EXECUTIVE SUMMARY

ENVIRONMENTAL IMPACT ASSESSMENT OF INTEGRATED MUNICIPAL SOLID WASTE PROCESSING FACILITY

OKHLA, DELHI

Submitted to

Delhi Pollution Control Committee

Submitted by

New Delhi Waste Processing Company Private Limited

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EXECUTIVE SUMMARY

A) INTRODUCTION

The Municipal Corporation of Delhi (MCD) is among the largest Urban Local Bodies (ULBs) in India that generates about 6,500 tonnes of garbage per days. Past trends shows that waste generation rate are increasing by 3-4 % per annum and the waste is likely to increase to 18,000 tonnes per day by year 2021.

There have been a number of initiatives in the past based on single technology suitable for a particular type of waste. Due to absence of segregation at source and none of these technologies are designed to work on mixed and un-segregated solid waste, most of these technologies have failed.

The proposed approach differs from the past initiatives in two significant ways – first, the approach is not influenced by any particular technology of waste handling, rather it is an integration of technologies that have been tried and tested under Indian conditions and second, there is a focus on development phase of the project and to institutionalise the activity.

The proposed Integrated MSW to Power Plant consisting of MSW processing plant to convert MSW to RDF, biomethanation plant and power plant is to be put up at the space available at Okhla, New Delhi.

i) Project Proponent

The proposed project is being developed by Infrastructure Leasing & Financial Services (IL&FS). ILFS has incorporated New Delhi Waste Processing Company Private Limited, Okhla, New Delhi (NDWPCL) – a 100% subsidiary for developing commercially viable municipal waste projects through public private framework in various parts of the country. New Delhi Waste Processing Company Private Limited is developing projects for processing and disposing municipal waste using the technologies of processing and disposing municipal waste and also to produce as by-products, inter alia, refuse derived fuel, fluff, organic manure, biogas and use such products for generating electricity and producing fly ash for brick manufacturing.

ii) Project Location

The proposed project site is at a distance of 3 km from Nehru Place and adjacent to existing Okhla STP. The coordinates of the site are 28°32' 50.59" N and 77°16' 59.01" E, with an average elevation of 210 m above mean sea level.

The project site encompasses an area of 13.5 acres and has an approach road, which meets NH- 2 at a distance of 1 km. The geographical location of the proposed waste processing plant is shown in ***Figure ES-1****.*

B) PROJECT DESCRIPTION

The Integrated MSW Processing Complex consists of MSW processing plant to convert MSW to RDF, biomethanation plant and power plant. The integrated MSW to RDF processing plant and Biomethanation is being designed on following major parameters:

The RDF plant at okhla will be designed to process 1300 TPD of MSW and is expected to generate around 450 TPD of Refuse Derived Fuel (RDF) in the form of fluff. The fluff is expected to have a Gross Calorific Value (GCV) of 2,500 Kcal/kg to 3,000 Kcal/kg of fluff.

In addition to the foresaid quantity (450 TPD) of RDF fluff, about 225 TPD of fluff from Timarpur Plant (for which NOC have already been obtained) will also be fired in the boiler for generating 16 MW of power per day.

The plant is also being designed to process 100 TPD of green waste for producing biogas and manure in a Biomethanation plant. The biogas generated is expected to be about 5,500 to 6,000 Nm^3 / Day and manure quantity is expected to be about 7 TPD.

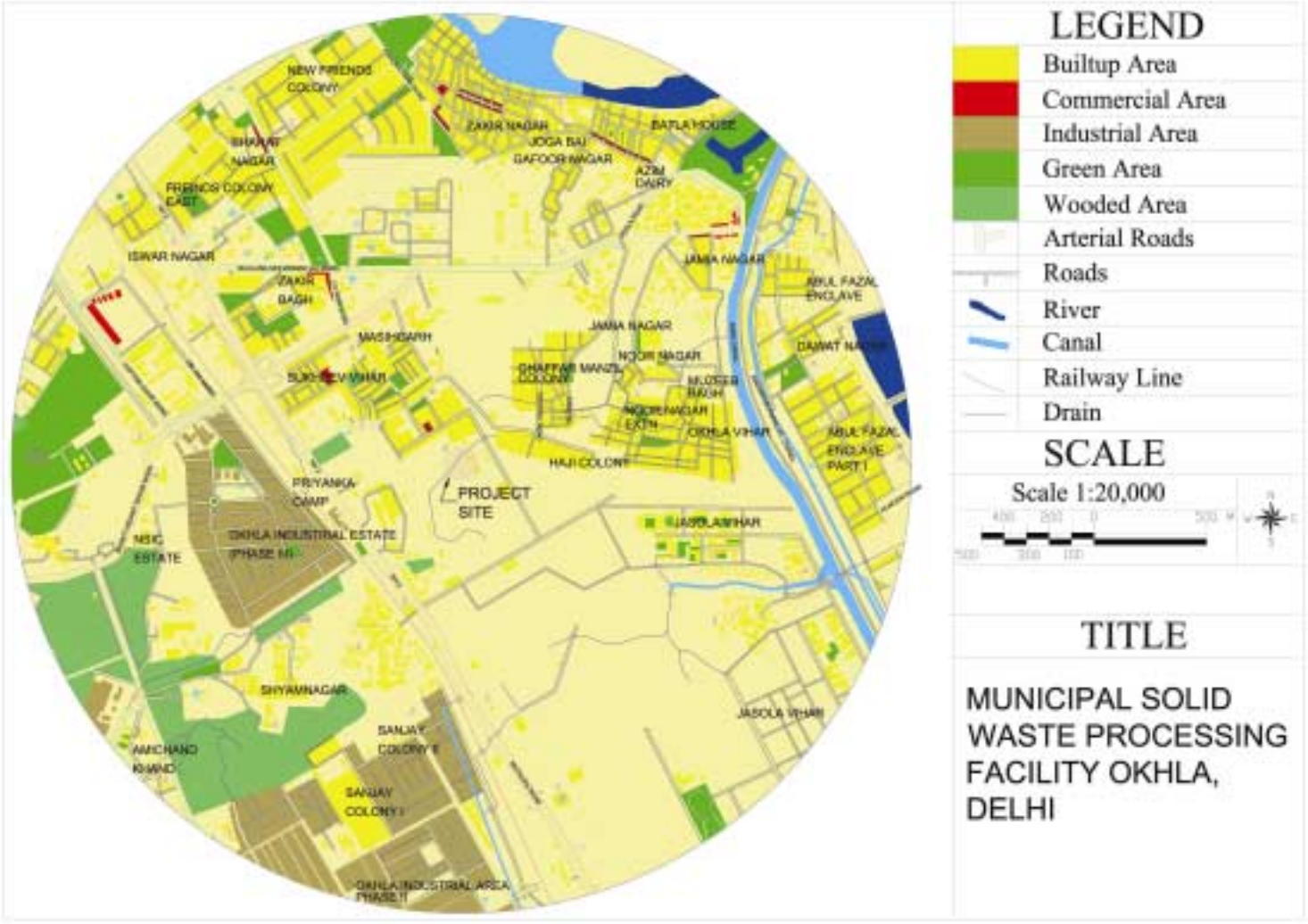
450 TPD of RDF fluff from Okhla Plant and 225 TPD of RDF fluff from Timarpur Plant and Biogas quantity of 5,000 Nm3/day will be available for firing in a specially designed boiler to generate high pressure / high temperature steam. The steam generated from the boiler is expected to generate about 16 MW of power.

MSW for Okhla plant will be collected from fourteen circles of NDMC, eight wards of city zone and six wards of SP zone. It is expected there will be 300 -350 incoming trucks to bring in 1300 TPD of Mixed MSW and 100 TPD of organic waste to Okhla site for processing.

The RDF plant, the biomethanation plant and the power plant are expected to operate for 330 days in a year. During the 30 days closure the boiler and other machines will be taken up for inspection and maintenance.

The total cost of the project, excluding the cost of the land is estimated to INR 1700 million.The project will be made operational in a span of 24 months from the start date.

FIGURE ES-1: SURROUNDING FEATURES OF THE PROJECT SITE



i) Conversion of MSW to RDF

The proposed plant will process 1300 MT of MSW and produce 450MT of RDF per day in the form of fluff. The fluff is expected to have a gross calorific value (GCV) of 2,500 kcal/kg to 3,000 Kcal/kg of fluff.

The plant has been designed for maximum moisture content of 50% and would be in operation for 330 days in a year. In order to meet the regular requirement of fuel for the boiler, it is envisaged to have a main storage area for RDF. This storage capacity will meet the fuel requirements of the boiler for about 3 days.

The conversion process of MSW into RDF involves the processes such as – Homogenization, Size reduction, Drying, Segregation and Densification (Optional)

MSW brought to the plant site, would be weighed at the weighbridge station prior to unloading in the two MSW storage pits. After unloading the MSW will be sprayed with Herbal pesticide in the form of mist at the receiving pit. Normally quantities sprayed will be 1.5 Liter/Ton of MSW with 1% concentration.

MSW received at site is dumped into the storage pits, any yard segregation is not envisaged. The overhead hoists with excavative buckets pick up MSW and deposit it on to the "Vibratory cum Gross Screening Feeders". At this stage, while more than 95% material (size less than 300 mm) passes on to the main belt conveyor, the oversized materials are removed, both mechanically and manually. The constituents segregated at this stage are mostly lengthy textiles, large twigs and woody pieces, thermocol, any stray dead animal and consumer durables. The dead animal and consumer durables (hardly noticed in MSW) are put into trolleys and periodically taken out from the processing system and suitably disposed off.

The MSW after inspection is fed into a de-dusting cum pre-drying system to remove dust/sand/earth (10 mm particle size) in a Fines Separation Rotary Screen in which hot air is injected. After the fines separation, MSW is fed into another Rotary Screen to classify the material into two fractions: Over size + 150 mm and Undersize –150 mm.

Undersize fraction (- 150 mm) will primarily contain organic matter and is directly fed through a belt conveyor in to the Rotary Dryer. The oversize fraction (+ 150 mm) is fed into a Primary Shredder through a Magnetic Separator (to separate ferrous material) to reduce its size to - 150 mm. The output from the Primary Shredder is then fed into Rotary Dryer. A provision is also made to have a reversible belt conveyor, which can take material from RDF plant to Biomethanation plant and vice-versa, as per requirement.

In the Rotary Dryer, the material is dried by using Hot Air in a co-current manner. The hot air is generated in a fixed grate in a specially designed Hot Air Generator (HAG), in which woody

biomass segregated from MSW is combusted. Suitable pollution control equipment will be incorporated in the HAG. The output from the Rotary Dryer is then fed into the Rotary Trommel to separate the fines through 8 mm screen. The fine fraction so separated has significant quantum of organic matter that is useful as a soil enricher.

After the screening, the material is subjected to Air Classification in a specially designed Air Density Separator, in which the lighter components are entrained in the air and collected separately. The heavy material such as stones, glass falls through the classifier and is separated as Inert. These inert are then taken to a separate site where its constituents are further manually separated.

The light fraction thus separated comprises biomass, paper, textiles and other combustible material and is termed as Refuse Derived Fuel (RDF) Fluff, having an average GCV of 2,800 kcal/kg.

ii) Biomethanation Plant

Biogas is generated from treatment of 100 TPD of vegetable market waste (green waste). Biogas generated from 100 TPD of organic waste will be 5500 to 6000 m^3 per day, which is equivalent to about 2650 kg LPG per day.

Proposed process for Biomethanation plant is two phase The first stage fermentation is a hydrolysis stage and the second is the methanation and polishing stage. The first stage is designed to give maximum solid retention time for hydrolysis and the second stage is either proprietary modular UASB construction or specially developed hybrid design. Both stages operate in the Mesophillic range. Mailhem Group has tried out this design in similar application at Vijaywada and Hyderabad.

Biogas generated from 100 TPD of organic waste will be 5500 to 6000 m^3 per day, which is equivalent to about 2650 kg LPG per day.

The biogas generated is used as an auxiliary fuel for the boiler of the power plant. The composition of the biogas generated from this process is Methane (55% - 60%), Carbon Dioxide (35% - 40%), Moisture and Nitrogen (5% - 8%) and rest Hydrogen Sulphide.

Two digesters are provided for the process. Digesters are equipped with internal proprietary module, baffles and launders to ensure high solid retention. They are provided with gas tight top cover. High degree of BOD and COD reduction takes place in these digesters. Provision is made for scum removal and recycling from the top of the digester and sludge removal from the bottom. Biogas will collect under the top cover in the free board area and will subsequently collect in biogas holder. Part of the treated overflow is recycled back to the digester and the rest will be send by gravity to the UASB digester for secondary treatment.

UASB digester comprises of 8 individual compartments. Provision is made for liquid distribution of header and biogas collection header. Each compartment is equipped with modules, baffles and launders for further reduction in BOD and COD. Biogas collects in biogas holder is mounted on the top of this digester. The treated overflow from this digester is then sent to the aeration treatment section by gravity.

Biogas generated in the UASB digesters is collected in biogas holder, mounted on top of UASB digester. Biogas holder is Fabric Reinforced Neoprene Rubber membrane, with a capacity of 1000 m^3. It fills up even at a low pressure of 25mm WC.

A proprietary biological scrubber will be installed to remove the H_2S content of biogas and use the biogas for power generation. The boiler needs biogas at around 0.4 kg/ sq.cm. with H_2S less than 0.1%. Thus, the biogas needs to be pressurized and H_2S is to be reduced to less than 0.1%.

This scrubber has been successfully developed and demonstrated by Mailhem Group. Excess H_2S content in the biogas will lead to corrosion. In addition, the high CO_2 content of biogas must be stripped to ensure "Upgraded Biogas" which has high content of methane.

The over flow from the UASB digester is connected to the Aeration tank. Diffused aeration helps to reduce the BOD levels further and is suitable for discharge into river. Diffused aeration is carried out using blowers and fine bubbles diffusers. Modules and settlers tubes placed inside the aeration tank helps in 'clarifying' the water. The aerated water is settled in a settler tank adjoining the aeration tank. In settling tank, chlorine dosing will be carried out for disinfection. Chlorine dosing will take place in the chlorine contact chamber. Sodium Hypo chloride will be dosed for disinfection.

The sludge from the bottom of the UASB digesters and return sludge from the aeration system are all pumped through a thickener and D-canter Centrifuge. The D-Canter Centrifuge is housed in the manure yard itself. The filtrate is recycled back to the inlet chamber and the cake is collected in the manure yard. The "fertilizer value" of dried cake is then enhanced using bio-enzymes. This manure is then bagged, packed and sold as a good organic bio-manure.

iii) Power plant

The proposed power plant consist of one boilers of 80 TPH capacity with steam outlet parameters of 42 kg/sq. cm (g) & 415 Deg.C steam outlet temperature and one 16 MW bleed cum condensing turbogenerator generating power at 11 kV level.

The RDF is fluffed into a uniform density by a variable speed inclined pan conveyor, which tumbles the RDF in the lower hopper.

Combustion products from municipal refuse are very corrosive. Corrosion in refuse-fired boilers is usually caused by chloride compounds, which deposit on the furnace, superheater and boiler tubes.

The turbine will be designed for the operation with the inlet steam parameters at 41 ata and 410 °C. The turbine will be designed to provide the uncontrolled extraction steam at 6.5 ata. The balance of the steam supplied to the turbine flows through the LP section of the turbine into the surface condenser at a pressure of 0.1 ata. The turbogenerator shall be designed to the technical requirements given in the section on the Design Criteria of project Report.

The auxiliary oil pumps and the emergency oil pumps shall be arranged to have flooded suction. The oil coolers shall be water cooled with a duplex arrangement and changeover valves. The coolers shall be of shell and tube type with removable tube bundle. The provided surface area shall be adequate to cool the oil with 32 °C inlet cooling water temperature even with 20% of the tubes plugged.

The turbine governing system shall be electro-hydraulic designed for high accuracy, speed and sensitivity of response. All components used shall be well proven to assure overall system reliability and shall be designed for easy and quick replacement when necessary. The governor shall be configurable in the field.

The governor shall ensure controlled acceleration of the turbo generator and shall prevent overspeed without tripping the unit under any operating condition or in the event of maximum load rejection. The governor shall have linear droop characteristics with a suitable range for stable operation and shall have provision for adjusting the droop in fine steps.

The critical speed for the combined turbine and generator shall be sufficiently away from the rated speed to avoid any adverse effect on the operation of the unit over the range of operating speeds.

The plant will be provided with water cooled condenser for condensing the steam from the TG. The exhaust of the TG will be connected to the condenser through large steam piping. The condensate will be pumped back from the condensate storage tank to the deaerator of the boiler.

The requirement of compressed air for instruments and the control systems of the proposed power plant will be supplied by two (2) instrument air compressors with one(1) working and the other standby. The main plant control room housing the controls for the boilers and the Turbogenerator shall be air conditioned with window-mounted air-conditioners.

The turbogenerator station building will be provided with a forced ventilation system. Most of the areas will be ventilated with exhaust fans mounted on the walls or on the roof.

C) DESCRIPTION OF THE ENVIRONMNET

The study area has been classified into a core zone and buffer zone (also referred to as impact zone). The core zone is plant site whereas the buffer zone is an area approximately within a radius of 10 km from the project site as the center and the environmental quality of this area has been assessed through intensive baseline studies. Since this being a rapid EIA, only one season data was collected.

The studies were conducted by considering various parameters.The various environmental attributes were divided into primary and secondary studies. Primary environmental attributes such micro-meteorology, air, water, soil, noise, flora and fauna were assessed by conducting field studies and on-site monitoring and review of the past studies conducted, for the purpose of comparison; and Secondary attributes such as land use studies, geology, physiological characteristics, and socio-economic environment have been assessed by literature review of studies conducted in the past and by various government publications.

The baseline studies started with site visits and reconnaissance survey in the study area for fixing the monitoring locations for the primary data. Various Government, Semi-Government departments were approached for getting information for the secondary data generation.

As per Master Plan (2001) of Delhi, the landuse of the site for the proposed project is utility. The area around the project site is occupied by older alluvium of Pleistocene age. The proposed site is a part of Alluvial plain on south eastern sides of the Delhi ridge. The alluvial deposits of Quarternary age mainly composed of unconsolidated clay, silt, sand with varying proportions of gravel and kankar.

The depth of bedrock for the project site varies from 200 to 300 m below ground level. Project area is located in Zone IV of the Bureau of Indian Standards (BIS) 2000, seismic zone map for India.

i) Soil

The physical and chemical characteristics of the composite soil sample were studied . The result shows that the moisture retention capacity of the soil is 39.2 % , which is good. Soil of the area is slightly basic with a pH of 7.76. The analysis of the sample shows SAR for the soil sample is 0.79, which indicate that the soil is not sodic in nature.CEC value of the soil samle stidied is 17 meq /100 gm, which is low and it, can be concluded that the soil is sandy.

ii) Meteorology

Primary micrometeorological data for the period of one season (post monsoon) was collected at proposed project site and long-term climate trend data was obtained from the closest surface

India Meteorological Department (IMD) station, located at the Safdarjung Airport, in New Delhi. A pollutant dispersion model uses meteorological variables to spread out (dilute) gases and particles.

The climate of New Delhi is influenced by its inland location and is characterized by extreme dryness with intensely hot summers and cold winters. Only in the monsoon season (July, August, and September) do air masses of oceanic origin reach New Delhi resulting in increased humidity, cloudiness, and precipitation.

The normal annual rainfall for New Delhi is 797.3 mm, with 81% of the rainfall occurring in the monsoon months of July, August, and September.

iii) Ambient Air Quality

A site-specific background air quality monitoring program was conducted for the proposed project site for post monsoon season. Background data was collected for SPM, RSPM, SO2, NOx, and CO.

Five air quality monitors stations(AQ1, AQ2, AQ3, AQ4, AQ5) were placed on and around the site. SPM levels obtained at 3 out of the 5 locations have greatly exceeded NAAQS. RSPM level observations at 2 out of the 5 locations have exceeded NAAQS. NO_x & SO_2 levels are well within the specified standards for industrial and residential areas i.e.120$\mu g / m^3$, 80 $\mu g / m^3$ respectively .CO levels are well within the specified standards for industrial and residential areas i.e. 5000 $\mu g / m^3$,2000 $\mu g / m^3$ respectively.

iv) Noise Environment

Noise monitoring was conducted at 5 critical locations within the impact zone, wherever possible including the project site, approach roads, and sensitive locations such as residential areas and hospitals.

The results of the monitoring program indicated that levels of noise exceeded AAQSRN at three out of five locations during both the daytime and night time, most likely due to high levels of traffic noise.

v) Traffic Pattern and Density

Traffic counts were carried out for the Delhi – Mathura road adjacent to the site, to provide background values of traffic density, and correlate such data to the levels of air pollution and noise along the road. The examination of traffic density was also used to estimate the affects of Waste to Energy plant on the local infrastructure.The results of the monitoring indicated the following:

- *On weekends, the total number and overall traffic frequency of LMV is increasing in comparison to that during weekdays.*
- *The scenario for HMV is just the opposite in comparison to LMV i.e. the total number and frequency is decreasing on weekend than that during weekdays.*
- *Motorcycles are plying more during weekdays whereas during weekends the cars show the maximum contribution amongst the total number of LMV.*
- *Buses exhibit the maximum fraction (~70 %) of all the HMVs plying in the area both during weekdays as well as weekends.*

vi) Water Environment

River Yamuna is the main surface water source near the site at a distance of 2 km from the project site.

The depth of ground water in this region is shallow (5-10 mts) with a water table fluctuation of about 2 - 4 mts and the flow direction is towards Yamuna. Ground water potential in the area is low with a yield prospect of 10 – 15 m^3 per hour.

The physicochemical characteristics of ground water samples collected from different sources were compared with the standard (IS 10500: Indian Standards/Specifications for Drinking Water) reference values. Total Dissolved Solids (TDS) and Total Hardness (TH) in both the ground water samples exceeded desired limit for drinking water. Chloride content at one of the ground water location i.e. Okhla STP slightly exceeds the desired limit.

Water sample from river Yamuna was compared against IS 2296: Class C -Water to be used for Drinking after Conventional Treatment. It indicated that DO level is slightly lower (3.6 mg/l in comparison to standard 4 mg/l) than the standard whereas BOD (29 mg/l in comparison to standard 3) and Coliform level (99580 MPN/100 ml in comparison to standard 5000 MPN/100 ml) are much higher than the standard value. Turbidity and Fluoride content were also found to be higher in the sample collected from River Yamuna.

vii) Biological Environment

During the field survey, common afforested tree species such as Eucalyptus, Dalbergia sissoo, Azadirachta indica, Ficus religiosa, Pongamia pinnata, Cassia fistula etc. were recorded around the periphery of the acquired land. Besides, the ground storey represented by herbs and shrubs like Datura metel, Ipomoea carnea, Cassia occidentalis, Jatropha gossypifolia, Calotropis procera, Abuliton indica, Aerva sp, Chenopodium sp, Sida acuta, Solanum indicum, Solanum xanthocarpum, Amaranthus caudatus, Cyperus bulbosus, Cynodon dactylon and Phalis minor the proposed project. No threatened, endangered and endemic flora found or reported to occur in or near to the proposed site.

Asola-Bhatti (ecological sensitive area) as the part of Delhi ridge is located at a distance of 7-8 km from the proposed site. It is a densely forested region, contains several species of trees that include Azadirachta indica, Acacia nilotica, Prosopis cineraria, Prosopis juliflora, Zyziphus mauritiana, Cassia fistula, Butea monosperma, Capparis decidua, Carissa carandas, Pongamia pinnata and the magnificent Delonix regia among others.

A few common bird species were recorded during the survey from the study area. These include house sparrow (Passer domesticus), house crow (Corvus splendens), Pariah kite (Milvus migrans govinda), Black drongo (Dicrurus adsimilis) , Babbler (Turdoides caudatus), Red vented bulbul (Pycnonotus cafer) , Pied wagtail (Motacilla alba), Common myna (Acridotheres tristis) etc. The pariah kites were found in large numbers because of the existing landfill site. No endangered, threatened or rare bird species were recorded from the study area.

A few butterfly species were recorded during the survey and these include Psyche (Leptosia nina nina), Plain tiger (Danaus chrysippus), tawny coster (Acraea violae), Yellow grass (Eurema hecabe), Common crow (Euploea core).

Two species of reptiles viz., garden lizard (Calotes sp.) and skink (Scincilla sp.) were recorded in the project area during the survey. No snake was encountered or indirect evidences were found about their presence in and around the survey area. Dialogue with the workers from the landfill site could confirm the presence of rat snake in the study area, which was encountered rarely.

viii) Socio economic asessment

According to 2001 census, the population of the Okhla (ward Number 7) is 1,25,935 (of 21781 households) which falls within the confines of Defence Colony sub district and represents 20.64 % of total sub-district population. Defence Colony sub district comprises a total

population of 6,10,076 (of 1,24,126 households), represents 4.4 % of the population of NCT Delhi (13.8 million).

The sex ratio (Number of females per 1000 males) for the Defence Colony and Kalkaji sub districts of South Delhi are 815 and 773 respectively, as against the national average of 933. This figure is almost equal to the Okhla ward, which is 817 females per 1000 males.

Literacy rate for the Defence Colony sub district, Okhla as per the 2001 census was 84.46, 82.08 respectively, as against the literacy rate of 81.7% for Delhi.

As per the 2001 census of Okhla ward, main workers constitute 28.7 % , marginal workers constitute 1% and the non-workers constitute 70.3 % of the total work force. The main workers are primarily engaged in Secondary and Tertiary activities i.e. 93.1% work for service, trade and commerce or manufacturing sector. Employment in primary activities such as cultivation is negligible, with only 0.2% cultivators and 0.5 % of agricultural laborers. Almost 6.3% of the workforce is engaged in household industries.

D) POLLUTION SOURCES

Probable environmental impact can be anticipated after analyzing the pollutants generated during the life span of the project. Pollutants generated from the proposed project are solid, liquid and gaseous in nature during construction as well as during operation phase. The generation of pollutants could be continuous, periodic or accidental. Sources of pollutants and their characteristics during the construction and operation phase of the proposed project are presented in the following table:

SN	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
CONSTRUCTION PHASE				
1.	*Ground working and construction activities*	*Air emissions – SPM, PM_{10}, CO, NO_x, SO_2*	*Dust from construction activities and excavation. Particulates, NO_x and CO from vehicle exhaust*	*Temporary during construction phase only. Bulk of the emissions are expected from ground working and leveling activities.*
		Earth / solid waste	*Solid waste from construction activities*	*Periodic*
		Noise	*Noise generated from construction equipments and machineries*	*Temporary during initial construction phase.*
		Liquid Waste	*Surface Run-off, oil, paints*	*Periodic during rainy season, Temporary – during construction phase*
2.	*Vehicular movement*	*Air emissions and noise*	*Vehicle exhaust emissions*	*Continuous / Periodic*
3	*Labour Activity*	*Solid Waste*	*Domestic Solid Waste generated due to labour activities*	*Temporary – during the initial construction phase*

SN	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
		Waste Water	*Sewage generation due to labour activities*	*Temporary – during the initial construction phase*
4	*Hazardous Waste*	*Oil, Grease, Chemicals, Paints*	*Due to Construction Activities*	*Temporary – during the initial construction phase*
OPERATION PHASE				
1	*Vehicular movement and unloading*	*Air emissions and noise*	*Vehicle exhaust emissions Fugitive emission during unloading*	*Continuous / Periodic*
2	*Primary Storage*	*Liquid waste*	*Leachate generated from the waste stored in pits*	*Continuous*
3	*RDF Plant*	*Air Emission - Fine particulate matter, CO, CO2,*	*Dust from Rotary Trommel (primary and secondary), Dryer solid discharge chute, coarse fluff discharge chute, ADS cyclone and different material transfer points CO, CO_2*	*Continuous*
		Solid Waste	*Rejects of municipal waste collected after different processes - Brick stone, glass ceramic pieces, leather, rubber, plastics etc* *Ash generated from HAG unit*	*Continuous*
		Noise	*Noise due to vehicular movement, noise from blowers, shredders*	*Continuous*
		Waste water	*Water blow down water from dust washers, aspirators*	*Continuous*
4	*Biomethanation*	*Waste Water*	*Biogas cleaning rejects*	*Continuous*
		Noise	*Noise pollution from biogas / air blower*	*Continuous*
5	*Power Plant*	*Air - SPM, PM_{10}, CO, NO_x, SO_2,* *Dioxins and Furans, HCl*	*Firing of RDF fuel in Boiler* *Plastic and chlorinated compound in waste*	*Continuous* *Periodic*
		Waste Water	*Liquid effluents would be generated from the following* • *RO rejects* • *MB unit regenerating waste* • *Boiler blow down* • *Cooling tower blow down* • *Waste water from floor washing*	*Continuous*
		Solid waste	*Boiler ash*	*Continuous*
		Hazardous waste	*Used Oil Generation*	*Periodic, during oil changes*

SN	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
		Noise	*Noise from turbo generator, compressor and other rotating equipments*	*Continuous*
6	*Maintenance / housekeeping*	*Wastewater*	*Domestic sewage water* *Floor washing*	*Continuous*
		Solid waste	*Used equipment parts and garden wastes*	*Continuous*
7	*Air conditioners*	*Air emission*	*Ozone Depleting Substance release*	*Continuous*
8	*Storm Water drains*	*Wastewater*	*Contamination discharge from site – Mainly suspended solids*	*Periodic during rainy season*

i) Predicted air emissions from the site

During the construction phase, SPM is expected to be the main pollutant, associated with on-site roads (paved and unpaved), stockpiles and material handling. The proposed activities during construction phase would primarily involve development of site and construction of new plant.

During the construction phase, pollution emission sources shall be distributed throughout the project site and shall fall under the category of area source. The project area is flat, so extensive formation work is not expected during this phase. In addition, due to the confined nature of heavy construction activity during this limited period, tailpipe emissions from construction equipment are assumed to be negligible.

The total area of the site is approximately 13.5 acres. The entire site will not be simultaneously under heavy construction, with different sections of the site generating SPM in a progressive manner. Thus, it is conservatively assumed that the SPM emission would not be significantly high to warrant any impact prediction.

During the operation phase the proposed project would result in minor increase in traffic and vehicular activity on the Delhi-Mathura road, on account of increase in number of vehicles for transportation of waste to the project site and transfer of finished product and rejects from the project site. It is estimated that about 325-350 additional trips would be made to the project site for transportation of waste, finished products and rejects.

The vehicular traffic generated due to the proposed project is negligible as compared to the total traffic on Delhi-Mathura Road, hence the contribution due to proposed project is negligible, hence modeling has not been done for the tailpipe emissions (i.e. CO, NO_x and SPM) for vehicles traveling along this road.

ii) Noise Emissions Sources

Sources of noise emissions are expected from various construction equipments. General noise levels generated from the operation of equipment and machinery.Since the construction phase is expected to be minor in nature, hence the possibility of all the equipments working together is ruled out. Hence, the noise generated is not anticipated to be high.

During the operational phase, the major sources of noise are:

- *Noise due to vehicular movement inside the plant premises and on the Delhi Mathura road*
- *Noise from blowers, shredders of RDF plant*
- *Noise pollution from biogas / air blower of Biomethanation plant*
- *Noise from turbo generator, compressor and other rotating equipments of the power plant*

Most noise producing equipments will be provided with acoustical enclosures, hence the ambient noise is not anticipated to be high. The noise generated during the plant operation is related to occupational exposure. For workers safety earplugs would be provided and equipments would be maintained to ensure optimum working condition.

Baselines studies indicate that the noise generation due to the traffic on the Delhi-Mathura Road is higher than the prescribed limit. Green belts are proposed in the site development plan to mitigate the effect. The noise generated due to the additional vehicle (325-350) vehicles is not anticipated to be very high and would be negligible in comparison the noise generated by vehicles currently plying on the Delhi-Mathura road.

iii) Water & waste water management

During the construction phase, water will be required for construction activities and for domestic requirement of the labours on site. About 25m^3 per day of water will be required for construction activities and about 7m^3 per day will be needed for onsite labour activity. Water required for domestic use will be taken from the city supply and the construction water requirement will be fulfilled by the treated water from Okhla STP or tankers.

Similarly, wastewater stream during construction period shall be from construction activities and onsite labour activities. Wastewater generation due to construction activities would be very less. It is proposed to deploy local labour to the maximum extent possible; hence, wastewater generation from labour activities shall not exceed 5.5m^3 per day. Temporary soak pits and septic tanks shall be constructed on the site during construction phase to prevent contamination of the surface and ground water resources.

During the operation phase of the project, water would be required for the following activities:

- *Domestic consumption and service requirement*
- *In RDF Plant, for aspirators, dust washers, non IBR boilers etc*

- *In Biomethanation plant, water would be required for the plant operation*
- *In Power plant, water would be utilized for cooling condenser, generator, air cooler, TG lube oil cooler, compressor and as make up water.*
- *Firefighting requirement*

City water supply from Delhi Jal Board (DJB) would be the major source of water for domestic and other service requirement. Apart from this, treated wastewater from Okhla STP will be utilized for plant operation.

Wastewater during the plant operation would be generated from the following activities

- *Domestic sewage water*
- *Leachate generated during waste handling activities*
- *RDF Plant – Blow down water from aspirators and dust washers.*
- *Biomethanation plant*
    - *Waste water from digestrate dewatering*
    - *Biogas cleaning rejects*
- *Power Plant - Liquid effluents would be generated from the following*
    - *RO rejects*
    - *MB unit regenerating waste*
    - *Boiler blow down*
    - *Cooling tower blow down*
    - *Multigrade filter blow down*
    - *O M Plant backwash*
    - *Waste water from floor washing*

E) IMPACT ASSESSMENT

Summary Matrix of Predicted Impacts due to Proposed Project

SN	*Components*	*Activities*	*Predicted impacts*	*Extent of Impacts*
CONSTRUCTION PHASE				
1.	*Ambient Air Quality*	*Dust emissions from site preparation, excavation, material handling and other construction activities at Site.*	*Minor negative impact inside plant premises. No negative impact outside plant site.*	*Impacts are temporary during construction phase. Impacts will be confined to short distances, as coarse particles will settle within the short distance from activities.*
2.	*Noise*	*Noise generated from construction activities and operation of construction equipment*	*Minor negative impact near noise generation sources inside premises. No significant impact on ambient noise levels at sensitive receptors.*	*Temporary impacts during construction phase. No blasting or other high intensity noise activities envisaged. Baseline noise well within the prescribed limits.*
3.	*Water quality*	*Surface runoff from project site Oil/fuel and waste spills. Improper debris disposal*	*Minimal due to effective Environment Management Plan.*	*Impact will be temporary. Local labour will be employed. Water disposed from the site will meet the quality norms specified for disposal to surface water body.*
4	*Topography and Geology*	*Change in topography*	*No significant Impacts*	*Region is flat and hence no impacts on topography.*
5	*Soils*	*Pollution of soil Impact on top soil*	*No negative impact*	*Proposed Plant is to be constructed on the existing plant site. Hence no impact on soils anticipated More all the waste storage areas are properly lined to ensure no leachate or hazardous chemical percolates to soil.*
6	*Ecology Flora and Fauna*	*Habitat disturbance during construction activity*	*No impact*	*The site and adjacent areas do not have any significant flora and fauna diversity and density.*
7.	*Socio-economy*	*Increased job opportunity for locals.*	*Minor positive*	*Local labour to be deployed.*
8	*Traffic Pattern*	*Movement of the truck for bringing waste to the project site and finished products and rejects from the project site*	*Minor negative Impact*	*The increase in traffic owing to project activities is very less in comparison to the traffic currently plying on Delhi Mathura Road.*

SN	Components	Activities	Predicted impacts	Extent of Impacts
OPERATIONAL PHASE				
1.	Ambient Air Quality	Particulate emissions from RDF plant, Boiler, material handling and vehicle movement on the highway	- Ambient Air Quality inside the plant premise much below the prescribed limits. - All the stacks confirm to the prescribed CPCB limits.	Minimal as proper air pollution control equipment is installed
2.	Noise	Noise from plant operation and vehicular movement	- Minor negative impact inside premises. - No significant impact at sensitive receptors.	Baseline noise in the plant premise is within the prescribed standards.
3.	Water Quality	Oil/fuel and waste spills. Discharge of treated sewage water Discharge of contaminated storm water	No significant adverse impact	All the effluent from the site would be treated and would meet the quality criteria for disposal on surface water body, prior disposal..
4.	Water Availability	Daily water requirement for the project activities 100 m^3 for domestic usage 150 m^3 for RDF plant 3800 m^3 for power plant and 150 m^3 for biomethanation plant	Positive impact	- No use of ground water for the project activities - Domestic water requirement would be fulfilled from DJB supply and Plant water requirement would be from treated STP water
5	Soils	Storage and disposal of solid wastes; Discharge of sewage; Fuel and material spills	No negative impact	
6.	Ecology Flora and Fauna	Landuse change Discharge of wastewater for green belt development	No negative impact	Waste water meets the standards for disposal on land and surface water body
7.	Socio-economy	Additional increase in manpower	Beneficial impact	--
8.	Traffic Pattern	Additional increase in traffic	No impact	Traffic on Delhi Mathura road is very high in comparison to the increase in traffic owing to the project activities

F) ENVIRONMENT MANAGEMENT PLAN

Environment Management Plan (EMP) plays a vital role in safeguarding the environment largely through reducing the negative impacts of the project. The proposed project has positive and negative impacts during operation phase for which mitigation measures are suggested. Environmental monitoring program and implementation arrangements are also dealt with in the subsequent section.

i) EMP for Air Environment

During construction phase, the main air emissions anticipated is dust. The most cost-effective dust suppressant is water, because a source of water tends to be readily available on a construction site. Water can be applied using water trucks, handheld sprays and automatic sprinkler systems. Furthermore, incoming loads could be covered to avoid loss of material in transport, especially if material is transported off-site.

During operation phase, the potential sources of air pollution are likely to occur from the boiler and fugitive emissions during material handling and processing.

Fugitive Dust and Odour from waste handling and processing: The unloading as well as processing of the waste would generate dust and odours. These activities will be carried out under covered areas with proper ventilation, which are under negative pressure as well.

To control the odour and also for convenient uploading of MSW from trucks to this processing plant, it is dropped into one of two specially designed pits and immediately on unloading the fresh lot of MSW is sprayed with a herbal insecticide through fogging nozzles. These pits are sheltered inside the building and each pit is provided with a separate mechanized collapsible shutter. These shutters are opened only during the unloading of MSW.

Furthermore, the entire process building is kept under a slight negative pressure which allows fresh air to enter the building and the inside air along with any residual odour is taken outside the building and passed through filters/water washed before it is allowed to escape into the atmosphere..

Air emissions from RDF plant: The Rotary dryer in the RDF plant will have a Hot Air Generator(HAG) in which biomass segregated from MSW will be combusted to generate hot air. The following pollution control equipment will be installed:

a) The dust discharge from dryer will be collected by cyclones, dust settling chamber and final cleaning of air will be carried out in bag filters. The air from ADS cyclone will also be sent to the dust filtration system.

b) Secondary shredder will be provided with bag filters before air is let out to atmosphere

c) The dust collection will be carried out at the following points:

- *Rotary Trommels*
- *Dryer solids Discharge chute*
- *Discharge chute of Rotary Trommel (Secondary)*
- *Coarse fluff discharge chutes*
- *Secondary cyclone discharge duct*
- *All material transfer points*

<u>Biomethanation Plant</u>: For the biomethanation plant, a continuous monitoring system will be provided to check for any gaseous leaks in the system. A proprietary biological scrubber will be installed to remove the H_2S content of biogas and use the biogas for power generation. The biogas will be automatically flared if there is excess gas production or during breakdowns / shutdowns in either the upstream or downstream processes.

<u>Power Plant</u>: The power plant boiler is provided with electrostatic precipitator, which will remove most of the dust content and the clean flue gas will be discharged through chimney of minimum height 65 Meter. The stack height for the boiler will be 65 m to assimilate any contaminants.The formation of Nitrogen Oxide is controlled by admission of secondary air and maintaining temperature balance in the boiler.The Boiler will have a Gas recirculation system to recirculate the flue gas thus enabling the reduction in unburnt carbon, reduction in the excess air required.

The dioxin and furans emission is controlled in three stages in the entire project flow:

- *Extensive segregation techniques to remove all plastic and other chlorinated compounds such as PVC, rubber, etc. so that it doesn't form part of the RDF. This reduces the dioxins/furans production substantially in the boiler flue gases.*
- *Controlling the SPM levels to further control any potential emission of dioxins and furans, as a large extent of dioxins and furans are adsorbed onto the surface of SPM. The SPM level will be maintained at 50 mg/Nm^3 which is much below the national standards will control of dioxins/furans to a great extent.*
- *Furnace design at with 2 sec retention and temperature of 850 ^oC after secondary air injection will ensure further destruction of any Dioxin formed.*
- *The above measures will reduce the dioxins and furans emission and the levels will be negligible. However, to reduce any chances of dioxin and furan emissions, a dioxin and furan emission control system will be installed. Due to unavailability of dioxin and furan control equipment manufacturer in India, it is proposed to install High Performance Dioxin Removal Device (Activated Carbon Pack Column) which can be fitted with the existing system even at a later date.*

ii) EMP for Noise Environment

To mitigate the impact of noise from construction equipment during the construction phase the following measures are recommended for implementation:

Noise Shields - Construction equipment producing the maximum noise level should be fitted with noise shields.

Time of Operation - Noisy construction equipment should not be permitted during night hours.

Job Rotation and Hearing Protection - Workers employed in high noise areas will be rotated. Earplugs/muffs, or other hearing protective wear will be provided to those working very close to the noise generating machinery.

During operation phase, there are a number of sources of noise pollution such as truck traffic, blowers, and shredders. Where necessary, enclosures would be provided to ensure that noise levels do not exceed the prescribed standards (85 dBA at 1 m distance from the equipment). For the workers' safety, earplugs would be provided and equipments would be maintained to ensure optimum working conditions.

In the power plant, major noise producing equipment such as turbo generator, compressors will be provided with suitable noise abatement enclosures. Equipment will be statically and dynamically balanced to eliminate any vibration that can lead to noise generation. Blow off valves, discharge pipes, relief valves and other noise producing static equipment will be equipped with silencers. Pipelines will be suitably sized to avoid excess velocities that can lead to noise generation. Wherever necessary, insulation will be provided for reducing heat loss and noise pollution. The above abatement measures will ensure that noise levels are kept below standards from the rotating equipment.

Further, green belt development around the project will further reduce noise pollution, and the following species can be used in a greenbelt to serve as noise breakers:

- *Tectona grandis (Teak);*
- *Butea monosperma (Palash);*
- *Leucana leucocephala (Subabual);*
- *Mangifera indica (Aam); and*
- *Dalbergia Sissoo (Shisham).*

iii) EMP for Water Environment

Following management, measures are suggested to protect the water quality during the construction phase.

- *Avoid excavation during monsoon season*

- *No discharge of wastewater to soil and ground water body*
- *Check dams will be provided to prevent construction runoff from the site to the surrounding water bodies.*
- *Pit latrines and community toilets with septic tanks will be constructed on the site during construction phase to prevent wastewater from entering the ground water.*
- *To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area will be kept effectively impervious.*
- *All stacking and loading areas should be made impervious and provided with proper garland drains equipped with baffles to prevent run off from the site to contaminate surface or ground water resources.*

The project will not use any ground or surface water resources. The main water requirement for the project will be met through treated sewage from the Okhla STP and only domestic requirement will be taken from Delhi Jal Board.

Storm Water Management:

A detailed "Storm Water Management Plan" has been developed after considering the above sources. The plan incorporates best management practices, which includes the following:

- *Regular inspection and cleaning of storm drains.*
- *Cover waste storage areas.*
- *Avoid application of pesticides and herbicides before wet season.*
- *Secondary containment and dykes in fuel/oil storage facilities.*
- *Conducting routine inspections to ensure cleanliness.*
- *Preparation of spill response plans, particularly for fuel and oil storage areas.*
- *Good housekeeping in the above areas.*

Effluent Treatment:

Effluent from RDF Plant: Effluent generated from the process include blow down water from the aspirator and dust washer. About 112 m3/day of wastewater per day would be generated from the process. Wastewater from the process would be recirculated back to the RDF plant. Spill over from the process would be collected and treated prior disposal.

Effluent from Biomethanation plant: Effluent generated in the process (filtrate from the centrifuge) is recycled back to the system and mixed in the feed preparation tank for meeting the dilution water requirement. Blow down water from the scrubber: Biological scrubber would be installed to remove H_2S gas produced during the process. About 25 litres of dilute H_2SO_4 will be produced per day as effluent. Since the quantity of the effluent produced is very less and very dilute, it will be recycled back to biomethanation plant.

Effluent from Power Plant: For the power plant, liquid effluent generated from the RO rejects, MB unit regeneration waste and boiler blow down will be neutralized in a neutralizing pit and then treated, if any further treatment is required. Filter backwash water and cooling tower blow down will be sending directly to the common monitoring basin. In the CMB, the water will be checked for proper pH and TDS values as per the Central Pollution Control Board (CPCB) norms and suitable treatment will be done to bring the effluent to the level prescribed by the CPCB. Treated water from CMB will be pumped back to the biomethanation plant.

Leachate: The municipal waste arriving at the site will be unloaded in to two 9 M deep pit, which is covered. The small quantities of leachate generated will be collected in the sump adjacent to the pit and will be pumped to the bio-methanation plant for treatment along with effluent from the plant.

iv) Management of Inerts and other wastes

Biomethantion sludge: The sludge from the bottom of the anaerobic digesters, UASB digesters and return sludge from the aeration system are all pumped through a thickener and D-canter Centrifuge. The D-Canter Centrifuge is housed in the manure yard itself. The filtrate is recycled back to the inlet chamber and the cake is collected in the manure yard. The "fertilizer value" of dried cake is then enhanced using bio-enzymes. This manure is then bagged, packed and sold as a good organic bio-manure.

Fly Ash: Quantity of fly ash generated is too small to support an independent commercial viable plant. As on date, Rajghat Fly Ash Brick Plant in Delhi is lifting the fly ash from Indraprastha Power Plant disposal site. One more plant is being installed at IP Plant disposal site. This will be operational within next 6 months. It is likely that there will be shortage of fly ash. However, distribution of fly ash free of cost is an issue and may take some time before it is sorted out. It will have to be disposed off and the best option is to supply it to the existing brick plant.

Bottom Ash: The bottom ash from Power plant and HAG may not be difficult to dispose. It is understood that there is a big market in Zakhira for utilization of bottom ash. Its low bulk density makes it a preferred material in low cost housing. (It is being used in bathrooms & toilets as soleing material). Alternately, the bottom ash is mixed with lime and used as strong solid material for carpeting on loose soils. One can also use it for this purpose in the plant and its surrounding areas.

v) Green Belt Development

For the purpose of pollution attenuation, the green belt shall be developed.

First tier: *Trees having fast growth potential with conical canopy called as dispersion zone*
Second Tier: *Small trees having good level of air pollution tolerance limits, which is referred to as Tolerance zone.*
Third Tier: *Shrubs having hairy leaves and thick and round canopy.*

vi) Environmental management system and monitoring plan

For the effective and consistent functioning of the project, an Environmental Management System (EMS) should be established at the site. The EMS should include the following:

- *An Environmental management cell*
- *Environmental Monitoring*
- *Personnel Training*
- *Regular Environmental Audits and Corrective Action*
- *Documentation – Standard operating procedures Environmental Management Plans and other records.*

G) RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

As part of the Integrated Municipal Waste Processing project, it is important to identify associated safety hazards and carry out a basic risk assessment. The main safety hazards arise due to the generation and use of biogas and boiler hazards.

Biogas is generated in the biomethanation units and is used as a fuel in the boilers. The main hazard associated with biogas is the fire hazard. The biogas consists of about 60% methane, 1% H_2S (which is scrubbed in a scrubber down to 0.1% max.), up to 40% CO_2 (it too would be reduced in the scrubber) and balance nitrogen and moisture. It is essential that biogas release-consequence estimation be carried out and these include hazards due to loss of containment of biogas from the supply line from the biomethanation unit to the boiler at the rate of about 5500 m^3/day, release of biogas from the flare and a boiler explosion due to flame out scenario or false start/ false fire scenario in the boiler combustion chamber. Consideration of the effects of such scenarios on the surroundings is estimated.

<u>Boiler hazards</u>: Biogas is used widely as a heating fuel in boilers and care is essential in preventing explosive pockets forming within lines and box particularly during start-up and shutdown. A study of 100 explosions indicated that about a little less than 50% occurred during lighting off period, 40% during operation and about 10% during re-lighting following burner flame extinguishments. No explosions were reported while furnace box temperature was above 760 ^oC. A number of explosions occurred during warming up phase. Lighting of explosions was

mostly in multi burner furnaces where operators failed to close all individual main burner gas cocks and to establish reliable pilot flames at all burners before opening the main furnace gas valve. Firing explosions were primarily caused by the following:

- *Operation of burners with insufficient air for perfect combustion resulting in formation of explosive carbon monoxide air mixtures in the furnace box.*
- *Accidental burner flame failure with no means of automatic fuel cut-off*
- *Re-lighting explosions following accidental burner flame extinguishments were caused by failure to purge the furnace before reintroducing an ignition source.*

i) Disaster Management Plan

Emergency prevention through good design, operation, maintenance and inspection are essential to reduce the probability of occurrence and consequential effect of such eventualities. However, it is not possible to totally eliminate such eventualities and random failures of equipment or human errors, omissions and unsafe acts cannot be ruled out. An essential part of major hazard control has therefore, to be concerned with mitigating the effects of such Emergency and restoration of normalcy at the earliest.

The overall objective of a disaster management plan is to make use of the combined resources at the site and outside services to achieve the following:

1. *To localize the emergency and if possible eliminate it;*
2. *to minimize the effects of the accident on people and property;*
3. *effect the rescue and medical treatment of casualties;*
4. *safeguard other people;*
5. *evacuate people to safe areas;*
6. *informing and collaborating with statutory authorities;*
7. *provide authoritative information to news media;*
8. *initially contain and ultimately bring the incident under control;*
9. *preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;*
10. *investigating and taking steps to prevent reoccurrence*