ENVIRONMENTAL RISK ASSESSMENT

Environmental risk assessment is a systematic approach for identification, evaluation, mitigation and control of hazards that could occur as a result of failures in process, procedures, or equipment. Increasing industrial accidents, loss of life & property, public scrutiny, statutory requirements and intense industrial processes, all contribute to a growing need to ensure that risk management is conducted and implemented.

Industries are endeavoring progressively to prevent hazardous events, avoid production & manpower losses and other fallouts associated with industrial accidents by conducting risk assessment, onsite & off site management plan and adopting the safety measures. This also assists industries to enhance employee knowledge of operations, improve technical procedures, maintain accurate process safety information and increase overall productivity. This Chapter gives an outline of the associated environmental and other risks, their assessment and remedial measures. It also describes an approach for emergency planning to be adopted by the Plant management.

1.1.1 Objectives

The objectives of environmental risk assessment are governed by the following, which excludes natural calamities:

a) Identification of potential hazardous areas so that adequate safety measures can be adopted to reduce the likelihood of accidental events.

b) Identification of the stakeholders and evaluation of their risk along with proposing adequate control techniques.

c) Managing the emergency situation or a disastrous event, if any, during the plant operation.

1.1.2 Definition of Environmental Risks

The following terms related to environmental risks are defined before reviewing the environmental risks:

- Harm .. Damage to person, property or environment.

- Hazard .. Situation that poses a level of threat to life, health, property, or environment. A hazardous situation that has come to pass is called an incident. Hazard and possibility interact together to create risk. An environmental hazard is thus going to be a set of circumstances, which leads to direct or indirect degradation of environment and damage to the life and property.

- Risk .. The probability of harm or likelihood of harmful occurrence and its severity. Environmental risk is a measure of the potential threats to the environment, life and property.

- Consequence .. Effect due to occurrence of the event, which may endanger the environment permanently or temporarily and, or, loss of life and property.

- Environmental Disaster .. The consequence can extensively damage any one or all the four components of the environment, namely, (i) physico-chemical, (ii) biological, (iii) human and (iv) aesthetics

1.1.3 Environmental Risk Evaluation

Environmental Risk Evaluation acts as a scrutinizing vehicle for establishing the priority in risk management that concerns human health, loss of productivity and environmental quality in general. The proposed facility would have installations, such as, storage and handling of fuel oil and fuel gases which would be under the purview of Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and its amendments thereof.

Risk is the determination of likelihood and severity of the credible accident/event sequences in order to determine magnitude and to priorities identified hazards. The likelihood of occurrence & Severity of consequence are described as follows:

Likelihood (L)	Description	Rating
Most Likely	Expected in normal circumstances	5
Likely	Likely to occur in normal circumstances	4

Possible	May occur in normal circumstances	3
Unlikely	Remote chance of occurrence but conceivable	2
Inconceivable	Not conceivable even in future	1
Severity (S)	**Description**	**Rating**
Catastrophic	Casualties, Disastrous Environmental damage, Financial loss (>1000 crore)	5
Major	Major injuries & Environmental damage, Financial loss (>100 crore)	4
Moderate	Moderate injuries & Environmental damage, Financial loss (>10 crore)	3
Minor	Minor injuries & Environmental damage, Financial loss (>1 crore)	2
Insignificant	No injuries & Environmental damage, Financial loss (>0.1 crore)	1

For conducting qualitative Risk assessment using qualitative likelihood & severity as indicators, Risk Potential is calculated using the following formula and presented in form of a matrix below.

L x S = Risk Potential (R)

Likelihood (L)	**Severity (S)**				
	1	**2**	**3**	**4**	**5**
5	**5**	**10**	**15**	**20**	**25**
4	**4**	**8**	**12**	**16**	**20**
3	**3**	**6**	**9**	**12**	**15**
2	**2**	**4**	**6**	**8**	**10**
1	**1**	**2**	**3**	**4**	**5**

High Medium Low

The relative risk potential can be used to prioritize necessary actions to effectively manage hazards as per the risk value defined below:

Risk	**Risk priority**	**Action**
15-25	High	Requires Immediate action
5-12	Medium	Requires planned approach for mitigation the risk
1-4	Low	No requirement of Immediate action but requires attention for attenuation to avoid future events

"High Risk" events must have immediate actions, to resolve risk to life and/or the environment. Department/Personnel responsible for actions must be clearly identified including demarcation of proper follow-up procedure.

A further detail risk assessment method such as quantitative risk assessment may be required to determine suitable controls measures.

A summarized list of environmental risk potential for the likely events is presented in Table 7-1 as per the above stated Risk rating.

TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-1 - ENVIRONMENTAL RISK POTENTIAL EVALUATION**

Event	Nature of hazard	Risk Ranking			Mitigation Measures
		L	S	RP	
Fire at coal stockyard	Fire	4	3	12	- Fire fighting system with alarm - Awareness/training of personnel with emergency preparedness plan - Assembly points with adequate signages
By product gas leaks from the pipe line/valves	Fire Toxic	3	4	12	- Fire fighting system with alarm - - CO detector with hooter
Leakage/spillage of acids/alkalis	Corrosive	2	3	6	- Dyke/embankment around Bulk storage area - Concrete flooring - Provision of acid resistant PPE to Personnel working around the area
Leakage/rupture in the various product storage tanks in Coal Tar & Benzol Refining Units	Toxic Fire	2	4	8	- Dyke/embankment around Bulk storage area - Emergency Collection tanks provided to minimize potential impacts of leaks/spills - Provision of spill management kits online - Hazards signage along with MSDS at convenient location
Failure of Fume/Dust Extraction System	Health hazards	1	3	3	- Alarm system - Automatic tripping
Emission of VOC, dioxin & furan	Toxic (Health hazards)	3	2	6	- Adoption of Control measures to keep emission within norms
Handling & leakage of fuel gases like propane, LPG	Fire	3	4	12	- Fire fighting system with alarm - Isolated storage location & strict adherence to guidelines around the location
Catastrophic rupture of fuel/byproduct gas storage	Fire Toxic	3	5	15	- Proper emergency preparedness plan and awareness/training of personnel
Release of untreated wastewater	Toxic	3	3	9	- Provision of catch pit to arrest the accidental release
Contamination by hazardous	Toxic	2	3	6	- Strict adherence to management measures

Event	Nature of hazard	Risk Ranking			Mitigation Measures
		L	S	RP	
waste					- Hazardous waste storage location to be lined by suitable liner to avoid contamination of soil/groundwater - Monitoring to check seepage of wastes into soil/groundwater
Occurrence of fire due to static electricity/electric spark	Fire	2	3	6	- Fire alarm & Foam based Fire fighting system
Accidental discharge of hydraulic oil under pressure	Fire	2	4	8	- PPE's for personnel working in the area - Pit to be provided to contain the oil leakage
Splashing of molten metal and slag	Corrosive	2	5	10	- Administrative controls to prevent presence of personnel inside liquid steel/slag handling area - Fire fighting system in the concerned area - Heat resistant jackets/apron for personnel working near the concerned area
Workplace hazards like confined space, working with improper tools, poor illumine-tion, poor ventilation, etc	Health hazards	3	3	9	- Proper workplace maintenance with respect to illumination, ventilation etc in adherence with latest norms. - Strict adherence to safe work practices
Non conformance to safe working practices including usage of PPEs	Health hazards	3	4	12	- Strict adherence to safe work practices

Note: This assessment is based from the past experience in the operation of similar installations and best practicable designs for the proposed Project. The present risk potential evaluation is primarily based on human errors or faulty operation or failure of the control systems.)

From the Table 7-1, it is seen that most of the events have low to moderate risk potential except the catastrophic rupture gas holders which has higher risk potential. Therefore consequence modeling for catastrophic failure of Gas holders has been carried out using DNV Phast Lite 7.1 to quantify the radial extent of the impact from this potential event.

For BF and LD gas holders, toxic exposure due to catastrophic failure of gas holders has been considered due to relatively high concentration of Carbon monoxide gas in BF and LD gas. For Coke oven gas holder, heat

radiation from ignition of leaked gas from failure scenario has been considered due to its relatively high concentration of hydrogen and methane.

Fig. 7-1 shows the maximum concentration footprint of leaked gas from catastrophic rupture of the BF gas holder. The concentration of interest (151.5 ppm) corresponding to the STEL value of BF gas extends up to a maximum distance of around 154 m downwind.

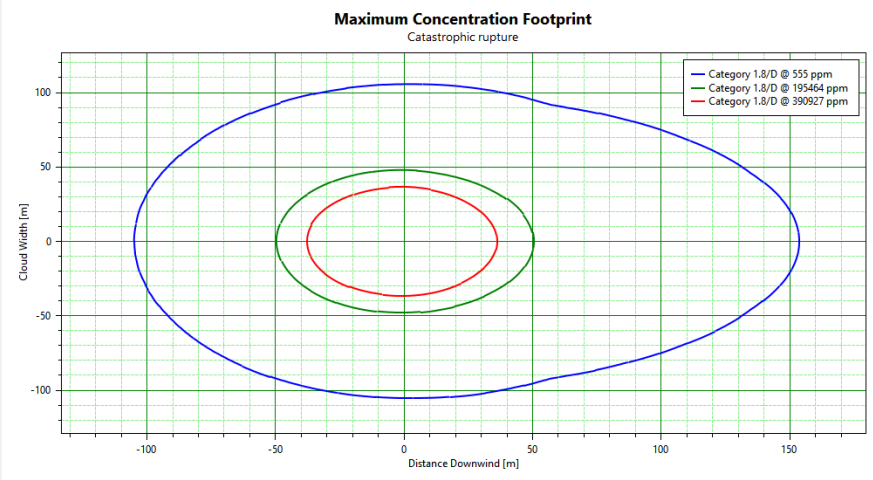

FIG. ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-1 - MAXIMUM CONCENTRATION FOOTPRINT FOR BF GAS HOLDER**

Fig. 7-2 shows the maximum concentration footprint of leaked gas from catastrophic rupture of the LD gas holder. The concentration of interest (555 ppm) corresponding to the STEL value of LD gas extends up to a maximum distance of around 103 m downwind.

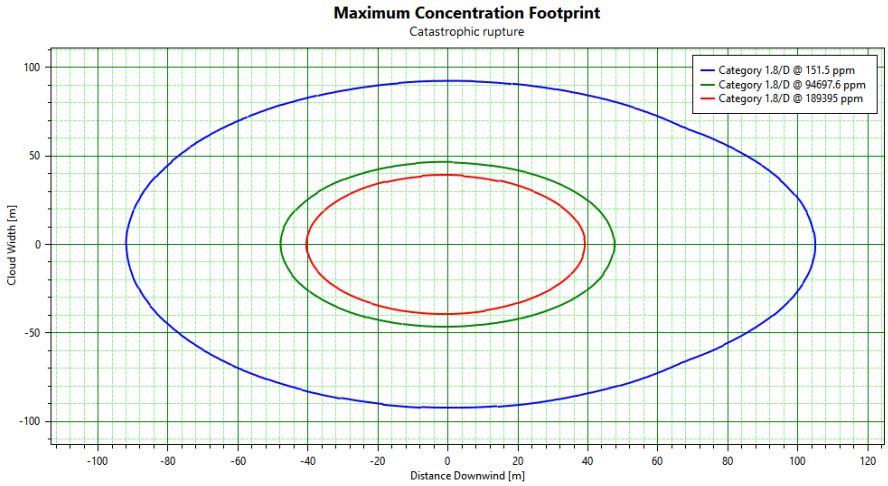

FIG. ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-2 - MAXIMUM CONCENTRATION FOOTPRINT FOR LD GAS HOLDER**

Fig. 7-3 shows the intensity radius for fireball arising due to catastrophic rupture of the CO gas holder. Two radiation levels of interest have been plotted and as observed, the 4 kW/m^2 (pain threshold) radiation level extends up to about 290 m distance and the 12.5 kW/m^2 (first degree burns) radiation level extends up to about 100 m distance.

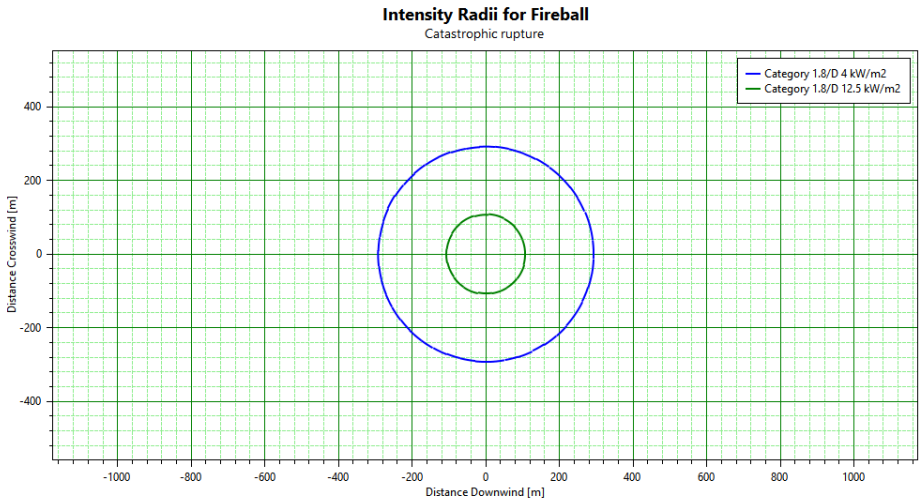

FIG. ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-3 - FIREBALL INTENSITY RADIUS FOR CO GAS HOLDER**

A HAZOP Study for the selected units/areas needs to be undertaken at the 'design-freeze' stage, when P&I diagrams, shop layout drawings, control logic diagrams, technical specifications etc are made ready. For these areas, 'Fault Tree Analysis' of the failure of equipment/valve component or due to human error can be carried out to assess more realistically the risk involved and draw up final management measures. It is also suggested to conduct HAZOP Study for the fuel gas distribution network to incorporate last minute corrections in the design of the system from fail-safe angle, prior to commissioning. JSWUSL would implement OHSAS 18001 and DuPONT Safety practices to improve safe working conditions and achieve zero harm status.

1.2 ON-SITE AND OFF-SITE EMERGENCY MANAGEMENT PLAN

Emergency planning is an integral part of the overall loss control program and is important for effective management of an accident to minimize the losses to the people and property, both in and around the facility.

The main aspect in emergency management planning is prevention by technical and organizational measures and minimization of accidents and demonstrates the organizational commitment to the safety of employees and populace in & around the plant. JSWUSL shall have an Emergency Plan for their proposed facilities as per the provision stipulated under Section-41 B (4) of the Factories Act, 1948 (as amended), Rule 13 (1) of MSIHC Rules, 1989 (as amended)and other applicable regulations.

JSWUSL would implement an On-site Emergency plan approved by Director (Factories and Boiler), Bhubaneswar.The objectives of the On-site Emergency Plan are:

i) Rapid control and containment of possible hazardous situations.
ii) Minimizing the risk and the impact of accident.
iii) Effective rehabilitation of affected persons.

The considerations in an emergency planning include the following:

i) Identification and assessment of hazards and risks
ii) Hazard, consequence analysis
iii) Implementation and compliance of the regulatory provisions as per regulatory requirements
iv) Pre-emergency planning
v) Emergency preparedness measures
vi) Emergency response procedures and measures, steps to be taken before during and after emergency.
vii) Emergency organization and responsibilities
viii) Alarm and communication procedures
ix) Equipping Emergency control centre, Identifying Assembly,
x) Rescue points, Medical facilities.
xi) Emergency recovery procedures
xii) Training rehearsal, evaluation and updating the plan
xiii) Consequences of defaults or non-compliance of regulations

The Plant Head who would also act as Works Main Controller (WMC) would assume the overall responsibility for implementation of emergency planning at the time of crisis on the site. He would be assisted at next level by Head Environment, Head OHS and Heads of various plant units who would act as Site Incident Controllers (SIC), coordinating with a Combat Team Leader (CTL), a Rescue Team Leader (RTL) and an Auxiliary Team Leader (ATL) to mitigate the emergency situation. The Emergency command structure of the plant is shown in Fig. 7-1.

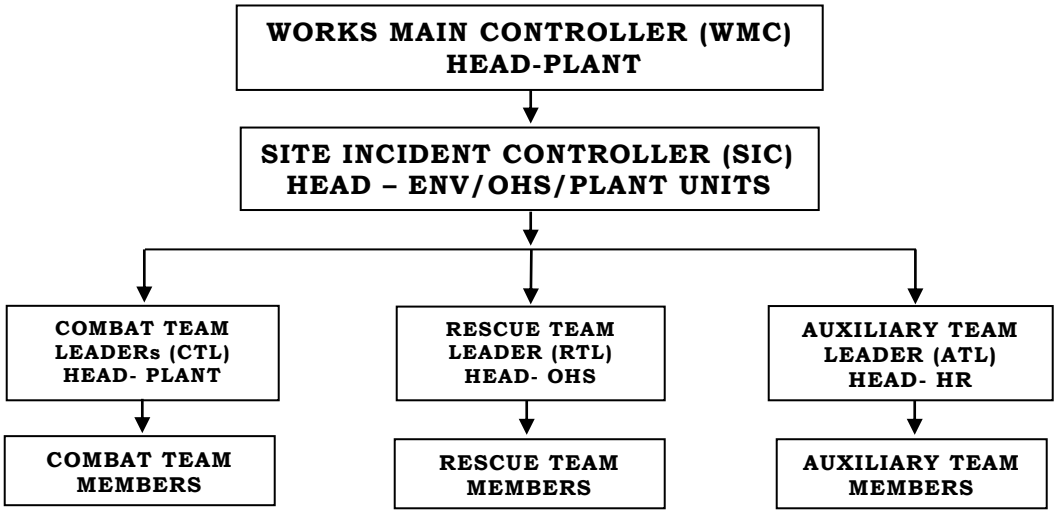

FIG. ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-4 - EMERGENCY COMMAND STRUCTURE**

The action plan for on -site emergency plan is presented below in Table 7-2.

TABLE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-2 - ACTION PLAN FOR ON-SITE EMERGENCY**

Step No.	Initiator	Responsibilities
1	The person noticing the emergency	• Inform Security Gate, CTL & the concerned Shift-in–charge immediately.
2	CTL	• Inform SIC and rush to spot and organize his team. • Take charge of the situation, arrange for fire fighting and medical first-aid available at site. • To start combating, shut-down equipments, arrest the

Step No.	Initiator	Responsibilities
		leakage of gas/fire.
3	SIC	• Inform WMC and rush to emergency site. • Discuss with CTL, assesses the situation and call the RTL & ATL • Organize the Rescue Team and Auxiliary Team and send the rescue Team to site. • Arrange to evacuate the unwanted persons and call for additional help. • Pass information to the WMC periodically about the position at site.
4	WMC	• Rush to emergency site and observe the ongoing activities. • Take stock of the situation in consultation with the SIC. • Move to Emergency Control Room. • Take decision on declaration of emergency. • Advise ATL to inform the statutory authorities and seek help of mutual aid from partners as required. • Decide on declaration of cessation of emergency. • Ensure that the emergency operations are recorded chronologically.
5	RTL	• Consult with SIC and organize his team with amenities to arrest fire fighting and medical treatment. • Rush to Emergency Site through safe route along with the team members. • Arrange to set off the fire by fire fighting equipments and hydrant points to arrest the fire or to evacuate the area. • Shift the injured persons to hospital by ambulance after providing necessary first aid. • To inform the ATL for necessary help from mutual aid Partners.
6	ATL	• On being directed by WMC, inform about the emergency to statutory authorities. • Seek help of Mutual Aid partners and Coordinate with Mutual Aid partners to render their services. • Arrange to inform the relatives of casualties. • Take care of visit of the authorities to the Emergency site.
7	Team members	• Each of the team members to follow the instruction of concerned team leader to mitigate the emergency.

The emergency control center would be located strategically in an area of minimum risk with easy access to concerned personnel. Emergency control centers would be stocked with the following infrastructural support facilities/equipments:

i) An adequate number of external & internal telephones
ii) Radio equipment/Public adresssal system
iii) Safety gears
iv) First aid facilities, Stretchers, gas masks, etc
v) Fire-fighting system with additional sources of water

vi) Additional work and layout plans detailing alternate routes and affected areas, during an emergency.
vii) Note pads, pens and pencils.
viii) List of key personnel, with addresses, telephone numbers, etc.

The off-site emergency plan would be an integral part of any major hazard control system. This particular plan relates to only those accidental events, which could affect people and the environment outside the plant boundary. Incidents, which would have very severe consequences, yet have a small probability of occurrence, would be in this category.

The implementing authority of the off-site plan would be the local authority and not the plant authority. Plant Head in consultation with the Safety, Admin & other concerned department would be coordinating with the district administration/ local authority for safeguarding nearby settlements during off-site emergency situation.

The basic structure of the off-site emergency procedure would cover the following:

i) Identification of local authorities like police, district collector's office, their names, addresses and communication links.
ii) Details of availability and location of heavy duty equipment like bull dozers, fire-fighting equipment etc.
iii) Details of specialist agencies, firms and people upon whom it may be necessary to call.
iv) Details of voluntary organisations.
v) Meteorological information.
vi) Humanitarian arrangements like transport, evacuation centres, first aid, ambulance, community kitchen etc.
vii) Public information through media, informing relatives, public address system etc.

1.3 DISASTER MANAGEMENT PLAN (DMP)

A disaster is a catastrophic event that causes serious injuries, loss of life & extensive damage to Plant & its surroundings. The types of possible disaster would be due to i) Disaster due to emergencies on account of fire, spillages, etc. ii) Disaster due to natural calamity on account of flood, earthquake, cyclone, storm, cloud burst, lightning and iii) Disaster due to external factors on account of food poisoning, sabotage etc.

The objective of the DMP is to make use of the combined resources of the plant and the outside services to achieve the following:

i) Effective rescue and medical treatment of casualties
ii) Safeguard other people
iii) Minimize damage to property and the environment
iv) Initially contain and ultimately bring the incident under control
v) Identify any casualties
vi) Provide for the needs of relatives
vii) Provide authoritative information to the news media
viii) Secure the safe rehabilitation of affected area
ix) Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In effect, DMP helps to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy.

Few elementary disaster management measures undertaken to prevent disaster due to the above mentioned hazards are as follows:

i) Design, manufacture, operation and maintenance of all plant machineries/structures as per applicable national and international standards as laid down by statutory authority

ii) Preparation of layout to provide 'Assembly Point' and safe evacuation route for personnel in case of a hazardous event/disaster, as can be inferred from Risk & Consequence modeling

iii) Adherance to emergency (both on site & off-site) preparedness plan, emergency response team, emergency

communication, emergency responsibilities, emergency facilities, and emergency actions

iv) Proper Alarm system and training the personnel for appropriate response during disastrous situation.

v) Complete fire protection coverage for the entire plant as per regulatory stipulations

vi) Creation and maintenance of Disaster Control Room (DCR) with adequately trained personnel who can handle all sorts of emergency situation

vii) Provision of funds for prevention of disaster, mitigation, capacity-building and preparedness.

During contingency, an officer will be manning the DCR having links with all plant control rooms. On getting information about any accident, the officer will verify from the affected plant control room and inform the Disaster Controller (DC) and/or other co-ordinators immediately.

The responsible officers of Disaster Control Group will assemble in the DCR and formulate control procedures as per the contingency plans and execute their responsibilities as per the plan. The functions of the various officers of the Disaster Control Group will be as follows:

Disaster Controller

i) To declare "Disaster Emergency" after consulting senior officers available and inform Fire Station Control Room to sound the sirens accordingly and arrange to convey the message in public address system

ii) To report to DCR immediately

iii) To receive messages from the communication centre

iv) To take decisions in consultation with the Commanding Officers of different services and convey them to the disaster point

v) To be responsible for planning and provisions of assistance from township and from local authorities

vi) To keep higher authorities informed about the situation

Officer In-charge

Disaster Controller will nominate an officer whose functions will be as follows:

i) To be responsible for the operation of DCR and for the dispatch of messages

ii) To keep liaison with all activities and give up to date and accurate appreciation of the situation

iii) To be responsible for the efficient organisation of the DCR

The Commanding Officers of various services are designated Coordinator (services), Coordinator (Operation) and Coordinator (external services). The following are their functions:

i) To report to the Control Post immediately on hearing "Disaster Siren"

ii) To keep Disaster Controller posted with the up-to-date information regarding manpower and material available concerning their respective services

iii) To assist Disaster Controller for provision of material and man power concerning his service

iv) To convey message to his service teams through communication centre after consulting Disaster Controller

The WMC would be in communication with the District Disaster Management Authority (DDMA) regarding pre-disaster activities in alignment with the overall plan developed by the DDMA or the Collector. JSWUSL would adhere to the relevant rules regarding prevention of disasters, as stipulated by relevant local authorities.