident reporting and investigation program is evaluated and updated by The University of Mary Washington's Workmen's Compensation Coordinators and the Safety Department annually to determine whether the plan is being followed and if further training may be necessary.

Investigations:

Finding the cause of safety incidents is the first step in preventing similar incidents in the future. Safety Management Group's safety professionals have extensive experience at investigating workplaceaccidents, fatalities, and other incidents involving injuries or near misses.

When a serious workplace accident occurs, it's imperative that companies conduct a prompt and thorough accident investigation. An incomplete, inaccurate or biased investigation can aggravate the problem and increase your potential liability. Our safety professionals understand OSHA and know how to properly conduct the workplace investigation and perform interviews, even in high-profile cases receiving media attention.

In addition to preventing future incidents, a thorough investigation will allow your company to fulfill any legal requirements, determine the cost of an accident, determine compliance with applicable OSHA safety regulations, and process workers' compensation claims. Incidents that involve no injury or property damage should still be investigated to determine the hazards that should be corrected.

Industrial psychology in accident prevention:

Many efforts are being made to reduce accidents in the manufacturing plants and great stress is being placed on safety. Efforts are being made in two directions.

i) Reducing the liability of the situation

ii) Minimising the possible influence of any relevant personal factors.

The most common type of safety training is to make employees safety conscious and safety-wise. Many psychological principles are used to safeguard the workers. The measures taken by the safety engineers cover a spectrum of techniques, procedures and guidelines directed toward reducing situational liability.

These include the installation of protective guards on machines, changes of method, arrangement of material and equipment, use of protective clothing and gear, improvements in the environment and other techniques aimed at minimising the specific types of hazards.

It has been increasingly recognised that the design of equipment and the nature of the physical environment can effect the accident liability. There is more focus on the design of equipment and work stations to suit the individual physical aspects (like height, weight etc.) that contribute to safety. Let us consider atleast a few of the possible approaches to reduce accidents from the human liability rather than from situational side.

Safety Trails:

A safety outcomes trial (SOT) is a prospective, randomized, controlled trial that is specifically designed and adequately powered to test a safety hypothesis using a clinical outcome (single or composite) such as

irreversible morbidity or mortality as the primary trial endpoint.

UNIT-III

SAFETY ACTS

Features of Factories Act
Objective of Factories Act :

The main objectives of the Indian Factories Act, 1948are to regulate the working conditions in factories, to regulate health, safety welfare, and annual leave and enact special provision in respect of young persons, women and children who work in the factories.

1. Working Hours:

According to the provision of working hours of adults, no adult worker shall be required or allowed to work in a factory for more than 48 hours in a week. There should be a weekly holiday.

2. Health:

For protecting the health of workers, the Act lays down that every factory shall be kept clean and all necessary precautions shall be taken in this regard. The factories should have proper drainage system, adequate lighting, ventilation, temperature etc.

Adequate arrangements for drinking water should be made. Sufficient latrine and urinals should be provided at convenient places. These should be easily accessible to workers and must be kept cleaned.

3. Safety:

In order to provide safety to the workers, the Act provides that the machinery should be fenced, no young person shall work at any dangerous machine, in confined spaces, there should be provision for manholes of adequate size so that in case of emergency the workers can escape.

4. Welfare:

For the welfare of the workers, the Act provides that in every factory adequate and suitable facilities for washing should be provided and maintained for the use of workers.

Facilities for storing and drying clothing, facilities for sitting, first-aid appliances, shelters, rest rooms' and lunch rooms, crèches, should be there.

5. Penalties:

The provisions of The Factories Act, 1948, or any rules made under the Act, or any order given in writing under the Act is violated, it is treated as an offence. The following penalties can be imposed:-

(a) Imprisonment for a term which may extend to one year;

(b) Fine which may extend to one lakh rupees; or

(c) Both fine and imprisonment.

If a worker misuses an appliance related to welfare, safety and health of workers, or in relation todischarge of his duties, he can be imposed a penalty of Rs. 500/-.

Introduction of Explosive Act:

Power for Central Government to prohibit the manufacture, possession or importation of specially dangerousexplosives.

This Act shall come into force on such day1 as the Central Government, by notification in the OfficialGazette, appoints.

(1) This Act shall come into force on such day5 as the Central Government, bynotification in theOfficial Gazette, appoints.

Central Government may, for any part of 1[India] 2 [***] make rules3 consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a licence granted as provided by those rules, the manufacture, possession, use, sale, 4[transport, import and export] of explosives, or any specifiedclass of explosives."

(2) Rules under this section may provide for all or any of the following, among other matters, that is to say:—

(a) the authority by which licences may be granted;

(b) the fees to be charged for licences, and the other sums (if any) to be paid for expenses by applicants forlicences;

(c) the manner in which applications for licenses must be made, and the matters to be specified in suchapplications;

(d) the form in which, and the conditions on and subject to which, licences must be granted;

(e) the period for which licences are to remain in force; the authority to which appeals may be preferred under section 6F, the procedure to be followed by such authority and the period within which appeals shall be preferred, the fees to be paid in respect of such appeals and the circumstances under which such fees may be refunded; 6[(ee) the authority to which appeals may be preferred under section 6F, the procedure to be followed by such authority and the period within which appeals shall be preferred, the fees to be paid in respect of such appeals and the circumstances under which such fees may be refunded;"

(eea) the total quantity of explosives that a licensee can purchase in a given period of time;

(eeb) the fees to be charged by the Chief Controller of Explosives or any officer authorised by him in this behalf, for services rendered in connection with the manufacture, transport, import or export of explosives;]

(f) the exemption absolutely or subject to conditions of any explosives 6[or any person or class of persons] from the operation of the rules.6[or any person or class of persons] from the operation of the rules

Boiler Act: The Indian Boilers Act-1923 was enacted with the objective to provide mainly for the safety oflife and Property of persons from the danger of explosions of steam boilers and for achieving uniformity in registration and inspection during operation and maintenance of boilers in India.

"Steam Boiler" means any closed vessel exceeding 22.75 litres which is used exclusively for generating steam under pressure and includes any mountings and other fittings attached to suchvessel which is wholly or partly under pressure when steam is shut off.

Every boiler owner is required to make an application to the Chief Inspector of Boilers for the inspection of the boiler along with the treasury challan of the requisite fees as per requirements of Indian Boilers Act- 1923. The requisite fee for the inspection of the boiler has been prescribed under Delhi Boilers Rules-1927.

Under Indian Boilers Act-1923 Indian Boilers Regulation-1950 has been framed. This Regulation deals with the materials, procedure & inspection techniques to be adopted for the manufacture of boilers & boiler mountings & fittings. The boiler is inspected by the Inspectorate as per the procedure laid under IBR -1950 and if found satisfactory, a Certificate is issued for operation for amaximum period of 12 months.

The boilers which are not found satisfactory during the inspection are repaired as per the procedure laid under Indian Boilers Regulation-1950 & are re-inspected as explained above. The Boilers which are transferred to NCT of Delhi are also inspected in the similar fashion after their records are obtained from the parent state.

The Boilers are also casually visited by the Inspectorate from time to time to check the validity of their certificates, safe and efficient operation. The show cause notice is issued to the boiler owner whose boiler is found working without a valid certificate and given a specified time to comply with. If the complianceis not made during the stipulated period, then necessary action as deemed fit under the Act is taken against the erring boiler owner.

REGISTRATION OF THE BOILER :

Every boiler owner who purchases a new boiler submits an application to the Chief Inspector of Boilers along with the inspection fees as per regulation 385 of IBR-1950 and the certificates of the manufacture in form of II, III & IV issued by the Chief Inspector of Boilers of the manufacturing state, for the registration of the boiler.

The Boiler is inspected and its M.B along with (Memorandum of Inspection Book) is prepared. All calculations for the pressure parts of the boiler are made as per IBR-1950 and a P.O. (Provisional Order) is issued for a maximum period of six months to operate the boiler at the maximum working pressure as calculated.

The boiler is offered for the STEAM TEST by the boiler owner within the validity of PO and if found satisfactory, a certificate for a period of 12 months is issued.

INSPECTION OF STEAM PIPE LINE:

The Steam-Pipe-Line is used to carry the Steam from the boiler to the user's equipment and it hasbeen defined as:

"Steam Pipe" means any pipe through which steam passes from a boiler to prime mover or otheruser or both if:-

(i) The pressure at which steam passes through such pipe exceeds 3.5 kilograms per square centimeters above atmospheric pressure: or
(ii) Such pipe exceeds 254 millimetres in internal diameter; and includes in either case, anyconnected fitting of a steam pipe.
The boiler owner submits the layout of the SPL in duplicate alongwith the requisite fees. The layouts of the SPL are checked for the safe working pressure and flexibility as per IBR-1950. The steam pipe line is later on subjected to Hydraulic Test Pressure and allowed to be used at requisite pressure if found satisfactory.

INSPECTION UNDER CONSTRUCTION :

New Boilers, Valves, Mountings and other components are required to be inspected at different stages of the fabrication to comply with the Indian Boiler Regulation-1950 or other renowned standards of the world with the motive of maintaining quality, interchangeability, efficient operation and as well as the safety of workers, and property.

EXAMINATION OF THE BOILER ATTENDANTS

Each boiler is required to be worked by qualified Boiler Attendant. As such the examinations are conducted by the department from time to time to enable the personnel's to qualify to operate the boilers as per the guidelines of "Delhi Boiler Attendant Rules, 1953."

EXAMINATION OF WELDER

As per Indian Boiler Regulation-1950 all welding work in the boilers, Steam Pipe Lines and its related components etc. is required to be carried out by the qualified High Pressure Welders. To enable the personnel's to qualify as High Pressure Welders, examinations are conducted by this section from time to time.

ESI Act: The promulgation of Employees' State Insurance **Act**, 1948 envisaged an integrated need based social insurance scheme that would protect the interest of workers in contingencies such as sickness, maternity, temporary or permanent physical disablement, death due to employment injury resulting in loss of wages or earning capacity. the Act also guarantees reasonably good medical care to workers and their immediate dependants.

Following the promulgation of the ESI Act the Central Govt. set up the ESI Corporation to administer the Scheme. The Scheme, thereafter was first implemented at Kanpur and Delhi on 24th February 1952. The Act further absolved the employers of their obligations under the Maternity Benefit Act, 1961 and Workmen's Compensation Act 1923. The benefit provided to theemployees under the Act are also in conformity with ILO conventions.

Workman's compensation Act:

An Act to provide for the payment by certain classes of employers to their workmen of compensation for injury by accident. Whereas it is expedient to provide for the payment by certainclasses of employers to their workmen of compensation for injury by accident

The Workmen's Compensation Act, 1923 provides for payment of compensation to workmen (or their dependants) in case of personal injury caused by accident or certain occupational diseases arising out of and in the course of employment and resulting in disablement or death. The Act was last amended in 1976.

The laws provide employees with monetary awards to cover loss of wages directly related to the accident as well as to compensate for permanent physical impairments and medical expenses. The laws also provide benefits for dependents of those workers who are killed in work-related accidents or illnesses.

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INTRODUCTION

The growing complexity of industry in this country, with the increasing use of machinery and consequent danger to workmen, along with the comparative poverty of the workmen themselves, rendered it advisable that they should be protected, as far as possible from

hardship arising from accidents. After a detailed examination of the question by the Government of India, Local Governments were addressed in July 1921, and provisional views of the Government of

India were published for general information. The advisability of legislation had been accepted by the great majority of Local Governments and of employers' and workers' associations and the Government of India believed that public opinion generally is in favour of legislation. In June,

1922 a committee was convened to consider the question. After considering the numerous replies and opinions received by the Government of India, the committee was unanimously in favour of legislation, and drew up detailed recommendations. On the recommendations of the committee theWorkmen's Compensation Bill was introduced in the Legislature.

STATEMENT OF OBJECTS AND REASONS

The general principles of workmen's compensation command almost universal acceptance and India is now nearly alone among civilised countries in being without legislation embodying those principles. For a number of years the more generous employers have been in the habit of giving compensation voluntarily, but this practice is by no means general.

The growing complexity of industry in this country, with the increasing use of machinery and consequent danger to workmen, along with the comparative poverty of the workmen themselves, renders it advisable that they should be protected, as far as possible from hardship arising from accidents. An additional advantage of legislation of this type is that by increasing the importance for the employer of adequate safety devices, it reduces the number of accidents to workmen in a manner that cannot be achieved by official inspection. Further, the encouragement given to employers to provide adequate medical treatment for their workmen should mitigate the effects of such accidents as do occur.

The benefits so conferred on the workman added to the increased sense 16(3) The Workmen's Compensation Occupational Diseases (Punjab) Rules, 1964 of security which he will enjoy, should render industrial life more attractive and thus increase the available supply of labour. At the same time, a corresponding increase in the efficiency of the average workman may be expected.

A system of insurance would prevent time burden from pressing too heavily on any particular employer. After a detailed examination of the question by the Government of India, Local Governments were addressed in July 1921, and provisional views of the Government of India were published for general information. The advisability of legislation has been accepted by the great majority of Local Governments and 'at employers' and workers' association and the Government of India believe that public opinion generally is in favour of legislation. In June 1922,a committee was convened to consider the question.

This committee was composed, for the most part of members of the Imperial Legislature. After considering the numerous replies and opinions received by the Government of India, the committee was unanimously in favour of legislation and drew up detailed

recommendations regarding the lines which in its opinion such legislation should follow. The Bill now presented follows these recommendations closely. A number of supplementary provisions have been added where necessary, but practically no variations of importance have been made. The Bill contains two distinct proposals. In Chapter II modifications are made in the ordinary civil law affecting the liability of employers for the damages in respect of injuries sustained by their workmen; these clauses will operate only in actions before the ordinary civil courts.

The main part of the Bill makes provisions for workmen's compensation and sets up special machinery to deal with claims falling under this category. Both parts of the Bill, however, apply to the same classes of workmen. If the scope of the employers' liability clauses was made wider than the scope of the workmen's compensation provisions, there would be considerable danger of a great increase in litigation.

The classes included are those whose inclusion was recommended by the committee, and are specified in Schedule II. Two criteria have been followed in the determination of the classes to be included— (1) that the Bill should be confined to industries which are more or less organised;

(2) that only workmen whose occupation is hazardous should be included. The general principle is that the compensation should ordinarily be given to workmen who sustained personal injuries by accidents arising out of and in the 16(3) The Workmen's Compensation Occupational Diseases (Punjab) Rules, 1964 course of their employment. Compensation will also be given in certain limited circumstances for disease. The actual rates of compensation payable are based on the unanimous recommendation of the committee. They are in every case subject to fixed maxima, in accordance with the committee's recommendations. It should be remembered, however, that the more highly paid workmen will be enabled in cases to which the employers' liability clauses will apply, to obtain damages on a scale considerably in excess of the maximum fixed for workmen's compensation. A consistent endeavour has been made to give as little opportunity for disputes as possible. Throughout the Bill in the definitions adopted the scales selected, and the exceptions permitted the great aim has been precision in order that in as few cases as possible should the validity of a claim for compensation or the amount of that claim be open to doubt. At the same time, on the unanimous recommendation of the committee provision has been made for special Tribunal to deal cheaply and expeditiously with any disputes that may arise, and generally to assist the parties in a manner which is not possible for the ordinary civil courts. ACT 8 OF 1923 The Workmen's Compensation Bill having been passed by the Legislature received its assent on the 5th March, 1923. It came into force on 1st day of July, 1924 as THE WORKMEN'S COMPENSATION ACT, 1923 (8 of 1923).

LIST OF AMENDING ACTS AND ADAPTATION ORDERS

1. The Repealing and Amending Act, 1924 (7 of 1924).
2. The Repealing and Amending Act, 1925 (37 of 1925).
3. The Workmen's Compensation (Amendment) Act, 1926 (29 of 1926).
4. The Workmen's Compensation (Amendment) Act, 1929 (5 of 1929).
5. The Workmen's Compensation (Amendment) Act, 1933 (15 of 1933).
6. The Government of India (Adaptation of Indian Laws) Order, 1937.
7. The Workmen's Compensation (Amendment) Act, 1937 (7 of 1937).

8. The Workmen's Compensation (Amendment) Act, 1938 (9 of 1938).
9. The Workmen's Compensation (Amendment) Act, 1939 (13 of 1939).
10. The Workmen's Compensation (Second Amendment) Act, 1939 (42 of 1939).
11. The Workmen's Compensation (Amendment) Act, 1942 (1 of 1942).
12. The Workmen's Compensation (Amendment) Act, 1946 (1 of 1946). 16(3) The Workmen'sCompensation Occupational Diseases (Punjab) Rules, 1964
13. The Indian Independence (Adaptation of Central Acts and Ordinances) Order, 1948.
14. The Adaptation of Laws Order, 1950.
15. The Part B States (Laws) Act, 1951 (3 of 1951).
16. The Adaptation of Laws (No. 3} Order, 1956.
17. The Repealing and Amending Act, 1957 (36 of 1957).
18. The Workmen's Compensation (Amendment) Act, 1959 (8 of 1959).
19. The Repealing and Amending Act, 1960 (58 of 1960).
20. The Workmen's Compensation (Amendment) Act, 1962 {64 of 1962).
21. The Central Labour Laws {Extension to Jammu and Kashmir) Act, 1970 (51 of 1970). 22. TheWorkmen's Compensation (Amendment) Act, 1976 (65 of 1976).
23. The Workmen's Compensation (Amendment) Act, 1984 (22 of 1984).
24. The Delegated Legislation Provisions (Amendment) Act, 1985 (4 of 1986).
25. The Workmen's Compensation (Amendment) Act, 1995 (30 of 1995).
26. The Workmen's Compensation (Amendment) Act, 2000 (46 of 2000).

Industrial Hygiene: Industrial Hygiene has also been defined as the practice of identifying of hazardous agents; chemical, physical and biological; in the workplace that could cause disease or discomfort, evaluating the extent of the risk due to exposure to these hazardous agents, and the control of those risks to prevent ill-health in .

Industrial hygiene has been a profession since the 1940s, working with science and technology to protect the health and safety of workers and the community. Our industrial hygiene team helps clients meet and maintain regulatory compliance in all industrial health and safety areas.

Our knowledgeable team of Certified Industrial Hygienists are experienced in a variety of settings including manufacturing, public works, heavy industrial, remediation, commercial, warehousing, healthcare, laboratories and office environments. Our dynamic team of Certified Industrial Hygienists, Certified Safety Professionals, indoor environmental scientists, engineers, and business professionals brings a holistic and practical approach to solving workplace hazards.

Employer responsibilities:

To protect the health of employees, exposure measurements must be unbiased, representativesamples of employee exposure. Employers must:

- Devise sampling plans to evaluate occupational exposures to airborne concentrations of chemicalsubstances as well as ingestion and dermal absorption
- Determine the need for exposure measurement
- Evaluate exposure measurement data
- Make decisions concerning what action is required by federal regulations.

Occupational safety:

Occupational safety deals with all aspects of physical, mental and social health and safety in a workplace. It is the umbrella for company's efforts to prevent injuries and hazards in all workenvironments.

Every industry presents various kinds of safety hazards to its employees. The spectrum of possible occupational safety risks ranges from severe and immediate physical dangers to milder hazards. The more immediate cases can be fires, explosions, chemical hazards or other such dangers that present an immediate threat to an employee's life. Milder hazards include challenges in ergonomics, workloads, mental capacity and general well-being of employees. The latter kinds of risks often take place in an office environment. However, whatever business you are in, there is always the possibility of an accident happening to someone.

Well-maintained occupational safety saves money

The biggest and non-measurable cost of a safety failure might be of the personal kind. A lost limb or years of mental rehabilitation can force an individual to adopt a completely new lifestyle and even self-identity. It's hard to define how to put a price tag on those types of incidents. Fatal injuries, where people actually get killed at completing their tasks, are also unquestionably beyond what we can economically quantify. Besides the one being killed, there are several other direct stakeholders such as family and friends, coworkers and other parties that suffer from it.

These accidents also directly impact the company's bottom line. An injured employee easily means countless lost man hours and quickly adds up to not only billions but trillions of euros in company's expenses. Only in the US the costs of non-fatal injuries and occupational diseases account for more than estimated $450B. Similarly, fatal injuries in 2013 accounted for the estimated $214B in the US. From a company's perspective, the expenses do not add up only because of lost in productivity, but also because of the increasing insurance costs.

Another big loss to a company comes from decreased work morale and increased employee retention. People want to feel safe. It comes as no surprise if employees' work morale decreases after seeing, for instance, a coworker fall of a lifting track because of inadequate safety measures. And the best people tend to leave first.

Occupational safety creates new opportunities

Instead of just seeing occupational safety as hazards and costs which should be controlled and limited, another viewpoint is to embrace it as an untapped opportunity. One example of doing this is the story of Alcoa. The aluminum products manufacturer is famous for understanding the importance of occupational safety and showing how investment in it can positively affect company profits. When Paul O'Neill started as the CEO of Alcoa, he announced that he wanted to make the company the safest one in the US. Instead of only wanting to hear reports of already occurred injuries and fatalities, he wanted employees to give out suggestions and ideas how to improve safety. And that eventually changed the whole company culture and employees started to also share their other improvement ideas. Alcoa ended up notably increasing its profits based on ideas that came from their employees. Not only that, butthey also learned how to adapt and learn from failure and make better processes.

Occupational safety affects company reputation and productivity

Companies of all forms and from all fields should really take a look at their occupational safety. Adapting and learning from failure is crucial if a company is looking to improve processes in the VUCA world.

All the previously mentioned reasons are enough to drive a possible change needed at a workplace. We are also living in an era when anyone can update their social media profiles of bad management experiences orpost a review of the company to Glassdoor.com. No company should want a possible future recruit to read online that the workplace is not investing in occupational safety. It might soon lead to a situation where the HR department receives less and fewer applications from good candidates.

It is evident that even the smallest acts of not taking care of employees' health and safety are a huge concern for companies both big and small. But the concern should not initially come from complaints in social media. Willingness and interest to invest in occupational safety should strive from a sincere interest in employees' safety and health and therefore also company's productivity and growth. This again can be turned into a huge asset in improving employee retention and hiringthe best people.

Diseases Prevention: The Epidemic Diseases Act, 1897 is a law which was first enacted to tackle bubonic plague in Mumbai (formerly Bombay) in former British India. The law is meant for containment of epidemics by providing special powers that are required for the implementation of containment measures to control the spread of the disease.

The Act has been routinely used to contain various diseases in India such as swine flu, cholera, malaria and dengue.In 2018, the Act was enforced as cholera began to spread in a region of Gujarat. In 2015, it was used to deal with dengue and malaria in Chandigarh and in 2009 it was invoked in Pune to combat swine flu. Starting in March 2020, the act is being enforced across India in order to limit the spread of coronavirus disease 2019 during the COVID-19 pandemic in India.

Ergonomics: Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

When evaluating a job, looking for three main characteristics known as Ergonomic Stressors: the force required to complete a task, any awkward or static working postures adopted in completing a task, and the repetitiveness of a task. Any of these factors, or any combination of these factors, may place someone at greater risk for discomfort.

Purpose

The Department of Environment, Health and Safety's (EHS) purpose is to help all UNC employees create and maintain a healthy and safe working environment.

Goal:

EHS wants to provide information and education to allow any employee to avoid injury. EHS wants to educate people on the basics of ergonomics. Not only will they be able to help themselves at work, but these principles can be applied to home, hobbies or help friends and coworkers who may have similar issues. Remember, knowledge is contagious.

Services

Services EHS offer include:

- Providing information about ergonomics
- Providing consultation regarding workstation setup
- Giving on-campus training on ergonomics (as requested)
- Providing product evaluations
- Providing an online self-assessment tool. This tool will walk the individual through a self

evaluation and provide the user with recommendations to modify their workstation.

Occupational Disease : An "occupational disease" is any disease contracted primarily as a result of an exposure to risk factors arising from work activity. "Work-related diseases" have multiple causes, where factors in the work environment may play a role, together with other risk factors, in the development of such diseases.The WHO Global Plan of Action on Workers' Health called for improving the diagnosis, reporting and registration of occupational diseases and building capacities for estimating the occupational burden of diseases

WHO's activities regarding occupational and work-related diseases include:

- Carrying our estimates of the global burden of disease from major occupational risks, such as injuries, airborne exposures, carcinogens, ergonomic stressors, noise and other specific risks.
- Incorporating occupational diseases and their causes in the 11th revision of the International Statistical Classification of Diseases and Related Health Problems.
- Working with ILO to develop diagnostic and exposure criteria for occupational diseases and to enable primary and secondary health care providers to detect and report such diseases.

STRESS:

Some of the factors that commonly cause work-related stress include:

- Long hours.
- Heavy workload.
- Changes within the organization.
- Tight deadlines.
- Changes to duties.
- Job insecurity.
- Lack of autonomy.
- Boring work.

FATIGUE:

Workers' fatigue is a significant problem in modern industry, largely because of high demand jobs, long duty periods, disruption of circadian rhythms, and accumulative sleep debt that are common in many industries.

Fatigue is the end result of integration of multiple factors such as time awake, time of day, and workload. Then, the full understanding of circadian biologic clock, dynamics of transient and cumulative sleep loss, and recovery is required for effective management of workplace fatigue. It can be more investigated in a new field of sleep medicine called occupational sleep medicine. Occupational sleep medicine is concerned with maintaining best productivity and safety in the industrial settings. The fatigue risk management system (FRMS) is a comprehensive approach that is based on applying scientific evidence of sleep knowledge to manage workers fatigue. It is developing rapidly in the highly safety demand jobs; especially truck drivers, pilots, and power plant workers. The objective of this review is to explain about fatigue in the workplace with emphasis on its association work performance and errors/accidents. Also, we discussed about different methods of fatigue measurement and management.

Safety And The Physical Environment: Ensuring a clean, safe, and healthy environment can help to promote physical, social, and emotional health throughout a community. Physical environment refers to the level of upkeep, ambient noise, lighting, indoor air quality and/or thermal comfort of the school's physical building and its location within the community**.**

HSE management is responsible for planning, implementing, monitoring and optimising operational processes in the areas of environmental management, health protection and occupational safety.

General categories

- **Environmental**. 1.1 Air emissions and ambient air quality. 1.2 Energy conservation.
- Occupational **health and safety**. 2.1 General facility design and operation. 2.2 Communication
- and training. ...

- Community **health and safety**. 3.1 Water quality and availability. ...
- Construction and decommissioning.

Engineering methods of controlling chemical hazards:

Hazardous chemicals present a number of risks upon the people in the workplace. To help mitigate theserisks, the hazards associated with dangerous substances must be controlled in a professional

Controlling the risk associated with hazardous chemicals is one part of the four phases of the methodology that is used to manage the risks of hazardous chemicals in the workplace.

STOREMASTA methodology for managing risk:

The way that this methodology can be used to manage hazardous chemicals in the workplace is that you must first identify and assess their potential risks. This must be done before any controls are implemented to mitigate the risks associated with hazardous chemicals.

Identifying risk is a process that involves identifying situations involving hazardous chemicals that could potentially harm people.

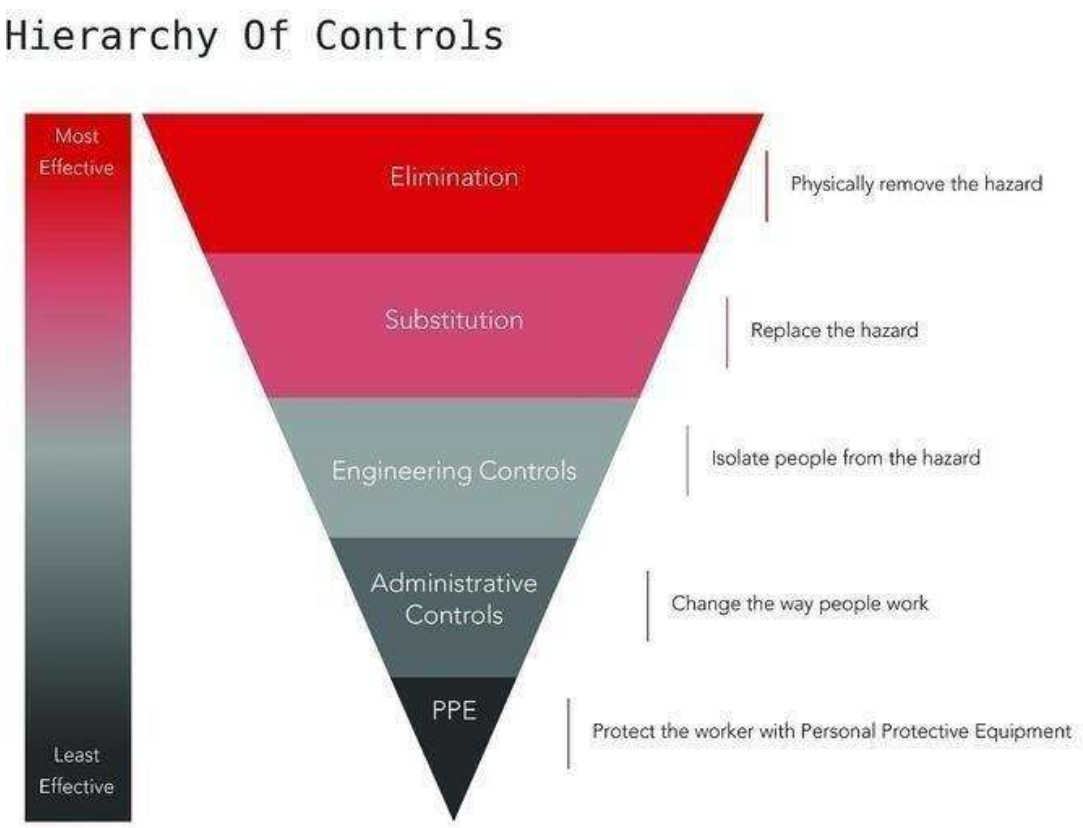
Once the potential risks associated with hazardous chemicals have been identified, the risk must be assessed. Assessing risk allows you to evaluate what would happen if someone was exposed to hazardous chemicals. A risk assessment will allow you to calculate the magnitude of the risk by determining the severity and likelihood of an incident occurring.

Once you have identified and assessed the severity of the risks, you will have valuable data that will allow you to determine the best methods that should be used to control the risk.

We will now go into more detail on how to control the risk associated with hazardous chemicals. Controlling the risks associated with hazardous chemicals must be done by following the hierarchy of controls.

How to control the risk of hazardous chemicals

As outlined above, managing the risks associated with hazardous chemicals has four distinct phases. The third phase of this process is to implement controls to reduce the risks associated with hazardous chemicals. When you are considering what controls to use to reduce the risk associated with hazardous chemicals, you must follow the hierarchy of controls.



Elimination

The risk control measure that has the greatest level of effectiveness is elimination. Before any other control measures are considered, elimination must be applied first. Elimination is the method of totally removing a hazard or hazardous practice from the workplace. Some examples of eliminating the use ofa hazardous chemical in the workplace include:

- Eliminating the use of chemical adhesive by using fasteners such as screws or nails.
- Eliminating the use of flammable forklift gas by using electric power forklifts instead of LPG powered forklifts.

Isolation

If it's not possible to substitute the use of a hazardous chemical with another chemical that is less hazardous, you must then isolate the hazardous chemical from people and other incompatible substances. This can be done in a number of ways. For example; if one part of a manufacturing process involves the use of a hazardous chemical, you could build a ventilated enclosure over this part of the manufacturing process. This enclosure would stop the airborne contaminants from this area moving into other areas of the manufacturing facility where people are present. The airborne contaminants that are generated inside this enclosure should be vented to the outside atmosphere in a safe location where people don't congregate.

If large quantities of hazardous chemicals are stored in the workplace, you could isolate these hazardous chemicals from people by storing them outdoors in a compliant chemical storage container. Isolating hazardous chemicals from people by storing them outdoors reduces the risk of harm to people in the event of a workplace fire or chemical spill.

Hazardous substances must also be isolated from other incompatible substances. If incompatible substances mix, it can result in violent chemical reactions that can harm people and property. Incompatible hazardous substances can be isolated by storing them in separate chemical storage cabinets and dangerous goods storage containers.

Engineering Controls

If isolation cannot be achieved, you can implement a number of engineering controls to reduce the risk associated with hazardous chemicals. Engineering controls are physical in nature and are devices or processes that eliminate exposure to hazardous chemicals. Engineering controls can be used to:

- Minimise the generation of hazardous chemicals
- Suppress or contain chemicals
- Limit the area of contamination in the event of spills

Engineering controls can include devices such as mechanical ventilation systems, compliant chemicalstorage containers or the automation of processes involving the use of hazardous chemicals.

Methods for Industrial Noise Control:

Noise attenuation is achieved by decreasing the intensity or volume of sound in a controlled environment. There are many noise reduction strategies that can be employed in industrial settings. One of the most effective and logical approaches to noise attenuation is to install systems that minimize noise from the start, using control techniques such as:

- Damping – A method of reducing noise levels from chutes, hoppers, machine guards, conveyors,panels and more
- Selecting efficient equipment – Selecting fans, compressors, PD blowers and engines that operateefficiently contribute significantly to noise attenuation
- Adjusting Fan Speed – Fan noise is in direct correlation with fan speed, so simple adjustments canproduce significant results
- Controlling high-pressure steam, natural gas, and other vent noises
- Attenuating noise from process exhausts with stack silencers
- Acoustically treating fans, blowers, and ventilating equipment
- Closing openings in enclosures and barrier walls required for utilities

Industrial Noise Control Products and Systems:

The environmental impact caused by industrial processes such as vent blow-offs, rooftop fans and

HVAC equipment, chillers, cooling towers, oil and gas building ventilation systems, power gen engines, and other noise generating processes can be addressed by installing various types of noise abatement equipment. We partner with the leading manufacturers of industrial noise control products and systems to offer a broad range of reliable industrial noise control solutions.

Industrial Fan Silencers :Fans are found in almost all industrial applications and can be large contributors to the problem of industrial noise. Exhaust and supply fan silencers can significantly reduce noise in both indoor and outdoor environments.

Acoustic Louvers : Where ventilation air is required, addressing noise concerns from a processing area within a building or machinery noise mitigation from a facility, acoustic louvers are a provenmeans of attenuation.

Industrial Exhaust Silencers : In addition to selecting the right noise control equipment, SysTech will access the entire noise attenuation application and reduce the overall sound level. Process silencers are applied to PD blower and compressor exhausts, stack discharges, and the venting or blow-off of high-pressure gases.

Noise Control Enclosures: Engineered acoustically for superior noise control, sound enclosures are an extremely effective means for containing industrial equipment noise.

Duct Silencer – Where a noise sound radiates from a ducted system or enclosure, duct silencers are typically applied with success.

Acoustic Building Ventilation Systems: When very high equipment noise levels are present in a building caused by large compressors, engines, generators, and motors, and heat removal ventilation systems are required, SysTech offers customized acoustic ventilation systems to meet both ventilation and noise reduction requirements.

Duct Lining : Ventilation systems using acoustic absorbent material such as foam or fiberglass will effectively decrease airborne noise.

Vibration Isolation Pads – Vibration control, employing anti-vibration machine mounts such as springs or neoprene will reduce transmission of noise created by vibration.

Acoustic Flexible Connectors: They serve a dual purpose in containing noise generated by the fan blade rotation and that induced by vibration.

Code and regulations for worker safety and health:

The Occupational Safety, Health and Working Conditions Code, 2019 was introduced in Lok Sabha by the Minister of Labour and Employment, Mr. Santosh Kumar Gangwar, on July 23, 2019. Following this, it was referred to the Standing Committee on Labour and Employment, on October 9, 2019. The Code seeks to regulate health and safety conditions of workers in establishments with 10 or more workers, and in all mines and docks. It subsumes and replaces 13 existing labour laws relating to safety, health and working conditions.

The Occupational Safety, Health And Working Conditions Code, 2020 is a code to consolidate and amend the laws regulating the Occupational safety and health and working conditions of the persons employed in an establishment. The Act replaces 13 old central labour laws.

The bill was passed by the Lok Sabha on 22 September 2020, and the Rajya Sabha on 23 September 2020.The bill received the presidential assent on 28 September 2020, but the date of coming into force is yet to be notified in the official gazette.

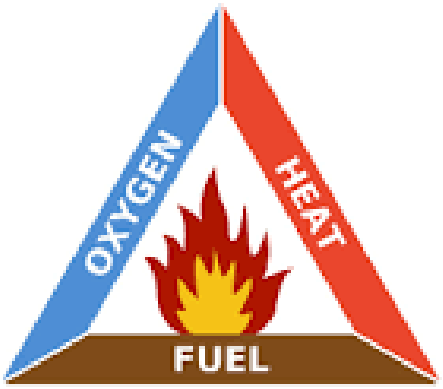
The bill was formulated according to the Report and Recommendations of the Second National Commission on Labour.

It amalgamated The Factories Act, 1948, The Plantations Labour Act, 1951, The Mines Act, 1952, The Working Journalists and other Newspaper Employees (Conditions of Service and Miscellaneous Provisions) Act, 1955, The Working Journalists (Fixation of Rates of Wages) Act, 1958, The Motor Transport Workers Act, 1961, The Beedi and Cigar Workers (Conditions of Employment) Act, 1966, The Contract Labour (Regulation and Abolition) Act, 1970, The Sales Promotion Employees (Condition of Service) Act, 1976, The Inter-State Migrant workmen (Regulation of Employment and Conditions of Service) Act, 1979, The Cine Workers and Cinema Theatre Workers Act, 1981, The Dock Workers (Safety, Health and Welfare) Act, 1986 and The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.

UNIT-4
FIRE PREVENTION AND PROTECTION

SOURCES OF IGNITION

FIRE TRIANGLE:



The **Fire Triangle** is a basic model used to understand how fire starts and continues to burn. It shows that **three essential elements** are required for combustion. If any one of these elements is removed, the fire will be extinguished.

The three elements are:

1. **Fuel**
2. **Heat**
3. **Oxygen**

2. Components of the Fire Triangle

□ 1. Fuel

Fuel is any **combustible material** that can burn. It may exist in **solid, liquid, or gaseous form**.

Types of Fuels:

- **Solid fuels** – Wood, paper, cloth, coal, plastic
- **Liquid fuels** – Petrol, diesel, kerosene, alcohol
- **Gaseous fuels** – LPG, methane, propane, hydrogen

- Fuel must reach its **ignition temperature** to burn.
- Smaller particle size → faster burning (e.g., wood dust burns faster than a wooden block).
- Surface area affects rate of combustion.

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2. Heat

Heat provides the **energy required to raise the temperature of fuel** to its ignition point.

Sources of Heat:

- Open flames
- Electrical sparks
- Hot surfaces
- Friction
- Chemical reactions
- Welding operations
- Sunlight (in some cases)

Key Temperatures:

- **Flash Point** – Minimum temperature at which a liquid gives off vapors that can ignite.
- **Fire Point** – Temperature at which fuel continues to burn after ignition.
- **Ignition Temperature** – Minimum temperature required to start combustion without external flame.

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3. Oxygen

Oxygen supports combustion. Normally, air contains about **21% oxygen**, which is sufficient for most fires.

Key Points:

- Fire cannot continue if oxygen level drops below **16%**.
- Some materials (like oxidizers) can release oxygen internally and sustain fire.

Working Principle of Fire Triangle

When:

- Fuel is present,
- Sufficient heat is applied,
- Oxygen is available,

➡ Combustion reaction occurs

➡ Fire is produced

➡ Heat generated sustains the reaction

This is a **self-sustaining chain process** as long as all three elements are present.

Principles of Fire Extinguishing –

1. Introduction

Fire extinguishing is based on the principle of **breaking the Fire Triangle (Fuel–Heat–Oxygen)** or the **Fire Tetrahedron (Fuel–Heat–Oxygen–Chain Reaction)**.
If any one of these elements is removed or controlled, the fire will be extinguished.

The four main principles of fire extinguishing are:

1. **Cooling**
2. **Smothering**
3. **Starvation**
4. **Inhibition (Chain Reaction Breaking)**

2. Cooling (Removal of Heat)

□ Principle:

Cooling reduces the temperature of the burning material **below its ignition temperature**, stopping combustion.

Working:

- Heat is absorbed by the extinguishing agent.
- Temperature of fuel decreases.
- Combustion reaction slows down and stops.

□ Common Extinguishing Agent:

- **Water** (most effective cooling agent)

□ Suitable For:

- Class A fires (wood, paper, cloth, rubber)

□ Advantages:

- Easily available
- High heat absorption capacity

□ Limitations:

- Not suitable for electrical fires
- Not suitable for oil/petrol fires (spreads fire)

3. Smothering (Removal of Oxygen)

□ Principle:

Smothering reduces or eliminates oxygen supply to the fire.

Since combustion needs at least **16% oxygen**, reducing oxygen concentration stops fire.

□ Working:

- A blanket of gas, foam, or solid material covers the fire.
- Oxygen supply is cut off.
- Combustion stops.

□ Common Agents:

- CO_2 extinguisher
- Foam extinguisher
- Sand
- Fire blanket

Suitable For:

- Liquid fires (petrol, diesel)
- Electrical fires (CO_2)

4. Starvation (Removal of Fuel)

□ Principle:

Removing combustible material stops fire because fuel is no longer available.

□ Methods:

- Shut off gas supply valves
- Remove nearby combustible materials
- Create fire breaks
- Isolate fuel tanks

□ Applications:

- Industrial plants
- Oil refineries
- Gas storage areas

5. Inhibition (Breaking Chain Reaction)

□ Principle:

Some extinguishing agents stop the **chemical chain reaction** occurring in flames.

This is related to the **Fire Tetrahedron**, where chain reaction is the fourth element.

□ Working:

- Special chemicals react with free radicals in flame.
- Interrupt combustion reaction.
- Fire stops rapidly.

□ Agents Used:

- Dry Chemical Powder (DCP)
- Halon (now banned in many countries)
- Halocarbon compounds

□ Suitable For:

- Electrical fires
- Flammable liquid fires
- Gas fires

FIRE EXTINGUISHERS

PORTABLE FIRE EXTINGUISHERS

1.The term portable is applied to manual equipment used on small, beginning fires or used between the discovery of a fire and the functioning of automatic equipment or the arrival of professional fire fighters.
2. Portable extinguishers are classified to indicate their ability to handle specific classes and sizes of fires.
3. Use Class A extinguishers for ordinary combustibles, such as wood, paper, some plastics, and textiles, where a quenching-cooling effect is required.
4. Use Class B extinguishers for flammable liquid and gas fires, such as oil, gasoline, paint, and grease fires, where oxygen exclusion or a flame interrupting effect is essential.
5. Use Class C extinguishers for fires involving electrical wiring and equipment where the dielectric non conductivity of the extinguishing agent is of first importance. These units are not classified by a numeral, because Class C fires are essentially either Class A or Class B but also involve energized electrical wiring and equipment. Therefore, choose the coverage of the extinguisher for the burning fuel.
6. Use Class D extinguishers for fires in combustible metals, such as magnesium, potassium, powdered aluminum, zinc, sodium, titanium, zirconium, and lithium. Persons working in areas where Class D fire hazards exist must be aware of the dangers in using Class A, B, or C extinguishers on a Class D fire. Of course, they should also know the correct way to extinguish Class D fires. These units are not classified by a numerical system and are intended for special hazard protection only.

Types of Fire Extinguishers

1. Water (APW) Extinguishers
2. Foam Extinguishers
3. Carbon Dioxide (CO_2) Extinguishers
4. Dry Chemical Extinguishers
5. Wet Chemical Extinguishers
6. Class D Extinguishers
7. Class K Extinguishers

1. Water (APW) Extinguishers Class of Fire:

• Class A: Ordinary combustibles (wood, paper, cloth, trash, plastics) Mechanism:
• APW stands for "Air-Pressurized Water."
• Uses water to cool down the burning material, effectively reducing the heat of the flames. Advantages:
• Simple and easy to use.
• Effective for common combustibles.
• Non-toxic and inexpensive.
Disadvantages:

• Not suitable for: Class B (flammable liquids) and Class C (electrical) fires, as water can spread flammable liquids and conduct electricity.

2. Foam Extinguishers Class of Fire

: • Class A: Ordinary combustibles

• Class B: Flammable liquids (oil, gasoline, paints, solvents)

Mechanism: • Forms a blanket over the fire, smothering it and preventing re-ignition. • The foam cools the fire and seals the flammable vapors.

Advantages:

• Effective on both Class A and B fires.

• Prevents re-ignition by forming a barrier between the fuel and the oxygen.

Disadvantages:

• Not suitable for: Class C (electrical) fires, as foam can conduct electricity.

3. **Carbon Dioxide (CO2) Extinguishers Class of Fire:**

• Class B: Flammable liquids

• Class C: Electrical fires Mechanism:

• Displaces oxygen, smothering the fire.

• CO2 is cold as it exits the extinguisher, which helps to cool the fire.

Advantages:

• Leaves no residue.

• Effective on electrical fires without causing damage to equipment.

Disadvantages:

• Not suitable for: Class A fires, as it may not displace enough oxygen to effectively cool down the fire.

4. Dry Chemical Extinguishers Class of Fire:

• Class A, B, and C (multipurpose dry chemical)

• Class B and C (ordinary dry chemical) Mechanism

• Uses a chemical powder to interrupt the chemical reaction of the fire.

• Multipurpose dry chemical extinguishers often use monoammonium phosphate.

Advantages:

• Versatile, can be used on multiple types of fires.

• Provides rapid extinguishing.

Disadvantages:

• Leaves a residue that can be harmful to sensitive equipment.

• May obscure vision temporarily during discharge.

5. Wet Chemical Extinguishers Class of Fire:

• Class K: Cooking oils and fats Mechanism:

• Forms a soapy foam on the surface of the burning oil or fat, preventing re-ignition.

• Contains a special potassium-based solution that reacts with the burning oils/fats to create a layer of foam.

Advantages:
• Highly effective on deep fat fryers and other cooking appliances
. • Cools and smothers the fire simultaneously.
Disadvantages:
• Not suitable for: Class A, B, C, or D fires.

6. Class D Extinguishers Class of Fire:
• Class D: Flammable metals (magnesium, titanium, sodium, etc.) Mechanism:
• Uses a dry powder that absorbs heat and forms a crust to smother the fire.
Advantages:
• Specifically designed for metal fires.
• Prevents the metal from reacting with air or water. Disadvantages:
• Not suitable for: Class A, B, C, or K fires.

7. **Class K Extinguishers Class of Fire**:
• Class K: Cooking oils and fats Mechanism:
• Uses a wet chemical agent that reacts with the cooking fat or oil to form a foam layer
• This process, called saponification, cools the fire and prevents re-ignition.
Advantages:
• Specifically designed for high-temperature cooking oil fires.
• Effective in commercial kitchens. Disadvantages:
• Not suitable for: Class A, B, C, or D fires. Fire Extinguisher Classes and Symbols
• Class A: Green triangle with "A" inside - Ordinary combustibles.
• Class B: Red square with "B" inside - Flammable liquids.
• Class C: Blue circle with "C" inside - Electrical equipment.
• Class D: Yellow star with "D" inside - Flammable metals.
• Class K: Black hexagon with "K" inside - Cooking oils and fats. 29 Sprinkler and Water-Spray Systems

Describe the Classification of Fires and Suitable Fire Extinguishing Agents.

Fires are classified based on the type of fuel involved, and
each class requires a specific extinguishing agent.
Classification of Fires:

1. **Class A Fires**
    1. Involving solid materials like wood, paper, cloth.
    2. Extinguishing agent: Water, foam.
2. **Class B Fires**
    1. Involving flammable liquids like petrol, diesel, oils.
    2. Extinguishing agent: Foam, CO_2, dry chemical powder.
3. **Class C Fires**
    1. Involving flammable gases like LPG, CNG.
    2. Extinguishing agent: Dry chemical powder.
4. **Class D Fires**
    1. Involving combustible metals like magnesium, sodium.
    2. Extinguishing agent: Special dry powders.
5. **Class E Fires**
    1. Involving live electrical equipment.
    2. Extinguishing agent: CO_2, dry chemical powder.

Proper identification of fire class is essential to avoid accidents and ensure effective fire control.

FIRE SAFETY

CLASSES OF FIRE

A	Combustible solids such as wood, paper, and textiles
B	Flammable liquids such as petrol, diesel, and oils
C	Flammable gases such as propane, butane, and methane
D	Combustible metals such as magnesium, eleminium and lithium
E	Electrical equipment * not assigned by NFPA
F	Cooking oils and fats

EXTINGUISHING TECHNIQUE

Pull the pin

Aim at the base of the fire

Squeeze the handle

P A S S

Pull the pin

Aim at the base of the fire

Squeeze the handle

Sweep from side to side

TYPES OF FIRE EXTINGUISHER

Water
Fires involving solids only

Foam
Solids and burning liquids

Dry Powder
Solids, liquids gases, and electrical equipment

CO_2
Burning liquids and electrical equipment

Wet Chemical
Cooking oils and fats

EXTINGUISHING METHODS

- Cooling, e.g, water
- Smothering, e.g. foam, fire blanket
- Starvation, e.g.

• There are many types of sprinklers and water-spray systems for extinguishing fires. The type of building, operations performed in it, and materials used will help determine the type of sprinkler or water-spray system used. Automatic sprinklers are the most extensively used and most effective installations of fixed fire-extinguishing systems.

• There are six basic types of automatic sprinkler systems: wet-pipe, dry-pipe, preaction, deluge, combined dry-pipe and precaution, and limited water-supply systems.

• In the wet-pipe system, which represents the greatest percentage of sprinkler installations, all parts of the system's piping are filled up to the sprinkler heads with water under pressure. Then, when heat actuates the sprinkler, water is immediately sprayed over the area below.

• The dry-pipe system generally substitutes for a wet-pipe system in areas where piping is exposed to freezing temperatures. A good rule of thumb is to use a dry-pipe system when more than 20 sprinklers are involved.

• Precaution systems are similar to dry-pipe systems. However, they react faster and hence minimize water damage in case of fire or mechanical damage to sprinklers or piping.

• The deluge system wets down an entire area by admitting water to sprinklers that are open at all times. Deluge valves that control the water supply to the system are actuated by a fire detection system located in the same area as the sprinklers. This type of system is primarily designed for extra hazard buildings where great quantities of water may have to be applied immediately over large areas.

• The combination dry-pipe and precaution systems are used on installations that are larger than can be accommodated by one dry-pipe valve.

• The limited water-supply system is used for installations that do not have access to a continual or large supply of water. Water-Spray Systems

• Water spray is effective on all types of fires where there is no hazardous chemical reaction between the water and the materials that are burning.

• Water-spray systems can be designed effectively for any one, or any combination, of the following purposes:

• extinguishing fire • controlling fire where extinguishment is not desirable, such as gas leaks

• exposure protection; that is, absorbing heat transferred from equipment by the spray

• preventing fire by having water spray dissolve, dilute, disperse, or cool flammable materials. Dry-chemical piped systems

• have been developed for situations where quick extinguishment is needed, either in a confined area or for localized application, and where reignition is unlikely. These systems are adaptable to flammable liquid and electrical hazards. They can be operated manually or automatically, or be activated at the system or by remote control

. • Automatic or manually controlled steam jet systems can be used to smother fires in closed containers or in small rooms, such as heaters, drying kilns, smoke ovens, asphalt-mixing tanks, and dry-cleaning tumbler dryers. However, such systems are practical only where a large supply of steam is continuously available.

• However, steam has not been found effective on deep-seated fires that may form glowing embers, or in enclosures where the normal operating temperature is not considerably higher than air temperatures. Inert gas systems

• It can prevent fires and explosions by replacing the oxygen in the air with an inert gas, such as CO2, nitrogen, flue gas, or other non-combustible gases, until it reaches a level (or percentage) where combustion will not take place.

• Preventing the development of explosive mixtures is the best defense against explosions. Equipment for handling and storing flammable gases should be designed, constructed, inspected, and maintained so that the danger of leakage and of explosive mixture formation is reduced to a minimum. Explosion suppression system

• It can be used to reduce the destructive pressure of an explosion. These systems are designed to detect an explosion as it is starting and to actuate devices that suppress, vent, or take other action to prevent the full explosive force.

Active vs Passive Fire Protection Systems

Active vs Passive Fire Protection Systems

Aspect	Active Fire Protection System	Passive Fire Protection System
Meaning	Systems that detect and control fire by action	Systems that resist and prevent fire spread
Operation	Operates manually or automatically	Works without activation
Main Function	Detects, alarms, and extinguishes fire	Contains fire and protects structure
Power Requirement	Usually requires power	No power required
Human Involvement	Required (manual / automatic)	Not required
Response Time	Immediate response	Delays fire spread
Examples	Fire extinguishers, sprinklers, alarms, hydrants	Fire walls, fire doors, fire stoppers

Fire stoppers

Fire stoppers (fire stopping systems) are materials and assemblies used to **seal openings and joints in fire-resistance-rated walls, floors, and ceilings** to prevent the spread of:

- 🔥 Flame
- 🌡️ Heat
- 💨 Smoke
- ☠️ Toxic gases

Purpose of Fire Stopping

- **Compartmentation** – Maintains fire-rated separations.
- **Life Safety** – Allows safe evacuation time.
- **Property Protection** – Limits fire and smoke spread.
- **Code Compliance** – Required by building codes worldwide.

Fire Stoppers Are Required

Fire stopping is required at:

- 🔌 Electrical conduit penetrations
- 🚰 Plumbing pipe penetrations
- 💨 HVAC duct openings
- 🧱 Joints between walls and slabs
- 🏢 Curtain wall perimeter gaps
- 🔥 Cable trays and data cable bundles

Types of Fire Stopping Materials

A. Sealants (Fire-Rated Caulk)

- Flexible
- Used around small gaps
- Acrylic, silicone-based

B. Intumescent Materials

- Expand when exposed to heat
- Seal gaps when plastic pipes melt
- Common around PVC pipes

C. Firestop Mortar

- Cement-based
- Used in large openings
- Rigid system

D. Firestop Collars

- Metal collar with intumescent lining
- Wrap around plastic pipes
- Expand to crush the pipe during fire

E. Firestop Wrap Strips

- Used around non-metallic pipes
- Installed inside wall openings

F. Firestop Pillows / Blocks

- Removable
- Used in cable tray openings

G. Fire-Resistant Foam

- Expanding foam
- Used for irregular openings
- Must be fire-rated (not regular spray foam)

Advantages of Proper Fire Stopping

- Saves lives
- Limits smoke migration
- Reduces structural damage
- Ensures legal compliance
- Reduces insurance risk

Hydrant Pipes —

Hydrant piping is a critical part of a **fire hydrant system**, designed to deliver water at required pressure and flow during a fire emergency.

Hydrant pipes are pipelines that connect:

- Fire water storage tank
- Fire pump
- Hydrant valves
- Landing valves / hose cabinets
- Yard hydrants

They form part of a building's **fire protection water distribution system**.

Design and installation are guided by:

- National Fire Protection Association (NFPA 14 – Standpipe & Hose Systems, NFPA 24 – Private Fire Service Mains)
- International Code Council (IBC)
- Bureau of Indian Standards (IS 3844 – Hydrant System)

Purpose of Hydrant Pipes

✓ Supply large quantity of water during fire
✓ Provide water to firefighters
✓ Maintain pressure at all hydrant outlets
✓ Ensure water availability at every floor

Types of Hydrant Piping Systems

A. Wet Riser System

- Pipes always filled with water
- Used in high-rise buildings
- Connected to fire pump

B. Dry Riser System

- Pipes normally empty
- Fire department pumps water during fire
- Used in buildings (up to certain height as per code)

C. Downcomer System

- Vertical pipe from overhead tank
- Water flows by gravity

D. Yard Hydrant System

- Underground piping
- Supplies external hydrant posts

Types of Pipes Used in Hydrant Systems

1. Mild Steel (MS) Pipes

- Most common
- Medium/Heavy class
- Painted red
- IS 1239 / IS 3589 compliant

2. Ductile Iron (DI) Pipes

- Used underground
- High strength
- Corrosion resistant

3. GI Pipes (Galvanized Iron)

- Used in small installations
- Less common for large hydrant systems

4. HDPE Pipes

- Used for underground yard hydrant mains
- Corrosion resistant

5. Pipe Sizing

Pipe diameter depends on:

- Number of hydrants
- Flow requirement
- Building height

Typical Sizes:

- 100 mm (4”) – Main riser
- 150 mm – Large buildings
- 80 mm – Branch lines
- 65 mm – Hydrant outlet connection

Fire Hoses & Monitors

Fire hoses and monitors are **water discharge devices** used in firefighting systems to control and extinguish fires by delivering water (or foam) at required pressure and flow.

Standards commonly referenced:

- National Fire Protection Association (NFPA 14 – Standpipe Systems, NFPA 1961 – Fire Hose, NFPA 1962 – Hose Testing)

FIRE HOSES

- Fire hoses are flexible pipes connected to hydrants.
- They carry water or foam to the fire location.
- Made of rubber or synthetic materials.
- Used by trained personnel for firefighting

A **fire hose** is a flexible pipe used to carry water from:

- Hydrant valve
- Landing valve
- Fire engine
- Monitor outlet

to the fire location.

2. Types of Fire Hoses

A. Delivery Hose (Non-Percolating Hose)

- Rubber-lined
- No water seepage
- Used in hydrant systems
- Most common in buildings

B. Percolating Hose

- Slight seepage through jacket
- Keeps hose cool
- Used in high-temperature areas

C. Suction Hose

- Rigid and reinforced
- Used to draw water from tanks
- Connected to fire pump

3. Hose Construction

A fire hose consists of:

1. **Inner Lining** – Rubber or synthetic (waterproof)
2. **Reinforcement Jacket** – Woven polyester / synthetic fiber
3. **Outer Cover** – Abrasion-resistant

4. Standard Hose Sizes

Common internal diameters:

- 25 mm – Hose reel
- 38 mm – Small hose
- 50 mm (2") – Standard building hydrant
- 63 mm / 65 mm (2.5") – Industrial hydrant

Typical length:

- 15 m
- 30 m

As per Bureau of Indian Standards IS 636:

- Type A – Non-percolating
- Type B – Percolating

FIRE MONITOR:

A **fire monitor** (also called a water cannon) is a high-capacity discharge device that delivers a large volume of water or foam over long distances.

Used in:

- Oil & gas plants
- Refineries
- Warehouses
- Airports
- Chemical industries

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2. Types of Fire Monitors

A. Fixed Monitor

- Permanently installed
- Mounted on pipeline
- Used in industrial areas

B. Portable Monitor

- Can be moved
- Connected to hydrant outlet

C. Trailer-Mounted Monitor

- Mobile firefighting equipment

D. Remote-Controlled Monitor

- Electrically or hydraulically operated
- Used in hazardous areas

3. Monitor Capacity

Typical discharge:

- 500 LPM
- 1000 LPM
- 2000 LPM
- 3000+ LPM

Operating pressure:

- 7–14 bar (depends on design)

4. Monitor Components

1. Inlet flange
2. Swivel joint (horizontal rotation)
3. Elevation adjustment
4. Nozzle (jet/spray/foam)
5. Control handle

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5. Monitor Nozzle Types

- Solid jet nozzle
- Fog nozzle
- Foam nozzle (for flammable liquid fires)

FIRE WATCHERS

A **Fire Watcher (Fire Watch Personnel)** is a trained person assigned to:

- Monitor areas for fire hazards
- Detect early signs of fire
- Take immediate action
- Raise alarm and initiate emergency response

Fire watchers are typically required when:

- Hot work (welding, cutting, grinding) is performed
- Fire protection systems are impaired
- During shutdown or maintenance
- Construction activities in occupied buildings

Duties of a Fire Watcher

✓ Inspect work area before hot work
✓ Remove combustible materials
✓ Keep fire extinguisher ready
✓ Monitor sparks and slag travel
✓ Stay during work and at least 30–60 minutes after completion
✓ Know emergency contact procedures
✓ Maintain fire watch log

Fire Watch During System Impairment

When:

- Sprinkler system is shut down
- Fire alarm system is under maintenance
- Hydrant system is not functional

A fire watcher must:

- Continuously patrol affected areas
- Carry communication device
- Check exits and escape routes
- Immediately report smoke/fire

4. Equipment Required for Fire Watch

- Portable fire extinguisher (ABC or CO_2)
- Communication device
- Flashlight
- PPE (helmet, gloves, safety shoes)
- Fire watch checklist/log sheet

5. Fire Watch Log Details

- Date & time
- Area covered
- Nature of work
- Name of watcher
- Hazards observed
- Corrective actions
- Signature

6. Importance of Fire Watchers

✓ Prevent small sparks from becoming major fires
✓ Compensate when fire systems are down
✓ Ensure compliance with safety codes
✓ Reduce property and life risk

LAYOUT OF STANDPIPES

A **standpipe system** is a vertical piping system installed in buildings to supply water for firefighting at different floor levels.

Purpose of Standpipes

✓ Provide water to upper floors
✓ Reduce need to run hoses from ground level
✓ Support fire department operations
✓ Reduce fire response time

3. Types of Standpipe Systems

A. Class I

- 65 mm (2½") outlets
- For trained firefighters

B. Class II

- 38 mm (1½") hose reel
- For trained occupants

C. Class III

- Combination of Class I and II

4. Wet vs Dry Standpipe

Wet Standpipe

- Always filled with water
- Used in heated buildings

Dry Standpipe

- Normally empty
- Fire department pumps water into system
- Used in parking garages / unheated areas

5. Basic Layout of Standpipe System

1. Water Source

- Underground tank / municipal supply

2. Fire Pump

- Main pump
- Diesel backup
- Jockey pump

3. Vertical Riser (Standpipe)

- Typically 100 mm diameter
- Installed in staircases

4. Landing Valves

- Installed at each floor
- Located in fire-rated stairwell

5. Hose Connections

- Fire department connection (FDC) at ground level

6. Isolation Valves

- At base of riser
- For maintenance

6. Standpipe Location Requirements

As per codes:

✓ Installed in enclosed staircases
✓ Within protected shafts
✓ Accessible to firefighters
✓ Maximum travel distance limits (as per NFPA 14)

Usually:

- One standpipe per stairwell
- Required in buildings over 3–4 stories (varies by code)

7. Pipe Sizing & Pressure

Typical requirements (as per National Fire Protection Association NFPA 14):

- Minimum 100 mm riser

- 500–1000 GPM flow (depending on building class)
- Minimum 7 bar at topmost outlet (varies by hazard)

Pressure regulating valves (PRV) may be required in high-rise buildings to avoid excessive pressure at lower floors.

8. Standpipe Layout Variations

Single Riser System

- One vertical pipe
- Small/medium buildings

Multiple Riser System

- Multiple staircases
- Large buildings

Loop System

- Interconnected risers
- Improves reliability

9. Testing & Commissioning

✓ Hydrostatic test (1.5 times working pressure)
✓ Flow test at top outlet
✓ Check PRVs
✓ Pump performance test

Fire Station

- Fire station is a central place for firefighting operations.
- Equipped with fire trucks, pumps, ladders, and rescue tools.
- Provides quick emergency response.
- Includes communication and control facilities.

Fire Alarm Systems:

Fire alarm systems are critical for detecting fires early and alerting occupants to evacuate. They can also notify emergency services, helping to mitigate damage and ensure safety. Here are the main types of fire alarm systems

Local Alarm Systems Overview:

• Local alarm systems are designed to alert the occupants of a building to the presence of a fire.
Components:

• Detectors: Smoke, heat, or flame detectors that sense fire.

• Alarms: Bells, sirens, or flashing lights that notify occupants.

• Control Panel: Manages the signals from detectors and triggers alarms.

Operation:

• Detection: When a detector senses a fire, it sends a signal to the control panel.

• Alarm Activation: The control panel activates the alarms, alerting occupants.

• No External Notification: These systems do not automatically notify emergency services.

Advantages:

• Simplicity: Easy to install and maintain.

• Cost-Effective: Generally less expensive than more complex systems.

• Immediate Notification: Quickly alerts building occupants.

Limitations:

• No External Alert: Requires manual notification of emergency services.

• Limited to Building: Only alerts those within the building

Applications:

• Medium to Large Buildings: Suitable for schools, commercial buildings, and industrial facilities.

Central Station Systems Overview:

• Central station systems are monitored by an external central monitoring station, providing continuous oversight and immediate emergency notification.

Components:

• Detectors: Smoke, heat, or flame detectors.

• Alarms: Bells, sirens, or flashing lights. •

Control Panel: Manages signals and alarm activation.

• Communication Link: A connection to a central monitoring station, often via phone lines or the internet. Operation:

• Detection: A detector senses a fire and sends a signal to the control panel.

• Alarm Activation: The control panel activates local alarms.

• External Notification: The control panel sends a signal to the central monitoring station.

• Monitoring: The monitoring station assesses the alarm and contacts emergency services if necessary.

Maintenance of Fire Trucks

- Includes engine and pump inspection.
- Hoses, ladders, and tools are checked regularly.
- Fuel, battery, and brakes are maintained.
- Ensures readiness during emergencies.

Foam Generators

- Foam generators produce firefighting foam.
- Foam is made by mixing water, air, and foam concentrate.
- Used for flammable liquid fires.
- Common in refineries and airports.

Escape from Fire and Rescue Operations

Escape from fire and rescue operations are planned actions taken to save human life during fire emergencies. Proper escape methods and organized rescue operations reduce panic, injuries, and loss of life.

Escape from Fire

1. **Remain calm and raise alarm**
   As soon as fire is noticed, the alarm should be raised to alert everyone in the building. Panic should be avoided to ensure safe movement.
2. **Use safe escape routes**
   Occupants should use staircases and emergency exits and never use lifts during fire. Exit routes must be clearly marked and free from obstructions.
3. **Protection from smoke**
   Smoke is more dangerous than fire. People should crawl low under smoke and cover their nose and mouth with a wet cloth to avoid inhalation.
4. **Closing doors and windows**
   Doors and windows should be closed while escaping to prevent the spread of fire and smoke.

5.Assembly at safe place

After escape, everyone should gather at a designated assembly point for head count and Safety confirmation

Rescue Operations

1. **Search and rescue**
   Firefighters search for trapped persons and rescue them safely using ladders, ropes, and breathing apparatus.
2. **Evacuation**
   Injured and vulnerable persons such as children and elderly are evacuated first.
3. **Fire control and containment**
   Fire is controlled using appropriate extinguishing agents to prevent further spread.
4. **First aid and medical assistance**
   Immediate first aid is given to victims before shifting them to hospitals

Fire Drills

Fire drills are simulated fire emergency exercises conducted to train people on how to respond during real fire situations. They improve preparedness and safety awareness.

Importance of Fire Drills

1. **Training employees and occupants**
   Fire drills educate people about evacuation routes, alarms, and safety procedures.
2. **Reducing panic during real fire**
   Regular drills make people familiar with emergency actions, reducing fear and confusion.
3. **Testing fire safety systems**
   Fire alarms, sprinklers, and emergency lighting are checked during drills.
4. **Improving evacuation time**
   Fire drills help in reducing evacuation time and ensuring orderly movement.
5. **Identifying weaknesses** : Problems like blocked exits and faulty alarms are identified and corrected.

First Aid for Burns

Burns are injuries caused by heat, fire, chemicals, electricity, or radiation. Immediate first aid reduces pain, prevents infection, and limits damage.

Types of Burns

1. **First-degree burns** – Affect outer skin layer
2. **Second-degree burns** – Affect deeper skin layers with blisters
3. **Third-degree burns** – Severe burns damaging tissues

First Aid Treatment

1. **Remove victim from source**
   The injured person should be moved away from fire or heat source safely.
2. **Cool the burn**
   The burnt area should be cooled under clean running water for at least 10–15 minutes.
3. **Remove tight objects**
   Rings, watches, or tight clothing should be removed before swelling occurs.
4. **Do not burst blisters**
   Blisters should not be broken as it may cause infection.
5. **Cover the burn**
   Cover the burn with a clean, sterile cloth or dressing.
6. **Seek medical help**
   Serious burns should receive immediate medical attention.

UNIT-5

BUILDING FIRE SAFETY

Objectives of Fire-Safe Building Design

Fire-safe building design aims to **reduce risk, protect life, and limit damage** during a fire. The main objectives are:

1. **Life Safety**
    1. Protect occupants from injury or death.
    2. Ensure safe and quick evacuation through adequate exits, staircases, and signage.
2. **Early Detection and Warning**
    1. Detect fire at an early stage using smoke detectors and alarms.
    2. Provide clear audible and visual warnings to occupants.
3. **Fire Prevention**
    1. Reduce chances of fire ignition by proper electrical design, safe materials, and good housekeeping.
    2. Separate hazardous areas from occupied spaces.

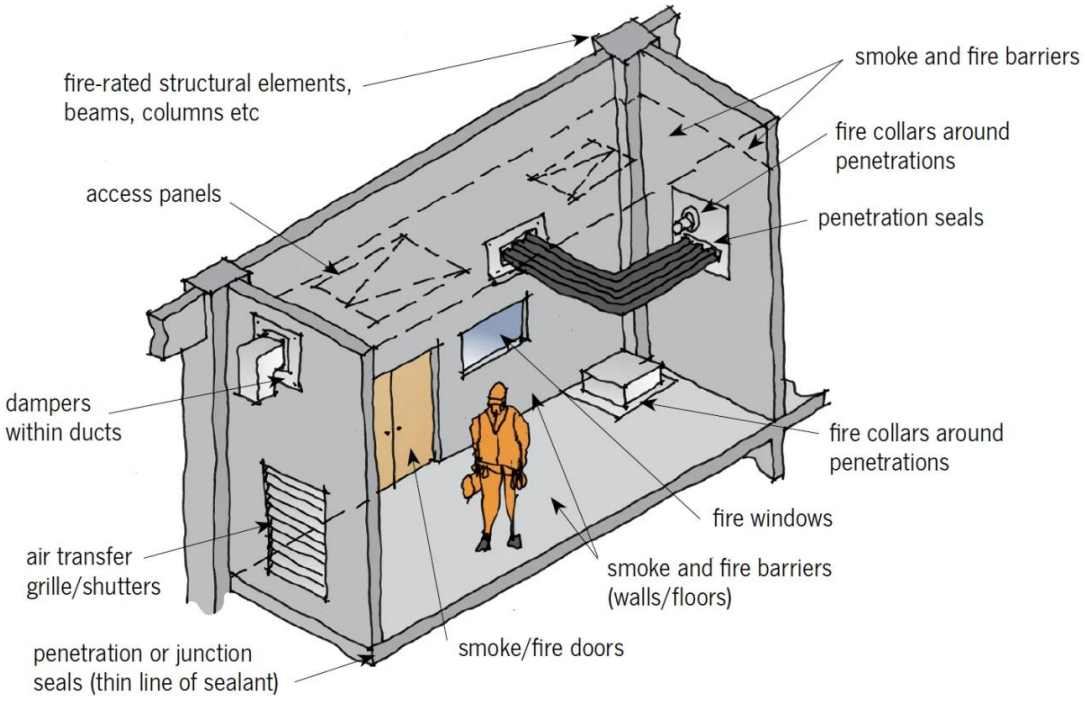

Figure 1. Passive fire protection building components

4.Fire Containment

- Limit the spread of fire and smoke using fire-resistant walls, floors, doors, and compartmentation.
- Control smoke movement to keep escape routes usable.

5.Structural Stability

- Maintain building strength for a specified time during fire.
- Prevent premature collapse to allow evacuation and firefighting.

6.Safe and Efficient Evacuation

- Provide sufficient number and width of exits.
- Design clear escape routes, emergency lighting, and refuge areas.

7.Firefighting Access and Facilities

- Enable easy access for fire services.
- Provide fire hydrants, sprinklers, fire lifts, and fire control rooms.

8.Property Protection

- Minimize damage to building, equipment, and contents.
- Reduce economic loss and downtime.

9.Compliance with Codes and Standards

- Meet requirements of fire safety codes (NBC, local fire regulations).
- Ensure legal safety and occupancy approval.

10.Post-Fire Safety

1. Reduce toxic smoke and heat.

Fire Load

Fire load is the **total amount of combustible material** present in a building, expressed as **heat energy per unit floor area**.

- **Definition:** Total potential heat released if all combustible materials burn.
- **Unit:** MJ/m² (or kcal/m²)
- **Formula:**

Fire Load= $\sum(W \times H)/A$

Where
W = weight of combustible material (kg)
H = calorific value (MJ/kg)
A = floor area (m²

Importance:

- Decides **fire risk level**, **type of construction**, and **fire-protection systems**.

Fire-Resistant Materials

Materials that **withstand fire for a specified time** without losing strength or integrity.

Common fire-resistant materials:

- **Concrete**
- **Fire clay bricks**
- **Asbestos-cement sheets**
- **Fire-resistant glass**
- **Vermiculite / perlite boards, Brick masonry** and **Gypsum board**

Fire Testing

Fire testing evaluates how long a material or element can resist fire under **standard conditions**.

Purpose:

- Determine **fire resistance rating** (30, 60, 90, 120 minutes)
- Check **strength, integrity, and insulation**

Types of fire tests:

1. **Fire resistance test** – Structural members (walls, beams, columns)
2. **Flame spread test** – Surface materials
3. **Ignitability test** – Ease of catching fire
4. **Smoke density test** – Amount of smoke produced

Standard testing:

- Carried out in **furnace tests** as per building/fire codes.

Structural fire protection

Designing and protecting **load-bearing elements** (columns, beams, slabs) so they **retain strength and stability during fire** for a fixed time, preventing collapse and allowing **safe evacuation and firefighting**.

Objectives

- Ensure **life safety**
- Prevent **sudden/progressive collapse**
- Provide adequate **Fire Resistance Rating (FRR)**
- Limit **fire spread**
- Protect **property**
- Follow **fire safety codes**

Fire Behaviour of Materials

- **Reinforced Concrete:**
  Good fire resistance; concrete cover protects steel; strength loss is slow
- **Steel:**
  Very strong normally; loses strength above **550°C**; needs protection
- **Timber:**
  Combustible; chars slowly; resistance improved with fire-retardant treatment

Protection Measures, FRR & Benefits

Structural Fire Protection Measures

- **Fire-resistant construction:** RCC, brick masonry, fire clay bricks
- **Member protection:**
  - RCC: extra concrete cover
  - Steel: intumescent coating, fireproof spray, concrete encasing
  - Timber: fire-retardant chemicals, protective boards

Fire Resistance Rating (FRR)

- Time a member resists fire: **30, 60, 90, 120, 180 min**
- Depends on material, size, load, and protection method

Compartmentation

- Divide building into fire compartments
- Use fire-resistant walls, floors, doors

Advantages

- Saves **lives**
- Reduces **damage and loss**
- Gives more **evacuation time**

Improves **overall building safety**

Structural Integrity

Structural integrity is the ability of a building to **remain stable and safe** during fire, without sudden collapse.

Key points:

- Structure should withstand **fire, heat, and loads**
- Prevent **progressive collapse**
- Maintain stability for **safe evacuation & firefighting**
- Achieved by fire-resistant materials and proper design

Concept of Egress Design

Egress design means **safe movement of people out of a building** during fire or emergency.

Includes:

- Exit access (corridors, passages)
- Exits (doors, staircases)
- Exit discharge (open safe area)

Requirements:

- Clear and unobstructed paths
- Adequate number of exits
- Proper signage and emergency lighting
- Fire-resistant staircases

Exit – Width Calculations

Exit width depends on **number of occupants**.

General principles:

- Width must allow **quick and safe evacuation**
- Based on **occupant load**
- Stairways and doors should not be narrow
- Multiple exits preferred to avoid congestion
- **Occupant load** = number of persons expected to use the exit.
- Fire codes specify a **minimum width per person/unit** to ensure **safe and quick evacuation**.
- **Total exit width = occupant load × required width per person**, distributed among **doors, corridors, and staircases**.

Fire Certificate

Fire certificate is an **official approval issued by the Fire Department** stating that a building **complies with prescribed fire safety norms and regulations**.

Purpose of Fire Certificate

- Ensure **life safety** of occupants
- Confirm availability of **fire protection systems**
- Permit **occupancy and use** of the building
- Reduce **fire risk and property loss**

When is it Required?

- High-rise buildings
- Commercial and industrial buildings
- Educational institutions, hospitals, malls
- Public assembly buildings

Republic of the Philippines
Department of the Interior and Local Government
BUREAU OF FIRE PROTECTION
NATIONAL CAPITAL REGION
FIRE DISTRICT IV
Taguig City Fire Station
Central Fire Station Radian St. Arca South Western Bicutan Taguig City
837-4496/837-0740/356-9423/taguigcityfirestation_fses@yahoo.com

FSIC NO. R16 16-1843841 — 2/26/2021 DATE

FIRE SAFETY INSPECTION CERTIFICATE

☐ FOR CERTIFICATE OF OCCUPANCY
☐ FOR BUSINESS PERMIT (NEW/RENEWAL)
☐ OTHERS

TO WHOM IT MAY CONCERN:

By virtue of the provisions of RA 9514 otherwise known as the Fire Code of the Philippines of 2008, the application for FIRE SAFETY INSPECTION CERTIFICATE of BLAST FUNCTIONAL FITNESS, INC. (Name of Establishment) owned and managed by BLAST FUNCTIONAL FITNESS, INC. (Name of Owner/Representative) with postal address at UNIT R-308 31ST 2ND AVE, FORT BONIFACIO, CITY OF TAGUIGFort Bonifacio (Address) is hereby GRANTED after said building structure or facility has been duly inspected with the finding that it has fully complied with the fire safety and protection requirements of the Fire Code of the Philippines of 2008 and its Revised Implementing Rules and Regulations.

This certification is valid for BUSINESS (Description) valid until 2/26/2022

Violation of Fire Code provisions shall cause this certificate null and void after appropriate proceeding and shall hold the owner liable to the penalties provided for by the said Fire Code.

Fire Code Fees:
Amount Paid: 1376.49
O.R. Number: 5071146A
Date: 1/17/2021
019-05150263

RECOMMEND APPROVAL:
SINSP ALEXANDER DALE Q BAENA
CHIEF, Fire Safety Enforcement Section
APPROVED:
SUPT BERNARDT ROSETE
CITY/MUNICIPAL FIRE MARSHAL

NOTE: "This Certificate does not take the place of any license required by law and is not transferable. Any change in the use of occupancy of the premises shall require a new certificate."

THIS CERTIFICATE SHALL BE POSTED conspicuously

PAALALA: "MAHIGPIT NA IPINAGBABAWAL NG PAMUNUAN NG BUREAU OF FIRE PROTECTION SA MGA KAWANI NITO ANG MAGBENTA O MAGREKOMENDA NG ANUMANG BRAND NG FIRE EXTINGUISHER"

Applicant/Owner's COPY "FIRE SAFETY IS OUR MAIN CONCERN"

BFP-QSF-FSED-005 Rev. 03 (03.03.20)

Issued After Checking

- Fire exits and staircases
- Exit width and egress design
- Fire detection and alarm systems
- Sprinklers, hydrants, extinguishers
- Fire lifts and access roads
- Emergency lighting and signage

Validity of Fire Certificate

- The **fire certificate is valid for a specified period** (usually **1 to 3 years**, as per fire authority rules).
- After this period, it **must be renewed** through **inspection by the Fire Department**.
- Renewal ensures all **fire safety systems are in proper working condition**.

Fire Safety Requirements for High-Rise Buildings

A **high-rise building** requires special fire safety measures because evacuation and firefighting are difficult at greater heights.

Main Fire Safety Requirements

1. **Fire-Resistant Structure**
    1. Use of RCC and fire-resistant materials
    2. Adequate **fire resistance rating (FRR)** for columns, beams, and slabs
2. **Means of Escape**
    1. Minimum **two fire-escape staircases**
    2. Fire-resistant, **pressurized staircases**
    3. Adequate **exit width** based on occupant load
3. **Fire Detection & Alarm System**
    1. Smoke detectors on all floors
    2. Manual call points and audible alarms
4. **Fire Suppression Systems**
    1. Automatic **sprinkler system**
    2. Internal and external **fire hydrants**
    3. Fire extinguishers on every floor

5.Fire Lifts

4. Special lifts for **firefighters' use** 2. Operable during fire emergencies.

6.Refuge Areas

1. Safe areas provided at **regular floor intervals**
2. Used for temporary shelter during evacuation

7.Emergency Lighting & Signage

1. Illuminated exit signs

   Emergency lighting in corridors and staircases

8.Fire Control Room

1. Central control to monitor alarms, sprinklers, and communication

9.Access for Fire Services

1. Fire tender access roads around the building
2. Adequate open space for firefighting operations

10.Fire Certificate

- Mandatory approval from Fire Department
- Periodic inspection and renewal