Hazard Identification and Risk Assessment in Manufacturing Plant

D. Sriram¹, B. Surender², S. Saravanakumar³, M. G. Rajagopal⁴, S. R. Arun⁵

PG Scholar¹, Assistant Professor²,³,⁴,⁵

Department of Mechanical Engineering (M.E Industrial Safety Engineering)
Excel College of Engineering and Technology, Komarapalayam, Tamil Nadu, India

Abstract:
In this project, FLSmidth at Arakkonam Foundry Division to be fruitful it is to distinguish the Hazards to survey the related risks and to bring the risks to fair dimension. Danger recognizable proof and hazard investigation is conveyed for unfortunate occasions that can prompts a danger, the examination of risk system by which this bothersome occasion could happen and more often than not the estimation of degree, size and probability of destructive impacts. It is broadly acknowledged inside foundry as a rule that the different systems of hazard evaluation contribute enormously toward enhancements in the wellbeing of complex tasks and gear. At the point when machine-related mechanical risks can't be disposed of through innately safe structure, they should then be diminished to an adequate dimension, or the hazards that reason them must be separated from the laborers by watchmen that permit the base security separations to be regarded. The vast majority of the risks identified with mechanical hazards can be decreased to satisfactory powers or vitality levels by applying a hazard decrease methodology. If this is inconceivable, the risks must be detached from individuals by gatekeepers that keep up a security separate between the threat zone and the general population, with the primary outcome being to lessen access to the risk zone.

1. INTRODUCTION

1.1 INTRODUCTION ABOUT INDUSTRIAL SAFETY ENGINEERING

Basic Need for Human Being
Abraham Maslow, a famous economist, and researcher found out a theory of hierarchy of human needs. There are five different levels in Maslow’s hierarchy of needs.
• Physiological needs.
• Safety & Security needs.
• Social Needs.
• Esteem needs.
• Self-Actuating needs.

In the progressive system of human needs, Physiological necessities are the essential needs, which are fundamental to survival, for example, the requirement for sustenance, water, air and asylum. These are the most fundamental and intuition needs in the progressive system of necessities.

Safety as a Basic Need for Human
In the crude day’s individual needed to spare him from the hazards of wild creatures, harmful creepy crawilies, substantial downpour, and flood and so on. After development, the risks are manmade. These dangers are emerging for the most part from workplace, for example, production line, Office, transport, eatery, and emergency clinic and so on.

Safety Definitions
In beginning of wellbeing development, the meaning of security was given as the condition or condition of being sheltered, free from risk or hazards that is exempted from hurt, damage or misfortunes. However, at this point as per ISO 18001:2000 Occupational Health and Safety Management System determines the new definition that is “Wellbeing is a State in which the danger of mischief to individual or harm to property is constrained to average dimension”.

1.2 HISTORY OF INDUSTRIAL SAFETY
Advancement in Industrial Safety before 1911 was not huge with no Workmen's Compensation laws all states handle modern wounds under the customary law. Before Workman Compensation Legislation, the harmed employee for the wounds endured. The employee contributed to the cause of the accident. □ The employee knew the hazards involved in the work before the accident. □ There was sustained and still agree to work in the condition for work. □ There was no employer negligence.

First Statutory Law for Industrial Safety Movement
In 1908 the province of New York passed the primary Workmen's Compensation Act, which stated, as a result that paying little heed to blame, the executives would pay for wounds at work. After 1911 in USA the wellbeing the board wound up in the situation by methods for enactment, which paying for wounds at work, it was chosen that keeping mishap from event would be monetarily sounder than paying them. This choice by ventures and the executives brought forth composed security development. During the period of mechanical improvement in western nations and UK, alongside quick modern advancement, mishap in processing plants likewise expanded, attributable to muddled. Hardware, complex occupation prerequisites and quick moving generation lines considering expanded episodes and human torment, individuals started to give thought with respect to how to counteract mishap in enterprises. As an outcomes government in these nations confined an Act and Rules, for example, Workman Compensation Act, which sets down tenets that the administration should pay remuneration for the wounds happening amid their work to their representatives. In India laborers pay Act was passed and came to presence from the year 1923.

Improving Working Conditions
In the early long periods of wellbeing development, the board focused intensely on revising unsafe physical conditions. This delivered exceptional outcomes amid the initial 20 years. This was the initial step, conceivably because conditions were so clearly terrible furthermore, conceivably since individuals trusted that these conditions were really the reasons for the damage.
Heinrich’s Safety Philosophy
In 1931 the principal version of H.W. Heinrich's book Industrial Accident Prevention was distributed in U.S.A. In it he recommended that dangerous demonstrations are the reasons for high level of mishaps, that individuals cause a larger number of mishaps than perilous conditions. After Second World War just the modern Safety development began gain energy. This was a result of quick industrialization caused progressively number of mishaps in ventures, so the board required much exertion to anticipation of mishap and wellbeing develops as a designing order. In recent years, the administration and different statutory bodies outlines security tenets to advance the wellbeing in workplace. Those bodies not just focus on the specialist’s wellbeing the concentrated on Environmental Issues which causes the ecological contamination and influence the encompassing condition straightforwardly. To make mindfulness about social obligations these bodies made different guidelines and guidelines. The Safety Department centres that principles and guideline to agree.

1.3 INTRODUCTION ABOUT THE INDUSTRY
Organization History
FLSmith (FLS), established in the year 1882, is the world’s leading total supplier of cement technology, minerals processing equipment and services with more than 15000 employees worldwide. The company is operated globally from the corporate centre in Denmark and through project and engineering centres in USA and India. FLS has had a significant presence in India since the early sixties. Over the years, FLS, India has built modernized or revamped numerous plants and systems in India and abroad.

Arakkonam Foundry Division - AFD
- Foundry Project conceptualized in the middle of 2007 and inaugurated on 30th April,2009.
- Quality Management System certified to ISO 9001.
- Implementation of HSE Management system in compliance with OHSAS 18001 underway.
- Installed capacity-2250 tons per annum with a modern cyclic operation system.
- Current annual production - 900 tons.
- Product weight ranges from 1 Kilogram to 1000 Kilograms.
- Product covered so far is Heat Resistant (MAT 5830/5840/5850-ASTM A 297 Grade HH & HK), Wear resistant and other steel grades.
- FLS Quality assurance.
- Excellent on time delivery record.
- Competitive pricing.
- Experienced staff

Road Map of AFD

Figure 1.1 Road Map of AFD

1.4 INTRODUCTION ABOUT COMPANIES POLICIES
Quality Philosophy of AFD
Objective
- Produce quality castings on time in a competitive manner for projects and after sales service groups within cement and mineral industries.
- Strive for continual development of the processes and improve cost effectiveness.
- Strive to maintain excellent relationship with all stakeholders.
- Ensure health and safety of personnel.
- Protect the environment and recycle most of the by-products and save energy.

AFD Reporting Structure

Figure 1.3 AFD Reporting structure

2. SAFETY MEASURES
2.1 SAFETY MEASURE TOOLS
Security Measures are the key components which are utilized to spare the general population from the hazard. There are different number of instruments are utilized to diminish the hazard, that are:
2.1.1 Fire Extinguishers

- Fire dousers are commonly utilized in businesses to shield the specialists from flame mishaps by keeping them from spreading.
- Fire quenchers are kept in spots over the plant where it very well may be effectively gotten to by the representatives.
- Old fashioned handle type fire dousers were supplanted totally with the crush type as it is easy to understand while working.
- Almost every employee in shop floor was trained to handle fire extinguishers through training.
- In AFD, totally 350 extinguisher were employed across the plant.
- Standard Operation for Fire Extinguisher
  - Pull the safety clip/pin.
  - Aim the target.
  - Squeeze the lever or plunger/knob.
  - Sweep side to side.

2.1.2 Fire Hydrant System

- Fire hydrant framework is a sort of flame smothering framework which primarily utilizes water at a high weight as a stifling medium.
- Fire hydrant framework needs a tremendous measure of water to put off flame, which for this situation is enhanced by capacity tank.
- Fire hydrants utilize three siphons like Main siphon, Jockey siphon, Diesel Engine Pump.
- The force for the hydrant is created by main pump.
- Jockey siphon is a 1HP fly engine which is utilized to keep up the weight (6 bar) in the hydrant framework.
- When the weight in the hydrant framework decreases beneath 4bar fundamental siphon joins with the racer siphon to keep up the weight.

2.1.3 Fire Hydrant Details

- Total Hydrant Access Point: 30 No’s
- Tank Capacity: 2,20,000 lit

2.1.4 Fire flooding system

- Flooding frameworks is a sort of flame concealment frameworks which stifle the fire before even it begins spreading and, in this manner, bringing it levelled out.
- It releases substantial measure of quenching medium (here it is CO2) in a small amount of time.
- Semi programmed Co2 flooding framework is utilized in persistent procedure plant which are inclined to flame sparks.

2.1.5 Fire Hose Reel

- A Hose Reel is a round and hollow axle made both of metal, fiberglass, or plastic and is utilized for putting away a hose.
- The most basic styles of hose reels are spring driven (which is self-withdrawing), hand wrench, or engine driven.
- Hose reels are arranged by the measurement and length of the hose they hold, the weight rating and the rewind technique.
- Hose reels can be fixed in a permanent location.

2.1.6 Fire Alarm Systems

- Fire caution frameworks comprise of smoke/fire finders and alert framework which are associated with the control board.
- The alarm system may be automatically actuated or manually actuated or both.
- These caution and finder framework are set over the region which should have been ensured against flame.
- These signals are nourished into the control board which cautions/educates the proximate people of the need to make a move, for the most part to empty.
- This is finished by methods for a blazing light, strobe light, electromechanical horn, “beeper horn”, ring, ringer, speaker, or a blend of these gadgets. The System Sensor Advance Horn makes a signalling sound and electromechanical sound together.
- In AFD designing structure, office, Telephone Exchange, substations are ensured with smoke identifiers alongside alerts.

- Diesel Engine pump is used for circulating water for hydrant systems.
- The hydrant points are checked daily whether it is functioning properly or not.
2.1.7 Sprinkler Systems

- Sprinkler frameworks consequently distinguish and after that control, stifle, or quench fires.
- Distribution channels send water to the sprinkler heads utilizing a city water source to keep up and increment water weight as indicated by plan criteria.
- Auto sprinklers with storm valve framework are utilized in paint / synthetic stores and LPG yard as a fire concealment framework, which are fire centre zones in AFD.

2.2 ENGINEERING SAFETY CONTROL SYSTEMS

Two Hand Operated Push Button

- In AFD practically all work is done in machines and generally the administrators are trainee, which force the opportunity for tomfoolery and perilous act which may prompt wounds.
- In request to keep this wound, rather than working the machines with a solitary hand two hand pushbuttons are utilized.
- Unless the two catches are worked all the while the machine won't work, which keep the administrator from expanding his hand into the working zone.
- Thus, the safety is ensured in shop floor through engineering controls.

Guard System

Safety Light Curtains/Safety Sensors recognize the interruption of fingers, hands, arms, legs or human bodies into risky territories.
- They feature fail-safe designs that detect internal circuit failures to ensure safety.
- A photoelectric transmitter extends a variety of synchronized, parallel infrared light shafts to a collector unit.

At the point when a hazy article interferes with at least one pillars the control rationale of the light drape sends a stop flag to the monitored machine.

3. RISK ASSESSMENT

At the point when machine-related mechanical hazards cannot be dispensed with through inalienably safe plan, they should then be decreased to an adequate dimension, or the dangers that reason them must be confined from the specialists by gatekeepers that permit the base wellbeing separations to be regarded. The greater part of the dangers identified with mechanical hazards can be diminished to satisfactory powers or vitality levels by applying a hazard decrease methodology. If this is inconceivable, the risks must be secluded from individuals by watchmen that keep up a security separate between the threat zone and the general population, with the fundamental outcome being to lessen access to the risk zone.

The main factors to be taken into consideration so that guards are effective are:

- The accessibility to the danger zone by the different parts of the human body.
- The anthropometric dimensions of the different parts of the human body.
- The measurements of the threat zones just as their situation in space and in connection to the ground or the working stage.

Hazards of Mechanical

1. Mass, velocity (kinetic energy of the controlled or uncontrolled moving components)
2. Acceleration, force
3. Potential energy, namely the accumulation of energy inside the machine produced by:
   - Elastic components (springs, etc.)
   - Gases/liquids under pressure (hydraulic, pneumatic, etc.)
   - Vacuum/pressure effect

A. Hazards associated with components and tools:

- Moving components and tools
- Relative location of moving components and tools
- In-running nips (rollers, conveyors, etc.)
- Inadequate strength
- Hazardous shapes (cutting, pointed, rough, etc.)

B. Hazards associated with gravity:

- Mass and stability (components or worker falling under the effect of their weight)
C. Electrical hazards
- Live conductors
- Live machine components
- Electrostatic hazards

D. Thermal hazards
- Objects or materials at extreme temperatures (high or low)
- Presence of fire or blast; nearness of water and liquid metal
- Radiation from wellsprings of warmth; cold or hot workplace, and so on.
- Noise
- Vibration
- Radiation
- Low frequency, radio frequency, microwave, X-ray, and gamma radiation.
- Laser/infrared, visible and ultraviolet light, etc.

E. Hazards produced by materials, products, contaminants:
- Hazardous materials (harmful, toxic, corrosive, reactive, humid, teratogenic, carcinogenic, mutagenic, or irritating)
- Infectious materials, and combustible, flammable, oxidizing or explosive materials, compressed gases, etc.

F. Hazards produced by non-respect of ergonomic principles:
- No neutral posture, force, repetition, absence of micro-breaks, frequent handling
- Inadequate lighting, etc.
- Inadequate visibility, poor location of controls
- Difficult access to the working space, layout of premises, etc.

G. Plan of the guide
- Is the danger zone, which is located above, accessible from below?
- Is the danger zone accessible from above the guard?
- Is the danger zone accessible through one of the openings in the guard?
- Is the danger zone accessible from below the guard?

Definition of the terms used in the guide risk analysis:
Combination of the determination of the limits of the machine, hazard determination (also called identification), and risk estimation.

H. In-running nip or convergence zones
Danger points at the rollers, reels, barrels, or drums whose development makes a narrowing and is the reason for a danger of parts of the body or the entire body being attracted between:
- Two rollers, power-operated or not, turning in opposite directions.
- A turning roller and a stationary component of the machine.
- Rollers turning a similar way or transport lines moving a similar way and with various velocities or surfaces (friction).
- One roller and transmission belts, a conveyor, and potentially, a sheet of material.
- There are also convergence zones on the non-powered rollers (guiding rollers) driven by the sheet of material.
- The risk level can be related to different factors such as the type and strength of the material, the winding angle, and the velocity of the sheet of material and the moment of inertia.

4. RISK ANALYSIS
A risk analysis has three steps:
- Determining the limits of the machine.
- Determining (identifying) the hazards.
- Estimating the risks.

I. Determining the limits of the machine
The absolute initial phase in the hazard the executive’s procedure includes setting up the cut off points of the hazard evaluation. Toward the finish of this progression, you should probably depict the conditions in which the machine will be utilized: who will utilize the machine, for to what extent, with what materials, and so forth.

The machine's life cycle (structure, establishment, use, unsticking, support, and transfer), predictable utilizations, and the clients' normal dimension of experience are also established. Only once these conditions have been determined can hazard identification and risk estimation begin.

J. Identifying the hazards
Hazards are the reason for every dangerous circumstance. At the point when presented to a danger, a specialist is in a perilous circumstance, and the event of a dangerous occasion prompts a mishap that can result in damage. Hazard distinguishing proof is a standout amongst the most essential strides in the hazard the board procedure. The rundown of hazards must be cautiously settled.

The CSST's data unit can be valuable for this. A list of all the vitality sources or all the man-machine interfaces that can influence the wellbeing and security of uncovered specialists must be cautiously settled, regardless of whether they are moving components (mechanical hazard), energized segments (electrical hazard), machine parts that are excessively hot or excessively chilly (warm hazard), commotion, vibration, unmistakable (laser) or undetectable radiation

5. RISK ESTIMATION
Risk estimation consists of comparing the different hazardous situations identified. This relative comparison establishes an action priority, for example. Risk is characterized as the mix of the seriousness of the damage (S) and the likelihood of event of this mischief.

The probability of the harm occurring can be divided into three parts:
1. The frequency and duration of exposure to the hazard (F).
2. The probability of a hazardous event occurring (O).
3. The possibility of avoiding or reducing the harm (A).

K. Severity of the harm (S)
The seriousness of the damage can be evaluated by considering the seriousness of the wounds or unfriendly wellbeing impacts. The proposed choices are:
S1- Minor injury (normally reversible). For example: scrape, laceration, bruise, slight injury, etc.
S2- Serious injury (normally irreversible, including death). For example: limb broken or torn out, serious injury with stitches, etc.

L. Frequency or duration of exposure to the hazard (F)
The exposure can be estimated by taking into consideration:
- The need to access the danger zone (for example, for normal operation, maintenance, or repairs).
- The reason for access (for example, manual feeding of materials).
- The time spent in the danger zone.
• The number of people that must access it. The frequency of access.

6. PROTECTION BY REDUCING THE FORCES AND ENERGY LEVELS OF MOVING COMPONENTS

At times, the powers and vitality dimensions of moving segments can be constrained so as to take out damage to the human body. This standard, which depends on risk decrease, can be connected just if the moving parts have qualities that guarantee the required wellbeing capacity (nonappearance of sharp edges, cutting segments, and so forth.).

In this case, the following factors must be taken into consideration:
• Accessibility of the danger zone.
• Anthropometric dimensions.
• Kinetic energy.
• Pressure on parts of the body.
• Shapes and dimensions of the contact surfaces.
• Reliability of the system (optional).
• Response time of the mechanisms (optional).

1. Creation of in-running nips
In-running nips can be created either:
• By cylinders in contact (or very close) turning in opposite directions.
• By two cylinders not in contact.
• By a cylinder close to a stationary object.
• By a cylinder in contact with a belt (chain) or the worked material.

6. PROTECTION BY REDUCING THE FORCES AND ENERGY LEVELS OF MOVING COMPONENTS

At times, the powers and vitality dimensions of moving segments can be constrained so as to take out damage to the human body. This standard, which depends on risk decrease, can be connected just if the moving parts have qualities that guarantee the required wellbeing capacity (nonappearance of sharp edges, cutting segments, and so forth.).

In this case, the following factors must be taken into consideration:
• Accessibility of the danger zone.
• Anthropometric dimensions.
• Kinetic energy.
• Pressure on parts of the body.
• Shapes and dimensions of the contact surfaces.
• Reliability of the system (optional).
• Response time of the mechanisms (optional).

7. RECOMMENDATIONS
• Trolley for handling gauges may be provided to avoid chemical contact.
• Surgical gloves may be provided.
• Providing air curtain instead of glass door.
• Provide a safety guard for conveyor area to protect operator access.
• Providing curtains for avoid Heat radiation.
• Re-Placing the rubber mate by metal sheet.
• Providing fabricated guard on the robot arm traveling path.
• Separate register is to be kept up by every one of the segments to record every one of the licenses issued and got with full subtleties of Job, area. People included and so on.
• As a proactive methodology, in the wake of preparing, individual from each capacity to be selected as BBS eyewitness. He should search for dangerous conduct and record, exhort, direction to evade any mishap.

Figure 6.1 by cylinders in contact (or very close) turning in opposite directions.

Figure 6.2 Access by reaching upward

Figure 6.3 Protection of a cylinder close to a stationary component

7. RECOMMENDATIONS
• Trolley for handling gauges may be provided to avoid chemical contact.
• Surgical gloves may be provided.
• Providing air curtain instead of glass door.
• Provide a safety guard for conveyor area to protect operator access.
• Providing curtains for avoid Heat radiation.
• Re-Placing the rubber mate by metal sheet.
• Providing fabricated guard on the robot arm traveling path.
• Separate register is to be kept up by every one of the segments to record every one of the licenses issued and got with full subtleties of Job, area. People included and so on.
• As a proactive methodology, in the wake of preparing, individual from each capacity to be selected as BBS eyewitness. He should search for dangerous conduct and record, exhort, direction to evade any mishap.
• The organization needs to execute designing controls (appropriate walled in area) and authoritative controls (revolution of workers) to diminish presentation to high clamour levels.

8. CONCLUSION

Hazard recognizable proof and risk appraisal completed in AFD - FLSmidth. It is seen that inadmissible risks are tended to through control measure and wellbeing improvement ventures. The other control measures pursued are strict Work grant framework, supervision and SINGLE POINT LESSON with Dos and Don'ts containing visuals. The Dos and Don'ts are conspicuously shown at the fitting zones which increment the mindfulness among individuals and help to keep the further episodes. Amid the examination it was discovered the wellbeing the executive’s frameworks/rehearses are being pursued and furthermore adequate firefighting/insurance frameworks are accessible. For crisis plan is accessible, Crisis reaction technique are known to the concerned. Wellbeing interlocks for the machine and gear is arranged amid the buy itself. All security gadgets useful test has been done by concerned dept. what is more, their records are all around kept up. At whatever point there is change all the while, the hazard recognizable proof and risk evaluation is to be investigated and refreshed.

AFD - FLSmidth the executives is finding a way to improve the wellbeing execution, by giving better wellbeing, great workplace and essential preparing to all representatives towards accomplishing accidents free workplace.

It is not adequate on the off chance that we have a decent information on wellbeing, Company must try it as a culture/conduct based. It is trusted that by executing the proposals prescribed in this task, the hazards can be limited or dispensed with which improves the general security of AFD - FLSmidth.

Thus, this Hazard Identification and Risk Assessment HIRA) venture has been taken in the development arrange itself to distinguish the conceivable potential hazards and risks including in AFD - FLSmidth. In this Context, discoveries and suggestions are made in this venture work might be used by the board to decrease the accidents.

Accomplishing ZERO ACCIDENT and INCIDENT is the target of the security association in the Industry by method for reinforcing wellbeing, the wellbeing special exercises and worker's contribution in killing of dangerous conditions and Unsafe Acts, the GOAL can be absolutely accomplished.

9. REFERENCES

[1]. FLSmidth HSE Manuals
[2]. RLI Course Notebooks
[3]. The Factories Act 1948
[4]. Tamil Nadu Factories Rule 1950
[5]. Arakkonam Foundry Division Safety Plan
[6]. Is 15656:2006 Of Hazard Identification and Risk Analysis Code of Practice
[7]. Hazard Identification and Risk Assessment OHASAS 18001 Manual