DETAILED PROJECT REPORT

FOR

INTEGRTED GRAIN BASED DISTILLERY

SUITABLE TO PRODUCE 2 x 45,000 LPD OF ENA/ETHANOL/RECTIFIED SPIRIT/MALT SPIRIT WITH 2 X 3.0 MW CAPTIVE POWER PLANT ALONG WITH 8000 CASES/DAY OF IMFL/IMIL BOTTLING UNIT

SUBMITTED BY

STARTLIGHT ENERGY PVT. LTD.

KALAHANDI, ODISHA

CONTENTS

SUMMARY

1.0 Starlight Energy Pvt. Ltd. (SEPL) is a company registered under Indian Companies Act, 1956 having its registered office at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha.

2.0 The company is planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant alongwith around 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha.

3.0 The project is planned to be established in two phases. In phase 1, the company would install a 45 KLPD grain based distillery unit having 3.0 MW cogeneration power plant along and around 8000 cases/day of IMFL/IMIL bottling unit. After the commissioning of the phase 1, the promoters of the project would implement the phase 2 having identical project of 45 KLPD grain based distillery unit having 3.0 MW cogeneration power plant alongwith additional around 8000 cases/day of IMFL/IMIL bottling unit.

4.0 Kalahandi district occupies the Southwestern portion of Orissa and is situated at 20^{o}4'58.8'' N latitude and 82^{o}12'00'' E longitude. Kalahandi district has an area of 8,364.89 sq.km and ranks 7th among the 30 districts of Orissa. Forest occupies 4,964 of the total geographical area of the district, i.e. not cultivated area of the District in the year 1993 is 375752 Hect. The district has two distinct physiographic regions, the plain lands and the hilly tracts. The plan region runs Southward upto Bhawanipatna and then westward through Junagarh and Dharmgarh and then further up to the boundary of the district. The plains cover about 59 percent of the total area of the district. The hilly tracts are mostly located in the south western part of Bhawanipatna sub division. Some of the hilly regions are covered with dense forest.

5.0 The average annual rainfall of the district is 1378.20 mm. There are large variations in the day and night temperature. The summer seasons starts from the beginning of March. May is the hottest month when the maximum temperature is about 45 ^{o}C. December is the coldest month, as the mean daily minimum temperature is recorded at 11 ^{o}C. Relative humidity is generally higher from June to December.

6.0 The district has five types of soils. The area on the river bank of Udanti, Utei and Sagada are alluvial sandy and sandy loam spills. Tel, Indravati which form the tributaries of large rivers like Mahanadi and Godavari are amongst the principal rivers of Kalahandi. Bauxite, Graphite, Manganese, Iron and Quartz are some of the minerals available in the district.

7.0 The promoters of the project are already having more than 90 acres of land at village Village - Goud-Sargiguda, Taluka Junagarh, Dist. Kalahandi. Out of this, the promoters of the project would yearmark 40 acres of land for the proposed 2 x 45 KLPD grain based distillery project. The benefits of the location are as below;

- Required raw material is abundantly available in the nearby adjoining area.
- Raw materials can also be easily procured from grain surplus nearby states such as Chhatisgarh, West Bengal, Jharkhand
- Good availability of water
- Well connected by road/rail network
- Proximity to spirit and ethanol consuming market
- Manpower available for industrial purposes

8.0 The grain based distillery process will have process steps namely - grains receiving and storage, grains handling and milling, slurry preparation/liquefaction, saccharification and instantaneous fermentation, HIFERM fermentation, multi-pressure distillation, decantation, multi-effect evaporation, spirit storage.

9.0 The industry would install 3.0 MW extraction cum condensing turbine for the cogeneration power plant. 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. Biomass would be used as fuel for the boiler furnace.

10. The industry would install 2 x 300 m^3/day water treatment plant (D M plant), 2 x 1500 m^3/day cooling towers, two D G sets of 500 KVA capacities as a part of the utilities.

11. 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. The daily fuel (biomass) requirements for the 30

TPH boiler furnace of the cogeneration power plant would be around 5.5 MT/hour or 160 MT/day. Biomass is abundantly available in the Kalahandi district.

12. Besides the main products as mentioned before, the company would also produce byproducts such as CO_2, Fusel Oil, DDGS, Corn Oil (in case of maize used as raw material).

13. Fresh water requirements for the industry would be around 750 m^3/day for each phase and total requirements would be around 1500 m^3/day. This includes water requirements for grain based distillery operations, bottling requirements and boiler requirements.

14. During the operation of each phase of the project, waste water in the form of spent wash (355 m^3/day), spent lees (100 m^3/day), MEE condensate (215 m^3/day) would be generated. Besides this, misc. effluent such as floor/fermentor washing effluent @ 10 m^3/day, cooling towers blow down @ 35 m^3/day, domestic effluent @ 9 m^3/day, D.M. plant reject @ 15 m^3/day, bottle washing and spillages @ 22 m^3/day and boiler blowdown @ 15 m^3/day would also be generated.

15. The industry would install multiple effect evaporators for the treatment of spent wash thereby making the project as ZERO EFFLUENT DISCHARGE INDUSTRY. The spent less and MEE condensate would be reused in the process/utilities. The other misc. streams effluent after treatment would be used on land for irrigation purposes.

16. The estimated cost of project for the Phase 1 for 45 KLPD distillery project, 8000 cases of bottling of country liquor/IMFL and cogeneration of 3.0 MW of power would be around Rs. 50.00 Crores. The cost does not include the land cost. The estimated cost of project for the Phase 2 for 45 KLPD distillery project, 8000 cases of bottling of country liquor/IMFL and cogeneration of 3.0 MW of power would be 25 % more as the phase 2 commissioning would take atleast 2 years from the date of commissioning of the phase 1.

CHAPTER – 1

INTRODUCTION

Starlight Energy Pvt. Ltd. (SEPL) was incorporated on 20.10.2004 having its registered office at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha. The company is having two full time directors namely Shri Sunil Choudhary & Shri. Dulal Choudhury. The description of the directors is as below;

1. SHRI SUNIL CHOUDHARY, Director, Age : 44 years
   Father's Name : Late Pawan Kumar Choudhary
   Address : F – 9, Civil Township Rourkela – 769004 Orissa, India
   Education Qualification : B. E. (ChE) U.S.A University of Louisiana
   Experience : 15 years of Industrial Management

2. DULAL CHOUDHURY, DIRECTOR, Age : 62 years
   Name: Mr. Dulal Choudhury
   Father's Name: Shri. B Choudhury
   Address: Basanti Colony, Rourkela
   Education Qualification: B.Com
   Experience: 35 Years of Industrial Management

Besides this, the management team comprises of many other senior members. The company is managed by well - qualified persons having progressive attitude and qualification.

The promoters of the project are already having a small distillery unit, M/s Suidihi Distillery Pvt. Ltd. at Village Suidihi, Post Lathikata, District Sundergarh, Odisha. This unit is the first grain based unit in the state of Odisha. The promoters having learnt from the operation of the unit strongly believe that there is ample scope for a larger integrated grain based distillery in the State of Odisha.

Based on the past experience of the directors of the company, the company is planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant along and around 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha. The project is planned to be established in two phases. In phase 1, the company would install a 45 KLPD grain based distillery unit having 3.0 MW cogeneration power plant alongwith

around 8000 cases/day of IMFL/IMIL bottling unit. After the commissioning of the phase 1, the promoters of the project would implement the phase 2 having identical project of 45 KLPD grain based distillery unit having 3.0 MW cogeneration power plant alongwith additional around 8000 cases/day of IMFL/IMIL bottling unit.

The proposed project shall be catering to the demand of Odisha State and neighboring States where-in almost all liquor companies like Seagram, Jagatjit, ABD, Radico, USL and many others are manufacturing their reputed IMFL brand and due to shortage of ENA are importing ENA from other far away States which is taking time and also incurring losses of Government revenue. Also, the demand of Ethanol is growing and the government has made it mandatory for blending of minimum 5% Ethanol in Petrol. The implementation of the project shall be as below:

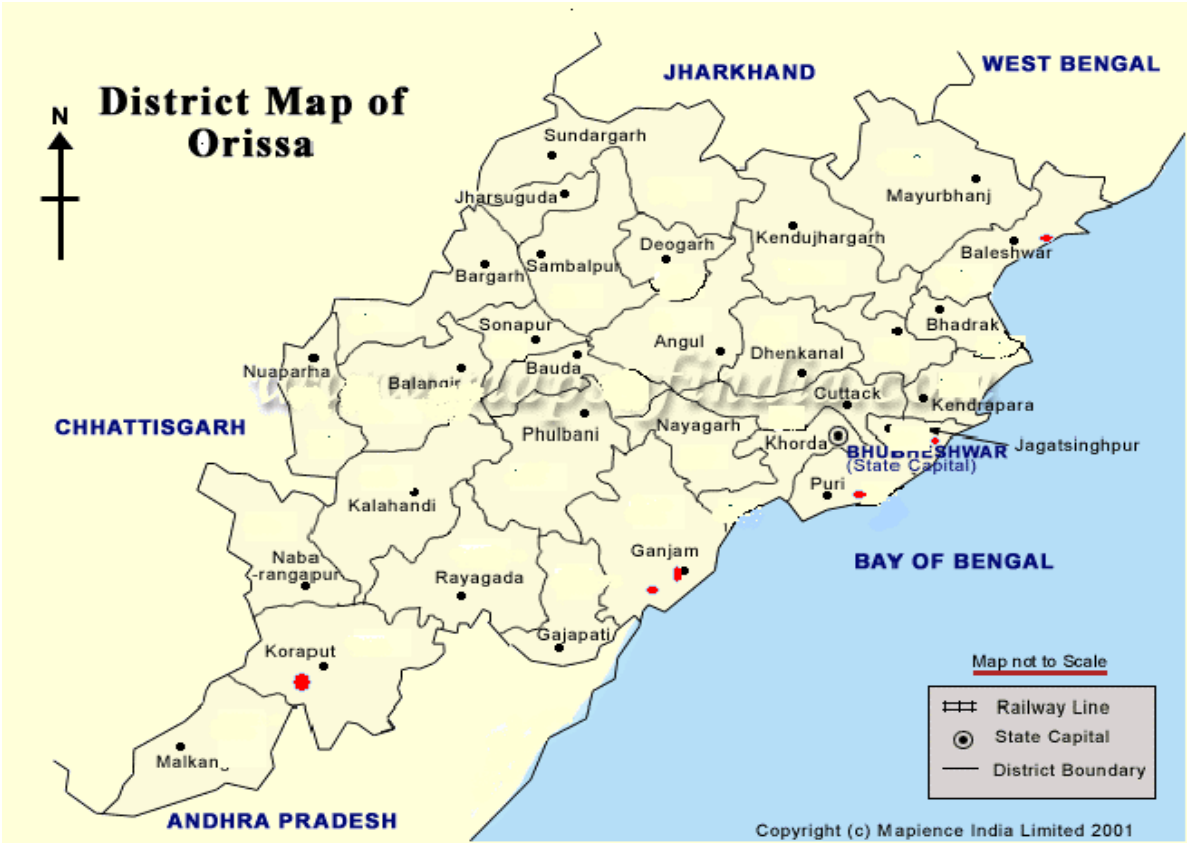
Phase	Project Description	Installed Capacity	Expected COD
I	Integrated Distillery Unit with IMFL/IMIL Plant, Biomass Power Plant- Phase I	45 KLPD with 8000 cases/ day of IMFL/IMIL Bottling Plant and 3.0 MW Captive Power Plant	15-12-2015
II	Integrated Distillery Unit – Phase II	45 KLPD with 3.0 MW Captive Power Plant	15-12-2017

CHAPTER – 2

PROJECT LOCATION

Starlight Energy Pvt. Ltd. are planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant along and around 8000 cases/day of IMFL/IMIL bottling unit at Village Goud Sargiguda, Taluka Junagarh, Dist Kalahandi, Odisha. The company has already purchased land at the said location for the proposed project.

2.1 About the State : Odisha, formerly known as Orissa is an Indian state on the subcontinent's east coast, by the Bay of Bengal. It is surrounded by the Indian states of West Bengal to the north-east and in the east, Jharkhand to the north, Chhattisgarh to the west and north-west and Andhra Pradesh to the south. Odisha is the 9th largest state by area in India, and the 11th largest by population. Oriya (officially spelled *Odia*) is the official and most widely spoken language, spoken by three quarters of the population.



DISTRICT MAP OF ODIHSA

2.2 ABOUT THE DISTRICT

Kalahandi district occupies the Southwestern portion of Orissa and is situated at 20°4'58.8'' N latitude and 82°12'00'' E longitude. It is bounded in the North by the District of Balangir and Nuapara, South by the District of Rayagada, West by the District of Nawarangpur and Raipur (Chhattisgarh) and East by the District of Rayagada and Boudh. The District Headquarters is at Bhawanipatna town which stands almost to the Eastern border. Kalahandi district has an area of 8,364.89 sq.km and ranks 7th among the 30 districts of Orissa. Forest occupies 4,964 of the total geographical area of the district, i.e. not cultivated area of the District in the year 1993 is 375752 Hect. In the same year, 11,602 hectors were left as fallow lands or cultivable wasteland.

2.2.1 Topography : The district has two distinct physiographic regions, the plain lands and the hilly tracts. The plan region runs Southward upto Bhawanipatna and then westward through Junagarh and Dharmgarh and then further up to the boundary of the district. The plains cover about 59 percent of the total area of the district. The hilly tracts are mostly located in the south western part of Bhawanipatna sub division. Some of the hilly regions are covered with dense forest.

2.2.2 Physiographics : The district has two sub-divisions, 12 Police Stations, five Tahsils, 13 Blocks, 1 Municipality, two N.A.Cs., 1 Treasury, 5 Sub-Treasuries and 195 Gram Panchayats of 2185 villages.

2.2.3 Rainfall and Climate : The climate of the district is of extreme type. It is dry except during monsoon. There are large varieties of day and night temperature. The average annual rainfall of the district is 1378.20 mm. The variation in the rainfall from year to year is not large. The monsoon starts late in June and generally lasts up to September. 90% of the rainfall is received from June to September. August is the month with more number of rainy days. About 28 % of rainfall is received during this month. Drought is normal feature of this district.

2.2.4 Temperature and Humidity : There are large variations in the day and night temperature. The summer seasons starts from the beginning of March. May is the hottest month when the maximum temperature is about 45 °C. The temperature drops down with the onset of monsoon towards the second week of June and throughout the monsoon the weather remains cool.

December is the coldest month, as the mean daily minimum temperature is recorded at 11 ^{o}C. Relative humidity is generally higher from June to December. It is lower (27 %) in the non-monsoon months. During August, it is the highest (70 %) and March is the month lowest when it is lowest (27 %). Northern plateau (at 2150 MSL) of Sunabeda in Komna Block of Nuapara district has a cooler climate so also the Rampur area (at 2700 Feet MSL).

2.2.5 Soil and Land Classification : The district has five types of soils. The red laterite soil which is different in phosphorus and nitrogen is found all over the district. Occurrence of heavy soil is common mostly under the foothill and hillocks in Bhawanipatna and Dharmgarh Tehsil. It is rich in potassium and Nitrogen but poor in Phosphorus. Sandy loan soil is seen in Lanjigarh and of the Bhawanipatna Tahsil. The area on the river bank of Udanti, Utei and Sagada are alluvial sandy and sandy loam spills. The fertility of soil in Dharmgarh and Jaipatna Tahasil areas is high.

The red soil, black clay, sand loam, yellow soils occur in the district with following percentages;

Red soil - 31.68%

Black clay (heavy) - 13.90%

Clay & sandy loam - 54.44%

2.2.6 Rivers : Tel, Indravati which form the tributaries of large rivers like Mahanadi and Godavari are amongst the principal rivers of Kalahandi. However, Tel is by far the longest and most important river of the District. The tributaries of river Tel and Moter, Hati Sagada, Ret, Uttei, Raul, Sundary, Undanti lands are also the important other rivers. Most of the rivers are rained and go dry during summer.

2.2.7 Minerals : Bauxite, Graphite, Manganese, Iron and Quartz are some of the minerals available in the district. Of these, only Bauxite and Graphite has been commercially exploited. Bauxite is found in Lanjigarh Block at Niamgiri in large scale. Manganese deposits are found mostly in Khariar Plateau of Nuapada District and Iron ores in places adjoining Koraput district. All these ores are of poor grade and are not considered suitable for economy exploitation. According to the National Council of Applied Economic Research, the known deposits of minerals in the district cannot by themselves sustain heavy mineral based industry.

MAP OF KALAHANDI DISTRICT

KALAHANDI DISTRICT AT A GLANCE

S. No.	Parameter	
1.	Total Geographical Area of the district	8364 sq. km.
2.	Area under Forests	2538.01 sq. km. (32 %)
3.	Area under agriculture (including forest land)	7920 sq. km.
4.	Total population of the district	1573054
5.	Sex ratio (female : male)	1003 : 1000
6.	Literacy Ratio	60.22 %
7.	Population Density	199/sq. km.
8.	Administrative setup	
	Number of Sub-Division	2
	Number of Tahsils	7
	Number of Municipality	1
	Number of N.A.C.	2
	Number of Blocks	13
	Number of Police Station	12
	Number of Gram Panchayat	273
	Total Number of villages	2236
	No. of Inhabited Villages	2099
9.	Land Data	
	Govt. Land	229337.58 hectares
	Forest Land	253801 hectares
	Non-forest Land	200681.86 hectares
	Gochar/Communal/Nalas	18618.99 hectares
10.	Total cultivable area	393550 hectares
	Area under paddy cultivation	183000 hectares
	Total irrigable area (through any means other than rain water)	114840 hectares
11.	Agricultural economic pattern	
	Marginal farmers (below 1 hectare)	64751
	Small Farmers(1 to 2 hectare)	42516
	Semi medium farmers(2 to 4 hectares)	35481
	Medium farmers(4 to 10 hectares)	17548

	Large Farmers (10.09 hectares and above)	1791
12.	Crops production (MT/annum)	
	Paddy	46497.33
	Wheat	6.46
	Maize	93.10
	Ragi	92.76
	Mung	99.14
	Biri	104.58
	Kulthi	161.93
	Til	9.53
	Groundnut	131.51
	Mustard	10.80
	Potato	120.47
	Sugarcane	3317.52
13.	% of village having electricity supply	62.96

2.3 SELECTION OF SITE

The basic criteria for the selection of site for the grain based distillery project are as below;

- Raw material availability
- Raw material cost
- Transportation cost
- Accessibility to markets within and nearby states
- Availability of water
- Availability of land in abundance
- Connectivity of road/rail network.
- Market for final Product

Based on the above assumptions, following states are fit for the installation of the grain based distillery projects;

- West Bengal
- Punjab
- Haryana
- Odisha

- Jharkhand
- Chhattisgarh

Advantages of the location at Village - Goud-Sargiguda, Taluka Junagarh, Dist. Kalahandi (Odisha) for setting up 2 x 45 KLPD grain based distillery project.

The promoters of the project are already having more than 90 acres of land at village Village - Goud-Sargiguda, Taluka Junagarh, Dist. Kalahandi. Out of this, the promoters of the project would yearmark 40 acres of land for the proposed 2 x 45 KLPD grain based distillery project. Besides this, the other benefits of the location are as below;

- Required raw material is abundantly available in the nearby adjoining area.
- Raw materials can also be easily procured from grain surplus nearby states such as Chhatisgarh, West Bengal, Jharkhand
- Good availability of water
- Well connected by road/rail network
- Proximity to spirit and ethanol consuming market
- Manpower available for industrial purposes

CHAPTER – 3

PROCESS DESCRIPTION

3.0 Starlight Energy Pvt. Ltd. are planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant alongwith around 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 having 3.0 MW cogeneration power plant alongwith additional around 8000 cases/day of IMFL/IMIL bottling unit would be installed. After the commissioning of the first unit, the company would start the installation of the similar second unit in phase 2.

3.1 Grain based Distillery Process/Operations

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

Figure 1 shows the schematic flow diagram of the process operations.

3.1.1 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.

3.1.2 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.

3.1.3 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.

3.1.4 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. CO_2 can then be taken to CO_2 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.

3.1.5 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.

3.1.6 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.

3.1.7 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).

3.1.8 ECOVAP Evaporation System - Integrated Evaporation Scheme

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 are 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.
- Cooling water from cooling tower is used in the surface condensers for condensing the vapors.

3.1.9 DWGS Dryer with Cooling and Conveying System

System Description for Dryer

- 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.
- 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.
- Dry product partially recycled back to Feed conditioner for feed conditioning through Product Screw & Recycle Conveyor.
- Entire operation of the Dryer is controlled through Control panel.

3.1.9 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.

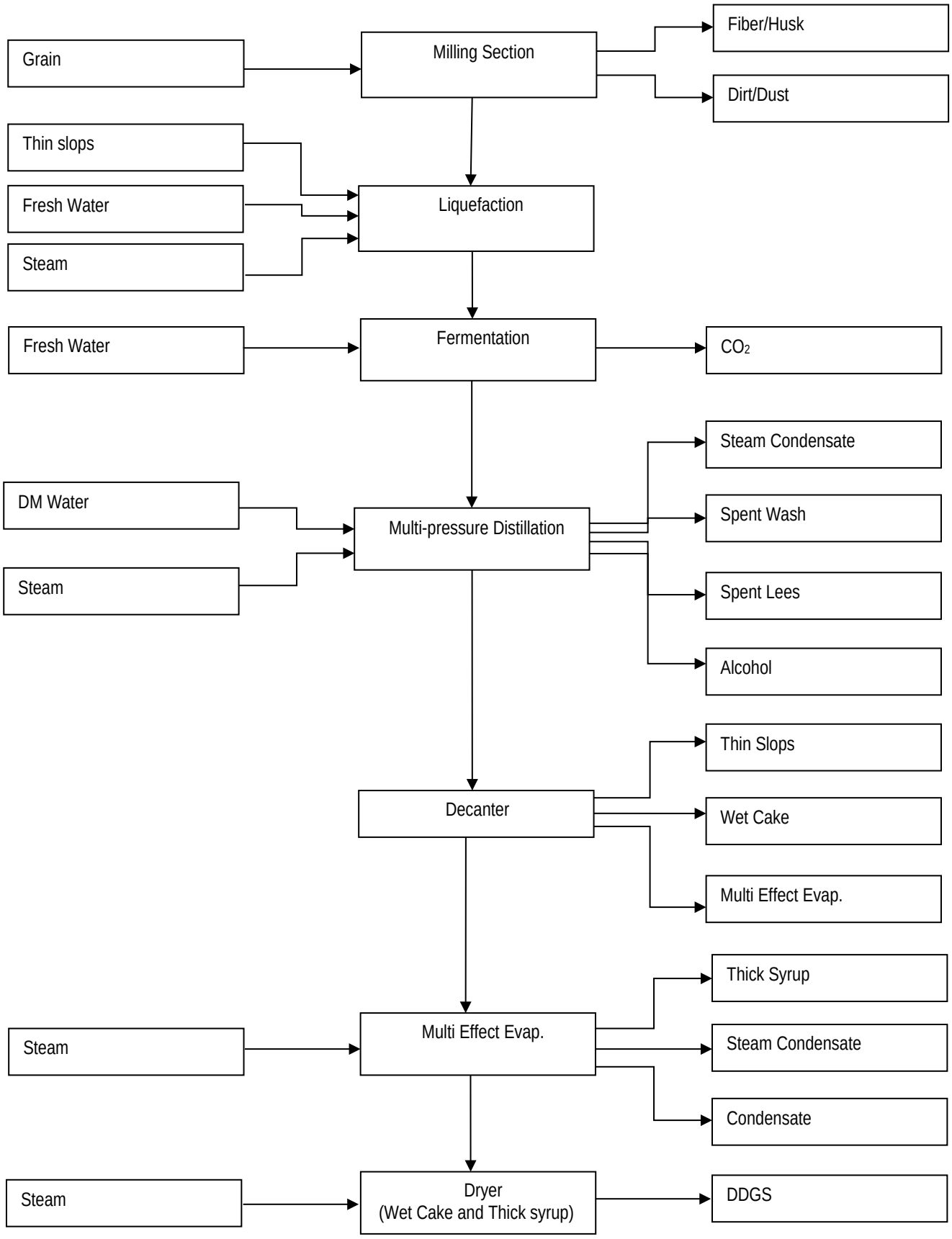


Figure 3.1 : Process Flow Chart of Grain based distillery

3.2 Bottling of country liquor/IMFL

Starlight Energy Pvt. Ltd. are planning to set up 8000 cases per day of bottling plant (each 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 litres) 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 bottling 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.

3.3 Co-generation Power Plant

Starlight Energy Pvt. Ltd. are planning to set up 2 x 3.0 MW 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 MW 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

3.3.1 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 Fluidised Bed. Combustion of fuel in this bed is termed as Fluidised 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 550^0 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 Fluidising Air Fan : It is used for fluidising 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 fluidising 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.

3.3.2 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 the 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.

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

3.4 Utilities

3.4.1 Water treatment plant – 2 x 300 m^3/day

It is proposed that the water to be used will be received from the river water. 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.

3.4.2 Electrical system

The plant power requirement (including that for power plant auxiliaries) will be about 2.0 MW each for 2 x 45 KLPD plants. Out of total installed power generation capacity of about 6 MW, the surplus power, after meeting in-house requirements, will be exported to state grid.

3.4.3 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.

3.4.4 Cooling water – 2 x 1500 m^3/hour

The maximum process and power plant cooling water requirement will be 1500 m^3/hour for each of the 45 KLPD distillation units. The cooling tower will be counter/cross flow induced draft cooling tower with total capacity of about 2 x 1500 m^3/hr capacity divided into four 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 re-entertainment of the vapors into the cooling tower. Evaporation and drift loss will depend on season and an average figure will be about 1.65 %. 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.

CHAPTER – 4

RAW MATERIALS

4.0 Starlight Energy Pvt. Ltd. are planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant along and around 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 having 3.0 MW cogeneration power plant and around 8000 cases/day of IMFL/IMIL bottling unit would be installed. After the commissioning of the first unit, the company would start the installation of the similar second unit in phase 2. The distillery would be operational for 330 days in a year.

4.1 Raw Materials Requirements for Grain based Distillery

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;

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

4.2 Biomass Requirements for Boiler

Starlight Energy Pvt. Ltd. would be installing 2 x 3.0 MW cogeneration power plant alongwith the distillery unit. The cogeneration power plant would be installed in two phases. After the commissioning of the first phase, the company would start the installation of the similar second unit in phase 2.

The daily fuel (biomass) requirements for the 30 TPH boiler furnace of the cogeneration power plant would be around 5.5 MT/hour or 160 MT/day. Phase wise daily consumption of biomass for the cogeneration power plant is given below;

S. No.	Item	Unit	Phase 1	Phase 2	Total
1.	Biomass consisting of rice husk, cotton stalk, mustard stalk etc.	MT	160	160	320

Agriculture occupies a vital place in the economics of Kalahandi District. It provides direct and indirect employment to around 68 % of the total work force of the district. The total cultivable area of the district is 391000 hectares covering 49.3 % of the total geographical area of the District.

In Kalahandi district, there are 93 nos. of rice mills established by different entrepreneurs for milling paddy with a total capacity 258 MT/H. So the total rice husk generation is around 225000 tonnes/year. The surplus biomass available for the power generation purpose in and around Kalahandi district is around 300000 tonnes/year, which mainly consists of rice husk and other crop & agricultural residues. The total power potential available in Kalahandi district is around 30 MW. Hence the biomass is readily available for the proposed total capacity of 6 MW (2 x 3.0 MW).

CHAPTER – 5

PRODUCTION

5.0 Starlight Energy Pvt. Ltd. are planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant along and around 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 having 3.0 MW cogeneration power plant and around 8000 cases/day of IMFL/IMIL bottling unit would be installed. After the commissioning of the first unit, the company would start the installation of the similar second unit in phase 2. The distillery would be operational for 330 days in a year.

5.1 Production from Grain based Distillery

Phase wise daily production of products and by-products from the distillery plant is given below;

S. No.	Item	Unit	Phase 1	Phase 2	Total
1.	ENA/RS/Ethyl Alcohol/Malt spirit	KL	45	45	90
2.	By-products				
	CO_2	MT	40	40	80
	Fusel Oil	MT	1	1	2
	DDGS	MT	25	25	50
	Corn Oil (in case of maize used as raw material)	MT	2	2	4

5.2 Production from Bottling Plant

Phase wise daily production of IMFL/country liquor from the bottling plant is given below;

S. No.	Item	Unit	Phase 1	Phase 2	Total
1.	IMFL/country liquor	Cases	8000	8000	16000

5.3 Production from Cogeneration Power Plant

Phase wise daily production of power and steam from the cogeneration power plant is given below;

S. No.	Item	Unit	Phase 1	Phase 2	Total
1.	Electrical Power	MW	3.0	3.0	6.0
2.	Steam	MT	600	600	1200

CHAPTER – 6

ENVIRONMENTAL MANAGEMENT AND POLLUTION CONTROL

6.0 Starlight Energy Pvt. Ltd. are planning to set up a 2 x 45 KLPD capacity grain based distillery unit having 2 x 3.0 MW cogeneration power plant along and around 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 having 3.0 MW cogeneration power plant and around 8000 cases/day of IMFL/IMIL bottling unit would be installed. After the commissioning of the first unit, the company would start the installation of the similar second unit in phase 2.

During the operation of the distillery unit, bottling plant and the cogeneration power plant, environmental pollution would be generated from different sources. The industry would adopt the latest technologies for the abetment of pollution generated by the production process.

6.1 Fresh Water Requirements

6.1.1 Grain Based Distillery Process

The impending water uses and consequent water pollution that would be caused by the grain based distillery may be because of the following;

a) Process and dilution water
b) Cooling water make-up
c) Washing (fermentor, bottle, floor, etc.)
d) Water treatment plant maintenance
e) Domestic consumption

Process and dilution water

The fresh water requirements in the process (in fermentation, liquefaction, ENA etc.) would be about 292 m^3/day for each unit (45 KLPD) of distillery plant. Besides this, 40 MT/day of direct steam would be consumed in the process for liquefaction section, in each unit. This figure is after adjusting for all recycle and reuse potential of various streams.

Cooling water make-up and blowdown

The cooling water throughput rate will be a maximum of 1500 m^3/hour for each unit. Around 1.65 % of the total recirculation water is lost in evaporation, drift, and blow-down losses. A part of the process water generated (215 m^3/day of condensate from Multi effect evaporation and 100 m^3/day of spent lees) would be reused for the cooling tower makeup water for each of the

unit. Thus, fresh make-up water requirement will be about 285 m^3/day. The blow-down rate will be less than 35 m^3/day for each of the unit.

Washing

The wash water requirement (for washing of fermentor and floor) will be about 20 m^3/day for each of the unit. Whole of this water will contribute to wastewater generation.

Water treatment plant maintenance

The D M water treatment requirement is about 300 m^3/day (soft water – for boiler, process, bottling, etc., requirements) for each of the unit. Treatment plant maintenance will generate about 15 m^3/day of reject water for each of the unit. Whole of this water will contribute to wastewater. The effluent streams may be acidic/alkaline (depending on regeneration of cationic/anionic ionic exchanger) and will have high TDS. There is no other pollutional parameter of concern.

Domestic consumption

Some of the water will be required for cooking, drinking, sanitation, etc. Average daily requirement is expected to be about 10 m^3/day, for each of the unit. Of this, less than 90%, i.e., ~9 m^3/day will be obtained as domestic wastewater for each of the unit.

Overall water requirement

Total average fresh water consumption for the grain based distillery project can be summarized as under;

S. No.	Purpose	Phase 1	Phase 2	Total
1.	Process & dilution water	292 m^3/day	292 m^3/day	584 m^3/day
2.	Cooling water	285 m^3/day	285 m^3/day	570 m^3/day
3.	Washing Requirements	20 m^3/day	20 m^3/day	40 m^3/day
4.	Water treatment plant	15 m^3/day	15 m^3/day	30 m^3/day
5.	Domestic requirement	10 m^3/day	10 m^3/day	20 m^3/day
	Total	622 m^3/day	622 m^3/day	1244 m^3/day

6.1.2 Fresh Water Requirements for Bottling Process

The average water requirement for blending during bottling of country liquor/IMFL will be about 25 m^3/day, for each of the unit, which will completely be present in final product. There will be no wastewater generation. Besides this, around 10 m^3/day of water would be required for the bottle washing and equipment washing.

S. No.	Purpose	Phase 1	Phase 2	Total
1.	Water requirements for blending	25 m^3/day	25 m^3/day	50 m^3/day
2.	Washing Requirements	10 m^3/day	10 m^3/day	20 m^3/day

6.1.3 Fresh Water Requirements for Boiler

The average boiler feed water requirement will be about 600 m^3/day for each of the boilers, out of which around 85%, i.e., about 510 m^3/day, will be met through return condensate. Thus about 15 %, of the steam generated, will be either used (in the industrial processes) or lost as blow-down (in order to maintain desired TDS concentration in the boiler feed water, continuous or intermittent blow-down of condensate is employed). Remaining feed water requirement will be met through D.M. water. The D.M. water required for the purpose will be about 90 m^3/day for each of the boilers. The boiler blowdown, contributing to wastewater generation will be a maximum of 15 m^3/day form each of the boiler.

S. No.	Purpose	Phase 1	Phase 2	Total
1.	Boiler water requirements	90 m^3/day	90 m^3/day	180 m^3/day

6.2 Effluent Generation

The grain based distillery process will result in generation of following types of effluents from the process operations;

a) Spent Wash from Distillation Process : The project would result in generation of spent wash from the distillation process. Spent wash @ 355 m^3/day would be generated during from each of the unit during the the production of alcohol @ 45 KL/day. The spent wash would be sent to the decanter where wet cake @ 45 MT/day would be separated from each of the unit. Further apart of the thin slops (60 m^3/day) would be reused in the process and remaining 250 m^3/day would be treated in multi-effect evaporation system.

b) Condensates from Process and MEE : The project would result in generation of process condensates (spent lees) from the distillation process and multiple effect evaporation condensates. Spent lees @ 100 m^3/day would be generated and MEE condensate @ 215 m^3/day would be generated from each of the unit. Whole of the condensates after treatment would be used for makeup water of cooling towers.

c) Effluent from other processes : Besides the above mentioned streams, effluent would be generated from misc. other streams such as – floor/fermentor washing effluent @ 10 m^3/day, cooling towers blow down @ 35 m^3/day, domestic effluent @ 9 m^3/day, D.M. plant reject @ 15 m^3/day, bottle washing and spillages @ 22 m^3/day and boiler blowdown @ 15 m^3/day, from each of the two units. This effluent would be moderately polluted and after treatment would be used on land for irrigation purposes.

The details of effluent generation from each unit are as given below;

S. No.	Purpose	Phase 1	Phase 2	Total
1.	Grain based distillery process			
	Spent Wash	355 m^3/day	355 m^3/day	710 m^3/day
	Spent Lees	100 m^3/day	100 m^3/day	200 m^3/day
	MEE Condensate	215 m^3/day	215 m^3/day	430 m^3/day
	Fermentor/floor washing	20 m^3/day	20 m^3/day	40 m^3/day
	Cooling tower blow down	35 m^3/day	35 m^3/day	70 m^3/day

	Domestic Effluent	9 m^3/day	9 m^3/day	18 m^3/day
	D M plant reject	15 m^3/day	15 m^3/day	30 m^3/day
2.	Bottling Section			
	Bottle washing and spillages	12 m^3/day	12 m^3/day	24 m^3/day
3.	Boiler Section			
	Boiler Blowdown	15 m^3/day	15 m^3/day	15 m^3/day

6.3 Air Pollution Generation

The air pollution will be due to combustion emissions released by the boiler furnaces. The boiler furnaces, AFBC type, will use chiefly rice husk as fuel, with a maximum consumption of about 5.5 MT/hour for each of the boiler.

The critical SPM concentration in the flue gas will be less than 30.0 g/Nm^3. Majority of the particulates (about 60-70%) will have sizes in the range of 2-10 μm. The emissions are expected to have temperature in the range of 140-150°C.

As per the statutory norms (as applicable to the industry), the flue gas emission shall not have SPM levels (in the stack) exceeding 100 mg/Nm^3. Additionally, the stack height requirements for discharge of emissions will need to be complied with.

DG sets : The industrial unit is planning to have two DG sets, each of 500 kVA as backup to state power supply. As per the applicable norms, the DG sets will be housed in an acoustic chamber. The combustion emission outlet, of the DG set, will be provided with a muffler along with a minimum stack height of 5.5 m above the height of nearest building.

6.4 Solid Wastes Generation

The grain based fermentation will result in high protein solids @ 25 MT/day from each of the unit. It has potential to be used for cattle feed making.

The boiler furnace will result in ash generation @ 15 MT/day from each of the unit.

6.5 Hazardous Waste Generation

The plant facility will result in generation of about 1 kL/year of spent oils (lubricants and transformer oil), which will be stored on site and sold to authorised recyclers.

6.6 THE POLLUTION CONTROL SYSTEM

6.6.1 Wastewater Treatment System

The industry would install multiple effect evaporators for the treatment of spent wash generated from the industry. Whole of the spent wash after decantation would be sent to the MEE for concentration of solids. The details of the MEE for spent wash are as given below;

Multiple Effect Evaporation

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 are 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.
- Cooling water from cooling tower is used in the surface condensers for condensing the vapors.

Treatment of Condensates

The spent lees and condensates from stage I and stage II of multiple effect evaporation (315 m^3/day) from each unit would be collected in a collection tank. The condensates would be treated in a condensate polishing unit consisting of aeration, clarification, sand filteration and activated charcoal filteration before its final reuse in cooling water makeup. The industry would install two separate condensate polishing units with each unit of distillery plant as per Phase 1 and Phase 2, development. The detailed design consideration of one set of condensate polishing unit are as follows;

Collection tank

The collection tank will be provided with an HRT of about 6 hours for 315 m^3/day of effluent. So, the collection tank will have a total capacity of around 80 m^3. The tank will have conventional rectangular geometry.

Aeration tank

The tank will have completely mixed flow regime. The specifications of the tank are as under;

	Flow Rate	–	315 m^3/day
1.	BOD loading	–	500 mg/l
2.	MCRT	–	6 days
3.	F/M	–	0.2
4.	MLSS	–	3500 mg/l
5.	MLVSS/MLSS ratio	–	0.8
6.	HRT	–	20 hours
7.	Effective tank volume	–	~ 300 m^3
8.	Air requirement (for diffused aeration)	–	~ 800 m^3/hour
9.	Nutrient ratio (BOD:N:P) required	–	100:7:1
10.	Treatment efficiency (BOD_3 removal)	–	> 95%

The tank will be provided with fine-bubble diffused aeration system. The air is supplied by the twin-lobe roots blowers of desired capacity at 0.5 kg pressure.

Secondary clarifier

The secondary settling unit is meant to separate the solids from the mixed liquor from the aeration tank. The process is very critical for the efficient operation of the ASP. The clarifier can be described as under;

a)	Design overflow rate	=	16 m^3/m^2.day
b)	Peaking factor	=	2.5
c)	Design flow (at p.f.)	=	33 m^3/hour
d)	Settling area required	=	50 m^2

The secondary clarifier will be rectangular in geometry. The separated solids (underflow) would be either recycled back into the aeration tank or would be wasted (to adjust for the excess sludge generated) onto sludge filter beds.

Intermediate Storage Tank

An intermediate storage tank of around 2 hours HRT would be provided for feeding the treated effluent in the pressure sand filter and activated charcoal filter. The tank will have conventional rectangular geometry.

Sand Filteration

The pressure sand filter will have following specifications;

a)	Working principle	–	down flow
b)	Maximum flow rate	–	20 m^3/hour
c)	Minimum flow rate	–	10 m^3/hour
d)	Maximum working pressure	–	3 kg/cm^2
e)	Minimum working pressure	–	1.5 kg/cm^2
f)	Pressure vessel type	–	vertical cylindrical
g)	Filtration rate	–	14 m^3/m^2.hour
h)	Effective diameter	–	1500 mm
i)	Effective height	–	2500 mm
j)	Filteration media type	–	Graded sand with under bed
k)	Top layer (anthracite 1-2 mm)	–	700
l)	Second layer (sand 0.4-0.8 mm)	–	600 mm
m)	Total bed depth	–	1300 mm
n)	Backwash velocity required	–	0.8-1.2 m^3/m^2.min
o)	Backwash water feed rate	–	~1 m^3/min

Activated Charcoal Filteration

The activated charcoal filter will have following specifications;

a)	Working principle	–	down flow
b)	Maximum flow rate	–	20 m^3/hour
c)	Minimum flow rate	–	10 m^3/hour
d)	Maximum working pressure	–	3 kg/cm^2
e)	Minimum working pressure	–	1.5 kg/cm^2
f)	Pressure vessel type	–	vertical cylindrical
g)	Filtration rate	–	16 m^3/m^2.hour
h)	Effective diameter	–	1500 mm
i)	Effective height	–	2500 mm
j)	Filteration media type	–	charcoal with minimum 600 iodine value
k)	Total bed depth	–	1300 mm
l)	Backwash velocity required	–	0.8-1.2 m^3/m^2.min
m)	Backwash water feed rate	–	~1 m^3/min

Final Treated Effluent Storage Tank

The final treated effluent storage tank will be provided with an HRT of about 4 hours. The tank will have conventional rectangular geometry. Treated effluent from this tank would be transferred to the cooling towers for their makeup requirements.

Treatment of Other Streams

Effluent generation from other misc. streams as discussed above would be less than 110 m^3/day for each of the unit. The industry would install two separate condensate polishing units with each unit of distillery plant as per Phase 1 and Phase 2, development. The mixed effluent would be moderately polluted. The mixed effluent would be collected in a collection tank. Thereafter it would be treated through anaerobic biofilteration, aeration and clarification. The treated effluent would be disposed on land for irrigation purposes. The detailed design consideration of effluent treatment plant for one set of the unit is as follows;

Collection tank

The collection tank will be provided with an HRT of about 8 hours for 110 m^3/day of effluent. So, the collection tank will have a total capacity of around 35 m^3. The tank will have conventional rectangular geometry.

Primary clarifier

The primary settling unit is meant to separate the solids from the untreated effluent. The process is very critical for the efficient operation of the ETP. The clarifier can be described as under;

a)	Design overflow rate	=	12 m^3/m^2.day
b)	Peaking factor	=	2.5
c)	Design flow (at p.f.)	=	12 m^3/hour
d)	Settling area required	=	23 m^2

The primary clarifier will be rectangular in geometry. The separated solids (underflow) would be wasted onto sludge filter beds.

Anaerobic Biofilter

Average Flow Rate assumed	110 KLPD
Average COD Load	6000 mg/l
Peak daily COD Load	500 kg/day
COD loading assumed	0.3 kg/m^2.day
Surface area required	2000 m^2
Surface area available per m^3 with media	110
Volume of media required	18
Capacity of tank	110 m^3

Aeration tank

The tank will have completely mixed flow regime. The specifications of the tank are as under;

	Flow Rate	–	110 m^3/day
1.	BOD loading	–	600 mg/l
2.	MCRT	–	6 days
3.	F/M	–	0.2
4.	MLSS	–	3500 mg/l

5.	MLVSS/MLSS ratio	–	0.8
6.	HRT	–	24 hours
7.	Effective tank volume	–	~ 110 m^3
8.	Air requirement (for diffused aeration)	–	~ 400 m^3/hour
9.	Nutrient ratio (BOD:N:P) required	–	100:7:1
10.	Treatment efficiency (BOD_3 removal)	–	> 95%

The tank will be provided with fine-bubble diffused aeration system. The air is supplied by the twin-lobe roots blowers of desired capacity at 0.5 kg pressure.

Secondary clarifier

The secondary settling unit is meant to separate the solids from the mixed liquor from the aeration tank. The process is very critical for the efficient operation of the ASP. The clarifier can be described as under;

a)	Design overflow rate	=	16 m^3/m^2.day
b)	Peaking factor	=	2.5
c)	Design flow (at p.f.)	=	12 m^3/hour
d)	Settling area required	=	17 m^2

The secondary clarifier will be rectangular in geometry. The separated solids (underflow) would be either recycled back into the aeration tank or would be wasted (to adjust for the excess sludge generated) onto sludge filter beds

Septic Tank for Domestic Treatment

The septic tank will provide and effective HRT of at least 48 hours, for maximum daily flow, to biologically stabilize, partially, the organic pollution load. A two compartment septic tank will be used for the purpose. The stabilisation compartment (first compartment) will have volumetric capacity of 20 m^3/day, with aspect ratio (length:width) of at least 3. Floor slope at 1:5 will be provided for sludge accumulation. The effective submerged depth of tank will not exceed 2.5 m. Provision will be made for periodic withdrawal (pumping out) of accumulated sludge. The actual tank dimensions will be worked out to suit the process and site requirements.

6.6.2 Air pollution control system

a) The each of the boiler furnaces will use a maximum of 5500 kg/hour of biomass as fuel.

b) The air-fuel ratio (combustion air) required for complete combustion is 1:5.8, i.e., 1 kg of fuel requires about 5.8 kg (~ 4.8 Nm^3) of air – assuming 30% excess air.

c) Flue gas generation will be about 6.8 kg/kg of fuel.

d) Maximum rate of emission generation will be about 27000 Nm^3/hour.

e) The temperature of the flue gas at the outlet of the furnace will be about 140-150°C.

f) The critical SPM levels will be less than 30000 mg/Nm^3.

g) Sufficient velocity will be maintained in the ducts/conduits in order to ensure that there is un-clogged flow.

h) All of the bends, in the gas flow ducts, are recommended to have throat radius of 2 times the diameter of the duct. Sharp bends, in the ducts/conduits are to be completely avoided.

i) The emissions follow ideal gas behaviour. Gas flow is incompressible.

j) Due consideration has been accorded to the changes in gas properties and behaviour with changes in temperature.

k) All inlets, outlets, and approaches are proper, so that there is no turbulence in the flow. The inner surfaces of the ducts and the APCD (coming in direct contact of the gas flow) will be reasonably smooth. There will not be any kind of leakage from any part of the duct/conduit, APCD, or machinery.

l) The sampling port will be provided in the stack, such that its height is, at least, 8 times the stack diameter, from the inlet to the stack. The emission shall be discharged into the atmosphere at a height, above the sampling port, at least 2 times the stack diameter.

m) *While the specifications and operating parameters, being specified hereunder, represent theoretically optimised values, there may be some variation in any of these during actual erection/commissioning (to suit site conditions) and operational fine-tuning of the system. Every effort will be made to ensure that the system's performance does not get affected adversely.*

Approach duct

There will be two ducts conveying furnace emissions into the APCD and each will have a diameter of 1200 mm. All bends in the ducts will have throat radius of at least 2500 mm.

Electro-static precipitator (ESP)

Electrostatic precipitator would be installed to each of the boiler furnaces. The ESP will have following technical specifications;

1.	Design gas flow rate	–	27000 m^3/hour
2.	Temperature	–	140-150ºC
3.	Maximum inlet dust load	–	22 g/Nm^3
4.	Outlet emission dust load	–	<100 mg/Nm^3
5.	Plate area	–	1000 m^2
6.	Specific collection area	–	50 m^2/m^3s
7.	Velocity through ESP	–	0.50 m/s
8.	Treatment time	–	~22 s
9.	Migration velocity	–	~4.9 cm/s
10.	Number of fields	–	3
11.	Efficiency	–	> 99.54%

Collection electrode specifications;

1.	Height of Panel	–	6 meters
2.	Material	–	IS 513/CRCA
3.	Total no. of plates	–	240
4.	Width of panel	–	735 mm
5.	Thickness	–	18 SWG

Emitting (discharge) electrode specifications;

1.	Height of panel	–	6 meters
2.	Total no. of electrodes	–	1350
3.	Type	–	Spiral
4.	Material	–	ERW tubes and carbon steel studs
5.	Spacing between emitter & collector electrode	–	200 mm
6.	Spacing between collecting plates	-	400 mm

Electrical specifications;

1.	TR sets	–	3 nos.
2.	TR control type	–	Microprocessor controlled
3.	Nos. per field	–	1
4.	TR rating Output voltage Output current	 – –	 120 kV DC 3 x 300 mA

Rapping system specifications;

1.	Type	–	Microprocessor based electromagnetic plunger
2.	Total no. of rapper per unit	–	18
3.	Rapper impact force (max.)	–	20 ft. lb. (adjustable)

Design pressure

1.	Maximum	–	± 300 mm WG
2.	Maximum pressure drop – flange to flange	–	20-25 mm WG

Power consumption

- Maximum 120 kW – this includes corona (without losses), rapper, PA system, insulator heaters, hopper heaters, RAVs.
- Power consumption is at steady state for the rated inlet parameters in the basis of design.

The flue gas cleaning system will achieve SPM removal efficiency of more than 99.54%, resulting in emission discharge with SPM concentration of less than 50 mg/Nm^3.

Stack

The stack shall have adequate height to properly disperse SO_2 generated or 30 m, whichever is more. The stack height is calculated using the equation;

$$H = 14\ (Q)^{0.3}$$

Where, H is stack height (in m), and

Q is quantity of SO_2 generated (in kg/hour).

a) Rate of fuel combustion = 5.5 MT/hour

b) Rate of combustion of S (maximum) = 5.5 kg/hour

c) Maximum SO_2 in the emissions (Q) = 11 kg/hour

d) Stack height (minimum) = 30 m

e) Stack diameter = 1.0 m

f) Height of sampling port above inlet = 12 m (minimum)

A sampling port with platform shall be provided for monitoring purposes. A ladder arrangement shall be provided to access the sampling port.

Blower (ID fan)

To satisfy the suction requirements, and to compensate for the pressure drops (flow losses), a centrifugal blower shall be provided. It will have the capacity to produce the flow rate of 30 Nm^3/s and total pressure of 0.25 m of water column.

6.6.3 Ash management

The air pollution control system, for the new boiler furnace, will comprise of;

a) Ash vessels

b) Conveying pipes

c) Ash silo

d) Ash storage

e) Ash disposal

This ash handling will be totally enclosed system. The ash handling system shall be designed to take care of 100% fuel burning. Ash collected from the bottom of furnace (bottom ash) and the ash collected in the air heater hoppers and ESP (air pollution control system) hoppers will be taken to an ash silo through a pneumatic conveying system. Ash silo will have the capacity of storage for 1 day of ash. The ash from the silo will be unloaded through the ash conditioner and stored on land. This ash will be finally used for the making of flyash bricks within the premises.

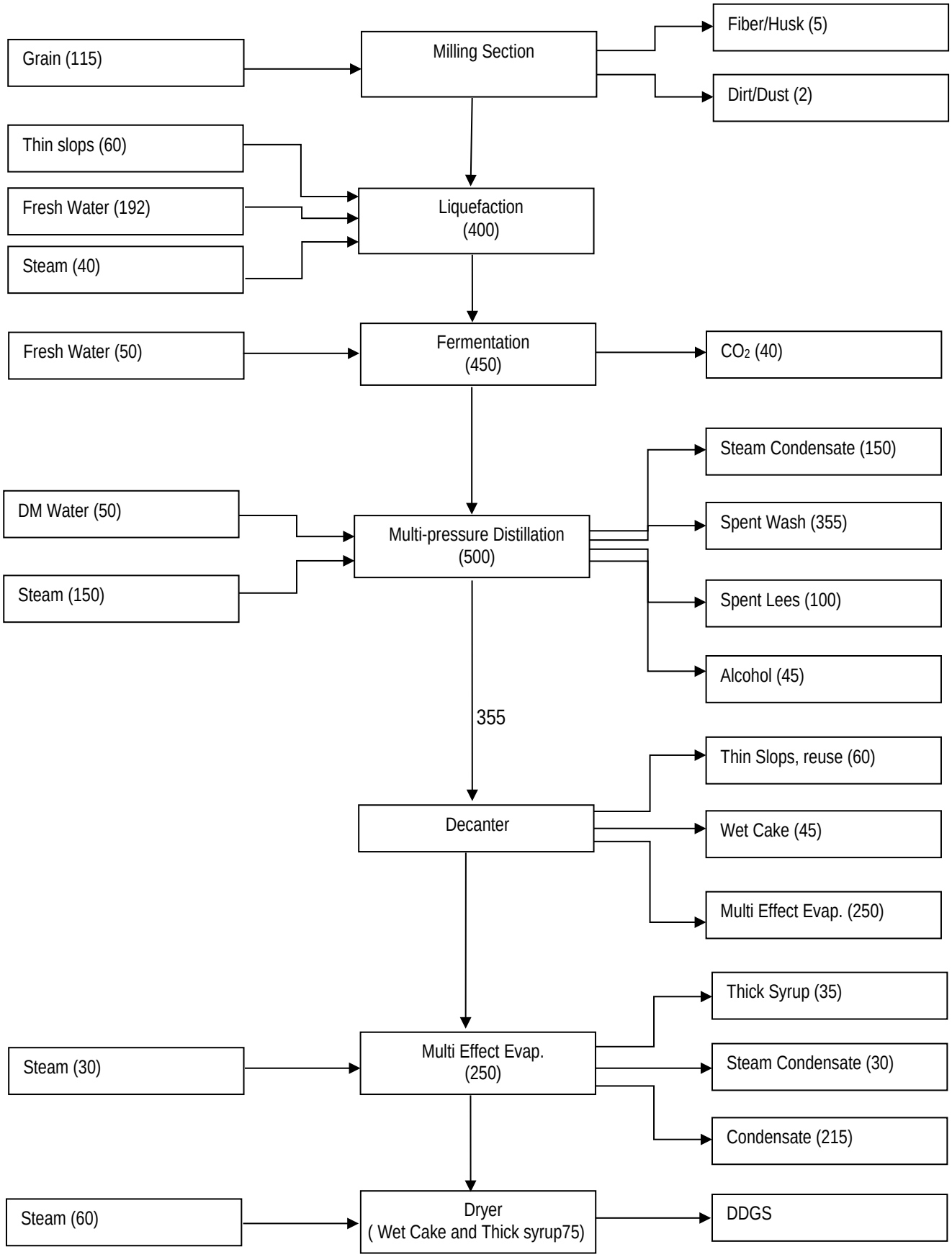
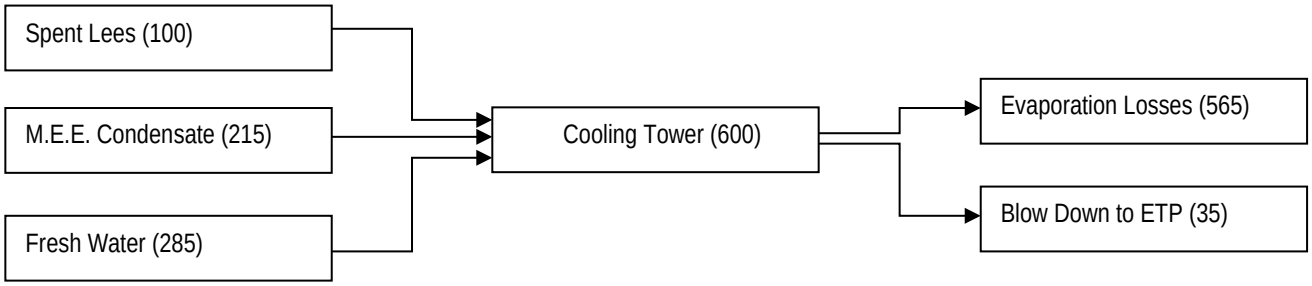


Figure 2 : Idealised Water Balance (for 45 KLPD distillery plant)

All values are in V/V except grains which are in MT/day

Cooling Tower Balance



Water Balance for Misc. use

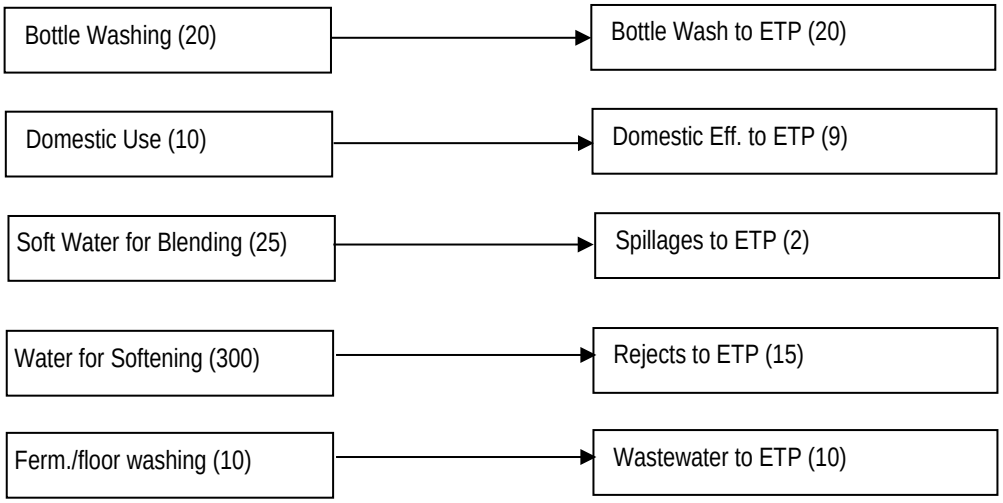
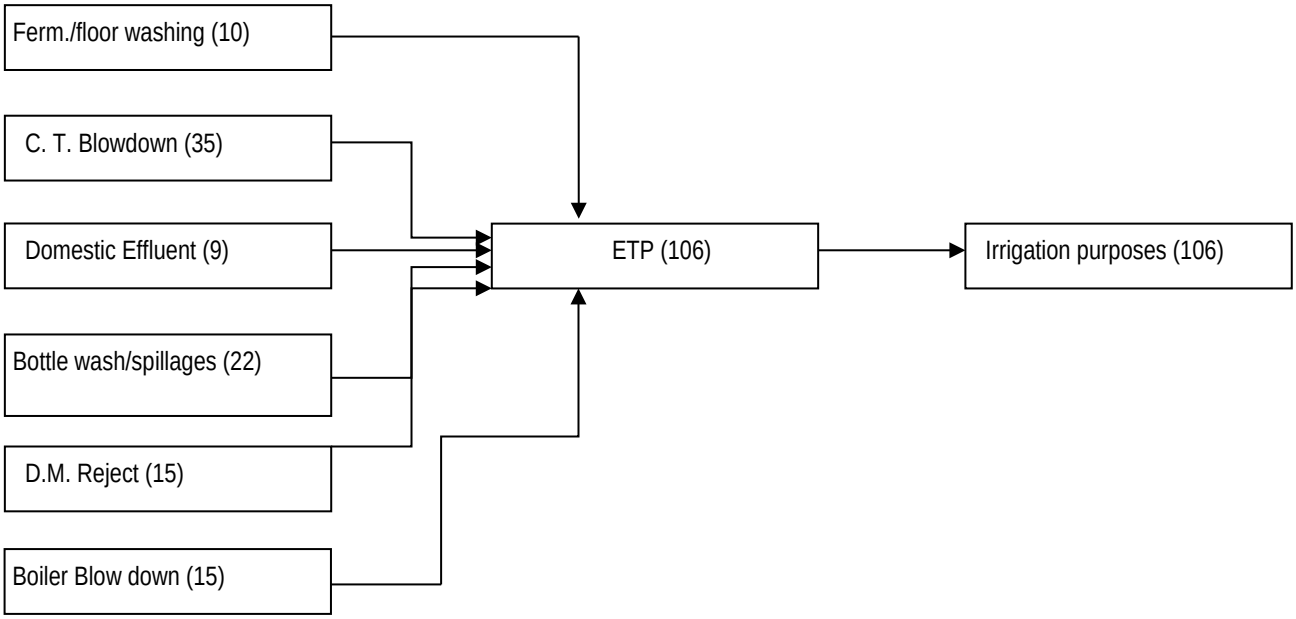


Figure 2 (contd...) : Idealised Water Balance (for 45 KLPD distillery plant)

All values are in MT/day

Water Balance for Treatment



CHAPTER – 7

PROJECT ESTIMATES

ESTIMATED OVERALL PROJECT INVESTMENT

The estimated cost of project for the Phase 1 for 45 KLPD distillery project, 8000 cases of bottling of country liquor/IMFL and cogeneration of 3.0 MW of power would be as below;

Section	DESCRIPTION	AMOUNT (Rs. in Lacs)
Section A	Supply of Plant & Machinery : Grain Storage silos (30 days) Section including Grain loading & pre-cleaning along with MCC electricals and Instrumentation.	125.00
	Supply of Plant & Machinery : Grain Milling Section Twin mill along with MCC electrical and Instrumentation. (Indian Make)	150.00
	Supply of Plant & Machinery : Grain flour handling & weighment, common equipment along with respective MCC electricals & Instrumentation	
SECTION B	Supply of Plant & Machinery : Liquefaction Section along with MCC electricals and PLC- SCADA based Instrumentation.	1270.00
	Supply of Plant & Machinery: Saccharification & Fermentation Section (With MS+Epoxy Fermentors) along with MCC electricals and PLC-SCADA based Instrumentation.	
	Supply of Plant & Machinery: Multi-Pressure Distillation Section along with MCC electricals and PLC SCADA based Instrumentation.	
	Supply of Plant & Machinery: Decantation Section including Decanter Centrifuge along with MCC Electricals and Instrumentation. Integrated Evaporation of Part Thin Slops Plant alongwith MCC Electricals and (common) PLC- SCADA based Instrumentation.	
	Supply of Plant & Machinery: DWGS Drier with Cooling & Conveying, Semi-Auto Bagging system along with its MCC Electricals & Instrumentation.	
	Supply of Plant & Machinery: Daily Spirit Receivers & Alcohol Bulk Storage along with MCC Electricals & Instrumentation.	
	Auxiliaries for Process Sections including Cooling Tower, CWRP, Diesel driven pump for distillation cooling tower in emergency, Piping Valves & Electricals; Instrument Air compressor & its piping from common Air compressor.	
	Evaporation process condensate treatment plant with its MCC, electrical & instrumentation.	

SECTION C	Boiler with Accessories: (30 TPH; 45 kg/cm^2_g; 440^{O}C) Section along with MCC electricals and PLC Instrumentation. Includes Main Boiler, Fuel Feeding, Ash Handling, Bag Filters, Multi-Cyclone, PRDS/DSH, Part Steam Piping upto Turbine, etc.	400.00
	Turbine & Alternator: Back Pressure Type (3.0 MW) along with electrical and Instrumentation. (Make Triveni/Maxwatt)	180.00
	Steam Piping &Valves, Interconnections, Condensate Piping, PRDS/DSH, Insulation, Steam Header, etc.	
SECTION D	Electrical distribution : Transformer, DG Sets, Power Control Center, Cabling from PCC to respective MCC, Earthing, Synchronization Panel, In-Plant & Yard Lighting, etc.	180.00
SECTION E	Borewell (1 No.) ; Water Treatment Plants (Soft Water & DM Water), Water distribution Piping & Valves, Flow-meters & Tantalizers, (Instruments) etc.	120.00
SECTION F	Bottling & Blending Section : 6 Semi-Automatic Lines ; 16 Blending Tanks ; 6 Finished Product Tanks, Misc. Electricals, Filteration, ENA & DM Water Tank, etc. – Independent Bottling Hall Equipment	440.00
SECTION G	Fire Fighting arrangement, weigh bridge, laboratory equipment.	125.00
SECTION H	Effluent Treatment Plant (ETP) for miscellaneous streams.	90.00
SECTION I	Complete MS Structural work for Process section and utility section such as columns, Beams, Roof truss, Gratings, Hand railing, Staircases, Tie beams etc including interconnecting Steam & Water distribution Pipe Racks, Cable Tray, Ash Silo,etc.	1400.00
	Complete Civil Works including Foundations, drains, land preparation, roads, buildings, offices, stores, workshop, canteen, guesthouse, Boiler Chimney, Blending & Bottling Halls, DDGS Storage Godowns, Flooring, Boundary Wall, Gates, Underground Water Tanks, Pits, Sumps, Borewells, Equipment & Structure foundations, platforms, laboratory, etc.Also included in the scope is Green Belt development, Rain Water Harvesting, etc.	
	Civil & Structural Works for above Bottling Hall	
SECTION J	Estimated TAXES & DUTIES – For all above scope	520.00
	TOTAL FIXED ASSETS	4000.00

TOTAL PROJECT COST : 45 KLPD

Sr. No.	Description	Amount
1	Total Fixed Assets	4000.00
2	Working Capital Margin	270.00
3	Interest on Term Loan during Construction	270.00
4	Pre-Operative Expenses	120.00
5	Contingencies	150.00
	TOTAL PROJECT COST	5000.00

The estimated cost of project for the Phase 2 for 45 KLPD distillery project, 8000 cases of bottling of country liquor/IMFL and cogeneration of 3.0 MW of power would be around 25 % more as the phase 2 commissioning would take atleast 2 years from the date of commissioning of the phase 1.