CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

CONTENTS

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

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SESL 6 MW Municipal Solid Waste based Power Project

Version 02

28/09/2006

A.2. Description of the small-scale project activity:

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The project utilizes municipal solid waste available in the cities of Vijayawada and Guntur to produce 6 MW power to export to state grid. Vijayawada city, located in Krishna District of Andhra Pradesh state generates around 500 MTD solid waste per day (2002) and is estimated to generate around 724 MTD by the year 2007[1]. Guntur city, located in Guntur district generates around 400 MTD solid waste. All the waste generated in these cities dumped in open landfills unscientifically, leading to acute shortage of land fill site near the city. The project activity involves the processing of municipal solid waste in to Refuse Derived Fuel (RDF) fluff and generation of power using the fluff as fuel in power boilers.

Very few of these kind of projects are in India. This plant is one of the first projects of its kind in the country and unique for having integrated facility of MSW processing and Power generation in the same location.. It is a power plant based on Combustion of processed Municipal Solid Waste, generally known as Refuse Derived Fuel RDF. The Municipal Corporations of Vijayawada and Guntur have entered into agreements with the company for supply of 225 TPD and 280 TPD of MSW respectively and the company processes MSW so supplied and produce RDF in Fluff /Pellet form. The production of Fluff form of RDF is found to be viable and less maintenance prone. The fluff is being used as the main fuel for the generation of steam and to generate power by thermal route there from. SESL has set up processing plants in both Vijayawada and Guntur to prepare fluff and power generation unit set up at Vijayawada. The fluff produced by processing of MSW in the process plant at Guntur is transported using trucks by road (about 40 km) to the integrated facility at Vijayawada where together with the fluff produced at Vijayawada processing facility, is used for combustion as main fuel in the boiler of the power plant. In addition to the fluff, plant also uses other renewable biomass fuels like Rice husk and other permitted agricultural wastes as per MNES guidelines.
SESL had entered into an agreement with TIFAC (Technology Information, Forecasting, Assessment Council of Government of India and acquired the know how for refinement of MSW to produce fluff. The

[1] www.indiawteplan.com

steam generator is manufactured indigenously but the basic design and detailed design conforms to know how of reputed suppliers in the world which has provided the design, supervision, and technical services. A few items such as Rapping Car mechanism is imported for the unit. The plant processes the waste and generates RDF Fluff which is combusted as main fuel in the specifically designed steam generator with the technical know-how of international company to generate steam. The steam generated in the boiler passes through the steam turbine to generate power. For the processing of MSW, special purpose equipments like specially designed shredders, and air density separators, conveyors and rotary screens are used. Water cooled condenser is being used to condense the exhaust steam emanating from Steam Turbine and only a minimum quantity of Water is treated for make up requirements of Boiler feed water.

Contribution to sustainable development

The project has contributed to the sustainable development in the following manner:

- The project contributes to improvement in the local and national environment conditions.
- This helped in the reduction of methane emissions from the landfills and also in generation of clean power using RDF pellets/fluff, byproduct of MSW.
- This also helped in reduction in GHG emissions due to the power generation using fossil fuels.
- The project also contributed in terms of streamlining the collection and segregation process before further treatment and increases the chances of recovery of products that can be reused and recycled.
- The project also generated direct and indirect employment to the local people in the city.
- It also helped in creating hygienic working and environment condition for the locals engaged in waste collection and segregation from the dumping site.
- The project has provided the local bodies relief from ever increasing problem of finding dumpsites for disposal of MSW and contributed to renewable energy in the country

Hence, the project is helping to the sustainable development by improving economic, social and environmental conditions.

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)

India	Shriram Energy Systems Limited (Private entity. Project developer.)	No

See contact information in Annex-1 to this PDD

A.4. Technical description of the small-scale project activity:

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The technical description of the project activity is as follows:

Incoming MSW from the city using trucks is unloaded on tipping floor. Before shredding, the incoming MSW is inspected on the horizontal conveyer and odd objects like big inert pieces, wooden pieces, long iron pieces etc. are hand picked and removed. After inspection, it is pushed on the slat conveyor for primary shredding.

In primary shredding, MSW is delumped in to small sizes to enable easy drying and separation. Delumped MSW is dried from 45% moisture to 25% moisture, either on a paved sun drying yard or in a Rotary dryer connected to garbage fired hot air generator. Dried MSW is passed through a rotary sieve for separation of fine dirt and sand and fine material is sent as soil conditioner for further processing. Screened MSW is passed through density separation phase in air density separator and heavy particles are rejected before sending for dumping. This is a seasonal process. MSW is then passed through a cage mill for further size reduction. Dried combustible material having 40 - 100 mm size is RDF (Refuse Derived Fuel) and its calorific value is about 1800 to 2400 kcal/kg.

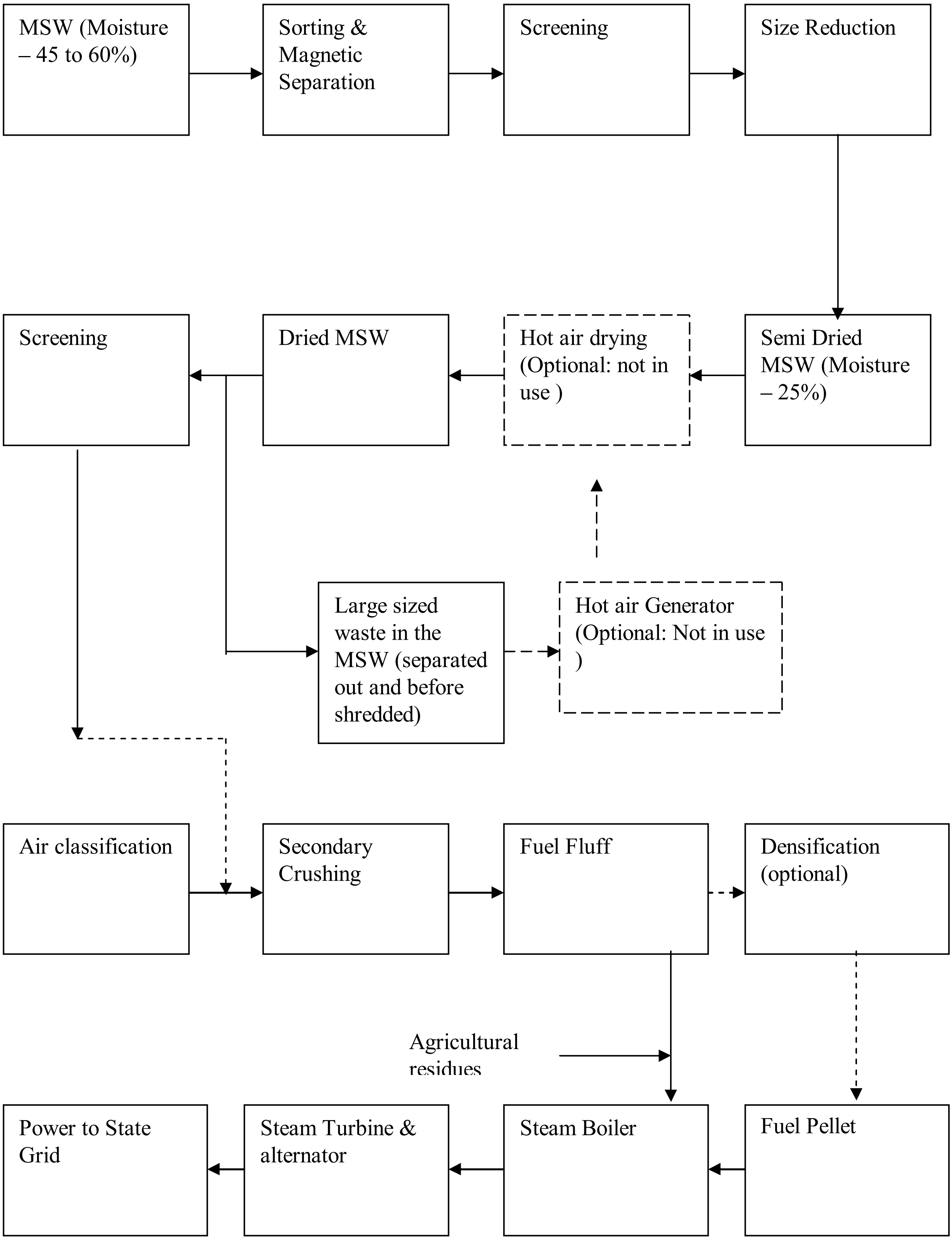
RDF Fluff is combusted in boiler of 28 TPH to generate steam in boiler with 65-ata and 485^{o}C configuration. Boiler is of travelling grate type and can handle multiple fuels mixed with RDF fluff. The steam generated in the boiler passes through the steam turbine to generate power. Steam turbine is of straight condensing type with inlet steam conditions of 62 ata and 480^{o}c, exhausting steam at 0.10 ata to a water cooled condenser and coupled to an alternator of 6 MW maximum continuous rating (MCR) capacity. Thus the project resulted in reduction in GHG by reducing the methane emissions from the landfill which would have occurred in the absence of the project activity and exporting clean, green power to the state grid replacing fossil fuel generated power in the state grid. The project is commissioned on 4th December 2003 on commercial basis, and sells the energy produced to APTRANSCO with which a Power Purchase Agreement (PPA) was made valid for 20 years.

The plant is designed with systems like

- Fluff handling system with storage and processing arrangements,

- Ash handling system,
- Water treatment plant,
- Compressed air system,
- Main steam systems,
- Fire protection system,
- water system which include raw water system, circulating water system, condensate system, De-mineralized water system and service with potable water system and
- Electrical system for its successful operation.

The single line diagram of the process flow is as shown below:



A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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India

A.4.1.2. Region/State/Province etc.:

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Krishna District, Andhra Pradesh

A.4.1.3. City/Town/Community etc:

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Vijayawada

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

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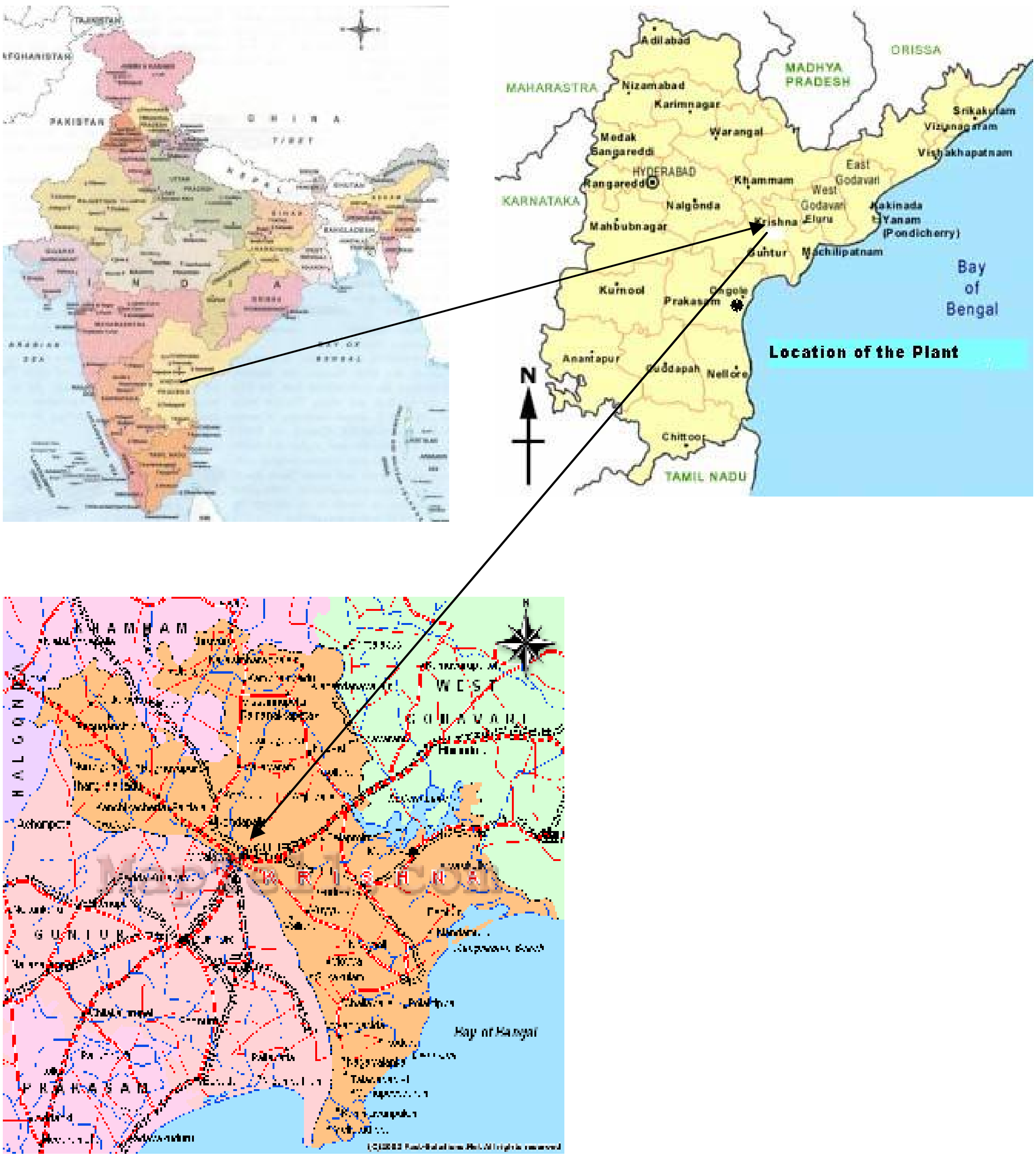
Plant is located in Vijayawada, the third largest city in Andhra Pradesh which is located on the banks of the Krishna River, and is bounded by the lndrakiladri hills on the West and the Budameru river on the North. Situated along the Madras-Howrah and Madras-Delhi rail route, this is the largest railway junction of the South Central Railway. The city forms a part of the Krishna district, and is spread over an area of 58 sq. kms (urban area), with a population of 7 Lakhs (1991 census).

Two National Highways, the National Highway 5 from Madras to Calcutta and the National Highway 9 from Machilipatnam to Hyderabad pass through the City connecting it to other parts of the country. It is connected to other areas of the state by state highways and district roads. The domestic airport located at Gannavaram, about 20 km., from the city connects Vijayawada to Hyderabad, capital of Andhra Pradesh state by air.

Other processing plant is located in Guntur town, which is around 45 km from Vijayawada.



A.4.2. Type and category(ies) and technology of the small-scale project activity:

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As per Clause 1 of Type III.E of Appendix B of **simplified modalities and procedures for small-scale CDM project activities (Version 09: 12 May 2006),** if project activity comprises measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery. Due to the project activity, decay is prevented through controlled combustion. The project activity does not recover or combust methane (unlike

III G). Measures shall both reduce anthropogenic emissions by sources and directly emit less than 15 kilo tonnes of carbon dioxide equivalent annually; this project is considered as small scale project. This project involves avoidance of methane through combustion of MSW and emits project emissions less than 15 kt per annum. Hence, the project activity falls under III.E category and Sectoral Scope 13 and 15.

Main Category: Type III: Other Project Activities
Sub Category: 'E', Avoidance of methane production from biomass decay through controlled combustion

Also, as per Clause 2 of Type I.D of Appendix B of **simplified modalities and procedures for small-scale CDM project activities (Version 09: 28 July 2006),** in case of unit which co-fires non renewable biomass or fossil fuel the capacity of the entire unit shall not exceed the limit of 15 MW, for the project to qualify as a small-scale CDM project. Therefore, the proposed project activity can also be defined under

Main Category: Type I - Renewable Energy Projects (Small Scale)

Sub Category: "D", Grid connected Renewable Electricity Generation (Renewable Biomass based Power Project)

Hence the project activity falls on Type III.E and Type I.D categories of small scale project activities.

The technology used for the project activity is described above in section A.4.

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

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The project activity encompasses the implementation of a power generation using municipal solid waste in India that uses the RDF produced from the processing of municipal solid waste and other biomass fuels such as rice husk to generate electricity. Predominantly MSW that is generated in cities in India is disposed in unmanaged solid waste disposal/dump sites. This practice leads to unabated methane emission from the anaerobic decomposition of organic matter in MSW.

Recognizing the increasing problem of unmanaged waste/dump sites the Ministry of Environment and Forests issued the Municipal Solid Wastes (Management and Handling) Rules (2000). The rules identify various technical options for treatment and disposal of MSW, including pelletisation that has to be in place by December 2003. However, since environmental regulation in India is poorly enforced and allocation of substantial financial resources to implement the Rule is lacking, it is likely that unmanaged MSW disposal sites would continue to be the prevalent means of waste management.

Municipal corporations of Vijayawada and Guntur collect the garbage, transport it to the dump yards and dispose it off as non sanitary land fill or open ground dumping. It is guess estimated that such transportation and disposal in these cities cost about Rs. 500 to Rs. 700 per ton of MSW. With the overloading of the existing landfill sites in the cities, garbage has to be transported to nearby twice the current distance for land filling, which results in cost escalation.

The other important option which forces authorities to continue to manage the sites in unmanaged way is the tipping fee required to be paid per ton of waste to be treated and disposed. Though the concept of tipping fees does not exist in India, the option requiring the least tipping fee reflects the fact that municipalities usually choose the cheapest disposal option within restrictions set by MSW rules. Hence, under these circumstances, it is very unlikely that municipalities would opt for options where MSW can be utilized in fruitful way to arrest generation of the methane and also generation of electricity.

The project activity envisages reduction of 678607 tCO_2 equivalent towards avoidance of methane production in addition to generation of power using fluff reduces emissions to the tune of 216200 tCO2 due to the displacement of equal amount of energy in fossil fuel dominated grid during entire crediting period of 10 years. The project emissions are minimal due to the internal usage of electricity for processing plants at Guntur and Vijayawada and for the transport of fluff from Guntur to Vijayawada (Refer Section E).

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

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Year	Annual estimation of emission reductions in tones of Co2e
2004-05	37035
2005-06	44453
2006-07	55106
2007-08	65978
2008-09	72188
2009-10	79042
2010-11	82859
2011-12	80818

2012-13	82859
2013-14	82859
Total estimated reductions (tones of CO2e)	**683197**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	**68320**

A.4.4. Public funding of the small-scale project activity:

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No public funding available for the project activity

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

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According to Appendix C of Simplified Modalities & Procedures for small scale CDM project activities, 'Debundling' is defined as the fragmentation of a large project activity into smaller parts.

With reference to the criteria mentioned, this MSW cum energy generation project is not a de-bundled component of a large project activity as there is no registered small scale CDM project activity (previous 2 yrs) or an application to register another small scale CDM project activity by the same (SESL) project proponent, in the same project category and technology/measure with project boundary within 1 km radius of this project activity.

SECTION B. Application of a baseline methodology:

B.1. Title and reference of the approved baseline methodology applied to the small-scale project activity:

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Title:

Avoidance of methane production from biomass decay through controlled combustion & Grid connected renewable electricity generation

Main Category: Type III: Other Project Activities

Sub Category: 'E', Avoidance of methane production from biomass decay through controlled combustion

And

Main Category: Type I - Renewable Energy Project (Small Scale)

Sub Category: "D", Grid connected Renewable Electricity Generation (Biomass based Power Project)

Reference:

The project activity meets the eligibility criteria to use the simplified modalities and procedure for small-scale CDM project activities as set out in paragraph 6 (c) of decision 17/CP.7.

Details of methodology for baseline calculations for CDM projects of capacity less than 15 MW are available in the "Appendix B of the simplified modalities and procedure for small scale CDM project activities". Reference has been taken from indicative simplified baseline and monitoring methodologies for selected small scale (CDM projects less than 15 MW) project activity categories.

Avoidance of methane production from biomass decay is covered in category III.E and renewable technologies that supply electricity to the grid are covered in category I.D. Category III.E comprises measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery. The category I.D comprises renewable such as small hydro, wind, geothermal and renewable biomass that supply electricity to/and displace an electricity from an electric distribution system that is or would have been supplied by at least one fossil fuel generation unit.

B.2 Project category applicable to the small-scale project activity:

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Main Category: Type III: Other Project Activities

Sub Category: 'E', Avoidance of methane production from biomass decay through controlled combustion

And

Main Category: Type I - Renewable Energy Project (Small Scale)

Sub Category: "D", Grid connected Renewable Electricity Generation (Biomass based Power Project)

Applicability Condition as per Methodology	Project Condition
AMS – III E	
Measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery	Project activity involves the avoidance of methane generation from MSW landfill sites through controlled combustion of processed MSW in boiler to produce electricity. In the absence of project activity, MSW in the landfill sites would have left to decay anaerobically and led to methane generation.
Decay is prevented through controlled combustion	Due to effective utilization of processed MSW to generate electricity, the project activity avoided the decay of the waste in the dumping sites
The project activity does not recover or combust methane	Project activity involves the combustion of processed solid waste material to generate heat to produce high pressure steam for power generation. This does not involve neither recovery or combustion of methane directly.
Measures shall both reduce anthropogenic emissions by sources, and directly emit less than 15 kilo tonnes of carbon dioxide equivalent annually.	Project emissions due to project activity due to combustion of non-biomass materials, fuel (diesel) for transportation as well as handling of MSW for processing RDF and ash Disposal in the facilities, the internal electricity consumption for processing facilities are less than 15 kt per annum (Refer Section E).
If the combustion facility is used for heat and electricity generation the project can use a	As the project activity involves both avoidance of methane and subsequent generation of electricity

corresponding methodology under type I project activities.	through controlled combustion and supply of power to grid, the project also eligible under small scale methodology AMS I.D.
AMS I.D	
If the unit added has both renewable and non-renewable components (e.g.. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.	The power generation capacity of the plant is restricted to 6 MW which is less than eligible limit of 15 MW, the project is eligible under AMS I.D small scale category. The project does not co fire any fossil fuel as per the guidelines of MNES.

As per the Kyoto Protocol (KP) baseline should be in accordance with the additionality criteria of article 12, paragraph 5(c), which states that the project activity must reduce emissions that are additional to any that, would occur in the absence of the certified project activity.

Document Annex B to attachment 3 regarding indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories, provides guidelines for preparation of Project Design Document (PDD) including baseline calculations. The category and the sub type of the activity are given above.

I. Baseline methodology mentioned in paragraph no. 8 of Type III.E of Annex B of the simplified modalities and procedures for small scale CDM project activities, states that baseline is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay in the uncontrolled landfill site and methane is emitted to the atmosphere. The baseline emissions are the amount of methane from the decay of the biomass or organic waste treated in the project activity. The Yearly Methane Generation Potential is calculated using the first order decay model based on the discrete time estimate method of the IPCC Guidelines, as described in category AMS III-G. Baseline emissions shall exclude methane emissions that would have to be removed or combusted to comply with national or local safety requirement or legal regulations

.

Baseline methodology mentioned in the paragraph no. 9 of Type I. D. of Appendix B of the simplified modalities and procedures for small scale CDM project activities, states that the baseline is the kWh produced by the renewable energy generating unit multiplied by an emission coefficient (measured in kg CO_2equ/kWh) calculated in transparent and conservative manner as under:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the simple OM and the average OM calculations must be considered.

OR

(b) The weighted average emissions (in kg CO_{2equ}/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available) and made publicly available. Based on the above guidelines provided in Version 09 of AMS I.D, the baseline emission factor is estimated using the combined margin approach as per the procedures laid in paragraph 9 of AMS I.D of Version 09. As this methodology suggested is similar to the procedures laid in ACM0002, the same has been considered for calculations.

Based on the above guidelines provided in Version 08 of AMS I.D, the baseline emission factor is estimated using the combined margin approach as per the procedures laid in paragraph 9 (c) and (d) of AMS I.D of Version 08. As this methodology suggested is similar to the procedures laid in ACM0002, the same has also been referred for calculations.

The project activity would displace an equivalent amount of electricity that would have been drawn from the grid generation mix. Since the displaced electricity generation is the element that is likely to affect both the operating margin in the short run and the build margin in the long run, electricity baselines should reflect a combination of these effects. Therefore the most appropriate approach for baseline methodology would be as described in Paragraph no. 9 under category I.D of Appendix B of the simplified M&P for small scale CDM project activities of the UNFCCC.

In this project case, the project is small scale only having generating capacity of 6 MW. Hence, this is an operating margin scenario where we can assume that the principal effect will be on the operation of current or future power plants. However in view of the predicted power deficit status in the state in future, a delay effect in future power plants may creep in due to the occurrence of this project although to a limited extent. Ideal baseline approach is envisaged as the one that combines both operating and build margin as prescribed in first alternative given in paragraph 9 under Category I.D of the UNFCCC M&P for small scale projects.

However, the key information and data used to determine the baseline scenario (variables, parameters, data sources, etc.) are listed in the following table.

Key Parameter	**Value**	**Data Source**
P_{wlc}	Power generation by all sources, excluding hydro, biomass and nuclear	All related authentic sources like APTRANSCO, TNEB, KPTCL, KEB, CEA etc
CMF	Base line "Combined Margin" emission factor calculated for grid electricity generation	Calculated for power plants in Southern Regional Grid
OM_{bef}	CO_2 operating margin emission factor for grid	Calculated for power plants in Southern Regional Grid
BM_{yr}	CO_2 build margin emission factor for grid	Calculated for power plants in Southern Regional Grid
TP_{gen}	Total power generated by the project activity	Measured from the plant records
TP_{exp}	Power exported to the grid per annum	From plant and KPTCL records
WA_{bef}	Weighted average emission factor of baseline calculated	Calculated for power plants in Southern grid
Text	Identification of power source / plant for the OM	
Text	Identification of power source / plant for the BM	

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

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The project activity meets the eligibility criteria to use simplified modalities and procedure for small-scale CDM project activities as set out in paragraph 6 (c) of decision 17/CP.7.

As per the decision 17/cp.7 Para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.

Further referring to Appendix A to Annex B document of indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories, project participants shall provide a qualitative explanation to show that the project activity would not have occurred anyway, at least one of the listed elements should be identified in concrete terms to show that the activity is either beyond the regulatory and policy requirement or improves compliance to the requirement by removing barrier(s) ;

Several barriers such as (i) technological barrier, (ii) investment barrier, and (iii) absence of common practice are assessed to exclude the MSW to pelletisation and then to energy generation project as a baseline option.

i. Technological barrier

Processing of municipal solid waste to generate energy is an emerging technology which incorporates a wide variety of diversity of systems designed both for processing of solid waste as well the combustion of the same. It is also established that a number of problems need to be resolved and technical developments to be carried out in this sector. However, the fact remains that countries like India still have limited experience with the processing systems meant for MSW processing and have to cope up with lack of long term experimental data for these processes for making a fool proof & established cost indices. Earlier to year of setting of this plant, few attempts made in India resulted in to varying degrees of success, while establishing a fact that unlike European experience, the Indian MSW has lower calorific value and mass combustion of MSW as received is not suitable in Indian context.

RDF firing energy plant facilities are complex and regardless of size, call for specialized design, automatic control sophistication and construction. Materials handling, fuel feeding, ash removal, air pollution control and overall operating procedures are far more complicated than those of a similarly sized biomass based power plant. In RDF firing, the garbage/MSW received is separated, classified and reclaimed in various ways to yield high calorific value fuel. The combustion of RDF poses its own set of unique problems to a boiler designer in the areas like fuel handling system, combustion, staging/fouling and corrosion/erosion, which can be quite different from those, encountered in a mass burn boiler system. No technology was available in India to handle the RDF generated from the MSW in India during the plant conceptualization. SESL has consulted all leading boiler manufacturers in country and received negative response on availability of technology to burn these pellets/fluff.

The furnace design of conventional traveling grate boiler included modest secondary air injection system with multiple small diameter nozzles designed for 25 to 30% of the total air supply, straight wall furnaces and gas re-injection systems. The result is less than desired combustion performance due to inadequate turbulent mixing in the furnace. Adopting these boilers to the combustion of pellets would have resulted in to poor combustion efficiency and hence poor power generation. As most of the boiler designs in India are conventional and are not specifically designed for combustion of RDF, no options were left for SESL except adopting basic know how from abroad where technologies for waste to energy systems were established. Even with the poor performance of European systems in handling lower calorific value RDF in India, SESL has taken risk to opt for technology from Europe where over 105 WTE plants are in operation. This design consists of two arches in the lower furnace front and rear secondary air injection nozzles are fitted in the twin arches at an angle. These secondary air injection nozzles are designed for delivering 40% of the total air supply during operation. Since the air injection is at right location at an angle it creates turbulent mixing and better air penetration. Because of that the combustion will be proper without gas injection system.

In addition to the above, SESL had to overcome problems due to high metal temperature corrosion. Combustion products from municipal refuse are very corrosive high metal temperature. Refuse boilers operating at higher steam pressures have higher temperature saturated water in the furnace tubes resulting in higher tube metal temperature. These higher tube metal temperatures will increase the corrosion rate. Hence to obtain satisfactory refuse boiler super heater performance, design changes to get the low flue gas temperature at the inlet of the super heater and to expose coolest steam conditions to the hottest gas temperatures were adopted.

In addition to technological problems with the boiler design, SESL has also faced problems with respect to the homogenization of the waste. Homogenization of waste is very much essential for better processing of the waste. The know-how from TIFAC had not transferred methodology to get the homogenization of the waste. SESL had itself taken initiatives to install systems like primary shredding using hammer mill to accomplish the homogenization. This step was unique to the project for the process plants both in Guntur & Vijayawada.

From the above, it is clear that the project had faced many technological barriers in implementing the project. Though the plant has been in operation since two years at 55% to 60% PLF, the problems related to waste handling and combusting still exist in present conditions also. This leads to frequent shut down of the plant and hence the significant revenue loss to the company. Additional revenue from CDM would definitely help the plant in maintaining the sustainability of the project to greater extent.

ii. Investment Barrier:

Generally the cost of setting up of 1 MW power plant using biomass like rice husk, wood chips, cotton stocks, groundnut shell etc., would be around Rs. 3.5 to 4 crores[2] where as for plant based on municipal solid waste will be around Rs. 7 to 8 crores, which is almost double to the cost of power generation from

[2] http://greenbusinesscentre.com/Documents/biomass.pdf

biomass. SESL had invested around Rs. 46 crores to set up the 6 MW power plant using MSW. SESL had faced many constraints in arranging the higher investment required to set up the plant.
SESL also faced several imponderables and uncertainties associated with the assessment and estimate of the project costs. SESL has faced difficulties in arranging finance for the smooth implementation of the project due to inadequate assessment of the following parameters:

- Lead time from concept stage to project completion was longer than usual and will cause a significant outflow on preoperative expenses than envisaged
- The long lead time will normally result in inflation of costs by the time the actual stage of project implementation sets in than assessed.
- Technology costs since unique combustion features are required for the combustion of waste derived fuel in the form of a steam generator
- Lack of previous, authenticated data of cost indices
- Technical, economical and institutional uncertainties associated with the implementation of a unique, first time project in the country.

The gestation period for the project had been estimated at 15 months during the financial closure time. However, the gestation period of the project has gone beyond 15 months and resulted into increase in project cost significantly. The reasons for the delay are briefly due to:

- Delay in engineering because of delayed receipt of design data
- Delay in receipt of procedural clearances for importing Rapping Control Panel
- Elevation of erection of structurals at a height of 20/25 meters
- Consequent reengineering for down stream ESP
- Difficulties in matching the alloy casting specifications as per German specifications for the traveling grate boiler
- Fabrication of boiler drum with circulating coil inside as per ALSTOM design and number of nozzles

Hence, the project envisaged an increase in the project cost to a level of Rs. 646 lakh. The final financial details of the project are as follows:

Parameter	Rs. Lakh
Estimated Cost	3940
Appraised by TDB	3940
Total revised cost	4586
Increase in the project cost	**646**

From the above, it is clear that the cost of setting up of 1 MW of plant had increased from Rs. 6.6 crore to Rs. 7.6 crore which is very higher than conventional biomass based plant. SESL had faced difficulties in raising this additional amount for the implementation of the project. Considering the higher initial investment per MW plant, SESL would have opted to set up plant using biomass. The IRR of the project with the present operating conditions is just 7.64%. Though better IRR was envisaged during the DPR preparation stage, the present IRR of the project is very low due to several technical and financial barriers the project faced during implementation and operation. Due to increase in the capital investment and other technical difficulties mentioned above for the successful operation of plant, the level of financial returns to the company are not able to match the requirements of the company for repaying the debts. In addition, the better IRR was projected during the initial stage considering higher capacity generation (i.e 6 MW) of more than 7500 operating hours per annum where as the present generation is not to the full potential due to frequent technical problems in the combustion equipment. The IRR of the project with CDM revenue is estimated at 12.41% which will definitely help for sustainable operation of the plant. The following assumptions were made while calculating IRR for the project without considering CDM revenue:

Power Generation Capacity	6000 kW
MSW assigned by the Municipal Corpns	505 TPD
Plant Load Factor for Power Plant	0.8
Cost of Auxiliary Fuel	Rs.1000 with 5% escalation
Calorific value of Fuel	2500 to 3000 KCAL/KG
O &M expenses of Power plant	4% of Project cost with 5% annual escalation
Debt to equity ratio	2.33:1
Average Interest on term loan	8%
Repayment period	5 - 7 years

From the above discussions, it is established that the company has been facing many financial barriers as well since implementation of the project.

iii. Common Practice:

Power generation using municipal solid waste is not a common practice in India. At present, there are only two plants in operation on commercial basis in India based on pelletisation technology. SESL is one of those two projects of its kind in India and is unique for having integrated waste processing cum energy generation plant at Vijayawada in India. Both financial and technological barriers for the project hinder the growth of rapid penetration in the country. From the previous sections, it is clear that the initial cost of setting up 1 MW plant using MSW is almost double the cost of power generation using other biomass fuels. Also, technological constraints in designing the systems to handle Indian municipal waste with low calorific value and high moisture content prevents the successful operation of the plant.

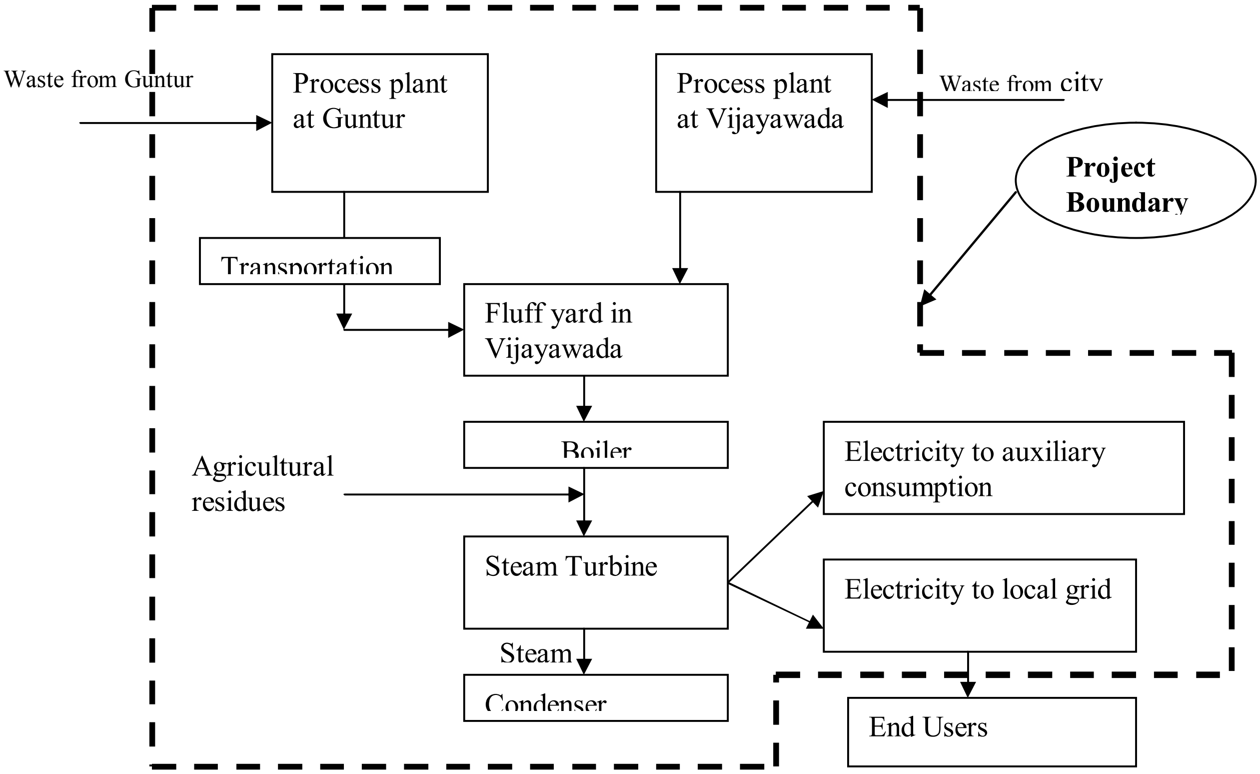
In addition to these, there is no concrete and effective policy from the government to promote the waste to energy plants and Government of India has recently initiated policy to promote the waste to energy projects under Accelerated program on Energy recovery from Urban Wastes[3]. Though MoEF through the Municipal Solid Wastes (Management and Handling) Rules (2000) identify various technical options for treatment and disposal of MSW, including pelletisation, that has to be in place by December 2003, the implementation of the same has been very poor in India due to the lack of substantial financial resources to implement the Rule.
From the analysis in the above sections, it is clear that the project is clearly additional.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:

>>

The project site in Guntur and Vijayawada has been taken as the project boundary for calculating methane emissions and emission reductions due to export of power to the grid. Part of the Waste collected from different areas of Vijayawada and Guntur will reach to project sites in both cities. The collected waste will be processed in to RDF in both the places. The processed RDF in Guntur will be transported to Vijayawada and together with the RDF produced at Vijayawada will be burnt in power boiler in Vijayawada for power generation. The project boundary for the project is as shown below:

[3] No. 10/3/2005-UICA, Government of India, dated 25th July 2005



B.5. Details of the baseline and its development:

>>

The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter is left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane from the decay of the biomass or organic waste treated in the project activity. The yearly methane generation potential is calculated using the first order decay model based on the discrete time estimate method of the IPCC guidelines, as described in category AMS III-G.

The method below is used to evaluate the yearly methane generation potential in the landfill. The quantity of methane projected to be formed during a given year is estimated using a first order decay model[4] based on the discrete time estimate method proposed in the IPCC Guidelines.

Percent DOC for various waste streams in the project activity is taken as per the test reports of the fluff combusted in the plant and the values considered for the same are as mentioned below:

[4] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC,2000)

Waste stream A to E	Percent DOC_j (by weight)
A. Paper and textiles	10.92
B. Gardern and park waste and (non-food) putrescibles)	30.20
C. Food waste	42.18
D. Wood and straw waste	3.51
E. Inert material	9.93

The amount of waste combusted in the project activity (fluff quantity) in each year (Q y) is also measured and recorded, as well as its composition through representative sampling, to provide above information for estimating the baseline emissions.

Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirement or legal regulations. Hence the emissions would be modified depending on the compliance status of municipalities in the state. Though MoEF through the Municipal Solid Wastes (Management and Handling) Rules (2000) identify various technical options for treatment and disposal of MSW, including pelletisation, that has to be in place by December 2003, the implementation of the same has been very poor in India due to the lack of substantial financial resources to implement the Rule. The baseline scenario therefore is identified as a gradual improvement of waste management practices to the acceptable technical options expected over a period of time to comply with the MSW Management Rules.

The status of municipal solid waste management practices in the state of Andhra Pradesh[5] is as given below:

Total MSW generation in AP	**35000**	TPD
Total Processed Waste	**1950**	TPD
Vijayawada + Guntur	560	TPD
Hyderabad	700	TPD
Suryapeta	150	TPD
Tirumala	300	TPD
Vijayanagaram	300	TPD
% Compliance	**5.6%**	

The total MSW generation in AP is estimated based on 0.5 kg/day MSW generation per person for a population of 70 million. The processed waste figures are based on population of respective locations for

[5] Data for 2005-06; Source: Government notification

which permissions are given by the Government to set up the processing plants. Considering the above compliance rate of 5.6% till now and likely scenario of few more municipalities in the row to adopt these measures in future, an increasing trend in compliance rate is considered for calculations for different years over entire crediting period.

Methodology for estimation of fraction of waste processed as per legislation

Solid waste management and handling rules, 2000 of MoEF states that all the municipalities in the country are expected to set up the waste processing and disposal facilities by the year 2003. But, the progress at this front in all the municipalities in the country was observed to be very minimal and there is expected to be a gradual increase in the disposal facilities. The main reasons for the slow progress in this regard could be due to high cost and specific requirements of various processing technologies. The Municipalities of Vijayawada and Guntur have taken initiatives in this regard to utilize the MSW in more efficient way and adopted privatization route to take up the process and allowed private companies to set up the power generating station. To account for the above factor of baseline emissions, the net baseline emissions will be a product of BEy and factor DF. This would exclude methane emissions, due to the compliance with national or local safety requirement or legal regulations.

Fraction of waste processed in the state can be given as:

$$DF = \sum_{i=1}^{i=n} C_i / Q_w$$

Where

C Capacity of the MSW treatment plants (TPD)

n no. of MSW treatment plants in the state

Q_w total waste generation in the state (TPD)

The fraction of waste treated by the prescribed technology to comply with the standards is fixed at various percentages for each year for the estimations. However, the compliance rate will be adjusted every year if the authorized data is available from sources like pollution control board of Andhra Pradesh state or any other related government sources. If the compliance rate is observed to be meeting the guidelines prescribed by Govt., for any year during the crediting period (based on data from APPCB and any other reliable Government sources, if available) the emissions due to controlled combustion of methane will be considered as zero from that year onwards during the crediting period.

The baseline methodology has followed the one specified under Project category I.D in Appendix B of the Simplified M&P for small scale CDM project activities.

As per the latest guidelines in I.D to estimate the baseline emissions, the emission factor is calculated as per the procedures laid in paragraph 9 (a) and 9(b). As this methodology suggested is similar to the procedures laid in ACM0002, the same has also been referred for calculations. The baseline emissions and the emission reductions from project activity are estimated based on the quantum of electricity to be exported by the project activity to the grid and the **Baseline Emission Factor (BEF)** of the southern regional grid calculated as a **combined margin (CM)**, consisting of the combination of **operating margin (OM)** and build **margin (BM)** factors.
The detailed calculation procedures are provided in Annex 3 in line with the procedures explained above and with necessary inputs from ACM0002.

The value of emission factor from the combined margin method for southern regional grid is 0.9071 kgCO2/kWh.

Date of completing the final draft of this baseline section
09/10/2006
Name of person/entity determining the baseline
Shriram Energy Systems Ltd, who is a project participant

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

>>

C.1.1. Starting date of the small-scale project activity:

>>

Starting date of project activity: 27/02/2002

C.1.2. Expected operational lifetime of the small-scale project activity:

>>

The life time of the project is 25 years

C.2. Choice of crediting period and related information:

>>

C.2.1. Renewable crediting period:

>>

Not applicable

C.2.1.1. Starting date of the first crediting period:

>>

Not applicable

C.2.1.2. Length of the first crediting period:

>>

Not applicable

C.2.2. Fixed crediting period:

>>

C.2.2.1. Starting date:

>>

Starting date of first crediting period: 01/01/2004

C.2.2.2. Length:

>>

10 years (10-y)

SECTION D. Application of a monitoring methodology and plan:

>>

D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

>>

Monitoring methodologies / guidelines mentioned in the UNFCCC document of "Annex B of the simplified modalities and procedures for small scale CDM project activities" for small scale projects (**Type III.E and I.D**) is considered as basis for monitoring methodology for the activity. The name and reference of the approved monitoring methodologies used for the project activity are:

Title:
Avoidance of methane production from biomass decay through controlled combustion & Renewable electricity generation for a grid

Main Category: Type III: Other Project Activities
Sub Category: 'E', Avoidance of methane production from biomass decay through controlled combustion

And

Main Category: Type I - Renewable Energy Project (Small Scale)
Sub Category: "D", Grid connected Renewable Electricity Generation (Biomass based Power Project)

Reference:
The project activity meets the eligibility criteria to use the simplified modalities and procedure for small-scale CDM project activities as set out in paragraph 6 (c) of decision 17/CP.7.

Monitoring methodologies for Avoidance of methane production from biomass decay is covered in category III.E and renewable technologies that supply electricity to the grid are covered in category I.D. Category III.E comprises measures that avoid the production of methane from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery. The category I.D comprises renewable such as small hydro, wind, geothermal and renewable biomass that supply electricity to/and displace an electricity from an electric distribution system that is or would have been supplied by at least one fossil fuel generation unit.

D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

>>

The project activity meets the eligibility criteria to use simplified modalities and procedure for small-scale CDM project activities as set out in paragraph 6 (c) of decision 17/CP.7.

Total annual project activity related emissions from the project are estimated to be less than 15 kt of CO_2 equivalent. Details of approved methodology for these calculations for CDM projects emit less than 15 kt CO_2 equivalents are available in the “Appendix B of the simplified modalities and procedures for small scale CDM project activities”. The project emissions due to the project activity are less than 15 kt (5.57kt) as mentioned in Section E and hence qualify to use the monitoring methodology as per the Type III E approved small scale methodology.

Also, details of approved methodology for baseline calculations for CDM projects of capacity less than 15 MW are available in the “Appendix B of the simplified modalities and procedure for small scale CDM project activities”. As the power plant is of 6 MW capacity, reference has been taken from indicative simplified baseline and monitoring methodologies for selected small scale (CDM projects less than 15 MW) project activity categories.

D.3 Data to be monitored:

>>

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
D 1	*Quantity*	*Quantity of waste processed in the plant (Fresh MSW wet waste)*	*TPD*	*M*	*Daily*	*100%*	*Paper/ Electronic*	*CP+ 2 years*	*Each load of MSW to be weighed at the plant entry and then processed to produce RDF fluff (baseline emission)*
D.2	*Quantity*	*Quantity of waste combusted in the boiler (RDF Fluff)*	*TPD*	*e & m*	*Daily*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*The RDF produced is typically weighed on each shift for benchmarking and transferred to fuel yard where it*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
									is mixed with predetermined quantities of Auxiliary fuel and the mixed fuel is fed continuously to boiler. Thus the quantity of RDF and Auxiliary fuel are measured as well as estimated and cross checked with stocks in the yard on daily basis to determine the fuel

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
									consumption figures.
D.3	*Percentage*	*Composition of waste processed (fresh MSW)*	*%*	*M*	*Monthly*	*100%*	*Paper/ Electronic*	*CP + 2 years*	Composition of the representative sampling of the waste processed will be analysed in the accredited laboratories
D.4	*Percentage*	*Composition of waste combusted (RDF fluff)*	*%*	*m*	*Monthly*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*Composition of the representative sample of the waste combusted will be analysed in the accredited laboratories and will be used for*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
									calculating baseline emissions
D.5	*Power*	*Electricity generated*	*KWh*	*M*	*Hourly measurement and monthly recording*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*Meter readings are noted and recorded in the control room.*
D.6	*Power*	*Auxiliary consumption in Vijayawada and Guntur plants*	*kWh*	*M*	*Monthly recording*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*Based on energy meter readings in Vijayawada and Guntur plants (project emission)*
D.7	*Power*	*Power export*	*kWh*	*M*	*Monthly measurement and monthly recording*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*As per export meter readings in sub stations and recorded joinotly with state grid*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
									officials
D.8	*Quantity*	*Quantity of other biomass type used*	*MT*	*M*	*Daily*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*Quantity of other biomass used in the project (like Rice husk) is measured using weigh bridge.*
D. 9	*Quantity*	*No of truck loads from processing plant in Guntur to Vijayawada*	*No.*	*M*	*Daily*	*100%*	*Paper/ Electronic*	*CP + 2 years*	*All the truck movements from Guntur processing plant to Vijayawada are recorded on daily basis along with the quantity of fluff received. This is used to*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
									calculate project emissions owing to the use of diesel consumption.
D.10	*Nos*	*Incremental distance of waste transportation*	*km*	*C*	*Daily*	*100%*	*Paper*	*CP + 2 years*	*As the plant is constructed adjacent to the dump site in the baseline scenario, there is no incremental distance for waste transportation with baseline scenario.*
D.11	*Quantity*	*Quantity of*	*MT*	*C*	*Monthly*	*100%*	*Paper/*	*CP + 2 years*	*Representative*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
		non biomass materials combusted					*Electronic*		*sampling of Waste combusted in the boiler are analysed for the percentage of non-biomass materials like plastics, rubbers to determine the project emissions.*
D.12	*Quantity*	*Ash Quantity*	*MT*	*M*	*Daily*	*100%*	*Paper*	*CP + 2 years*	*Ash quantity generated in the plant is calculated based the number of truck loads dispatched from*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
									the plant to brick manufacturers and their loading capacity
D.13	*Nos*	*Truck distance for ash transportation*	*km*	*e*	*Monthly*	*100%*	*Paper*	*CP + 2 years*	*Average truck distance of fly ash transportation to brick manufacturers is estimated based on the distance of the site from the plant*
D 14	*Quantity*	*Diesel consumption for Machinery to handle*	*Liters*	*M*	*Daily*	*100%*	*Paper*	*CP+2 years*	*To determine project emissions*

ID Number	Data type	Data variable	Data unit	Measured (m) Calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be achieved? (electronic/ paper)	For how long is archived data kept?	Comment
		MSW for processing							

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

>>

Data	Uncertainty level of data (High/medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why and how QA/QC procedures are planned
D.1	Low	*Yes*	Quantity of waste processed in the plant will be measured using the weigh bridge at the entrance of the plant. Weigh bridge is calibrated on regular basis as per the procedures of Department of Weighs and Measurements, Government of Andhra Pradesh, India.
D.2	Low	*Yes*	Quantity of waste combusted in the boiler will be measured using the weigh bridge before sending to the boiler. Weigh bridge is calibrated on regular basis as per the procedures of Department of Weighs and Measurements, Government of India
D.3	Medium	*Yes*	Composition of the MSW received in the plant is analyzed for representative sampling in Government accredited Laboratories. Representative sampling of the same will be furnished to the lab. As the composition is likely to change with the

			seasonal changes, the monitoring frequency of the same is considered monthly and the same will be reviewed time to time.
D.4	Medium	*Yes*	Composition of the waste combusted in the plant is analyzed for representative sampling in Government accredited Laboratories. Representative sampling of the same will be furnished to the lab. As the composition is likely to change with the seasonal changes, the monitoring frequency of the same is considered monthly and the same will be reviewed time to time
D.5	Low	*Yes*	Generation meter in the control room is calibrated once in a year from authorized service centres.
D.6	Low	*Yes*	Meters are regularly calibrated on yearly basis.
D.7	Low	*Yes*	Export meter in the substation is calibrated once in a year and the readings of the same are compared with the check meter installed in the sub station. Both the meters are calibrated on yearly basis which is statutory.
D.8	Low	*Yes*	Quantity of other biomass used in the plant will be measured using the weigh bridge at the entrance of the plant. Weigh bridge is calibrated on regular basis as per the procedures of Department of Weighs and Measurements, Government of Andhra Pradesh, India
D.9	Low	*Yes*	All the truck movements from Guntur to Vijayawada plant are recorded at the entrance and maintained.
D.10	Low	*Yes*	As the plant is constructed just adjacent to the dumping site in the baseline, there is no incremental distance of waste transportation for the project activity.
D.11	Low	*Yes*	Percentage of the non biomass quantities in waste combusted in the boiler is analyzed for representative sampling in accredited Laboratories. Representative sampling of

			the same will be furnished by the lab. As the composition is likely to change with the seasonal changes, though the monitoring frequency of the same is considered monthly and the same will be reviewed from time to time.
D.12 & D 13	Low	*Yes*	Ash quantity generated in the plant is measured based on the number of trucks and truck load capacity. The distance traveled to brick manufacturing places is estimated based on the site places.
D 14	Low	*Yes*	The diesel consumption is monitored on a daily basis and recorded on the basis of consumption

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

>>

Project proponent implemented the following operational and management structure in order to monitor emission reductions and any leakage effects, generated by the project activity

Project proponent formed a CDM team/committee comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. In the CDM team, a special group of operators will be formed who will be assigned responsibility of monitoring of different parameters and record keeping. On daily basis, the monitoring reports will be checked and discussed.

On monthly basis, these reports will be forwarded at the management level.

All the parameters mentioned in the monitoring plan have been monitoring in the plant but in other formats. The entire process of monitoring has been streamlined and will be made available in the required format during the verification process and for subsequent useful purposes. The Fuel Consumption data, etc are being maintained in different formats. The data formats for CDM have already been finalized and started monitoring accordingly to ensure and demonstrate existence of MVP in the plant.

The calibration of monitoring equipment is being maintained as per the requirement of APTRANSCO and the same is being done regularly. Power Generation, Export & Auxiliary Consumption, fuel consumption are being recorded daily and the same is being verified and approved by General Manager of the plant. These records are being sent to Head Office for review by the Director and for corrective actions if necessary.

Further, Internal Auditors also verify the monitoring data. As per the advices of the Internal Audit team, corrective actions will be taken up for more accurate future monitoring and reporting system.

The Plant is equipped with energy meters/export meters for monitoring and control purpose. There are two energy meters at APTRANSCO sub station to measure the export power, namely main meter and check meter with 0.2 class accuracy. The energy meters shall be tested and calibrated utilizing a standard meter. The standard meter shall be calibrated once in a year at the approved laboratory of Govt. of India or Govt. of AP as per terms and conditions of supply. The tests of meters shall be jointly conducted by authorised representatives of both the parties and the results and correction so arrived at mutually will be applicable and binding on both the parties. The energy meters shall not be interfered with, tested or checked except in the presence of representatives of company and APTRANSCO. If any of the meters is found to be registered inaccurately, the affected meter will be immediately replaced. The meters will be checked in presence of both the parties on mutually agreed periods. If during the test checks both the meters are found beyond permissible limits of error, both the meters shall be immediately replaced and the correction applied to the consumption registered by the main meter to arrive at the correct energy exported for billing purposes for the period of one month up to the time of test check, computation of exported energy for the period thereafter till next monthly reading shall be as per the replaced meter. Corrections in exported energy shall be applicable to the period between the two previous monthly reading and the sate and time of test calibration in the current month when error is observed.

Power generation, export and auxiliary consumption are being recorded at the plant from the installed meters. However, for applying monthly bill to APTRANSCO the meter readings will be taken every month by APTRANSCO officials in presence of company representatives and readings will be jointly certified.

The following log sheets are being maintained for the critical equipment of the plant and readings are being recorded on day to day basis:

1. Turbine log
2. Boiler log
3. Electrical log

If both the both and check meters fail to record or if any of the PT fuses are blown out, the export energy will be computed on a mutually agreeable basis for the point of defect.

Power generation, export and auxiliary consumption, fuel consumption are being recorded at the plant daily and the same is being verified by Manager of the plant. These records sent to head office for review by the director and for corrective actions if necessary.

Emission levels are being monitored as per the statutory requirement. Plant emission levels are being monitored and the results are being sent to APPCB. For this purpose, the service of external agency is being utilized.

The quantity of other materials like plastic combusted along with the fluff and composition of the municipal waste received is monitored on regular basis and the records for the same are maintained.

In addition, the plant also monitors the electricity consumption in two processing plants and Vijayawada and Guntur with the help of separate energy meters installed in the plants. Calibration of these meters is maintained as per the standard requirements. Daily consumption records are also maintained for the verification.

Number of trucks deliver the fluff from processing plant at Guntur to Vijayawada plant are monitored on regular basis and the records for number of truck trips per day are maintained.

All the above mentioned records will be cross verified by the general manager of the plant and will be further reviewed by the personnel from head office.

D.6. Name of person/entity determining the monitoring methodology:

>>

Shriram Energy Systems Ltd., who is a project participant

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

>>

E.1.1 Selected formulae as provided in appendix B:

>> Not applicable

E.1.2 Description of formulae when not provided in appendix B:

>>

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

>>

Project Activity Direct emissions

The total project activity related emissions shall be less than or equal to 15 kilo tonnes of CO_2 equivalent. Project emissions consist of

a. CO_2 emissions related to the combustion of the non-biomass carbon content of the waste (plastics, rubber and fossil derived carbon) and auxiliary fuels used in the combustion facility.

b. Incremental CO_2 emissions due to incremental distances between the collection points to the controlled combustion site and to the baseline disposal site as well as transportation of combustion residues and final waste from controlled burning site to disposal site,

c. CO_2 emissions related to the power used by the project activity facilities, including the equipments for air pollution control required by regulation. In case the project activity consumes grid-based electricity, the grid emission factor (kg_{CO2e}/kWh) is used, or it is assumed that diesel generators would have provided a similar amount of electric power, calculated as described in category I. D

Project emissions during 2004-05 and 2005-06 are calculated based on the actual values and values are projected with maximum capacity for the rest of the years.

Project Emissions due to combustion of non - biomass and/or other organic matter combusted

The amount of biomass and/or other organic matter combusted ($A_{j,x}$) by the project activity in a year shall be monitored.

$$PE_y = PE_{y,comb} + PE_{y,transp} + PE_{y,power}$$

where

PEy	Project activity emissions (kilo tonnes of CO_2 equivalent)
PEy,comb	Emissions through combustion of non-biomass carbon in the year "y"
PEy,transp	emissions through incremental transportation in the year "y"
PEy, power	emissions through electricity or diesel consumption in the year "y"

1. Project Emissions due to burning of plastics (non – biomass fuels) & auxiliary fuels

Along with RDF fluff combusted in the boiler, some insignificant quantity of plastics is also burnt as it is very difficult to segregate 100% plastics in the waste. Based on the test reports on % of non-biomass materials combusted in the boiler, 1.67% of non-biomass material is considered for calculations.

Also, plant uses other biomass materials like rice husk as supplementary fuels. These biomass materials are waste generated from the agriculture products. These agricultural products are formed by fixing the atmospheric CO_2 by the action of photosynthesis in the presence of sunlight, the CO_2 released due to combustion of biomass is assumed to be equal to the CO_2 fixed by the photosynthesis. Again the CO_2 released during the combustion will be consumed by the plant species for their growth. In view of the above, biomass combustion and growth of biomass and associated CO_2 consumption and release can be treated as cyclic process resulting in no net increase of CO_2 in the atmosphere. Hence, due to the usage of these biomass materials, the project will not lead to project emissions.

The project emissions due to the usage of non-biomass materials are estimated as below:

$$PE_{y,comb} = Qy_{,non\text{-}biomass} * 44/12 + Q_{y,fuel} * E_{y,\ fuel}$$

Plastic combusted per day	=	1.67% of the total fluff burned
	=	1.67% x 250 T[6]
	=	4.175 T
% Carbon content	=	90% (maximum)
Project emissions	=	4.175 x 0.90 x 44/12
	=	13.78 tons/day
	=	5029 tons/annum (for 365 days operation)

No fossil fuel is used in this project apart from MSW and other agricultural residues as per Government of India guidelines. Hence the emissions due to the usage of fossil fuel for combustion are considered as zero.

---

[6] Actual fluff burnt in the project activity is considered for the years 2004-05 and 2005-06 (Jan to Dec) where as 250 T is considered for rest of the years

2. Project Emissions due to transportation of waste to processing plants, fly ash to brick manufacturers and transport of fluff

In addition to above, project activity emissions due to the transport of RDF fluff from processing plant in Guntur to Vijayawada and transportation of waste to processing plants compared to baseline scenario and internal truck movements for fuel handling are considered. The project emissions due to the same are given below:

PEy, transp = (Qy/CTy) x DAFw x EF_{CO2} + (Qy,ash/CTy,ash) x DAFash x EF_{CO2}

N_y	is the number of truck trips during the period y
DAF	average incremental distance for waste transporation (tonnes/truck)
$EF_{km,CO2}$	is the average CO2 emission factor for the trucks measured in tCO2/km, and
$Q_{,y}$	is the quantity of waste combusted in the year 'y'
CT_y	average truck capacity for waste transportation (tonnes/truck)
$Q_{y,ash}$	quantity of combustion residues produced in the year "y" (tonnes)
$CT_{y,ash}$	average truck capacity for combustion residues transporation (tonnes/truck)
DAF_{ash}	average distance for combustion residues transporation (km/truck)

The emissions per year due to transportation of RDF to process plants (40 kms and 15 trucks per day), incremental distance of supply of waste to processing plants (as the plant is constructed adjacent to dump site, no increment in the distance), internal truck movements of both plants towards fuel handling (66000 liters per annum), transportation of flyash to brick manufacturers (around 140 km per day) and the transportation of agricultural residues for combustion (around 360 km) are less than 500 tCO_2/annum as shown below:

Emission leakage from trucks transporting RDF fluff to processing plants and fly ash to brick manufacturers

Distance covered per day	1100.00	Km
Mileage	4	Km/litre
Total diesel consumption	275.00	litres/day
No of days of operation	330	days/year
Diesel consumption/year	156750	Litres
Diesel consumption/year	139508	Kg
Density of diesel	0.89	Kg/l
CO_2 emissions from diesel considering IPCC's oxidation factor of diesel as 0.99 tCO2/TJ	70.686	TCO2/ TJ
Annual GHG emissions	**441**	**Tonnes/year**

3. Project Emissions due to grid electricity consumption in processing plants

Apart from the above project emissions, processing plants at Guntur and Vijayawada consumes certain amount of electricity for the internal power consumption. The emissions due to the usage of electricity at these locations should be considered. Electricity consumption at both processing plants is being measured with the installed energy meters and readings of the same are documented. Based on the average consumption at these locations since beginning, the emissions due to consumption in processing plants are around 454 tCO2/annum as shown below:

No. of units consumed per annum in processing Plants : 0.5 MU
Total CO_2 emissions due to electricity consumption : 5,00,000 x 0.9071
: 454 tCO_2/annum

4. Total Project Emissions

Total project emissions due to the project activity on conservative basis are tabulated below:

Sl. No	Project Emissions due to	Quantity, tCO2/annum
1	Project Emissions due to burning of plastics	5029[7]
2	Project Emissions due to combustion of auxiliary fuels	0
3	Project Emissions due to transportation of waste to processing plants, fly ash to brick manufacturers and transport of fluff	441
4	Project Emissions due to grid electricity consumption in processing plants	454
	Total	**5923**

To prove the project eligibility even with conservative estimations, project emissions due to auxiliary electricity consumption are calculated based on the name plate readings (maximum) of the connected loads instead of actual consumption figures (metered one) in the processing plants. The project emissions due to the same are around 6000 tons/annum. Project emissions due to burning of non-biomass materials are calculated as 1.67% non biomass materials as per test reports. Under conservative estimates also, the total project emissions from the project activity are less than 15 kt and hence the same will qualify for the small scale category.

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

>>

[7] Project emissions for the years 2004-05 and 2005-06 towards burning of plastic as per actual quantity of fluff burnt are 5029 tCO_2/annum.

Project emissions towards fluff burning are estimated for entire quantity of the fluff that is being produced in the plant and used for power generation. There is no leakage due to the use of fuel for other plants and uses.

As per the Socio economic impacts of biomass plants study conducted by the ASCI, Hyderabad indicates that Krishna district where the plant is located generates around 1.28 lakh tonnes of biomass material per annum and out of which around 22000 tonnes is of Rice Husk. Also, neighbouring Guntur district generates around 33000 tonnes of rice husk per annum and 2.83 lakh tonnes of biomass per annum. As the plant uses less quantity of rice husk for power generation, the project activity does not create any shortage in the availability of rice husk in the region and hence no leakage due to the same.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

>>

Considering no leakages envisaged in the project activity, the total project activity emissions are 5923 tCO2/annum.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

>>

(i) Baseline emissions due to avoidance of methane production

Theoretical calculation method of the methane emissions (in CO2-eq) according to IPCC is:

$$BE_y = MB_{,y} * GWP\_CH_4 - Md_{y,reg} * GWP\_CH_4$$

Where

$$MBy = \frac{16}{12}.F.DOCf.MCF.\sum_{x=1}^{y}\sum_{J=A}^{D} Aj,x.DOCj.(1-e^{-k_j}).e^{-k_j.(y-x)}$$

$MB_{,y}$	Methane generation potential in the year 'y' (tonnes of CH_4), estimated as in AMS III-G
MCF	Methane correction factor (fraction, default value is 0.8)
DOC_j	is percent of degradable organic carbon (by weight) in the waste type j
DOC_f	fraction DOC dissimilated to landfill gas (default value used)
F	Fraction of methane in the project's landfill gas (default is 0.5)
k_j	is the decay rate for the waste stream type j
y	is year for which LFG emissions are calculated

x is year since the landfill started receiving wastes: x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)

$A_{j,x}$ is amount of organic waste type j landfilled in the year x (tonnes/year)

MCF methane correction factor (fraction)	=	0.8	IPCC default
DOC_F fraction DOC dissimilated to landfill gas	=	0.77	IPCC default
F: Fraction of CH_4 in landfill gas	=	0.5	IPCC default
GWP_CH_4: GWP for CH_4 (tonnes of CO_2 equivalent/tonne of CH_4)	=	21	

Though Vijayawada and Guntur municipalities have initiated steps to process the waste generated using pelletisation and composting, additional huge investment still requires to dispose effectively the entire amount of waste generated in these cities. Hence, it is expected that the existing disposal practices should continue with gradual increase in implementation of processing plants on various technologies, and the compliance of the municipality would increase slowly.

To account for the above factor, in the baseline emissions that should exclude methane emissions due to the compliance with national or local safety requirement or legal regulations, the fraction of waste treated by the prescribed technology to comply with the standards has been taken, which will be assumed and will be updated with the report from the pollution control board.

The baseline emissions are calculated based on the following data and the values and equation are given in Enclosure I.

Waste stream	**Percent DOCj (by weight)**	**Percent of waste stream in municipal solid waste stream in %[8]**
Paper and textiles	40	10.92
Garden and park waste and other (non - food) putrescibles	17	30.20
Food waste	15	42.18
Wood and straw waste	30	3.51
Inert material	0	9.93
Total		100

[8] Based on the test reports of the MSW processed in the project activity

(ii) Baseline emissions due to power generation

Southern regional grid is considered for baseline analysis and calculation of anthropogenic emissions by fossil fuels during power generation. It is observed that, in the southern regional grid generation mix, coal, lignite, diesel and gas based power projects are responsible for GHG emissions. The average of the approximate operating margin and the build margin (combined margin) scenario of approved methodology have been considered for baseline calculations.

Scenario : Combined Margin

(a) Baseline Power Generation

$$P_{wlc} = P_{tot} - P_{lrc}$$

Where

P_{wlc}	Power generation by all sources, excluding hydro, biomass and nuclear
P_{tot}	Power generation by all sources of grid mix
P_{lrc}	Power generation by Hydel, nuclear, biomass projects

(b) Sectorwise baseline power generation

$$P_{fuel} = \frac{\sum P_f}{\sum P_{wlc}} x100$$

Where

P_{fuel} - Share (in %) of power generation by each fuel used (coal and gas in present scenario), out of total power generation excluding Plrc

P_f - Power generation by fuel used (in million kWh units)

(c) Calculation of Operating Margin emission factor

$OM_{bef} = \Sigma P_{fuel}$ *x* E_{fuel} *for base year for Scenario 1*

Where

OM_{bef} = OM emission factor of baseline calculated for each year (kg/kWh)

E_{fuel} = Emission factor (actual or IPCC) for each fuel type considered (e.g coal, gas)

(d) Calculation of Build margin emission factor for each source of baseline generation mix

BM_{yr} = Weighted average of emissions by recent 20% capacity additions or MWh of five most recent plants, which ever is higher

Where

BM_{yr} = Build margin for base year (kg/kWh) = $\frac{\sum fi,m,y\, x\, COEFi,m}{\sum_m GENm,y}$

Where

f,i,m.y amount of fuel i consumed in relevant power sources m in years(s), y

COEFi.m is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into
account the carbon content of the fuels used by relevant power sources *m* and the percent oxidation of the
fuel in year(s) *y*, and

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

(e) Combined Margin Factor

CMF for each year crediting period

= $(OM_{bef} + BM_{yr}) / 2$ (in kg/kWh)

(f) Power Generation and Export by project activity

$TP_{gen} = TP_{exp} + TP_{aux} + TP_{loss}$

Where

TP_{gen} Total power generated

TP_{exp} Total clean power export to grid per annum

TP_{aux} Total auxiliary consumption

TP_{loss} T&D loss

(g) Emission reduction by project activity

$ER = TP_{exp}\ x\ (NEF_B – NEF_p) – EL$

Where

ER Emission reduction per annum by project activity (tones/year)

TP_{exp} Total clean power export to grid per annum

NEF_B Final emission factor of baseline

NEF_p Net emission factor of project activity (=0)

EL Emission leakage (tonnes/year) (= 0)

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

>>

Following formula is used to determine Emission reduction

(a) For Avoidance of methane production from biomass decay

CO_2 emission reduction due to project activity	=	Baseline emissions for whole credit period after compliance adjusment	-	Project emissions for whole credit period
	=	**531576**	**-**	**55529**
	=	**476047**		

(b) For exporting power to the grid

CO_2 emission reduction due to project activity	=	Net CO_2 baseline emission x Electricity exported to grid in a year (in million kWh)	-	Project emission
	=	216200	-	0
	=	**216200**		

E.2 Table providing values obtained when applying formulae above:

>>

(i) Net emissions due to avoidance of methane production

Year	CO_2 equivalent emissions	Compliance[9] %	BAU (%)	Compliance adjusted	Project emissions	Actual net emissions	Net emissions as per the methodology[10]
2004-05	19202	0	100	19202	4071.4	15131	15131
2005-06	32332	10	90	29099	4071.4	25028	25028
2006-07	46856	10	90	42170	5923.3	36247	36247
2007-08	58937	10	90	53043	5923.3	47120	47120
2008-09	69066	20	80	55252	5923.3	49329	49329
2009-10	77633	20	80	62106	5923.3	56183	56183
2010-11	84949	20	80	67959	5923.3	62036	60000
2011-12	91260	30	70	63882	5923.3	57959	57959
2012-13	96762	30	70	67733	5923.3	61810	60000
2013-14	101610	30	70	71127	5923.3	65204	60000
Total				**531576**	**55529**	**476047**	**466997**

(ii) Net emissions due to export to grid

Operating Years	Baseline Emissions (tonnes of CO_2)	Project Emissions (tonnes of CO_2)	Certified Emission Reductions (tonnes of CO_2)
2004-05	21904	0	21904
2005-06	19426	0	19426
2006-07	18859	0	18859
2007-08	18859	0	18859
2008-09	22859	0	22859
2009-10	22859	0	22859
2010-11	22859	0	22859
2011-12	22859	0	22859
2012-13	22859	0	22859
2013-14	22859	0	22859
Total	**216200**	**0**	**216200**

[9] If the compliance rate is observed to be meeting the guidelines prescribed by Govt., for any year during the crediting period (based on data from APPCB and any other reliable Government sources, if available) the emissions due to controlled combustion of methane will be considered as zero from that year onwards

[10] As per the decision taken by board during EB 26 meeting and reference to point no. 63 in the EB 26 report, the emission reduction upto 60 kt is allowed for the type III project and the same is considered for the project activity.

(iii) Total net emissions

Operating Years	Net Emissions due to avoidance of methane (tonnes of CO_2)	Net emissions due to export power to grid (tonnes of CO_2)	Total Emission Reductions (tonnes of CO_2)
2004-05	15131	21904	37035
2005-06	25028	19426	44453
2006-07	36247	18859	55106
2007-08	47120	18859	65978
2008-09	49329	22859	72188
2009-10	56183	22859	79042
2010-11	60000	22859	82859
2011-12	57959	22859	80818
2012-13	60000	22859	82859
2013-14	60000	22859	82859
Total	**466997**	**216200**	**683197**

SECTION F.: Environmental impacts:

F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

The project being a municipal solid waste based power project it does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India. As per the government of India notification dated June 13, 2002 based on environment protection rule, 1986, public hearing and EIA is required for those industries/projects which are listed in the predefined list of ministry of environment and forest. Thermal power projects with investment of less than Rs. 100 crore have been excluded from the list. Hence, it is not required by the host party. Plant maintains all the statutory requirements as per the conditions mentioned in the consent for operation from APPCB. Also, plant has implemented the environment management plan as explained in Enclosure – II and brief summary of the same is given below:

1. Electrostatic precipitator is installed to bring down the suspended particulate matter concentration to less than 115 mg/m3.
2. Adequate stack height of 50.21 meters as per APPCB has been provided to disburse the emissions effectively.
3. Stake emissions for SPM, So2 and Nox are monitored by PCB to meet the statutory requirements.
4. No water is used to process MSW for production of fuel fluff and hence, no water pollution is caused
5. The quantity of effluent is minimized through reuse to the maximum possible extent.
6. The neutral effluent formed during the regeneration process of the ion exchanger is drained in to an underground pit and further neutralized if necessary..
7. The characteristics of the treated effluent are to conform to the APPCB's standards for on land irrigation and green belt development. Hence there is no adverse impact on ground water/surface water.
8. Inlet and outlet effluent samples are collected monthly and analyzed to ascertain the efficiency of ETP and to meet the statutory requirements.
9. Rejects like rubber, leather, glass, plastics etc., are sorted out and the same is disposed off separately.
10. Rejects like mixture of sand/grit/earth fine biomass is lifted by farmers to use it as manure.
11. All precautionary measures are taken to maintain the noise levels within the limits of 85 to 90 dBA as per the requirements of OSHA.
12. Fly ash generated in the plant is supplied to fire brick manufacturers.
13. Enough green belt is developed inside the plant for cleaner environment and to act as barriers to reduce sound levels.
14. Fire fighting system is installed to handle the emergency conditions in the plant.

SECTION G. Stakeholders' comments:

G.1. Brief description of how comments by local stakeholders have been invited and compiled:

>>

The local stakeholder comment invitation and compilation process involved is as follows:

The local stakeholders are immediately affected by the activities of the project. The effect is on the local environment, social life and economics. All the individuals and organizations falling in the above effects are perceived as stakeholders. They can be within the boundaries of the village, district, state or nation.

On deciding above criteria for qualification of the stakeholders, the idea was to decide most appropriate representatives who are covering above. During interaction of the corporate headquarter and the plant management, the stakeholders were identified as:

- Municipal corporations of Vijayawada and Guntur
- Customer (APTRANSCO)
- Local community
- Licensing and regulatory authorities like
- NEDCAP
- APPCB
- MoEF (Govt. of India)
- MNES (Govt. of India)

The views of the licensing and regulatory authorities are reflected in the form of permissions granted for the project. In this aspect, the permission by NEDCAP, MoEF, APPCB and MNES are indication of favorable impression for the project. Plant had invited all the relevant stakeholders to get the feedback on the project once in pre validation stage and again in post validation stage to reinforce the consultation process for the project activity on 3rd May 2006.

Stakeholders Involvement

The project does not require displacement of any local population. In addition, the population is also an indirect beneficiary of the project due to improvement of environment due to effective handling and management of municipal solid waste. The non-sanitary land filling practice being followed earlier has been controlled to control methane evolution in the dump yards besides hazardous gases like CO, CO2, SO2 etc.

Andhra Pradesh Pollution Control Board (APPCB) has prescribed standards of environmental compliance and monitors the adherence to the standards. The project has already received No Objection Certificate (NOC) from APPCB to operate the plant which is renewed every year.

Non-conventional Energy Development Agency of AP (NEDCAP) implements policies in respect of non-conventional renewable power projects in the state of Andhra Pradesh and nodal agency for the MNES and has accorded approval to the project.

As a buyer of the power, the APTRANSCO is a major stakeholder in the project. They hold the key to the commercial success of the project. APTRANSCO has already cleared the project and SESL has already signed Power Purchase Agreement (PPA) with APTRANSCO which is valid for 20 years.

The government of India, through Ministry of Non-conventional Energy Sources (MNES) , has been promoting energy conservation, promotion of renewable energy which include viable renewable energy projects including wind, small hydro and bagasse cogeneration / bio-mass power and municipal and industrial wastes. The project meets their requirements.

Members of Local community who are residing in the vicinity of the plant gave positive feedback on the project and are appreciative of improvements to create better environment and employment in the locality in addition to highlighting the benefits they are enjoying with the plant.

G.2. Summary of the comments received:

>>

As mentioned above, SESL has already received the approvals and clearances for their project from the following stakeholders:

- Consent order of Establishment from Andhra Pradesh Pollution Control Board;
- Power Purchase Agreement with APTRANSCO;
- Agreements with the Municipalities
- License from NEDCAP

Plant has also been getting Consent for Operation renewed regularly from Andhra Pradesh Pollution Control Board since beginning. Although, in India, public participation at any stage of project implementation is not required, being a CDM activity, project proponent has invited the local stakeholders. The summary of comments from various stakeholders is as below:

Most of the stakeholders expressed that as this project came up collecting and management of MSW has improved than earlier. In addition to these, they also felt that project has created jobs to local people. Most of the local community is of the opinion that disposal of garbage is regularised after the plant is installed as against earlier. They also expressed that electricity supply conditions are improved with the plant existence. They mentioned that there are no health related problems or diseases known to be due to the plant in the locality and the same has been confirmed by the health specialist in the local community who was also present. They also brought in to notice some of the remarks made by local MP in some of the local gatherings that the plant has actually improved MSW disposal system which has allayed any misgivings from the public. Local community has opined that mosquito menace is all prevalent in the city which can not be attributed to the plant operations. The Local community has appreciated the social service rendered by the plant management during times of distress like natural calamities, cyclones etc. The local community has also confirmed reduction in sound and noise from the plant than earlier. More effective steps have been solicited for control of odour.

Most of the stakeholders strongly believe that these kinds of projects in the state and country would reduce the environmental compliance costs significantly. They also felt that successful implementation and operation of project would make a path clear for setting up of more plants of similar kind and meet the potential available in the state and country.

In addition, the project has also received positive accolades from President of India in his address to the State Legislature, Chief Minister of Andhra Pradesh, Union Minister for Urban Development (who visited the project) and many other prominent personalities.

In summary, every stakeholder expressed that the project activity is helping the socio-economic development without affecting the local environment adversely.

G.3. Report on how due account was taken of any comments received:

>>

The relevant comments and important clauses mentioned in the project documents were considered while preparation of CDM project development document. The SESL management met all the stakeholders mentioned for appraisal and support. They were commended for their action towards environment protection and their efforts to utilize the waste available in the cities for fruitful purpose

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Shriram Energy Systems Limited
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Represented by:	
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Salutation:	Mr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding available for the project.

Annex-3

BASE LINE DATA

The methodology adopted for the calculation of the baseline is 'the combined margin emissions of the current generation mix". Year 2004-05 is considered as the base year for prediction of future capacity additions during the crediting period. Southern Grid generation data as tabulated in Enclosure-III is used for consideration of installed southern grid capacity and energy availability during the period 2004-05.

In order to arrive at the detailed break up of power generation mix in Southern Region, various documents and various web sites were refereed. The websites refereed for estimating the generation mix in southern regional grid are:

1. http://www.infraline.com
2. http://www.bisnetworld.net
3. http://www.apgenco.com
4. http://www.kptcl.com
5. http://cea.nic.in
6. http://www.tneb.org
7. http://www.ksebboard.com

As per the availability, actual generation figures as against the sector wise installed capacity were used. Wherever the break up of generation was not available, proportionate calculated figures were used so as to match the total energy availability.

Appendix A

Abbreviations

AP	Andhra Pradesh
APERC	Andhra Pradesh Electricity Regulatory Commission
APPCB	Andhra Pradesh Pollution Control Board
APTRANSCO	Transmission Corporation of Andhra Pradesh
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reductions
Cm	Centimeter
CO_2	Carbon Dioxide
DPR	Detailed Project Report
FFL	Finished Floor Level
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
IREDA	Indian Renewable Energy Development Agency
Kcal	Kilo Calories
Kg	Kilogram
KM	Kilometer
KP	Kyoto Protocol
KW	Kilowatt
KV	Kilovolts
kWh	Kilowatt hour
LP	Low Pressure
MCR	Maximum Continuous Rating
MNES	Ministry of Non-Conventional Energy Sources
MSW	Municipal Solid Waste
MT	Metric Tons
MU	Million Units
MUD	Ministry of Urban Development
MW	Megawatt
NEDCAP	Non Conventional Energy Development Corporation of Andhra Pradesh
NGO	Non Government Organizations
NOC	No Objection Certificate
PDD	Project Design Document

PIN	Project Idea Note
PLF	Plant Load Factor
PPA	Power Purchase Agreement
QA	Quality Assurance
QC	Quality Control
RDF	Residue Derived Fuel
RE	Renewable Energy
SEB	State Electric Board
SESL	Shriram Energy Systems Ltd
STG	Steam Turbine Generator
T&D	Transmission and Distribution
TDB	Technology Development Board
TIFAC	Technology Information Forecasting and Assessment Council
TJ	Tera Joule
UNFCCC	United Nations Framework Convention on Climate Change
WTE	Waste to Energy

Appendix B

REFERENCE LIST

Sr. No	References
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) http://cdm.unfccc.int
2.	Website of United Nations Framework Convention on Climate Change, http://unfccc.int
3.	UNFCCC decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol
4.	UNFCCC document: Appendix B to attachment 3, Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories
5.	Detailed project report on 6 MSW based power project – SESL
6.	Website of Central Electric Authority (CEA), Ministry of Power, Govt. of India- www.cea.nic.in
7.	CEA published document "16th Electric Power Survey of India"
8.	Website of APGENCO, www.apgenco.com
9.	Website of Ministry Non-Conventional Energy Sources (MNES), Government of India, http://mnes.nic.in
10.	Website of Indian Renewable Energy Development Agency (IREDA), http://ireda.nic.in
11.	Andhra Pradesh Power Profile at www.bisnetworld.net/bisnet/states
12.	www.infraline.com/power/
13.	APERC tariff order, R.P. No.84 / 2003 in OP No 1075 / 2000 dated 20.03.2004.
14.	Website of Climate Change Cell, Ministry of Environment & Forest, Govt. of India. http://envfor.nic.in

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Enclosure I

Procedure adopted for Baseline calculation

IPCC Default values used in the calculation are given below:

CER calculations for the reduction of Methane generation from MSW

Baseline Emissions

MCF methane correction factor (fraction)	=	0.8	IPCC default
DOCF fraction DOC dissimilated to landfill gas	=	0.77	IPCC default
F fraction of CH4 in landfill gas	=	0.5	IPCC default
CH4_GWP GWP for CH4 (tonnes of CO2 equivalent/tonne of CH4)	=	21	
BEy Baseline methane emissions from biomass decay	=	$MBy = \frac{16}{12}.F.DOCf.MCF.\sum_{x=1}^{y}\sum_{J=A}^{D} Aj,x.DOCj.(1-e^{-k_j}).e^{-k_j.(y-x)}$	

The amount of methane that would in the absence of the project activity be generated from disposal of waste at the solid waste disposal site (MB_y) is calculated with a multi-phase model. The calculation is based on a first order decay (FOD) model [*Option 1:* consistent with the 2006 IPCC Guidelines]. The model differentiates between the different types of waste *j* with respectively different decay rates k_j and different fractions of degradable organic carbon (DOC_j). The model calculates the methane generation based on the actual waste streams $W_{j,x}$ disposed in each year *x*, starting with the first year after the start of the project activity until the [*Option 1:* start] [*Option 2:* end] of the year *y*, for which baseline emissions are calculated (years *x* with x = 1 to x = [*Option 1:* y-1] [*Option 2:* y]). [*Option 1:* This approach is consistent with the calculation of methane emissions from waste disposal in the 2006 IPCC Guidelines.]

The amount of methane produced in the year *y* (MB_y) is calculated as follows:

$$MBy = \frac{16}{12}.F.DOCf.MCF.\sum_{x=1}^{y}\sum_{J=A}^{D} Aj,x.DOCj.(1-e^{-k_j}).e^{-k_j.(y-x)}$$

Where,

F fraction of methane in the landfill gas (default 0.5)

DOC_j per cent of degradable organic carbon (by weight) in the waste type j

DOC_f fraction of DOC dissimilated to landfill gas (IPCC default 0.77)

MCF Methane Correction Factor (fraction, IPCC default 0.8)

0.8 for **unmanaged solid waste disposal sites – deep and/or with high water table**. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste.

$A_{j,x}$ amount of organic waste type j landfilled in the year x (tonnes/year)

Waste stream	Percent DOCj (by weight)
Paper and textiles	40
Gardern and park waste and other (non - food) putrescibles	17
Food waste	15
Wood and straw waste	30

k_j decay rate for the waste stream type j

Waste stream	Decay-rate (kj)
Paper and textiles	0.023
Gardern and park waste and other (non - food) putrescibles	0.023
Food waste	0.231
Wood and straw waste	0.023

j waste type distinguished into the waste categories (from A to D), as illustrated in the table below

x year since the landfill started receiving wastes: x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)

y year for which emissions are calculated

Enclosure – II

Environmental Impact and Considerations

1. Introduction

The environmental impact of the MSW power plant covering the following aspects is briefly described below:

- Air Pollution
- Water pollution
- Noise Pollution

2. Land Environment

The incoming MSW is processed and only inert is land-filled thereby pollution presently being caused by open yard dumping of MSW is avoided. The power plant is not creating any major impact on land environment. Green belt is also developed within the plant premises.

3. Air Pollution Management

MSW Processing Plant

MSW was dumped nearby the site before commissioning the plant which caused enormous air pollution by way of burning of waste by rag pickers or otherwise. After the plant is commissioned, MSW is spread over a paved yard for a day or two with continuous shuffling and hence no biodegradation and no burning of MSW at present.

Power plant

The stack height of the plant is 50 m. The Electrostatic Precipitator (ESP) removes most of the particulates from the flue gas, thereby limiting the quantity of particulates emitted to atmosphere and it is designed such that the outlet dust concentration meets the pollution control board stipulations. ESP is provided for effectively maintaining the suspended particulate matter concentration. As the stack height is effectively provided, the emissions are dispersed effectively.

Dust control measures during fuel handling, preparing and feeding

Cyclone separators and bag filter are installed in the MSW processing plants for preventing the generation of dust.

4. Water Pollution Management

MSW processing plant

No water is used for processing MSW for production of fuel fluff and hence, no water pollution is caused.

Power plant

The water pollutants from the plant are

- Effluent from water treatment plant
- Steam generator blow down
- Plant sewage water

Effluent from water treatment plant

Reverse Osmosis plants are installed for basic water treatment in the plant. For Feeding to Steam Generator, a part of the treated water is sent to a polishing Ion Exchanger in mixed form for which Hydrochloric acid and caustic soda are added as regenerants. The neutral effluent generated during the regeneration process is drained into an underground for neutralizing. The effluent is further neutralized by the addition of either acid or alkali to achieve the required pH and mixed with blow down water as well as bleed water which dilute the stream before disposing off to the nearest sewerage disposal point.

Steam generator Blow down

The salient characteristics of the blow down water from the point of view of pollution are the pH and the temperature of water, since suspended solids are negligible. The pH is in the range of 9.5 to 10.3 and the temperature of the blow down is about 100 C, since it is first flashed in an atmospheric flash tank.

Sewage treatment

Sewage is treated in septic tanks located in suitable location inside the plant limits.

5. Solid waste management

MSW Processing Plant

During the process of segregation of MSW the following solid waste will be rejected:

Reject # 01 – Mixture of sand / grit / earth / fine biomass
Reject # 02 – Mixture of stones, rubber, leather, glass, plastics to the extent possible
Reject # 03 – Ferrous particles like nails, bottle caps, broken blades

From the Rejects of type 02, rubber, leather, glass, plastics to the extent possible etc is sorted out and the same is disposed off separately. The stones fraction is redumped into the adjacent dumping yard and being inert the same will not have any environmental impact.

Reject # 3 is lifted by rag pickers and will not be dumped.

Power plant

Most of the ash generated from the power plant is directly sold to brick manufacturers. Hence there will not be any impact on land environment due to the ash generation from power plant.

6. Noise level management.

The major noise generating sources in the power plant is turbine and generator (90 DBA), High pressure Boiler (87 DBA) and compressor (90 DBA) at 1 m distance from the source.

All equipment in the power plant is designed / operated to have a noise level not exceeding 85 to 90 DBA as per the requirement of Occupational Safety and Health Administration Standard (OSHAS).

The major noise level is confined to the working zones of the power plant. The predicted noise level at 0.5 km from the plant after commissioning will be around 35 DBA. Community noise level is not affected due to the green belt development and attenuation due to the physical barriers.

The following precautions are also observed:

Shock – absorbing techniques are adopted to reduce the impact.
Damping materials such as rubber / lead sheets is used for raping the work places like turbine generator, high pressure boilers, compressors, rooms etc.
By making use of absorbing material on roof walls and floors, the noise relection is reduced.
Ear mufflers are provided to the workers and this shall be enforced strictly.

Hollow concrete blocks are used in the main power block which reduces the noise level outside.

Enclosure – III

Calculation of Baseline Emission factor for Southern Region

	2001-02		2002-03		2003-04	
Sector	**MU**	**%**	**MU**	**%**	**MU**	**%**
Thermal Based	84031.63	62.95	92053.19	67.03	95898	67.15
Gas Based	10329.45	7.74	13950.1	10.16	16949	11.87
Diesel Based	4135.12	3.10	4358.5	3.17	3225	2.26
Hydro-State	26260.42	19.67	18286.79	13.32	16630	11.64
Nuclear Based	5243.83	3.93	4390	3.20	4700	3.29
IPP-Co-Generation+BIOMASS	2023.82	1.52	2676.32	1.95	1910	1.34
IPP-Wind	1456.09	1.09	1606.81	1.17	3500	2.45
Total	**133480.4**	**100.00**	**137321.7**	**100.00**	**142812.0**	**100.00**
Total generation excluding Low-cost power generation	98496.20	73.79	110361.79	80.37	116072.00	81.28
Generation by Coal and Lignite out of Total Generation excluding Low-cost power generation	84031.63	62.95	92053.19	67.03	95898.00	67.15
Generation by Gas out of Total Generation excluding Low-cost power generation	10329.45	7.74	13950.10	10.16	16949.00	11.87
Generation by Diesel out of Total Generation excluding Low-cost power generation	4135.12	3.10	4358.50	3.17	3225.00	2.26
Estimation of Baseline Emission Factor (tCO_2/MU)						
Simple Operating Margin						
Fuel 1 : Coal (Steam Stations)						
Avg. Calorific Value of Coal used (kcal/kg)		4845.0		4171.0		3820.0
Coal consumption (tons/yr)		53107000		65997000		52985000
Emission Factor for Coal-IPCC standard value (tonne CO2/TJ)		96.1		96.1		96.1
Oxidation Factor of Coal-IPCC standard value		0.98		0.98		0.98
COEF of Coal (tonneCO2/ton of coal)		1.91		1.64		1.51
Emissions per year (tCO2)		101460728.10		108546745.94		79812097.76

Fuel 2 : Furnace Oil (Steam Stations)						
Avg. Calorific Value of fuel used (kCal/kg)		10497		10726		10365
Fuel consumption (tons/yr)		115103.7		103163.46		50275.21
Emission Factor for Fuel- IPCC standard value(tonne CO2/TJ)		73.33		73.33		73.33
Oxidation Factor of Fuel-IPCC standard value		0.99		0.99		0.99
COEF of Gas(tonneCO2/ton of Oil)		3.19		3.26		3.15
Emissions per year (tCO2)		367270.60		336353.06		158399.89
Fuel 3 : Diesel Oil (Steam Stations)						
Avg. Calorific Value of fuel used (kCal/kg)		10293		9760		10186
Fuel consumption (tons/yr)		5821.65		7145.95		28076.35
Emission Factor for Fuel- IPCC standard value(tonne CO2/TJ)		74.07		74.07		74.07
Oxidation Factor of Fuel-IPCC standard value		0.99		0.99		0.99
COEF of Fuel(tonneCO2/ton of fuel)		3.16		3.00		3.13
Emissions per year (tCO2)		18397.05		21412.63		87802.02
Fuel 4 : LSHS (Steam Stations)						
Avg. Calorific Value of fuel used (kCal/kg)		10457		10524		10302
Fuel consumption (tons/yr)		7321.6		5361.84		4672.8
Emission Factor for Fuel- IPCC standard value(tonne CO2/TJ)		73.33		73.33		73.33
Oxidation Factor of Fuel-IPCC standard value		0.99		0.99		0.99
COEF of Fuel(tonneCO2/ton of gas)		3.18		3.20		3.13
Emissions per year (tCO2)		23272.59		17152.46		14632.90
Fuel 5 : Gas (Steam Stations)						

Avg. Calorific Value of Gas used (kCal/M3)		NA		NA		2000
Gas consumption (M3/yr)		0.00		0		1932274000.00
Emission Factor for Gas- IPCC standard value(tonne CO2/TJ)		56.10		56.10		56.10
Oxidation Factor of Gas-IPCC standard value		0.995		0.995		0.995
COEF of Gas(kgCO2/M3 of gas)		NA		NA		0.47
Emissions per year (tCO2)		0.00		0.00		903206.01
Fuel 6 : Naphtha (Gas Stations)						
Avg. Calorific Value of Fuel used (TJ/kt)		45.01		45.01		45.01
Fuel consumption (tons/yr)		149197.41		322854.84		478596.51
Emission Factor for Fuel- IPCC standard value(tonne CO2/TJ)		73.33		73.33		73.33
Oxidation Factor of Fuel-IPCC standard value		0.995		0.995		0.995
COEF of Fuel(tonneCO2/ton of Fuel)		3.284		3.284		3.284
Emissions per year (tCO2)		489997.65		1060327.52		1571818.00
Fuel 7 : HSD (Gas Stations)						
Avg. Calorific Value of Fuel used (kCal/kg)		10293		9760		10186
Fuel consumption (tons/yr)		4614.65		233853.7		192933.85
Emission Factor for Fuel- IPCC standard value(tonne CO2/TJ)		74.07		74.07		74.07
Oxidation Factor of Fuel-IPCC standard value		0.99		0.99		0.99
COEF of fuel(tonneCO2/ton of Fuel)		3.160		2.996		3.127
Emissions per year (tCO2)		14582.80		700735.68		603354.10
Fuel 8 : Natural Gas (Gas Stations)						
Avg. Calorific Value of Gas used (TJ/Million M3)		37.98		37.98		37.98

Estimated Gas consumption (Million M3/yr)		3230		3130		2010
Emission Factor for Gas- IPCC standard value(tonne CO2/TJ)		56.10		56.10		56.10
Oxidation Factor of Gas-IPCC standard value		0.995		0.995		0.995
COEF of Gas(tonneCO2/Million M3 of gas)		2120.024		2120.024		2120.024
Emissions per year (tCO2)		6847678.25		6635675.82		4261248.69
Fuel 9 : Diesel (Diesel Stations)						
Avg. Calorific Value of Fuel used (kCal/kg)		10293		9760		10186
Diesel consumption (tons/yr)		648561.05		736047.3		12667.55
Emission Factor for Diesel-IPCC standard value (tonne CO2/TJ)		74.07		74.07		74.07
Oxidation Factor of Diesel-IPCC standard value		0.99		0.99		0.99
COEF of Diesel (tonneCO2/ton of diesel)		3.16		3.00		3.13
Emissions per year (tCO2)		2049523.97		2205543.90		39614.71
Fuel 10 : LSHS (Diesel Stations)						
Avg. Calorific Value of Fuel used (kCal/kg)		10457		10524		10302
Fuel consumption (tons/yr)		0		0		569756.88
Emission Factor for Fuel-IPCC standard value (tonne CO2/TJ)		73.33		73.33		73.33
Oxidation Factor of Fuel-IPCC standard value		0.99		0.99		0.99
COEF of Fuel (tonneCO2/ton of Fuel)		3.18		3.20		3.13
Emissions per year (tCO2)		0.00		0.00		1784197.02
Fuel 11 : Lignite						
Avg. Efficiency of power generation with lignite as a fuel, %		30		30		30
Avg. Calorific Value of Lignite		2625		2686		2737

used (kCal/kg)						
Estimated lignite consumption (tons/yr)		17318250		17738000		20755000
Emission Factor for Lignite-IPCC standard value (tonne CO2/TJ)		101.18		101.18		101.18
Oxidation Factor of Lignite-IPCC standard value		0.98		0.98		0.98
COEF of Lignite (tonneCO2/ton of lignite)		1.09		1.12		1.14
Emissions per year (tCO2)		18873997.43		19780680.95		23584578.25
EF (OM Simple, excluding imports from other grids), tCO2/MU		1321.32		1262.25		971.99
EF (OM Simple), tCO2/MU		**1321.32**		**1262.25**		**971.99**
Average EF (OM Simple), tCO2/MU						**1185.19**
Considering 20% of Gross Generation						
Sector						
Thermal Coal Based-State					1554.00	5.15
Thermal Coal Based-Central					7296.00	24.20
IPP-Coal Based					0	0.00
Lignite based power plant					4668	15.48
IPP-Gas (Naphtha) Based					8520	28.26
IPP-Diesel Based					422.32	1.40
Hydro-State					2200.70	7.30
Nuclear Based-Central					0.00	0.00
IPP-Co-Generation + biomass					3493.40	11.59
IPP-Wind					2000	6.63
Total					**30154**	**100.00**
Generation by Coal out of Total Generation					8850.00	29.35
Generation by Gas out of Total Generation					8520.06	28.26
Generation by Diesel out of Total Generation					422.32	1.40
Generation by lignite out of Total Generation					4668	15.48
Built Margin						

Fuel 1 : Coal							
Avg. efficiency of power generation with coal as a fuel, %							32.5
Avg. calorific value of coal used, kcal/kg							4069.4
Estimated coal consumption, tons/yr							5752500.0
Emission factor for Coal (IPCC),tonne CO2/TJ							96.1
Oxidation factor of coal (IPCC standard value)							0.98
COEF of coal (tonneCO2/ton of coal)							1.605
Fuel 2 : Gas							
Avg. Efficiency of power generation with gas as a fuel, %							45
Avg. Calorific Value of Gas used (TJ/Million M3)							37.98
Estimated Gas consumption (Million M3/yr)							1794.64
Emission Factor for Gas- IPCC standard value(tonne CO2/TJ)							56.10
Oxidation Factor of Gas-IPCC standard value							0.995
COEF of Gas(tonneCO2/Million M3 of gas)							2120.024
Fuel 3 : Diesel							
Avg. efficiency of power generation with diesel as a fuel, %							41.7
Avg. calorific value of diesel used, kcal/kg							10348
Estimated diesel consumption, tons/yr							84168.1
Emission factor for Diesel (as per standard IPCC value)							74.07
Oxidation factor of Diesel (IPCC standard value)							0.99

COEF of diesel tonneCO2/ton of diesel						3.18
Fuel 4 : Lignite						
Avg. efficiency of power generation with lignite as a fuel, %						29
Avg. calorific value of lignite used, kcal/kg						2683
Estimated lignite consumption, tons/yr						5085715
Emission factor for lignite (as per standard IPCC value)						101.18
Oxidation factor of lignite (IPCC standard value)						0.98
COEF of lignite tonneCO2/ton of lignite						1.11
EF (BM , excluding imports) (tCO2/MU)						629.01
EF (BM), tCO2/MU						**629.0**
Combined Margin Factor (Avg of OM & BM)						**907.1**
Baseline Emissions Factor (tCO2/MU)						**907.1**

Generation capacity , KW	6000
Plant load factor, %	66
No. of hours of plant operation per annum	6000
No. of units generated in a year, millions	23.76
Auxilliary consumption per annum	2.970
No. of units exported to grid, millions	20.79

	Units Exported	GHG Emission reduction per annum
2004-05	24.15	21904
2005-06	21.42	19426
2006-07	20.79	18859
2007-08	20.79	18859
2008-09	25.20	22859
2009-10	25.20	22859

2010-11	25.20	22859
2011-12	25.20	22859
2012-13	25.20	22859
2013-14	25.20	22859
		216200

	Units Exported	GHG Emission reduction per annum
2004-05	24.15	21904
2005-06	21.42	19426
2006-07	30.35	27534
2007-08	30.35	27534
2008-09	36.79	33374
2009-10	36.79	33374
2010-11	36.79	33374
2011-12	36.79	33374
2012-13	36.79	33374
2013-14	36.79	33374