RISK ASSESSMENT & DISASTER MANAGEMENT PLAN AND OCCUPATIONAL HEALTH & SAFETY

This chapter deals with identification of hazards and disaster and preventive measures for disaster and occupational health and safety. Saraf Agencies Pvt. Ltd. may face certain types of hazards which can disrupt normal activities abruptly and lead to disaster like fires, inundation, failure of machinery, explosion to name a few. Titanium Plant also poses fire, electrocution, spill and explosion hazards. Disaster management plan formulated with an aim of taking precautionary step to control the hazard propagation and avert disaster and also to take such action after the disaster which limits the damage to the minimum.

1.1 RISK ASSESSMENT:

As a consequence of health and safety awareness many measures are being taken to ensure the security of an individual working in the industrial premises. Risk assessment follows an extensive hazard analysis. Risk is defined as a likelihood of an undesired event (accident injury or death) occurring within a specified period or under specified circumstances. This may be either a frequency or a probability depending on the circumstances.

In the working atmosphere, it is not possible to avoid or eliminate risk factor completely. However it is possible to minimize the risk factor to minimal or acceptable level.

1.1.1 Study of Risk:

The study of risk involves following steps

1. Risk analysis
2. Risk evaluation
3. Risk control.

1.1.2 Risk Analysis:

Risk analysis follows as extensive hazard analysis. It involves the identification and assessment of potential impact. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population, etc. Much of this information is difficult to get or generate. Consequently the risk analysis is often confined to maximum credible accident studies.

The hazard has been higher for workers directly exposed to coal handling areas where not only the danger due to failure of machinery but also inhalation of dust exists. Details of the characteristics as relevant to the hazardous nature of the process are tabulated in **Table No. C1-1**.

Table No. C1-1: Hazard Characteristics

Sl. No.	Chemical	Potential Hazard	Consumption
1	Chlorine	Reactive corrosive toxic and explosive on heating container	For water treatment
2	HSD	Inflammable	For DG set
3	Coal	Inflammable	For furnace

1.1.3 Risk evaluation:

All systems natural or manmade are subject to failure. The nature of failure varies widely as do the causes of failure and the events leading to failure. The failure of systems could be due to:

- Misconception of systems required capability or environment.
- Design deficiencies and erroneous assumption.
- Errors in operational process
- Improper management of the systems.
- Risk evaluation to determine the acceptable level and reduce the risk level.
- Control decision monitored for the meticulous implementation to prevent the occurrence of unclassified and unacceptable accidents.

Risk is defined as probability of occurrence of an accident and its consequences. The risk may be computed by the following formula:

$$FAR = \frac{10^8}{24*365*N} \sum_{i=1}^{n} (xi*fi)$$

Where:

xi	=	Number of deaths from a particular accident
fi	=	Frequency of occurrence of the particular accident
n	=	Potential types of accidents
n	=	Total number of people at risk
FAR	=	Fatality accident rate

The above concept of risk is quite straight forward. It is based on one specific aspect i.e. individual working in a particular environment that is exposed to a definite level of risk. In the present case of risk analysis in context, this formula is the best and appropriate to serve the practical purpose.

The formula is based on actual historical record of the accident episodes reported in that particular type of environment.

Accordingly the risk factor i.e. probability level of occurrence of accident works out to nil in this case.

In the following paragraphs along with disaster management plan several safety measures for individuals are also recorded. This forms a part of risk control.

All systems, natural or man-made are subject to failure. The nature of failure varies widely as do the causes of failure and the events leading to failures. The failure of system could be due to:

- Misconception of system requirement, capability or environment;
- Design deficiencies and erroneous assumption;
- Faulty construction, manufacture, erection and installation;
- Errors in operational processes, and
- Improper management of the system.

Attempts have been made to reduce failures of man-made systems with the introduction of safety measures, quality control, reliability analysis, condition monitoring and other approaches in design in order to reduce the probability of failure. Use of measures such as factor of safety are usually resorted to in order to improve the reliability of design and where health of the person is at great risk. Such factor has to be very high reducing probabilities of accidents/ disaster to a very low level.

Assessment of fire in tank and pool fire in dyke under wind free conditions using "Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program".

1.1.4 Risk Control:

On Site Emergency Planning:

The onsite emergency plan would be related to the final assessment and it is the responsibility of the occupier management to formulate it. The plan must therefore, be specific to the site.

The plan sets out way in which designated people at the site of the incident initiate supplementary action either inside or outside the workers at an appropriate time. An essential of the plan is the provision for making the affected unit safe, for example, by shutting it down. The plan also contains the full sequence of key personal to be called in from other sections or from off site.

Off Site Emergency Plan:

The offsite emergency plan is an integral part of any major hazard control systems. It was based on those accidents identified by the works management, which could affect people and the environment outside the works. Thus, the offsite plan follows logically from the analysis that took place to provide the basis for the onsite plan and the two plans was therefore complement to each other. The key feature of a good offsite emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan The role of the various parties that may be involved in the implementation of an offsite plan are described below. The responsibility for the off site plan has been likely to rest either with the works management or with the local authority.

Aspects to be included in an offsite emergency plan, some of the aspects to be included in offsite emergency plan are as follows.

1.1.5 Emergency Control Centers:

The emergency control center is the place from which the operations to handle the emergency will be directed and coordinated. It has to be attended by the site work main controller, key personnel and the senior officers of the fire and police services.

Emergency control centers therefore should contain the following:

1. Adequate number of external telephones.
2. Adequate numbers of internal telephones
3. A plan of the workers to show
4. Areas where there are inventories of HSD and chlorine
5. Location of safety equipment
6. Assembly point
7. Truck parking information
8. A nominal roll of employee
9. List of personnel with addresses telephone numbers
10. Specialized monitoring equipment will be available at all the sensitive points to deal with small to medium spillages of the chemical.
11. The equipment operators must be trained in development of the equipment.

1.1.6 General Safety Rules:

At the existing plant where fuels chemicals and other materials are reactive in nature following general guidelines are made.

1. Fitting dress and use of personnel protective equipment recommended for respective job has to be adhered to by everyone.
2. All unsafe conditions or natural occurrences have to be reported promptly to the supervisor/ head of the department of safety.

1.1.7 Personal Protective Equipment:

Personnel protective equipment play vital role in reducing the losses in case of an accident. They provide protection to the workmen from injuries during the execution of job. The various protective equipments are suggested as below.

Gloves and protective clothing: Since the chemicals are very corrosive and toxic, those called upon to handle has been provided with gloves and protective clothing.

Safety Helmets: Every one inside the plant and the visitors has to wear safety shoes for protecting their toes and heels. The material of the shoes has required being resistant to the type of chemicals available within the plant.

Safety Belts: Safety belts provide protection in case of fall while working at height.

Safety goggles and face shields: Suitable goggles protect the eyes from flying objects and harmful rays of welding and furnace flames and also heat, dust and

chemicals substances. Standard welders goggles, face shield or hood has been used by the workers and helpers while involved in operations, wherever applicable.

1.2 Disaster May Occur Due To Following Hazards In The Various Units Within The Plant:

a) Fire
b) Explosion
c) Oil spillage
d) Electrocution
e) Accident
f) Liquid hot metal spill

In any plant there are various activities or areas which pose substantial threat to the workers and hence hazardous in nature. The potential hazardous areas and the likely accidents with the concerned area have been enlisted below in **Table No. C1-2**.

Table No. C1-2: Hazardous Area with Concerned Accidents

Sl. No.	Hazardous Area	Likely Accident
1	Electrical rooms	Fire and electrocution
2	Transformer area	Fire and electrocution
3	Cable tunnel	Fire and electrocution
4	Storage facilities for coal/ fuel	Fire/spillage

1.2.1 Classification of Major Hazardous Units

Hazardous substances may be classified into three main classes namely flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have given in NFPA Codes 49 and 345 M. the major hazardous materials to be stored, transported, handled and utilized within the facility have been summarized in the **Table No. C1-3**.

In the Titanium Plant, LDO will be used in the reheating furnace. The storage volume of the tank will be such that it is sufficient for two shifts of operation of reheating furnace.

Table No. C1-3: Hazard Materials Stored, Transported and Handled

Materials	Hazardous Properties
Light Diesel Oil (LDO)	UN 1203. Dangerous Goods Class 3 - Flammable Liquid

1.2.2 Identification of Major Hazard Installations

Following accidents in the chemical/metal industry in India over a few decades, a specific legislation covering major hazard activities has been enforced by Govt. of

India in 1989 in conjunction with Environment Protection Act, 1986. For the purpose of identifying major hazard installations, the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals.

A systematic analysis of the fuels/chemicals and their quantities of storage has been carried out, to determine threshold quantities as notified by GoI Rules, 1989 and the applicable rules are identified.

1.2.3 Hazard Assessment and Evaluation

1.2.3.1Methodology

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock material, major process components, utility and support systems, environmental factors, proposed operations, facilities and safeguards.

1.2.3.2Preliminary Hazard Analysis (PHA)

A preliminary hazard analysis is carried out initially to identify the major hazards associated with storages and the processes of the plant. This is followed by consequence analysis to quantify these hazards. Finally, the vulnerable zone are plotted for which risk reducing measures are deducted and implemented. Preliminary hazard analysis for fuel storage are and whole plant is given in **Table No. C1-4**.

Table No. C1-4: Preliminary Hazard Analysis for the Whole Plant in General

PHA Category	Description of Plausible Hazard	Recommendation	Provision
Environmental Factors	If there is any leakage and eventually of source of ignition.		All electrical fittings and cable are provided as per the specified standards. All motor starters are flame proof.
Environmental Factors	Highly inflammable nature of the liquid fuels may cause fire hazard in the storage facility.	A well designed fire protection including foam, dry powder, and CO_2 extinguisher should be provided	Fire extinguisher of small size and big size are provided at all potential fire hazard places. In addition to the above, fire hydrant network is also provided.

1.2.3.3Fire Explosion and Toxicity Index (FE&TI) Approach

Fire, Explosion and Toxicity Indexing (FE & TI) is a rapid ranking method for identifying the degree of hazard. The application of FE & TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information.

The degree of hazard potential is identified based on the numerical value of F & EI as per the criteria given below:

F&EI Range	**Degree of Hazard**
0-61	Light
61-96	Moderate
97-127	Intermediate
128-158	Heavy
159-up	Severe

By comparing the indices F&EI and TI, the unit in question is classified into one of the following three categories established for the purpose (Table No. C1-5).

Table No. C1-5: Fire Explosion and Toxicity Index

Category	Fire and Explosion Index (F&EI)	Toxicity Index (TI)
I	F&EI < 65	TI <6
II	65 < or = F&EI < 95	6 < or = TI < 10
III	F&EI > or = 95	TI > or = 10

1.3 ACCIDENT LEVEL:

If there is any disaster in any part of plant/work place due to any reason the classification of areas, which may be affected, and nature of accidents can be made as follows:

Level I Operator level

Level II Local community level

Level III Regional/national level

Level IV International level

LEVEL - I ACCIDENTS

Under this level disaster may happen due to electrocution, fire, explosion, oil spillage, liquid hot metal spill and spontaneous ignition of combustible material.

This level has probability of occurrence affecting persons inside the plant. Various hazardous areas, which have been mentioned earlier as potential hazard areas will be affected during this level of accidents.

LEVEL II ACCIDENTS

Disaster of this level can occur in case of sabotage and complete failure of all automatic control/warning systems, and also if the fuel oil stored in tank leaks out. However probability of occurrence of this is very low due to adequate security, training and education of persons of plant responsible for operating such systems.

1.4 DISASTER PREVENTIVE MEASURE:

In order to prevent disaster due to fire, explosion, oil spillage, electrocution, liquid hot metal spillage and other accidents, following preventive measures has been adopted.

- Design, manufacture and construction of all plant and machineries building has been as per national and international codes as applicable in specific cases and layer down by statutory authorities.
- Provision of adequate access way for movement of equipment and personnel has been kept.
- Minimum two numbers of gates for escape during disaster has been provided.
- Water spraying in coal storage and iron ore area.
- System of fire hydrants comprising electrical motor division and diesel engine drivers fire pumps with electrical motor driver jockey pump for keeping the fire hydrant system properly pressurized and automatic water sprinkling system for all important transformers.
- Fire hydrants with fire hoses in all areas where fire can break.

1.4.1 Site Emergency Control Room:

In order to control the disaster more effectively, a Site Emergency Control Room (SECR) will be established at the plant site. The facilities to be provided are given in following sections:

- Plant Layout
- Plant Layout with inventories and locations of fuel oil, storage tanks, coal storage etc.
- Hazard identification chart, maximum number of people working at a time, assembly points etc.
- Population around factory
- Internal telephone connections
- External telephone connections
- Hotline connection to district collector, police control room, fire brigade, hospital etc.
- Public address system
- Torch lights
- List of dispensaries and registered medical practitioners around factory
- Area map of surrounding villages
- Nominal roll of employees
- Note pads and ball pens to record message received and instructions to be passed through runners.

- The blown up copy of Layout plan showing areas where accident has occurred.
- Fire hydrant system in different location

1.4.2 Safety Department:

Safety department has been manned by experienced engineers and other supporting staff who would bring safety consciousness amongst the work force of plant.

The safety department has been conducted regular safety awareness courses by organizing seminars and training of personnel among the various working levels.

1.5 CONTIGENCY PLAN FOR MANAGEMENT OF EMERGENCY:

To tackle the situation, a disaster control room has been set up having links with all control rooms of the plant. An up to date communication facility has been provided to control rooms. In case of disaster, emergency meeting of all concerned sectional heads has been convened to decide control measures and ensure its implementation. The emergency organization shall be headed by emergency leader called Site Main Controller (SMC) who will be plant manager. In his absence senior most person available at plant shall be emergency leader till arrival of plant manager.

Besides the top officials described above, rest of the employees shall be divided into three action teams namely A, B, C, and a Non action Group D. Action team 'A' will consist of staff of section in which accident has occurred. Action team 'B', will consist of staff of non affected sections and maintenance department. Action team 'C' will consist of supporting staff i.e. Security supervisor, Ware house Supervisor, Shift Supervisor etc. Group 'D' will consist of people not included in those teams like contractor, labour, security men etc.

Team 'A' comprising staff of affected section will be taking up the action in case of an emergency. Team 'B' will help team 'A' by remaining in their respective sections ready to comply with specific instructions of SMC. Team 'C' consisting of supporting staff will help team 'A' as required and directed by Team 'B'. Group 'D' will be evacuated to safe region under supervision of Team 'C'.

A multichannel communication network shall connect SECR to control rooms of plant, various shops, and other departments of plant, fire station and neighboring industrial units.

1.5.1 Outside Organizations Involved In Control of Disaster:

In the event of massive spillage of fuel oil or occurrence of fire, population inside and outside plant boundaries, vegetation and animal etc. may be affected. In such circumstances secondary fire may also take place. In such an event help shall be taken from outside agencies also. The organizations that shall be involved are as follows:

a. State and local authorities: District Collector, Revenue Divisional Officer, etc
b. Factory Directorate, Director of factories and boiler, Joint Director of factories and boiler, Asstt. Director of factories and boiler

c. Environmental agencies: Member Secretary of State Pollution Control Boards, Regional Officer State Pollution Control Board.
d. Fire Department: Chief District Officer
e. Police Department: District Superintendent of Police, SHOS of nearby Police Stations
f. Public Health Department:
    - District Medical Officer
    - Residential medical officers of PHCs in a radius of 4.5 km around plant site
g. Local Community Resources
    - Regional Transport officer
    - Divisional Engineer Telephones

The outside organizations shall directly interact with district magistrate who in consultation with SMC shall direct to interact with plant authorities to control the emergencies.

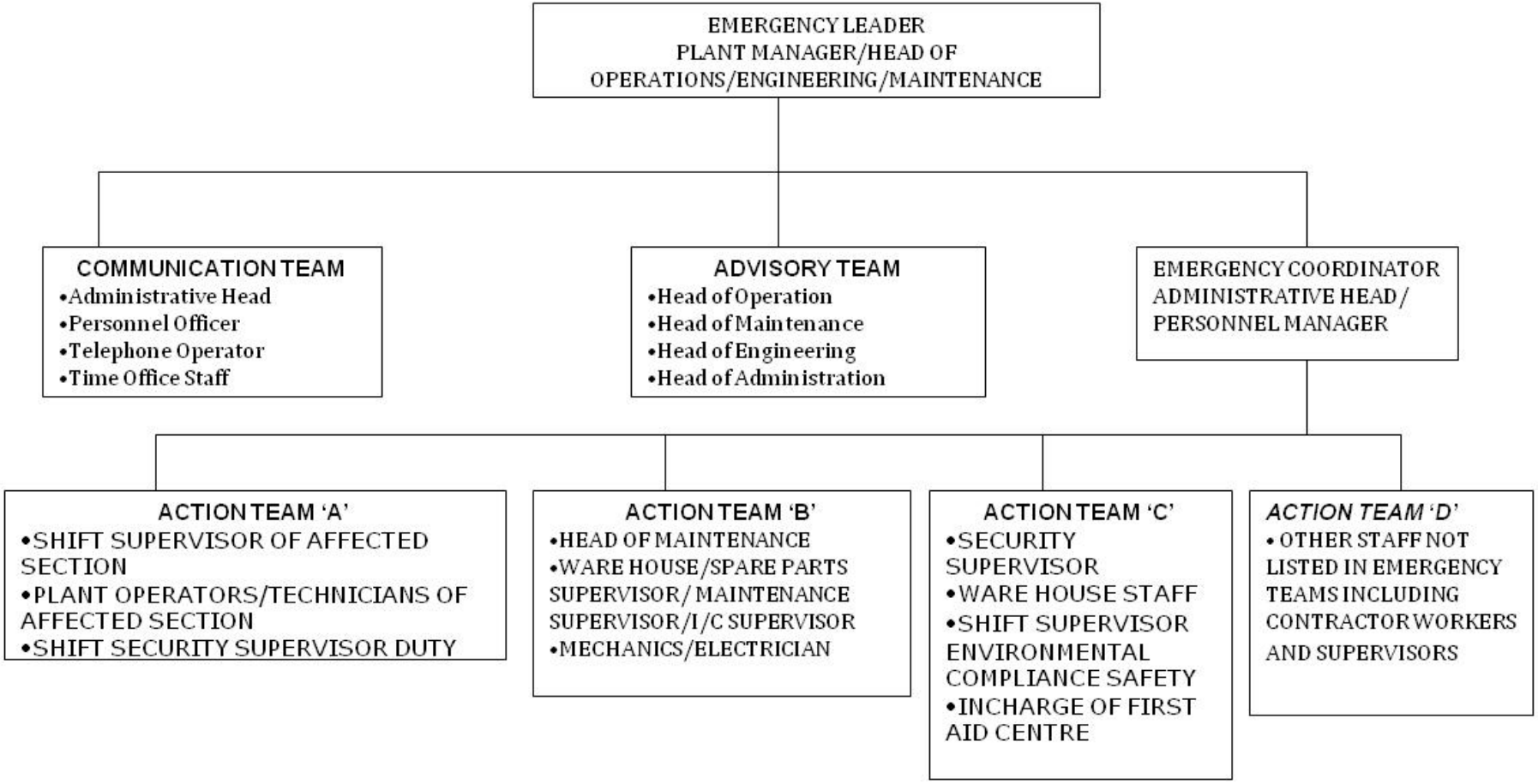

Fig.No.C1-1: General Coordination Among On Site Emergency Team Members

1.5.2 Hazard Emergency Control Procedure:

The onset of emergency will in all probability, commence with a major fire or explosion, the following activities will immediately take place to interpret and take control of emergency.

1. Staff member on duty will go to nearest fire alarm call point and trigger off the fire alarm.
2. On site fire crew led by fireman will arrive at the site of incident with fire foam tenders and necessary equipments.
3. Site main controller will arrive at SECR, from where he will receive information continuously from incident controller and give decisions and direction to the incident controller, plant control room, Emergency security controllers and to the site medical officer to take care of casualties.

Site Main Controller will be directing and deciding a wide range of following disparate issues. In particular SMC has to decide and direct.

- Whether incident controller requires reinforcement of manpower and facilities
- Whether plant is to be shut down or more importantly kept running.
- Whether staff in different locations is to remain indoors or to be evacuated and assembled at designated collection center.
- Whether missing staff members are to be searched or rescued.
- Whether off-site emergency plan to be activated and a message to that effect is to be sent to district headquarter.

When the incident has eventually been brought under control as declared by the Incident Controller, the SMC shall send two members of his advisory team as inspectors to incident site for:

- An assessment of total damage and prevailing conditions with particular attention to possibility of re-escalation of emergency which might, for the time being, be under control.
- Inspection of other parts of site, which might have been affected by impact of incident.
- Inspection of personnel collection and roll call centers to check if all persons on duty have been accounted for.
- Inspection of all control rooms of plant to assess and record the status of respective plants and any residual action deemed necessary.

Post emergency, the inspectors will return to SECR with their observations and report of finding and will submit the same to SMC.

1.6 MISCELLANEOUS PREVENTIVE MEASURES:

1.6.1 Alarm System to be followed During Disaster:

On receiving the message of "Disaster, from Site Main Controller, fire station control room attendant will sound SIREN I WAILING TYPE FOR 5 MINUTES. Incident controller will arrange to broadcast disaster message through public address system.

On receiving the message of "Emergency Over" from Incident Controller the fire station control room attendant will give "All Clear Signal, by sounding alarm straight for two minutes. The features of alarm system will be explained to one and all to avoid panic or misunderstanding during disaster.

1.6.2 Actions to Be Taken On Hearing the Warning Signal:

On receiving the disaster message following actions will be taken:

- All the members of advisory committee, personnel manager, security controller, etc. shall reach the SECR.
- The process unit persons will remain ready in their respective units for crash shutdown on the instruction from SECR.
- The persons from other sections will report to their respective officer.
- Residents of township will remain alert.

1.6.3 Safety Devices/Equipments:

In order to make the services more effective the workers and rescue team will be provided with the safety equipments and items like gas mask respirators, fire entry suits, fire blankets, rubber shoes or industrial shoes, rubber glove, ladders, ropes, petromax lamp torches etc.

1.6.4 Fire Extinguisher:

The different type of fire extinguishers has been installed at strategic locations in the plant and given in **Table No. C1-6**.

Table No. C1-6: Different Fire Extinguishers at Different Sites

Name of Site	Type of Fire Extinguishers
Generator area	CO_2 Type, Foam Type, Dry Chemical Powder
Cable galleries	CO_2 & Foam type, Dry chemical powder
High voltage panel	CO_2 & Foam type, Dry chemical powder
Control rooms	CO_2 & Foam type, Dry chemical powder
MCC rooms	CO_2 & Foam type, Dry chemical powder
Pump Houses	CO_2 & Foam type, Dry chemical powder
Fuel storage area	CO_2 & Foam type, Dry chemical powder sand basket
Guest houses and offices	Dry chemical powder, foam type
Godowns, store	CO_2 & Foam type

1.7 OCCUPATIONAL HEALTH AND SAFETY:

1.7.1 Organization and Communication:

The command structure has been given in figure earlier, the warning systems has been comprised of alarms, implementation procedures for hazard emergency and the site emergency control room shall operate as described earlier. There has been provision of name and appointments of incident controller, site main controller, their deputies and other key personnel.

For communicating the declaration of emergency and evacuation decision to the plant personnel, it is envisaged that the siren would be utilized.

- Declaration of emergency : - Intermittent three times with Half-minute interval
- Normal factory siren : - Continuous for 30 secs.
- All-clear signal : - Continuous for 3 mins.

1.7.1.1 Special Emergency Equipment:

Emergency Medical arrangement:-

- The first-aid box is available in plant premises – 4 nos.
- First-aid boxes are maintained in each department
- Adequate stock of essential medicines, bandages and other appliances are being maintained.

Fire Hydrant System: Fire Hydrant System is provided at different locations inside the plant as shown in plot plan. Fire Hydrant hoses are 63 mm. dia rubber line hose. Two motors along with two suitable pumps which can discharge 273 m3 of water per hour are provided to main header to maintain a pressure of 8.8 Kg/cm2. In case of temporary power failure, the fire pumps are run through DG sets. Two water reservoirs having capacity of 40000 Ltr. and 60000 ltrs are supplying water to the fire main line.

Fire Extinguishers: Required types of fire extinguishers has been provided at different locations of the existing plant.

Fire Buckets: Fire buckets filled with dry sand has been provided in different locations of the existing plant as given below:-

Table No. C1-7: Fire Buckets Location within Plant

Sl. No.	Place	Number
1	Main Gate	2
2	Quality Control	2
3	Mechanical Work Shop	2
4	Control Room	2

Siren: Company has Siren/ hooter arrangement, which can be activated manually during fire related emergency.

Communication: Public address system and EPABX telephone is available for effective communication inside the plant. Telephone directory is available in the entire department.

First Aid Box: Company has provided First Aid boxes with required first aid medicines at different locations inside the plant for any injury. First aid boxes are being checked once in a month and medicines are replenished.

Fire Tender: In case of in adequacy mutual aid help is taken from nearby adjacent industries as well as from Govt. fire station.

FIRE ALARM SYSTEM

There is an electric siren, installed at emergency control room, which warns to workers and employees in case of any emergency standby arrangement in case of power failure DG set is available for the fire alarm system.

1.7.1.2 Meteorological Information:

During emergencies, the knowledge of exact wind direction helps the factory personnel to decide on the escape route to be taken for safe evacuation of personnel and also the safe assembly point and Emergency Control Centre. Therefore, the windsack has provided at the top-most point of the factory building (at TG Building) for easy identification of the wind direction. There is also a Wind direction and speed indicator in the plant.

These are the arrangements for obtaining details of weather conditions prevailing at the time and weather forecasts.

1.7.2 Specific Treatment:

The major injuries due to hazards present are:

- Burn with hot substances
- Impact injuries with machines and equipments
- Injuries due to fall from height

Specific treatment / preventive measures for these types of injuries and hazards have been provided in the Medical Centre. Eye and body showers have been provided in different required places of plant which has been identified by the Safety Officer. Major hazards/injuries and treatment facilities in the plant are given in **Table No. C1-8**.

Table No. C1-8: Major Hazards/ Injuries & Treatment Facilities in Plant

Unit	Hazards/Injuries	Treatment facilities at OHC
RMHS	Uncontrolled dust emissions / failure of Emission control System.	All primary pathological diagnosis, X-Ray, Ultra sound, ECG, Trauma cases, Audiometry Test, Spirometry test, Vision testing, Eye treatment, Burn treatment, Poisoning treatment, Electrical Shock treatment, Ambulance Facility

The emergency, critical cases & diseases which cannot be treated shall be referred & treated at specialized hospitals i.e. Medical Colleges & super specialty hospitals.

Industrial Safety:

For protection of working personnel, equipment and machineries from any damage or loss and to ensure uninterrupted production, adequate safety and fire fighting measures have been planned for the existing plant. Important provisions are as follows:

- Laying down specific Safety, Health & Environment policy to guide
- Provision of adequate personal safety appliances to workers engaged in hazardous installations.
- Practices of safety inspections / monitoring at regular intervals by a team of experienced professionals to guide & educate the workforce.
- Provision of detection and alarm system to allow a developing fire to be detected at an early stage.
- Mock drills will be conducted once in Six months for tackling on-site emergency.

Plant uses a wide variety of specialized equipments and methods for handling construction materials. This equipment ranges from the most basic forklift to Cranes, Derricks, Hoists, Elevators and Conveyors. The hazards of using powerful equipment and of moving heavy materials require a wide variety of protective measures for employees on the site. The work talks about regulatory requirements and safe use for this equipment. The work covers safe rigging and slings for proper lifting, and safety requirements for specific types of Cranes, Derricks, Hoists, Elevators, Conveyors, and forklifts. Bearing this in mind the cranes, hoists, lifts are periodically tested and certificate issued for continuous use. Safe operation practice document and safe maintenance practice document should be prepared and given to operating and maintenance personal.

Safety Management:

No. of elements of safety management are quite large. They also vary from case to case. They can be grouped under five broad categories or sub-systems.

1. Managerial Systems
2. Accident Prevention Systems
3. Support Systems
4. Event Management Systems
5. Evaluation Systems

Managerial Systems:

- Safety Policy
- Safety Organization
- Safety Objectives
- Safety Responsibilities
- Safety Accountability
- Safety Coordination
- Safety Budget
- Safety Committees

- Safety Meetings
- Safety Laws / Rules

Accident Prevention Systems:

- Equipment and workplace standards
- Maintenance & Testing Procedures
- Contractor & Visitor Control
- Safety Work Permit (SWP)
- Hazard Identification, Reporting, Investigation & corrective Action
- Inspection Systems
- Monitoring Systems
- Risk Assessment
- Personal Protective Equipments

Support Systems:

- Induction
- Management skills training
- Job specific training
- Safety Awareness Promotion
- Safety Information Services

Event Management Systems:

- Emergency Management
- Occurrence Reporting, Investigation & Analysis
- Compensation & Rehabilitation

Evaluation Systems

- Safety Performance Reviews
- Safety systems audits (Internal)
- Safety systems reviews
- SWPs compliance
- Safety action plan review
- Safety system audits (External)

Appropriate Personal Protective Equipments (PPE)

Personal protective equipments are given in **Table No. C1-9**.

Table No. C1-9: Personal Protective Equipments

Sl. No.	Unit	Hazard	Injury	Use of PPE
1	Material handling and storage	Dust pollution Hands going between running parts of conveyors Machineries sound Coal heap auto ignition, HSD ignition	Eye Injury, Dust inhalation Physical injury Hearing system damage Burn injury	a) Safety Goggles Eye wash taps b) Safety boot, Hand leather gloves c) Ear muffles Fire fighting equipments

1.7.3 Occupational Health:

Occupational health service is a cross disciplinary area concerned with protecting safety, health & welfare of the people engaged in work or employment.

International Labour Organization (ILO) & World Health Organization (WHO) ensure a common definition of Occupational Health. The definition as follows:

"*Occupational Health should aim at the promotion & maintenance of the highest degree of physical, mental & social well being of workers in all occupation, the prevention amongst workers of departures from health caused by their working conditions, the protection of workers in their employment from risk resulting from factors adverse to health, the placing & maintenance of workers in an occupational environment adapted to physiological & psychological capabilities and to summarize, the adaptation of work to man and each man to his job."*

The modern definition of Occupational health is *"The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations – total health of all at work".*

OCCUPATIONAL HAZARD

Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment, or a combination of these. The common health hazards are:

(1) Exposure to high temperature operations

(2) Exposure to carbon monoxide

(3) Exposure to fugitive dust in material handling and crushing/ grinding operations, which may cause respiratory diseases

(4) Direct contact with moving machines and equipment.

OCCUPATIONAL HEALTH HAZARDS

The hazards/ conditions responsible for deterioration of health condition of workers in an industry are termed as Occupational Health Hazards.

TYPES OF OCCUPATIONAL HEALTH HAZARDS

The Occupational Health Hazards are mainly as follows:

A. Physical Hazards

The main factors contribute to the physical hazard are as follows:

- Temperature - Heat / Cold
- Illumination
- Noise
- Vibration
- Radiation
- Atmospheric pressure

Diseases due to physical agents

The following diseases can be caused due to over exposure of the person to the respective physical conditions of environment.

- Heat- Heat hyperpyrexia, Heat Exhaustion, Heat Syncope, Heat Cramps, burns, Prickly heat
- Cold - Frost bite
- Light – Occupational Cataract
- Atmospheric pressure - Caisson disease, air embolism, explosion
- Noise - Occupational deafness
- Radiation - Cancer, Leukemia, aplastic anemia, Pancytopenia
- Electricity - Burns, Shocks

Heat illness

- Predisposing Factors for heat illness are
- Physical activity
- Extremes of age, poor physical condition, fatigue
- Excessive clothing
- Dehydration
- Cardiovascular disease
- Skin disorders
- Obesity
- Drugs

B. Chemical Hazards

- Routes of entry - Inhalation, Ingestion, skin absorption. (inhalation is the main route of entry)

<u>Chemical agents can be classified into-</u>

- Metals - Lead, TEL, As, Hg, Cd, Ni, Co etc.
- Aromatic Hydrocarbons - Benzene, Toluene, phenol etc.
- Aliphatic Hydrocarbons - Methyl alcohol
- Gases - Simple asphyxiates: N_2, CH4, CO_2
- Chemical asphyxiants: CO, H_2S, HCN
- Irritant gases: Ammonia, SO_2, Cl_2,
- Systemic poison: CS_2

C. Biological Hazard

- Bacteria - Tetanus, Tuberculosis, Brucellosis, Milkmen), Gonorrhea (Sex-workers - Genital organs get affected).
- Virus - Hepatitis, AIDS
- Protozoal & Parasitic - Malaria, Hookworms, tapeworms etc.
- Fungi-(Agri-workers) - Tinea-infections, Coccidiomycosis, Psittacoses, ornithosis, etc.

D. Mechanical Hazards

- Injuries - Falls, cuts, abrasions, concussions, contusions, etc.
- Ergonomic Disorders - Musculo-skeletal disorders (MSDs), Cumulative-trauma-Disorders (CTDs) etc.

- Ergonomics : `Adjustment of Man & Machine`

Application of human biological sciences with engineering science to achieve optimum mutual adjustment of man & his work, the benefit being measured in terms of human efficiency and well being

Tool / machine design to fit to work. Ergo tools/ ergo friendly tools: Tools which reduce the stresses or problems resulting in CTD's / MSD's.)

E. Psychosocial Hazards

- Lack of job satisfaction, insecurity, poor interpersonal relations, work pressure, ambiguity, etc.
- Psychological & behavioral changes – hostility, aggressiveness, anxiety, depression, alcoholism, drug addiction, sickness absenteeism.
- Psychosomatic disorders- Hypertension, headache, body-ache, peptic ulcers, asthma, diabetes, heart disorders, etc.

TYPES OF CONTROL

There are three types of control / remedial measures for mitigating the hazards. The controls are as follows:

- Medical (required monitoring effectiveness of Engg. Controls)
- Engineering (Best Engg. Control is to reduce exposure)
- Administrative / Legal. (Emphasis given to reduce the exposure)

A. Medical Control

Under medical control the following measures shall be taken up

1. Pre –placement examination.
2. Periodical health checks up.
3. Medical and health care facilities.
4. Supervision of work environment.
    - Water supply , food, general plant cleanliness
    - Toilet. Proper garbage & waste disposal.
    - Sufficient space.
    - Lighting.
    - Ventilation.
    - Protection against hazards.
5. Notification
6. Maintenance and analysis of records.
7. Health education and counseling.

B. Engineering Controls

- Designing-building, Work station
- Good Housekeeping.
- Ventilation
- Mechanization
- Substitution
- Enclosure
- Isolation

- Local Exhaust Ventilation.
- Personal Protective Devices.
- Work Environment Monitoring
- Statistical Monitoring

C. Administrative / Legal control

i. Formulation and implementation of Factory Act to regulate:

1. Health, safety and welfare of workers.
2. Employment of young persons.
3. Hours of work.
4. Leave with wages.
5. Occupational diseases.
6. Employment in hazardous processes

ii. Insurance facilities for workers:

1. Medical benefit.
2. Sickness benefit.
3. Maternity benefit.
4. Disablement benefit.
5. Dependent's benefit.
6. Funeral expenses.
7. Rehabilitation allowance.

Occupational Health Centre (OHC):

The OHS centre is being developed and shall become operational soon. Till then, first aid centre available inside the premises close to the worksite which is well equipped and manned by competent person and safety officer. As per requirement First-aid boxes has been provided and maintained in different locations. At present Occupational Health surveillance study is being carried out by MBBS doctor, Chhatrapur.

The emergency section normally referred as first aid centre has have round the clock manning with doctors & paramedical staff and treatment facilities with ambulances as required. Any work related injury is first treated in this section & if required it may be referred to a referral hospital for further treatment. All emergency provisions like oxygen cylinders, eye & body showers & other facilities would be available in this section.

The other section of curative wing would have several facilities for diagnosis, treatment, study of epidemiological status of working population & other facilities for detecting occupational health diseases.

A. Health Passport & Health check up

Health Card / Passport have been issued to all employees for keeping track of their history of health status. Annual health check-up of all employees have been done by a panel of doctors (Specialists). Annual health checkups have been planned in advance by the in-charges of Safety & OHC with mutual consultation. A summarized health status of all employees with comparative study to previous years has been submitted to Head of Unit & Safety inspector.

The pre-placement health checkup has been carried out by the doctors & paramedical staffs of OHC.

B. Sanitation

Sanitation programme & its implementation inside the plant premises have been closely monitored by the Head of Safety, Health & Environment. Head OPC shall be responsible for implementation of the sanitation programme to avoid spreading of venerable diseases.

C. Hazard Monitoring

It is also include the occupational hazard monitoring unit like heat, dust & noise etc or other specified environmental conditions of the factory. Work Place monitoring has been taken up as per factory rule by safety department officials.

D. Industrial psychology

It will also have an industrial psychology section to gauze the mental health of employee. A lungs function test centre to measure the residual capacity of lungs, a personal audiometric section to measure hearing loss of employee will also be established.

E. Laboratory facilities, training & awareness

- The occupational health centre have been well supported part with pathological & microbiological lab for all vital facts and analysis.
- In addition it will have a health education & counseling section where one trained health educator will counsel people to adopt healthy practices. FIRST AID training has been imparted to employees selecting department wise for emergency rescue & immediate action such training will be imparted to employees of expansion project.
- OHC will also conduct regular occupational health training programs for employees.
- Periodic health status of all the employees have been monitored & indexed by a statistics group attached to OHC.

1.7.4 Occupational Health Surveillance of the Workers:

The company has been carried out the following Health surveillance;

i. Pre - employment medical checkup at the time of employment.
ii. Periodical medical checkup will be done for all employees as:
    - <30 Once in five years
    - 31-40 Once in four years
    - 41-50 Once in two years
    - Above >50 years once every year
iii. First aid training will be given to the employees.
iv. Monitoring of occupational hazards related to noise, Heat, chemical (Raw materials & Product) exposure shall be carried out at frequent intervals, the records of which shall be documented.

v. Evaluation of health of workers viz. chest X ray, Audiometry, Spirometry Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre-employment and periodical examinations will be carried out.

1.7.5 Mitigation Measures for Protection of Health of Workers:

Following measures are implemented for protection of health of workers.

(1) Maintenance of pollution control system such as dust suppression system, safety appliances;

(2) Regular maintenance of equipment;

(3) Regular checking and up keeping of break down or leakage;

(4) Use of personal protection equipment wherever needed;

(5) Display of relevant safety norms to be followed in different operational areas. Lay use of safety perpose.

(6) Use of 'Safety Permit' system for certain maintenance jobs;

(7) Provision of ear plugs or muffs to workers exposed to high noise levels;

(8) Rotation of duties of workers;

(9) Creating awareness amongst workers concerning health, pollution and safety through posters, discussion, slogan etc.;

(10) Periodical medical examination of workers;

(11) Provision of suitable civil amenities such as plain drinking water, good service in canteen, etc.;

(12) Assessment of risk from health hazards at work place;

Monitoring of different factors leading to occupational health hazards and taking timely action to mitigate the impact etc.