Hazard Identification And Risk Assessment In Construction of Thermal Power Plant

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Abstract- *Purpose of this paper is to identify and analyse the potential hazards associated with construction work of thermal power plant and risk assessment of each individual hazard of each processes and systems. Hazard identification and risk assessment of different construction processes which are being carried out in the thermal power plants and to minimize their effect in order to make the working place safe. For any industry to be successful it should meet not only the production requirements, but also maintain the highest safety standards for all concerned. The industry has to identify the hazards, assess the associated risks and bring the risk to tolerable level on a continuous basis.*

Keywords- Construction Safety, Hazard Identification, Risk Assessment,

I. INTRODUCTION

The construction industry has grown phenomenal globally in last decade. It consists of number of processes such as construction, refurbishment, demolition, excavation work scaffolding work, crane operations, hoisting operations, forklift operations etc. The rate of the worker accidents and injuries in construction locations is the highest compared to all other type of workplaces. Although considerable improvement has been achieved in occupational safety, it is still challenging to handle and control the risks of such workplace activities. Accidents in the construction industry often have severe consequences on the workers, their families and the public. With the help of hazard identification and risk assessment accidents and injuries are significantly optimised.

II. REVIEW OF LITERATURE

Shiva Nandan N, K. Muthukumar et al. (2021) observed that the important element of any safety and health program is the identification, assessment, removal and or control of potential risks within the worksite. The objective of this work is to pick out the capacity hazards arising out of a typical house construction site, examine the risks to decide their capacity to cause an accident, evaluate the risk.

Abdulrahman Adam, Aisha Ahmed et al. (2020) found that thermal power plant is considered to be a very risky industrial plant since it consists of a number of processes to generate electricity by use of fossil fuel. Hazard identification and risk assessment for Sudanese thermal power plant is conducted to identify physical, chemical, biological and environmental hazards in the plant.

Ashokkumar T C, Dr Muthukumar K et al. (2020) had found that HIRA technique is adopted in the old rotary printing department and dyeing department to assess the risk levels in terms of quantified values. The control measures were also developed for each area and activities identified with potential safety issues.

II. PROBLEM STATEMENT

Various important construction hazard items were identified in the system at target construction site of power generation plant.

A list of high hazardous activities in building construction projects for facilitating hazard assessments are as follows:

i.) Excavation works
ii.) Scaffolding and ladder works
iii.) Erection of structural frameworks
iv.) Working at Height/Roof works
v.) Crane use
vi.) Construction machinery and tools usage
vii.) Works on contaminated sites
viii.) Welding and cutting works
ix.) Works in confined spaces

III. OBJECTIVE OF STUDY

Accidents are very common in construction sites across the construction industries which are reported very frequently. Safety related problems which are very common in construction sites in India. The objectives of this paper are to investigate and identify the hazards and risks associated with

the various construction processes which may results in occupational accidents and injuries in construction of thermal power plant, and to propose effective safety measures to optimize the number of accidents and injuries in construction locations.

IV. METHODOLOGY AND ANALYSIS

A Hazards Identification and Risk Assessment (HIRA) is a risk assessment tool that can be used to assess which hazards pose the greatest risk in terms of how likely they are to occur and how great their potential impact may be. It is not intended to be used as a prediction tool to determine which hazard will cause the next emergency.

HIRA Process

There are four steps to create and maintain a HIRA:

Figure 1: HIRA Process

i) Hazard Identification - The purpose of hazard identification is to identify and develop a list of hazards for each job in the organization that are reasonably likely to expose people to injury, illness or disease if not effectively controlled. Workers can then be informed of these hazards and controls put in place to protect workers prior to them being exposed to the actual hazard.

ii) Risk Assessment - Risk assessment is the process used to determine the likelihood that people exposed to injury, illness or disease in the workplace arising from any situation identified during the hazard identification process prior to consideration or implementation of control measures.

iii) Risk Analysis - The information collected in the risk assessment step will be analyzed in this step. The desired outcome of the risk analysis is the ranking of the hazards. This highlights the hazards that should be considered a current priority for your emergency management program.

iv) Monitor and Review - It is important to remember that a HIRA is an ongoing process and hazards and their associated risks must be monitored and reviewed.

V. RISK ASSESSMENT

Table 1: Risk Likelihood

Probability	Risk Likelihood	Weightage
>Month	Highly Unlikely	1
≤Month>Week	Unlikely	2
≤Week> Day	Likely	3
≤Day	Very Likely	4

Table 2: Risk -Level of Consequence – Guidance Criteria

Level of Harm	Human	Property	Exposure Level
Slightly Harmful	Momentary Discomfort	No action required	Below / Equal to Prescribed Threshold Limit Value (TLV) (8 Hrs)
Harmful	Minor Injuries (Non reportable) requires First Aid	Minor Damages	Above the Prescribed Threshold Limit Value (TLV) (8 Hrs) however < 20%
Very Harmful	Major Injuries, absence from the work ≥ 48 hours / temporary disability	Severe damages	Above the Prescribed Threshold Limit Value (TLV) (8 Hrs) however within 20% 40 %
Extremely Harmful	Fatal / Permanent Disability, Major incidents involving large number of people	Annihilation (Complete destruction)	Above the Prescribed Threshold Limit Value (TLV) (8 Hrs) AND > 40 %

Table 3: Criteria for classification of Risk

Likelihood (L)		Exposure (Sc)		Consequence (C)			Range (L+Sc+C)	Risk Class
Likelihood (L)	Weigh-tage	Scale (Sc)	Weigh-tage	Human	Property	Weigh-tage		
Highly Unlikely (HUL)	1	Spot	1	Discomfort	Aesthetic damage	1	1-3	Trivial
Unlikely (U)	2	Section	2	Minor Injury	Minor damage	2	4-8	Moderate
Likely (L)	3	Plant/ Premises	3	Major Injury	Severe damage	3	9-27	Substantial
Very Likely (VL)	4	Outside Plant	4	Fatal /Permanent Disability	Annihilation (Complete destruction)	4	28-64	Intolerable

Table 4: Identification of Hazards and Risk assessment

Sr. No.	Name of Activity	Identified Hazard	Risk Assessment			Risk Score	Risk Class	Control Measures
			L	C	Sc	LxCxSc		
1	Material Handling by Crane / hydra, winch	a. Falling object impact	1	3	1	3	Trivial	1. Training to riggers 2. Regular T&P inspection
		b. Moving object impact	2	2	1	4	Moderate	1. Use of tagline

2	Excavation (Green/brown field)	a. Contact with underground services e.g. gas pipes / electric cables / telecom cables / Sewer line / Water pipes.	1	4	1	4	Moderate	1. Clearance from customer before excavation 2. Operator training for careful excavation. 3. Efficient supervision 4. Emergency preparedness
		b. Flooding due to adjacent / underground water source, sewer line etc.	1	3	1	3	Trivial	1. Pumping facility 2. Availability of sand bags
		c. Exposure to dangerous rotating parts	2	3	1	6	Moderate	1. Tool Box Talks 2. Fencing/ guarding
		d. Exposure to excessive dust	2	2	2	8	Moderate	1. Water sprinkling 2. Use of dust masks
		e. Collapse of edges/walls, fall of material, excavated soil, unstable adjacent structure.	2	4	1	8	Moderate	1. Use of PPEs
		f. Falls in excavations, vehicle sliding in to pits	1	4	1	4	Moderate	1. Barricading/marking caution 2. Illumination
		g. Contact with overhead live electric lines	1	4	1	4	Moderate	1. Shutdown before work
3	Excavation by controlled blasting	a. Flying object Impact	1	3	2	6	Moderate	1. Use of PPEs 2. Prior intimation to all for area vacation
		b. Exposure to Noise	4	1	1	4	Moderate	1. Use of ear plugs
		c. Exposure to dust	4	1	2	8	Moderate	1. Use of dust masks
4	Re-bar (Steel) work	a. Cut, penetration by re-bars during cutting, bending	3	2	1	6	Moderate	1. Use of leather hand gloves
		b. Electric shock	2	2	1	4	Moderate	1. Use of defect free cables
		c. Impact by stressed bar	2	2	1	4	Moderate	1. Tool Box Talks/Training 2. Regular inspection of T&Ps
5	Shuttering/form Work	a. Fall from height due to failure of shuttering support vertical members.	1	4	2	8	Moderate	1. No work on form work without inspection and clearance by competent person.
		b. Slip, Trip and fall due to horizontal supports and tie-rods	3	2	1	6	Moderate	1. Use of PPEs 2. Proper illumination

		c. Cut, penetration or pricking by protruded nails out of shuttering and plank cuttings.	4	1	1	4	Moderate	1. Only trained staff to work 2. Use of PPEs 3. Remove protruding nails from the planks before clearance.
		d. Fall from height from the edges of roof or height shuttering.	1	4	1	4	Moderate	1. Hard Barricading at the edge 2. Proper Illumination 3. Use of fall protection devices
6	Dismantling of lattice structures / towers	a. Injury or fatality due to collapse of tower.	1	4	3	12	Substantial	1. Provide stay wire to support unbalanced load. 2. Barricade area for unauthorised entry.
		b. Fall from height	1	4	1	4	Moderate	1. Use of PPEs and fall protection devices
		c. Impact by falling object	2	4	1	8	Moderate	1. Use of PPEs 2. Barricade the area
		d. Induction / electrocution	2	2	2	8	Moderate	1. Use of discharge rods 2. Ensure earth switches are on
		e. Impact by lifted/ supported equipment	2	2	1	4	Moderate	1. Use of PPEs 2. Use of Tag line
		f. Burn by falling splatters of gas cutting.	2	1	2	4	Moderate	1. Barricading
		g. Pinch, cut, pricking by lattice members	3	2	1	6	Moderate	1. Use of hand gloves.
7	Concreting	a. Slips, trips and falls	3	2	1	6	Moderate	1. Safe access routes
		b. Electric shock (if electric vibrators are used)	2	3	1	6	Moderate	1. Using electrical vibrators is not permitted
		c. Eye, ear, skin and respiratory tract irritation from exposure to cement	3	2	1	6	Moderate	1. Use of PPEs 2. Regular tool box talks
		d. Skin irritation from wet concrete	4	2	1	8	Moderate	1. Water availability for wash
		e. exposure to rotating, vibrating or dangerous parts	1	3	1	3	Trivial	1. Fencing/ guarding
		f. Danger from stressed or tensioned parts	2	3	1	6	Moderate	1. Tool Box Talks
8	Welding	a. Emission of fumes and gases	3	1	1	3	Trivial	1. Proper ventilation
		b. Exposure to radiation and light	2	2	1	4	Moderate	1. Use of PPEs
		c. Splatters	3	1	1	3	Trivial	1. Facility of First aid
		d. Exposure to live wire	1	2	1	2	Trivial	1. Safe electrical connection

		e. Fire	1	3	2	6	Moderate	1. Availability of extinguisher
		f. Exposure to heat	2	2	1	4	Moderate	1. Use of clean & cold water
9	Gas Cutting	a. Emission of fumes and gases	2	2	1	4	Moderate	1. Proper ventilation
		b. Fire and/or explosion	1	4	3	12	Substantial	1. Regular inspection 2. Tool box talk/training 3. Use of gas cylinders in vertical position 3. Emergency preparedness
		c. Splatters	3	2	1	6	Moderate	1. Facility of First aid 2. Use of PPEs
10	Drilling/Reaming	a. Sudden release of tensioned part	4	1	1	4	Moderate	1. Regular inspection of T&P 2. Tool box talk/training
		b. Flying object impact	2	2	1	4	Moderate	1. Use of PPEs
		c. Cut/burn by sharp and hot chip edges	2	2	1	4	Moderate	1. Use of PPEs
		d. Exposure to moving parts	1	2	1	2	Trivial	1. Fencing/ guarding
11	Working at Height	a. Fall from height	1	4	1	4	Moderate	1. Use of PPEs 2. Ensure work platform with top, mid rail and toe board. 3. Use of Fall arrester, lifeline 4. Use of good quality ladders
		b. Falling of hand tolls, parts, materials	3	3	1	9	Substantial	1. Use of safety nets 2. Barricading
		c. Collapsing of scaffold/ platform/ Ladder	2	3	1	6	Moderate	1. Tool box talk/Trainings 2. Daily checklist & inspection
		d. Unstable lifting machine/ device	2	4	1	8	Moderate	1. Third party inspection 2. Levelled ground for cranes
		e. Impact by crane/boom	2	4	1	8	Moderate	1. Operator trainings
12	Lifting/erection of heavy equipment /materials	a. Falling object impact	2	3	1	6	Moderate	1. Use of PPEs
		b. Overturning of crane	1	4	1	4	Moderate	1. Third party inspection 2. Levelled ground for cranes
		c. Impact by crane swing /reverse/boom	2	3	1	6	Moderate	1. Operator trainings
		d. Collapse of erected material/ equipment	1	4	2	8	Moderate	1. Use full hard-wares, tightness check by torque wrench. 2. Experience supervision 3. Load/tension balancing

		e. Striking of moving objects	2	2	1	4	Moderate	1. Use of tag lines
13	Lattice/pipe structure erection	a. Fall from height	1	4	1	4	Moderate	1. Use of PPEs 3. Use of fall arrester, life line
		b. Falling object impact	3	3	1	9	Substantial	1. Barricading caution
		c. Collapse of structure	1	4	1	4	Moderate	1. Use full hard-wares, tightness check by torque wrench. 2. Experience supervision 3. Load/tension balancing
		d. Unstable/ overturning of crane/man-lift	1	4	1	4	Moderate	1. Third party inspection 2. Levelled ground for cranes 3. Operators training
		e. Pinch/cut by material	2	2	1	4	Moderate	1. Use of proper tools
14	Working in confined space	a. Exposure to oxygen deficiency/ toxic fumes	1	4	1	4	Moderate	1. Use of O_2 detectors and gas detectors to assess the level before entry 2. Emergency preparedness
15	Vehicle driving	a. Road accident	1	3	1	3	Trivial	1. Caution boards 2. First aid facility 3. Restrict entry for unauthorized drivers
16	Piling/Rig operation	a. Excessive noise	3	1	2	6	Moderate	1. Use of ear plugs
		b. Slip, trip and falls	2	2	1	4	Moderate	1. Tool box talks
17	Shot/Sand Blasting operation	a. Exposure to shots and dust	3	2	1	6	Moderate	1. Use of PPEs like nose masks, head scarf, helmet, goggles, hand gloves, aprons.

VI. CONCLUSION

In this paper we observe that risk assessment is very helpful for finding hazards conditions in construction of thermal power plant. Hazard analysis and risk assessment can be used to establish priorities so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be considered later and based on the investigation study, a framework of risk assessment process of hazards currently applied in const ruction sites has been developed. Based on the study analysis, a Guidelines of Risk Assessment Process of Hazards in Construction Sites have been proposed.

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