

Risk Assessment (RA) FOR

Proposed establishment of Grain Based Ethanol Distillery of capacity 100 KLPD with 2.5 MW co-generation power plant

at Village – Nayagaon Kushahar, Khijirpura, Tehsil – Kesaria, District - East Champaran, Bihar, Pin - 845424 , India

Reference

- **National Policy on Biofuels,- 2018 on dated 04th June 2018 (Approved by the Cabinet on dated 16-05-2018) and Amendments to the National Policy on Biofuels - 2020**
- **MoEF&CC Notification S. O. 2339 (E) dated 16th June 2021**

Category: B2, 5(ga) as per MoEF&CC Notification & its amendment

Applicant



M/s Tirhut Udhyog Private Limited

Registered Office: Kalpana Residency, Satsang Nagar, Kolhua Paigamberpur, District – Muzaffarpur, Bihar - 843108

Consultant



PARAMARSH

SERVICING ENVIRONMENT AND DEVELOPMENT

QCI/ NABET Certificate No: NABET/EIA/2124/RA 0224

(Valid up to May 01, 2024)

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RISK ASSESSMENT

1.0 RISK ASSESSMENT & EMERGENCY PROCEDURES

Accidents related to industrial hazards results in great loss in human and financial capital and have significant impact on the environment. These risks can be sometimes so drastic and fatal that they can easily jeopardize the financial viability of a business along with other hardships. Therefore, the risk assessment deals with the objective of analyzing hazards associated with each and every activity being carried out in an industry in the most simple and comprehensive ways to bring out a well-designed and feasible plan in the Indian context.

Risk is the probability that the hazard will occur (i.e. an adverse effect or/event that will result from a given set of exposure condition). Since the risk is typically expressed as a mathematical probability, the range of risk can be stated as zero (having no possibility of adverse effect or event). Risk is the mathematical product of hazard and exposure. This relationship can, be expressed by the following formula.

$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}$$

PRIMARY POTENTIAL HAZARD IN THE PROJECT

The proposed project deals with various instruments like handling and storage of grains, biomass, for boiler.

The products of the industry include Ethanol (Absolute Alcohol - Fuel Grade). All these instruments and product/byproducts can be hazardous due to their mechanical and chemical properties. The plant possesses high risk of accident if they are not properly taken care of.

As per the Manufacture, storage and import of Hazardous Chemical rules, 1989, the flammable chemicals are categorized into the following three categories:

Class I A: Liquids having flash point below 73° F and boiling point below 100°F

Class I B: Liquids having flash point at or above 140 °F and below 200 °F

Class I C: Liquids having flash point at or above 73°F and below 100 °F

SECONDARY POTENTIAL HAZARD FOR THE PROJECT

The secondary potential hazards can arise from the processes undertaken during the transport or transfer of materials from storage or during storage in the plant. It includes:

- Spilling or leakage during loading/unloading of materials into the storage tanks
- Leakage in the storage tanks due to some technical or mechanical default, poor maintenance and defects in the tanks.
- Spilling during transport or transfer of products due to damaged pipeline or other factors.
- The list of products stored as identified under MHSIC are given in the table

List of products to be stored

S. No	Chemical	Properties/Hazard associated with the chemical	Major Hazards to health
01	Ethanol	Ethanol 99.8 % v/v Chemical name – Ethyl alcohol Colorless, alcoholic odor Flash point -53°F Boiling Point- 78°C Explosion limit value -3.5-15 Extremely volatile liquid	Highly volatile and hence can cause sudden explosion and fires even with little exposure. - It is severe eye irritant. - Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting. - Repeated exposure may impact kidney, liver, spleen and blood

(Source: Safety Data sheet, <http://sds.chemtel.net/webclients/ram/XQ6210.pdf>)

Hazard Identification & Risk Assessment (HIRA)

Hazard identification involves the enlisting of hazards in each unit of the ethanol plant and conduct HAZOP study on the basis of it. Risk assessment involves the finding of impact evaluation of a hazard, its frequency, its probability of major accidents etc.

Major on site and off site hazards in ethanol plant are given below:

On-site

- ❖ Uncontrolled exposure to fugitive dust, noise, and other emissions
- ❖ Contact with chemicals and solid wastes
- ❖ Accidents like uncontrolled emissions/spillages due to handling of product and raw material

Off-site

- ❖ Exposure to pollutants due to release from offsite/ storage/related activities
- ❖ Unpredicted contamination due to accidental explosions/release due to a natural hazard
- ❖ Possible sudden releases and deposition of toxic pollutants in vegetation

1.1 ON SITE EMERGENCY PLAN

Identification of hazards and proposed safety systems The following types of hazards are identified at the site.

Hazard identification in an Ethanol Plant.

S. No.	Name	Description	Severity	Hazard
1	Transport of raw material and storage	Grains	Minor	Leakage, Accidents, Fire
		Biomass/coal	Minor	Leakage, Accidents, Fire
		HSD Storage	Major	Leakage, Fire, explosion
		Chemicals (Caustic soda, acids etc)	Major	Inhalation & Exposure to skin, Fire
		Enzymes, yeast,	Minor	Inhalation & Exposure to

S. No.	Name	Description	Severity	Hazard
		nutrients etc		skin
2	Ethanol Manufacturing	Distillation	Major	Fire, explosion & Heat
3	Power room & DG Sets	Transformer area	Major	Noise Fire & electrocution
		Electrical rooms	Major	Electrocution, short circuit
4	Other Units	DG Sets, electrical rooms	Major	Noise, fire, explosions, heat & electrocution
5	Products	Alcohol	Major	Leakage, Fire, Explosion

Assessment of Risk along with mitigation measures

Qualitative risk assessment is done based on both probability and impact which provides greater insight into the absolute risk severity. The study of risk and its impact evaluation finds out the influence on a project due to a particular risk including positive and negative and its impact on objective such as schedule, cost, quality, or performance.

Description of hazards identified, risk assessment and mitigation measures are below.

Ethanol Plant operations (working area)

Activity	Associate d hazards	Health impact	Risk rating	Proposed control & mitigation measures
Working near distillation column	Heat, Fire, Slipping, falling from stairs	Physical injury and burning	High	• Use of Personal protective equipment • Fire-fighting facilities • Provision for immediate availability of first aid • Proper maintenance of all distillation equipment and periodic checking

Power room & D.G. Set operation

Activity	Associated hazards	Health impact	Risk rating	Proposed control & mitigation measures
Working near DG	High noise	Hearing impairment	Medium	• Use of PPEs • Acoustic enclosures
Maintenance operations for DG	Physical hazard and electrocution	Physical injury and burns	High	• Use of PPEs • Restricted entry of staff • Use of flame proof fittings
HSD storage area	Leakage / Fire	Severe burns and physical injury	High	• Storage will be away from ignition source • Regular monitoring to check the leakages and spillages • Firefighting facility will be provided • PPEs will be provided • First aid box

Handling and storage of raw material and products

Activity	Associated hazards	Health impact	Risk rating	Proposed control & mitigation measures
Transportation of raw materials and products	Physical hazards, spillage of material	Injury due to road accidents	Medium	- Trained drivers to be employed - Proper first aid kits to be provided in all vehicles - SDS training to be provided for hazardous chemicals - Transport Emergency (TREM) cards to be provided to the drivers
Handling & storage of grains/ Biomass/coal	Spillage from silo	Physical injury	Less	Proper handling of grains/biomass/coal - Training to workers involved in handling and storage - Concerned PPEs to be provided to workers - Inspection and regular monitoring of storage area - Provision of level indicators for storage tanks
Handling and storage of chemicals	Spillage and leakage of hazardous chemicals	Physical injury	High	Proper labeling of harmful chemicals - Immediate First aid provisions - Discarded containers to be stored properly - Training of SDS to be provided to workers - Proper ventilation to avoid fuming in the storage area
Handling and storage of alcohol	Inhalation, ingestion & fire	Exposure to over 1000 ppm may cause headache, drowsiness and lassitude, loss of appetite, and inability	High	Avoid all possible sources of ignition like spark or flame. - Use spark/flame proof hand tools - Electrical wiring will be flame proof type - Proper cleaning provisions if any spillage occurs - Proper fire safety systems

Activity	Associated hazards	Health impact	Risk rating	Proposed control & mitigation measures
		to Concentrate, throat Irritation. • Ingestion causes depression of central nervous system, nausea, vomiting, and diarrhea • Liquid or vapor may cause eye and skin irritation • Burn injury		• Training for proper handling of alcohol. • Provision of level indicators for storage tanks of alcohol • Avoidance of plastics, rubber and coatings in the storage area.

Mitigation Planning:

Mitigation planning is an integral part after hazard identification, mitigation measures counts for all the measures needed to be taken in order to prepare for avoiding any hazard at first, and devise the emergency plan layout. This helps to localize the emergency or eliminate it and minimizes the affects of the accident overall. Elimination of emergency requires prompt actions to be taken by the emergency staff- fire fighting equipments, water sprays, while for minimizing the effects first aid, evacuation plan, rescue and rehabilitation is required.

1.1.1 Proposed mitigation measures

(A) Electricity hazard measures

- All electrical equipment/machinery to be provided with proper earthing.
- Earthed electrode shall be regularly tested and maintained
- Emergency lighting shall be available at all critical locations
- Easy accessibility of fire-fighting facilities
- All electrical equipment shall be free from carbon dust, oil deposits
- Use of approved insulated tools
- Flame and shock detectors and central fire announcement system to be provided
- Temperature sensitive alarm and protective relays to make alert and disconnect equipment before overheating shall be provided

(B) Fuel storage measures

- Biomass handling unit/Agency will be at minimum 500 meters away from the residential area and eco-sensitive zones.
- Biomass handling unit will be located at a minimum 500 meters away from the state or national highway.
- The unit will have adequate water supply through pipe. biomass storage unit is to be ensured for stacking in heaps.
- Ash dispersion will be prevented by covered transportation.
- Fire-fighting measures will be readily available

(C) Precautionary measures for falling material

- Safety helmets to be used to protect workers against falling material.
- Barriers like toe boards or mesh guards is to be provided to prevent items from slipping or being knocked off the edge of a structure.
- No-entry zone will be defined in working areas.
- Dangerous areas during construction phase will be excluded and proper PPEs will be made available.

(D) Safety measures for storage & handling of alcohol

Handling and storage of alcohol will be done as per prescribed norms. Automated handling will be installed. Following precautionary measures would be taken for safety:

(a) Handling and storage measures

- Alcohol storage area shall be kept away from oxidizers, heat and flames.
- Proper care will be ensured for handling alcohol.
- Ventilation shall be properly provided.
- Avoidance of storage of plastics, rubber and coatings in the alcohol area.
- Grounding of the container and transferring of equipment to eliminate static electric sparks.
- Fire extinguishers should be provided in an easily accessible place.
- The entire premises should be marked as “No Smoke Zone”.
- Proper labelling of the storage tanks along with their material of construction, name, number, chemical stored and SDS should be done.

(b) First aid measures

For skin contact, eye contact & inhalation.

- For chemical splashes into the eye, flush immediately with copious amount of water. Do not apply eye ointments except under medical advice.
- For skin burns splash cold water and contact to nearest medical care.
- First aid boxes to be made available and made accessible as well.
- Primary first aid mock drills to be carried out for the employee.
- For metal burrs, particles and splinters in the eyes, report to the medical centres for removal.

(c) Fire Fighting Measures

- Use of extinguishing media surrounding fire (as water, dry BC or ABC powder), CO, Sand, dolomite, etc.
- Foam System will be provided to extinguish fire from the alcohol storage tank. The foam blanket will suppress the flammable vapours that can combine with air and result in more fire subsequently.
- Special Fire Fighting Procedures; Keeping the fire upwind and avoiding downwind direction, closing all possible sources of ignition. Water in straight hose stream shall be avoided which will scatter and spread fire. Spray or fog nozzles will be promoted.
- Hazardous Decomposition Products: gases of Carbon Monoxide (CO) & Carbon Dioxide (CO₂).

(d) Spillage or Leakage of toxic material Measures:

In case of alcohol spillage, removal & shutting off of all possible sources of ignition, absorb small quantities with paper towels and safe place like fume hood shall be chosen for proper evaporation and burning of these towels should be done in a safe manner, use of respiratory and/or liquid-contact protection by the clean-up personnel will be promoted.

- Relevant Personal Protective Equipment (PPE's) to be provided to those handling toxic chemicals
- All finished products to be stored under adequate safe condition
- The design (including selection of materials) fabrication, assembly, testing, and inspection of piping systems containing flammable liquids must be suitable for the expected working pressures and structural stresses.
- Spare barrels of sufficient quantity will be kept ready for any emergency spillage or Leakage
- Smoking should be prohibited inside the factory
- All pipe joints provided with heavy duty gaskets to prevent any leakage
- Dyke wall to be provided to areas where hazardous chemicals are stored

1.1.2 Environment Health and Safety Cell

The company will have full-fledged EHS cell (Environment Health & Safety Cell).

Main function of EHS cell will be;

- To assess/quantify the potential risks/hazards to environment, health of employees & society
- Provide safety within the plant.

- Supervising installation of fire-fighting system, fire alarm, provision of safety/protective equipment to workers
- Keep a record of regular medical check-ups.
- Periodic monitoring of different parameters shall be carried out to ensure safety of environment and society.
- Conduction of trainings and mock drills in regular intervals for workers to ensure the safety in case of any accident or natural hazard.

Procedure for extinguishing fire

The following steps will be taken during a fire accident in the system:

- On receiving message about fire, one of the systems will be diverted to the place of the fire accident along with a staff member.
- Followed by plant fire station to be informed by phone or walkie-talkie of nearby area.
- In the meanwhile, the pipe system will be operated to obtain maximum pressure on output.

Fire-fighting with water

Adequate and reliable arrangement is required for fighting the fire with water such as:

- Provision for fire hydrant.
- Arrangement of pipelines of water all around vulnerable areas.
- Provision of valves at appropriate points
- Provision of overhead tanks which will be providing water.

Fire-fighting with fire extinguishers

Carbonaceous fire can be extinguished with water, whereas other types of fire require suitable fire extinguishers to do the job effectively. Adequate number of fire stations would be provided.

- In case of fire, other spray groups will be diverted to the fire area
- In case of fire in the greenbelt, greenbelt will be cut near the burning portion to save the remaining parts.
- Foam material fire-fighting will be provided to control fire from the alcohol storage tank.

A) Alarm System

All moving machinery, compressors, lifting equipment, storage Tanks of hazardous chemicals, tankers etc. are provided within built design and safety measures to meet any abnormality in operation. All moving parts are adequately guarded. Extensive instrumentation has been provided on equipment, storage Tanks, to check excessive pressure, temperature, level, etc. Preventive maintenance of all machinery storage tanks will be done on regular basis. Schedule inspection and maintenance of lifting tackles, machinery and Storage Tanks is carried out.

Proper attention is paid to maintain good Various controls loops have been provided in Plant for safe & convenient working of the system. It has been ensured that these interlocks & controls are in line to control any unforeseen variation of process parameters. Low level,

high level, high temperature & pressure alarms have been provided wherever necessary to inform the operating personnel for taking appropriate time & control the situation from escalating into unsafe condition.

The Plant has provided several trips, interlocks & alarms to avoid any process parameters deviations, which may lead to a serious hazard in the plant.

B) Communication

Fast communication is the essence of crisis management. The emergency Control rooms will be set up at **M/s Tirhut Udhog Pvt Ltd**, and at office of District Magistrate, for central co-ordination. The control rooms will provide with adequate communication facilities.

Executive Engineer, Telephones will provide necessary hot line Facilities in addition to the normal telephone facilities provide. He will arrange to provide quick communication of all incoming and outgoing calls.

C) First Aid

M/s Tirhut Udhog Pvt Ltd will be having First Aid Centre equipped with all necessary medicine and equipment and there is a doctor and a trained pharmacist /compounder. Emergency vehicle will also available round the clock. The plant personnel are to be trained in first aid.

E) Safety

The safety wing led by a Safety Manager will meet the requirement of emergencies round the clock. The required safety appliances will be distributed at different locations of the plant to meet any eventualities.

Poster/placards reflecting safety awareness will be placed at different locations in the plant area.

F) Evacuation Procedure

As the major hazard is only due to fire, which has more or less localized impact no mass evacuation procedures are required. Evacuation would involve only the people working very close to the fire area.

Objectives of disaster management plan

The overall objectives of the emergency plan will be:

- To localize the emergency and if possible, eliminate it
- To control and contain the incident as early as possible
- To safeguard other employees by evacuating them to safe assembly points
- To minimize the damage to the plant and material and to limit environment pollution
- To rescue accident victims and organize medical treatment
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency

Various steps involved in Disaster Management Plan can be summarized as follows:

- Minimize risk occurrence (Prevention)
- Rapid Control (emergency response)
- Effectively rehabilitate damaged areas (Restoration)

H) Duties and Responsibility of Key Personnel of Environmental Management Cell

Key Personnel	
Immediate Works Incident Controller(IWIC)	• He will assess the situation and depending upon the severity of the accident, he will declare the emergency and also ask security men to raise emergency alarm, if required. • He will ensure all the machines/operations are safely shut down, and critical equipment have been isolated. • He will communicate to Works Incident Controller and Works Main Controller. • He will instruct the essential technical persons of the works to control the situation. • He will ensure that all non-essential workers have moved to the pre-designated assembly points. He will direct sectional staff to extinguish fire and also inform security staff to rush to accident site and undertake firefighting operations at full scale. • He will also direct the first aiders to perform their duties, if required. • He will perform all duties assigned to Works Incident Controller till his arrival.
Works Incident Controller (WIC)	• He will ensure all the machines/operations are safety shut down, and critical equipment have been isolated; He will also ensure isolation of damage area. • He will follow the emergency mitigation procedure as per the action plan. • He will ensure that firefighting personnel are carrying out firefighting operations • He will decide and order for safe evacuation of people from the plant depending upon severity of the incident. • He will maintain close liaison with Works Main Controller. • He will direct Medical Officer for quick removal of victims to nearest hospitals. • In case the situation is beyond the control of the plant, he will advise Communication Coordinator to inform outside agencies for assistance.
Works Main Controller (WMC)	• He will ensure that precautions and actions taken by the WIC have been taken care off. He will ensure the availability of the vehicles for transportation of victims. • He will ensure that arrangements for quick removal of victims to nearest hospital have been made. • He will ensure that effective firefighting operation will be carrying out. • In case he finds the situation beyond the control of plant, he will ensure that information to the Fire Brigade/

	other govt officials for assistance has been sent. • He will provide necessary coordination with the concerned authorities in performing their duties. • He will also help the concerned authorities for carrying out the investigations. • He will ensure that relatives of the victims have been informed. • He will be responsible for the release of any statement to the press in coordination with local authorities.
GM (HRD)/ DGM (Personnel)	• He will act as Communication Coordinator. • He will communicate with company's Head office in consultation with Works Main Controller. • He will coordinate with outside agencies in consultation with Works Incident Controller/ Works Main Controller. • He will also inform to the concerned authorities about the incident, after approval of the Works Main Controller. • He will issue statements to outside agencies, press, TV channels etc. in consultation with Works Main Controller.
Accounts Officer	• He will proceed to the emergency control room within time. • He will follow the instructions given to him by WMC/WIC. • He will arrange release funds for emergency as per procedures.
DGM (Sales)/AGM (QC)	• He will rush to the assembly points to attend the assembled persons • He will make head count for the persons present at the assembly points and will inform the Emergency Control Centre. • He will provide attendance of the assembled workers to the Emergency Control Room.
DGM (Material)	• He shall arrange smooth flow of material from stores required for emergency combat operations. • He shall arrange additional DG Sets or other emergency equipment/ firefighting equipment from outside, if required. • He shall ensure the safety of material in stores.
Chief Maintenance Manager	• He shall be the Engineering Coordinator • He will rush at site and guide maintenance team for attending the leakage and providing technical guidance to the firefighters, leakage attending staff and render help to IWIC.

	• He will shut down the plant/ equipment in a safe manner with the help of Engineers/supervisors/ operators of concerned section. • He will also act in consultation with Works Incident Controller and provide all sort of technical advice for ensuring effectiveness of firefighting operations
Chief Manager(Electrical)	• Shall rush to site on knowing about the incident. • Shall guide personnel about attending to electrical works requirement arising out of emergency. • Shall ensure to cut off supply to affected area, if required. • Shall ensure availability of emergency power to essential services and fire pumps etc.
Chief Medical officer	• The moment he comes to know about the accident, he will report to the Immediate Works Incident Controller at site i.e. shift in charge at that time and will perform the duties mentioned below: • Will ensure that first aiders have been called on. • Will ensure that the ambulance/staff car is available at the site for evacuation. • Will ensure that all the essential medicines are kept ready for the treatment. • Shall ensure that victims get proper medical care • Will decide and consider sending casualties to outside medical agencies for further specialized treatment. • Will prepare documentation and maintain records of affected persons. • Will make a close contact with the District Medical Officer for necessary help, if required in emergency. • Will ensure that the Medical Facilities, available from other nearby hospitals are in close contact. • During emergency one Medical Officer shall be available at accident site.
Manager (Admin)	• He shall act as Transport Coordinator and arrange extra vehicles for use in emergency.
Safety Officer	• He will rush to the accident site and render help to IWIC. • He will arrange and ensure regular flow of necessary firefighting/ safety equipment/ material required to meet the emergency. • He will ensure proper running of fire pumps. • He will follow the instructions given to him by WMC.
Security Officer	• He shall supervise the fire combat operations. • He will direct the security men to control the activities at main gate with the help of security men.

	• He will control the traffic at main gate. • He will arrange to open emergency exits, if required and arrange to control the movement of personnel etc. through these gates, if needed in consultation with WIC. • Security Officer shall inform key persons of the organization about the incident.
Staff of each section of the shift	• Will remain calm and cool, they will show no panic. • Will shut down the plant/equipment in a safe manner and will follow the instruction given by WIC/WMC/IWIC/contact to the emergency control room for further instructions
Maintenance Staff (Electrical/Mechanical)	• Will be ready to render services in controlling the situation to the WIC/IWIC. • Will provide emergency equipment in readiness in case required. • Will disconnect the electric supply of the affected area. • Will provide lighting and keep emergency generator ready, if required
Security Men	• Will prevent the entry of unauthorized person and traffic. • Will keep the road and main gate and exit gates free from obstacles for clear passage to the evacuation procedures. • Will help in controlling the situation by actuating fire-fighting operations. • Will give information to nearby villages with the help of PA system after getting instruction from key officials. • Will also use PA system to communicate to plant personnel. • Will start fire-fighting operations as per directions of IWIC
Store Supervisor	• Will provide necessary requirements from the store. • Will provide the list of the items stored in the stores to the WIC/WMC
First Aiders	• Will proceed to the accident site and will report to the Medical Officer/Immediate • Works Incident Controller. • Will shift affected persons to a safe place or to health centre. • Will provide first aid to affected person.
All workers, including contract workers who have not been assigned any duty, will rush to the assembly point and remain there and wait for instructions from the Assembly Point coordinator and should render help if required and as per instructions	

I) Personal Protective Equipment (PPE)

This equipment is used mainly for three reasons; to protect personnel from a hazard while performing rescue/accident control operations, to do maintenance and repair work under hazardous conditions, and for escape purposes. The list of Personal Protective Equipment provided at the facility and their locations shall be available in ECC. Personal protective equipment plays a vital role in overcoming major disastrous situation saving life during onsite emergency.

Summary of recommended personal protective equipment according to hazard onsite

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation	Safety glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords	Plastic helmets with top and side impact protection
Hearing protection	Noise, ultra-sound	Hearing protectors (ear plugs or ear muffs)
Foot protection	Falling or rolling objects, points objects. Corrosive or hot liquids	Safety shoes and boots for protection against moving and falling objects, liquids and chemicals
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures	Gloves made of rubber or synthetic material (Neoprene) , leather, steel, insulation materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors	Facemasks with appropriate filters for dust removal and air purification (chemical, mists, vapors and gases). Single or multi-gas personal monitors, if available
	Oxygen deficiency	Portable or supplied air (fixed lines). Onsite rescue equipment
Body / leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration	Insulating clothing, body suits, aprons etc. of appropriate materials
Contact with HSD	Fuel oil storage and fuel Handling	Canister type gas mask. PVC or Rubber. Goggles giving complete protection to eyes. Eye wash fountain with safety

J) Mock Drill

As per the Industrial Major Accident Hazard Rules,

- Mock drills of the on-site emergency plan will be conducted every month.

- A detailed report of the mock drill conducted will be made immediately available to all the concerned authority
- Also, Major Fire and Minor Fire mock drills will be conducted once in three months and one month respectively.

K) Training

On job training to the engineers of risk analysis and preparedness during emergency to reflect in the operation of terminal, especially from the safety stand point. Firefighting team will be trained for handling emergency situations. The types of training which may impart are as follows:

- Training on the use of Personal protective Equipments.
- Training on preparedness during the fire and related emergencies
- Training on preparedness during spillage/ leakage emergencies
- Training on handling and cleaning of hazardous chemicals
- Training on control of toxic releases.
- Training on good housekeeping practices

Warning alarm and security system:

Plant will have electric alarm to sound emergency at plant and following patterns to indicate emergency. For efficient security of the plant adequate security guards and supervisors with adequate training for firefighting undertake security round the clock.

Situation	Pattern of warning system
Fire/explosion/ethanol leakage	A wailing sound for 2 minutes
All clear siren	Straight run sound for 2 minutes

1.1.3 Details of PESO certification

The Company has already applied for PESO permission and will also fulfill all conditions related to storage of ethanol like:

- No vessel shall be located within the bonded area of petroleum or other flammable liquid storages.
- The above ground vessels to be covered by earth (mound) shall be installed on concrete foundation or compacted sand.
- Above ground vessel for storage of corrosive, flammable or toxic gas in liquefied state shall be provided with enclosure wall all around the ground. The minimum distance between vessel and enclosure wall shall be the diameter of the vessel or five meters, whichever is less.
- The height of the enclosure wall shall be thirty centimetres on the upper side and gradually increasing to maximum sixty centimetres on the lower side, at the end of which a shallow sump for collection of the spilled liquid shall be provided.
- The company will follow all the PESO terms and conditions for proper functioning and to prevent any damages due to ethanol storage.

1.1.4 Consequence analysis

Major hazards associated with ethanol plant are fire and explosion.

- Fire hazard due to alcohol storage, fuel storage, boiler operations etc. and explosion due to boiler operations, grain/ biomass storage etc.

- Hazards due to ethanol - Flammable. Risk of ignition. Ethanol is a highly flammable liquid, vapours may form explosive mixtures with air. Vapors of ethanol might travel/spread to a potential source of ignition capability and then flash back immediately. Containers may explode when heated. Vapors may form explosive mixtures with air.

[Source: SDS of ethanol]

Fire due to ethanol leakage can cause irreparable damage within plant premises. Burning men and property in areas of leakage.

Carbon dioxide gas released during fermentation can also cause various hazards if not collected properly and leakage occurs. Carbon dioxide is an odourless, colourless and toxic gas. The consequence analysis at various concentrations is given below: Carbon Dioxide is a powerful cerebral dilator. Carbon dioxide, if present at concentrations between 2 and 10% might cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. Above 8% nausea and vomiting might appear and above 10% it might cause suffocation and lethality can occur within minutes. [Source: SDS of Carbon dioxide]

Common terminologies

Accident Site

The location either the factory premises or a transportation route where an unexpected event of failure /release of hazardous substance which have the potential of resulting into serious injuries or loss of life, extensive damage to property and/or environment occurs.

Airborne release

Release of any chemical into the air.

QUANTITATIVE RISK ASSESSMENT FOR THE PROPOSED ESTABLISHMENT OF GRAIN BASED ETHANOL DISTILLERY CAPACITY 100 KLPD WITH 2.5 MW CO-GENERATION POWER PLANT:

1. **SCOPE OF THE STUDY:** Storage tank for Ethanol and HSD

2. **OBJECTIVE OF THE STUDY:**

- Identification of worst-case accidental events
- Assessment of risk arising from the hazards and consideration of its tolerability to personnel, distillery and the environment which includes the following
 - Calculation of physical effects of accidental scenarios.
 - Identification and quantification of the risks and contour mapping on the layouts.
 - Evaluation of risk against the risk acceptable limits.
 - Risk reduction measures to prevent incidents, to control accidents.

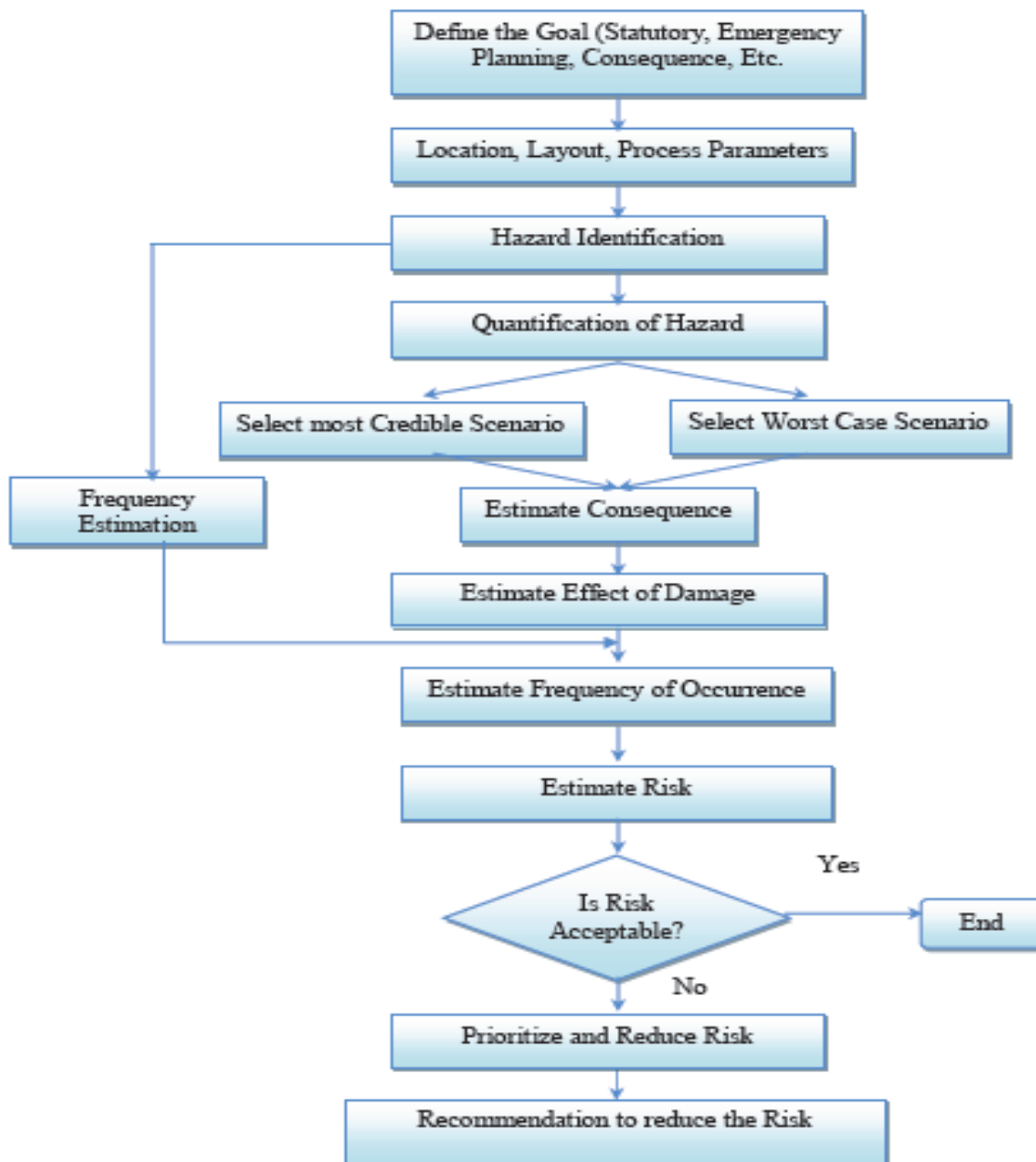
3. **SOFTWARE USED**

In the risk analysis study, probable damages due to worst case scenarios were quantified and consequences were analyzed with object of emergency planning. Various measures taken by the company and findings of the study were considered for deciding acceptability of risks.

Use of ALOHA software for consequence analysis has been done.

ALOHA is an acronym for Areal Locations of Hazardous Atmospheres.

ALOHA is the hazard modeling software program for the CAMEO software suite, which is used widely to plan for and respond to chemical/hazardous materials emergencies. Details about a real or potential chemical/hazardous materials release can be entered into ALOHA and it will generate threat zone estimates for various types of hazards. ALOHA can model toxic gas clouds, flammable gas clouds, BLEVEs (Boiling Liquid Expanding Vapor Explosions), jet fires, pool fires and vapor cloud explosions. The threat zone estimates are shown on a grid in ALOHA and they can also be plotted on maps in MARPLOT, ESRI'S Arc Map, Google Earth and Google Maps. The red threat zone represents the worst hazard level; the orange and yellow threat zones represent areas of decreasing hazards.



4. IDENTIFICATION OF HAZARDS AND RELEASE SCENARIOS

Containment is defined as one or several devices; any parts which are permanently in open contact with one another, and which are intended to contain one or multiple substances. A Loss of Containment is one containment system that will not lead to the release of

significant quantities of hazardous substance from other containment systems. The following data were collected to envisage scenarios:

- Composition of materials flowing through equipment (tanks);
- Equipment conditions (phase, temperature, pressure);

Accidental release of flammable liquids/gases can result in severe consequences. Delayed ignition of flammable gases can result in blast overpressures covering large areas. This may lead to extensive loss of life and property. In contrast, fires have localized consequences. Fires can be put out or contained in most cases; there are few mitigating actions one can take once a flammable gas or a vapor cloud gets released. Major accident hazards arise, therefore, consequent upon the release of flammable gases.

5. CONSEQUENCE CALCULATIONS

In consequence, analysis, use is made of a number of calculation models to estimate the physical effects of an accident (spill of hazardous material) and to predict the damage (lethality, injury, material destruction) of the effects.

Accidental release of flammable liquids can result in severe consequences. Immediate ignition of the pressurized chemical will result in a jet flame. Delayed ignition of flammable vapors can result in blast overpressures covering large areas.

The calculations can roughly be divided in three major groups:

- a. Determination of the source strength parameters;
- b. Determination of the consequential effects;
- c. Determination of the damage or damage distances.

6. SOURCE STRENGTH PARAMETERS

1. Calculation of the outflow of liquid vapors out of a vessel/tank or a pipe, in case of rupture. In addition, two-phase outflow can be calculated.
2. Calculation, in case of liquid outflow, of the instantaneous flash evaporation and of the dimensions of the remaining liquid pool.
3. Calculation of the evaporation rate, as a function of volatility of the material, pool dimensions and wind velocity.
4. Source strength equals pump capacities, etc. in some cases.

7. CONSEQUENTIAL EFFECTS

- Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.
- Intensity of heat radiation [in kW/ m²] due to a fire, as a function of the distance to the source.
- Energy of vapor cloud explosions [in bar], as a function of the distance to the distance of the exploding cloud.
- Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.

8. SELECTION OF DAMAGE CRITERIA

The damage criteria give the relation between the extents of the physical effects (exposure) and the effect of consequences. For assessing, the effects on human beings consequences

are expressed in terms of injuries and the effects on equipment / property in terms of monetary loss. The effect of consequences for explosion or fire can be categorized as:

- Damage caused by heat radiation on material and people
- Damage caused by explosion on structure and people

In consequence, analysis studies, in principle three types of exposure to hazardous effects are distinguished:

- Heat radiation due to fires - in this study, the concern is that of Jet fires and pool fires
- Explosions
- Toxic effects, from toxic materials.

The knowledge about these relations depends strongly on the nature of the exposure. Following are the criteria selected for damage estimation:

a) Heat Radiation

The effect of fire on a human being is in the form of burns. There are three categories of burn such as first degree, second degree and third-degree burns. The consequences caused by exposure to heat radiation are a function of:

- The radiation energy onto the human body [kW/m²];
- The exposure duration [sec];
- The protection of the skin tissue (clothed or naked body).

The limits for 1% of the exposed people to be killed due to heat radiation, and for second degree burns are given in the table below:

Table: Damages to human life due to heat radiation

Exposure Duration	Radiation energy (1% lethality), kW/m ²	Radiation energy (2 nd degree burns), kW/m ²	Radiation energy (1 st degree burns), kW/m ²
10 sec	21.2	16	12.5
20 sec	9.3	7.0	4.0

Table: Effects due to incident radiation intensity

Incident Radiation(kW/m ²)	Type of Damage
0.7	Equivalent to Solar Radiation
4.0	Sufficient to cause pain within 20 sec. Blistering of skin (first degree burns are likely)
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.
37.5	Heavy Damage to process equipments

Reference: CCPS, Guidelines for Chemical Process Quantitative Risk Analysis

The actual results would be less severe due to the various assumptions made in the models arising out of the flame geometry, emissivity, angle of incidence, view factor and others. The radiation output of the flame would be dependent upon the fire size, extent of mixing with air and the flame temperature.

As per the guidelines of CPR 18 E Purple Book:

- The lethality of a jet fire and pool fire is assumed to be 100% for the people who are caught in the flame. Outside the flame area, the lethality depends on the heat radiation distances.

Proposed Establishment of Grain Based Ethanol Distillery capacity 100 KLPD with 2.5 MW co-generation power plant at Village – Nayagaon Kushahar, Khijirpura, Tehsil – Kesaria, District - East Champaran, Bihar, Pin - 845424 , India	M/s Tirhut Udhog Pvt Ltd
	Risk Assessment

- ✚ For the flash fires lethality is taken as 100% for all the people caught outdoors and for 10% who are indoors within the flammable cloud. No fatality has been assumed outside the flash fire area.
- ✚ Overpressure more than 0.3 bar corresponds approximately with 50% lethality.
- ✚ An overpressure above 0.2 bar would result in 10% fatalities.
- ✚ An overpressure less than 0.1 bar would not cause any fatalities to the public.
- ✚ 100% lethality is assumed for all people who are present within the cloud proper.

Table: Damage due to overpressures

PeakOverpressure	Damage Type	Description
0.30 bar	Heavy Damage	Major damage to plant equipment structure
0.10 bar	Slight Damage	Repairable damage to plant equipment and structure
0.03 bar	Significant Damage	Shattering of glass

Table: Proposed Ethanol Inventory at Site

S.No.	Name of hazardous materials & location	Nature of hazard	Size	No. of tanks	MOC	Capacity of storage (m ³)
1.	Ethanol Google coordinates: 26°22'38.73"N; 84°49'40.51"E	Fire & Explosion	Dia.: 10.7 m Height: 11.25 m	2	MS	1011
2.	HSD Google coordinates:26°22'34.00"N; 84°49'42.44"E	Fire & Explosion	Dia.: 0.8 m Height: 1.2 m	1	MS	0.8

1. ETHANOL

Table: Detail of storage of chemicals

Weather Data: (during baseline)	
Average wind speed; blowing from	4.8 m/h; W
Average Ambient Temperature	25 deg. C
Relative Humidity	50%
Ground Roughness	Open Country
Cloud Cover	5 tenths
Stability Class	C
SITE DATA:	
Location:	Kesaria, East Champaran, Bihar
Building Air Exchanges Per Hour	0.41 (sheltered single storied)

CHEMICAL DATA:

Chemical Name:	ETHANOL
CAS Number:	64-17-5
Molecular Weight:	46.07 g/mol
Ambient Boiling Point:	172.5° F
Vapor Pressure at Ambient Temperature:	0.78 m

Scenario: Tank containing an unpressurized flammable liquid

Type of tank failure:

- a. Leaking tank, chemical is not burning and forms an evaporating puddle

Type of Tank Failure

Scenario:
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

☒ Leaking tank, chemical is not burning and forms an evaporating puddle

☐ Leaking tank, chemical is burning and forms a pool fire

☐ BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from flammable chemical which is not burning as it leaks from tank:

- Downwind toxic effects
- Vapor cloud flash fire
- Overpressure (blast force) from vapor cloud explosion

OK Cancel Help

Hazards to analyse:1. Toxic area of vapour cloud

Hazard To Analyze

Scenario:
Flammable chemical escaping from tank.
Chemical is NOT on fire.

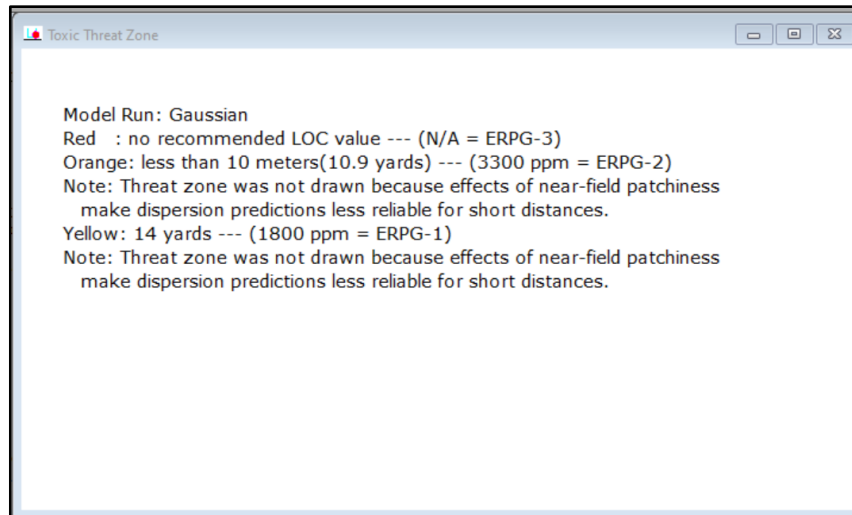
Choose Hazard to Analyze:

☒ Toxic Area of Vapor Cloud

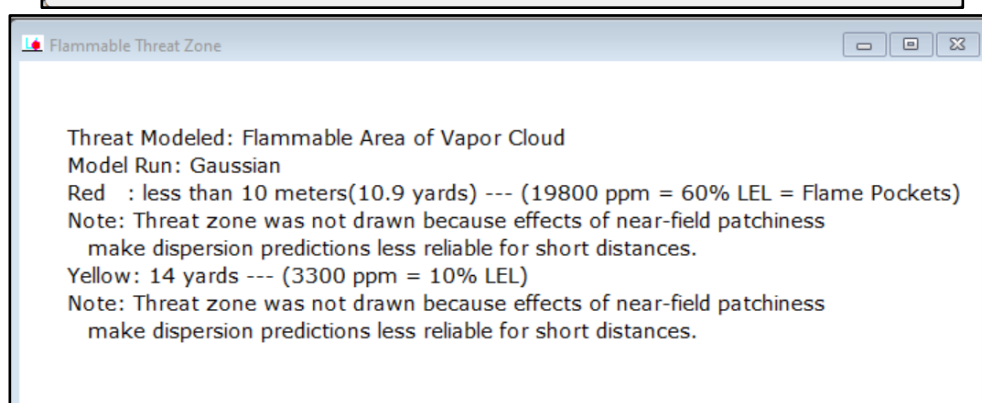
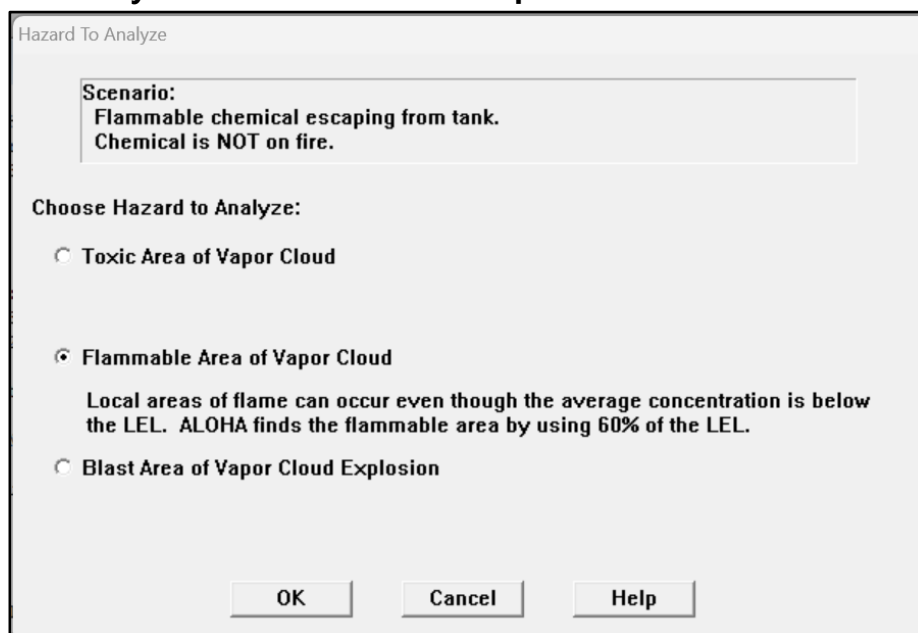
☐ Flammable Area of Vapor Cloud

☐ Blast Area of Vapor Cloud Explosion

OK Cancel Help



Hazards to analyse:2. Flammable area of vapour cloud



Hazards to analyse:3. Blast area of vapour cloud explosion

The image shows two screenshots from a risk assessment software. The top screenshot is a dialog box titled "Hazard To Analyze". It contains a text box for the scenario: "Flammable chemical escaping from tank. Chemical is NOT on fire." Below this, there are three radio buttons under the heading "Choose Hazard to Analyze:". The first is "Toxic Area of Vapor Cloud", the second is "Flammable Area of Vapor Cloud", and the third, which is selected, is "Blast Area of Vapor Cloud Explosion". At the bottom are "OK", "Cancel", and "Help" buttons. The bottom screenshot is a window titled "Overpressure (Blast Force) Threat Zone". It displays the following text: "Threat Modeled: Overpressure (blast force) from vapor cloud explosion", "Type of Ignition: ignited by spark or flame", "Level of Congestion: congested", "Model Run: Gaussian", and "No explosion: no part of the cloud is above the LEL at any time".

Hazard To Analyze

Scenario:
Flammable chemical escaping from tank.
Chemical is NOT on fire.

Choose Hazard to Analyze:

☐ Toxic Area of Vapor Cloud

☐ Flammable Area of Vapor Cloud

☒ Blast Area of Vapor Cloud Explosion

OK Cancel Help

Overpressure (Blast Force) Threat Zone

Threat Modeled: Overpressure (blast force) from vapor cloud explosion
Type of Ignition: ignited by spark or flame
Level of Congestion: congested
Model Run: Gaussian
No explosion: no part of the cloud is above the LEL at any time

Type of tank failure:

b. Leaking tank, chemical is burning and forms a pool fire

The image shows a screenshot of a dialog box titled "Type of Tank Failure". It contains a text box for the scenario: "Tank containing an unpressurized flammable liquid." Below this, there are three radio buttons under the heading "Type of Tank Failure:". The first is "Leaking tank, chemical is not burning and forms an evaporating puddle", the second, which is selected, is "Leaking tank, chemical is burning and forms a pool fire", and the third is "BLEVE, tank explodes and chemical burns in a fireball". Below the radio buttons is a text box for "Potential hazards from chemical which is burning as it leaks from tank:". It contains three bullet points: "- Thermal radiation from pool fire", "- BLEVE (if heat raises the internal tank temperature and causes the tank to fail)", and "- Downwind toxic effects of fire byproducts (cannot be modeled by ALOHA)". At the bottom are "OK", "Cancel", and "Help" buttons.

Type of Tank Failure

Scenario:
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

☐ Leaking tank, chemical is not burning and forms an evaporating puddle

☒ Leaking tank, chemical is burning and forms a pool fire

☐ BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from chemical which is burning as it leaks from tank:

- Thermal radiation from pool fire
- BLEVE
(if heat raises the internal tank temperature and causes the tank to fail)
- Downwind toxic effects of fire byproducts
(cannot be modeled by ALOHA)

OK Cancel Help

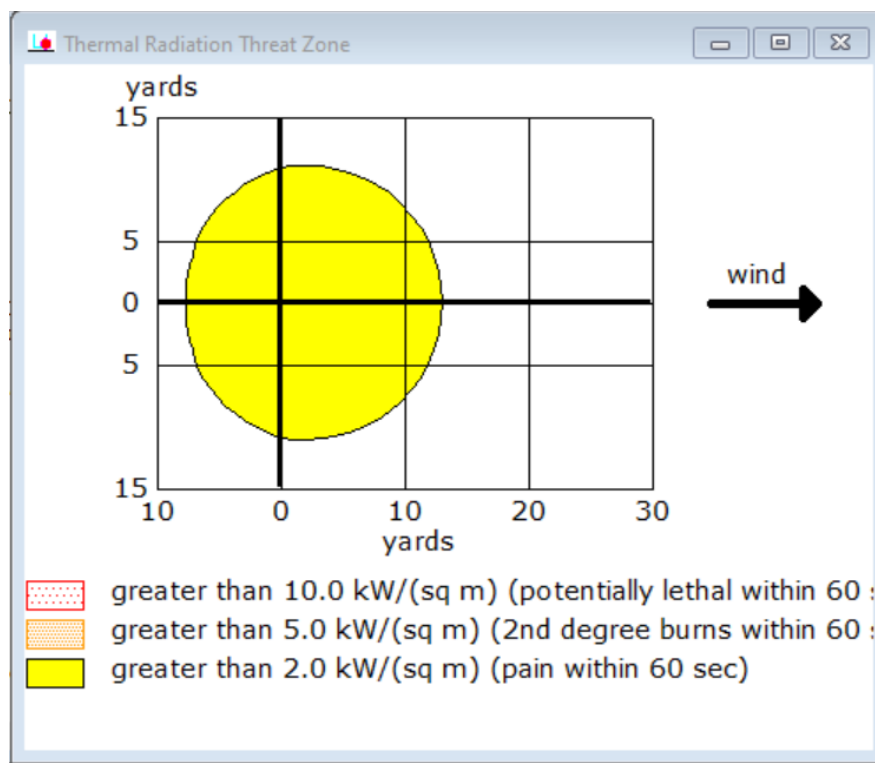


Fig.: Pool fire threat zone

THREAT ZONE:

Yellow: 13 yards --- (2.0 kW/(sq m) = pain within 60 sec)

Type of tank failure:

- c. BLEVE, tank explodes and chemical burns in a fireball

Type of Tank Failure

Scenario:
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

☐ Leaking tank, chemical is not burning and forms an evaporating puddle

☐ Leaking tank, chemical is burning and forms a pool fire

☒ BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from BLEVE:

- Thermal radiation from fireball and pool fire
- Hazardous fragments and blast force from explosion [cannot be modeled by ALOHA]
- Downwind toxic effects of fire byproducts [cannot be modeled by ALOHA]

OK Cancel Help

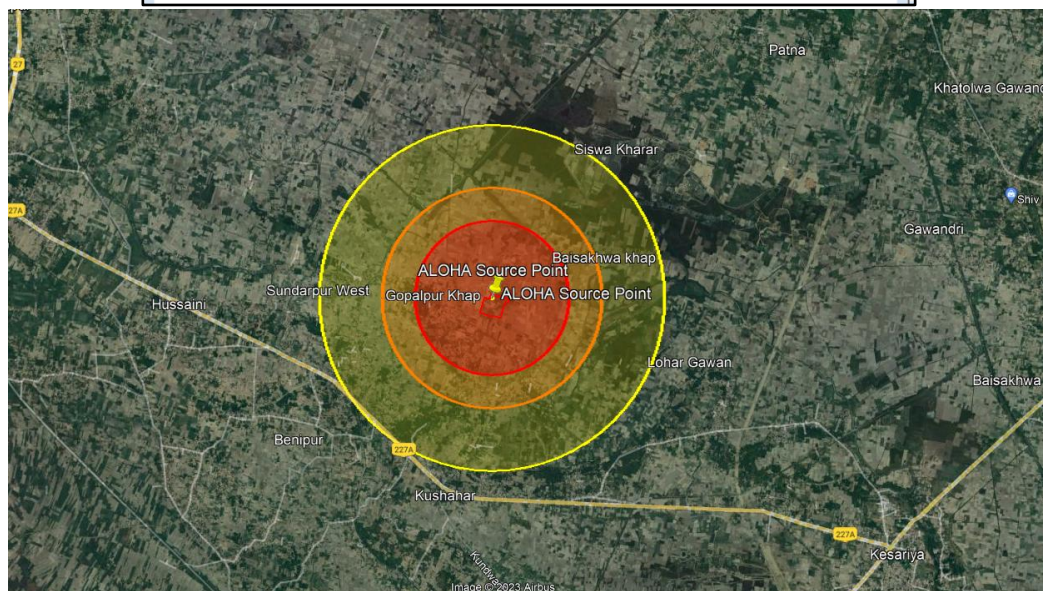
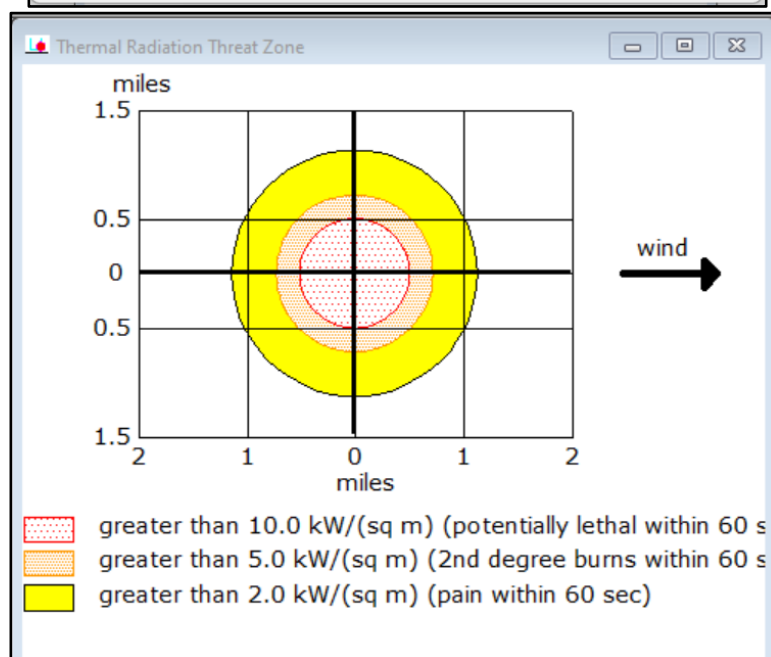


Fig.: BLEVE threat zone

THREAT ZONE:

- Red: 894 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
- Orange: 1279 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
- Yellow: 1.1 miles --- (2.0 kW/(sq m) = pain within 60 sec)

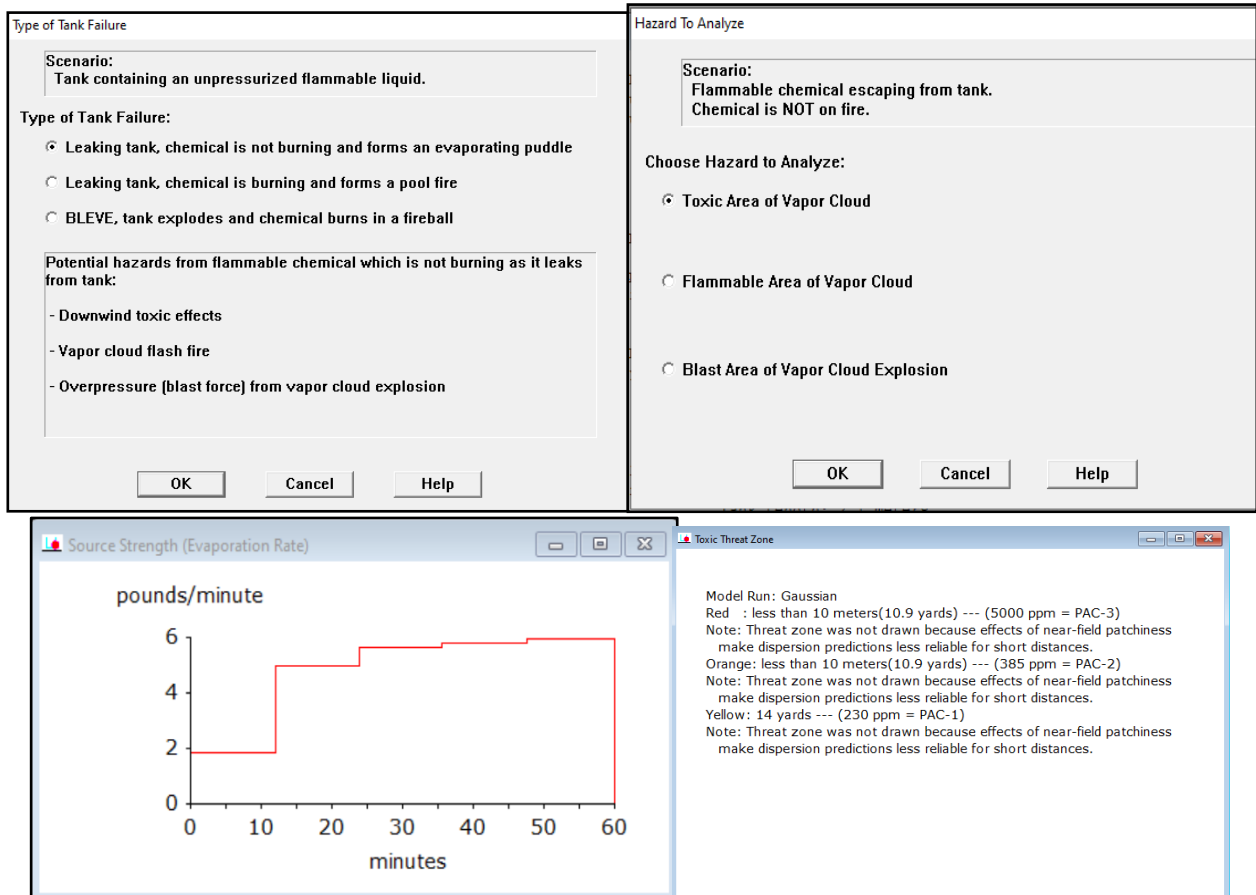
2. HIGH SPEED DIESEL

CHEMICAL DATA:	
Chemical Name:	HSD (N-Octane)
CAS Number:	111-65-9
Molecular Weight:	114.23 g/mol
Ambient Boiling Point:	257.6° F
Vapor Pressure at Ambient Temperature:	0.018 atm

Scenario: Tank containing an unpressurized flammable liquid

Type of tank failure:

1. Leaking tank, chemical is not burning and forms an evaporating puddle



2. Leaking tank, chemical is burning and forms a pool fire

Type of Tank Failure

Scenario:
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

☐ Leaking tank, chemical is not burning and forms an evaporating puddle

☒ Leaking tank, chemical is burning and forms a pool fire

☐ BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from chemical which is burning as it leaks from tank:

- Thermal radiation from pool fire
- BLEVE (if heat raises the internal tank temperature and causes the tank to fail)
- Downwind toxic effects of fire byproducts (cannot be modeled by ALOHA)

OK Cancel Help

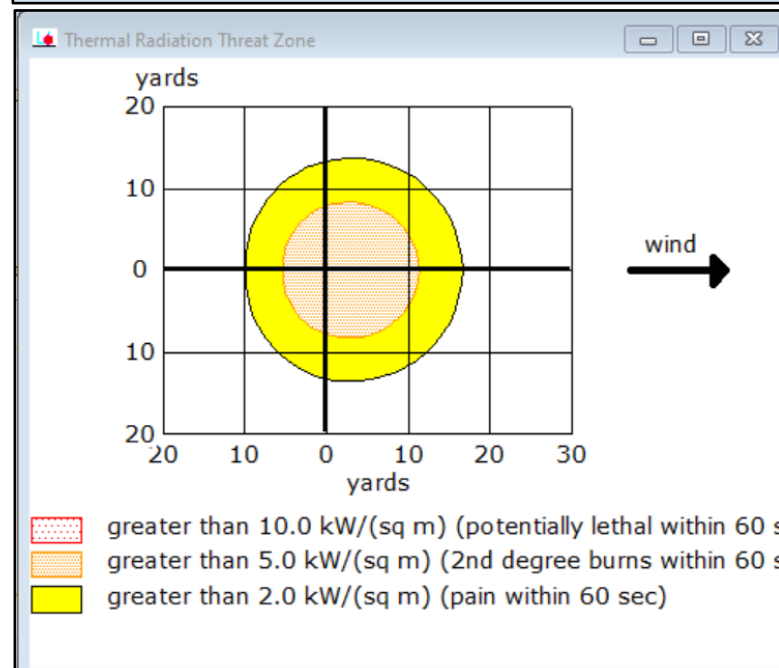
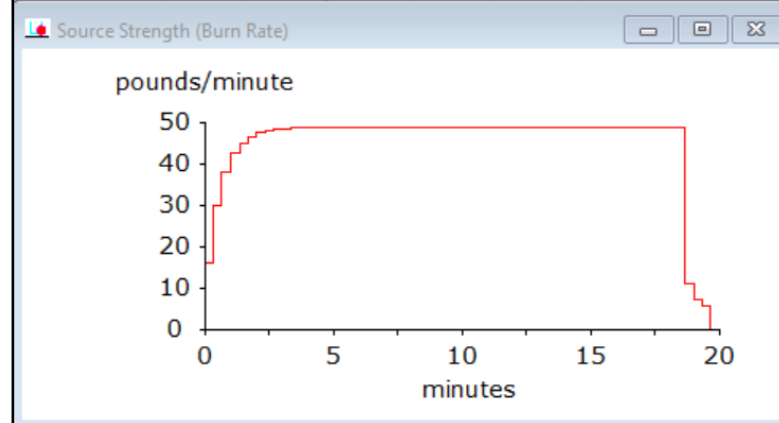




Fig.: Pool fire threat zone

THREAT ZONE:

- Red: less than 10 meters (10.9 yards) --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
- Orange: 12 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
- Yellow: 17 yards --- (2.0 kW/(sq m) = pain within 60 sec)

Type of tank failure: 3. BLEVE, tank explodes and chemical burns in a fireball

Type of Tank Failure

Scenario:
Tank containing an unpressurized flammable liquid.

Type of Tank Failure:

- ☐ Leaking tank, chemical is not burning and forms an evaporating puddle
- ☐ Leaking tank, chemical is burning and forms a pool fire
- ☒ BLEVE, tank explodes and chemical burns in a fireball

Potential hazards from BLEVE:

- Thermal radiation from fireball and pool fire
- Hazardous fragments and blast force from explosion
[cannot be modeled by ALOHA]
- Downwind toxic effects of fire byproducts
[cannot be modeled by ALOHA]

OK Cancel Help

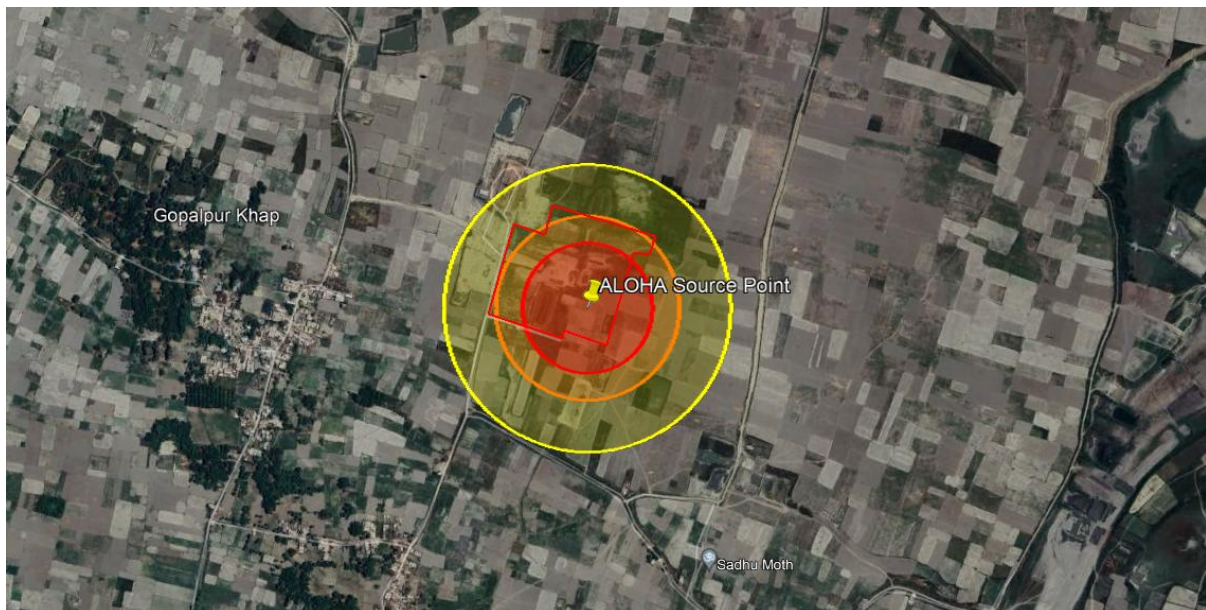
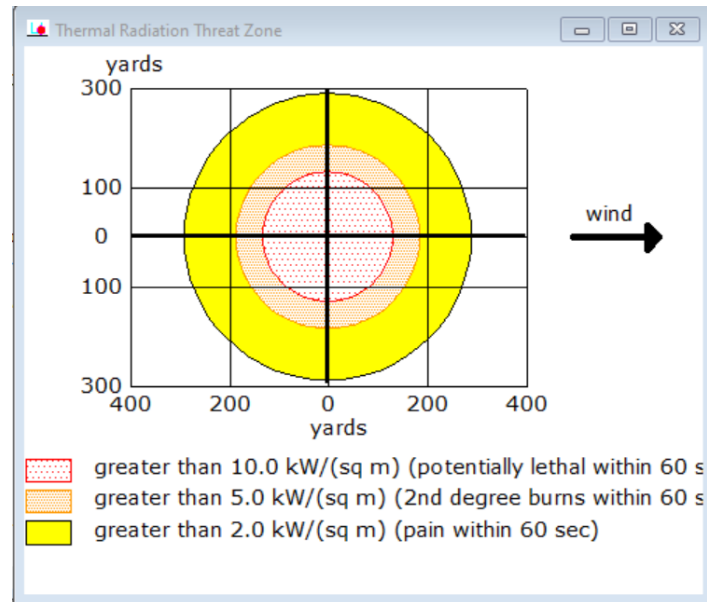


Fig.: BLEVE threat zone

THREAT

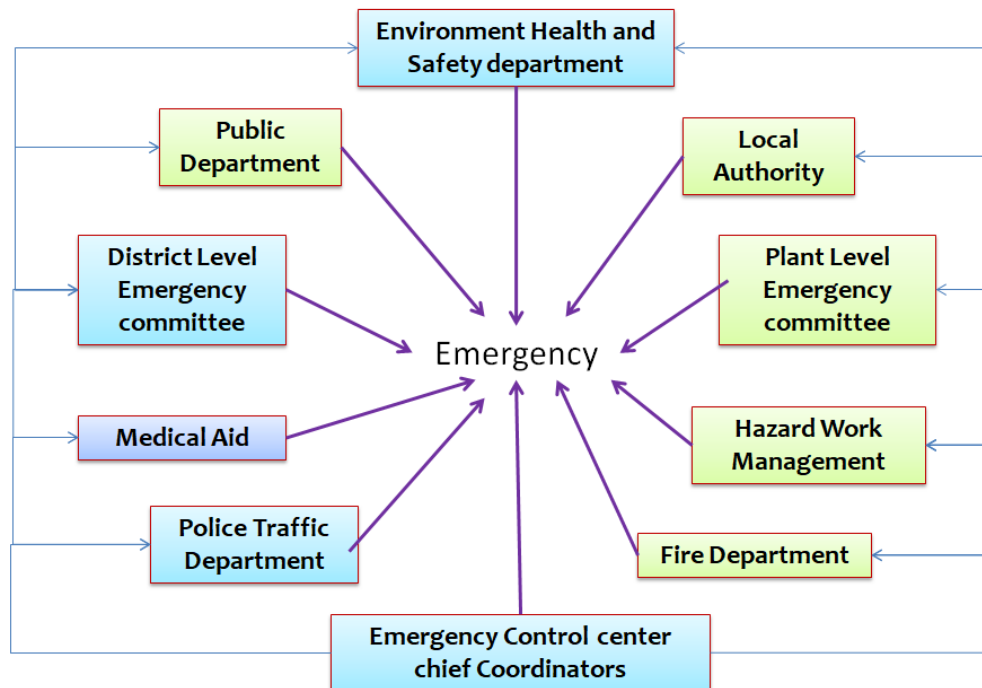
- Red : 131 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
- Orange: 185 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
- Yellow: 289 yards --- (2.0 kW/(sq m) = pain within 60 sec)

ZONE:

1.3 OFF SITE EMERGENCY PLAN

Off site emergency plan is based on those accidents/mishaps identified by the works management, which could affect people and the environment outside the plant site. The roles of the various parties that may be involved in the implementation of an off-site plan are described below. The responsibilities for the off-site plan will be likely to rest either with the management of industry or with the local Government authority. Table below shows communication nos. during offsite emergency. Consideration of evacuation in case of emergency may include the following factors:

- If fire hazard occurs but without explosion risk (e.g. an oil storage tank), only houses close to the fire area need evacuation
- In case fire is escalating very fast it is necessary to evacuate people nearby
- In case of acute emergency people are advised to stay indoors and shield themselves from the fire



Organization

The organizations which may be involved, predefined warning systems, defined implementation procedures, emergency control centers include name and appointments of all personnel having prior responsibilities.

Communications

Identification of personnel involved during emergency situations, communication center, call signs, network, list of telephone numbers.

Special Emergency Equipment in case of offsite emergency

Details of availability and location of special emergency equipment like heavy lifting gear, specified firefighting equipment, fireboats etc.

Voluntary Organizations

Chief authorities shall have telephone numbers, contact numbers of all organizations concerned in case of emergency.

Non-governmental organizations (NGO)

NGO's shall be involved to provide valuable source of expertise in specific fields and information to support emergency response efforts. NGOs shall be performing tasks required during emergency.

- Evacuation of personnel from the affected area
- Arrangements at rallying posts and parking yards
- Rehabilitation of evacuated places

Chemical information

All the Safety Data Sheet of hazardous chemicals shall be made available in case of handling chemical disaster.

Meteorological information

Arrangements shall be made for obtaining details of weather conditions prevailing at or before the time of accident and weather forecast updates.

Humanitarian Arrangements

Transport, evacuation centers, emergency feeding, treatment of injured, first aid, ambulances, temporary mortuaries.

Public Information

- Persons shall be allotted responsibility to deal with the media-press office
- Information shall be conveyed to relatives etc.

Assessment

- Analyzing the accident scenario and collecting information on the causes of the emergency
- Updating and reviewing the efficiency and effectiveness of all aspects of the emergency plan.

Role of local authority

Local Authorities like Panchayat, Sabha, Samiti, municipalities can help in combating emergency situation after assessing the impact scenario in rescue phase.

Role of police

Police force will assist in controlling situation at the accident site, organizing evacuation and removing of any seriously injured people to hospitals. It will also co-ordinate with the transport authorities, civil defense and home guards if required, co-ordination with army, navy, air force and state fire services if accident is major, Establish communication centre with easy contact with ECC.

Role of Fire Brigade

The fire brigade is to be organized to put out fires and provide assistance as required during emergency.

Media

The media will be made available with ready and continuous access to designated officials with relevant information, as well as to other sources in order to provide essential and accurate information to public throughout the emergency and to avoid confusion.

Role of health care authorities

- Prompt ambulance services should be maintained during the emergency
- Hospitals and doctors must be ready to treat all type of injuries to casualties during emergency.

- Co-ordination with Primary Health Centres and medical centres for easy availability of medicines near plant site.
- Temporary mortuary and identification of dead bodies
- Receiving information for no. of casualties and emergency cases to act accordingly.

Procedure for Testing & Updating the Plan

Simulated emergency preparedness exercises and mock fire fighting exercises including mutual aid scheme resources and in conservation with district emergency authority to be carried out time to time.

1.4 OCCUPATIONAL HEALTH AND SAFETY

Occupational health and safety will be categorized broadly into two categories:

1. Protection of Health
2. Promotion of Health

Protection of Health

In an industry, the most important factor for proper running of it is the health of employees which has to be taken care of by following some measures like:

- Proper regular checkup of employees
- Regular training of employees
- 24 hrs First aid and medical availability
- Records maintenance

Promotion of Health

- Training regarding importance of health
- Programs related to health education
- Records maintenance
- Organizing health campaigns

Occupational health centre

The industrial premises will have one occupational health centre for regular check-up of employees and to deal in case of emergency. The centre will be equipped with all the emergency facilities and a qualified doctor as well as staff for auxiliary works.

Plan and Fund allocation for Occupational and Safety Hazards

M/s Tirhut Udhog Pvt Ltd will be allocating a fund of Rs. 10.0 lakhs/annum for occupational and safety measures inside the plant premises.

S. No.	Description	Amount (Rs. In Lakh per annum)
1	Doctor's Retainer Fee (including staff)	2.5
2	Medicine Expenses	3.5
3	Health Check-up Exp	2.0
4	Ambulance Expenditure	2.0
	Total Amount in (Rs.)	10.0

Occupational Hazards & Their Mitigation Measures during Ethanol Plant Operations

S. No	Hazards	Permissible exposure		Impact	Mitigation measure
		ppm	mg/m ³		
1	Sodium hydroxide (Caustic)	2 mg/m ³	--	Caustic soda can cause burns	• Proper PPEs to be provided to workers. • Handling in accordance with good industrial hygiene and safety practice • Avoid contact with water. Direct contact with water may cause an exothermic reaction
2	Carbon dioxide	5000	9000	Headaches, dizziness, restlessness, a tingling or pins or needles feeling, difficulty breathing, sweating, tiredness, increased heart rate, elevated blood pressure, coma, asphyxia, and convulsions	• Carbon dioxide will be collected and sold to vendors. • Proper monitoring and maintenance of fermentation equipment. • Proper PPEs to be provided to workers exposed to the zone. • Regular checking of pipes and bolts for avoiding any fugitive emissions. • Proper CO2 monitors to be provided
3	Ethyl alcohol	1000	1900	Alcohol storage tank bursting or leakage can cause fire or explosion hazards	• Proper flow meter to check the flow of alcohol in storage tanks. • Proper training to employees to act in case of alcohol leakage. • Proper fire extinguishers adequate for the fire that can happen in Ethanol Plant i.e. foam type. • All personal contact, including inhalation should be avoided. • Appropriate natural ventilation should be provided. • Proper fire hydrant network will be spread in all the areas prone to fire hazard. • Fire sensors and alarms. • PESO guidelines to be strictly followed
4	Dust exposure	--		Sudden dust cloud can affect the respiratory tract and interfere with	• Proper dust mask for persons handling grains/biomass • Regular water sprinkling to avoid dust dispersion.

S. No	Hazards	Permissible exposure		Impact	Mitigation measure
		ppm	mg/m ³		
				breathing. Cause pneumoconiosis Some particles dissolve in the bloodstream. The blood then carries the substance around the body where it may affect the brain, kidneys and other organs	- Storage of grains/biomass in covered sheds and continuous water sprinkling. - Proper greenbelt will be developed in all the areas having the probability of dust explosions.
5	Noise Exposure	75 dB(A) during day time And 70dB(A) during night time		Elevated workplace or environmental noise can cause hearing impairment, hypertension, ischemic heart disease, annoyance, and sleep disturbance.	- Proper PPEs to be provided like ear muffs and ear plugs - Alternation of duties. - Regular audiometry check-up. - Proper maintenance, oiling & greasing of machines to detect any loosened nuts, bolts
6	Heat exposure	--		Prolonged or intense exposure to hot temperatures can cause heat-related illnesses such as heat exhaustion, heat cramps, and heat stroke	- Alternation of duties. - Proper PPEs to the workers
7	Electro caution	--		Electric shock, brain damage	- Proper earthing of instruments. - Doubly insulated instruments/machineries. - Proper PPEs like rubber gum boots to be provided.
8	Physical	--		Fall, slip trip, physical injuries	- Proper PPEs for workers operating at heights like safety helmets, fall protection etc. - Proper first aid facilities at all danger prone areas

Source: National Institute of Occupational Safety and Health document

1.5 OCCUPATIONAL HEALTH SURVEILLANCE

In ethanol plant, the occupational health surveillance of the employee will be done on a regular basis and record of the same will be maintained as per the Factories Act.

Pre placement and periodical health check-up tests to be undertaken. The check-ups will be dependent on age, sex, duration of exposure and department wise. Following tests will be done regularly:

Health Checkup Parameters

1. Physical Fitness Certificate
2. Pulse Rate
3. Blood Pressure
4. Complete Blood Examination Haemoglobin% (Hb%), WBC, RBC, etc.
5. Vision
6. Central Nervous System (CNS)
7. Respiratory System-Lung Function (RS)
8. Cardio Vascular System (CVS)
9. Electro Cardio Gram (ECG)
10. Chest X-ray
11. Total Leucocyte Count (TC)
12. Differential Leucocyte Count (DLC)
13. Absolute Eosinophil Count (AEC)
14. Complete Urine Examination [Physical / Chemical /Albumin, Sugar & Bile Salt
15. Random blood Sugar (RBS)

Frequency of Medical Examination

- Once in a year

Personal Protective Devices and Measures

- Industrial Safety helmets, Crash helmets
- Goggles
- Safety Shoes & Rubber Gumboots
- Aprons
- Ear muffs and Ear Plugs
- Full body Safety harness
- Leather hand gloves, Heat Resistive hand gloves, Chemical hand gloves and Cut resistance hand gloves
- Safety belt / line man's safety belt

