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ANNEXURE V

BILL METER READINGS OF GENERATING GENERATING PLANT

READING SHOULD BE TAKEN ON 1ST WORKING DAY OF EVERY MONTH, AT 12.00 NOON.

NAME OF THE GENERATING PLANT

PLACE: TALUKA: DISTRICT: STATE:

C.T. RATIO AVAILABLE/CONNECTED:

P.T. RATIO AVAILABLE/CONNECTED:

SCALE FACTOR (IF ANY):

MULTIPLYING FACTOR (MF):

BILLING METER MAKE / NUMBER:

METER READINGS:

	EXPORT METER READING	MPORT METER READING
KWH		
PREVIOUS READING		
CURRENT READING		
DIFFERENCE		
DIFFERENCE X MULTIPLYING FACTOR		

Authorised Signatory	Authorised Signatory	Authorised Signatory
EXECUTIVE ENGINEER	EXECUTIVE ENGINEER	AUTH. REPRESENTATIVE
TRANSMISSION	PROCURER	GENERATING PLANT

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DATE

NOTES:

1. PROCURER shall maintain a daily logbook to record hourly readings of the Bill Meter/ HT Meter.
2. The Generating Plant shall maintain a daily log to record the hourly generation and supply in KWh, along with the schedule given by PROCURER's Dispatcher.
3. If the meter is changed, the reason/s, date, time of meter change and new meter make and number must be recorded by both parties.
4. May not need any signature if downloadable meters are used subject to the AERC guidelines issued from time to time.

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ANNEXURE VI

CHECK METER READINGS OF GENERATING GENERATING PLANT
NAME OF THE GENERATING PLANT
PLACE: TALUKA: DISTRICT: STATE:

C.T. RATIO AVAILABLE/CONNECTED:

P.T. RATIO AVAILABLE/CONNECTED:

SCALE FACTOR (IF ANY):

MULTIPLYING FACTOR (MF):

BILLING METER MAKE / NUMBER:

METER READINGS:

	EXPORT METER READING	MPORT METER READING
KWH		
PREVIOUS READING		
CURRENT READING		
DIFFERENCE		
DIFFERENCE X MULTIPLYING FACTOR		

Authorised Signatory	Authorised Signatory	Authorised Signatory
EXECUTIVE ENGINEER	EXECUTIVE ENGINEER	AUTH. REPRESENTATIVE
TRANSMISSION	PROCURER	GENERATING PLANT

DATE
NOTES:

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1. PROCURER shall maintain a daily logbook to record hourly readings of the Bill Meter/ HT Meter.
2. The Generating Plant shall maintain a daily log to record the hourly generation and supply in KWh, along with the schedule given by PROCURER's Dispatcher.
3. If the meter is changed, the reason/s, date, time of meter change and new metermake and number must be recorded by both parties.4. May not need any signature if downloadable meters are used subject to the AERC guidelines issued from time to time.

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ANNEXURE VII

DAILY GENERATION REPORT

Name and Address of Generating Plant:

Date:

Installed generation Capacity: .. ..MW

Active Power (KWh)

Time	Scheduled	Meter Reading	Difference x M.F.
00			
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
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21			
22			
23			
24			
TOTAL			

Summary of Active Power, KWh

Time	Scheduled	Meter Reading	Difference x M.F.
Daily 0600 - 2200 2200 - 0600			
Cumulative for Month 0600 - 2200 2200 - 0600			

To:

1. Concerned SLDC, PROCURER
2. Executive Engineer, Transmission, PROCURER

Authorised Representative of the Generating Plant

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Annexure VIII

MONTHLY TRIPPING REPORT

Name and Address of the Generating Plant:

Installed generation Capacity: MW

Date of First Commissioning (Synchronising):

Date of Commercial Operation:

Date of Synchronising
Progressive Days (generation): Days

TRIPPING ON FAULT:

	Tripping			RELAY OPERATED		REASON FOR TRIPPING			SYNCHRONIZATION		Total Time Lost		REMARKS
S. N.	Date	Time				Mech	Elect	Other	Date	Time	Hr.	Min	
		Hr.	Min							Hr. Min			

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ANNEXURE IX

PLANNED & FORCED OUTAGE

S. N.	Outage			RELAY OPERATED		REASON FOR TRIPPING			SYNCHRONIZATION		Total Time Lost		REMARK
	Date	Time				Mech	Elect	Other	Date	Time	Hr.	Min	
		Hr.	Min							Hr. Min			

Progressive Days:

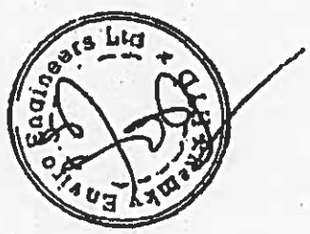
Time Lost: During Month& Year

Since First Commissioning

To:

1. Concerned SLDC, PROCURER
2. **Authorised Person/** Executive Engineer, STU/other Transmission Licensee/PROCURER (as the case may be)

AUTHORISED REPRESENTATIVE OF THE GENERATING PLANT



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ANNEXURE X

Quoted Tariff (As per RFP)

The quote as submitted by successful bidder, in the following format, from year of commencement of supply to subsequent 25 years

Year	Tariff (Rs./kwh)
FY 2010	
FY 2011	
FY 2012	
FY 2013	
FY 2014	
FY 2015	
FY 2016	
FY 2017	
FY 2018	
FY 2019	
FY 2020	
FY 2021	
FY 2022	
FY 2023	
FY 2024	
FY 2025	
FY 2026	
FY 2027	
FY 2028	
FY 2029	
FY 2030	
FY 2031	
FY 2032	
FY 2033	
FY 2034	

Notes:

1) Please refer Clause 2 of EPA (Agreement)

2) The Quoted Tariff in Rs./kWhr shall be provided up to three (3) decimal points

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ANNEXURE – 20

Requirements of Material handling equipments (automobiles) for MSW processing project

Sr.No	Equipment	For 1500 TPD		Remarks
		Nos	Cost / in Lacs	
1.	Tractors (HP 40 to 45)	6	46.8	
2.	Tractors (HP 70)	4	41.6	
3.	Pay loader attachment for 70 HP Tractor	4	78.0	
4.	Dozer plates	2	3.9	
5.	JCB Backhoe & Pay loader	6	195.0	
6.	Skid Loader (Bob cat type or similar)	4	83.2	
7.	Compost turning Machine	2	39.0	
8.	Spray tankers with pressurized jetty	2	7.8	
9.	Tipper Trolleys	8	20.8	
10.	Dumper Trucks	4	62.4	
11.	forklift	2	39.0	
12.	Super vision - jeep	2	13.0	
13.	Other utilities, sprayers,Wheel barrows & Safety devices		0.00	
14.	EOT Cranes for feeding	2	65.0	
Total			695.50	

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ANNEXURE – 21

Key Cost Elements for Bio Composting and RDF recovered from MSW
Please provide cost per tonne of recovered products

Item	From Mixed MSW recovery		Cost assigned to compost	Cost assigned to RDF
	A. Compost Lacs	B. RDF Lacs	Amount Rs (%)	Amount Rs. (%)
	20% (750 TPD)	40 % (100 TPD)		
Diesel /yr	177.94	23.73		
Electricity/yr	35.59	4.75		
Packing Bags /yr	266.91	35.59		
Direct Labor /yr	355.88	47.45		
Treatment Materials	13.69	23.73	86%	14%
Repairs/yr	106.76	14.24		
Fixed over heads /yr	53.38	7.12		
Interest and depreciations /yr	106.76	14.24		
miscellaneous/yr	13.00	13.00		
Total	**1129.00**	**183.82**		
Total amount	**1313.72**			

Total cost of Compost (Final Product)= 2063.74 Rs./MT

Total cost of RDF (Final Product) = 1259.04 Rs./MT

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DETAILED PROJECT REPORT

Integrated Waste Management Complex Guwahati

January, 2008

Submitted by

GUWAHATI WASTE MANAGEMENT COMPANY PRIVATE LIMITED (GWMCPL)

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SECTION 1.0
INTRODUCTION

1.1 Indian Scenario In MSW Management

Metropolitan cities in India with growing population, migration of people from rural areas to cities and rapid industrialization produce an enormous quantity of urban waste (Municipal Solid Waste - MSW) and industrial waste every day requiring its disposal. For example, Delhi with nearly 16 million inhabitants is understood to produce over 7,000 Tonnes of MSW daily. By and large, the Municipal Corporations in various cities collect the MSW, transport it to the dump yards and dispose it off in open ground dumping or non-sanitary landfill.

Despite the fact that the urban local bodies utilize major part of its staff and resource for collection and disposal of MSW, nearly half of MSW generated remains unattended in many cities. It is due to the fact that these local bodies lack financial and adequate institutional mechanisms.

As regards to citizens, they feel that waste generated by them can be just thrown in the public places and it is the duty of the urban local bodies only to take care of them. There has been a lack of community sensitization and public awareness towards waste minimization, storing waste in a segregated manner and disposing them in the proper place, etc.

The leftover garbage in the public places gives rise to morbidity especially due to microbial and parasitic infections and infestations in all segments of populations, with the urban slum dwellers and the waste handlers being the worst affected. In addition, the non-sanitary land filling practice currently followed has been causing uncontrolled methane emission into the atmosphere. A host of other hazardous gases like CO, CO_2, SO_x, NO_x etc. are also generated from the dump yards due to uncontrolled and incomplete combustion of garbage as well as due to

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decomposition (by auto-ignition) causing atmospheric pollution. Since MSW is dumped on the open ground, it also gives rise to ground water contamination by Leachate that is produced out of garbage and contains a number of dissolved and suspended materials.

It is reported that the bigger urban local bodies spend around Rs.1, 000/- to Rs.1,500/- per ton on garbage for its collection, transportation and disposal. About 65% of the above amount is spent on collection, 30% on transportation and a mere 5% on disposal.

With overloading of the existing landfill sites in cities, garbage may have to be transported nearly twice the current distance for land filling, escalating the cost of transportation. Once the existing landfill site is exhausted, identification of new landfill sites has also become a very difficult task.

The quantity as well as quality of MSW generated in the metropolitan cities are generally governed by the parameters such as Population, Standards of living, Socio-economic conditions, Commercial and Industrial activities, Food habits, Cultural traditions, Climatic conditions etc. It is estimated that about 1, 00,000 Tonnes of MSW is generated daily in the country and the urban area's contribution is over 60%. It is reported that in Indian cities, waste generation varies from 0.25 kg to 0.60 kg per capita per day. Average MSW generation in cities in developed countries varies from 1.5 kg to 3.0 kg per capita per day. Unlike developed countries, in India, MSW is not segregated at source and is found in a mixed condition. Rag pickers extract recyclable materials like paper, glass, plastics, metals etc. from the waste.

Most of the developed countries have been successful in addressing the problem of solid waste management by evolving efficient MSW management systems and providing suitable technological solutions to garbage disposal / treatment. With the ever-increasing generation of garbage, it is time for immediate and concerted

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action. The proper disposal of urban waste is not only absolutely necessary for the preservation and improvement of public health but it has an immense potential for resource recovery.

Municipal Corporations/Urban bodies in the country are attempting to set up facilities for processing of MSW as per MSW (Management & Handling) Rules, 2000, which involve,

- Infrastructure development for collection, storage, segregation, transportation, processing and disposal of MSW.
- Apply for Grant of authorization for setting up waste processing and disposal facilities including landfills from the State Board or Committee.
- Notify the waste collection and segregation schedule to the generators of these wastes, to help them comply.
- Organize awareness programmes for citizens to promote reuse or recycling of segregated materials and community participation in waste segregation.
- Processing of MSW has been given an impetus due to adverse effect on environment through air, water and land pollution.
- Submission of an annual report to:
  Secretary-in-charge of the Department of Urban Development of the State or Union Territory of metropolitan cities.
  The District Magistrate or the Deputy Commissioner in case of non-metropolitan cities.
  The State Pollution Control Board or Committee on or before June 30 of every year.

1.2 Present Technologies In India

MSW Processing / Treatment / disposal technologies

The organic content of MSW tends to decompose, which apart from being a health hazard also leads to various odour problems. It also leads to pollution of

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the environment. To ensure a safe disposal of the MSW it is desirable to reduce its pollution potential as well as to recover useful products out of it. Several processing methods are adopted for this purpose.

1.2.1 Sanitary Land Filling

Garbage disposal by land filling is widely resorted to by city / town Municipalities. Low-lying wastelands on the out skirts of cities are identified and the MSW is dumped at such sites. Rag pickers collect recyclable items from the dump yard and also set fire to the MSW dump. Such indiscriminate acts cause soil, air and water pollution in its neighbourhood. Also if some form of waste disposal systems are not operational, it would necessitate creation of new dump yards farther away which results not only in wastage of land but also increases cost of transportation of garbage. If land filling can be made clean and scientific (free from pollution) such operations termed as Sanitary Land Filling can be encouraged.

As per the MSW handling rules 2000, the organic waste is not supposed to be disposed at landfill site. Only the inert and the construction & demolition waste should be disposed at landfill site. In most of the western countries, the govt. has directed the local bodies to treat the garbage and dispose the inert to the landfill site. The local bodies have initiated treatment of garbage by using various technologies to reduce the landfill site as much as possible. In India, the first scientific engineered landfill site is in the process of implementation at Surat.

1.2.2 Landfill gas

When large amount of MSW are disposed off at landfill sites, the sites act as bio-reactors in which micro-organisms produce bio-gas composed of about 50% carbon dioxide and 50 % methane. In an engineered/sanitary landfill, this can be extracted from gas wells through network of perforated plastic pipes laid within the refuse. About 400 cubic meters of gas (at NTP) can be produced from each ton of waste in a landfill. Over a period of 10 years, one ton of domestic solid

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waste is expected to produce in excess of 100 times its own volume in bio-gas. The generation of large quantities of methane from landfill sites improved throughout the early 1980s, and the number of sites using this technology is on the increase

Selection of suitable landfill sites has become an important and major step, which dictates the extent of preparations required for safe disposal and tapping of the gas. Mining of the site and use the material as manure eventually is also an option. In view of the high organic content in Indian city garbage, this option is considered attractive. However, large-scale operations and commercial viability of this technology are yet to be demonstrated in the country.

1.2.3 Recovery and Recycling

The practice of recovering recyclable items like papers, plastics, metals, glass, leather / rubber, bio-mass etc from MSW is well established in developed countries. Automated plants of different capacities are operational at different levels of techno-economics, specific to each plant. The biomass separated is either composted into manure, pelletised into densified fuel pellets or compacted for ease in transporting and burning. In the Indian context, the percentage of recyclable (plastics, metals, glass, paper etc) being very low, since rag pickers take out these items both at the source as well as from dump yards, the MSW management is complex and tends to be economically more difficult.

1.2.4 Composting

The organic matter separated from MSW can be converted into fertilizer by mechanical composting, bio-technological process using special cultures or using vermiculture. All these processes are being carried out in small-scale operations in India. There exist a weakness in the compost plant on a standalone basis. The composting requires a large area and the cycle time is very high to convert to

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organic manure. Since glass pieces and inert is mixed with the garbage, the quality of the manure is not very suitable for any agricultural purpose. The efforts made in each of these methods and their success rates are briefly described in the following paragraphs.

Mechanical Composting

A number of plants were installed in major cities in the country like Mumbai, Pune, Bangalore, Hyderabad, New Delhi etc. Most of them are closed or non-operational due to lack of viability. The problems reported are high cost of production and marketability, inefficient plant management, presence of glass pieces in the product, product acceptability, etc.

Bio-tech Composting

Specially developed cultures are used for composting the bio-degradables derived from MSW. The Department of Bio-technology, Government of India, has developed the technology for commercial application. Some industries like M/s Excel Industries have adopted this technology in Mumbai and other places. It is understood, the results are reported to be encouraging, marketability has been established.

Vermiculture

The process involves intense intrusion of earthworms into the MSW bed, which convert MSW into nutrition rich soil conditioner. Small-scale successful operations are reported from Pune. Mumbai Municipal Corporation had set up a pilot plant with technical assistance from IIT, Bombay. However, large-scale plants didn't come up.

Composting Initiatives in India

1978-1980: On the insistence of Agricultural Ministry, GoI, over a dozen composting plants, using foreign technologies were set up but all of them except KCDC in Bangalore and NDMC in Okhla stopped functioning.

1990-1995: Private sector initiatives and NGO action for proper treatment and utilization of municipal solid waste resulted into reestablishment of bio-composting plants, and at several places decentralized vermin composting activity started.

1995-2000: Over a dozen new composting plants were set up in the cities of Bhopal, Gwalior, Vijaywada, Bangalore, Calcutta, Thane, Ahmedabad, Delhi, Aurangabad, Calicut, Trivandrum and Puri. The technology was developed, which is capable of handling un-segregated waste with the assumption that as and when source segregated waste is available, the efficiency of screening facility will go up, resulting in better plant operation.

1997-till date: There has been increased interest by Urban Local Bodies for putting up bio-composting projects under BOO, BOOT and Joint Sector models.

1.2.5 Energy Recovery from MSW

The energy content in MSW in urban areas is due to the presence of combustibles such as plastics, paper, rags and various other biomass wastes discarded by domestic and commercial establishments. The Energy Content Fraction (ECF) of garbage in India is lower compared to the ECF factor of garbage in developed countries. However, it is important to note that the moisture content of Indian garbage is rather high at 50% - 60% and paper / plastic fraction is low. These factors dictate the technology options suitable for Indian city garbage for energy recovery. The major technology options for energy recovery under practice in the

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developed countries include Incineration, Anaerobic digestion, Landfill gas, Fuel pellets, etc.

Incineration

There are over 500 mass burn municipally owned incinerators in USA and UK burning about 13% of MSW. The modern mass incinerators reduce the volume of MSW by 90% and the ash that is virtually sterile is land filled.

There are two types of incinerators in use. These include incinerators which burn MSW as received and the other type of incinerators which burn loose combustible waste derived from MSW after processing / refining.

The thermal energy generated through incineration is utilised for production of electricity and/or for heating purposes. The post 1995 incinerators are required to operate to new European Commission (EC) requirements of emission controls. The Toxic emissions should be brought down to concentrations as low as 0.1 to 2.0 nanogram per cubic metre by appropriate combustion control methods.

A Pilot Plant for incineration of Municipal Solid Waste (MSW) of Delhi city and generation of power as a by-product was set up with assistance from Government of Denmark at Timarpur, Delhi in the year 1987. This plant was designed to process 300 TPD of MSW with Net Calorific Value (NCV) of 1463 kcal/kg for rated power output of 3.75 MW with an approximate capital cost of Rs.25.0 crore. The supplier of the technology as well as the turnkey contractor was M/s Volund Miljotecknik A/S, Denmark. The Plant was on trial run and was operated for a few months and was subsequently closed down in the year 1990 due to mismatch of quality of incoming MSW (of NCV in the range of 800 – 1000 kcal/kg) with the plant design.

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In Indian context it will be essential to refine MSW through moisture reduction followed by separation of combustibles before feeding the same to the combustion chamber. As the incineration plant set-up at Timarpur, New Delhi did not have suitable mechanism to reduce moisture content and separate the combustibles, the plant could not be operated successfully.

Since the Indian garbage is heterogeneous in nature, direct combustion is not appropriate to feed directly into the boiler. Due to absence of segregation at source, none of these foreign technologies work on Indian garbage. There has to be some broad level segregation at the processing plant and after the segregation, different technologies need to be applied for processing of different types of broadly segregated wastes.

Anaerobic Digestion

The biodegradable wastes of organic or vegetable origin can be processed in anaerobic digestion plants to produce a mixture of methane and carbon dioxide. The methane fraction can be separated and used as fuel for power generation, heating purposes including domestic cooking. The organic material separated from MSW is shredded and fed into the Anaerobic Digester (AD). The process is similar to that of generation of sludge gas from sewage. The solid to liquid ratio in the digester is of the order of 15% - 25% and some improved AD converters can take as high as 30% solids. The wastes remain in the heated digester at temperatures in the mesosphillic range (25 – 45 deg. C) for varying periods (10-20 days), the duration being dictated by different criteria like external temperature fluctuations and others variables like the waste composition itself. Some newer processes operate at the thermophillic range (temperature of 55 – 60 Deg C) and offers better rate of degradation. Gases given off during the decomposition are continuously drawn off.

A 5.0 MW waste to power plant based on bio-methanation of MSW was commissioned in Lucknow in 2003 at an approximate cost of Rs.80.0 Crores. Due to heterogeneous mix of Indian garbage, the municipality was not able to supply green waste and the plant got shut down.

Refuse Derived Fuel

The Fuel pellets generally known as Refuse Derived Fuel (RDF) is made by refining municipal solid waste in a series of mechanical sorting and shredding stages to separate the combustible portion of the waste. Either a loose fuel, known as fluff, floc or coarse RDF (c-RDF), or densified pellets or briquettes (d-RDF) are produced.

RDF production can complement materials recycling schemes. Glass, clean paper, metals and any other materials are removed from the waste stream for recycling before it is delivered to the plant. Further materials recovery is conducted at the RDF production site, as many plants incorporate some degree of manual sorting and most plants provide eddy current separators for non-ferrous metal extraction. The mechanically separated organic wastes that will not form part of the fuel are either landfilled or subjected to further treatment to produce compost. Various recycling stages can be incorporated into the RDF process, enabling maximum recycling to take place. RDF production also permits a level of flexibility, so that, if for example, no markets were available for low-grade waste paper, it could instead be temporarily redirected to the fuel process rather than being wastefully land filled.

The majority of d-RDF plants produce pellets approximately the size and shape of wine bottle corks, while c-RDF usually looks a little like the fluff from a vacuum cleaner. The composition of the raw waste, which is dependent on such factors as climate, diet, living standards and degree of urbanization, will obviously influence fuel characteristics, so that detailed local waste analyses are essential at a very early project stage.

Studies on the calorific value of RDF indicate that removing the non-combustibles like glass & metals and combustibles like waste paper still leaves MSW with sufficient energy content fraction to make RDF production viable

In Europe, much of the early development work on RDF technology was done in England, where construction began on the Byker, Newcastle, and Doncaster, South Yorkshire plants in 1976. Italy was also a pioneer in the construction of RDF plants, and two plants were commissioned in 1978 in Pieve di Corano and Ceresara, both in the northern Italian Mantua District. The Herten plant in Germany with two production lines was commissioned in 1981 and each of the two lines is capable of producing 7.5 tonnes of RDF and one tonne of ferrous scrap an hour. RDF is sold to cement industry. In Netherlands, the ICO power plant in Amsterdam has been treating 1,50,000 tonnes of waste each year since 1983. Such plants also exist in France at Laval in Mayenne; in Switzerland at Chatel St Denis and five plants are installed in Sweden.

In USA a number of d-RDF plants are operational including Thief Falls in Michigan, Northern Tier in Pennsylvenia, Yankton in South Dakota and Iowa Falls and Cherokee, both in Iowa. In Asia, one such plant is known to exist in Korea at Seoul.

Densified RDF, which is manufactured in most of the plants has the advantage that it is easy to handle, transport and store. The d-RDF is often transported to considerable distances for use in cement plants and co-generation power plants. For example, the RDF from Udine plant is transported 400 km to a fluidised bed gasification plant in Chinati, South of Florence. Pellets from Mantua plants are delivered 150 km to Ravenna cement works.

Separation of combustibles from MSW is an important step in the production of fuel pellets. Further, the moisture content of Indian city garbage makes the

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process much more complicated. As most of the recyclable items such as glass plastic, paper and metals are picked up by rag pickers, the garbage received at the dump yards cannot justify investment for automatic separation system employed by the developed nations.

Appreciating the need for finding appropriate technological solution to MSW disposal problem, the Department of Science & Technology (DST), Govt. of India had initiated technology assessment studies and after detailed analysis, DST commissioned a MSW processing plant under Integrated Waste Management Project (IWM) in 1990 in Mumbai to demonstrate the Technology of processing MSW and recovery of fuel (energy) in the form of Refuse Derived Fuel Pellets at a pilot plant scale (150 TPD MSW Processing). The technology of processing MSW into fuel fluff / densified fuel pellets of calorific value around 3500 kcal/kg has been indigenously developed and successfully demonstrated at a production scale of about 2.0 TPH (40 TPD).

The pellets produced were test marketed in and around Bombay at a promotional price of Rs.1,000/- per tonne. About 1000 tonnes of fuel pellets were test marketed for use in Boilers in process industry. The soil separated from MSW, a part of the rejects from the plant was found to contain fine organic matter that was used as a soil enricher.

After successful demonstration, DST has handed over the above pilot plant to the Mumbai Municipal Corporation for its onward transfer to willing private entrepreneurs for commercial exploitation.

In fact, the major breakthrough that was achieved in the above pilot project was the indigenously developed low cost and effective refinement process of MSW. The refined MSW either in fluff form or in densified form with moisture content around 10%-15%, ash content around 10%-15% and calorific value in the range

of 3,500 kcal/kg has been understood to be suitable for any emerging technologies for power generation.

The experience of handling large quantities of garbage indicates that it was preferable to design a commercial scale garbage processing plant as an Integrated Process Plant which can produce energy rich fuel fluff / densified fuel pellets as well as manure of appropriate form. After the successful demonstration of the fuel pellets production, it was decided to transfer the Technology to the interested agencies for commercial exploitation.

Based on successful demonstration of Waste to Fuel pilot Plant in Mumbai, DST has transferred the technology, through its autonomous body, TIFAC to M/s SELCO International Ltd., at Hyderabad, to establish the first commercial plant in India having a capacity to process 700 TPD MSW and to produce fuel fluff / Pellets that would be used for generating power. As advised by lending institutes, SELCO's proposal of power plant was split into two phases i.e. 1st phase – Fuel Recovery plant and 2nd phase – Power Plant.

SELCO commissioned in 1999, a 700 TPD process plant and has been producing fluff / pellets / briquettes. The Power Plant phase of this project generating 6.6 MW of electrical Power (through RDF combustion route) was commissioned in 2003 and since then the plant is operational.

In 2003, M/s Shriram Energy systems has commissioned a 6.0 MW power plant in Vijayawada with two waste processing streams, one each at Vijayawada and Guntur and since then the plant is operational.

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1.3 Critical Analysis of Various Technologies

Limitation in Sanitary Landfill

- The sanitary landfill site is only for the disposal of the inert material generated from the garbage. The matter that is not used for any other purpose is to be dumped at the landfill site, thus reducing the requirement of landfill area
- The infrastructure cost required for setting up and the operating cost for maintaining a landfill site is very high. In case municipal body has to implement the guidelines of the Solid Waste Handling Rules 2000, the cost impact on the citizen will be enormous.
- Green waste is not supposed to go to the Sanitary Landfill.
- The international trend is to reduce quantity of MSW going to Sanitary landfill.
- Results in substantial pollution

Limitation in Incineration Technologies

- High moisture content
- Since segregation is not done the heating value varies over considerable range
- Requires extensive support fuel thus making the project unviable.

Limitation in Composting

The cost of installation of this technology is comparatively lower than the other alternatives but the cost of end product i.e. organic fertilizer is high because of the following reasons:

a. Tried in various cities but a very few are working
b. The land requirement for treatment is high. A plant processing 1000 TPD of MSW by vermiculture technology would typically require more than 50 Hectares of land.

c Cost of transportation is very high because of the location of end consumer at farther distance from the city limit.

d Process rejections are very high

e Cost of operation is high because of the quantum of mechanization required for initial segregation of the waste.

f Required sale price for self-sustaining operations is high. A mechanized composting plant of 300 TPD input capacity was set up in Okhla sewage treatment plant in 2.5 Hectares land adjacent to the NDMC' compost plant. The process involved aerobic composting in windrows after separation of inorganics, magnetic separation followed by mixing in a homogeniser after size reduction in rasper. The organic fertilizer thus produced failed to find the market at desired sale price. The plant operation was discontinued in the year 2000 due to the absence of buyers of compost on account of high transportation cost.

Limitation in Biomethanation

- Suitable for only segregated green waste
- Stand alone project based on bio-methanation tried in Pune & Lucknow failed due to incompatibility of mixed waste / low yield of methane
- Bio-methanation is a better option than composting. Land area requirement in the biomethanation is very nominal compare to the compost plant.

1.4 Conclusion

The above mentioned technologies have been tried on a standalone basis in various parts of the country none of which could provide a comprehensive solution to treat the MSW. Since the garbage is heterogeneous in nature, there should be different technologies that can treat the mixed and green waste separately.

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SECTION 2.0
INTEGRATED MUNICIPAL WASTE COMPLEX

2.1 Limitations of Present Approach of MSW management

Indian urban population has touched a level of 102 crore in 2001 and is growing @ 20 % per decade. The daily garbage generation is about 1.2 Lakh MT. After the intervention of Hon'ble Supreme Court, the MSW Rules have been framed for ensuring proper treatment and disposal of Municipal Solid Waste.

A number of initiatives have been taken for treating Municipal Solid Waste. Composition of Indian urban waste, being substantially different than that of Western countries because of different process of its collection and transportation, poses unique challenges. However, a critical analysis of such initiatives has identified the following factors for their non-sustainability:

a. These initiatives/interventions were driven by "A TECHNOLOGY". Incineration Technology for Timarpur, Bio-Methanation Technology for Lucknow, RDF Technology for Hyderabad. However, there have not been any efforts to look at a mix of technologies to treat various components of the Municipal Solid Waste in an efficient manner.

b. Traditionally, liquid and solid wastes have been kept in watertight compartments. However, there is a tremendous synergy between the two if these two could be treated in an integrated manner.

c. Since there is no segregation at source in India, many of the technologies, which were tried, were not found suitable to Indian Municipal Solid Waste. Timarpur and Lucknow are clear examples of the same.

d. The minimum project development work was carried out. This means that activities relating to identification of land, obtaining various approvals, preparing a technical and financial report, analysis of garbage, planning for garbage transportation (truck routing plan) were partly completed. This has a major adverse affect on the project viability as well as replicability

e. The selection of operator was done in a non-transparent manner by following the MOU route. In fact, in most of the cases, technology providers were the operators as well.

f. No effort was made to see utilization of the inert coming out of the project either in compost plant and bio-methanation plant or in RDF plant. The inert was supposed to be sent to landfill.

2.2 Integration

The limitations of individual technologies can be mitigated by bringing together a mix of technologies by integrating them together to provide a holistic solution to the treatment of urban waste. An integration of technology so carried out would have the following benefits:

a. It treats various components of urban waste in an efficient manner so as to provide optimum utilization of waste to produce compost, bio-gas, power and building materials.

b. Liquid and solid wastes when treated in the same complex provide tremendous synergy for being treated in an efficient manner.

c. It leads to optimization of cost by treating larger quantities at the same place, sharing infrastructure and variable costs.

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d. It is environmentally desirable, as the rejects of one process becomes inputs for the other process.

e. An integrated complex can treat the residual wastes by making building blocks as well as other products.

g. When treatment of liquid waste is integrated with urban solid waste, viability of treatment of liquid waste also improves substantially.

2.3 Integration of Solid and Liquid Waste

The integration essentially means:

Solid & liquid wastes could be treated in the same complex.

The treatment process would be well integrated in terms of input and output.

Each stream of the garbage will be treated by the technology most suitable for it. Thus such a complex would have compost and methane from bio-methanation process, fuel and power from RDF plant, bricks and roadblocks from inert plant.

The integration is essential for the following reasons:

- It is technically required to produce methane to support combustion in boiler of RDF. For this purpose mixing of sludge of the STP along with green waste is carried out to produce methane. This serves two purposes:

* This replaces the requirement of bio-mass for the RDF plant which has been observed as a major weakness of that technology.

* It reduces the cost of bio-methanation process, because separate fuel engines are not required.

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- The integration improves the viability of the project as it leads to cost optimization.

- The integration is also environmentally desirable, as it uses wastewater. Secondly, it substantially reduces need of land for landfill and thirdly it produces very high quality compost much superior to the product of a compost plant.

- It produces green fuel and reduces methane emission – one of India's support to the cause of Kyoto Protocol

- It improves viability of Municipal Body (MB), as they do not have to spend money on acquiring land for landfill sites and about 40% of capital expenditure on STP (sludge pumping station, digesters, gas holders and sludge drying beds) is loaded to the project operator along with about 50% of O&M cost. Secondly, it reduces the average distance of transportation, thereby bringing long-term benefits to the Municipality. Thirdly, it ensures sustained treatment of sewage.

- Such a complex can further add value to the Municipal Body by integrating door-to-door collection and transportation of garbage by the operator. This would ensure that door-to-door segregation of garbage takes place by the BOT operator, which improves operational viability of the projects. This would also meet the obligation of MB under MSW Handling Rules 2000.

The consortium has marketed the integrated concept and various municipalities accepted the integrated concept of solid and liquid waste. The consortium has signed MOU with the following municipal bodies:-

- Municipal Corporation of Delhi (MCD)
- New Delhi Municipal Council (NDMC)

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- Pune Municipal Corporation (PMC)
- Kanpur Municipal Corporation
- Ajmer Municipal Council (AMC)
- Bikaner Municipal Council (BMC)
- Kota Municipal Council (KMC)
- Udaipur Municipal Council (UMC)
- Agra Nagar Nigam
- Saharanpur Nagar Palika Parishad

2.4 Highlights of MSW Rules 2000

Policy Issues

Highlights of Gazette notification issued by Ministry of Environment and Forests MoEF) for MSW (Management and Handling) rules 2000.

A. Responsibility of Municipal Authority

Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.

The municipal authority or an operator of a facility shall make an application for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee in order to comply with the implementation program laid down.

The municipal authority shall comply with these rules as per the implementation schedule laid down:

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B. Responsibility of the State Government and Union Territory Administration

The Secretary-in-charge of the Department of Urban Development of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of these rules in the metropolitan cities

The District Magistrate / the Deputy Commissioner of the concerned district shall have the overall responsibility for enforcement of the provisions of these rules within the territorial limits of their jurisdiction.

C: Responsibility of the Central Pollution Control Board / the State Board or the Committees

The State Board or the Committee shall monitor the compliance of the standards regarding ground water, ambient air, leachate quality and the compost quality including incineration standards as specified.

The State Board or the Committee shall issue the authorization to the municipal authority or an operator of a facility stipulating compliance criteria and standards including such other conditions as appropriate.

The authorization shall be valid for a given period and after the validity is over, a fresh authorization shall be required.

2.5 Proposed Approach – Management of MSW

The proposed approach complies with the MSW handling rules 2000 and complies to the rules and regulations of Ministry of New and Renewable Energy (MNRE). The proposed approach differs from the past initiatives in two significant ways – first, the approach is not influenced by any particular

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technology of waste handling (rather it's 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 institutionalize the activity.

The other important issue in implementation of these projects is lack of focus on the development phase and the need to develop institutional framework to implement these projects. The municipalities are too engrossed in their day-to-day problems and have no resources, experience or expertise to implement such projects.

Technology Issues

There have been a number of initiatives in the past based on single technology suitable for a particular type of waste. Unfortunately, we have not been able to implement segregation at source and none of these technologies are designed to work on mixed & un-segregated solid waste. Thus, in view of above there has to be some broad level segregation at the processing plant and after the segregation with different technologies applied for processing of different types of broadly segregated wastes. Accordingly, IL&FS has tied up with Andhra Pradesh Technology Promotion Centre (APTDC) for the conversion of garbage into fluff, which is directly fed into the boiler. Based on the above technology, two plants are running successfully for the last years in Hyderabad and Vijayawada. The significant problems in the exiting two plants were critically assessed and mitigated in the proposed plant.

Financial Issues

The development phase entails high risks and as it is the economic viability of these projects is marginal. Most municipalites are also constraint by financial resource shortages and the augmentation of resources by bringing in private capital is must. The project has to be made attractive from the perspective of

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private investors to attract investment. And if the private sector were to assume high risks they would expect high returns, which is difficult in case of these projects. Thus, development phase becomes very important and there has to be active support from all entities to help in mitigation of developmental risks.

Development Phase

The development phase includes getting permits and clearances, getting land, tying up MSW/Sewage supply, tying up power sale, tying up water requirements etc. The bankable document will comprise of technical studies, economic and financial analysis, environmental studies, market demand studies, resource mobilization, and development of contractual framework, risk analysis and allocation.

The following steps would be followed:

Step-I: Development of Bankable Projects

- Primary survey for quantification and characterization of the garbage
- Collection and transportation plan to minimize the transportation cost
- Concession agreement with Municipality/local bodies
- Techno-Economic Feasibility Report / DPR
- Ready Statutory / Non-statutory Clearances
- Ready Power Purchase agreement
- Sources of project finance
- Land details with site, soil, water investigations

Step-II: Selection of Developer

- Issue of Request for qualification (RFQ)/Request for proposal (RFP)
- Pre-bid meeting
- Evaluation and selection of the BOT operator

Step-III: Project execution Assistance

- Monitoring during the implementation period

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- Provide assistance for speedy implementation of the project.

The proposed approach does not entail any financial out flow from the municipalities. On the contrary, the Consortium expects that the promoter may be in a position to pass on a token amount per unit of electricity generated from the MSW. Thus, the approach is expected to provide motivation to the municipalities to supply the contracted amount of MW. It is likely to "suck the garbage" from the city and generate revenue flow to the ULBs, which in turn can be utilized for improving the infrastructure facilities for collection and transportation.

2.6 Major stakeholders in the project

Guwahati Municipal Corporation (GMC)

Guwahati Municipal Corporation is the largest Municipalities in the north-eastern region of India providing civic services to an estimated population of 8.5 Million citizens. The project will thus be designed to have additional capacity to accept waste from GMC. GMC has consented to provide land .The developer will be responsible for collection, transportation, processing of waste by suitable technology like composting, power plant etc and development of land fill site at Boragaon, Guwahati.

Infrastructure Development Corporation of Assam Limited (IDCAL)

Infrastructure Development Corporation of Assam Limited (IDCAL) is a Joint Venture Company incorporated by Government of Assam through Guwahati Metropolitan Development Authority (GMDA) and Infrastructure Leasing and Financial ServicesLimited (IL&FS) for development of urban infrastructure projects in Guwahati and other areas of Assam. IL&FS group has significant experience and expertise to render advice, develop projects, facilitate formulation of policy and related aspects for catalyzing Public Private Partnership. IL&FS through its subsidiaries have been actively working in the MSW sector in various

States of India including Delhi, Rajasthan, Uttar Pradesh, Maharashtra and Tamil Nadu

Infrastructure Leasing & Financial Services (IL&FS)

IL&FS is a leading institution of India, promoted by Public sector Financial Institutions and Banks of India including UTI, Central Bank of India and HDFC among others, with an objective, inter alia, of developing projects in the infrastructure sector on commercial basis. IL&FS group companies have significant experience and expertise to render advice, develop projects, facilitate formulation of policy and related aspects for catalysing Public Private Partnership (PPP), identify prospective developers, undertake mobilisation of financial resources from both the domestic Financial Institutions and multilateral agencies and participate as a co-promoter in specific projects.

Andhra Pradesh Technology Development & Promotion Centre (APTDC)

APTDC, established under the joint participation of the Govt. of Andhra Pradesh, Confederation of Indian Industry (CII) and Technology Information, Forecasting & Assessment Council (TIFAC - under the Department of Science & Technology, Govt. of India) is conceived as a one-stop shop for Technology Development & Promotion, Technology Upgradation and Induction of New Technologies as a unique model in the country.

APTDC provides user-friendly environment, linking support and guidance from global experts and Government in upgrading the industrial growth. The Centre uses network of institutions/agencies in and outside the country, in order to stimulate and successfully accomplish SMEs technology projects and help them in problem solving.

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APTDC is incorporated as a Society. An apex Governing Council, chaired by the Secretary of the Department of Science & Technology, Govt. of India and consisting of members from Govt. of India, Govt. of AP, TIFAC, and CII guide, monitor and control the operations of the centre and lay down policy guidelines and resolve policy issues. APTDC has the following functions

- Technology Services (from concept to commissioning) for promoting technologies having societal benefits.
- IPR Facilitation Services for promoting innovation and assistance in protecting inventions.
- SME Services for handholding SMEs in their technological endeavour (technical problem solving, technology development / upgradation etc.) to become globally competitive.

APTDC is TIFAC's exclusive agency in promoting, transferring and implementing its MSW to RDF technology.

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