RISK ASSESSMENT

The objective of risk assessment is to analyze and ensure a safer & healthier working environment. As it is an integral part of a good occupational health and safety management plan. Risk assessment includes the following:

i) Hazard Analysis.

ii) Evaluation of risk associated with that hazard.

iii) Determination of appropriate ways to eliminate or mitigate the hazard.

Risk analysis deals with the identification and quantification of risks, the plant equipment and personnel are exposed to, due to accidents resulting from the hazards occurring in the plant. On the other hand, hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that may exist in the plant.

Hazard and risk analysis involves very extensive studies and requires very detailed design and engineering information. The various hazard analysis techniques that may be applied are, hazard and operability studies (HAZOP), fault tree analysis, event tree analysis and failure mode analysis.

Risk analysis involves also the identification and assessment of risks to neighboring public as a result of hazards. This requires a thorough knowledge of failure probability, formulation of credible accident scenario etc. As in practice, the risk analysis is confined to Maximum Credible Accident (MCA) scenarios.

The risk assessment study covers the following:

- Identification of potential areas.
- Identification of failure cases.
- Visualization of the resulting scenarios.
- Assessment of overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios.
- Specific recommendation on the minimization of the worst accident possibilities.
- Preparation of broad Risk/Disaster Management Plan.

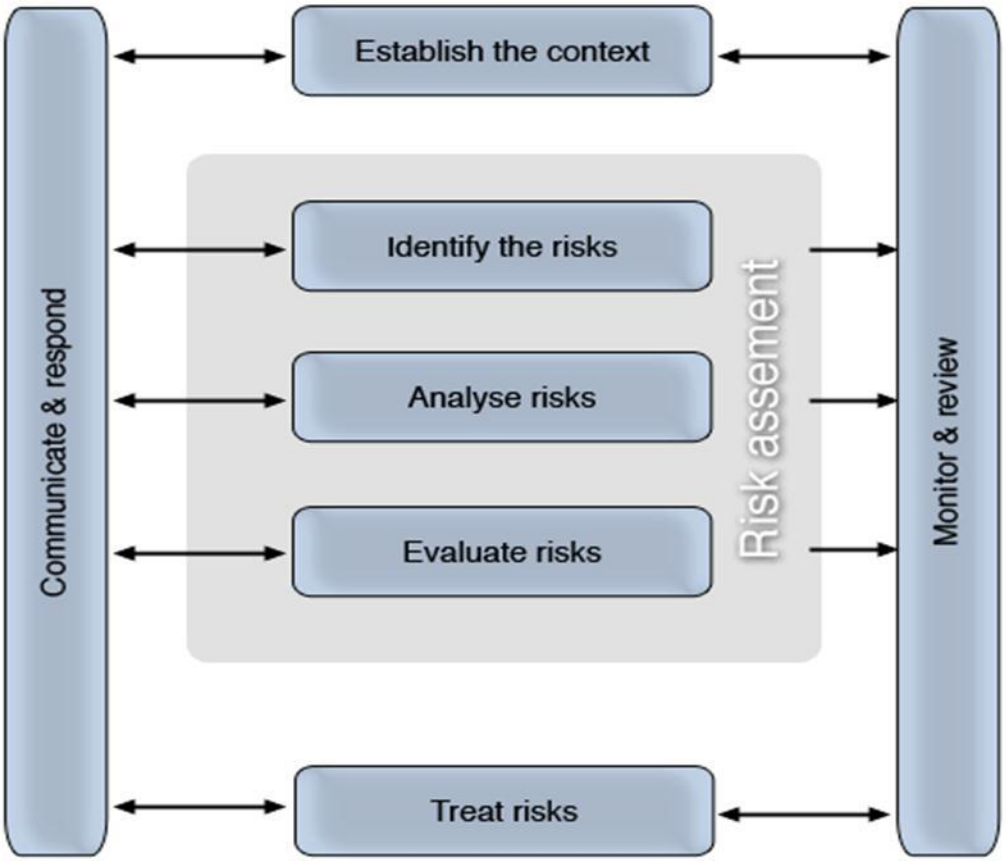

Figure 07 - 05- Risk Assessment Methodology

7.5.1 Hazard Identification

The technique employed here for the hazard identification is Maximum Credible Accident (MCA) analysis. MCA is an accident with maximum probability to occur. MCA analysis does not include quantification of probability of occurrence of an accident. In practice, the selection of accident scenarios for MCA analysis is carried out on the basis of engineering judgment and expertise in the field of accident analysis.

Process information study and relevant data would help in the identification of hazard in the plant. Inventory analysis and following Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules-1989 are also the methods in hazard identification. It is reiterated here that the inventory of hazardous inflammable chemicals will be above the threshold limit and does warrant on-site emergency disaster management plan.

Except FO, no other hazardous chemicals are handled in the process and hence, release of the same due to leakage from pipes, process equipment, damage of cylinders, valves etc., are not anticipated.

7.5.2 MCA Scenarios

A MCA has been characterized as accident with maximum damage potential, which is still believed to be probable. As an initial step in this study, a selection has been made from the processing plants and storage units which are believed to represent the high level of risk for the surrounding in terms of damage distance.

1. Methodology

The following steps are employed for visualization of MCA scenario:

- Chemical inventory analysis
- Identification of hazardous processes in individual units
- Identification of accident scenarios and chemical release
- Analysis of past accident scenarios and chemical release
- Analysis of past accidents of similar nature to establish credibility to identified scenarios.
- Natural hazard like earthquake, floods.

2. Short listing of MCA Scenarios

Natural hazards that can happen in Bilaspur region are earthquake and floods only. In case of earthquake, the maximum damage, it can cause is cracks or partial peeling of plaster in buildings as Bilaspur falls under *Zone-II* which is not prone to earthquake. However the buildings are designed and constructed as per standard guidelines to meet seismic consideration.

Another natural hazard is flooding which cannot occur in the site by virtue of higher elevation and its surface drainage pattern.

Based on the storage quantities and properties of the chemicals, following hazards have been identified for MCA analysis.

- Pool fire of furnace oil due to rupture/leakage.

- General fire hazards

7.6 HAZARD ASSESSMENT AND EVALUATION

Preliminary Hazards Analysis (PHA) is based on the philosophy "Prevention is better than cure". This technique, if applied early in the project life cycle, will help eliminate hazards and thus avoid costly design modifications later.

A preliminary hazard analysis has been carried out to identify the major hazards associated with storage areas and the processes of the plant.

This is followed by a consequence analysis to quantify these hazards. Finally, the vulnerable zones are plotted for which risk reducing measures are deduced and implemented.

The likely potential hazards associated with the pellet plant are listed in **Table 07 – 14.**

Table 07 - 14
Potential hazard within the facilities and chemical inventory

Sr. No.	Facility	Process	Potential Hazard	Provision
1.	Oil Storage Facility (02X200KL)	Induration	Pool fire	Provision for fire protection System including foam, safe distance from other process buildings

1. Maximum Credible Accident Analysis

Hazardous substances may get released as a result of failures or catastrophes, which may possibly damage the surrounding area. The results of consequence analysis are useful for understanding the situation and emergency planning.
There is one scenario considered for MCA analysis:

- Pool fire due to leakage of Furnace oil tank

2. Consequence analysis

As stated in Chapter – 2, the process involves consumption of inflammable chemicals like furnace oil which are stored in the tank with dyke. Elaborate arrangements are provided to tackle any accidents, leakage etc. within the storage area. In view of this conundrum, a detailed risk analysis is carried out, to find the risk on pool fire.

3. Results and discussions

Furnace Oil/LDO is stored in tanks. As per norms these storage tanks are provided with dyke walls. There are 02 furnace oil tank of each 200 KL storage facility.

In this study the total heat radiation intensity resulting from the accidental pool fires to the nearest buildings is estimated. In this case the nearest building is hearth layer separation building which is about 30m from the oil storage facility.

Pool fire for total catastrophic failure is considered for worst case scenario i.e., burning of one tank of furnace oil with the capacity of 200 KL. The result of heat radiation distance calculated using Heskestad formula method for furnace oil pool fire is shown in Table 07 - 15.

Table 07 - 15
Heat radiation distance during pool fire for Furnace Oil

Sr. No.	Intensity of fire in kW/m2	Distance in m	Effects of thermal radiation
1.	37.5	71	Sufficient to cause damage to process equipment. 100% lethality
2.	25.0	87	Minimum energy required to ignite wood at indefinitely long exposures (no piloted). 50% lethality
3.	12.5	122	Minimum energy required for piloted ignition of wood, melting of plastic tubing. 1% lethality
4.	9.5	140	Pain threshold reached after 8sec; second degree burns after 20 sec.
5.	4.0	216	Sufficient to cause pain to personnel if unable to reach cover within 20 sec; however blistering of the skin (second degree burns) 3rd degree burn
6.	1.6	342	Will cause no discomfort for long exposure 2nd degree burn

7.7 OTHER SAFETY PRECAUTIONS

Disaster Control Centre (DCC)

From this DCC office the plant in-charge supervises and directs the emergency situation. This is located at administration building. Necessary Personnel Production Equipment (PPEs) and other monitoring instruments are made available for disaster handling. The disaster control is planned for LPG leakage, CO emission and oil pool fire only.

Evacuation Centre/Assembly points

Adequate numbers of assembly points are provided and their locations are earmarked.

Wind Socks

Wind socks are provided at suitable locations in different buildings to indicate the direction of wind for emergency escape.

Emergency Power Supply

Critical plant units are connected to DG sets and regulated auto mode apart from other critical equipment's.

Guidelines to Unit Heads

- Keep in touch with DCC/plant in-charge.
- Communicate safe route and safe assembly point to all employees.
- Communicate all instructions to the employees in the building.
- Shut down of plant in consultation with plant in-charge. Guidelines to employees
- Avoid using telephones and lifts.
- Listen to announcement/communication from the unit head.
- On receipt of clearance from plant in-charge for evacuation, follow standard evacuation procedure.
- If the emergency has occurred in the same plant, combat the emergency as per the set procedure.

Standard evacuation procedure

Operating personnel of the facility shall wait for instruction from shift incharge. Personnel who are not operating any plant/facility at the time of hazard outbreak on hearing disaster management declaration or 'SIREN ON' receipt of evacuation clearance from plant in-charge, shall follow as below:

- Do not panic.
- Come out of the building with a wet cloth over the nose in case of LPG leakage.
- If caught in an emergency without respiratory protection, hold the breath and escape, if possible, without breathing. If this is not possible, short shallow breaths should be taken so as not to fill lungs. Any exposure to fumes should be reported so that the affected gets immediate medical attention.
- Go to the safe assembly point through safe route.

- Avoid using telephones during emergency

OTHER SAFETY PRECAUTIONS

General instructions

- Resort to water fogging/curtain in the downwind area closer to the spillage to prevent/reduce the chances of gas cloud formation and thereby to contain the release. The firemen should always fight from the upwind side to avoid hazardous gases. Low pressure wide angle water spray to be given as back up protection to operating personnel involved in tackling the emergency. Do not apply water directly on leaks as it may increase the leak.
- Line up standby crew to relieve the combating crew.
- Pool up additional safety gears like breathing air cylinders and protection suits.
- Rescue trapped personnel if any, and arrange for first aid/medical treatment.
- Avoid or remove all ignition sources. Take care that oxidizing material or any other incompatible material does not come into contact with leak or spill.

Fire related instructions

Cordon-off and evacuate the area. Switch off all artificial supply and exhaust ventilation of the affected building. For other buildings, if the situation warrants switch off all artificial supply and exhaust ventilation.

- Fire alarm shall be manually activated by breaking the glass cover of manual call-points using a hammer or by removing the front cap of MCPs installed in respective buildings.
- Identify the nature of fire (Electrical, oil, metal etc.) and cut off the source of fire.
- Ensure that power supply is isolated.
- Select the appropriate firefighting technique/extinguisher.
- Put-off fire from a safe distance. Approach fire from upwind to avoid hazardous gases and toxic decomposition products. When escaping gas is burning, the best procedure is to stop the flow of gas before attempting to extinguish the fire.
- Prevent the spread of fire by cooling the adjacent areas and critical equipment. Isolate materials not yet involved in the fire and protect personnel.

- Move gas cylinders if any, from fire area if this can be done without risk. Be cautious on pressure vessels, chemical handled/stored, cables etc. Explosive decomposition may occur under fire conditions. Use extreme caution since heat may rupture containers/vessels, which may possibly fly. Otherwise, fire exposed containers, tanks or pipelines should be cooled by application of hose streams and this should begin as soon as possible (within the first several minutes) and should concentrate on any dry portions of the container.
- Explosion or collapse of vessels may release toxic/inflammable gases. In such cases follow standard guidelines. Suitable PPEs have to be used accordingly. Release of inert gas in confined space has to be kept in mind while choosing the appropriate PPE.
- Protect the nearby buildings, structures, areas, equipment, and materials.
- Ascertain and rescue the trapped personnel and arrange medical aid to affected victims. Firemen are to be fully protected with fire suits while attempting rescue of personnel.
- The contaminated fire fighting water shall be prevented from entering storm drain. If possible, it may be contained with the help of bunds.
- Protect the electrical installations from water while fire fighting.
- For a massive fire in a large area, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from fire area and allow fire to burn. Stay away from ends of tanks, but be aware that flying material from ruptured tanks may travel in any direction.

Oil storage fire

- Evacuate the nearby buildings if required,
- If required stop the traffic on the nearby road.

During Earthquake

Although, Village Paraghat, Tehsil Masturi, District Bilaspur falls under Seismic Zone–II, the precautionary measures are described below.
During earthquake following are the instructions to be followed:

- Trace information from local bodies and media.
- Inform all workers in site about the expected danger.
- Arrange for safe shut down of the facility in consultation with plant in-charge.
- Isolate the system to prevent any leakage/spread of contamination.
- Isolation of power supply to the building.
- Safe evacuation to an open area/Emergency Assembly Point.

- After earth quake, tremors may follow. In case of collapse of a building/structure, rescue operation shall start immediately.
- All forklifts, search lights, medical resources, fire services etc. shall be pressed into service immediately.
- Look for any consequential (domino) effects like leakage of hazardous chemicals/ release of toxic gas/fire, damage to the building/structure etc. and take appropriate action.

7.8 MAINTENANCE OF SITE DISASTER MANAGEMENT PLAN

Following are the steps envisaged for maintenance of disaster management plan:

Training

Safety section shall arrange for appropriate training/refresher program for all personnel.
Every incident controller, in consultation with safety officer and medical officer, shall identify and arrange for specific training to be imparted to his workmen, supervisory staff and engineers to combat emergencies, which can arise in areas under his jurisdiction.
Firemen, in addition to their normal firefighting training, shall also be trained to handle toxic gas releases and chemical spills. Evaluation and monitoring program shall be introduced for assessing emergency preparedness in this case also.

Maintenance of equipment

Safety section shall test the equipment at the DCC once in three months. Medical section will test the equipment in emergency vehicle once in three months/ after every usage.
Electronics and Instrumentation section shall test the emergency communication system at prescribed intervals.

Mock Drills/Exercises

Safety section will plan and carry out mock drills at stipulated interval to acquaint the safety group and all employees about relevant aspects of 'DISASTER MANAGEMENT PLAN', to detect any lacunae in the plan and to eliminate panicness at the time of actual emergency. Feedback will be obtained and corrective action will be taken accordingly.

Testing of Siren

To ensure the sirens are working correctly, they shall be tested regularly. The testing is a part of routine maintenance. Siren test lasts for approximately two minutes. Siren Test shall

be done on first Monday of every month for two minutes, one minute each for declaration of emergency and termination.

Updating of Plan

Safety section shall update the contact details once in every six months. Safety section shall update and revise the plan every five years or whenever there is a change in plant activities.

Record maintenance

Emergency Data

The chronological log of events during the entire period of disaster shall be maintained by plant in-charge, Safety.

Training

The records of training shall be maintained by Head Safety.

Maintenance of Equipment

Maintenance records of equipment's shall be with safety head. Permit system (General, Hot Work, and Electric Lock out) shall be issued with due ensuring the safety instructions while attending the requisite job.

Drills/Exercises

Records of all drills/exercises shall be maintained by Heads of HSE.

7.9 CONCLUSION

The consequence analysis for all the low probability events (accidents) carried out for man induced events show that access to the plant or its operation would not be jeopardized.
If pool fire occurs, it would not damage the other essential plant equipment such as transformers, water storage tanks etc., which are located quiet far away from the vicinity of specified heat intensity contours.

The maximum distance of head radiation of 4 KW/m2 is expected at a distance of 216m from the dyke. The disaster mainly limited to plant area.

The Material Safety Data Sheets (MSDS) for HSD, Furnace oil is enclosed as Annexure for immediate reference.

Occupational and Safety

As described earlier, pool fire hazard is expected during fire accident. The maximum TLV as per ACIGH is 5 mg/m3 of oil mist. The oil level mist is not recorded so far in the plant. In case of fire also, the permissible level of 5 mg/m3 of the oil mist in the air will not be reached. Further, the plant is handling FO by burning for thermal treatment to pellet. In this process, oil mist generation is not expected.

Hence, it is expected the health of the workers will not be affected due to oil mist.

Evaluation health status of worker

The company is monitoring worker health status during the new joining of worker later on yearly basis two times for all employees' thorough pre-placement and periodical medical examination.

In future, similar type of Medical examinations are planned to be conducted annually. The annual report will be submitted to MoEF, RO office.