proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

Report of Functional Area Expert

On"Risk Assessment

&

Hazard Management"

(RH)

Study Period:Jan to March 2015

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

INTRODUCTION

1.1 Project Proponent:M/s Starlight Energy Ltd.

Name of the Project:proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit

Location: Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha.

SCOPE OF WORK AS PER TERMS OF REFERENCE (ToR) LETTER

ToR Point no.:

7 (XIII) Onsite and Offsite Disaster (natural and Man-made) Preparedness and EmergencyManagement Plan including Risk Assessment and damage control. Disaster managementplan should be linked with District Disaster Management Plan.

8. Occupational health

i. Plan and fund allocation to ensure the occupational health & safety of all contract and casualworkers

ii. Details of exposure specific health status evaluation of worker. If the workers' health is beingevaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far& Near vision, colour vision and any other ocular defect) ECG, during pre placement andperiodical examinations give the details of the same. Details regarding last month analysed data of above mentioned parameters as per age, sex, duration of exposure and departmentwise.

iii. Details of existing Occupational & Safety Hazards. What are the exposure levels of hazardsand whether they are within Permissible Exposure level (PEL). If these are not within PEL,what measures the company has adopted to keep them within PEL so that health of the workerscan be preserved,

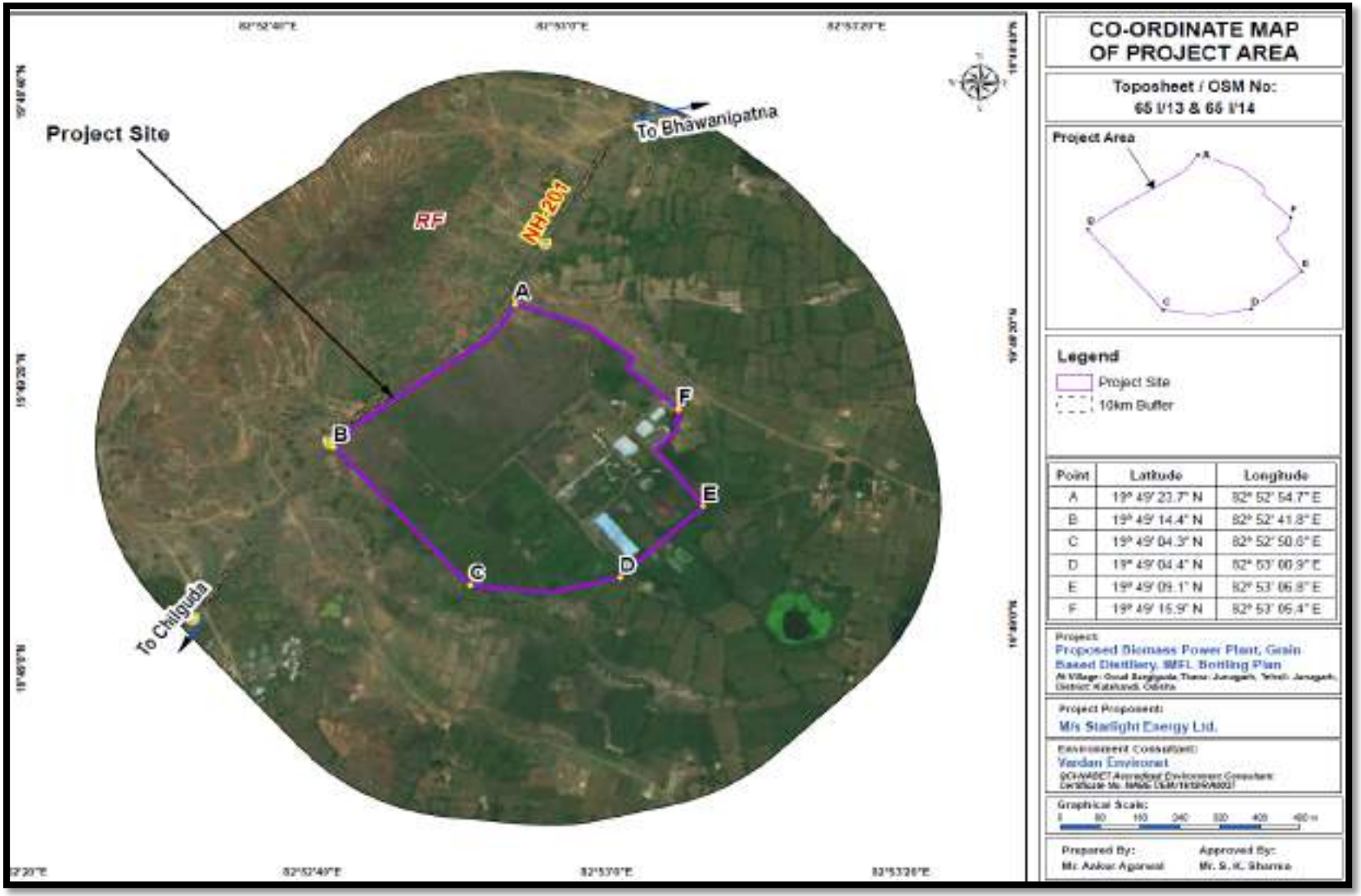
proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

1.0 Project Description

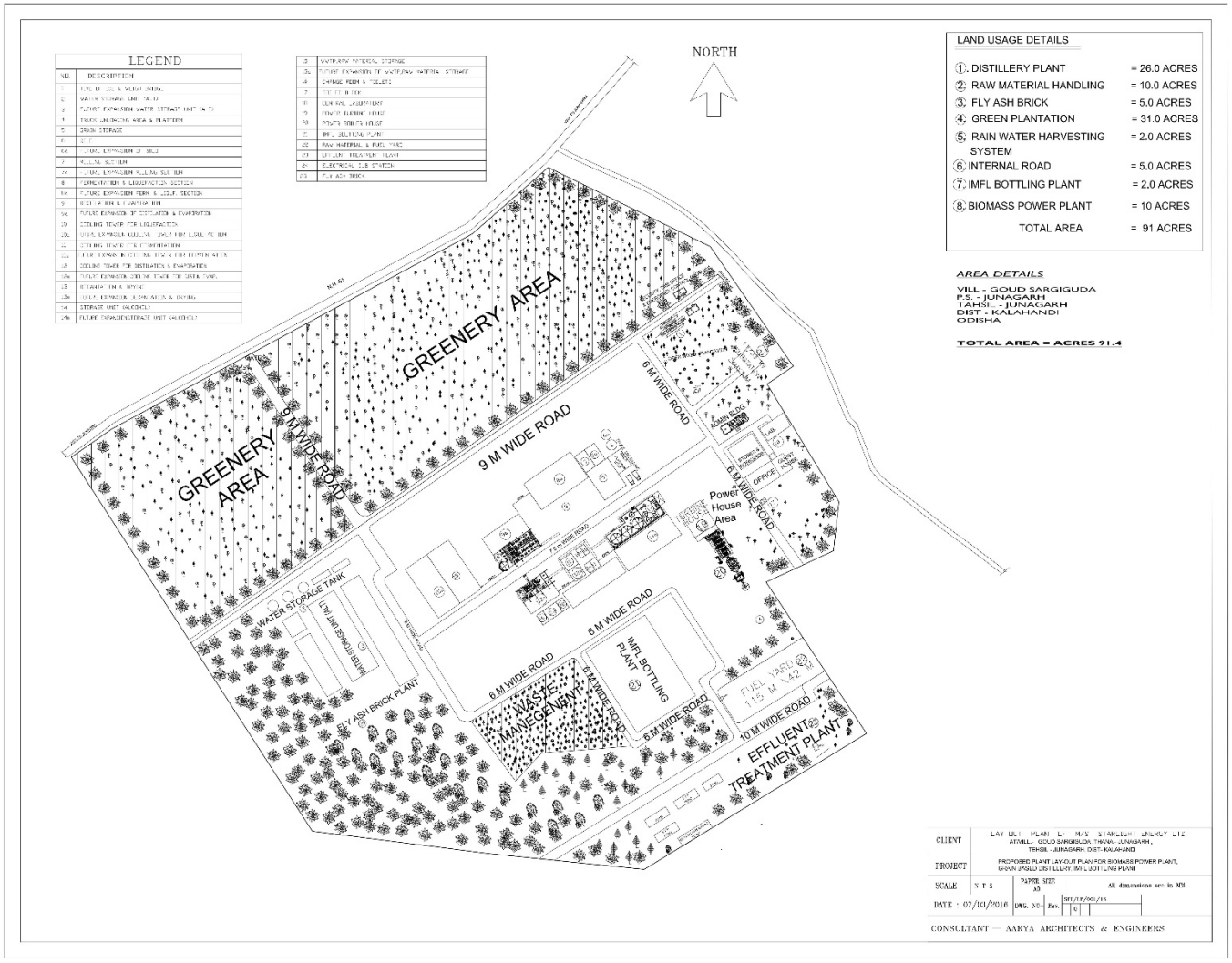
1.1 Type of Project

M/s Starlight Energy Ltd. are planning to set up grain-based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plant and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha. The company would be installing the project in two phases. In phase 1, 45 KLPD capacity grain-based distillery unit, 3.0 MW cogeneration power plants and 8000 cases/day of IMFL/IMIL bottling unit would be installed. After the commissioning of the phase I, the company would start the installation of the identical similar unit in phase 2. Proposed distillery is grain based and will work for 330 days/annum.

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha



proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha



proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

1.2 **TECHNOLOGY AND PROCESS DESCRIPTION** The grain-based distillery process will have following steps/operations. Similar process steps would be followed in both the phases. Accordingly, common process steps/operations for both the phases of the distillery project are described below;

A. Grains receiving and storage
B. Grains handling and milling
C. Slurry preparation/liquefaction
D. Saccharification and instantaneous fermentation
E. HIFERM Fermentation
F. Multi-pressure distillation
G. Decantation
H. Multi-effect evaporation
I. Spirit storage

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

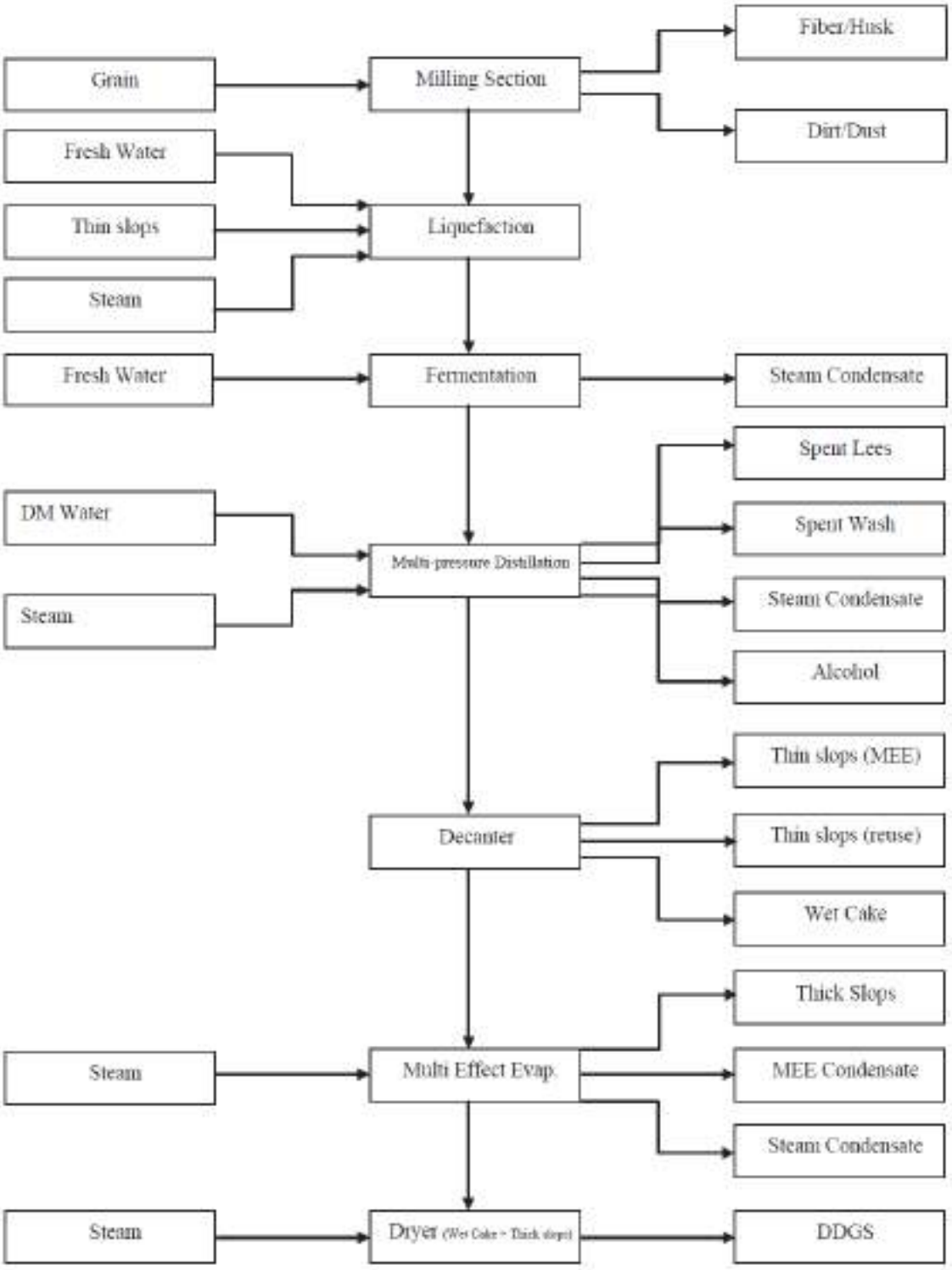


Fig No-1.3 Process flow diagram

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

1.2 Process Description

Grain receiving and storage

Grains such as broken rice/rotten rice, rotten wheat and other edible grains are procured from various sources, and are stored in gunny bags in covered storage godowns. Grains may also be stored into silos.

Grain handling and milling

The grain would be lifted in bucket elevators, screened followed by removal of stones and iron matter. Cleaned grains would then be milled using dry milling process in hammer mills. The flour would be fed through the bucket elevators and conveyed to the batch tipping machine through a screw conveyor. The flour addition would be metered through the batch tipping machine with load cell arrangement, before transferring the flour to the slurry tank through another screw conveyor (pre-masher) for slurry preparation process.

Slurry preparation/liquefaction

In liquefaction process, starch is hydrolyzed to dextrin. The Liquefaction is carried out in Single stage Liquefaction Tank. Feedstock Flour is transferred to Premasher and mixed with Recycle Streams and liquefying enzyme. Slurry from Premasher is taken to Liquefaction tank where temperature is maintained by means of steam. Necessary retention time is maintained in the Liquefaction Tank. Slurry pH is maintained by supplying dilute caustic solution. Contents in Slurry Tank are kept in suspension by Agitation. The Liquefied Slurry is then cooled in Slurry Cooler using cooling water supply and transferred to Pre-fermentation and Fermentation section.

Saccharification and instantaneous fermentation

Yeast seed material is prepared in Prefermentor by inoculating sterilized mash with yeast. Optimum temperature is maintained by circulating cooling water. The contents of the Prefermentor are then transferred to Fermenter.

The purpose of Fermentation is to convert the fermentable substrate into alcohol. To prepare the mash for Fermentation, it is diluted with water. Yeast is added in sufficient quantity to complete Fermentation to produce alcohol.

At the start of the cycle, the Fermenter is charged with mash and contents of the Prefermentor. Significant heat release takes place during Fermentation. This is removed by passing the mash through heat exchangers to maintain an optimum temperature. The recirculating pumps also serve to empty the Fermenters into Beer Well. CO2 can then be taken to CO2 vent line where it is vented out. After emptying of Fermenter, it is cleaned with CIP using cleaning nozzles.

After CIP, Fermenter is ready for next batch to be filled.

HIFERM Fermentation

The Fermentation process is engineered to operate in batch mode depending upon the quality of raw material. The purpose of Fermentation is to convert the fermentable sugars into alcohol. During Fermentation, sugars are broken down into alcohol and Carbon-dioxide. Significant heat release takes place during Fermentation. The fermenter temperature is maintained at around 30 – 32^{o}C by forced recirculation flow through plate heat exchangers. We have given a provision for spent wash recycled to Fermentation depending on solids concentration in fermented wash.

ECOFINE – MPR WE Multi-Pressure Distillation

Multi-Pressure Distillation system has Seven Distillation columns operating at various pressure conditions. Heat energy from columns operating under high pressure is utilized for columns operating under low pressure to optimize the operation for energy consumption.

Wash to ENA Mode:

Following Columns will be under operation:

1. Analyser Column
2. Degasser Column
3. Pre-Rectifier Column
4. ED Column
5. Rectifier cum Exhaust Column
6. Recovery Column
7. Simmering Column

Pre-heated fermented wash will be fed to Degasser column. Fermented wash is stripped off alcohol by ascending vapors in Analyser column. Rectifier vapors provide energy to Analyser column through a Thermosyphon reboiler. Vapors of Degasser column are condensed and taken to Recovery Feed Tank. The condensed Analyser vapors are taken to Pre-Rectifier Column. Analyser Condensate is concentrated in Pre-Rectifier column, which operates under pressure. Condensing steam provides energy to pre-rectifier column through a vertical Thermosyphon reboiler. A Technical Alcohol cut of about 1-2% of total spirit is taken from the Pre-Rectifier column.

Concentrated alcohol draw from Pre-Rectifier column is fed to ED column for purification. Dilution water in the ratio of 1:9 is added in this column for concentrating higher alcohol at the top. Top of this column is condensed in its condensers and fed to recovery feed tank while bottoms are fed to Rectifier cum Exhaust Column for concentration. Rectifier Column operates under pressure and condensing steam provides energy to this column through a vertical Thermosyphon reboiler. Technical Alcohol cut is taken out from the top of this column while ENA draw is taken out from appropriate upper trays and fed to Simmering

Column after cooling. Fusel Oil build up is avoided by taking fusel oil draws from appropriate trays.

These fusel oils along with the condensate of Degasifying & Extractive Distillation columns are fed to recovery column for concentration. A technical alcohol cut is taken out from the top of this column.

Simmering Column is operated under high reflux for better separation of methanol and di-acetyls. Final ENA product draw is taken from the bottom of this column.

Decantation & Thin Slops Recycle Section

Decantation section comprises of a Centrifuge Decanter for separation of suspended solids from Spent Wash coming out of Grain Distillation Plant. Wet cake has 30-32% w/w solids as removed from bottom of Decanter which can be sold directly in wet form as cattle feed (DWG).

Thin slops coming out of Decanter are collected in a tank and partly recycled into the process & further for Evaporation for concentration upto 35-40% w/w solids. The concentrated thin slops called as Syrup is mixed with Wet cake and sold in wet form as cattle feed (DWGS) or the entire mixture can be dried in a DDGS Dryer and then sold in dry form as Cattle feed (DDGS).

ECOVAP Evaporation System - Integrated Evaporation Scheme

The suggested treatment scheme Effect working on the principle of falling film & Force Circulation

a) Analyzer vapors is fed to the first effect evaporator shell side and steam is fed to shell side finisher at the given pressure and temperature as the heating medium.

b) Vapors from last effect are condensed in Surface Condenser. A Shell & tube type Multi-pass Surface condenser is employed for condensing the shell side vapors.

c) The product at the desired concentration 35-40% is obtained at the outlet of Finisher.

d) Each effect is provided with recirculation cum transfer pump.

e) The condensate from surface condensers is collected in a common condensate pot. The condensate is transferred for further treatment / Recycle by using centrifugal pump.

f) The Pure steam condensate are collected in receiving vessels and can be pumped to desired battery limit

g) Highly efficient operating pumps have been provided for pumping the required fluid.

h) The plant is having high level of automation to get consistent output at required concentration.

i) The system operates under vacuum. Water-ring vacuum pumps are used to maintain a desired vacuum.

j) Cooling water from cooling tower is used in the surface condensers for condensing the vapors.

DWGS Dryer with Cooling and Conveying System

System Description for Dryer

a) Wet distiller's grains shall be fed into the dryer housing at controlled rate through a suitable feeding system. The Rotary Tube Bundle is enclosed in an insulated dryer housing and its outer flights are fixed. Dry saturated steam is to be supplied to the tube bundle through rotary joint at one end & the condensate is discharged through rotary joint mounted on another end.

b) During the course of rotation, these flights pick up the material and shower them on to the tube bundles. The heat transfer is primarily by conduction. The water vapors are exhausted through an Exhaust Blower & passed through a cyclone separator for separating fines.

c) Dry product partially recycled back to Feed conditioner for feed conditioning through Product Screw & Recycle Conveyor.

d) Entire operation of the Dryer is controlled through Control panel.

Spirit storage

Spirit storage would be divided into two sections. One would be daily spirit receiver section and the other would be bulk storage section. The spirit coming out of distillation would be transferred to daily spirit receivers (separated for Ethanol/RS/ENA). Subsequently, after gauging, the spirit would be transferred to respective bulk storage tanks.

B. BOTTLING OF COUNTRY LIQUOR/IMFL

Starlight Energy Pvt. Ltd. are planning to set up 8000 cases per day of bottling plant (8000 cases per day in phase 1 and phase 2, totaling 16000 cases per day after the commissioning of both the phases) for the production of Indian Made Foreign Liquor and country Liquor at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha.

The process would involve mixing of ENA with DM water along with liquor essence blends, caramels, and colours in stainless steel blending tanks. The ratio of spirit to DM water would be controlled by proof requirements in the end product. For example, one case (equivalent to 9 l itres) of IMFL (75% proof) requires 4 litres of spirit and 5 litres of DM water. The blend would be subjected to physical filteration. Subsequently, the blend would be filled in bottles. The bottles would be labeled, packed, and stored for final dispatch. The industry would install 4 bot tling lines in phase 1 and similarly 4 bottling lines in phase 2 would be installed for the production of Indian Made Foreign Liquor and country Liquor.

C. CO-GENERATION POWER PLANT

Starlight Energy Pvt. Ltd. are planning to set up 2 x 3.0 M W biomass based cogeneration power plant (3.0 MW each in phase 1 and phase 2, totaling 6 MW after the commissioning

of both the phases) for the production of power and extraction of steam for distillery process use at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha.

The industry would install 3.0 M W extraction cum condensing turbine for the cogeneration power plant. Once the industry commissions the phase 1 for whole of the project, the promoters of the project would install another 3.0 MW cogeneration power plant of similar configuration.

The cogeneration power plant is divided in three parts, namely;

- Boiler & Auxiliaries
- Turbine & Auxiliaries
- Generator & Auxiliaries

Boiler & Auxiliaries

Boiler: The industry plans to install a 30 TPH capacity fluidized bed boiler (FBC) for the production of 3.0 MW of cogeneration of power with steam. FBC boiler is most suitable technology for the biomass fuel to be used. When air passes upward at low velocities through a mass of finely divided solid particles (such as ash & crushed refractory) the particles are not disturbed. As air flow is gradually increased, the particles become suspended. Further increase in the air flow gives rise to bubble formation and vigorous turbulence. The bed of solid particles has the same

characteristics of the liquid and thus the bed is termed as Fluidized Bed. Combustion of fuel in this bed is termed as Fluidized Bed Combustion (FBC). The boiler would be having other auxiliaries as described below;

Drum: The feed input, separation of steam and water & blow down are all carried through the drum.

Furnace: It is the primary part of boiler where the chemical energy available in the fuel is converted to thermal energy by combustion. It is the designed for efficient & complete combustion.

Super Heater: These are meant for raising the steam temperature above the saturation temperature to a maximum of around 5500 C (due to the metallurgical problem, the percentage of heat to super heater is approx 30%).

De-Super Heater: To control the super heater temperature & always try to maintain the steam temperature constant during variation of load, de-super heater is used.

Draft System: The combustion process in a furnace can take place only when it receives a steady flow of air & has the combustion gases are continuously removed.

Economizer: The economizer absorbs heat from the flue gas mainly as sensible heat to the feed water. By this, the efficiency of boiler is improved.

Water Wall/Evaporator: Where water converted into steam by latent heat addition. Support: All modern boilers are top support units. The hanger rods are designed for the direct tensile stress resulting from the weight of units & the bending stress from the pressure part expansion.

Soot Blower: Deposits result from combustion of husk & relatively smaller extent from oil. Means have to be provided to prevent an accumulation of deposit from chocking the boiler gas passes & to maintain boiler heating surface in a suitably clean condition for effective heat transfer whilst on load. Steam is used for soot blowing.

Air Heater: It is now an essential boiler auxiliary because hot air necessary for rapid & efficient combustion in the furnace & also for the husk & to recover waste heat from the flue gas to increase boiler efficiency.

Primary Fluidizing Air Fan: It is used for fluidizing the bed of fuel and giving the upward movement.

Forced Draft Fan: To take air from atmosphere at ambient temperature to supply essentially the combustion air required, in addition to fluidizing air.

Induced Draft Fan: To evacuate the gases out of the furnace & exhaust through the stack. The ID Fan maintains the negative draft inside the furnace.

Ash Collection: The method used for removal of ash from the flue gas consists of mechanical dust collector & electrostatic precipitator. The mechanical dust collector removes the coarser particles through cyclones. The ESP consists of two sets of electrodes. Wires which are charged at HVDC are called emitting electrodes. The collecting electrodes are in the form of plates, which are at earth potential. The dust particles in the flue gas get charged while coming in contact with the emitting electrodes. The charged particles are attracted to the earthed collecting particles and get discharged and fall down the hopper. Very high efficiency of ash collection upto 99.90% can be achieved in the ESP.

Boiler Feed Pump: It is multistage pump provided for pumping feed water from the deaerator storage tank to economizer of the boiler. Generally two pumps each of 100% capacity are provided.

Boiler Feed Water

The boiler shall be capable of operating with the following feed water quality* requirements;

a) pH : 8.8-9.2
b) Oxygen : 0.005 ppm
c) Hardness : 0
d) Total Iron : 0.01 ppm
e) Total Copper : 0.01 ppm
f) Total Silica : 0.02 ppm

g) Hydrazine : 0.01-0.02 ppm

h) Specific electrical conductivity: 0.5 micro ohms/cm

* At 25°C measured after cation exchanger in the H+ form and after CO2 removal (max.)

Steam Purity

The boiler shall be capable of supplying uninterrupted steam at the MCR rating with following steam purity levels.

a) Total dissolved solids: 0.1 ppm (max)

b) Silica (max): 0.02 ppm

Turbine & Auxiliaries

Turbine: The turbine shall be horizontal, single cylinder, extraction cum condensing design coupled to a generator to generate the rated output of 3.0 MW of electricity with the steam inlet parameters as specified in this specifications. The steam turbine, gear box, main oil pump with its interconnecting piping and its supports shall be assembled and aligned on a single skid and shall be delivered. All the cabling within the skid shall be laid in the metal conduits and shall be fixed to the base frame with respective junction boxes mounted on the skid. Main component & associated system of the turbine are described below;

Casing: It is essentially a pressure vessel, which must be capable of withstanding the working pressure & temperature of the steam. The casing is supported on each end, with provision to permit expansion at one end. The fixed blades (Orifice) are supported in the casing.

Rotor: It supports the moving blade.

Blades: These are the most important component of turbine as these are responsible for the converting heat energy to mechanical.

Gland Sealing System: Glands are used on turbine to prevent or reduce the leakage of steam air between rotating & stationary components which have a pressure difference with the atmosphere. If the cylinder pressure is higher than the atmospheric pressure then there will be a leakage of steam outward (HP sides). If the cylinder is below atmospheric pressure, then there will be leakage of air (LP side). Steam is generally used for sealing of labyrinth glands.

Condensate System: Water Cooled Condenser which minimizes the water requirement by 85%.

Condenser: It is basically a heat exchanger which condenses the exhaust steam from turbine into water (Condensate). It helps maintain negative pressure at the turbine exhaust thus enabling maximum utilization of enthalpy of the steam and thus improving cycle efficiency. An air-cooled condenser shall be provided to reduce the requirement of water.

Condensate Extraction Pump: These are multistage, vertical centrifugal pumps which pump the condensate from the condenser to the deaerator through the water cooled condenser shall be provided.

Air Ejector System: Is needed to continuously remove air & other non-condensable gases from the condenser to maintain vacuum in the condenser. Steam jet air ejectors and vacuum pumps are used for this purpose.

LP Heater: The condensate pumped by the condensate pump is heated in the LP heater by steam extracted from the turbine after it has performed some useful work. This improves the cycle efficiency.

Deaerator: The presence of certain gases like oxygen, carbon dioxide, & ammonia dissolved in water is harmful because of their corrosive action on boiler metal parts particularly at elevated temperatures. The condensate is sprayed inside the deaerator and it is heated by the extraction steam from the turbine. The airs etc are thus liberated from the condensate. The deaerated condensate thus comes to the storage tanks, from which the boiler feed pump pumps the condensate to the boiler.

Turbine Oil System: The high-pressure hydraulic oil for turbine control, oil for bearing lubrication of turbine generator are received from the turbine shaft mounted main oil pump. Start up AC and emergency DC pumps are provided for start up and maintain bearing oil flow during turbine trip. Turbine Oil Coolers are provided to cool the bearing oil.

Turbine Governing System: The main purpose of governor is to maintain speed of turbine during fluctuation of load on the generator by varying steam input to the turbine. The governing system consists of hydraulically operated Control Valves. It helps to start the turbine from rest to rated speed and synchronizing with the grid. The load on t he generator can be controlled in a pre-determined manner by the control valves. Emergency stop valve is provided to shut off the steam supply to the turbine completely in abnormal & emergency situation.

Generator & its Auxiliaries

Generator: The generator shall be of CACW, brush less design with horizontal shaft mounted AC exciter driven by a steam turbine through reduction gearing and fitted with one PMG on the extended shaft of alternator. Supplier shall clearly specify the excitation arrangement in case PMG is not applicable. The Generator shall be capable of delivering the maximum output obtainable from the steam turbine under any operating conditions at 0.8 power factor lag, 11 kv output with a frequency of 50 Hz. Main component & associated system of the generator are described below;

Stator: The stator houses the armature winding also supports the rotor bearings. The insulation of the windings is Class “F”, but designed for temp rise for Class “B” insulation.

Rotor: The generator rotor is cylindrical in construction and carries the DC field windings. The field is normally of 2 or 4 pole design.

Generator Bearing: These are the pedestal type of spherical sealing to show self-alignment & are support on s separate pedestal on suffering sides & turbine side.

Generator Cooling System: The heat loss in the generator windings are dissipated by air circulated by the rotor mounted fans. This heat should be taken off for safe operation of the generator. The air is in turn could be generator air coolers, located at four corners. Water is the cooling medium.

Generator Excitation System: The DC Power supply to the field winding will be given either through a static excitation system or through shaft mounted brush-less excitation system. The control system varies the DC Current to change the terminal voltage or reactive power.

Generator Protection: Generator has to be protected from faults occurring within generator stator or rotor & also from external faults/ abnormal operating condition in the grid which affected the generator. Various devise are used to detect which can give warning alarm or trip the unit automatically as required.

SUNDRY UTILITIES (EACH PHASE)

Condensate system

To maximize energy conservation, water utilization and plant efficiency, condensate would be recovered throughout the plant and returned for boiler feed make up. Allowance has been made for the necessary condensate receivers, pipes work, valves and traps sets, etc. About 85% of the steam supply to process is recoverable as condensate for re-feeding it into the boiler.

Water treatment plant – 300m3/day

It is proposed that the water to be used will be received from the river water. Ground water would be used only in case river water is not available. The water quality will require pre-treatment to satisfy the quality required for boiler feed water, process requirement, and blending during bottling. Treatment will involve sedimentation, sand filtration, activated carbon filtration, softening and ion exchange treatment (as required for different process requirements), suitable for quality of water required.

Electrical system

The plant power requirement (including that for power plant auxiliaries) will be about 2.0 MW each phase. Out of total installed power generation capacity of about 3 MW for each phase, the surplus power, after meeting in-house requirements, will be exported to state grid.

Standby electrical generator

It is proposed to install two 500 kVA diesel generator set to provide standby power in case of state power supply failure. They would be complete with synchronization panel.

Cooling water – 1000 m3/hour

The maximum process and power plant cooling water requirement will be 1000 m3/hour for each phase. The cooling tower will be counter/cross flow induced draft divided into 3 cells. The cooling tower shall be designed for a cooling range of 8°C, and an app roach of 5°C while operating under the atmospheric wet bulb temperature of about 27°C. The cooling tower shall be carefully sited such that there is no r e- entertainment of the vapors into the cooling tower. Evaporation and drift loss will depend on season and an average figure will be about 1.60 %. The cooling tower blow-downs will be approximately 0.1%. Whole of the quantity lost will be made-up by adding fresh water/treated condensate from the process.

D. <u>Multiple Effect Evaporators (Treatment of Spent wash):</u>

- The suggested treatment scheme Effect working on the principle of falling film & Force Circulation
- Analyzer vapors is fed to the first effect evaporator shell side and steam is fed to shell side finisher at the given pressure and temperature as the heating medium.
- Vapors from last effect are condensed in Surface Condenser. A Shell & tube type Multi-pass Surface condenser is employed for condensing the shell side vapors.
- The product at the desired concentration 35-40% is obtained at the outlet of Finisher.
- Each effect is provided with recirculation cum transfer pump.
- The condensate from surface condensers is collected in a common condensate pot. The condensate is transferred for further treatment / Recycle by using centrifugal pump.
- The Pure steam condensate is collected in receiving vessels and can be pumped to desired battery limit
- Highly efficient operating pumps have been provided for pumping the required fluid.
- The plant is having high level of automation to get consistent output at required concentration.
- The system operates under vacuum. Water-ring vacuum pumps are used to maintain a desired vacuum.

1.3 Proposed Facilities

The various Product & By product phase vise, produced by the project is defined in the below table:

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

Table 1.1: List of Product & By Product

S.No	Item	Unit	Phase 1	Phase 2	Total
	Product				
1	ENA/RS/Ethyl Alcohol	KL	45	45	90
2	IMFL/country liquor	Cases	8000	8000	16000
3	Electrical Power	MW	03	03	03
	By-Product				
1	CO2	MT	40	40	80
2	Fusel Oil	MT	1	1	2
3	DDGS	MT	25	25	50
4	Corn Oil (in case of maize used as raw material)	MT	2	2	4

1.4 Raw Material Requirement: The distillery will use grains such as broken rice, maize, bajra, jowar and other starch containing grains etc. as basic raw material. Besides this, processing chemicals would be used for the production of ENA/RS/ethyl alcohol. Phase wise daily consumption of raw materials for the distillery plant is given below in **Table – 1.2**

Table 1.2: Raw Material Requirement

S.No.	Item	Unit	Phase 1	Phase 2	Total
1.	Broken rice, maize, bajra, jowar and other starch containing grains etc.	MT	115	115	230
2.	Enzymes	Kgs.	100	100	200
3.	Sodium Hydroxide	Kgs.	50	50	100
4.	Urea	Kgs.	225	225	450
5.	Anti-foam agent	Kgs.	25	25	50
6.	Yeast	Kgs.	100	100	200

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

2.0 Objective of Risk Assessment:

The main objective of the risk assessment study is to propose a comprehensive but simple approach to risk analysis and suggesting suitable mitigation measures for industries and planning & management of industrial hazards.

The factory has been identified as a major hazard installation for manufacturing, storage and handling of Ethyl Alcohol in excess of the threshold quantity (1000 MT) assigned for a highly flammable liquid in accordance with the manufacture, storage and import of Hazardous Chemical Rules (MSIHC), 1989 by the Ministry of Environment and Forest, Government of India. Manufacture and storage of such a large quantity of hazardous chemicals has potential to cause a "Major Accident". The term major accident has been defined under MSIHC rules as under:

"An occurrence such as a major emission, fire or explosion involving one or more hazardous chemicals and resulting in uncontrolled developments in the course of industrial activity leading to serious effects both inside or outside the installation, likely to cause substantial loss of life or property including adverse effect on health and on the environment"

The present study was undertaken with the objective:

A. To identify the potential hazardous chemicals in the installation which have potential to cause major accidents.
B. To conduct preliminary study to identify the potential hazardous chemicals in the installation which have potential to cause major accidents.
C. To conduct preliminary hazards analysis of the hazardous installations.
D. To identify Maximum Credible Loss Scenario (MCLS) involving major accidents.
E. To assess the damages due to the consequential effects of the identified MCLS.
F. To carry out the fire hazard potential of the ethyl alcohol storage installation by DOW FIRE AND EXPLOSION
G. To suggest hazard control measures where ever necessary.

2.1Hazard Identification &Risk Assessment (HIRA)

Risk analysis involves the identification and assessment of risks to the population is exposed to as a result of hazards present. This requires an assessment of failure probability credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate consequently, the risk analysis in present case is confined to maximum credible accident studies and safety and risk aspect related to proposed expansion of grain-based Distillery, power plant and Bottling Plant IMFL.

Activities requiring assessment of risk due to occurrence of most probable instances of hazard and accident are both onsite and off-site.

2.1.1 Material Identification

Ethanol

The properties (chemical and physical) of Ethanol and Fire and Explosion Data is indicated inTable 2.1 (MSDS Table) given below-

IDENTITY OF MATERIAL

Table2.1: Material Safety Data Sheet of Ethanol

PRODUCT NAME	Ethanol
FORMULA	C_2H_5OH

Table 4.1: Physical and Chemical Properties of Ethanol

PHYSICAL STATE	LIQUID	**BOILING POINT/RANGE (°C)**	78
APPEARANCE and ODOUR	CLEAR, COLOURLESS, VOLATILE LIQUID	**IGNITION POINT** • **FUEL IN AIR ERCENTAGE** • **TEMPERATURE (°C)**	• 3-19 • 455
SOLUBILTY in WATER @ 21°C% VOLUME	100		
OCTANE (R+M)	98-100	**SPECIFIC GRAVITY, 15.6°C**	0.7936

REID VAPOR PRESSURE (psi)	2.3	**REASERCH OCTANE NUMBER/MOTOR OCTANE NUMBER (RON/MON)**	108.6/89.7
MELTING/FREEZING POINT (^oC)	43 to -49	**CUBICAL EXPANSION Lt/kl/^0C**	1.12

Table 4.2: Fire and Explosive Data of Ethanol

FLAME VISIBILITY	POOR	**EXPLOSIVE LIMIT**	4.3-19	**FLASH POINT, ^oC**	13

2.1.2 Identification of types of Hazards in Grain Distillery& Co-Generation Plant (HAZID)

The potentially hazardous areas and the likely accidents with the concerned area have been enlisted below **Table No.2.2**

Table 2.2
Possible Hazardous Locations onsite

Sr. No.	**Hazardous Area**	**Likely Accident**
1.	Storage yard (Biomass)	Fire
2.	Boiler fuel storage area	Fire and spillage
3.	Ethanol Storage Area	1. Fire & Explosion 2. Leak Scenario (10mm, 25 mm), Worst(Catastrophic Rupture) 3. Internal Floating Roof Failure 4. Earthing Failure 5. Spark Arrestor Failure

		6. Ruptureofhosepipe/pipeoftank/truck. 7. Weldbreakage/ruptureofpipelineconnectedtostoragetank. 8. Breakopenofflangeconnectedtostoragetank. 9. Heavyleakagesinstoragetanks. 10. Overfilling of storagetanks.
4.	Distillation (Multi pressure)	Fire, VCE, 1. Release of excessive flammable evapors ofethylalcoholthroughtheventofthedistillationcolumn due to: a) Failureorlessflowofcoolantintotheheatexchangerofthecondenserofthedistillationunit. b) Highertemperatureofsteamusedforboilingofethylalcohol c) Highertemperatureofthecoolingwater. d) Scalingoftheheatexchangerofthecondenser. 2. Vacuuminthewashboilingcolumn Thissituationmayariseduetocondensationofethanolvapouras aresultoffailureofsteamsupply. Thiswillleadtoincreaseofairpercentintothesystemrenderinge xplosiveatmosphereinsidethe columnanditmaybetotheextentofexplosionofthecolumn.Topr eventtheimplosionvacuumrelief valve has beenprovided. 2. Fireattheventofthecondenser This event may take place due to content with the electro static spark or any other source of ignition
5.	IMFL Plant	Vapor Release
7.	Transfer and Handling of Ethyl Alcohol	Pump seal, Gasket Failure Piping failure
8	Boiler Area	Fire & Explosion
9.	Turbine	Explosion

	room	
10.	Electrocution	Lose fitting
11.	Electrical rooms	Fire and electrocution
12.	Transformer area	Fire and electrocution
13.	Cable tunnel	Fire and electrocution
14.	Chimney	Air pollution

2.2 DAMAGE CRITERIA

In order to appreciate the damage effect produced by various scenarios, physiological/physical effects of the blast wave, thermal radiation or toxic vapor exposition are discussed.

A. LFL or Flash Fire

Hydrocarbon vapor released accidentally will spread out in the direction of wind. If a source of ignition finds an ignition source before being dispersed below lower flammability limit (LFL), a flash fire is likely to occur and the flame will travel back to the source of leak. Any person caught in the flash fire is likely to suffer fatal burn injury. Therefore, in consequence analysis, the distance of LFL value is usually taken to indicate the area, which may be affected by the flash fire.

Flash fire (LFL) events are considered to cause direct harm to the population present within the flammability range of the cloud. Fire escalation from flash fire such that process or storage equipment or building may be affected is considered unlikely.

B. Thermal Hazard Due to Pool Fire, Jet Fire

Thermal radiation due to pool fire, jet fire or fire ball may cause various degree of burn on human body and process equipment. The following table details the damage caused by various thermal radiation intensity.

C. Vapor Cloud Explosion

In the event of explosion taking place within the plant, the resultant blast wave will have damaging effects on equipment, structures, building and piping falling within the overpressure distances of the blast. Tanks, buildings, structures etc. can only tolerate low level of overpressure. Human body, by comparison, can withstand higher overpressure. But injury or fatality can be inflicted by collapse of building of structures. The following Table4.23 illustrates the damage effect of blast overpressure.

Table 2.3: Damage due to Overpressures

Peak Overpressure	**Damage Type**
12.04 psi	Total Destruction
4.35 psi	Heavy Damage
1.45 psi	Moderate Damage
0.44 psi	Significant Damage
0.15 psi	Minor Damage

D. Blast Effects

Petroleum Vapors evaporated from a large pool of spillage would normally spread out in the direction of wind and if a source of ignition is found before the lower inflammable level is reached, a flash fire preceded by a vapour cloud explosion will result. The resultant blast over pressure of the explosion may have serious damaging effects on building, structural and equipment, which are summarized below.

Table 2.4 Blast Overpressure Effects

Over pressure bar/ psi	**Mechanical damage to equipment**	**Damage to people**
0.3/4.41	Heavy damage of plant and structure	Fatality probability = 1 for humans indoor as well as outdoor 50 eardrum damage > 50 serious wounds from flying objects.

0.1/ 1.47	Repairable damage	1 % death > 1% eardrum damage > 1 serious wounds from flying objects.
0.03/ 0.441	Major glass damage	Slight injury from flying objects
0.01/0.147	10 % glass damage	--

Boiler Explosion

Explosion may lead to release of heat energy & Pressure waves. **Table 2.5**shows tentative list of Damages envisaged due to different heat loads**.**

Table 2.5: List of Damages Envisaged at Various Heat Loads

Sr. No.	**Heat loads (kW/m^2)**	**Type of Damage Intensity**	
		Damage to Equipment	**Damage to People**
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec
2	25.0	Minimum energy required to ignite wood	50% Lethality in 1 min. Significant injury in 10 sec
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected equipment	--
4	12.5	Minimum energy required to melt plastic tubing	1% lethality in 1 min
5	4.0	--	First degree burns, causes pain for exposure longer than 10 sec
6	1.6	--	Causes no discomfort on long exposures
Source*: World Bank (1988). Technical Report No. 55: Techniques for Assessing Industrial Hazards. , Washington, D.C: The World Bank.*			

2.3Dow Index of Ethyl Alcohol Tank Farm

Material Factor (MF) = 16

1) GeneralProcessHazards(GPH)Handlingandtransferofmaterials=
   a) LoadingofRoadTanker 0.5
   b) Warehousestorageintankfarm 0.3
   TotalpenaltyforGPH 0.8

2) SpecialProcessHazards(SPH)

3) PenaltyStorage& HandlingatTemperatureaboveFlashPoint 0.25
   OperationnearFlammableRange 0.50

4) Storage of flammablematerial
   Quantityofflammablematerial=14,85,0
   00Ltrs.i.e.1192MT Say 1200MT

HeatofcombustionofEthanol=26.0x10^{6}J/kgEnergyPresent=1200x26.0x10

^{6}x10^{3} Hence,penaltyforquantityofflammablematerial=1.0

Lossofmaterialthroughcorrosion&Erosion 0.10

Leakageofjointsandpacking 0.20

Total penalty for SPHtot = (0.25 + 0.50 + 1.0 + 0.10 + 0.20)

= 2.05

Penalty

Dow Fire and Explosion Index

= MF x (1 + GPHtot) x (1 + SPHtot)

= 16 x 1.8 x 3.05

= 87.84

Thus, the ethanol storage installation falls in category II.

Table 2.6: Degree of Hazards Based on FEI

FEI Range	**Degree of Hazard**
0 – 60	Light
61-96	Moderate
97 – 127	Intermediate

128 - 158	Heavy
159 and Above	Severe
Source: *Dow's Fire and Explosion Index Hazard Classification Guide, Seventh Edition, AIChE Technical Manual (1994)*	

2.4 Consequence Analysis of Maximum Credible Accident Scenario

A Maximum Credible Loss Scenario (MCLS) represents a major accident with and acceptable probability of occurrence having potential to cause consequential effect on the largest scale in the surrounding area that determines the probable largest possible damage potential of the hazardous installation for which there should be an adequate emergency plan to mitigate and control the emergency of such a scale.

Table 2.7: Probable Consequences of Failure at Starlight

Sl no	**FAILURE CASE: LIKELY CONSEQUENCES**	**Level**
1.	Pipeline/ rupture-Pool Fire (Small Leak)	Level 1
2.	Pipeline/ rupture – Flash Fire/ VCE(Large Leak)	Level 2
3.	Storage Tank leakage/ rupture – Pool Fire (Small Leak)	Level 1
4.	Storage Tank leakage/ rupture – Flash Fire/ VCE(Large Leak)	Level 3
5.	Failure of HOV/MOV of storage tanks-Flash Fire/ VCE(Large Leak)	Level 3
6.	Booster Pump suction/discharge leakage/ rupture – Flash Fire/ VCE(Large Leak)	Level 2
7.	Main Line Pump discharge/suction	Level 1

	leakage/ rupture– Pool Fire (Small Leak)	
8.	Main Line Pump discharge/suction leakage/ rupture– Flash Fire/ VCE (Large Leak)	Level 2
10.	Overheating/electrical spark/arc in control/administration/MCC room-Fire	Level 2
12.	Integrity failure of structures/tanks due to flood/storm/earthquake/third party activity- Flash Fire/ VCE (Large Leak)	Level 3
13.	Accumulation of combustible material-Fire	Level 1

2.4.1 MCA Study of Proposed Project

Study Assumptions

1. One of the largest storage tanks in the tank farm of ethyl alcohol storage is involved in a major accident scenario. The contents of the storage tank have discharged due to pipeline failure of the bottom discharge line of 10% failure of the valve in the discharge line.
2. The entire content of the storage vessel has discharge on the ground and formed a liquid pool of ethanol.
3. The damage to life and property is caused by the thermal radiation emitted in the surrounding area. The ambient temperature is 35 Deg. C.
4. All the Parameters and Selected Failure cases are based on Past Accident Scenario.
5. Consequence Modelling is carried out in PHAST Software Tool

Table Showing Consequence Analysis (Damage Distance with respect to Damage Criteria is shown in Table no 2.8

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

Scenario considered	Wind stability class	Flash fire At LFL concentration distance (m)	Jet Fire Damage distance for various heat loads (m)			Pool Fire Damage distance for various heat loads (m)			Pool Daimeter(m)	Distance downwind to overpressure 1 (0.02068 bar) [m]	Distance downwind to overpressure 2 (0.1379 bar) [m]	Distance downwind to overpressure 3 (0.2068 bar) [m]
			4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2				
Spirit storage tank 10MM LEAK	2F	5.01377	18.0046	14.6499	-	44.2696	29.4957	15.0153	19.6391	24.4337	12.8053	12.1033
	3D	4.09339	16.9195	13.7463	-	44.0264	30.0553	15.3446		-	-	-
	5D	4.00166	15.6116	12.6167	-	43.9256	30.6982	15.8349		-	-	-
Spirit storage tank 25 MM LEAK	2F	16.0956	39.135	31.9036	-	99.3773	65.5507	36.868	49.7286	62.8005	36.375	34.7797
	3D	11.6223	36.9794	30.0345	-	98.362	66.0289	38.2156		56.3521	35.1217	33.8401
	5D	8.18684	34.3985	27.7583	22.9688	97.6495	66.6247	40.364		43.3555	24.5393	23.4034

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

Scenario considered	Wind stability class	Flash fire At LFL concentration distance (m)	Jet Fire Damage distance for various heat loads (m)			Pool Fire Damage distance for various heat loads (m)			Pool Daimeter(m)	Distance downwind to overpressure 1 (0.02068 bar) [m]	Distance downwind to overpressure 2 (0.1379 bar) [m]	Distance downwind to overpressure 3 (0.2068 bar) [m]
			4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2				
Spirit storage tank Catastrophic Rupture	2F	3081.86	-	-	-	-	-	-	-	10653.7	5016.99	4781.29
	3D	2559.76	-	-	-	-	-	-		10162.1	4224.75	3977.58
	5D	2248.23	-	-	-	-	-	-		9930.85	3813.48	3501.37
IMFL Plant 10MM LEAK	2F	7.098	22.1006	18.0712	-	66.9561	45.3799	25.5548	30.0101	29.2568	13.7427	12.8061
	3D	7.32865	21.5668	17.452	-	66.6075	46.1762	26.5306		-	-	-
	5D	7.53172	20.8706	16.7059	13.7303	66.4094	47.0757	27.946		-	-	-
IMFL Plant 25 MM	2F	14.0552	43.838	35.7982	-	150.712	100.95	61.661	76.927	74.5238	46.7099	45.0308

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

Scenario considered	Wind stability class	Flash fire At LFL concentration distance (m)	Jet Fire Damage distance for various heat loads (m)			Pool Fire Damage distance for various heat loads (m)			Pool Daimeter(m)	Distance downwind to overpressure 1 (0.02068 bar) [m]	Distance downwind to overpressure 2 (0.1379 bar) [m]	Distance downwind to overpressure 3 (0.2068 bar) [m]
			4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2				
LEAK	3D	14.0828	42.3543	34.1952	27.3096	149.504	101.753	64.4924		64.1298	36.6334	34.9734
	5D	13.4951	40.5379	32.342	26.5423	148.493	102.552	68.7616		66.0472	37.006	35.2528
IMFL Plant Catastrophic Rupture	2F	101.446	-	-	-	750.656	507.309	344.658	760.598	792.158	234.526	200.862
	3D	96.407	-	-	-	745.442	507.691	351.202		815.308	230.968	195.693
	5D	128.541	-	-	-	760.598	526.874	382.234		848.316	253.497	217.588

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

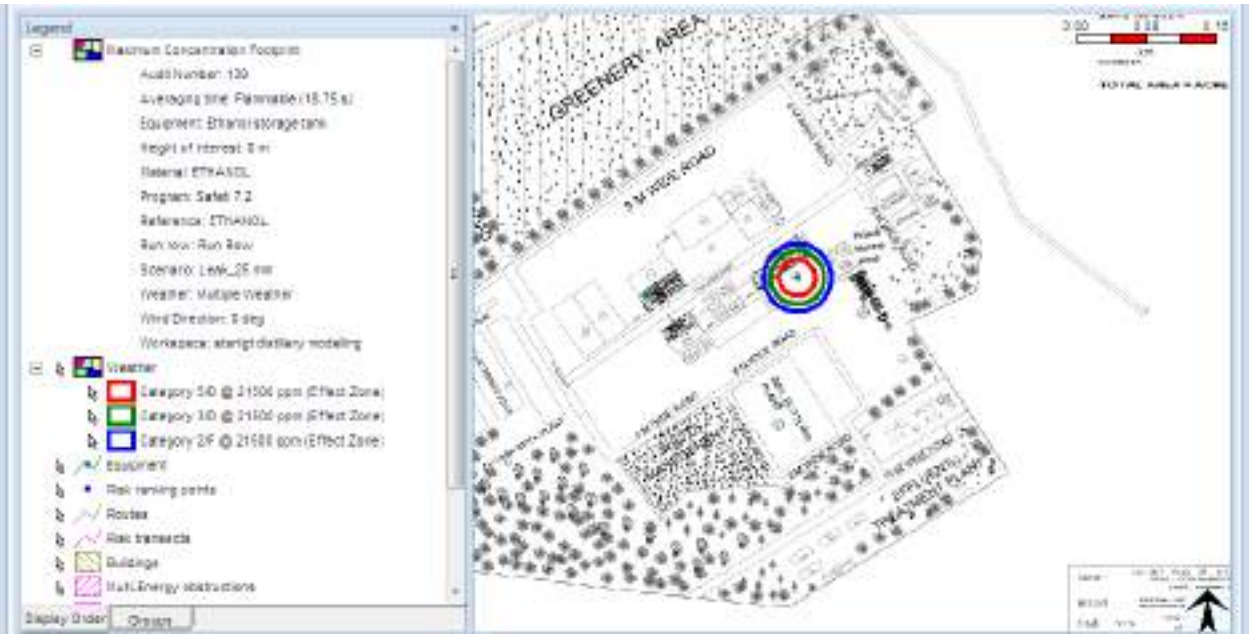
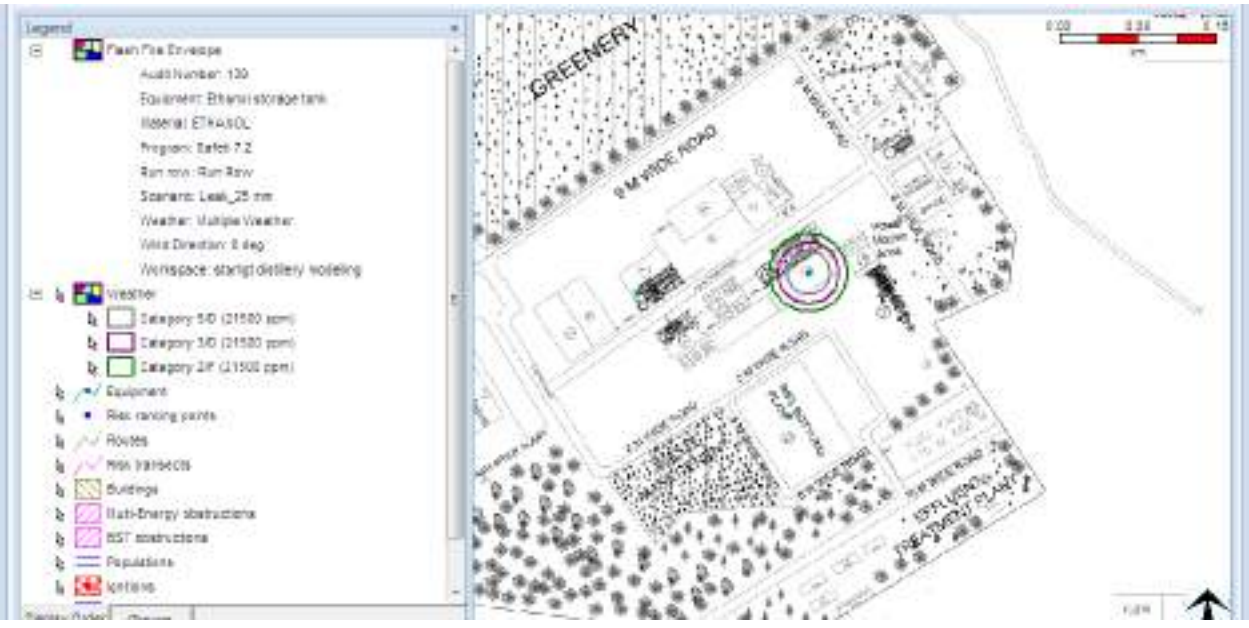
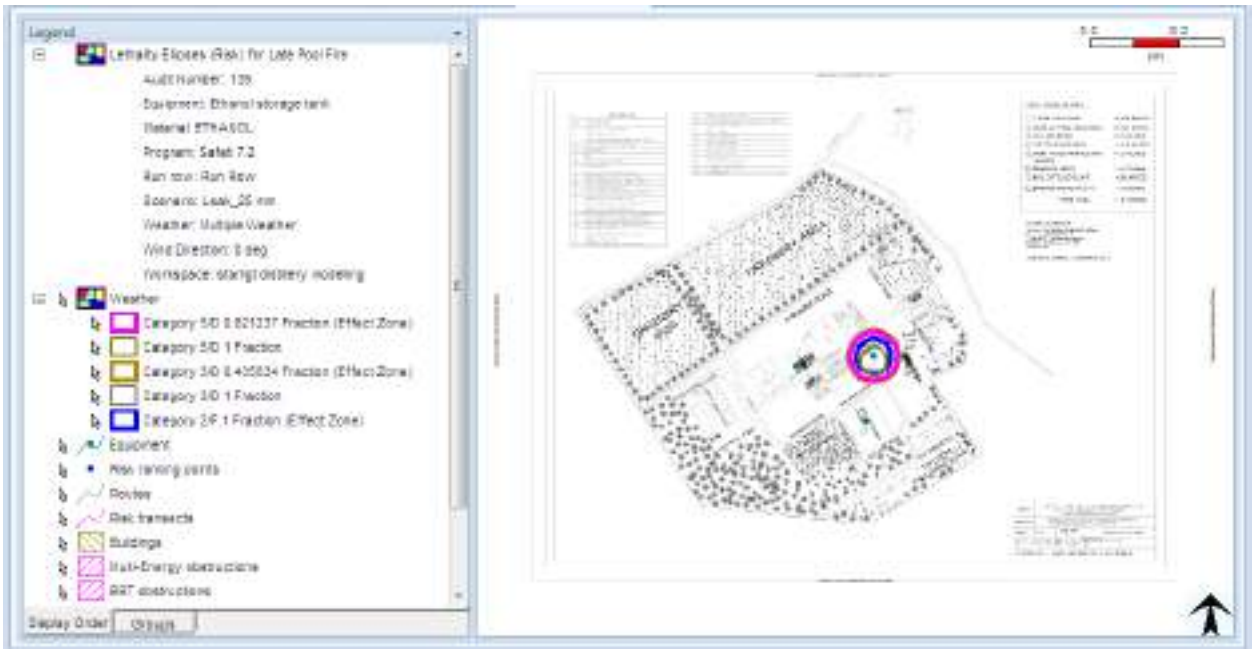


Fig No: 2.1 Maximum Concentration Footprint of Ethanol Storage Tank for credible scenario

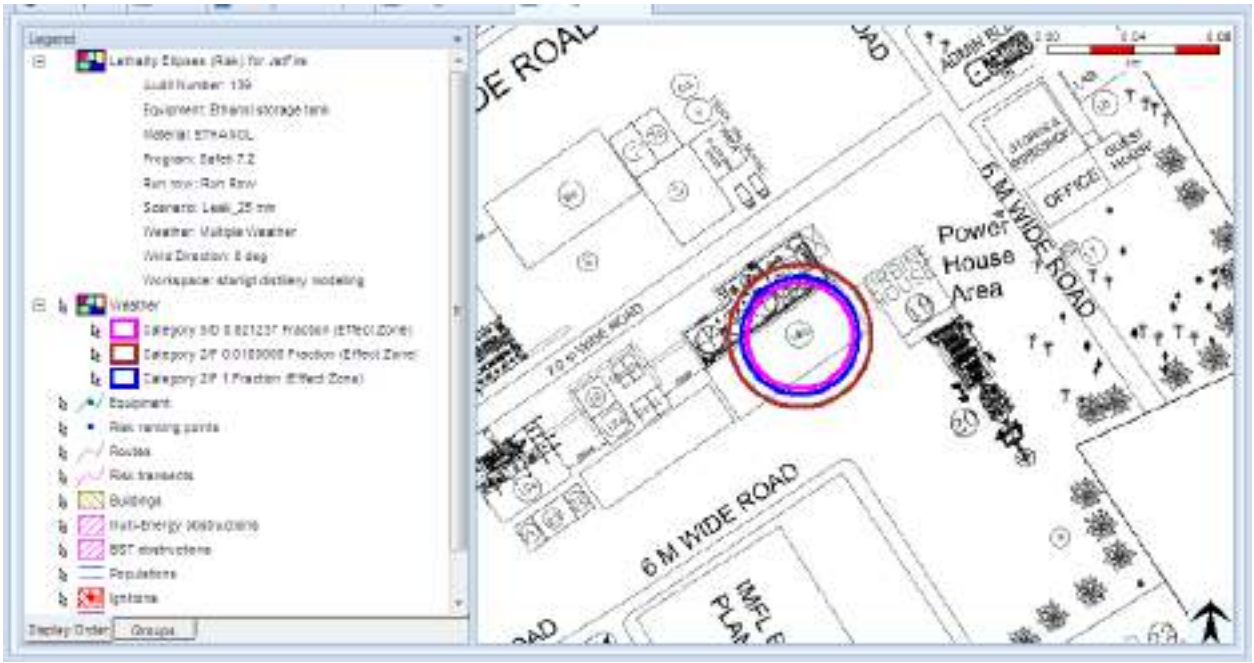


Flash Fire Envelope of Ethanol Storage Tank for credible Scenario

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

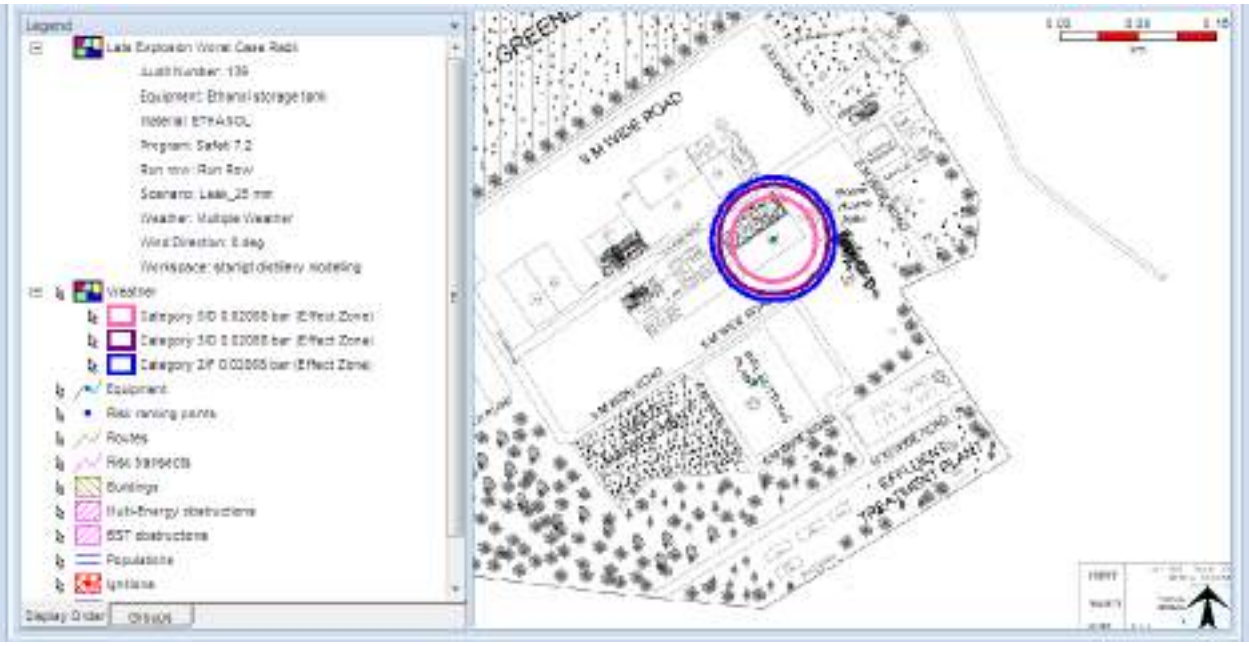


Lethality Ellipse (Risk) Late Pool Fire of Ethanol Storage Tank for Credible scenario

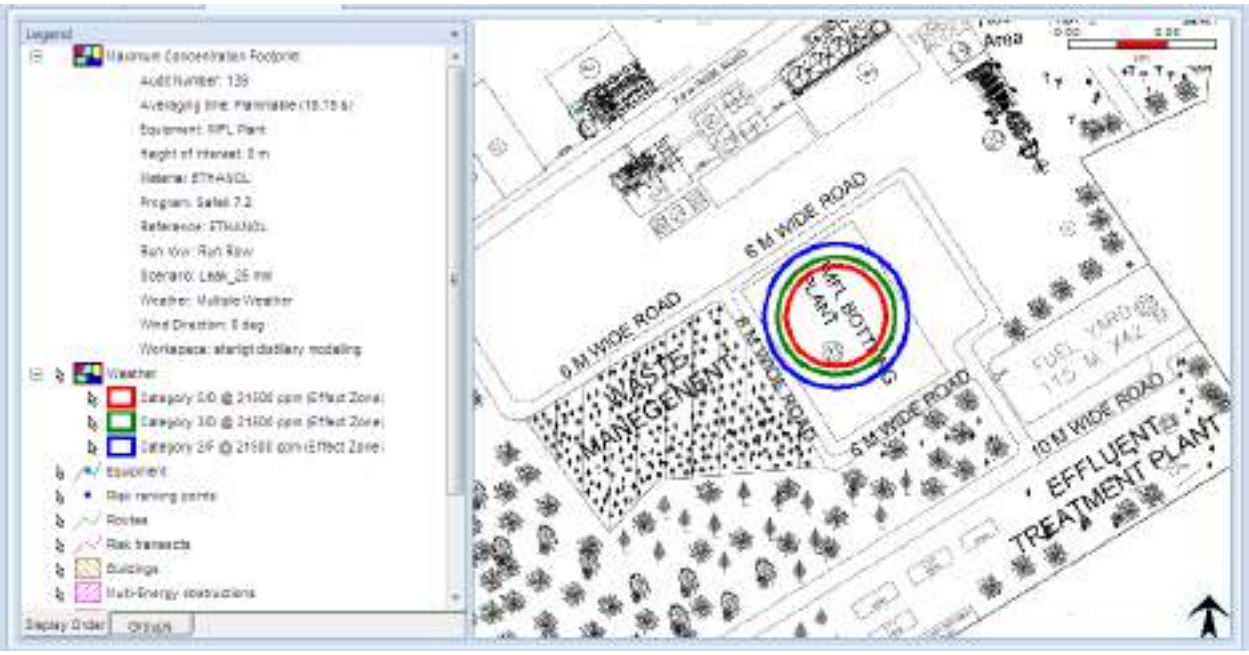


Lethality ellipses (Risk) Jet Fire of Ethanol tank for Credible scenario

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

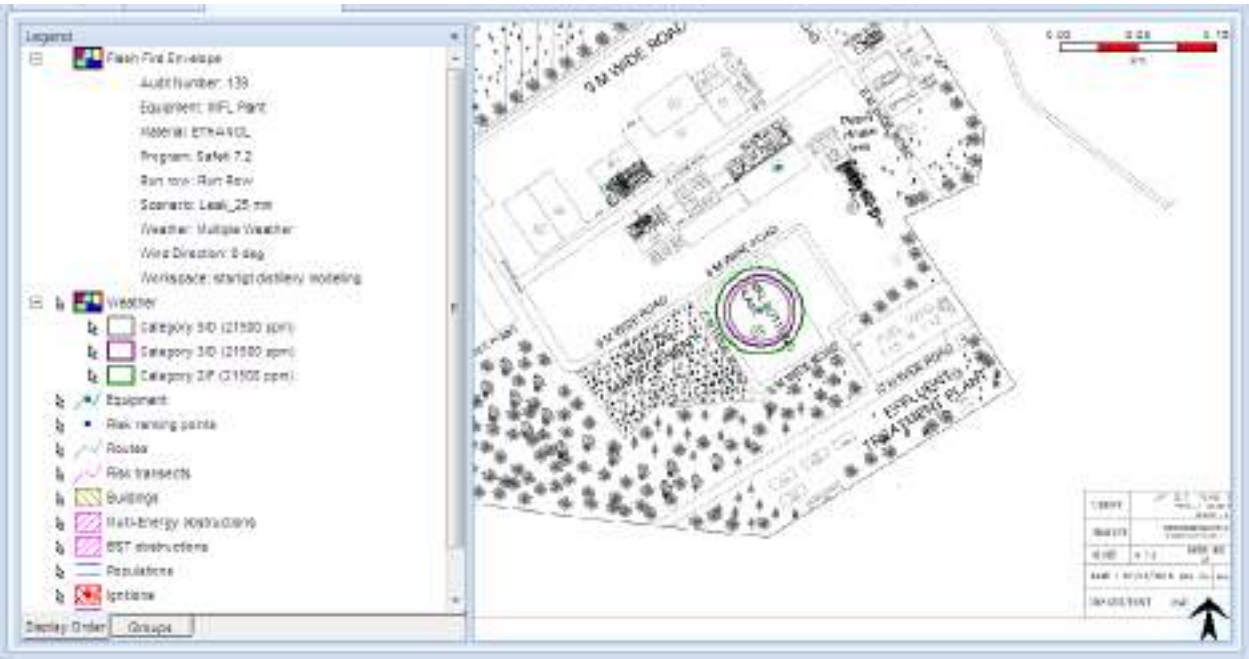


Late Explosion worst Case Radii of Ethanol Storage Tank for Credbile Scenario

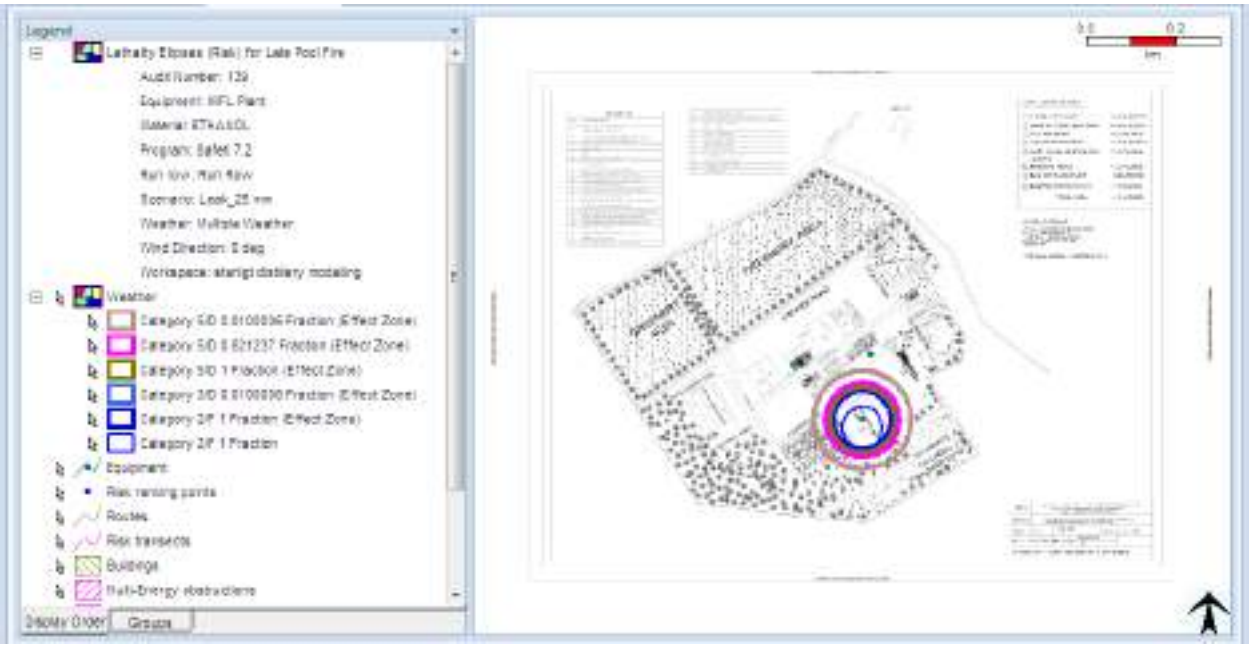


Maximum Concentration Footprint of IMFL Plant for credible scenario

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha

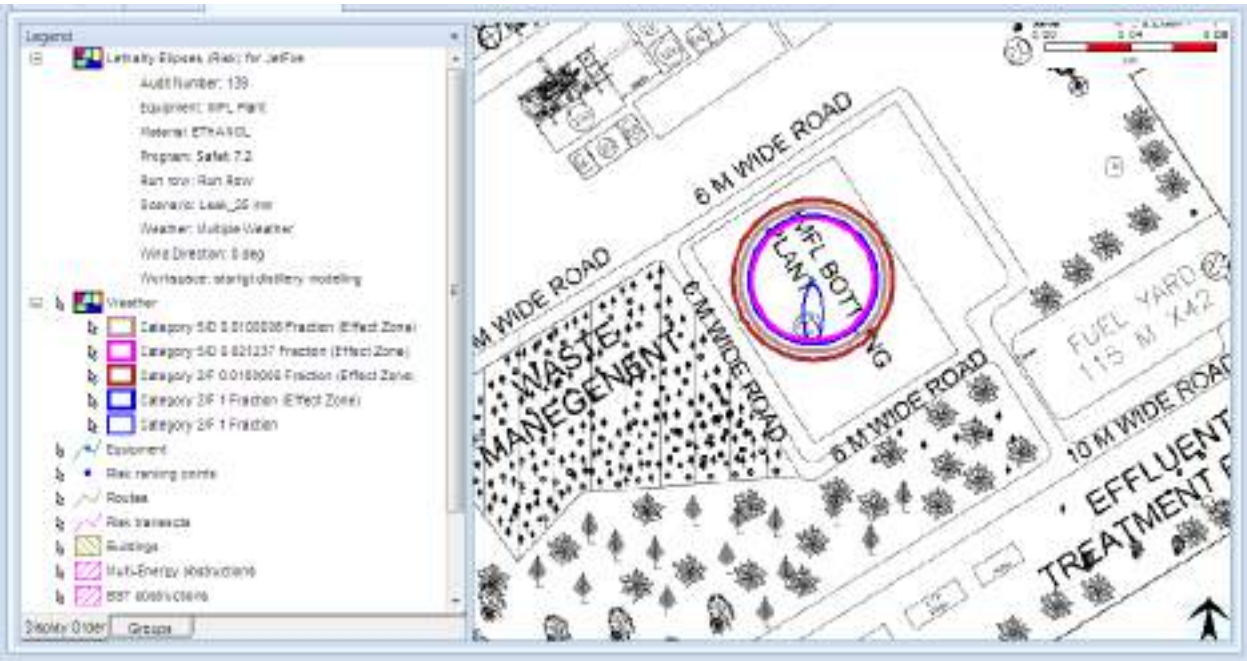


Flash Fire Envelope of IMFL Plant for credible Scenario

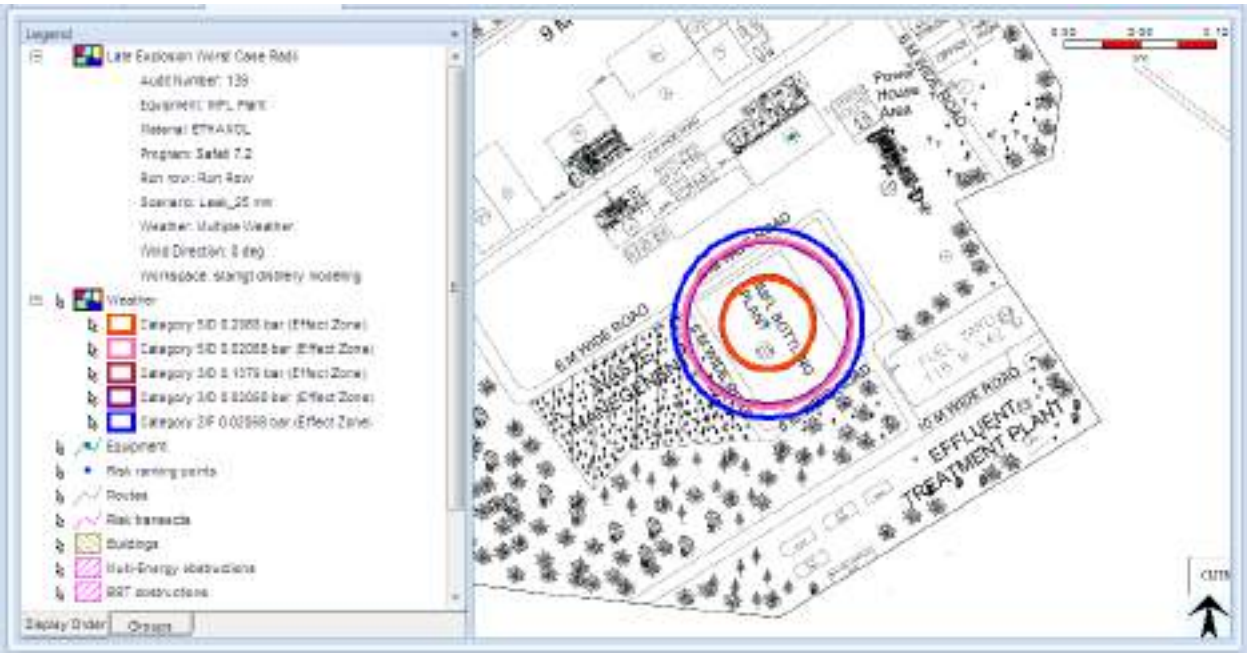


Lethality Ellipse (Risk) Late Pool Fire of IMFL Plant for Credible scenario

proposed to set up grain based distillery unit of production capacity 2 x 45 KLPD, 2 x 3.0 MW cogeneration power plants and 2 x 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist. Kalahandi, Odisha



Lethality ellipses (Risk) Jet Fire of IMFL Plant for Credible scenario



Late Explosion worst Case Radii of IMFL Plant for Credible Scenario

3.0 Conclusions and Recommendations

Proposed Project has underlying Hazards due to Ethanol Handling and Boiler Operation. Appropriate Mitigation Measures shall be taken to Reduces the chances of Emergency Scenarios generating onsite due to Fire and Explosion.

Plant will have Fire Fighting system installed along with fire Monitors. Emergency Response structure and Fire Organogram shall be followed once plant is operational

3.1 General Recommendations

1.Itisassumedthatthestoragevesselandprocessplanthasbeendesignedinaccordancetoan appropriatestandardsorcodeofpractices.Adherencetotheapproveddesignstandardensuresthe mechanicalintegrityoftheplant.Itmaybenotedthattheventsoftheethanolstoragevesselshavenot beenprovidedwithflamearrestorswhichprevententeringofsparkofflameintothevapourspaceof the storage vessel. Provision of vacuum cum pressure relief valve would minimize the loss by evaporationanditwillalsopreventtheexplosionofthestoragetankwhiledischargingethylalcohol.

2. Itisimportanttohaveproperwrittensafeoperatingproceduresforeachoftheoperationbeingcarriedoutinethylalcoholstorageanddistillery.Itshouldalsobeensuredthatthesewrittensafeoperating proceduresarestrictlyfollowed.

3. Scheduledinspectionandtestingofvessels,pipelines,valves,pumps,pressureregulators,pressure reliefvalves,levelindicatorsetc.shouldbecarriedoutandproperrecordtobemaintained.

4. Theincreaseintemperaturetoexternalsurfaceofthetanksbywayofheatingbytorchorpoolfire etc.shouldbeavoidedtopreventBELVE.

5. Thepotentiallyhazardousexcursionsfromnormaloperatingconditionsleadingtomajoraccident shouldbepreventedbyprovisionofalarm&tripsystemforpressure,temperatureandlevel.The manuallevelgaugingoftheethylalcoholstoragetankandtheloadingoftheroadtan

kerneedstobe strictlysupervisedtoavoidspillageduetooverflowing.

6. TheMCAstudyoftheethylalcoholtankfarmhashighlightedthenecessityofprovi sionofbundfor containmentofaccidentalspillagefromastoragevessel.

7. Inadvertentdriveawayprotectionfortheroadtankerduringethylalcoholloadi ngoperationshould beachievedbymeansofprovisionofwheelchokesandtakingawayoftheignitionke yfromthedriver.

8. Highstandardsofoperation,maintenanceandtestingcanbeachievedbyconduc tinghazardand operabilitystudyoftheidentifiedhazardousoperationsuchasroadtankerloading, distillation&liquor bottling.Thistakescareofconsequencesofdeviationfromthenormaloperatingpar ametersand therebysuggestingthenecessarysafetymeasures.

9. Periodicinspectionandtestingofpipelinesshouldbecarriedouttodetermineth ethinningdueto corrosionanderosionandrecordshouldbemaintained.

10. TheethylalcoholisconsideredasclassApetroleumhenceitsbulkstorageshoul dcomplywiththe requirementsofPetroleumActandRules.Thesalientaspectsofthisruletobecompli edare:

- Provisionofabundwithstormwaterdrainagewithavalvenormallykeptclosed.
- Provisionof1.8Mhighfencingtoprevententeringofunauthorizedpersons.
- Approvedtypeelectricalfittingtobeinstalledwithinthepremiseswhichsho uldbemaintained properly.
- Useofnonsparkingtoolsandprohibitionsofsmokingcarryingofmatchesand materialcapable of causingfire.
- Provisionofwaterhydrantline.
- Strictadherencetohotworkpermitssystem.

3.2 Specific Recommendations

(1) Preventive Measures for Electricity Hazard

- All electrical equipment's is to be provided with proper earthing. Earthed electrode are periodically tested and maintained
- Emergency lighting is to be available at all critical locations including the operator's room to carry out safe shut down of the plant
- Easy accessibility of fire fighting facilities such as fire water pumps and fire alarm stations is considered
- All electrical equipment's are to be free from carbon dust, oil deposits, and grease
- Use of approved insulated tools, rubber mats, shockproof gloves and boots, tester, fuse tongs, discharge rod, safety belt, hand lamp, wooden or insulated ladder and not wearing metal ring and chain.
- Flame and shock detectors and central fire announcement system for fire safety are to be provided.
- Temperature sensitive alarm and protective relays to make alert and disconnect equipment before overheating is to be considered
- Danger from excess current due to overload or short circuit is to be prevented by providing fuses, circuit breakers, thermal protection

(2) Safety Measures for Storage & Handling of Alcohol

Handling and storage of alcohol is done as per prescribed norms. The alcohol is directly fed to the bottling unit mechanically and no manual handling will be involved which will reduce the risk of spillage in the storage area. Following precautionary measures would be taken for safety:

(a) Handling and storage

Keeping away from heat, sparks and open flame, care will be taken for avoidance of spillage, skin and eye contact, well ventilation, Use of approved respirator if air contamination is above acceptable level will be promoted. For Storage and handling following precautions will be taken:

- Keeping away from oxidizers, heat and flames.
- Avoidance of plastics, rubber and coatings in the storage area.

- Cool, dry, & ventilated storage and closed containers.
- Grounding of the container and transferring of equipment to eliminate static electric sparks.

(b) At Distillation Section

with the vapors of the ethanol escaping through the vent. Therefore, it is necessary to provide a flame arrestor to the vent in order to prevent flash back of the flame.

The safety measures to control the above-mentioned hazards are:

- Provisionofmonitoringofflowrate,inletandoutlettemperatureofthecoolingwater.
- Scheduledcleaninganddescalingoftheheatexchangerofthecondenser whichhasbeenreportedto befilled.
- Monitoringofsteamtemperatureorpressure.Steampressureinthe unitismaintainedbetween8– 10 lbs, with the provision of a steam pressure regulating valves. The temperature of steam is maintainedbetween115– 120^{O}C.Correspondingtotheaforesaidpressuresetting.Thesecontrol measureswouldminimizethelossofethylalcoholvapourintheatm osphereleadingtoenhanced productionofthedistilledethylalcohol.

(3)First Aid Measures

For Skin contact, Eye contact, & Inhalation first aid measures to be taken onsite.

Medical help to be sought as soon as possible.

(4) Fire Fighting Measures

- Use of extinguishing media surrounding the fire as water, dry chemicals (BC or ABC powder), CO_2.
- Foam System for firefighting will be provided to control fire from the alcohol storage tank. The foam thus produced will suppress fire by separating the fuel from the air (oxygen), and hence avoiding the fire & explosion to occur

in the tank.Foam would blanket the fuel surface smothering the fire. The fuel will also be cooled by the water content of the foam.

- The foam blanket suppresses the release of flammable vapors that can mix with the air.
- Special Fire Fighting Procedures; Keeping the fire upwind. Shutting down of all possible sources of ignition, keeping of run-off water out of sewers and water sources. Avoidance of water in straight hose stream which will scatter and spread fire. Use of spray or fog nozzles will be promoted, cool containers will be exposed to flames with water from the side until well after the fire is out.

(5) Accidental Release Measures

For Spill Cleanup well Ventilation, Shutting off or removal of all possible sources of ignition, absorbance of small quantities with paper towels and evaporate in safe place like fume hood and burning of these towels in a safe manner), Use of respiratory and/or liquid-contact protection by the Clean-up personnel will be promoted.

(6) Role of Fire Fighting Group

A small spark of fire may result into loss of lives, machines and the damage by fire may result in high economic losses. This type of losses can be avoided by preventing and controlling the fire instantly for which fire–fighting group will be established.

The firefighting group would house and keep in readiness, the following types of equipment and arrangements.

- CO_2 extinguishers
- Dry powder chemical extinguishers
- Foam extinguishers
- 80 mm. spray hoses
- Fire hydrant

In order to avoid fire in cable galleries, all the power and control cables of FRLS type (Fire Resistant Low Smoke) will be used.

3.2 Environment Health and Safety Cell

A fully fledge EHS cell (Environment Health & Safety Cell) has been there at plant site. Main function of EHS cell is to assess the potential risks/hazards to environment, health of employees & society and safety within the plant. Installation of fire fighting system, fire alarm, provision of safety/protective equipment's to workers and regular medical check-ups have been taken up. Plant is maintained at zero discharge so no likely impact is likely to occur on environment and society. Also regular monitoring of different parameters is being carried out to ensure safety of environment and society. Trainings and Mock drills are also carried out in regular intervals for workers to ensure the safety in case of any accident or natural hazard.

3.3 Emergency Planning& Procedure

Emergency Control Center

Emergency Control Centre (ECC) is cell from which emergency operations are directed and coordinated. This centre activates as soon as on–site emergency is declared.

General Description of ECC

The ECC is located in an area that offers minimal risk being directly exposed to possible accidents.

During an emergency, the Emergency Management Staff, including the site controller shall gather in the ECC. Therefore, the ECC shall be equipped with adequate communication systems in the form of telephones and other equipments to allow unhampered organisations and other nearby facility personnel.

The ECC provides shelter to its occupants against the most common accidents; in addition, the ECC's communication systems are protected from possible shutdown. The ECC has its own emergency lighting arrangement and electric communication systems operation.**Figure 1.1** shows Team involved in Emergency planning.

Only a limited and prearranged number of people are admitted to the ECC, when in use. This eliminates unnecessary interference and reduces confusion.

The ECC is always ready for operation and provided with the equipment and supplies necessary during the emergency such as:

- Updated copies of the On–site Disaster Management Plan.
- Emergency telephone numbers.
- The names, phone number, and address of external agencies, response organizations and neighboring facilities.
- The adequate number of telephone (more than two).
- Emergency lights, Clocks, Personal protective equipment.
- List of fire extinguishers with their type no. and location, capacity, etc.
- Safety helmets – List of quantity & location.
- Status boards/message board.
- Material safety data sheets for chemicals handled at the facility.
- Several maps of the facility including drainage system for surrounding area showing:
  - Areas where hazardous materials are stored.
  - Plot plans of storage tanks, routes of pipelines, all water permanent lines etc.
  - The locations where personal protective equipment are stored.
  - The position of pumping stations and other water sources.
  - Roads and plant entrances.
  - Assembly areas & layout of Hydrant lines.

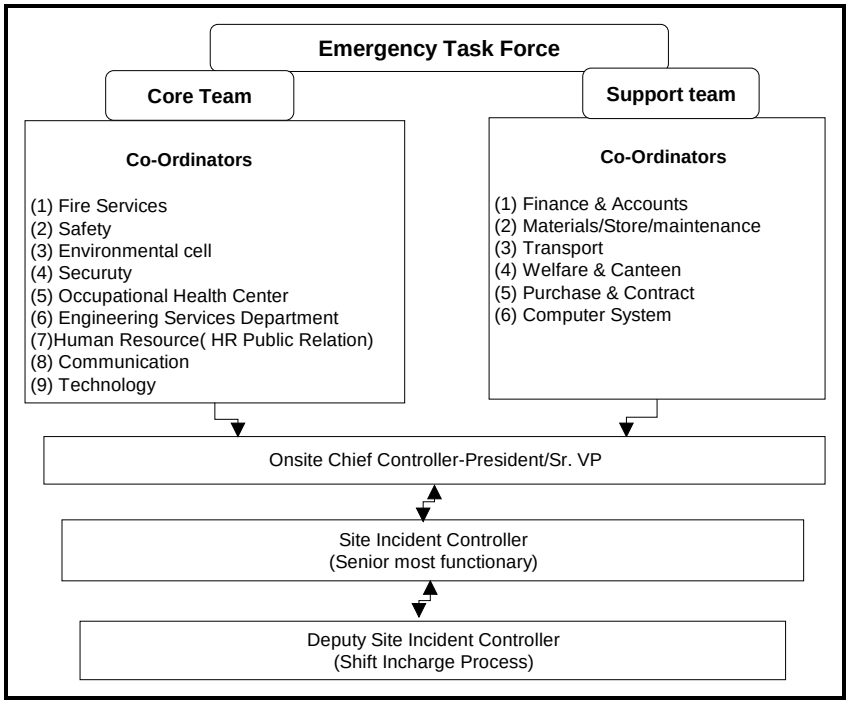


Figure. 1.1: Emergency Team

3.5Emergency Planning for Disaster due to Fire

Cable rooms, transformer, unit, auxiliary transformers, oil tanks, etc. within the plant are the likely areas for which disaster management plan is to be made to deal with any eventuality of fire. Stores, workshop, canteen and administrative building will be included.

4.0

4.0 Disaster Management Plan

4.3.1 Definition

A major emergency in an activity/project is one which has the potential to cause serious injury or loss of life. It may cause extensive damage to property and serious disruption both inside and outside the activity/project. It would normally require the assistance of emergency services to handle it effectively.

4.3.2 Scope

An important element of mitigation is emergency planning, i.e. identifying accident possibility, assessing the consequences of such accidents and deciding on the emergency procedures, both on site and off site that would need to be implemented in the event of an emergency.

Emergency planning is just one aspect of safety and cannot be considered in isolation from the proposed 45 KLPD capacity Grain based ethanol unit and hence before starting to prepare the plan, works management will ensure that the necessary standards, appropriate to safety legislation, are in place.

4.3.3 Objective

The overall objectives of the emergency plan will be:

- To localize the emergency and, eliminate it; and
- To minimize the effects of the accident on people and property.

Elimination will require prompt action by operations and works emergency staff using, for example, fire–fighting equipment, water sprays etc.

Minimizing the effects may include rescue, first aid, evacuation, rehabilitation and giving information promptly to people living nearby.

4.3.4 Identification of Hazards

The following types of hazards may be identified at Shahabad Ethanol plant.

- Fire in Electric Panels, Oil room and alcohol storage.
- Waste treatment processes.
- Cleaning of barrels, which have held chemical substances.

To deal the above emergencies, the Emergency Plan is prepared.

4.3.5 Safety Measures for Storage & Handling of Alcohol

The alcohol will be directly fed to the bottling unit mechanically and no manual handling will be involved which will reduce the risk of spillage in the storage area. Following precautionary measures would be taken for safety

- **Handling and Storage;** Keeping away from heat, sparks and open flame, care will be taken for avoidance of spillage, skin and eye contact, well ventilation, Use of approved respirator if air contamination is above acceptable level will be promoted. For Storage and handling following precautions will be taken:

- Keeping away from oxidizers, heat and flames.
- Avoidance of plastics, rubber and coatings in the storage area.
- Cool, dry, & ventilated storage and closed containers.
- Grounding of the container and transferring of equipment to eliminate static electric sparks.

In case of any emergency following measures would be taken:

- **First Aid Measures**: For Skin contact, Eye contact, & Inhalation.
- **Fire Fighting Measures:**

- Use of extinguishing media surrounding the fire as water, dry chemicals (BC or ABC powder), CO_2, Sand, dolomite, etc
- Foam System for firefighting will be provided to control fire from the alcohol storage tank. The foam thus produced will suppress fire by separating the fuel from the air (oxygen), and hence avoiding the fire & explosion to occur in the tank. Foam would blanket the fuel surface smothering the fire. The fuel will also be cooled by the water content of the foam.
- The foam blanket suppresses the release of flammable vapors that can mix with the air.
- Special Fire Fighting Procedures; Keeping the fire upwind. Shutting down of all possible sources of ignition, keeping of run-off water out of sewers and water sources. Avoidance of water in straight hose stream which will scatter and spread fire. Use of spray or fog nozzles will be promoted, cool containers will be exposed to flames with water from the side until well after the fire is out.
- Hazardous Decomposition Products: gases of Carbon Monoxide (CO) & Carbon Dioxide (CO_2).

- **Accidental Release Measures;** ForSpill Cleanup well Ventilation, Shutting off or removal of all possible sources of ignition, absorbance of small quantities with paper towels and evaporate in safe place like fume hood and burning of these towels in a safe manner), Use of respiratory and/or liquid-contact protection by the Clean-up personnel will be promoted.

4.4 Emergency Planning

4.4.1 General

Disaster Management Plan for an industrial unit is necessarily a combination of various actions which are to be taken in a very short time but in a present sequence to deal effectively and efficiently with any disaster, emergency or major accident with an aim to keep the loss of men, material, plant/machinery etc. to the minimum.

The main functions of the Disaster Management Cell are to prepare a detailed Disaster Management Plan, which includes:

- Identification of various types of expected disaster depending upon the type of the industrial unit.
- Identification of various groups, agencies, departments etc. necessary for dealing with a specific disaster effectively.
- Preparation – by intensive training of relevant teams/groups within the organization to deal with a specific disaster and keep them in readiness.
- Establishment of an early detection system for the disaster.
- Development of a reliable instant information/communication system.
- Organization and mobilization of all the concerned departments/ organizations / groups and agencies instantly when needed.
- A major disaster that can be expected due to fire in this proposed distillery.

4.4.2 Emergency Planning for Disaster due to Fire

Cable rooms, transformer, unit, auxiliary transformers, oil tanks, etc. within the plant are the likely areas for which disaster management plan is to be made to deal with any

eventuality of fire. Stores, workshop, canteen and administrative building will be included.

4.4.2.1 Classification of Fire

Class (A)

Fire involving combustible materials like wood, paper, cloth etc.

Class (B)

Fire due to liquid materials like oil, diesel, petroleum products and all inflammables.

Class (C)

Fires involving domestic and industrial gases like butane and propane etc.

Class (D)

Metal fires etc.

Class (E)

Electrical fires due to short circuiting etc.

4.4.3 Need of Establishing a Fire Fighting Group

A small spark of fire may result into loss of machines and the damage by fire may high economic losses. This type of losses can be avoided by preventing and controlling the fire instantly for which fire–fighting group will be established.

Establish which would house and keep in readiness, the following types of equipment and arrangements.

- CO_2 extinguishers
- Dry powder chemical extinguishers
- Foam extinguishers
- 80 mm. spray hoses
- Fire brigade
- Fire hydrant
- Protocol (chemical to combat oil fires).

In order to avoid fire in cable galleries, all the power and control cables of FRLS type (Fire Resistant Low Smoke) will be used.

4.4.4 Inspection

Fire alarm panel (electrical) will cover the entire plant. The inspection group will periodically inspect fire extinguishers in fire stations and machines and other places.

The groups will display emergency telephone number boards at vital points.

The group will regularly carry out general inspection for fire.

4.4.5 Procedure for Extinguishing Fire

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

As soon as the message is received about fire, one of the systems will be diverted to the place of the fire accident along with a staff member.

Simultaneously plant fire station will be informed by phone walkie for fire brigades and fire stations of nearby area.

In the meanwhile, the pipe system will be operated to obtain maximum pressure on output. In case cables are within the reach of fire, power supply will be tripped and the cables shifted.

4.4.6 Fire Fighting with Water

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

1. Provision for Fire brigade and Fire hydrant.
2. Arrangement of pipelines along and around all vulnerable areas.
3. Provision of valves at appropriate points to enable supply of water at the required place/area or divert the same to another direction/pipe line.
4. Provision of overhead tanks which will be providing with the water during power failure and it would work by the gravitational force.

4.4.7 Sources of Water for Fire Fighting

The following two sources of water have been considered for firefighting:

- Overhead Tank
- Raw Water Reservoir

4.4.8 Fire Fighting with Fire Extinguishers

To deal with fire – other than carbonaceous fires, which can be deal with by water – suitable fire extinguishers are required to do the job effectively. It is therefore, necessary to keep adequate number of extinguishers in readiness at easily approachable places. Adequate number of fire stations would be:

- Further, other spray groups from the system will be diverted to the spot.
- In case of fire in the belt, belt will be cut near the burning portion to save the remaining parts.
- After extinguishing the fire, the area will be well prepared for reuse.
- Foam System for firefighting will be provided to control fire from the alcohol storage tank. The foam thus produced will suppress fire by separating the fuel from the air (oxygen), and hence avoiding the fire & explosion to occur in the tank. Foam would blanket the fuel surface smothering the fire. The fuel will also be cooled by the water content of the foam.
- The foam blanket suppresses the release of flammable vapors that can mix with the air.

4.5 On–Site Emergency Plan

4.5.1 Introduction

The views of the possible hazards that can arise out of the daily operations in the distillery plant, various measures are adopted to prevent the occurrence of a major accident. This comprises of:

- Built in safety measures, alarms, trips and interlocks etc.
- Standard safe operating and maintenance procedures permit system etc.
- Training of all the involved staff in normal and emergency operating procedures.
- Training of all employees in safety, fire fighting and first aid.

  However, in spite of these precautions, it is required to foresee situation of major accident and plan for taking timely action to minimize the effects of such incident on the safety and health of persons working in the plant as well as those living around the premises.

4.6 Preparation of Plan

4.6.1 Alarm System

A siren shall be provided under the control of Security office in the plant premises to give warning. In case of emergencies this will be used on the instructions to shift in charge that is positioned round the clock. The warning signal for emergency shall be as follows:

- Emergency Siren: Waxing and waning sound for 3 minutes.
- All clear signal: Continuous siren for one minute.

4.6.2 Communication

Walkies & Talkies are located at strategic locations; internal telephone system EPBX with external P&T telephones would be provided.

4.6.3 Fire Protection System

4.6.3.1 Fire Fighting System

The fire protection system for the unit is to provide for early detection, alarm, containment and suppression of fires. The fire detection and protection system has been planned to meet the above objective an all–statutory and insurance requirement of Tariff Advisory Committee (TAC) of India.

The following systems of fire protection are proposed to be provided for the plant:

a) Fire alarm system
b) Fire containment
c) Hydrant system for the entire plant
d) High velocity water spray (HVWS) system
e) Carbon dioxide flooding system
f) Portable fire extinguishers.

(a) Fire alarm system

A fire alarm system would be installed to provide visual and audible alarm in the plant for fire detection at the incipient stage. This system would comprise manual call points located at strategic locations in areas which are normally manned, and automatic smoke and heat *detectors* located at important points such as the cable vault, the control room, switchgear room etc., to detect fire at an early stage, and provide visual and audible alarm.

(b) Fire containment

Strategic areas in the plant would be separated by adequately rated firewalls. All openings for switchgears and cable entry would be sealed by fireproof seals to prevent spread of fire from one area to another.

(c) Reserve water storage for fire demand

Reserve storage of 500 m^3 would be provided in the treated effluent storage tank with a suitable partition to cater to the water requirements of the fire protection system.

(d) Hydrant system

The hydrant systems comprise the following:

a) Four pumps, two motor driven and two diesel engines driven, each of 10m3/hour, capacity would be provided to keep both the hydrant and HVWS system mains pressurized. These pumps will take the suction from the water storage tank.

b) External as well as internal fire hydrants in all areas of the industry.

(e) High velocity water spray system

The HVWS system would be provided for the fuel storage area. Since the parameters for the HVWS system will be identical to that of the hydrant system, the diesel engine driven pump described in the hydrant system serve as a common standby for both HVWS system and hydrant system. The HVWS system consists of a number of high velocity water projectors. Smoke and heat detectors have been used strategically.

(f) Portable fire extinguishers

Wall/column mounted type portable fire extinguishers in various areas of the plant including the control room, administration building, canteen, stores, workshop, etc. would be provided. These portable fire extinguishers are basically of carbon dioxide and dry power type.

4.6.4 First Aid

A first aid centre with adequate facilities shall be provided. It shall be maintained round the clock by a compounder cum dresser and a doctor. An Ambulance shall also be provided at site to carry affected people to hospital.

4.6.5 Security

The security requirements of the company premises shall be taken care of by CSO assisted by a Fire In charge. The team, apart from the normal security functions will manage the role required during a disaster management operation as a part of the crisis control team.

4.6.6 Safety

The safety wing led by a Safety Manager will meet the requirement of emergencies round the clock. The required safety appliances shall 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.

4.6.7 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.

4.6.8 Emergency Control Center

Provision is made to establish an Emergency Control Centre (ECC) from which emergency operations are directed and coordinated. This centre is activated as soon as on–site emergency is declared.

The ECC consists of one room, located in an area that offers minimal risk being directly exposed to possible accidents.

During an emergency, the Emergency Management Staff, including the site controller will gather in the ECC. Therefore, the ECC is equipped with adequate communication systems in the form of telephones and other equipments to allow unhampered organisations and other nearby facility personnel.

The ECC provides shelter to its occupants against the most common accidents; in addition, the ECC's communication systems are protected from possible shutdown. The ECC has its own emergency lighting arrangement and electric communication systems operation.

Only a limited and prearranged number of people are admitted to the ECC, when in use. This eliminates unnecessary interference and reduces confusion.

The ECC is always ready for operation and provided with the equipment and supplies necessary during the emergency such as:

- Updated copies of the On–site Disaster Management Plan.
- Emergency telephone numbers.
- The names, phone number, and address of external agencies, response organizations and neighbouring facilities.
- The adequate number of telephone (more than two).
- Emergency lights, Clocks, Personal protective equipment.
- List of fire extinguishers with their type no. and location, capacity, etc.
- Safety helmets – List of quantity & location.
- Status boards/message board.
- Material safety data sheets for chemicals handled at the facility.
- Several maps of the facility including drainage system for surrounding area showing:

❖ Areas where hazardous materials are stored.
❖ Plot plans of storage tanks, routes of pipelines, all water permanent lines etc.
❖ The locations where personal protective equipment are stored.
❖ The position of pumping stations and other water sources.
❖ Roads and plant entrances.
❖ Assembly areas & layout of Hydrant lines.

4.6.9 Communication Equipments and Alarm Systems

This kind of equipment is absolutely vital for notifying accident; make the emergency known both inside and outside of the facility, and coordinating, the response actions among the various groups involved in response operations.

In particular, this equipment is used to communicate within the facility; communicate between the facility and outside organizations; and inform the public.

Different communications systems can vary in effectiveness, depending on the task. The most common types installed in the plant are given below.

4.6.9.1 Sirens

These are audible alarm systems commonly used in facilities. In case of any emergency siren will be operated short intermittently for 1.5 minutes.

An alarm does more than just emergency warning. It also instructs people to carry out specific assignments, such as reach to assembly point for further instructions and actions, or carry out protective measures; this can be achieved only if the people are familiar with the alarm systems and are trained to respond to it.

4.6.10 Personal Protective Equipments

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 are available in ECC.

Effective command and control accomplish these functions necessitates personal trained in this On–site Disaster Management Plan with adequate facilities and equipments and equipment to carry out their duties and functions. These organizations and the facilities required to support their response are summarized in the following subsections.

4.6.11 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.

4.6.12 Disclosure of Information to Worker & Public Awareness System in Existence & Anticipated

- Safety awareness among workers by conserving various training programmes and Seminars, competition, slogans etc.
- Practical exercise.
- Distribution and practices of safety Instructions.
- Safety Quiz contests.
- Display of Safety Posters & Safety Slogans.
- Developing Safety Instructions for every Job and ensuring these instructions/booklets or manuals by the workers.

Material Safety Data Sheet (MSDS) For Ethanol

Identification

CASNo. :64-17-5

Typical Composition : Mixture of aromatics & olefins

Characteristics : Colorless liquid with Alcohol odor, soluble in water, miscible with chloroform &ether

PhysicalPrope

rties Specific

Gravity : 0.79

BoilingPoint :78.32°C

FlashPoint : 13.0 (CC) 17.8°C(OC)

AutoIgnitionTemp. : 422.7°C

FlammabilityLimits : Lower (LEL): 3%; Upper (UEL) :19%Category : Class A (F.P <23°C.)

Reactivity : Stable under normal storage conditions. Reacts violently with Acetyl bromide (Evolves hydrogen bromide), Dichloromethane + Sulfuric Acid +Nitrate or Nitrite, Disulfuryl. Tetrachlorisilane + water and strongoxidents.

Fire/Explosion Hazards

Forms explosive products on reaction with ammonia + silver nitrate (forms silver nitrite and silver fulminate)

Fire Fighting: Alcohol Foam, carbon dioxide, dry chemical powder,

halones be used. Health Hazards

IDLH : Not

Available

TLV/TWA :

1000ppm

Target Organs : Respiratory system, Liver

Pathway : By inhalation, Ingestion, Eyes,Skin

Symptoms : Lightheadedness, drowsiness, irritation in eyes, nose,

throat, skin,. First Aid:

Eye - If this chemical contact the eyes, immediately wash the eyes with large amount of water for 15 min, occasionally lifting lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with thischemical.

Skin - If this chemical contacts the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attentionpromptly.

Breath - If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon aspossible.

Signature of FAE

Anuradha Sharma