

# IDENTIFICATION OF OCCUPATIONAL DISEASES, HEALTH RISK, HAZARD AND INJURIES AMONG THE WORKERS ENGAGED IN THERMAL POWER PLANT

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## Abstract

Thermal power plant uses coal as fuel for their working. Coal after burning leaves ash. Disposal of this ash is also one important task. Ash comes in contact with open environment and has adverse effects on health of human being. Due to these various health problems like skin diseases, breathing problem etc. are started in man working under those premises. Some other elements like boiler, turbine, generator, material handling are those elements due to which hazards and accidents take place while operation and maintenance of these. This work focuses on identification of various Occupational diseases and injuries, health risks associated with the man power working in thermal power plant. This data were collected by questionnaires and personnel interview of the workers working in different section of the thermal power plant like boiler section, turbine & generator section, coal & ash handling plant, hydrogen plant etc. Analysis is done in terms of different variables, such as age, skills experience, type of injuries and type of diseases. Results are shown in the form graph and chart. The results indicate a remarkable and visible impact on health of workers during operation and maintenance.

**Key Words:** Occupational hazards and Diseases, health risk, Injuries, Questionnaires, Personnel interview.

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## 1. INTRODUCTION

Thermal power plant has caused environmental impacts at all stages of the process in the area. It also caused various occupational diseases and injuries to the workers working. Each Occupational disease and injury has a major effect on economy due to loss of productive hour, man-power losses, compensation to the victim's. Due it this reason for reduction of all occupational diseases, injuries/fatalities, corrective and preventive measures should be done.

There are several kinds of ailments which were recorded in the thermal power plant. These included Allergic reactions that interfered with breathing, asthma, emphysema, chronic bronchitis, Lung cancer, pneumonia, tuberculosis, wheezing, stroke, Chest pain, shortness of breath, cough, irregular heartbeat, swelling in legs and feet (not caused by walking), skin allergies, High B.P, anxiety, eye irritation and fatigue.. There are several legal parameters which are proposed and regulated by the government and other safety organizations. These parameters are essential to be followed up for safe working operation and conditions.

Risk = Consequence × Likelihood

Some common safety rules and regulations which are essential in the power plant to follow up given in the:

- Factories Act 1948 & M.P./C.G. Rules 1962

- The Indian Boiler Act 1923 & Regulations, 1950 (Amendment 2007)
- Water Act -1974
- Hazardous Waste (Management & Handling) Rules, 1989.
- Indian Electrical Act 2003 & Rules 1956
- IS Standards
- OSHA Standard 1970
- Third Schedule (See section 89 and 90), List of Notifiable Diseases, The factories Act, 1948

Breaches of these laws and regulations generate hazards which can cause the harm by generating;

- Unsafe act
- Unsafe conditions
- Behavioral mishaps

In present scenario of visited thermal power plant we have seen the various breaches of laws and hazardous conditions which may lead to the threats to the people, property and environment.

## 2. TERMINOLOGY

**Accident-** A sudden event that results in an undesired outcome such as property damage, bodily injury or death.

**Occupational accident-** Accident occurring at the workplace which may cause damage to machinery, tools or people.

**Injury-** Physical damage to body tissues caused by an accident or by exposure to environmental stressors. This injury may lead to death and is then called a "fatal accident" or may cause partial disability or lead to sick leave for a period of time.

**Hazard-** Any existing or potential condition in the workplace which, by itself or by interacting with other variables can result in death, injury, property damage or other loss. Simply, hazard is a potential source of harm.

**Risk-** The likelihood of harm (in defined circumstances).

**Harm-** The loss to a person (or people) as a consequence of damage.

**Damage -** The loss of inherent quality suffered by an entity (physical or biological).

**Danger -** The degree of exposure to a hazard.

**Safety -** The absence of danger.

**Occupational safety -** Risk identification at the workplace and preventive measures taken to reduce or eliminate the hazard which may lead to accident.

**Safe behaviour-** Acting in such a way that no risk of injury is caused by one's behaviour.

**Safety professional-** A person whose basic job function and responsibility is to prevent accidents and other harmful exposures and the personal injury, disease or property damage that may ensue.

**Occupational Health:** The protection and promotion of the health of workers by preventing and controlling occupational diseases and accidents and by eliminating occupational factors and conditions hazardous to health and safety at work.

**Health Hazards-** When work is associated with health hazards, it may cause occupational diseases, be one of the multiple causes of other diseases or may aggravate existing ill-health of non-occupational origin. In developing countries, where work is becoming increasingly mechanized, a number of work processes have been developed that treat workers as tools in production, putting their health and lives at risk. The occupational health lessons learned during the industrial revolution should be borne in mind in planning for health developing countries if such problems are to be avoided.

**Occupational Hygiene-** This is the practice of assessment and control of environmental factors and stresses arising in or from the workplace, which may cause injury, sickness, impaired health and well-being or significant discomfort and inefficiency among workers or among the citizens of the community.

It encompasses the study of:

- Toxicology
- Industrial processes
- The chemical and physical behaviour of air contaminants.
- Environment sampling techniques and statistics
- The design and evaluation of ventilation systems
- Noise control
- Radiation protection
- The health effects of occupational hazards

**Occupational Diseases-** Occupational diseases are adverse health conditions in the human being, the occurrence or severity of which is related to exposure to factors on the job or in the work environment. Such factors can be:

- **Physical:** e.g. heat, noise, radiation, vibration, light.
- **Chemical:** e.g. solvents, pesticides, heavy metals, dust.
- **Biological:** e.g. microorganisms; virus, bacteria, protozoan, insect or other living organism.
- **Ergonomic:** e.g. improperly designed tools or work areas, repetitive motions.
- **Psychosocial stressors:** e.g. lack of control over work, inadequate personal support.
- **Mechanical:** These mainly cause work accidents and injuries rather than occupational diseases.

**Techniques used in recognizing health hazards-**

1. Material Inventory
2. Process Inventory
3. Walk-through occupational hygiene survey
4. Air-sampling programmes

**Exposure measurement techniques-**

These techniques are based on the nature of hazards and the routes of environmental contact with the worker, e.g.

- Air sampling can show the concentration of particulates, gases and vapours that workers may inhale.
- Skin wipes can be used to measure the degree of skin contact with toxic material that may penetrate the skin.
- Noise dosimeters record and electronically integrate workplace noise level to determine total daily exposure.

**Aim of occupational safety-**

The occupational safety philosophy has been developed in order to:

- Prevent need less destruction of health and waste of human and other resources.
- Raise the morale of workers
- Prevents inefficiency in the workplace due to the effects of accidents
- Prevents social harm caused by accidents
- Promote accident prevention.

**Causes of occupational accidents and injuries**

1. Human factors
2. Environmental factors

### 3. METHODOLOGY

Methodology adopted for this work is based on the information available from the workers of different section and different age groups working in thermal power plant by the systematic questionnaire and personal interview. The main objective of this study is to find out the various occupational diseases, hazards, accidents and prepare a systematic safety measures to minimize them. The interview can be conducted randomly on 100 workers.

**Questioners and checklist against which this work can be conducted are as follows;**

#### APPENDIX 1 - Occupational Questionnaire

**EMPLOYEE FEEDBACK FORM**

Use this form to record any workplace health and safety hazards, and comments or suggestions for improvement regarding operation, maintenance, processes and procedures.

**Personnel Information related to Employee while working in TPP**

PASTE YOUR RECENT PASSPORT SIZE COLOUR PHOTOGRAPH	D E T A I L S	Organization Name : <input type="text"/>
		Name of Power Station/ HQ : (where employee presently posted)
		Name of Office/ Unit/ Circle/ Division/Deptt.: (where employee presently posted)

1. Employee Name: Mr./Mrs. : <input type="text"/>	
2. Date of Birth /Age: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	3. Gender : <input type="checkbox"/> Male <input type="checkbox"/> Female
4. Designation :	5. Blood Group :
6. Employee Code:	7. Social Insurance Number : (Y /N) <input type="text"/>
8. Educational Qualification :	
9. Status : <input type="checkbox"/> Permanent <input type="checkbox"/> Temporary <input type="checkbox"/> Casual	
10. Marital Status: <input type="checkbox"/> Unmarried <input type="checkbox"/> Married <input type="checkbox"/> Divorcee <input type="checkbox"/> Widow	
11. Work Experience: (No. of years since working in the Plant)	
12. Mailing Address:	
City /Town/Village:	Province /State : <input type="text"/>
Contact No. :	E:mail : <input type="text"/>
13. Leave Period (Earned Leave, Medical Leave, Leave with half pay, Leave without pay, Maternity leave) during FY:	

**Questioners related to different type of injuries to the workers while working TPP**

1. Any injury during working in plant (major/minor):	
(i) Reasons-	
(ii) Which part/parts of the body is affected due to this-	
(iii) Number of days lost due to this-	
2. How much load you bear in a day:	
3. Do you have better knowledge about the current job:	<input type="checkbox"/> YES <input type="checkbox"/> NO
4. Do you wear all necessary PPEs during work:	<input type="checkbox"/> YES <input type="checkbox"/> NO
5. Interval of rest during work:	
<u>Have you ever had any of the following conditions during 6 months?</u>	
	<b>Y/N</b>
Any reportable diseases	<input type="checkbox"/> <input type="checkbox"/>
Skin allergies or rashes	<input type="checkbox"/> <input type="checkbox"/>
Eye irritation	<input type="checkbox"/> <input type="checkbox"/>
Weakness or fatigue	<input type="checkbox"/> <input type="checkbox"/>
Lung cancer	<input type="checkbox"/> <input type="checkbox"/>

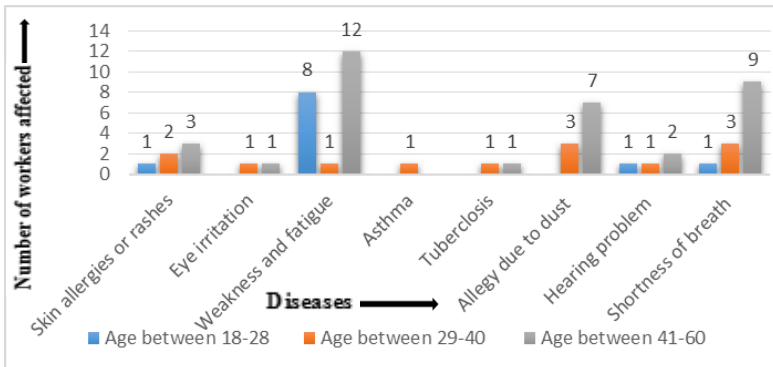
Chest injuries or surgeries	<input type="checkbox"/>	<input type="checkbox"/>
Asthma as an adult	<input type="checkbox"/>	<input type="checkbox"/>
Pneumonia in the last month	<input type="checkbox"/>	<input type="checkbox"/>
Tuberculosis	<input type="checkbox"/>	<input type="checkbox"/>
Kidney diseases	<input type="checkbox"/>	<input type="checkbox"/>
Respiratory allergy due to dust	<input type="checkbox"/>	<input type="checkbox"/>
Hearing Problem	<input type="checkbox"/>	<input type="checkbox"/>
<u>Pulmonary or Lung illness during 6 months?</u>		
Shortness of breath during activity	<input type="checkbox"/>	<input type="checkbox"/>
Cough	<input type="checkbox"/>	<input type="checkbox"/>
Wheezing	<input type="checkbox"/>	<input type="checkbox"/>
<u>Cardiovascular or heart problems during 6 months?</u>		
Heart Attack	<input type="checkbox"/>	<input type="checkbox"/>
Stroke	<input type="checkbox"/>	<input type="checkbox"/>
Irregular heart beat	<input type="checkbox"/>	<input type="checkbox"/>
Swelling in your legs or feet (not caused by walking)	<input type="checkbox"/>	<input type="checkbox"/>
High B.P	<input type="checkbox"/>	<input type="checkbox"/>
Any other kind of Symptoms apart from this?		
(i)		
(ii)		
Do you follow Health and safety rules :	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Do you provide first aid kits :	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Whether you have fire exits and fire extinguishers :	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Whether you report unsafe work and conditions:	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Did you use your personal protective equipment :	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Have you deal with violent customers:	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Whether you work alone the procedures :	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Will there is regular Inspections in plant	<input type="checkbox"/> YES	<input type="checkbox"/> NO
How you handle Emergency procedures:		
Do you think you have any sort of health problem while working here?		
Do you think thermal power plant is causing any kind of pollution or problem in area?		
17. Are there any pollution control devices installed?		
<b>EVALUATOR'S COMMENTS</b>		
Areas where improvement is needed:		
Specific goals for upcoming year :		
Other :		
<b>Prepared by</b> .....		
This information is collected under the authority of the Organization plant head. The content is regarding workplace, Health, Safety and Occupational Diseases. This is done mainly to prevent people, property and Environment in plant in future. I will never disclose this data to any one and it will only be used for worker's safety.		
<b>Employee Feedback:</b> (Please record your comments or suggestions)		
<b>Date</b> .....	<b>Employee Signature</b> Name .....	

**Table -1:** Number of worker Interview

Sr.No.	Worker's Age	No. of worker Interview in TPP
1.	Below 18	NA
2.	Between 18-28	22
3.	Between 29-40	33
4.	Between 41-60	45
Total		100

**Table -2:** Number of Workers Affected Diseases (Age wise)

Sr. No.	Diseases	Age		
		18-28	29-40	41-60
1.	Skin allergies or rashes	1	2	3
2.	Eye irritation		1	1
3.	Weakness and fatigue	8	1	12
4.	Asthma		1	
5.	Tuberculosis		1	1
6.	Allegy due to dust		3	7
7.	Hearing problem	1	1	2
8.	Shortness of breath	1	3	9

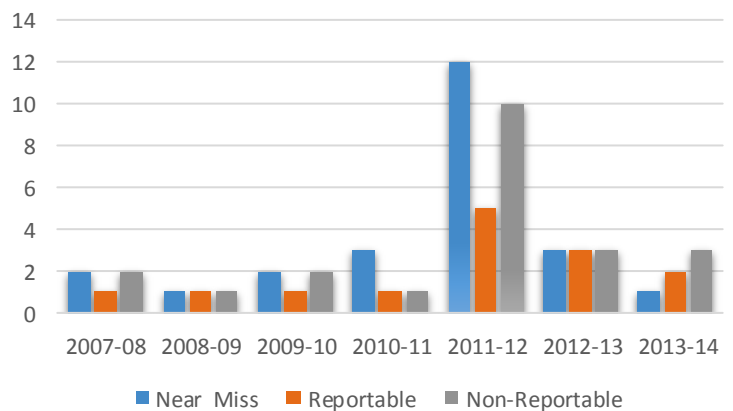


**Chart-1:** Shows the Number of workers affected by diseases in various section of Thermal Power Plant (Age wise)

**Table -3:** Year Wise Accident

Sr. No.	Year (1 April To 31 March)	Types of Accident		
		Near Miss	Reportable (R)	Non-Reportable (NR)
1.	2007-08	2	1	2
2.	2008-09	1	1	1
3.	2009-10	2	1	2
3.	2010-11	3	1	1
4.	2011-12	12	5	10
5.	2012-13	3	3	3
6.	2013-14	1	2	3

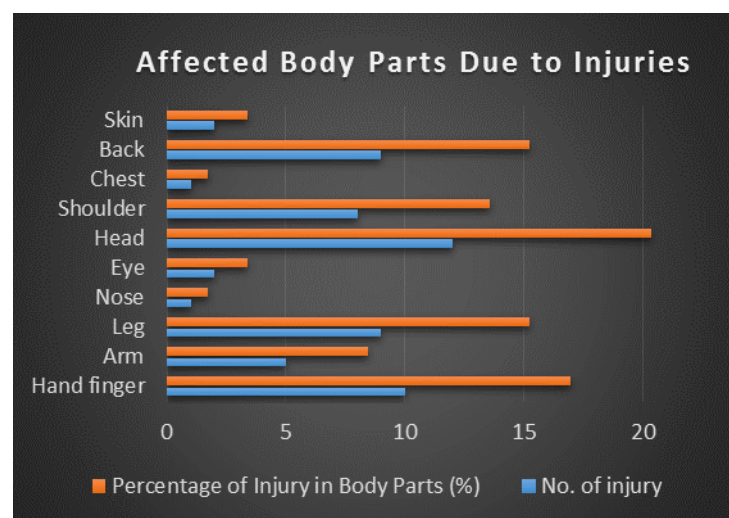
**Number of Near Miss ,Repotable and Non-Repotable Accidents**



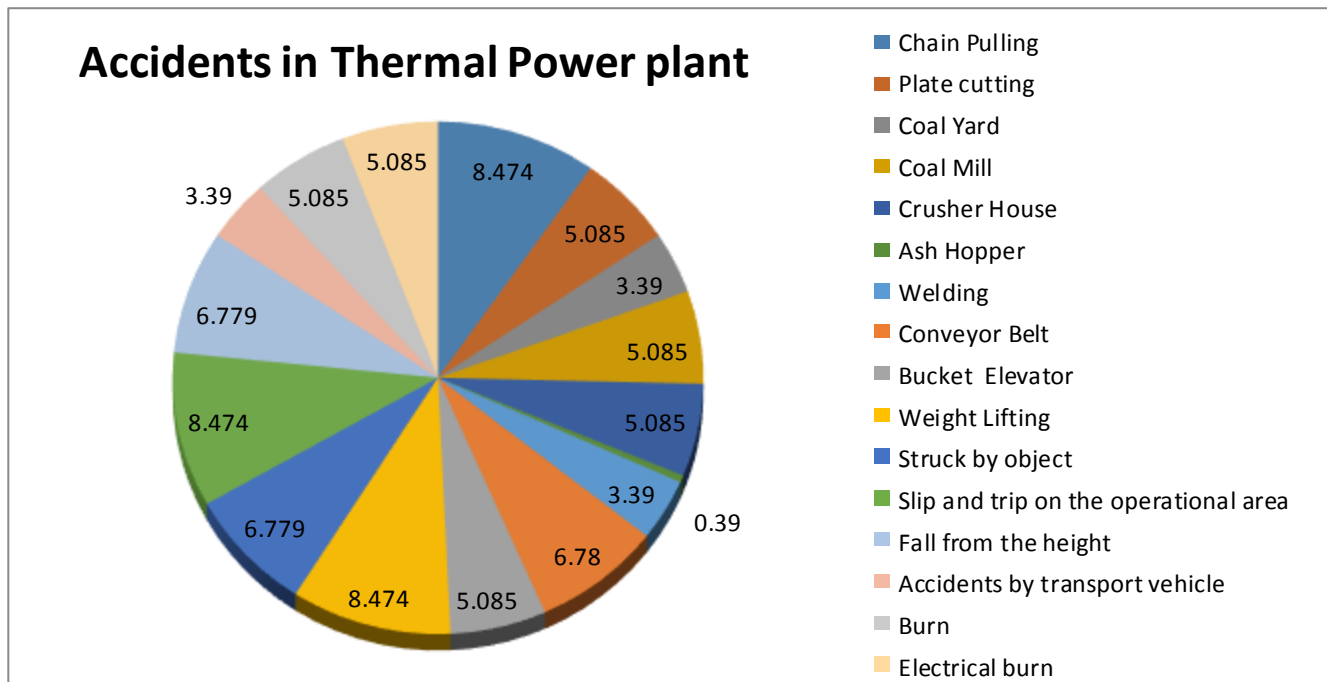
**Chart-2:** Shows the Near miss, Reportable and Non-Reportable accidents in Thermal power Plant

**Table -4:** Affected Body Parts/ Number of Injuries

Body parts	No. of injury	Percentage of Injury in Body Parts (%)
Hand finger	10	16.949
Arm	5	8.474
Leg	9	15.254
Nose	1	1.695
Eye	2	3.390
Head	12	20.339
Shoulder	8	13.560
Chest	1	1.695
Back	9	15.254
Skin	2	3.390
Total	59	100.00%



**Chart -3:** Shows the Affected Body Parts Due to Injuries



**Chart -4:** Pie Chart representation of cause wise accidents in thermal power plant from 2007-2014

**Table -5:** Causes of Accident

Accident Agent	No. of injury	Percentage of injury by Agent of Accidents (%)
Chain Pulling	5	8.474
Plate cutting	3	5.085
Coal Yard	2	3.390
Coal Mill	3	5.085
Crusher House	3	5.085
Ash Hopper	2	3.390
Welding	2	3.390
Conveyor Belt	4	6.780
Bucket Elevator	3	5.085
Weight Lifting	5	8.474
Struck by object	4	6.779
Slip and trip on the operational area	5	8.474
Fall from the height	4	6.779
Accidents by transport vehicle	2	3.390
Burn	3	5.085
Electrical burn	3	5.085
Electrical shock	2	3.390
Stroked by object	3	5.084
Others	1	1.695
<b>Total</b>	<b>59</b>	<b>100.00%</b>

**Table -6:** Causes of Plant Location Hazard

Sr. No.	PLANT HAZARD LOCATION	HAZARD DISCIPTION	PREVENTIVE MEASURE
1.	COAL HANDLING PLANT	Fire in coal storage	Regular inspection, water spray, isolation from ignition sources
		Coal dust explosion in coal conveyer bunker	Proper ventilation, spark proof electrical equipment
		Injury during coal handling like slip and trip	Proper PPE's
		Respiratory problem due to coal dust	Dust mask should be provided
		Catches on conveyer belt	Safety guard on the moving part
		Rail line and other transport line accidents	Speed limit on plant area
		Injury during maintenance on ball mill	Training, proper supervision, PPE's
		Fall from the height during work on conveyer belt, conveyer control room etc.	Safety belt, safety net should be provided, training
		Struck by falling object	Safety helmet, safety net

2.	<b>D.M. PLANT</b>	Fire hazard	Fire extinguisher, eliminate the possible ignition source
		Chemical burn by Spillage of sulphuric acid and caustic soda lye during unloading, overflow, Damage on storage tank or pipe line	Wash rinse exposed area, training, maintenance, proper supervision
		High noise level	Ear plug, ear muff should provided
3.	<b>BOILER SYSTEM</b>	Explosion in boiler due to over pressure and temperature	Continuous monitoring, maintenance
		Explosion in boiler due to improper combustion of fuel	Regular inspection, maintenance
		Burn injury due to hot water and hot steam pipeline leakage	Inspection, maintenance
		Exposure to the hot surface of pipeline or machineries	Regular inspection, maintenance
		Water tube burst due to Failure in boiler water level control	Continuous monitoring, maintenance
		Fire in diesel supply line	Regular inspection, maintenance
		Burn injury by hot fly ash	Maintenance, proper exhaust
		Catches on the moving part of the machinery like F.D. fans or motors	Proper fencing on the moving part of turbine
		Burst of the equipment body due to over pressure and over temperature	Regular inspection, maintenance
		Sleep , trip and from the height during routine work, maintenance or inspection	Training, proper supervision, PPE's
		4.	<b>GENERATOR AND TURBINE</b>
Damage on generator due to lack of lubrication in coupling shaft	Regular inspection, maintenance		
Fire on cooling oil	Proper storage, isolation from the ignition sources		

		Fire and explosion on hydrogen tank	Proper storage, isolation from the ignition sources
		High noise level	Ear plug, ear muff should provided
5.	<b>SWITCH YARD</b>	Fire on transformer	Regular inspection, maintenance
		Electric shock and electric burn routine work, maintenance or inspection of electrical panels in switch yard	Training, PPE's should provided
		Slip , trip and from the height during routine work, maintenance on switch yard	Safety belt, safety harness should provided, training
6.	<b>OTHER HAZARD</b>	Control room fire hazard	Fire extinguisher, eliminate the over heating
		Eye irritation and respiratory problem from the exposure of ammonia leakage from storage tank or pipeline	Wash rinse exposed area, maintenance
		Fire on ammonia storage tank	Fire extinguisher, eliminate the possible ignition source
		Fire hazard on fuel storage tank	Fire extinguisher, eliminate the possible ignition source

#### 4. DATA ANALYSIS

These data obtained by the questionnaire and personal interview was subjected to quantitative analysis. The percentage were calculate by simple mathematical formulas And results are shown in the form of graph and chart.

#### 5. CONCLUSIONS

This work has been conducted by taking some variables like age, skills, and experience into consideration to get an overall view of occupational diseases, hazards and injuries among the workers of thermal power plant to enhance safety conditions of the plant. While conducting this study, it was found that workers of different age groups were mainly suffered from shortness of breath and fatigue. Most of the injured workers are highly skilled or unskilled. Overconfidence was found to be the main cause of injuries and near misses for skilled workers and lack of awareness, carelessness were common in unskilled workers. It is also found that different types of diseases generally happen in thermal power plant, some diseases also occurs like kidney

diseases etc. In near future although these are not found in our diseases. This work also emphasizes on the main causes of accidents in thermal power plant, total number of accidents occur in past few years (from 2007 to 2014) and which body part got most affected due to these accidents. The main aim of this study is to find out the various occupational diseases, hazards and accidents in thermal power plant, also to find out a scenario of total occurrences of accident and their main causes.

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