7.3 RISK ASSESSMENT

7.3.1 INTRODUCTION

Risk analysis deals with the identification and quantification of risks, the plant equipments and personnel are exposed to, due to accidents resulting from the hazards present in the factory. Hazard analysis involves the identification and quantification of the various hazards that are likely to occur in the industry.

Both hazard and risk analysis are very extensive studies, and require a very detailed design and engineering information.

The various hazard analysis techniques that may be applied are Hazard and Operability (HAZOP) studies, Fault - Tree Analysis (FTA), event –tree analysis and, failure and effects mode analysis.
Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. This requires a through knowledge of failure probability, credible accident scenario, vulnerability of populations etc. Much of these information's are difficult to get or generate. Consequently, the risk analysis is oftenly confined to maximum creditable accident studies.

7.3.2 SCOPE OF THE STUDY

The scope of study includes the study of proposed operations, storage and handling of raw materials with respect to Hazard Identification. Risk Assessment and preparation of Disaster Management plan. Based on the Hazard Identification and analysis, the major disaster scenarios would be worked out to estimate the consequence of failure. A Disaster Management Plan (DMP) would also be evolved to meet the emergency situation including the occupational health and safety.

7.3.3 FIRE PROTECTION SYSTEM

The following Fire Protection system will be provided in the plant.

- Hydrant system covering the entire plant including all important auxiliaries and buildings. The system will be complete with piping, valves, instrumentation, hoses, nozzles and hydrants, etc.
- Sprinkler system for cable galleries / vaults / spreader room etc.
- High velocity water system for FO storage tanks.

- Portable fire extinguishers such as pressurized water type, carbon dioxide type and foam type will be located at strategic locations through out the plant.
- Modular type carbon dioxide panel injection fire extinguishing system will be provided in control equipment room, cable space below control room and at other unmanned electrical and electronic equipment room.

The following pumps will be provided in the fire protection system.

Fire water pumps:

(Fire water reservoir is part of the main water reservoir)

a) AC motor driven fire water pumps for hydrant, medium velocity water spray system and foam system.
b) AC motor driven fire water pumps for high velocity water spray system.
c) Diesel engine driven pump as stand by for the above.
d) AC motor driven Jackey pump 1 No. for maintaining pressure.

Suitable number of electric motor driven and diesel engine operated hydrant and spray pumps with automatic starting will be provided for the above systems. The fire water pumps will take suction from the fire water reservoir to be created in the plant area.

7.3.4 METHODOLOGY OF MCA ANALYSIS

The MCA Analysis involved ordering and ranking of various sections in terms of potential vulnerability. The following steps were involved in MCA Analysis.

- Preparation of an inventory of major storages and rank them on the basis of their hazardous properties.
- Identification of potentially hazardous storage sections and representative failure cases from the vessels and the pipelines.
- Visualization of chemical release scenarios.
- Effect and damage calculation from the release cases through mathematical modeling.
- Inventory Analysis and Fire & Explosion and Toxicity Index (FETI) are the two techniques employed for hazard identification process.

7.3.5 FIRE & EXPLOSION AND TOXICITY INDEX

The role of Fire & Explosion Index (FEI) aids quantitative hazard identification. The FEI is calculated by evaluating the loss potential of all the units in the storage area and the hazardous areas are classified accordingly. The FEI plays an important role in

- Identification of the equipment/areas that could likely contribute to the creation or escalation of incident and relative ranking of the incidents.
- Quantification of the expected damage of potential fire and explosion incidents.
- Preparation of guidelines for mitigating fire hazards.

The loss potential which could actually be experienced under the most adverse operating conditions is quantitatively evaluated. The FEI is used for any operation in which a flammable, combustible or reactive material is stored, handled or processed.

FEI = MF * GPH * SPH

Where MF : Material factor
GPH : General Process Hazard
SPH : Special Process Hazard

TOXICITY INDEX

The Toxicity Index is calculated using the the following formula.

$$TI = \frac{(Nh + Ts) * (1 + GPH + SPH)}{100}$$

Where Nh:

Ts:

GPH: General Process Hazard

SPH: Special Process Hazard

7.3.6 ASSESSMENT OF RISK AT M/s. ANKUR UDYOG LIMITED

Based on the storage inventory the following areas are identified as potential safety risk areas, shown in table 7.1

TABLE 7.1

POSSIBLE HAZARDS / RISKS FROM THE PROPOSED PROJECT

Equipment	Process	Potential Hazard	Mitigation
Sponge Iron Kiln	Reduction of Iron Ore	Falling of Hot Mass & Dust	• Ensuring before opening the kiln bottom door, first clean the inner surface of the stack cap, such that the dust particle and hard clinkers

			which deposited in the cap is fallen into the DSC. • Ensure before opening the DSC bottom door to check the DSC bar position and condition and to clean if big block of castables or any hard clinkers which is blocking the dust flow passage to wet scrapper chute. • Ensure to clean the dust by opening the man hole provided in the chute and check the spiking rods and the screen. In built safety system is provided in the construction of furnace with suitable refractory walls. • Allow the wet scrapper to run to remove the sludge, then open the drain pipe of the wet scrapper, which is located at bottom on either side, pour sufficient water to clean the sludge and the slurry dust to flow through drain pipe. • Ensure to stop the wet scrapper and open the top plate to check the alignment, weak and tear of the plates and take necessary precaution against the excessive worn out plate.
Sponge Iron Kiln	Reduction of Iron Ore	Air emission	Adequately designed ESP and other Air Pollution control systems will be provided with interlock to the kiln feeding system in order to prevent by passing of emissions through safety cap and also during non operation of ESP or any other pollution control devices.
Induction furnace			
IF	Converts charge into hot metal	Re-circulating water may come in contact with molten hot metal leading to spurting of metal or under extreme conditions explosion may also occur.	In built safety system is provided in the construction of furnace with suitable refractory walls.

		Charging materials being rusty and moisturized which may lead to spurting of metal	This may occur if raw materials are stored in open. However, raw material in the proposed steel plant will be covered
		Presence of oil and grease and other impurities, which may lead to unexpected fires.	Fuel supply into the furnace will be regulated and will be controlled by PLC systems.
Power plant			
Turbine	Convert pressure in the flue gas into Mechanical Energy	Mechanical & Fire Hazards Noise	Layout of Equipment / Machinery will be in accordance to factory and electrical inspectorate. Acoustic enclosure to Turbine
Generator	Convert Mechanical energy into electrical energy	Mechanical & Fire Hazards a) Lube Oil System b) Cable galleries c) Short circuits	Layout of Equipment / Machinery will be in accordance to factory and electrical inspectorate
		Noise	• Acoustic enclosure • Isolated panel rooms • Special foundation with vibration absorbers
Power Transformers	----	Fire and explosion	Automatic fire fighting system will be provided. Isolated with fencing and restricted entry.
Switch Yard	transformer	Fire	All electrical fittings and cables are provided as per the specified standards.
Switch Yard control room		Fire in cable galleries and switch	
Coal storage shed	Storage of coal for 10 days requirement.	Fire and spontaneous combustion	Coal storage yard will be continuously sprinkled with water with garden type sprinklers.
Coal handling bunkers	----	Fire and dust explosions	Continuous water sprinkling
Compressor House	Plant operation	Governor failure due to the failure of pins and springs leading to opening of safety valves	The design precautions of safety will be followed in manufacture and erection of compressors.
Coal storage	Coal dust is	Explosion Hazard	• Coal storage shall be minimised

yard	combustible		• Coal piles shall not be located above heat sources such as steam lines. • motors. • All mechanical & electrical equipment inside the coal storage area shall be approved for use in hazardous locations and provided with spark proof.
STG, draft fans, soot blowing from boiler, ventillation pipes	Noise generated due to operation of STG, working of fans, ventilation system,	Noise hazard	• Acoustic enclosures will be provided to STG. • Enclose fans, insulating ventilation pipes • use of dampeners.
LDO / FO storage area	MS tanks (3 x 25 KL)	Fire & explosion	Precautions as per TAC and OISD will be implemented.
Failure of APCS	DUST / SMOKE	Air emission	• Emergency alarm to be given to Villagers. • Intorlocking system will be provide to APCS. • Water sprinkling arrangements

Coal Handling Plant - Dust Explosion

Coal dust when dispersed in air can explode if it gets ignition source. Crusher houses and conveyor systems are most susceptible to this hazard. The minimum of explosive concentration of coal dust (33% volatiles) is 50 grams/m^3. Failure of dust extraction & suppression systems may lead to abnormal conditions and may increase the concentration of coal dust upto the explosive limits. The sources of ignition are incandescent bulbs, electric equipment & cables, friction & spontaneous combustion in accumulated dust. Dust explosion may occur at any time without any warning with maximum explosion pressure of 6.4 bars. Another dangerous characteristic of dust explosions is that it sets off secondary explosions after the occurrence of initial dust explosion.

Stock pile area shall be provided with automatic garden type sprinklers for dust suppression as well as to reduce spontaneous ignition/combustion in coal stock piles. Necessary water distribution net work will be provided for distributing water at all transfer points, crusher house, control room, etc.

A centralized control room with microprocessor based control system has been envisaged for operation of the coal handling plant. Except locally controlled equipment like travelling tripper,

dust extraction / dust suppression / ventilation equipment, sump pumps, water distribution system all other equipments will have provision for local control as well.

Control Measures for Coal Storage Yard

The entire quantity of coal will be stored in separate stack piles, with proper drains around to collect washouts during the monsoon. Water sprinkling system will be installed in and around the stocks of pile to prevent spontaneous combustion and consequent fire hazards. The stack geometry will be adopted to maintain minimum exposure of stock pile areas towards predominant wind direction. Temperature will be monitored regularly to detect any abnormal rise in temperature inside the stock pile to be enabled to control the same.

7.3.7 RISK & CONSEQUENCE ANALYSIS OF FIRE

The principle objective of this study is to identify the potential hazards, estimate the effects of hazards to people both within and outside the plant premises.

- Identification of possible failure cases of the facilities which might affect the population and property within the plant boundary.
- Assessment of consequential effect on surrounding population, property etc., due to onset of such failures.
- Suggest recommendations based on consequence analysis relevant to the situations.

7.3.7.1 METHODOLOGY

The hazards expected from this plant include the pool fire situation due to the leakage of HFO, LDO & FO from the storage tanks. There will be two Nos. of FO storage tanks each of 25 m^3 capacity, one No. of storage tank for HFO with a capacity of 25 m^3 & one No. of storage tank for LDO with a capacity of 25 m^3. The tanks, made of Mild steel, will be provided with dyke. The most credible failure is due to the rupture of the pipe connecting the storage tank. The worst case can be assumed as when the entire contents leak out into the dyke forming a pool, which may catch fire after getting source of ignition.

HFO, LDO & FO STORAGE TANK - POOL FIRE SCENARIO

The maximum quantity of HFO, LDO & FO stored at site will be 1 x 25 m^3, 1 x 25 m^3 & 2 x 25 m^3 capacity respectively. In the event of oil spillage through a small leakage or due to rupture of pipeline connecting the tank fire will follow after getting ignition source. As the tanks are provided with dyke, the fire will be confined within the dyke. Threshold limit for first degree burns is 4.5 kw/m^2. Based on these results it may be concluded that the vulnerable zone in which the thermal fluxes above the threshold limit for first degree burns (4.5 kw/m^2) is restricted to 19 m. The hazard distances for various radiation intensities are shown in table 7.2.

TABLE 7.2

HAZARD DISTANCES (Four Tanks on fire - scenario)

HFO Quantity: 1 x 25 m^3; LDO Quantity: 1 x 25 m^3; FO Quantity: 2 x 25 m^3

Radiation intensity		Hazard Distances
37.5 kw/m^2	(100% lethality)	2 m
25.0 kw/m^2	(50% lethality)	7 m
12.5 kw/m^2	(1% lethality)	12 m
4.5 kw/m^2	(1^{st} degree burns)	19 m

The hazard distances for Thermal radiation are confined to the plant premises only. Hence there will not be any thermal radiation impact on outside the population due to the pool fire scenario. The thick green belt to be developed will help to further mitigate the radiation intensity level outside plant boundary.

7.4 DISASTER MANAGEMENT PLAN

7.4.1 DISASTERS

A disaster is catastrophic situation in which suddenly, people are plunged into helplessness and suffering and as a result need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can be divided into two main groups. The first group includes those disasters which result from natural phenomena like earthquakes, volcanic eruptions, cyclones, tropical storms, floods, avalanches, landslides etc. The second group includes disastrous events occasioned by humans, or by their impact upon the environment. Examples are industrial accidents, radiation accidents, factory fires, explosions, escape of toxic gases or chemical substances from an

industrial unit, river pollution, mining or other structural collapses; air, sea, rail and road transport accidents. These disastrous events can reach catastrophic dimensions in terms of human loss.

There can be no set criteria for assessing the gravity of a disaster because it depends, to a large extent, on the physical, economic and social environment in which it occurs. What would be considered a major disaster in developing country, equipped to cope with the problems involved, may not mean more than temporary emergency elsewhere. However, all disasters bring in their wake similar consequences that call for immediate action, whether at the local, national or international level, for the rescue and relief of the victims. This includes the search for the dead and injured, medical and social care, removal of the debris, the provision of temporary shelter for the homeless, food, clothing and medical supplies and the rapid re-establishment of essential services.

7.4.2 OBJECTIVES OF DISASTER MANAGEMENT OF PLAN

The disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. Effective implementation of Disaster Management Plan will be ensured by its wide circulation among the staff and workers and training of the personnel through rehearsals.

The Disaster Management Plan would reflect the probable consequential severity of undesired event due to deteriorating conditions or through knock on effects. Further the management should be able to demonstrate that their assessment of the consequences uses good supporting evidence and based on currently available and reliable information, incident data from internal and external sources and if necessary the reports of out side agencies.

To tackle the consequences of a major emergency inside the factory or immediate vicinity of the factory, a Plan has to be formulated and this emergency plan is called Disaster Management Plan.

The objective of the Industrial Disaster Management Plan is to make use of the combined resources of the Plant and the outside services to achieve the following:

- Pool fire scenario due to HFO/LDO/FO storage
- Minimize damage to the property and the environment.

- Effect the rescue and medical treatment of victims.
- Fulfill the needs of relatives.
- Provide authoritative information to news media.
- Secure the safe rehabilitation of affected areas.
- Safeguard other people.
- Initially contain and then ultimately bring the situation under the control.
- Preserve subsequent records and equipment for subsequent enquiry of the cause and circumstances leading to emergency.

7.4.3 EMERGENCIES

7.4.3.1 GENERAL EMERGENCIES ANTICIPATED:

The emergencies that could be envisaged in the Plant are as follows:

- Pool fire scenario at HFO/LDO/FO storage tanks.
- Contamination of food / water.
- Sabotage / social disorder.
- Structural failures.
- Slow isolated fires.

7.4.3.2 SPECIFIC EMERGENCIES ANTICIPATED

During the study of risk assessment, the probabilities of occurrence of hazards are worked out along with the nature of damage. This is the reason why one should study risk assessment in conjunction with DMP.

7.4.3.3 EMERGENCY ORGANISATION

It is recommended to setup an Emergency Organization. A senior executive who has control over the affairs of the Plant would be heading the Emergency Organization. He would be designated as Site Controller. In the case of stores, utilities, open areas which are the not under the control of production heads, executive responsible for maintenance of utilities would be designated as Incident Controller. All the Incident Controllers would be reporting to the Site Controller.

Each Incident Controller organizes a team responsible for controlling the incident with the personnel under his control. Shift in-charge would be the Reporting Officer, who would report the incident to the Incident Controller.

Emergency Coordinators would be appointed who would undertake the responsibilities like fire fighting, rescue, rehabilitation, transport and support services. For this purposes, Security in-charge, staff of the Personnel Department/ Essential services would be engaged. All these personnel would be designated as key personnel.

In each shift, electrical supervisor, pump house incharge and other maintenance staff would be drafted for emergency operations. In the event of Power communication system failure, some of staff members in the office/ Plant offices would be drafted and their services would be utilised as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

7.4.3.4 EMERGENCY COMMUNICATION

Whosoever notices an emergency situation such as fire, growth of fire, leakage etc. would inform his immediate superior and Emergency Control Center. The person on duty in the Emergency Control Centre would appraise the site controller. Site controller verifies the situation from the Incident Controller of that area or the shift incharge and takes a decision about implementing on Site Emergency Plan. This would be communicated to all the Incident Controllers and Emergency Coordinators. Simultaneously, the emergency warning system would be activated on the instructions of the Site Controller.

7.4.3.5 EMERGENCY RESPONSIBILITIES

The responsibilities of the key personnel are appended below

7.4.3.5.1 SITE CONTROLLER

On receiving information about emergency, he would rush to Emergency Control Centre (ECC) and take the charge of ECC and the situation. He would assess the magnitude of the situation in consultation with the incident controller and decide:

- Whether affected area needs to be evacuated.
- Whether personnel who are at assembly points need to be evacuated.

- Declares Emergency and orders for operation of emergency siren.
- Organizes announcement by public address system about location of emergency.
- Assesses the areas which are likely to be affected, and need to be evacuated or alerted.
- Maintains a continuous review of possible development and assesses the overall situation to decide whether shutting down of any section or whole of the Plant is required.
- Directs personnel of rescue, rehabilitation, transport, fire brigade, medical and other designated mutual support systems, locally available, for meeting emergencies.
- Controls evacuation of affected areas. If the situation is likely to go out of control or effects are likely to go beyond the premises of the factory, informs to District Emergency Authority, Police, and Hospital and seeks their intervention and help.
- Informs Inspector of factories, Deputy Chief Inspector of factories, SPCB and other statutory authorities.
- Gives public statement, if necessary.
- Keeps record of chronological events and prepares an investigation report and preserves the evidences.

After managing the emergent situation and binging the normalcy at the work place, he makes an statement accordingly

7.4.3.5.2 INCIDENT CONTROLLER

- Assembles the incident control team.
- Directs operations within the affected areas with the priorities for safety to personnel, minimizes damage to the plant, property and environment and minimizes the loss of materials.
- Directs the shutting down and evacuation of Plant and areas likely to be adversely affected by the emergency.
- Ensures that all-key personnel help is sought.
- Provides advice and information to the Fire and Security officer and the local Fire Services as and when they arrive.
- Ensures that all non-essential workers / staff of the effected areas evacuated to the appropriate assembly points and the areas are searched for victims, if any

- Understands the need for preservation of evidence so as to facilitate any enquiry into the cause and circumstances, which resulted or escalated the emergency.
- Coordinates with emergency services at the site.
- Provides tools and safety equipments to the team members.
- Keeps in touch with the team and advise them regarding the method of control to be used.
- Keeps the Site Controller informed continuously about the progress being made?

7.4.3.5.3 EMERGENCY COORDINATOR - RESCUE, FIRE FIGHTING

- Rushes to Emergency Control Centre after knowing about the emergency.
- Helps the Incident Controller in containment of the emergency.
- Ensures fire pumps in operating conditions and instructs pump house operator to be ready for any emergency.
- Guides the fire fighting crew i.e. Firemen, trained Plant personnel and security staff.
- Organizes shifting the fire fighting facilities to the emergency site, if required.
- Takes guidance of the Incident Controller for firefighting as well as assesses the requirements of outside help.
- Arranges the traffic control at the gate and the incident area.
- Directs the security staff to the incident site to take part in the emergency operations under his guidance and supervision.
- Evacuates the people in the Plant or in the near by areas as advised by site controller.
- Searches for any casualties and arranges proper aid for them.
- Assembles search and evacuation team.
- Decides paths for the workers evacuating the site
- Maintains law and order in the area, and if necessary seeks the help of police and local administration.
- Arranges safety tools/equipments for the members of his team.

7.4.3.5.4 EMERGENCY COORDINATOR - MEDICAL, MUTUAL AID, REHABILITATION, TRANSPORT AND COMMUNICATION

- The event of failure of electric supply and there by internal telephone, sets up communication point and establishes contact with the Emergency Control Center (ECC) in the event of failure of electric supply and communication network.
- Organizes medical treatment to the injured and if necessary, will shift them to nearby hospitals.
- Mobilizes extra medical help from outside, if necessary
- Keeps a list of qualified first aid providers of the factory and seek their assistance.
- Maintains first aid and medical emergency requirements.
- Makes sure that all safety equipments are made available to the emergency team.
- Assists Site Controller with necessary data and coordinates the emergency activities.
- Assists Site Controller in updating emergency plan.
- Maintains liaison with Civil Administration.
- Ensures availability of canteen facilities and maintenance of rehabilitation centre.
- Remains in liaison with Site Controller / Incident Controller.
- Ensures availability of necessary cash for rescue / rehabilitation and emergency expenditure.
- Controls rehabilitation of affected areas at the end of emergency.
- Makes available diesel/petrol for transport vehicles engaged in emergency operation.

7.4.3.5.5 EMERGENCY COORDINATOR – ESSENTIAL SERVICES

He would assist Site Controller and Incident Controller

- Maintains essential services like Diesel Generator, Water, Fire Water, Compressed Air / Instrument Air, Power Supply for lighting.
- Plans alternate facilities in the event of Power failure, to maintain essential services such as lighting, etc.
- Organizes separate electrical connections for all utilities and during emergency ensures that the essential services and utilities are not affected.
- Gives necessary instructions regarding emergency electrical supply, isolation of certain sections etc to shift incharges and electricians.

- Ensures availability of adequate quantities of protective equipments and other emergency materials, spares etc.

7.4.3.5.6 GENERAL RESPONSIBILITIES OF EMPLOYEES DURING AN EMERGENCY

When an emergency warning is raised, the workers, if they are incharge of any process equipment, should adopt safe and emergency shut down and attend any prescribed duty as an essential employee. If no such responsibility has been assigned, he should adopt a safe course to assembly point and await instructions. He should not resort to spread panic. On the other hand, he must assist emergency personnel towards objectives of DMP.

7.4.3.6. EMERGENCY FACILITIES

7.4.3.6.1 EMERGENCY CONTROL CENTRE

During the emergency, the office block would function as Emergency Control Centre. It would have external Telephone & Fax facility. All the Incident Controllers, Officers, senior personnel would be available there.

The following information and equipments will be provided at the ECC.

- Intercom, telephone
- Fire suit / gas tight goggles / gloves / helmets
- Factory layout, emergency site plan
- Emergency lamp / torchlight
- Plan indicating locations of hazardous inventories, Plant control room, sources of safety equipment, work road plan, assembly points, rescue locations, vulnerable zones, escape routes.
- Hazard chart
- Self-contained breathing apparatus
- Hand tools, wind direction, wind velocity indications
- Public Address Megaphone, Hand bell, Telephone directories (Internal and P&T).
- Address with telephone numbers of key personnel, Emergency coordinator.
- Important addresses, telephone numbers of experts from outside, government agencies, neighboring industries etc.
- Emergency shut down procedures.
- Nominal roll of employees.

7.4.3.6.2 EMERGENCY POWER SUPPLY

Plant facilities would be connected to Diesel Generator and would be placed in auto mode.

7.4.3.6.3 FIRE FIGHTING FACILITIES

First Aid and Fire Fighting equipment suitable for emergency should be maintained as per statutory requirements/ TAC Regulations. Fire hydrant line covering major areas would be laid. It would be maintained at 6 kg / sq.cm. pressure.

7.4.3.6.4 LOCATION OF WIND SOCK

On the top of production block and on the top of administrative block wind socks would be installed to indicate direction of wind during emergency period.

7.4.3.6.5 EMERGENCY MEDICAL FACILITIES

Gas masks and general first aid materials for dealing with chemical burns, fire burns etc. would be maintained in the medical centre as well as in the emergency control room. Private medical practitioners help would be sought. Government hospital would be approached for emergency help.

Apart from Plant first aid facilities, external facilities would be augmented. Names of Medical Personnel, Medical facilities in Tilda & Raipur town would be prepared and updated. Necessary specific medicines for emergency treatment of burnt patients and for those affected by toxicity would be maintained.

Breathing apparatus and other emergency medical equipment would be provided and maintained. The help of near by industrial managements in this regard would also be taken on mutual support basis.

7.4.3.7 EMERGENCY ACTIONS

7.4.3.7.1 EMERGENCY WARNING

Communication of emergency would be made familiar to the personnel inside the plant and people outside. An emergency warning system would be established.

7.4.3.7.2 EMERGENCY SHUTDOWN

There are number of facilities which can be provided to help in dealing with hazardous conditions. The suggested arrangements are

- Stop feed
- Deluge contents
- Remove heat
- Transfer contents

Methods of removing additional heat include removal by the normal cooling arrangements or by the use of an emergency cooling system. Cooling facilities which vaporizes liquid may be particularly effective, since a big increase in vaporization can be obtained by reducing pressure.

7.4.3.7.3 EVACUATION OF PERSONNEL

The area would have adequate number of exits and staircases. In the event of an emergency, unrelated personnel have to escape to assembly point. Operators have to take emergency shutdown procedure and escape. Time office maintains a copy of deployment of employees in each shift at Emergency Communication Centre. If necessary, persons can be evacuated by rescue teams.

7.4.3.7.4 ALL CLEAR SIGNAL

At the end of emergency, after discussing with Incident Controllers and Emergency Coordinators, the site controller orders an all clear signal.