CHAPTER – II
PROCESS DESCRIPTION

2.0 TYPE OF THE PROJECT

NV Distilleries & Breweries (North East) Pvt Ltd is planning to set up a 200 KLPD Grain based distillery along with 15000 L/Day Malt Spirit, Bottling of IMFL, Country Liquor and 10 MW Cogeneration Power Plant at Village Bartezpur, PO Vijayanagar, District Kamrup (Assam).

As per the new EIA Notification dated 14th September 2006, the Project falls under Category "A", Project or Activity 5(g). Therefore it's necessary for NV Distilleries & Breweries (North East) Pvt Ltd to have Environmental Clearance from Ministry of Environment & Forests, New Delhi.

2.1 NEED FOR THE PROJECT

Alcohol has assumed a very important place in the Country's economy. It is a vital raw material for a number of chemicals. It has been a source of revenue by way of excise duty levied by the State Government on alcoholic liquors. It has a potential as fuel in the form of power alcohol for blending with petrol in the ratio of 20:80. The use of alcohol for the purpose of potable liquor is as higher as its use for industrial purposes. Alcohol is used for manufacture of country liquor consumed by common masses.

In the path of company's growth and development this project will serve as yet another milestone.

Looking at the market demand and absence of any distillery in the state, the company has planned for 200 KLPD Grain based distillery and to ensure self-sufficiency of the project with regard to power, a 10 MW co-generation power plant will be set up. Out of which upto 4.5 MW power will be the used for own consumption and about 5.5 MW will be supplied to the State Electricity Board.

2.2 LOCATION OF THE PROJECT

TABLE 2.1
PROJECT LOCATION

S.No.	Description	Details
1.	Village	Bartezpur
2.	PO	Vijayanagar
3.	District	Kamrup
3.	State	Assam

2.3 BASIC REQUIREMENT

2.3.1 Raw Material Requirement

The main raw materials required for this project will be grain flour, malt, rice husk, coal, pet coke, PNG, sulphuric acid antifoam agents, Di – ammonium phosphate, yeast , enzymes etc,. Their quantity with source, distance and mode of transportation is mentioned in the table given below:

TABLE – 2.2
RAW MATERIAL CONSUMPTION (PRODUCT WISE)

Raw Material	Quantity	Source	Distance (Approx.)	Mode of Transportation
Grain / Flour	480 – 540 TPD	Local market / Mandi's / Agencies	100 – 150 kms	Trucks / Railway
Malt	30 TPD	Barmalt / India Malt	1500 kms	Trucks
Rice Husk (RH) or Coal or Pet Coke (PC) or PNG	RH : 405 TPD OR Coal : 350 TPD OR PC : As reqd. PNG: As reqd.	RH : Local Mkt. Coal : Local / Imported	~ 250 kms	Trucks
Antifoam Agent	100 kg/day	Local Market	50 km	Tanker
Di-Ammonium Phosphate	400 kg/day	Local Market	50 km	Trucks
Yeast	400 kg/day	Local Market	50 km	Trucks
Enzymes	450 kg/day	Local Market	50 km	Trucks
Sulphuric Acid	200 kg/day	Local Market	50 km	Trucks
HSD	As reqd.	Local Petrol	20 km	Tanker

		Pump		

2.3.2 Water

The fresh water requirement of the proposed project is estimated as 3072 m^3/day. Water will be sourced from ground water as well as the recycle water. Detailed water balance is given in the table below:

TABLE – 2.3

TOTAL WATER INPUT

S. NO.	SECTION	QUANTITY TO THE PROCESS
1.	Process Water In Liquefaction & Fermentation	1362 MT
2.	DM water for RS dilution	1800 MT
3.	DM water for boiler feed	1560 MT
4.	Soft Water for Analyser Flash Tank	340 MT
5.	Soft Water for Vacuum Pump & Others	200 MT
6.	Blending (10000 Cases)	50 MT
7.	Bottle Washings (Considering 65 KL/Hr Recycling)	40 MT
8.	Soft Water Makeup for Cooling Tower	2000 MT
9.	Misc. Washing water	30 MT
10.	Other Domestic Usage	20 MT
11.	Process Water in Malt Fermentation	50 MT
	Total	**7452 MT**

TABLE – 2-4

TOTAL WATER OUTPUT

S. NO.	SECTION	QUANTITY FROM THE PROCESS
1.	Steam Condensate	1345 MT
2.	Spent Lees (Pr & Rect.)	1824 MT
3.	Water in Product	50 MT
4.	Bottle Washing	40 MT
5.	CT Evaporation & Drift Losses	2000 MT
6.	Spent Wash (Grain Slops)	2158 MT
7.	Malt Spent Wash	35 MT
	TOTAL	**7452 MT**

TABLE – 2.5
RECYCLING & UTILIZATION STREAM

S. NO.	S.ECTION	RECYCLE STREAM TO THE PROCESS
1.	Spent Lees Recycle for RS dilution	1350 MT
2.	Steam Condensate Recycle for Processboiler	1345 MT
3.	Spent Lees (Rect) - Cooling Tower Makeup	270 MT
4.	Spent Lees for Fermentor/Floor Washing	20 MT
5.	Thin Slops Recycle to Liquefaction Process	665 MT
6.	Process Condensate to Process	730 MT
7.	Total Recycling /Re-Utilizations of Water Per Day	**4380** MT

2.3.3 MAN POWER REQUIREMENT

The total manpower required will be 250-300 persons. For employment in unskilled category, preference will be given to local people. Employment in skilled category will be done from outside if the skilled labour force is not available in local areas.

TABLE – 2.6
MAN POWER REQUIREMENT

S. No.	Details	Manpower Requirement
1.	Skilled Manpower	25
2.	Semi-skilled Manpower	50-100
3.	Unskilled / helpers	25
4.	Contract (bottling + misc.)	150
Total		**~ 250 - 300 personnel**

2.3.4 Power

The total power requirement for the Project is estimated to be 4.5 MW. The companies proposal is to install 10 MW Co – Generation Plant in which up to 4.5 MW will be the own consumption & about 5.5 MW of power will be supplied to the State Electricity Board.

Power Connection is also being applied from State Electricity Board. However, this could be for the minimum requirement for operating only the Boiler & accessories.

2.3.4.1Steam Requirement

Steam generated from the boiler will be utilized in the generation of 10 MW Power. Steam generated from boiler will also be used for boiler feed water heating and distillery.

Fuel in the steam boiler will be burnt with the help of air in the boiler furnace. Water will be circulated in the boiler drum and tubes thus getting heated by the flame burning in the boiler furnace. Water comes out of the boiler drum located at the top of the boiler as steam. Flue gases rise in the boiler furnace and come in contact with the steam coming out of boiler drum. Steam after coming in contact with flue gases gets heated up further thus getting superheated. Super heated steam leaves the boiler in a pipe. Flue gases after super heating the steam pass through economizer where they pre-heat the boiler feed water before it enters the boiler drum. After economizer, flue gases pass through air pre-heaters where they heat the air which is fed to the boiler furnace for burning the fuel. After air pre heaters flue gases pass through an Electro Static Precipitator where the dust particles are collected on charged electrodes. After passing through ESP, clean flue gases with dust particle concentration also known as SPM level less than 150 mg/Nm^3 through a chimney of prescribed height. The dust is collected from the bottom of the ESP.

High pressure superheated steam from boiler will pass through a steam turbine and at the lower pressure will go to the condenser. The part of the steam will be extracted from the extraction points provided on the turbine, which will be used for distillery. The condensed steam will return to the steam boiler as condensate and will again be boiled as steam. While passing through the turbine, the high pressure and temperature steam will rotate the turbine rotor and an electric alternator mounted on the same shaft. Electric power will be generated by the alternator. This electric power generated will be consumed in house i.e. for running the distillery and utilities like boilers auxiliaries etc. and surplus power will be exported to the state grid.

The steam requirement for different purposes is given below:

TABLE – 2.7

STEAM REQUIREMENT

S. No.	Purpose	Steam Required
1.	Cooking & Liquefaction	8 TPH
2.	Multi – Pressure Distillation	27 TPH
3.	Evaporation	10 TPH
4.	Boiler Deaeration (Estimate)	4 TPH
5.	Misc Requirement -Turbine, etc	2 TPH
6.	Malt Spirit Plant	3 TPH
7.	Condensing Turbine	5 TPH
Total Steam Requirement		**59 TPH**
6.	Esimated Desuperheating Water Requirement	4 TPH
7.	**Actual Steam Flow Requirement**	**55 TPH**

2.3.4.2 Boiler Details

A boiler of 65 TPH capacity is proposed to be installed. Others details regarding this are mentioned in the table given below:

TABLE – 2.8
BOILER DETAILS

S. No.	Details	
1.	Type of Fuel	Rice Husk/ Coal/ Pet Coke/ PNG
2.	Capacity of Boiler	65 TPH
3.	Stack Height	45 m each
4.	Pollution Control Equipment Measures	Bag Filter/ESP

2.3.4.3 Details regarding the D.G. Sets

4 DG sets totalling a capacity of 6000 kVA (Two D.G. sets of 2000 KVA each and two D.G. sets of 1000 KVA) will be installed for the power backup. Details regarding the D.G. Sets are mentioned in the table given below:

TABLE – 2.9

DETAILS REGARDING THE D.G.SETS

S. No.	Details	
1.	Type of Fuel	HSD
2.	Capacity	• 2 X 2000 KVA • 2 X 1000 KVA
3.	Stack Height (above roof level)	• 9 m each for 2000 KVA capacity • 7 m for 1000 KVA capacity
4.	Pollution Control Equipment Measures	Adequate stack height/ Acoustic

2.4 TECHNOLOGY & PROCESS DESCRIPTION

2.4.1 Technical Specification of Raw Material

2.4.1.2 Specifications of Grains

Grains will have the following characteristics:

TABLE- 2.10

SPECIFICATIONS FOR GRAINS

S. No.	CONTENTS	% w/w (variation)
1	Starch	58 – 72
2	Total Solids	87 – 90
3	Moisture	10 – 13
4	Proteins	4 -13
5	Fats/Oils	0.5 – 5.0
6	Crude Fibres	0.3 – 3.0
7	Inorganic Ash	0.5 – 2.0
8	Other Organics	4-10

2.4.1.3 Fuel Analysis

TABLE – 2.11
ANALYSIS OF FUEL

S.No.	Parameters	Rice husk	Coal	Pet coke	PNG
1.	Moisture (%)	9.44	8	8	As Available
2.	Ash (%)	15.01	42	2	
3.	Carbon (%)	36.67	24	70	
4.	Hydrogen (%)	4.57	-	-	
5.	Nitrogen (%)	1.25	-	-	
6.	Oxygen (%)	32.88	-	-	
7.	Gross Calorific Value (Kcal/kg)	3275	3800	8000	
8.	Sulphur (%)	0.1	0.3	Below 6.7	

2.5 PROCESS & TECHNOLOGY

2.5.1 Grain Based Operation

A) STORAGE

Grains will be procured from various sources, such as Storage godowns, through agencies and will be unloaded into large Storage Silos after Pre-Cleaning.

B) GRAIN CLEANING, MILLING AND FLOUR HANDLING

The grain will be lifted in bucket elevators, screened followed by removal of stones and iron matter. Cleaned Grains will then milled using dry milling process in Hammer Mills. The flour will be fed through the bucket elevator and conveyed to the Batch Tipping Machine through a Screw Conveyor. The flour addition will 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.

C) SLURRY PREPARATION & LIQUEFACTION

Grain flour and process water will be fed at controlled rate to Slurry Tank. Mixed slurry will be taken to the Initial Liquefaction

Tank where additional quantity of water will be added as per the requirement. Viscosity reduction Enzyme and stabilizing chemicals and a portion of liquefying enzyme are also added at this stage. This slurry will be then "cooked" in the jet cooker.

The slurry will be continuously pumped to a steam jet cooker where high-pressure steam at 7.5 bar (g) rapidly raises the slurry temperature. The mixture of slurry and steam will be then passed through the Retention Loop. The retention loop has several "U" bends in series with sufficient capacity to provide the desired retention time at a given flow rate. The cooked mash will be discharged to a Flash Tank.

The cooking process, accomplished in the above manner, converts the slurry into a hydrated, sterilized suspension and is therefore susceptible to enzyme attack for liquefaction.

The gelatinized mash from the Flash Tank will be liquefied in the Initial and Final Liquefaction Tank where liquefying enzyme (alpha-amylase) will be added. The liquefied mash will be cooled in Mash Cooler and transferred to Saccharification cum fermentation section. This process initiates the formation of sugar.

D) SACCHARIFICATION AND INSTANTANEOUS FERMENTATION

Yeast Activation

Yeast seed material will be prepared in water-cooled Yeast Activation Vessel by inoculating sterilized mash with Active Dry Yeast. Optimum temperature will be maintained by cooling water. The contents of the Yeast Activation Vessel will be then transferred to Fermentor.

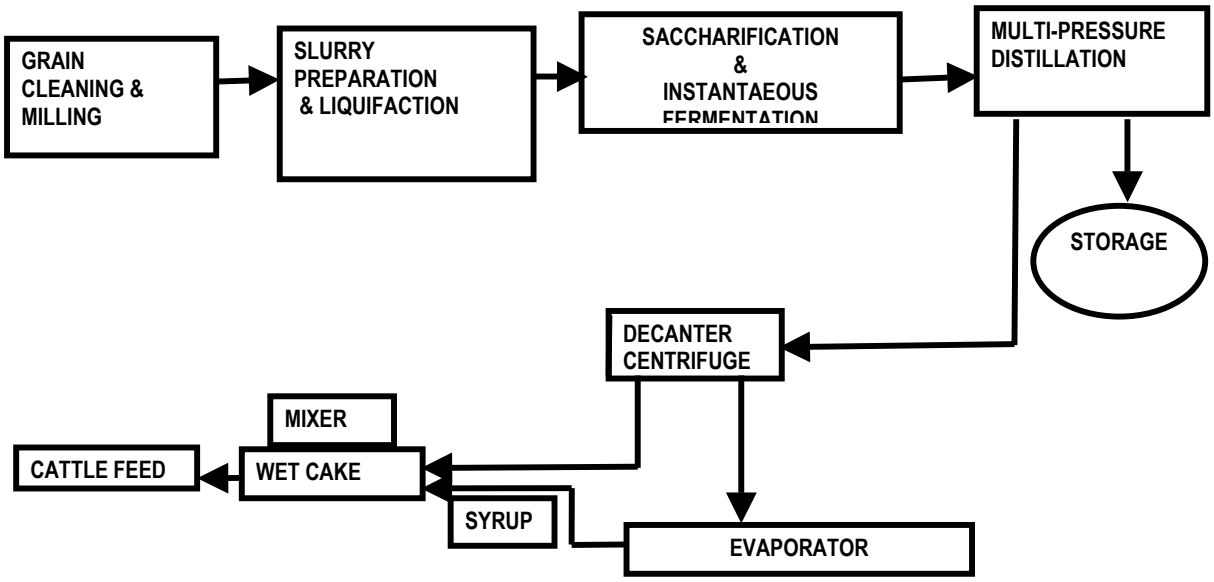
Saccharification & Instantaneous Fermentation

The Liquefied starch slurry comprising Dextrins will be partly taken for Yeast development in Yeast Activation vessel and majorly transferred into the Fermentor. Amyloglucozydase and

other nutrient Enzymes are first added to Saccharify the Starch Slurry causing formation of Sugars. Immediately, the Active Yeast will be introduced in the system for simultaneous Fermentation. The process of fermentation converts the fermentable substrate into alcohol. To prepare the mash for fermentation, it may have to be diluted with water. The pH of the mash will be adjusted by the addition of acid. Yeast will be available in sufficient quantity to initiate fermentation rapidly and complete it within the cycle time.

At the start of the cycle, the fermentor is charged with mash and contents of the Yeast Activation Vessel. Significant heat release takes place during fermentation. This is removed by passing cooling water through the Fermentor PHE's to maintain an optimum temperature. The recirculating pumps also serve to empty the fermentors into Beer Well. After the fermentors are emptied, they are cleaned with water and caustic solutions and sterilized for the next batch. The carbon dioxide evolved during the process is vented to atmosphere after recovery of alcohol in a scrubber.

PROCESS FLOW CHART FOR GRAIN BASED OPERATION



2.5.3 Malt Spirit Production

Malt spirit production will be 15000 L/day. Barley malt is the raw material used for production of malt spirit. Quantity of barley malt required will be 30 TPD. It contains starch and enzyme. Their enzymes get activated under certain condition of temperature and pH.

The following steps are involved in the manufacturing of Malt Spirit:

1) MALT HANDLING

Malt Received from nearby sugar factories will be unloaded & stored in silos and taken to mill for crushing**.**

2) MALT MILLING

The weighed barley will be screened to remove stones, dust etc. The screened malt will be taken to malt mill with the help of bucket elevator system. Barley malt is then crushed with roller mill. The gap between two rollers will be adjusted to get uniform ratio of crushed malt. (husk 20%, Coarse 70%, and fine 10%). The crushed malt is called **"Grist"** and stored in tank called Grist Bin.

Ratio of crushed malt is maintained to avoid choking at the time of brewing.

The grist will be mixed with hot water at predetermined temperature (64^{o}C, 85^{o}C and 95^{o}C) rested for fixed duration during which starch portion in the grist will be extracted by the water and simultaneously all the starch get converted in to fermentable sugar by the action of various enzymes present in the malt.

The liquid extract called “wort” will be separated from the solid spent grain and collected in wort receiver tank. Spent grain will be sold as cattle feed.

3) WORT COOLING

There are four phases of the fermentation

1. **Pitching**: About 10 million cells per ml are added to the wort.
2. **Yeast growth**: Yeast multiples resulting into a dense population of yeast biomass.
3. The yeast ferments the sugar into alcohol, CO_2.
4. After fermentation, the yeast floats to the top or settles to the bottom.

The optimum temperature at the start of fermentation, depending on the yeast strain, is between 8oC and 100oC. (This is why the wort has to be cooled down before yeast is pitched). Yeast after going a lag phase performs best at about 26oC to 30oC.

On an average fermentation takes about 3 days. At about 2nd day yeast flocculates out to the bottom of the fermentor. During fermentation the yeast assimilates the available sugars and generates alcohol and CO_2.

The wort after fermentation is called “wash”. The wash will be pumped into the primary distillation pot (wash pot) made up of copper, provide with heating arrangement called calendria and condenser for cooling the Vapour. Steam will be passed into

calendria where alcohol portion from wash get evaporated. Alcohol Vapour will pass through condenser gets condensed.

The distillate obtained from primary distillation is called “Low wine” is collected in Low wine tank. The primary distillation pot will be provided with sampling point to check the concentration of alcohol at regular intervals. Overall concentration of low wine will be checked.

The low wine will be pumped in secondary distillation pot made up of copper. Steam will be introduced into the pot by the coil heating arrangements. Alcohol Vapour will get evaporated, condensed in condenser and concentrated fresh malt spirit will be obtained which will be collected in fresh malt spirit tank.

Impure spirit with lower strength will be collected in impure spirits tanks, which will be mixed with next batch of secondary dilution process.

Spent wash generated during primary distillation will contain high BOD, where as spent generated during secondary distillation contains less BOD.

2.5.4 Power Co-generation [10 MW]

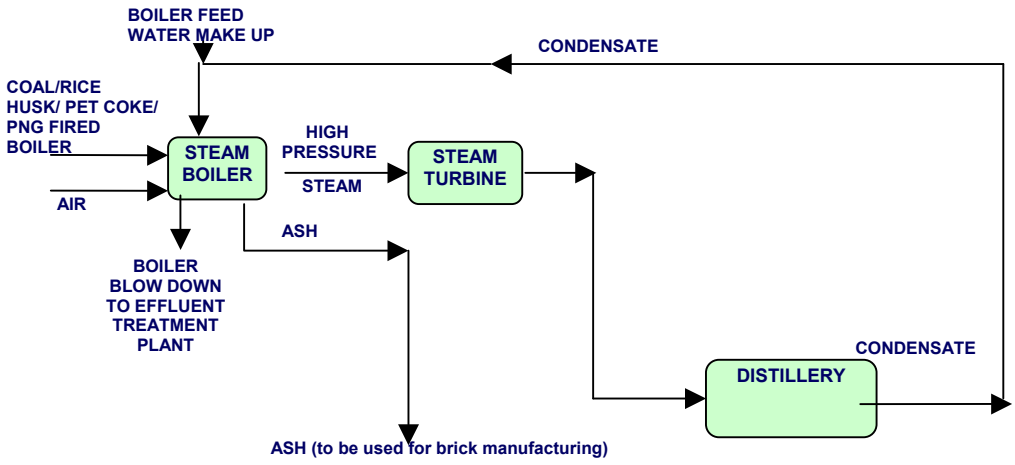
Detailed Manufacturing Process along with Technology Process

Proposed 10 MW co-generation plant consists of a high pressure water tube steam boiler and triple extraction cum condensing steam turbine. Fuel in the steam boiler will be burnt with the help of air in the boiler furnace. Water will be circulated in the boiler drum and tubes thus getting heated by the flame burning in the boiler furnace. Water comes out of the boiler drum located at the top of the boiler as steam. Flue gases rise in the boiler furnace and come in contact with the steam coming out of boiler drum. Steam after coming in contact with flue gases gets heated up further thus getting superheated. Super heated steam leaves the boiler in a pipe. Flue gases after super heating the steam pass through economizer where they pre-heat the boiler feed water before it enters the boiler drum. After economizer, flue gases

pass through air pre-heaters where they heat the air which is fed to the boiler furnace for burning the fuel. After air pre heaters flue gases pass through an Electro Static Precipitator where the dust particles are collected on charged electrodes. The dust is collected from the bottom of the ESP.

High pressure superheated steam from boiler is passed through a steam turbine and at the lower pressure goes to the condenser. The part of the steam is extracted from the extraction points provided on the turbine, which is used for distillery. The condensed steam returns to the steam boiler as condensate and is again boiled as steam. While passing through the turbine, the high pressure and temperature steam rotates the turbine rotor and an electric alternator mounted on the same shaft. Electric power is generated by the alternator. This electric power generated is consumed in house i.e. for running the distillery and utilities like boilers auxiliaries etc. and surplus power will be exported to the state grid. The power exported during season will be less and during non-crushing season maximum power will be exported to the grid.

PROCESS FLOW CHART FOR CO-GEN POWER PLANT



2.6 MITIGATION MEASURES

2.6.1 Air Pollution Control

The regular aerial emissions would be from Boiler, D.G. Sets and movement of Vehicles during transportation of raw materials. However following mitigation measures will be taken:

1. All the SO_2, NO_x, SPM, generated through burning assume to be discharge through stack of the boiler or incinerator. A 45-meter high stack equipped with the ESP will be installed with the boiler, will be equipped with 45 m Stack having ESP/Bag houses.
2. DG Sets will have stack of height, as per CPCB Guidelines.
3. Adequate measures for Fugitive Dust Emissions will be taken.
4. All the roads will be asphalted.
5. Development of Green Belt within the premises of the plant will help in attenuating the pollutants emitted by the plant.
6. Ambient air quality and stack emission would be regularly monitored to ensure that ambient air quality standards and suggested limits on stack emission loads would be met honestly at all the time.

2.6.2 Water Management

1. Water requirement of the plant is proposed to be met by tube wells and internal recycling of effluent and its utilization. Efforts would be made to conserve as much water as possible by recycling and reusing.
2. During grain operation, Grain Slops will be taken through Centrifuge Decanters for separation of Suspended Solids separated as Wet Cake which will be used as cattle feed.
3. Record of wastewater returned back to process for utilization in liquefaction/fermentation/cooling tower and to gardening would be kept (both the quantity and quality details).
4. Rainwater would be utilized to recharge the underground resource through scientifically designed rainwater harvesting system.

2.6.2.1 Effluent Treatment

2.6.2.1.1 Treatment of Effluent: Grain Route

- Grain Slops (Spent Wash) will be taken through Centrifuge Decanters for separation of Suspended Solids separated as Wet Cake and which goes as cattle feed as it contains higher protein and fibre content. (Also known as DWG – Distillers Wet Grains)
- Thin Slops from the Decanter Centrifuge are partly recycled back to process (30-35%) and partly taken to Thin Slops Evaporation Plant for concentration of remaining solids to form a Syrup. This Syrup is also mixed into the Wet Cake coming out of Centrifuge and forms part of Cattle Feed. (Also known as Solubles – Collectively known as DWGS)
- The Process condensate is cooled and collected into a neutralization tank with sufficient residence time. After Neutralization, this process condensate will be recycled into process and is used for green belt development within the complex.

2.6.3 Noise Pollution Control

1. There is no danger of noise pollution from plant. The green belt will (plantation of dense trees across the boundary) help in reducing noise levels in distillery plant as a result of attenuation of noise generated due to plant operations, and transportation.
2. Earmuffs would be used while running the equipments of the plant.
3. D.G. Set will be kept in acoustic enclosure.
4. A high standard of maintenance will be practiced for plant machinery and equipments, which helps to avert potential noise problems.

2.6.4 Solid Waste Management

1. Fly ash from the Boiler would be utilized in brick manufacturing.
2. The Solid waste from the Grain based operations generally comprises of the Fibres and proteins in the form of Wet Cake, ideally used as Cattle Feed.

3. The Yeast sludge will be sent to the Sludge Drying Beds or may be added to the Wet Cake.

2.6.5 Occupational Health & Safety Measures

Production of Ethanol involves storage handling and use of several chemicals. Some of these chemicals are toxic and hazardous in nature. Information about these chemicals is therefore important for the safety of the employees and the plant. Besides, the health status of the employees is also important which may be affected due to exposure to these chemicals. The exposures may be sudden and accidental or for a long period. In both of the cases there will be different health effects. Therefore safety measures dealing with these chemicals are of vital importance and will be followed judiciously.

1. In order to ensure good health of workers, regular health check-up of the plant workers would be carried out.
2. Occupational health surveillance programme would be taken as a regular exercise for all the employees and their records maintained.

2.6.6 Socio-Economic Environment

1. NV Distilleries & Breweries (North East) Pvt. Ltd. will give preference to the local population for employment in the semi-skilled and unskilled category. The skilled employees will be recruited through open recruitment process.
2. Medical and educational facilities for rural population in the vicinity are poor and the management of the company is ready to undertake an appropriate contribution towards their improvement.
3. Trained operators and workers in various aspects of ESH (Environment, Safety and Health) would be employed.
4. The managers and officers involved in Environment Management cell would undergo refresher workshop and up-gradation of information on various environmental issues from

time to time.

5. The industry would help in promoting the activities related to environmental awareness in nearby villages.

2.6.7 Green Belt Development

Green belt will be developed within the Plant premises covering a total area of about 8 acre (approx. 33% of total Plant area) of the total plot area. The plantation work for green belt development will be carried out as per CPCB guidelines, local species would be preferred.