



SAFETY AND RISK MANAGEMENT SYSTEM AT RPCL POWER PLANT IN BANGLADESH

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Abstract-This paper contains facts and investigations on hazards regarding safety in industrial level and findings about procedures to minimize the casualties from engineering perspective. Different industries require different safety engineering. As mechanical engineers we are responsible for the maintenance of major equipment in power generation sector which often exposes to hazardous situations. This research will include collection of data from RPCL as a subject and planned procedures to conduct a proper and adequate SMS (safety management system) for other engineering sectors as well. This study consists of safety management system of RPCL as well as different recommendations for further improvement in safety management system such as avoiding electrical short circuit, giving up the habit of cigarette, being careful about machine and lubricating system, checking fire equipment within 20 days, being conscious when handling materials and being attention every moment in working hours.

Keywords-Industrial hazard, Risk management, Emergency planning, Safety management.

I. INTRODUCTION

1.1 Introduction

The essential objective of safety engineering is to oversee risk, dispensing with or decreasing it to satisfactory levels. It moreover gives a precise way to distinguish dangers and control dangers, whereas keeping up affirmation that these chance controls are compelling. In mechanical progression and its suggestion have to be made our life much simpler, quicker and comfortable but to the opposite, life ended up mechanized, framework situated, risks and unsafe. Mechanization took put and machines are continuously supplanting the human work.

1.2 History of Safety Management in Bangladesh

Bangladesh labour act 2006 incompletely covers the security and wellbeing of the

labourers. But tragically they are not satisfactory and are not overhauled appropriately. The office of the chief auditor (explosive), chief examiner (industrial facilities) and chief boiler reviewer bargain and control with a few perspective of plant plan and operational safety. The government arrangement creators and mechanical business person don't appropriately care and advance security angle in Bangladesh. Most rousing thing is that as of late Institution of Engineers, Bangladesh has set up a committee within the title of "Industrial Security Board of Bangladesh" with security experts of diverse organizations and disciplines. The committee has as of now begun working by doing classes, workshops etc. and prepared to deliver all brief of security related bolster to interested concern.

Service of labour and business as of late locked in ISBB in conjunction with a few other institution to define a draft “National Security and Wellbeing Policy.” [1].

1.3 Importance

Security program gets to be an indispensably portion and mandatory thing of plant or mechanical operation presently a day since of taking after viewpoint.

- Safe and continuous operation guarantees consistent quality and peace within the plant conjointly sure to the laborer
- Management feels the ethical and moral commitment to protect her representatives from risks or mishaps.
- Safety minimization of contact between human and hazard.
- Prevention of physical harm to a person.
- To keep individuals unharmed, to secure resources, and to ensure the environment

But in this country the safety rules and program do not maintain in the plant properly. So, this rules and regulation of safety should be maintained all the plant properly.

1.4 Objectives

The objective of safety management system is to provide a structured management to eliminate or control risk in operation into an acceptable level.

- To analyze the safety management system of power sector and to find cause of danger.
- To analyze the emergency risk management.
- To analyze the emergency planning.

1.5 Scope

- This safety management deals with the establishment implementation & improvement of managing programmed structures, systems & components
- This safety management mainly focus on managing the physical structure, system and component.
- It also provide of managing obsolescence and on the application of management for long term operation
- This safety management is much important for industrial purpose or power plant sector.

1.6 Methods

To achieve the objectives above, the following methods will be followed:

- To study in details the safety and emergency management from books
- To visit some power plant
- To collect data from many employees
- To analyse the present safety management system of RPCL

1.7 Limitations

Safety can be limited in relation to some guarantee or a standard of insurance to the quality and in harmful function of an object or organization. It is used to order to ensure that the object organization will do only what is meant to do. Actually safety is relative-nothing is 100% safe under all condition.

II. INDUSTRIAL HAZARD

For our findings regarding safety issues first we have to know about what might cause accidents.

2.1 Causes of accidents

There are studies that have established some theories regarding causes of industrial accidents and hazard. Some of the very frequently followed theories are:

- The Domino Theory
- Multiple Causation Theory
- The Pure Chance Theory
- Biased Liability Theory
- Accident Proneness Theory
- The Energy Transfer Theory

Knowing about causes of accidents to properly handle them we have to know about Basic elements of accidents.

2.2 Basic Elements of Accidents

- Man to man relationship
- Man and machine relationship
- Man and environment relationship

2.2.1 Man and Machine relationship

- Proper selection of man power for specific jobs
- Proper consideration during transfer for the new assignment
- Periodical test of fitness and attitude
- To procure standard and quality equipment from renowned sources
- Condition monitoring data processing and periodic maintenance
- Ensure reliability of equipment

2.2.2 Man and environment relationship

- To analyze piping and instrumentation diagram, process flow diagram, plant layout
- Diagram to ensure safe work environment and safety of the plant, equipment and people
- Proper selection of manpower, machine
- To provide proper working place and condition of environment
- To frame safety rules and regulation
- To make safety audit and review situation
- To grow cleanliness attitude and safety culture of management people and workers

2.2.3 Definition of Hazard

A hazard is a situation in the workplace that has the potential to harm the health and safety of people or to damage plant and equipment. The situation could involve a task, chemical or equipment used. Hazard management is a continuous process that can be used to improve the health and safety of all workplaces.

A hazard is any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work. Basically, a hazard can cause harm or adverse effects. For example, the disease tuberculosis might be called a hazard by some but in general the TB-causing bacteria would be considered the hazard.

2.2.4 Types of Hazards

- Physical hazards
- Chemical hazards
- Biological hazards
- Mechanical hazards
- Psychological hazards

2.2.4.1 Physical hazards

- Heat and cold
- Light
- Noise
- Vibration
- Ultraviolet radiation
- Ionizing radiation

2.2.4.2 Chemical Hazards

There is hardly any industry which does not make use of chemicals. The chemical hazards are on the increase with the introduction of newer and complex chemicals. Chemical agents act in three ways: local action, inhalation

and ingestion. The ill-effects produced depend upon the duration of exposure, the quantum of exposure and individual susceptibility.

- Local actions
- Inhalation
- Ingestion

2.2.4.3 Biological Hazards

Workers may be exposed to infective and parasitic agents at the place of work. The occupational diseases in this category are brucellosis, leptospirosis, anthrax, hydatidosis, psittacosis, tetanus, encephalitis, fungal infections, schistosomiasis and a host of others. Persons working among animal products and agricultural workers are specially exposed to biological hazards.

2.2.4.4 Mechanical hazards

The mechanical hazards in industry center round machinery, protruding and moving parts and the like. About 10% of accidents in industry are said to be due to mechanical causes.

2.2.4.5 Psychological hazards

The psychosocial hazards arise from the workers' failure to adapt to an alien psychosocial environment. Frustrations, lack of job satisfaction, insecurity, poor human relationships emotional tension are some of the psychosocial factors which may undermine both physical and mental health of the workers. The capacity to adapt to different working environments is influenced by many factors such as education, cultural background, family life, social habits and what the worker expects from employment.

The health effects can be classified in two main categories –

a) Psychological and behavioral changes – including hostility, aggressiveness, anxiety, depression, tardiness, alcoholism, drug abuse, sickness absenteeism

b) Psychosomatic ill health – including fatigue, headache; pain in the shoulders, neck and back; propensity to peptic ulcer, hypertension, heart disease and rapid aging.

The physical factors play a major role in adding to or precipitating mental disorders among workers. The increasing stress on automation, electronic operations and nuclear energy may introduce newer psychosocial health problems in industry. Psychosocial hazards are therefore assuming more importance than physical or

chemical hazard.

2.2.5 Hazard Management

Hazard management is essentially a problem-solving process aimed at defining problems, gathering information about them and solving them. This is followed up by checking to see that the controls were successful and reviewing the whole process after a period of time or when something changes.

2.2.6 General Industrial hazards

- Throughout the installation and operation, there exists the potential to encounter industrial hazards. Typically these types of hazards are expected to be eliminated or safeguarded through engineering and design. Those not eliminated are controlled through guards and barriers, personal protective equipment, and administrative means, in that order. These hazards are commonly referred to as OSHA type hazards. The following list provides some examples but does not limit the possibility that others might exist.
- Walking-working surfaces.
- Means of egress
- Powered platforms, man lifts and other vehicle mounted platforms
- Need, selection and use of personal protective equipment
- General materials handling and storage
- Machinery and machine guarding
- Hand and portable powered tools
- Welding, cutting and brazing

2.2.7 Guiding principles of industrial hazards

- Everyone is responsible and accountable for the safe conduct of their own activities
- There are clear roles and lines of responsibility, authority and accountability at all levels of the organization. Everyone has the right to tell someone to stop a potentially dangerous or environmental threatening activity.
- Everyone in the workforce has the experience, knowledge, skills and abilities to perform their work safely and competently

- Management allocates resources to ensure work can be performed safely.
- Hazards shall be evaluated and appropriately controlled before work is performed to provide adequate protection to employees, the public and the environment.
- Engineered or administrative controls shall be in place to mitigate to acceptable levels work associated hazards
- No work will be performed unless it can be done safely

2.2.8 Models of hazard

Hazards are sometimes classified into three modes:

- **Dormant** - The situation has the potential to be hazardous, but no people, property, or environment is currently affected by this. For instance, a hillside may be unstable, with the potential for a landslide, but there is nothing below or on the hillside that could be affected.
- **Armed** - People, property, or environment are in potential harm's way.
- **Active** - A harmful incident involving the hazard has actually occurred. Often this is referred to not as an "active hazard" but as an accident, emergency, incident, or disaster

2.2.9 Acoustics Hazards

Risks

- Noise is a significant physical hazard. Over time, workers in environments with high sound levels can experience significant hearing loss. When workers experience continuous or near-continuous noise in the workplace, even lower sound levels can cause hearing impairment
- Additionally, infra-sound and ultra-sound which cannot be normally heard can still have adverse effects and must be monitored and controlled in order to minimize risks of hearing impairment

Regulations and Standards

- Limits on noise exposure are given in terms of sound pressure levels and durations of exposure: longer exposure

times require lower sound levels. For most jurisdictions, the sound level over an 8-hour shift should not exceed 83-85 dBA. However, noise levels must never exceed 140 dBA.

- Many jurisdictions, including OSHA in the United States, require that workers in noisy areas be periodically tested as a precaution against hearing loss. Additionally, if noise levels in a workplace exceed noise limits, a hearing conservation program must be implemented including routine monitoring, worker education, and exposure control including supplying workers with hearing protection equipment.

2.2.10 Electrical Hazards

- A dangerous condition where a worker could make electrical contact with energized equipment or a conductor, and from which the person may sustain an injury from shock; and/or,
- There is potential for the worker to receive an arc flash burn, thermal burn, or blast injury

Working near an electrical hazard is dangerous and can be fatal. Any work on or near energized equipment must be done only when measures are in place to provide protection from electric shock and burn. With adequate safety measures in place, every electrical injury and fatality can be prevented.

2.2.10.1 Electrical Injuries

There are basically two ways to be injured by electricity.

1. By electric shock and
2. by arc flash.

Electric shock -is the passing of electric current through the body. Electrical contact can cause involuntary physical movements. The electrical current may

- prevent you from releasing your grip from a live conductor
- throw you into contact with a higher voltage conductor
- cause you to lose your balance and fall
- cause severe internal and external burns
- kill you

A household 125-volt circuit can deliver 15 amps. Current as low as 30/1000 of 1 amp (30

mA) can cause breathing to stop. A 15-Amp circuit contains many times the current needed to cause death.

Arc flash -is a release of energy caused by an electric arc. The flash causes an explosive expansion of air and metal. The blast produces

- a dangerous pressure wave
- a dangerous sound wave
- shrapnel
- extreme heat
- extreme light

These dangers can result in blast injuries, lung injuries, ruptured eardrums, shrapnel wounds, severe burns, and blindness. Arc flash injuries can also result in death.

2.2.11 Cause of hazards

- Natural hazards
- Deadly forces
- Anthropogenic Hazards
- Sociological hazards
- Technological hazards

2.2.12 Sociological Hazards

- **Crime**

Crime is to breach the rules or laws for which some governing authority can ultimately prescribe a conviction. Individual human societies may each define crime and crimes differently. While every crime violates the law, not every violation of the law counts as a crime; for example: breaches of contract and of other private law may rank as "offenses" or as "infractions".

- **Arson**

Arson is the criminal intent of setting a fire with intent to cause damage. The definition of arson was originally limited to setting fire to buildings, but was later expanded to include other objects, such as bridges, vehicles, and private property. Arson is the greatest cause of fires in data repositories. Sometimes, human-induced fires can be accidental: failing machinery such as a kitchen stove is a major cause of accidental fires.

- **Civil disorder**

Civil disorder is a broad term that is typically used by law enforcement to describe forms of disturbance. Although civil disorder does not necessarily escalate to a disaster in all cases, the event may escalate into general chaos. Rioting has many causes, from antipathy over low minimum wages to racial segregation

- **Terrorism**

1. "An action to advance a political, religious or ideological cause and with the intention of coercing the government or intimidating the public".

2. "Premeditated, politically-motivated violence perpetrated against non-combatant targets by sub national groups or clandestine agents, usually intended to influence an audience"

3. The use or threatened use of violence for the purpose of creating fear in order to achieve a political, religious, or ideological goal.

4. The targets of terrorist acts can be anyone, including civilians, government officials, military personnel, or people serving the interests of governments

- **War**

War is a conflict between relatively large groups of people, which involves physical force inflicted by the use of weapons. Warfare has destroyed entire cultures, countries, economies and inflicted great suffering on humanity. Other terms for war can include armed conflict, hostilities, and police action

2.2.13 Control hazards

The main ways to control a hazard include

- **Elimination:** remove the hazard from the workplace.
- **Engineering Controls:** includes designs or modifications to plants, equipment, ventilation systems, and processes that reduce the source of exposure.
- **Administrative Controls:** controls that alter the way the work is done, including timing of work, policies and other rules, and work practices such as standards and operating procedures
- **Personal Protective Equipment:** equipment worn by individuals to reduce exposure such as contact with chemicals or exposure to noise

These methods are also known as the "hierarchy of control" because they should be considered in the order presented.

2.3 Remedies

- To make management worker bilateral agreement
- Prompt and justified dues payments
- Workers participation in decision

making

- Welfare measures

III. Risk Management

The process of identification, analysis and either acceptance or mitigation of uncertainty in investment decision-making. Essentially, risk management occurs anytime an investor or fund manager analyze and attempts to quantify the potential for losses in an investment and then takes the appropriate action (or inaction) given their investment objectives and risk tolerance. Inadequate risk management can result in severe consequences for companies as well as individuals. For example, the recession that began in 2008 was largely caused by the loose credit risk management of financial firms. Also risk management is the process of identifying, quantifying, and managing the risks that an organization faces. A risk management system includes various policies, procedures and practices that work in unison to identify, analyze, evaluate, address, and monitor risk.

3.1 Process for managing and identifying tasks

While a variety of different strategies can mitigate or eliminate risk, the process for identifying and managing the risk is fairly standard and consists of five basic steps.

First, threats or risks are identified.

Second, the vulnerability of key assets like information to the identified threats is assessed. Third, the risk manager must determine the expected consequence of specific threats to assets.

IV. EMERGENCY PLANNING

Emergency planning is a systematic and On Going process which should evolve as lessons and circumstances change. This planning should aim where possible to prevent emergency occurring, and when they do occur, good planning should reduce, control or mitigate the effects of the emergency.

4.1 Key Principles of Emergency Planning

- . The planning team anticipates both active and passive resistance to the planning process and develops strategies to manage these obstacles
- Planning utilizes an all-hazards approach to minimize threats to the

community.

- Planning elicits participation, commitment, and clearly defined agreement among all response and support organizations.
- Planning is based on accurate assessment (assumptions/opinions that can be substantiated) about the threats, typical human behavior in disasters and likely resources and support from out-side agencies, organizations, governments.
- Planning should address the linkage of emergency response to disaster recovery and hazard mitigation.

V. OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT

Occupational safety describes the potential dangers and well-being of employees in the workplace. Any health-risk that an individual is exposed to because of their employment or at their place of employment falls under the umbrella term of occupational safety.

5.1 Advantages of Implementing an Occupational Health and Safety Management System

- A safer workplace
- Moral
- Reduced costs
- Training
- Monitoring
- Integrated
- Stakeholder's confidence.

5.2 Rules of Safety Management

Safety is primarily the responsibility of the plantoperating organization. To discharge this responsibility, the operating organization needs to establish an effective safety management system. This is the essence of what is often referred to as self- regulation. The system developed needs to comply with the requirement of legislation and the relevant regulatory bodies

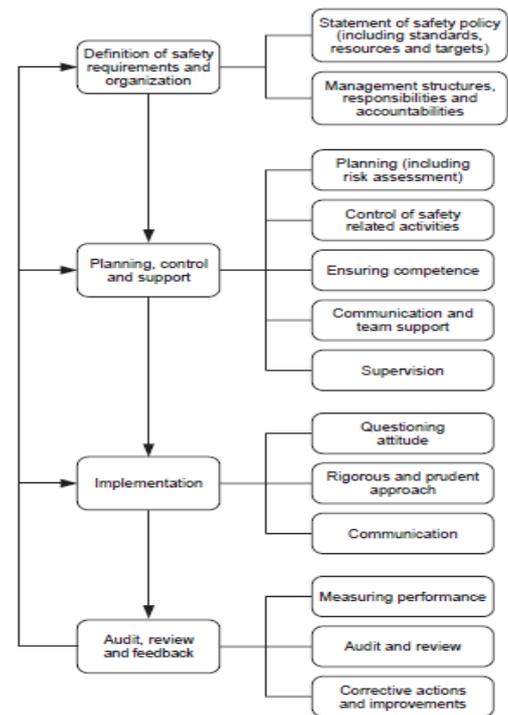


Figure 1: Illustration of components to the safety management

5.3 Statement of safety policy (including standards, resources and targets)

- Is there a safety policy statement that expresses the commitment of the organization to develop an effective system for the management of safety?
- Is the policy statement brought to the attention of all staff and reinforced by the active review support of senior managers?

VI. DATA ANALYSIS

By visiting RPCL, gathered information will be categorized according to following factors. Addition, changes and recommendations will be implemented to study safety requirements for any sort of industries:

6.1 Effect of Main Factors on Risks

Main factors are as follow:

1. Man
2. Machines
3. Electricity
4. Working Environment
5. Fire
6. Information
7. Explosion
8. Hand equipment
9. Material Handling
10. Insurance Policy

11. Plant layout
12. Safety Management System

Each of the factors will be optimized according to weighted moving average method.

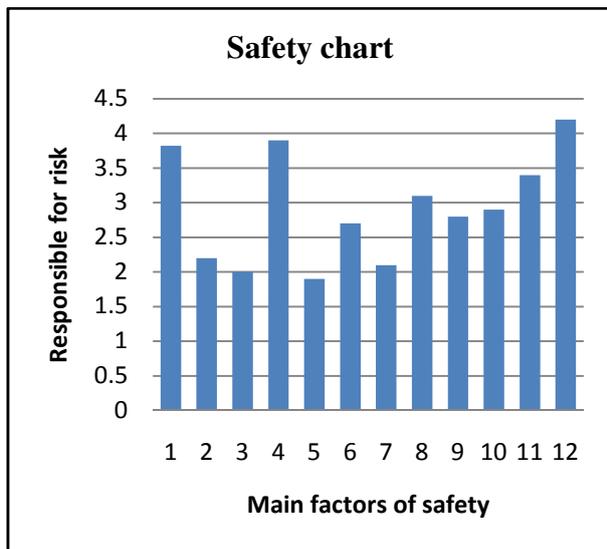


Figure 2: Responsible for risk vs main factors of safety

6.2 The Percentage of Various Causes of Accidents

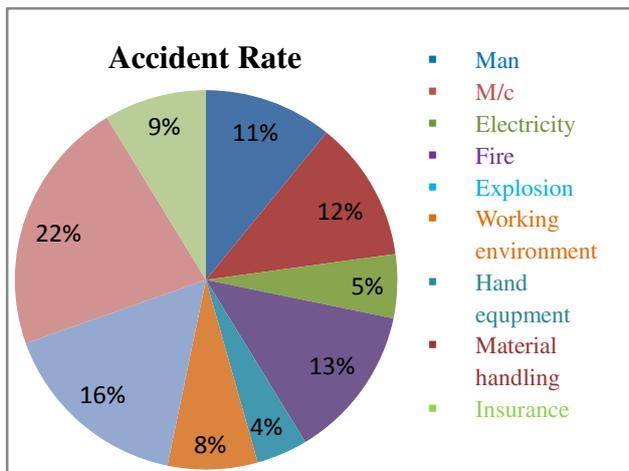


Figure 3: Accident rate for different causes

Figure 3 is used to see the percentage of various causes of accidents. The percentage of various causes such as man, machine, electricity, fire etc. is seemed to be this figure. According to Fig. 3, it is clear that the accident rate is high 22% for material handling. For better safety management, it is necessary to follow the safety rules and regulation and reducing the accident rate or risk to acceptable level.

VII. CONCLUSION AND RECOMMENDATION

It is strongly believed that safety is the most consideration in power plant or industrial sectors. It requires a periodic review of all equipment and operation a team qualified, safety minded operating and maintenance men. Social justice and sustainable economic growth can't be achieved without having safe and healthyworking condition. "A stitch in time saves nine", is as an old proverb. Safety management planning is a vital role for any organization for managing any situation, which is likely to happen at any time caused due to an accident. Safety management planning helps in assessing in advance the materials and manpower requirements and in formulating procedures for managing emergency situations Most of the Employee of a plant are not well trained and they don't maintain discipline during any occurrence of hazard. So, every plant or process unit must formulate a safety management planning.

The following suggestions are important for safety environment of the power plant:

- To avoid electrical short circuit, use standard quality wire, concealed or conduit the wire and change the wire timely.
- To give up the habit of cigarette
- To be careful about machine, lubricating system.
- Check the fire equipment within 20 days
- To be conscious, whilehandling materials
- To be attentive every moment in working hours.

Safety is one of the most important factors in industrial sectors or power sector all over the world. Crisis always promotes misunderstanding and chaos. Personal injury or death in the working place creates a situation which is not congenial for both management and workers. In addition it is necessary that all operating men be trained so that they know, and familiar with the instrument which they operate. This training must be periodically reviewed & upgraded with particular attention given to new employees with their known, how subject to examination.

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