CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Terrestre Ambiental Landfill Gas Project
Version 3
20/07/2006

A.2. Description of the project activity:

The Terrestre Ambiental Landfill Gas Project's (hereinafter TALGP) aim is to capture and flare the landfill gas produced at CGR (Waste Management Center) Piaçaguera to avoid emissions of methane gas to the atmosphere. This landfill (class II A and II B[1]) is owned by Terrestre Ambiental Ltda and located in Santos, State of São Paulo, Brazil

Terrestre Ambiental Ltda is a society between Terracom Construções Ltda and ESTRE (Empresa de Saneamento e Tratamento de Resíduos Ltda).

ESTRE is presented in the main metropolitan centers of state of São Paulo (São Paulo metropolitan region, Campinas metropolitan region, and Santos region). With the goal of adequately dispose industrial and municipal waste produced in such regions, ESTRE has already implemented five landfills.

CGR Piaçaguera counts on the best management practices for such business. Modern engineering has been applied during design, leachate is collected and sent for treatment, and all the pertinent environmental variables are continuously monitored.

The landfill gas (biogas) is collected through a passive system, with no systematic and monitored flare. Therefore, an extra-incentive is needed for Terrestre to make additional investments and enhance its landfill gas collection rate and install appropriate facilities to properly flare the methane produced at the site.

Landfill gas generation will be guaranteed throughout TALGP's lifetime from various strategic aspects CGR Piaçaguera enjoys:

- CGR Piaçaguera is located in Baixada Santista Region, in the coast of the State of São Paulo, formed by 9 municipalities, which, in most cases, do not have feasible areas where landfills could be developed because the region is surrounded by the Serra do Mar State Park, an APP – Área de Preservação Permanente (*Permanent Preserved Area*). In fact, all of those municipalities are both facing problems regarding their rubbish dumps/landfills capacity or environmental demands by the environmental

[1]Residues in Brazil are classified under norm NBR 10004, issued in november 2004, from ABNT, the Brazilian association for technical standards. Class I residues are classified as hazardous or present one of the following characteristics: flammability, corrosivity, reactive properties, toxicity and pathogenicity. Class II residues are classified as non-hazardous, and are divided into two sub-categories: II A – reactive, not classified as class I nor class II B; may present the following characteristics: combustibility, biodegradability or water solubility. Residues class II B are non-reactive, not presenting any soluble constituent in standard higher than potable water.

agency in the state of São Paulo (CETESB), requiring the dumps' areas to be recovered and obliging the authorities to find proper destination to the waste generated.

- CGR Piaçaguera receives waste from the two main cities of the region (Santos and Cubatão), among from the private companies located at the region. Considering these clients, CGR Piaçaguera receives around 1 200 tonnes of waste daily and is designed to receive 3 million tonnes.
- Studies conducted by ESTRE show that landfill development and operation is only feasible for waste disposition rates of at least 500 tonnes of waste per day. And moreover, there are no potential feasible areas for landfill development in the region, as the Serra do Mar State Park is protected by legislation.

TALGP will have a significant impact on sustainable development. First, while reducing methane emissions that would enhance climate change, it will also minimize the risk that any explosion occurs at the site – although CGR Piaçaguera's engineering and design specifically aims at avoiding this type of accidents. Second, given the fact that initiatives of this type are relatively new in Brazil, a significant technology transfer will be needed for the project's implementation and operation. Third, specialized operators will be needed for project operation, which means a positive impact on employment and capacity-building. The aforementioned elements concur in making the project extremely vital in the context of sustainable development.

A.3. Project participants:

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)
Brazil (host)	• Terrestre Ambiental Ltda (private entity) • Econergy Brasil Ltda (private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

CGR Piaçaguera is located in the city of Santos, around 60 km south of São Paulo, in Via Conego Domenico Rangoni, km 254.9.

A.4.1.1. Host Party(ies):

Brazil

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

São Paulo

A.4.1.3. City/Town/Community etc:

Santos

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

Figure 1 shows the location of Santos.

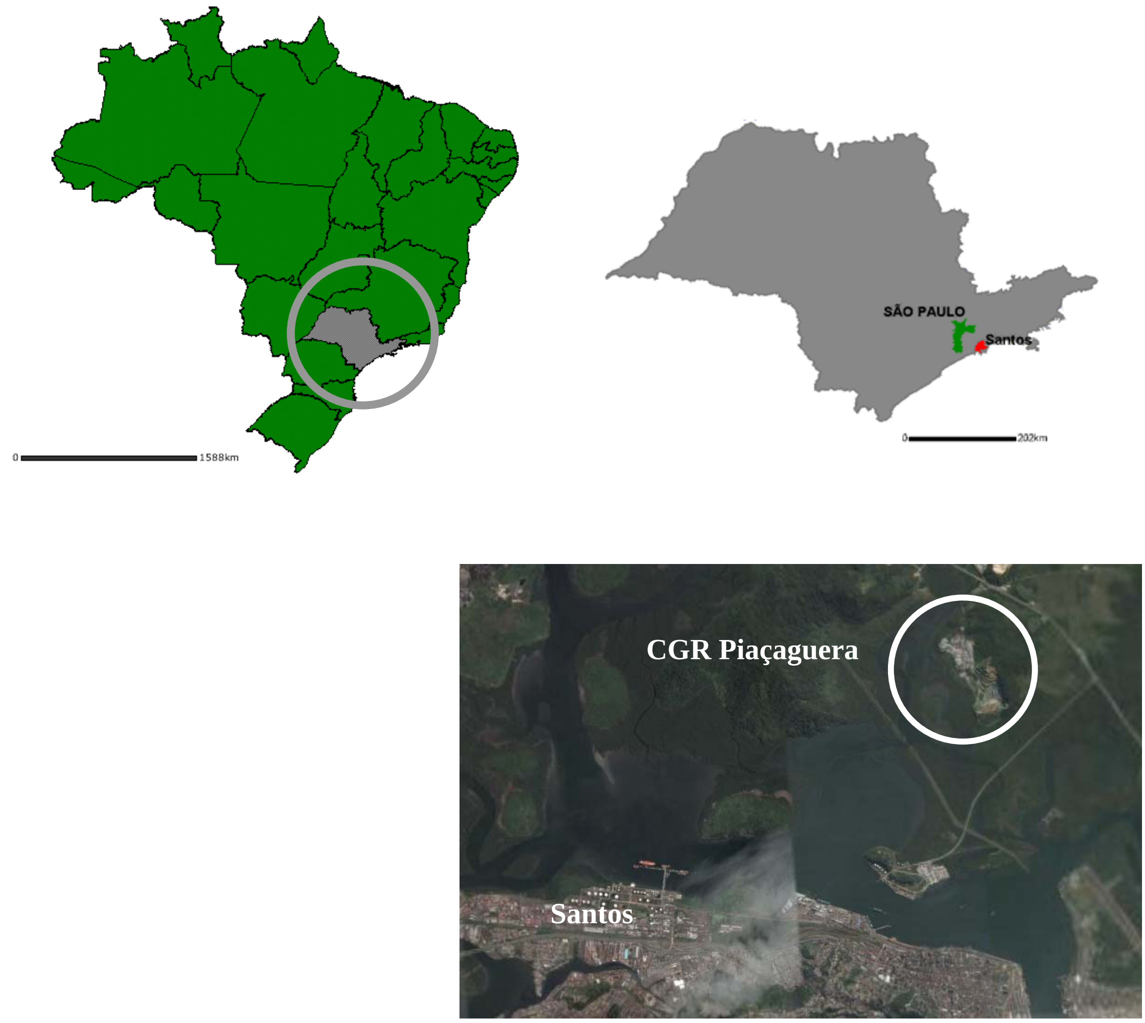

Figure 1. Santos and CGR Piaçaguera location

A.4.2. Category(ies) of project activity:

TALGP is designed as a sectoral scope 13 – waste handling and disposal – project

A.4.3. Technology to be employed by the project activity:

The State of São Paulo environmental agency – CETESB (Companhia de Tecnologia de Saneamento Ambiental) – classifies the state's landfills according to technology used, management techniques and other criteria in its Landfill Quality Index (*IQR – Índice de Qualidade de Aterros de Resíduos*). CGR Piaçaguera was qualified with an IQR of 9.6 (range 0 to 10) in CETESB's 2004 assessment of the state's landfills[2].

[2] CETESB – Companhia de Tecnologia de Saneamento Ambiental. *Inventário Estadual de Resíduos Sólidos Domiciliares*, 2004.

The technology to be employed will be the improvement of landfill gas collection and flaring, through the installation of an active recovery system composed by a collection and transportation pipeline network and a flaring system, as shown in Figure 2.

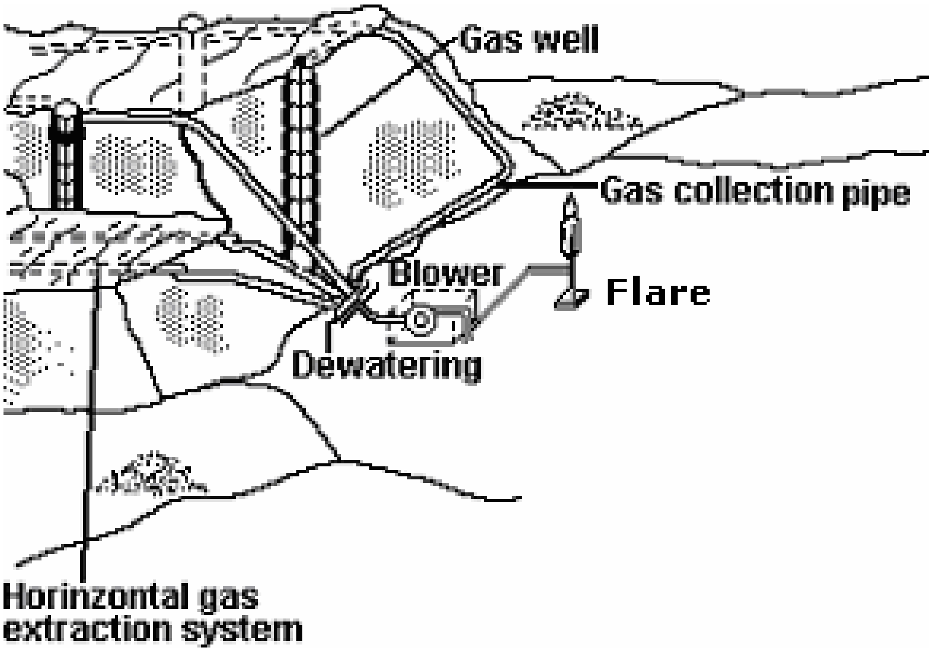

Figure 2. Schematic situation of a landfill with active gas recovery (Source: WILHELM, 1991[3].)

Following concrete examples from other landfill gas projects in the world, the TALGP may involve the installation of wellheads at the existing concrete wells to avoid the emission of methane to the atmosphere. An example of wellhead and the detail of its construction are shown on Figure 3 and Figure 4.

Figure 3. Example of wellhead (source: Biogás Ambiental[4])

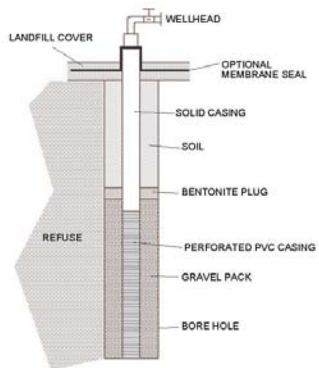

Figure 4. Internal detail of a well and wellhead

The use of the existing wells represents a distinct advantage since they are already installed and because at that location most of the gas flows to the atmosphere. However, some physical barriers might interrupt the gas flow from the generation point to the well, so new wells might need to be drilled.

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[3] V. WILHELM; *Safety Aspects of the Planning, Construction and Operation of Landfill Gas Plants*; paper; Sardinia 91 Third International Landfill Symposium; S. Margherita di Pula, Cagliari, Italy; 14 - 18 October 1991
[4] Biogás Ambiental; available at < http://www.biogas-ambiental.com.br/instalacaorede.htm>; accessed on Jan 31st, 2006.

A common practice all over the world is to use PVC equipment. It has the advantage to be more flexible and more resistant to high pressure, if compared to metal or concrete equipment. The disadvantage is represented by the high cost involved.

The wellheads are connected to a collecting pipeline. This pipeline transports the landfill gas to the manifolds. The manifolds are equipment that can be connected with more than 10 wellheads and transfer the collected gas to the transmission pipeline.

Figure 5. Example of manifold, connected with the transmission pipeline

The transmission pipeline is the last step of the collecting system. It transports the collected landfill gas to the flare. The transmission pipeline might be connected with all manifolds around the landfill. In order to preserve the operation of the equipment, a dewatering system might be installed to remove the condensate.

Figure 6. Example of a transmission pipeline

The collecting pipeline and the transmission pipeline are both usually in PVC, because this material can support high pressures and is flexible. The transmission pipeline is finally connected to the flare.

Figure 7. Example of flares (source: Biogás Ambiental)

This kind of technology is still not widely applied in Brazil. Very few landfills have already installed equipment for improving the amount of landfill gas collected. Therefore, Terrestre will need engineers and other specialists with experience in this area to advice the company while implementing the project. These professionals will also train local operators and engineers on operations and maintenance of the facilities.

Despite the fact that landfill gas projects can be of great potential in Brazil, the local market does not have flare suppliers. Technology will have to come from abroad and mainly from the United States and Europe. Technology transfer will hence occur from countries with strict environmental legislative requirements and environmentally sound technologies. Environmentally sound technologies are also needed for Terrestre to comply with its environmental guidelines.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The project activity will burn all the landfill gas collected in a flare, applying procedures of monitoring the flow and the amount of methane.

The current practice in CGR Piaçaguera, as explained in A.4.3, is passive venting. With TALGP's new facilities, it will be possible to efficiently flare the landfill gas. By that, methane that was previously released to the atmosphere will be flared and reduced to CO_2, therefore reducing the global warming effect, since methane is 21 times more powerful to the effect than carbon dioxide.

Emission reductions would not occur in the absence of the TALGP because the improvement of the landfill is not mandated by law and is not an economically attractive investment.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Years	Annual estimation of emission reductions in tonnes of CO2e
2007	144 275
2008	182 179
2009	214 804
2010	242 884
2011	267 053
2012	287 855
2013	305 759
Total estimated reductions (tonnes of CO2e)	**1 644 809**
Total Number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	234 972

A.4.5. Public funding of the project activity:

There is no Annex I public funding involved in this project activity.

SECTION B. Application of a baseline methodology

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

The baseline methodology applied to TALGP is ACM0001 - version 3: *"Consolidated baseline methodology for landfill gas project activities"*.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

This methodology is applicable to TALGP because the baseline scenario is the partial or total atmospheric release of the gas and the project activities is the capture of the gas through a blower and the installation of a collecting system and the use of a flare to burn the methane.

B.2. Description of how the methodology is applied in the context of the project activity:

With the implementation of the TALGP, methane that would be naturally released to the atmosphere in the baseline scenario will be captured through the use of a collecting and flaring system. Only a part of the methane is flared at the baseline due to safety and odor concerns.

As mentioned in A.4.3, a complete collecting network pipeline and a flaring system will be installed in order do avoid the emission of methane to the atmosphere. Such a system ensures that methane will be captured, transported and flared under controlled conditions, in a way that it will be possible to measure the amount of methane flared on-site.

The description of formulae used to estimate emission reductions for the project activity is indicated in D.2.4.of this document.

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 CDM project activity:

Application of the Tool for the demonstration and assessment of additionality of TALGP.

Step 0. Preliminary screening based on the starting date of the project activity

Since the TALGP will start its activities after the prompt-start date of 18/11/2004, the project participants will not benefit from the crediting period starting prior to the registration of the project activity.

Thus Step 0 is not applicable.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations.

Sub-step 1a: Define alternatives to the project activity
Since the project activity will not deliver commercial goods or services (i.e. electricity generation or thermal energy) and no other incentives will be obtained for the capturing and flaring of the methane, and taking into account that there is no legislation that obligates the landfill to destroy the methane, the landfill would continue with its core business (final disposal of solid waste) and the methane would continue to be released to the atmosphere, continuing the baseline scenario.

Sub-step 1b: Enforcement of applicable laws and regulations
The alternative, which is to continue with the business as usual situation before the decision of implementing this CDM project activity is consistent with the applicable laws and regulations.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method
As the TALGP generates no financial or economic benefits other than CDM related income, the simple cost analysis scenario is applied.

Sub-step 2b. – Option I. Apply simple cost analysis
As the baseline scenario is in accordance with national laws and regulations and as the project activity will not receive income from the sale of electricity, the implementation of the project activity will have no other benefits than the CDM revenues.

Step 4. Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity
According to the latest official statistics on urban solid waste in Brazil – *Pesquisa Nacional de Saneamento Básico 2000* (PNSB 2000) – the country produces 228 413 tons of waste per day, which corresponds to 1.35 kg/inhabitant/day. And though there is a worldwide trend towards reducing, reusing and recycling, therefore reducing the amount of urban solid waste to be disposed in landfills, the situation in Brazil is peculiar. Most of the waste produced in the country is sent towards open dumps which are, in most of the cases, areas without any sort of proper infrastructure to avoid environmental hazards. Figure 8 shows the final destination of the waste per municipality, according to PNSB 2000.

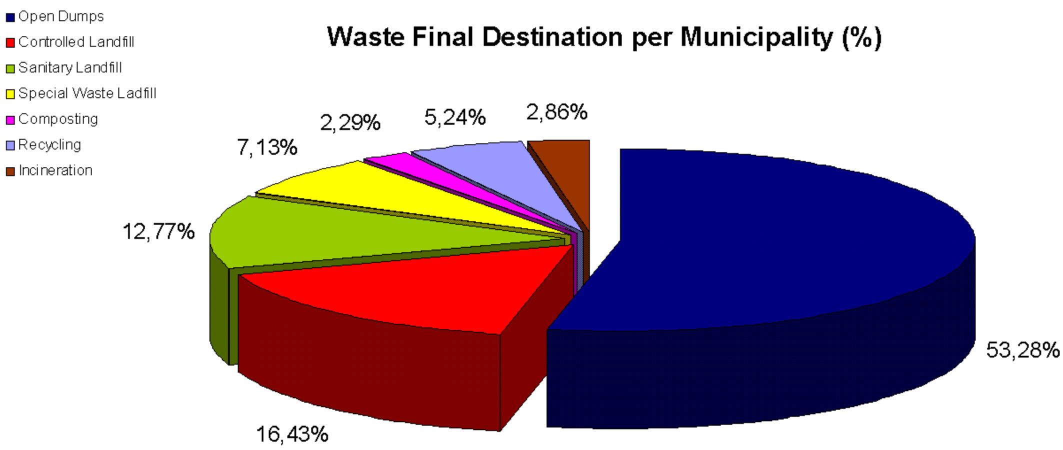

Figure 8. Waste Final Destination per Municipality in Brazil (Source: PNSB, 2000[5])

Only few of the existing Brazilian landfills have installed a collecting and flaring methane system. The majority of landfills operate with natural emission of methane to the atmosphere, through concrete wells.

Sub-step 4b. Discuss any similar options that are occurring:
As mentioned above, some landfills, such as Bandeirantes Landfill, Nova Gerar Landfill, Onyx Landfill, Marca Landfill, Sertãozinho Landfill, Salvador da Bahia Landfill and ESTRE Paulínia Landfill, operate with a forced methane extraction and destruction, using blowers, collection system and flaring system.

This kind of project activity is not widely spread in Brazil and the landfills that operate this type of project represent only a small portion of the total existing landfills.

Step 5. Impact of CDM registration
CDM registration will reduce the economic and financial barriers to the project activity. The commercialization of the generated CERs represents the sole benefit of the project. Registration will reduce investment risk and foster the project owners into expanding business activities.

The benefits and incentives mentioned in the text of the Tool for demonstration and assessment of additionality, published by the CDM-EB, will be experienced by the project: anthropogenic GHG reductions; financial benefits from the revenue obtained by selling CERs; and, likelihood to attract new players and new technologies (currently there are companies developing new technologies of biogas extraction and extra-efficient flares and the purchase of such equipment is to be fostered by the CER sales revenue) thus reducing investor's risk.

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

The project activity will take place in Centro de Gerenciamento de Resíduos (CGR) Piaçaguera, Terrestre's landfill located in Santos – SP. At that site, Terrestre receives waste from some companies and from the municipalities of Santos, Guarujá, Cubatão e Bertioga, important cities from the Baixada Santista Region.

[5] IBGE - Instituto Brasileiro de Geografia e Estatística. *Pesquisa Nacional de Saneamento Básico*, 2000.

The boundary is, in this case, the project activity site, where the landfill operations and LFG emissions take place and where gas flaring will take place.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

This baseline study was concluded on 20/07/2006, by Econergy, which is a Project Participant. Contact information in Annex I.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

01/01/2007

C.1.2. Expected operational lifetime of the project activity:

21 years 0 months

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

C.2.1. Renewable crediting period

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

01/01/2007

C.2.1.2. Length of the first crediting period:

7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

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C.2.2.2. Length:

Left blank on purpose

SECTION D. Application of a monitoring methodology and plan

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

The methodology applied to TALGP is ACM0001 – version 3: "*Consolidated monitoring methodology for landfill gas project activities*".

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

This methodology is applicable to the TALGP because the baseline scenario is the partial or total atmospheric release of the gas and the project activities is the capture of the gas through a blower and the installation of a collecting system and the use of a flare to burn the methane.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

Left blank on purpose

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

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D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Left blank on purpose

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

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D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. LFG_{total}	Total amount of landfill gas captured	Flow-meter	m^3	m	Continuously	100%	Electronic and paper	Measured by a flow meter. Data to be aggregated monthly and yearly.
2. $LFG_{flare,y}$	Amount of landfill gas sent to flares	Flowmeter	m^3	*m*	Continuously	100%	Electronic and paper	Measured by a flow meter.
5. FE	Flare/combustion efficiency	Flare fabricant	%	*m*	(1) Continuously (2) quarterly, monthly if unstable	100%	Electronic and paper	(1). Continuous measurement of operation time of flare (e.g. with temperature) (2) Periodic measurement of methane content of flare exhaust gas
6. $w_{CH4,y}$	Methane fraction in the landfill gas	Gas analyzer	m^3CH4/ m^3LFG	*m*	Continuously (quarterly, monthly if	100%	Electronic and paper	Measured by continuous gas quality analyzer.

					unstable)			
7. T	Temperature of the landfill gas	Temperature sensor	ºC	*m*	Continuously	100%	Electronic and paper	Measured to determine the density of methane D_{CH4}.
8. p	Pressure of the landfill gas	Pressure sensor	Pa	*m*	Continuously	100%	Electronic and paper	Measured to determine the Density of methane D_{CH4}.
10. EL_{IMP}	Total amount of Electricity imported to meet project requirement	Electricity meter installed in the blower	MWh	*m*	Continuously	100%	Electronic and paper	Required to determine CO2 emissions from use of electricity to operate the project activity.
11.	CO2 emission intensity of the electricity	Calculated using ACM0002.	tCO_2e/MWh	*c*	At the validation and in the baseline renewal.	0%	Electronic and paper	Required to determine CO2 emissions from use of electricity to operate the project activity
13.	Regulatory requirements relating to landfill gas projects	Local regulations	test	n/a	At the validation and in the baseline renewal.	100%	Electronic and paper	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y.}$

Obs: All data from the table above will be archived according to internal procedures, until 2 years after the end of the crediting period.

Note that for the “Simple OM”, “Simple Adjusted OM” and the “Average OM” as well as the “BM, was chosen a data vintage based on ex ante Monitoring. Thus at least EGy shall be monitored, and all parameters will be required to recalculate the combined margin at any renewal of a crediting period, using steps 1-3 in the baseline methodology ACM0002.

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}}$ **(tCO_2e/GWh)** $EF_{BM} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_m GEN_{m,y}}$ **(tCO_2e/GWh)** $EF_{electricity} = \frac{EF_{OM} + EF_{BM}}{2}$ **(tCO_2e/GWh)** **$EP_y = EC_y . EF$**	$F_{i,j(or\ m),y}$ Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y *j,m* Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports4 from the grid $COEF_{i,j(or\ m)\ y}$ Is the CO2 emission coefficient of fuel i (tCO2 / mass or volume unit of the fuel), taking intoaccount the carbon content of the fuels used by relevant power sources j (or m) and the percent oxidation of the fuel in year(s) y, a $GEN_{j(or\ m),y}$ Is the electricity (MWh) delivered to the grid by source j (or m) $EF_{electricity,y}$ Is the CO2 baseline emission factor for the electricity. EP_y: Are the project emissions during the year y in tons of CO_2; EC_y are the electricity consumed by the blower during the year *y*, in MWh

Obs: project emissions will be measured directly at the site.

D.2.3. Treatment of leakage in the monitoring plan

According with ACM0001, no leakage will be accounted for the project activity.

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Left blank on purpose.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The Methodology ACM0001 states that greenhouse gas emission reduction achieved by the project activity during a given year "*y*" (ER_y) is the difference between the amount of methane actually destroyed/combusted during the year ($MD_{project,\ y}$) and the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg\ ,y}$), times the approved Global Warming Potential value for methane (GWP_{CH4}), plus the emission reductions of the net electricity fed to the grid ($EL_{EX,\ LGFG} – EL_{IMP}$) minus the emission reduction due to the replacement of the fossil fuel used in the baseline, as follows:

$$ER_y = \left(MD_{project,y} - MD_{reg,y}\right) \times 21 + \left(EL_{EX,LGFG} - EL_{IMP}\right) \times CEF_{electricity} - ET_y \times CEF_{thermal}$$, where:

ER_y = emission reductions of the project activity in year *y* (tCO_2e);
$MD_{project,\ y}$ = quantity of methane destroyed at year *y* (tCH_4);
$MD_{reg,\ y}$ = methane that would have been destroyed during the year *y* in the absence of the project activity (tCH_4);
GWP_{CH4} = Global Warming Potential of Methane (tCO_2e/tCH_4);
$EL_{EX,\ LGFG}$ = net quantity of electricity exported during year y, produced using landfill gas (MWh).
EL_{IMP} = net incremental electricity imported, defined as difference of project imports less any imports of electricity in the baseline, to meet the project requirements (MWh);
$CEF_{electricity}$ = CO_2 emissions intensity of the electricity displaced (tCO_2e/MWh);
ET_y = incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project, for energy requirement on site under project activity during the year y (TJ);
$CEF_{thermal}$ = CO_2 emissions intensity of the fuel used to generate thermal/mechanical energy, (tCO_2e/TJ);

As the TALGP is not a project to produce and sell electricity to the grid and as the landfill did not consume fossil fuel for energy requirements in the baseline, $EL_{EX,\ LGFG} = 0$ and $ET_y = 0$.

So, the formulae is updated to:

$$ER_y = \left(MD_{project,y} - MD_{reg,y}\right) \times 21 - EL_{IMP} \times CEF_{electricity}$$

The TALGP does not have any contractual obligations to burn methane; so $MD_{reg,y}$ is calculated based on the "Adjustment Factor", a value estimated as 20% of total methane produced at the baseline that is flared due to odor and security concerns:

$$MD_{reg,y} = 0{,}2 \times \mathrm{MD}_{\mathrm{project,y}}$$

and

$$ER_y = 0{,}8 \times MD_{project,y} \times 21 - EL_{IMP} \times CEF_{electricity}$$

The sum of the quantities fed to the flare, to the power plant and to the boiler must be compared annually with the total generated. The lowest value must be adopted as $MD_{project,y}$. The following procedure applies when the total generated is the highest.

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$$

As the project won't produce electricity or replace a fossil fuel consumed in the baseline, the methane destroyed by the project activity $MD_{project,y}$ during year y is determined by monitoring only the quantity of methane actually flared:

$$MD_{project,y} = MD_{flared,y}$$

and

$$MD_{flared,y} = LFG_{flared,y} \times w_{CH_4} \times D_{CH_4} \times FE$$, where

$MD_{flared,y}$ = quantity of methane destroyed by flaring during year y (tCH_4);
$LFG_{flared,y}$ = quantity of landfill gas flared during the year (m^3_{LFG});
$w_{CH4,y}$,= methane fraction of the landfill gas (m^3CH_4/ m^3_{LFG});
D_{CH4} = methane density (tCH_4/m^3CH_4);
FE = flare efficiency (%);

The estimative of the amount of landfill gas produced during year y is shown in E.4. The data used to determine the baseline scenario is presented in Annex 3

In other words, ER_y is equal to:

$$ER_y = \left(0{,}8 \times LFG_{flared,y} \times w_{CH_4} \times D_{CH_4} \times FE \times 21\right) - EL_{IMP} \times CEF_{electricity}$$

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1. LFG_{TOTAL}	*Low*	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
2. $LFG_{flare,\,y}$	*Low*	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
5. FE	*Medium*	Regular maintenance should ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.
6. $w_{CH4,\,y}$	*Low*	Gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

There will be a team assigned to monitor emission reductions from the project. They will be responsible for collecting and archiving the pertinent data according to the monitoring plan.

D.5 Name of person/entity determining the monitoring methodology:

This monitoring study was concluded on 20/07/2006, by Econergy Brasil, which is a Project Participant. Contact information in Annex I.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The only source of GHG project emissions is the CO_2 emissions due to the import of electricity. It is calculated multiplying the grid's Emission Factor (EF) by the amount of electricity imported, in MWh, as presented on D.2.4.

As demonstrated on Annex 3, the EF for the S-SE-CO electric subsystem is equal to 0.2647 tCO_2e/MWh. Assuming that the blower is estimated to need around 3 000 MWh/year, the emission due to the import of electricity equals to 794 tCO_2e/year.

E.2. Estimated leakage:

According to ACM0001, no leakage effects need to be accounted.

Thus, $\mathbf{L_y = 0}$.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

$E.1 + E.2 = 0.2647 \times 3000 + 0 = 794$ tCO_2e/year

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

GHG emissions by sources in the baseline were estimated using IPCC's guidelines[6]. In the case of TALGP, the derivative of first order decay model approach was used:

$$Q_{T,y} = \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)} \right]}{F}$$, where:

- $Q_{T,y}$ = landfill gas produced during year T (m^3_{LFG});
- k = decay constant (1/year);
- R_y = amount of waste disposed on year y (kg);
- L_0 = methane potential generation (m^3_{CH4}/Mg_{waste});
- T = actual year;
- y = year of waste disposal;
- F = fraction of methane at the landfill gas (%)

To summarize, relevant factors for landfill gas estimation are:

• Year the site opened;
• Year the site closed;
• Amount of waste disposed at the site in a given year;
• Methane generation rate constant (k);
• Methane generation potential (L_0).

[6] Revised 1996 IPCC Guidelines for National Greenhouse Gases Inventory.

Terrestre provided waste flow data from year 2003 to 2005 together with the estimative .for 2006 through 2015. The emission reductions estimative were calculated only considering the landfill's closure year in 2023.

According with USEPA[7], a collection efficiency for energy recovery between 75% and 85% sounds reasonable "because each cubic foot of gas will have a monetary value to the owner/operator". As TALGP´s only source of income are the CERs revenues from the destruction of methane, it can be assumed that for this project, the value of the each cubic feet of gas captured will also have a monetary value to the owner of the project. Adopting the range presented above, a conservative value of 75% of collection efficiency was used to estimate the amount of emission reductions. So, $LFG_{flare,y}$ is equal to 75% of total landfill gas emitted to the atmosphere at the baseline:

In other words, the amount of Methane destroyed by the project activity is calculated as follows:

$$MD_{project,y} = 0{,}8 \times 0{,}75 \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)} \right]}{F} \times w_{CH_4} \times D_{CH_4} \times FE \times 21$$

or

$$MD_{project,y} = 0{,}6 \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)} \right]}{F} \times w_{CH_4} \times D_{CH_4} \times FE \times 21$$

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

$$ER_y = \left(0{,}6 \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)} \right]}{F} \right) \times w_{CH_4} \times D_{CH_4} \times FE \times 21 - EC_y \times EF$$

This equation has been used for estimation purposes only, as the real emission reductions will be measured at the project site following the monitoring methodology for TALGP.

Project emission reductions are estimated to be **1 644 809 tCO2e** over the first 7 years crediting period.

[7] **USEPA**; *Turning a Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook*; September 1996

E.6. Table providing values obtained when applying formulae above:

Year	Estimation of project activity emission reductions (tonnes of CO2e)	Estimation of the baseline emission reductions (tonnes of CO2e)	Estimation of leakage (tonnes of CO2e)	Estimation of emission reductions (tonnes of CO2e)
2007	794	145 069	0	144 275
2008	794	182 974	0	182 179
2009	794	215 598	0	214 804
2010	794	243 678	0	242 884
2011	794	267 847	0	267 053
2012	794	288 649	0	287 855
2013	794	306 553	0	305 759
Total (tonnes of CO_2e)	**5 559**	**1 650 368**	0	**1 644 809**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The possible environmental impacts are to be analyzed by the State Secretary of Environment (SMA – Secretaria de Estado do Meio Ambiente), through DAIA – Environment Impact Assessment Department (Departamento de Avaliação de Impacto Ambiental) and CETESB – State of São Paulo Environmental Agency (Companhia de Tecnologia de Saneamento Ambiental). Terrestre has all the pertinent licenses for CGR Piaçaguera, and will carry out the necessary process in order to obtain the working license for the flaring facility. From December-2002 to June-2004, the landfill received 2 temporary Operational Licences, until the definitive Operational Licence from 21 June 2004. The CGR Piaçaguera's Operation License is shown in Figure 9 to 13.

There will be no transboundary impacts resulting from TALGP. All the relevant impacts occur within Brazilian borders and will be mitigated to comply with the environmental requirements for project's implementation.

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LICENÇA DE OPERAÇÃO

VALIDADE ATÉ : 18/06/2009

Nº 18000614

Data 21/06/2004

de Novo Estabelecimento

IDENTIFICAÇÃO DA ENTIDADE

Nome: TERRESTRE AMBIENTAL LTDA.

CNPJ: 05.567.711/0001-66

Logradouro: RODOVIA PIAÇAGUERA-GUARUJÁ (SP-55)

Cadastro na CETESB: 633 - 01995 - 2

Número	Complemento	Bairro	CEP	Município
	KM 72	MORRO DAS NEVES	11100-000	SANTOS

CARACTERÍSTICAS DO PROJETO

Atividade Principal

Descrição: ATERRO SANITÁRIO

Código: 00.02.00-1

Bacia Hidrográfica: 51 - BAIXADA SANTISTA

UGRHI: 7 - BAIXADA SANTISTA

Corpo Receptor:

Classe:

Area (metro quadrado)

Terreno	Construída	Atividade ao Ar Livre	Novos Equipamentos	Lavra(ha)
1074563,00		1074563,00		

Horário de Funcionamento (h)			Número de Funcionários		Licença de Instalação	
Início		Término	Administração	Produção	Data	Número
07:00	às	07:00	5	20	12/09/2002	18000426

A CETESB-Companhia de Tecnologia de Saneamento Ambiental, no uso das atribuições que lhe foram conferidas pela Lei Estadual nº 997, de 31 de maio de 1976, regulamentada pelo Decreto nº 8468, de 8 de setembro de 1976, e suas alterações, concede a presente licença nas condições e termos nela constantes;

A presente licença está sendo concedida com base nas informações apresentadas pelo interessado e não dispensa nem substitui quaisquer Alvarás ou Certidões de qualquer natureza, exigidos pela legislação federal, estadual ou municipal;

A presente Licença de Operação refere-se aos locais, equipamentos ou processos produtivos relacionados em folha anexa;

Os equipamentos de controle de poluição existentes deverão ser mantidos e operados adequadamente, de modo a conservar sua eficiência;

No caso de exigência de equipamentos ou dispositivos de queima de combustível, a densidade da fumaça emitida pelos mesmos deverá estar de acordo com o disposto no artigo 31 do Regulamento da Lei Estadual nº 997, de 31 de maio de 1976, aprovado pelo Decreto nº 8468, de 8 de setembro de 1976, e suas alterações;

Alterações nas atuais atividades, processos ou equipamentos deverão ser precedidas de Licença Prévia e Licença de Instalação, nos termos dos artigos 58 e 58-A do Regulamento acima mencionado;

Caso venham a existir reclamações da população vizinha em relação a problemas de poluição ambiental causados pela firma, esta deverá tomar medidas no sentido de solucioná-los em caráter de urgência;

A renovação da licença de operação deverá ser requerida com antecedência mínima de 120 dias, contados da data da expiração de seu prazo de validade.

USO DA CETESB

SD Nº 18001305

ENTIDADE

EMITENTE

Local: Agência Ambiental de Santos

CETESB COMPANHIA DE TECNOLOGIA DE SANEAMENTO

Engº Paulo Sergio Fonseca

Gerente da Agência Ambiental de Santos

CREA nº 194585/D - Reg. nº 18.5824-0

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Figure 9. CGR Piaçaguera's Operation License (page 1 of 5)

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EXIGÊNCIAS TÉCNICAS

1. CRONOGRAMA: Deverá ser apresentado, à CETESB, cronograma físico detalhado da implantação das obras do aterro sanitário de modo a permitir o acompanhamento pela equipe técnica da CETESB.

2. PROJETO: A ESTRE deverá proceder os ajustes necessários do projeto básico de forma a adaptá-lo ao trecho da gleba de sua propriedade (arrendada da FIRPAVE), alterações estas relativas principalmente a estabilidade dos taludes, drenagem de líquidos percolados, drenagem de gases e drenagem de águas pluviais. As adaptações e eventuais modificações do projeto deverão ser submetidos à aprovação de CETESB.

3. PROJETO: Apresentar, à CETESB, previsão de vida útil do aterro sanitário.

4. IMPERMEABILIZAÇÃO DA FUNDAÇÃO E ASPECTOS HIDROGEOLÓGICOS: Efetuar uma caracterização hidrogeológica que permita um melhor conhecimento do comportamento da percolação das águas através das fraturas e áreas planas, especialmente nos contatos com os depósitos sedimentares e paredes de rocha fraturadas. A definição deste padrão de fluxo é importante para determinar a estabilidade do maciço rochoso e do lixo, bem como para estabelecer medidas que evitem a contaminação das águas subterrâneas e superficiais.

5. IMPERMEABILIZAÇÃO DA FUNDAÇÃO E ASPECTOS HIDROGEOLÓGICOS: Para a proteção da base, deve ser adotado o sistema "trifásico" formado por argila - manta de PEAD (espessura mínima de 2 mm) - argila.

6. IMPERMEABILIZAÇÃO DA FUNDAÇÃO E ASPECTOS HIDROGEOLÓGICOS: Nas fraturas das paredes da encosta deverão ser construídos drenos individuais nas zonas pouco fraturadas, com posterior aplicação de concreto projetado, seguido de mantas de PEAD, conforme evolução do aterro. Nas zonas intensamente fraturadas, onde é praticamente inviável a aplicação de drenos individuais, deverá ser construído um dreno contínuo, englobando toda a zona de fratura.

7. IMPERMEABILIZAÇÃO DA FUNDAÇÃO E ASPECTOS HIDROGEOLÓGICOS: Definir um plano de monitoramento detalhado para a área do aterro, com especial atenção para possíveis contaminações do aqüífero e infiltrações pelas fraturas e base do aterro, o que incrementaria o volume de chorume.

8. DRENAGEM DOS LÍQUIDOS PERCOLADOS: Definir se o sistema de drenagem dos líquidos percolados, interno do maciço sanitário, será implantado em todas as camadas de resíduos ou apenas nas cotas 30, 45 e 50 metros. Caso a implantação dos drenos seja proposta em todas as camadas, apresentar plantas individuais de cada uma delas.

9. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: Adotar sistema de tratamento para os líquidos percolados.

10. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: Em nenhuma hipótese será tolerado o lançamento de chorume bruto no corpo receptor.

11. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: Construir um tanque de acumulação que contenha todo o chorume gerado durante o período necessário para a entrada em regime do sistema de tratamento dos líquidos percolados e/ou quando da ocorrência de falhas ou paralisação do sistema.

12. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: Não poderá ser realizada a recirculação dos líquidos percolados, para evitar prejuízos à estabilidade do aterro sanitário.

13. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: A vazão dos líquidos percolados estimada para o futuro aterro sanitário deverá ser melhor determinada via realização de balanço hídrico para a área. Conforme o resultado, caso necessário, deverá ser reavaliado o dimensionamento do sistema de coleta e tratamento dos líquidos percolados.

14. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: O efluente tratado, lançado no corpo receptor, deverá

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Figure 10. CGR Piaçaguera's Operation License (page 2 of 5)

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atender os padrões de emissão fixados no Artigo 18 do Regulamento da Lei nº 997 de 31/05/76, aprovado pelo Decreto nº 8468/76.

15. TRATAMENTO DOS LÍQUIDOS PERCOLADOS: Optando-se pela disposição e tratamento dos liquidos percolados em sistema de tratamento de esgoto sanitário, deverá atender os padrões de emissão fixados no Artigo 19-A do Regulamento da Lei nº 997 de 31/05/76, aprovado pelo Decreto nº 8468/76, devendo ser solicitado, à CETESB, o respectivo CADRI - Certificado de Aprovação de Destinação de Resíduos.

16. DRENAGEM DE ÁGUAS SUPERFICIAIS: Detalhar as camadas do aterro contemplando o sistema de drenagem de águas superficiais provisório a ser implantado. O dimensionamento das caixas dissipadoras de energia deverá ser apresentado.

17. GEOMETRIA DO SUBATERRO: Definir a declividade da última camada de material de cobertura e apresentar planta específica de cada camada a ser implantada, representando sua geometria e sistemas de drenagem (liquidos percolados, águas pluviais e gases).

18. FECHAMENTO DO SUBATERRO: A camada de selamento deverá ter uma declividade minima de 2% (dois por cento) para garantir o bom escoamento das águas superficiais. Deverá também ser prevista a drenagem da camada de terra a ser colocada sobre a manta de PEAD, para evitar a saturação do solo superficial.

19. JAZIDAS PARA EMPRÉSTIMO DE SOLO (USO DE FOSFOGESSO): Eventual uso de fosfogesso para cobertura intermediária dos resíduos dependerá de prévia avaliação dos órgãos ambientais, inclusive CETESB.

20. DRENAGEM DE GASES: Implantar e operar adequadamente o sistema de drenagem de gases gerados no aterro sanitário, não devendo ocorrer a percepção de emissão residual de substâncias odoriferas fora dos limites da área de propriedade do aterro.

21. REINTEGRAÇÃO DA ÁREA DO ATERRO AO ESPAÇO LOCAL: Apesar da proposta ser satisfatória, recomenda-se o plantio de mudas espaçadas de 2 X 2 metros, para garantir bom adensamento, assim como a utilização de espécies pioneiras, de crescimento rápido.

22. MONITORAMENTO DO ATERRO SANITÁRIO: O Plano de Monitoramento das Águas Subterrâneas e Superficiais deverá ser implantado de acordo com a padronização adotada pela CETESB, conforme os parâmetros indicadores de contaminação das águas subterrâneas e as condições que seguem abaixo:

PARÂMETROS INDICADORES DE CONTAMINAÇÃO DAS ÁGUAS SUBTERRÂNEAS

A análise das águas com a listagem completa deve ser efetuada na primeira amostragem e repetida anualmente. A análise das águas com a listagem mínima será realizada trimestralmente a partir da segunda amostragem, e se repetirá, por três vezes, até ser complementado o ciclo de um ano, ocasião em que serão analisados os parâmetros da listagem completa.

Esse procedimento se repetirá pelo tempo necessário, a ser estipulado pela CETESB.

Os resultados obtidos serão submetidos à apreciação da CETESB que, a seu critério, poderá alterar a periodicidade e os parâmetros das análises.

LISTAGEM COMPLETA:

CARACTERÍSTICAS FISICAS E ORGANOLÉPTICAS
1. Condutividade elétrica,
2. Sólidos totais dissolvidos,
3. Dureza total,
4. pH,

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Figure 11. CGR Piaçaguera's Operation License (page 3 of 5)

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5. Óleos e graxas,
6. Cor aparente,
7. Turbidez.

COMPONENTES INORGÂNICOS
1. Alumínio,
2. Bário,
3. Cádmio,
4. Cobre,
5. Chumbo,
6. Cloretos,
7. Cromo total,
8. Ferro total,
9. Fosfato total,
10. Magnésio,
11. Manganês total,
12. Mercúrio,
13. Nitrogênio nitrito,
14. Nitrogênio nitrato,
15. Nitrogênio kjeldahl,
16. Potássio,
17. Selênio,
18. Sódio,
19. Zinco.

COMPONENTES ORGÂNICOS
1. BTX,
2. Fenol,
3. Tricloroetileno,
4. Diclorometano
5. Cloreto de metileno,
6. Cloreto de vinila

BACTERIOLÓGICOS
1. Coliformes totais,
2. Coliformes fecais,
3. Pseudomonas aeruginosas,
4. Salmonella.

LISTAGEM MÍNIMA:

1. Condutividade elétrica,
2. Sólidos totais dissolvidos,
3. pH,
4. Óleos e graxas,
5. Cloreto,
6. Alumínio,
7. Cromo total,
8. Chumbo,
9. Mercúrio,
10. Cádmio,
11. Ferro,
12. Manganês,
13. BTX,

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Figure 12. CGR Piaçaguera's Operation License (page 4 of 5)

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14. Diclorometano,
15. Tricloroetileno,
16. Cloreto de vinila,
17. Coliformes totais,
18. Coliformes fecais.

23. MONITORAMENTO DO ATERRO SANITÁRIO: Os parâmetros a serem analisados para as amostras de Águas Superficiais, a serem coletadas em pontos situados à montante e à jusante da área do aterro, nos corpos de água superficiais próximos e nas caixas de drenagem de águas de nascentes limpas, são os mesmos estabelecidos para as águas subterrâneas acrescidos de OD e DBO.

24. MONITORAMENTO DO ATERRO SANITÁRIO: Apresentar Plano de Monitoramento do aterro após o seu encerramento, com duração mínima de 10 (dez) anos, sendo que os proprietários do aterro sanitário permanecerão como responsáveis, mesmo transcorrido esse período, por todos os eventos que advenham desse tipo de empreendimento.

25. MONITORAMENTO DO ATERRO SANITÁRIO: Apresentar relatórios anuais do plano de monitoramento do aterro, contemplando quantidade, descrição e local de disposição dos resíduos, bem como os dados resultantes do monitoramento geotécnico e de águas subterrâneas do aterro.

OBSERVAÇÕES:

1. A presente Licença de Operação é válida para o aterro sanitário CGR-Piaçaguera, localizado no Sítio Santa Rita ou Santa Cruz, Bairro Morro das Neves, Rodovia Cônego Domênico Rangoni (SP-55), km 72, Santos, São Paulo, para a disposição de resíduos sólidos domiciliares e industriais Classe II-A "Resíduos Não Perigosos - Não Inertes", conforme Norma Brasileira ABNT - 10.004 - Resíduos Sólidos - Classificação.

2. Esta Licença foi reemitida em 11/05/2005, conforme Solicitação de Alteração de Documentos.

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Figure 13. CGR Piaçaguera's Operation License (page 5 of 5)

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The CGR Piaçaguera is one of the few landfills that has an Environmental Licence from CETESB, showing Terrestre Ambiental is totally committed to environmental integrity in its practices.

There are no significant environmental impacts in TALGP. The necessary infra-structure to flare the gas and produce energy will not likely cause any significant impacts in the site.

Flaring gas, nevertheless, may cause gaseous emissions, such as volatile organic compounds and dioxins that have to be controlled. During the environmental licensing procedures, all the necessary measures will be taken to mitigate such impacts, as requested for issuance of the working licence by the environmental agency.

SECTION G. Stakeholders' comments

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

As required by the Interministerial Comission on Global Climate Change (CIMGC), the Brazilian DNA - Designated National Authority, invitations must be sent for comments to local stakeholders as part of the procedures for analyzing CDM projects and issuing letters of approval. This procedure was followed by Terrestre to take its GHG mitigation initiative to the public. Letters and the Executive Summary of the project were sent to the following recipients:

- Prefeitura Municipal de Santos – SP / *Municipal Administration of Santos – SP;*
- Secretaria Municipal do Meio Ambiente / *Municipal Secretariat of Environment;*
- Câmara dos Vereadores de Santos - SP / *Municipal Legislation Chamber;*
- Secretaria Estadual do Meio Ambiente / *Environmental Secretariat of São Paulo State;*
- CETESB / *State of São Paulo Environmental Agency;*
- Rotary Club de Santos;
- Ministério Público do Estado de São Paulo / *Public Ministry of São Paulo State;*
- Fórum Brasileiro de ONGs (FBOMS) / *Brazilian NGO Forum.*

G.2. Summary of the comments received:

A comment from *Fórum Brasileiro de ONGs* was received. According with the comment, the entity expresses gratitude for the correspondence dispatched by Terrestre. FBOMS also recognizes their role, as one of several institutions listed in the "Resolução n° 1", created by CIMGC,,that must invited for comments. They highlight their support in transparency mechanisms of analysis process and approval of CDM projects. They mention the importance of consulting local stakeholders for comments in order to improve of sustainability and the quality of projects collaborating with the implementation of international climate exchange regime. Furthermore, FBOMS affirms it is waiting for a Brazilian Federal Government manifestation, by means of CIMGC, about how the comments and analysis made by FBOMS integrants for CDM projects are considered into the final decision. Therefore, it emphasizes its interest in technical information evaluation, but a lack of a more detailed analysis of the project does not mean their approval of the same.

It also suggest the application of sustainability criteria in order to evaluate the project's real impact on sustainable development.

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

Terrestre appreciated the comments from FBOMS..A letter was sent from Terrestre expressing its gratitude for the considerations about the TALGP and availability of providing any necessary additional information. Terrestre informed that they might study the adoption of a sustainability criteria certification, but recognizes that the CDM verification procedures already include the assessment of such criteria.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant -1:

Organization:	TERRESTRE AMBIENTAL LTDA.
Street/P.O.Box:	Avenida Presidente Juscelino Kubitschek, 7830 Torre IV, 4º andar
Building:	-
City:	São Paulo
State/Region:	São Paulo
Postfix/ZIP:	04543-9000
Country:	BRAZIL
Telephone:	55-11-3706.8877
FAX:	55-11-3078.3355
E-Mail:	estre@estre.com.br
URL:	www.estre.com.br
Represented by:	Alex Schlosser
Title:	
Salutation:	Mr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex 1 involved in TALGP.
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Annex 3

BASELINE INFORMATION

Table 1. Baseline determination information

DATA	VALUE	UNIT	SOURCE
L_0 (methane potential generation)	0.07	m^3_{CH4}/kg_{waste}	USEPA[8]
k (decay constant)	0.15	1/year	
Year of opening	2003		Terrestre
Year of closure	2023		
R_x	Variable	t_{waste}	
EAF (Emission Adjustment Factor)	20	%	ACM0001

[8] USEPA – United States Environmental Agency; *Turning a Liability into an Asset: a Landfill Gas-to-Energy Project Development Handbook*; LMOP – Landfill Methane Outreach Program, 1996

USEPA (1996) suggests values of *k* and L_0 to be applied to the model. Because of the uncertainty in estimating L_0, gas flow estimates derived from the model should also be bracketed by a range of plus or minus 50 percent. To make a conservativeness approach, L_0 was assumed to be minus 50% of the lowest value of the range (2.25-2.88 ft^3/lb). Converting the units to m^3_{CH4}/kg_{waste}, the value assumed for L_0 is *0.07*.

As the Baixada Santista Region is located in the coast of the State of São Paulo, between the sea and the Serra do Mar, the region has intensive rains, during the whole year. So, the value of k was estimated as 0.15/year, an average of the suggested value.

The data of annual waste disposal was estimated by Terrestre, from 2007 to the year of closure.

Project Emissions due to electricity purchased were estimated through approved methodology ACM0002 “Consolidated methodology for grid-connected electricity generation from renewable sources” Version 6.

ACM0002 considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, there are two main grids, South-Southeast-Midwest and North-Northeast, therefore the South-Southeast-Midwest Grid is the relevant one for this project.

The method that will be chosen to calculate the Operating Margin (OM) for the electricity baseline emission factor is the option (b) *Simple Adjusted OM*, since the preferable choice (c) *Dispatch Data Analysis OM* would face the barrier of data availability in Brazil.

In order to calculate the Operating Margin, daily dispatch data from the Brazilian electricity system manager (ONS) needed to be gathered. ONS does not regularly provide such information, which implied in getting it through communicating directly with the entity.

The provided information covers years 2002, 2003 and 2004, and is the most recent information available at this stage (At the end of 2005 ONS supplied raw dispatch data for the whole interconnected grid in the form of daily reports[9] from Jan. 1, 2002 to Dec. 31, 2004, the most recent information available at this stage).

Simple Adjusted Operating Margin Emission Factor Calculation

According to the methodology, the project is to determine the Simple Adjusted OM Emission Factor ($EF_{OM,\ simple\ adjusted,\ y}$). Therefore, the following equation is to be solved:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}} \quad (tCO_2e/GWh)$$

[9] *Acompanhamento Diário da Operação do Sistema Iterligado Nacional*. ONS-CNOS, Centro Nacional de Operação do Sistema. Daily reports on the whole interconnected electricity system from Jan. 1, 2002 to Dec. 31, 2004.

It is assumed here that all the low-cost/must-run plants produce zero net emissions.

$$\frac{\sum_{i,k} F_{i,k,y} . COEF_{i,k}}{\sum_{k} GEN_{k,y}} = 0 \text{ (tCO}_2\text{e/GWh)}$$

Please refer to the methodology text or the explanations on the variables mentioned above.

The ONS data as well as the spreadsheet data with the calculation of emission factors have been provided to the validator (DOE). In the spreadsheet, the dispatch data is treated as to allow calculation of the emission factor for the most three recent years with available information, which are 2002, 2003 and 2004.

The Lambda factors were calculated in accordance with methodology requests. The table below presents such factors.

Year	Lambda
2002	0.5053
2003	0.5312
2004	0.5041

Electricity generation for each year needs also to be taken into account. This information is provided in the table below.

Year	Electricity Load (MWh)
2002	275 402 896
2003	288 493 929
2004	297 879 874

Using therefore appropriate information for $F_{i,j,y}$ and $COEF_{i,j}$, OM emission factors for each year can be determined, as follows.

$$EF_{OM,simple\_adjusted,2002} = (1-\lambda_{2002}) \frac{\sum_{i,j} F_{i,j,2002} . COEF_{i,j}}{\sum_{j} GEN_{j,2002}} \therefore EF_{OM,simple\_adjusted,2002} = 0.4229 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2003} = (1-\lambda_{2003}) \frac{\sum_{i,j} F_{i,j,2003} . COEF_{i,j}}{\sum_{j} GEN_{j,2003}} \therefore EF_{OM,simple\_adjusted,2003} = 0.4417 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2004} = (1-\lambda_{2004}) \frac{\sum_{i,j} F_{i,j,2004} . COEF_{i,j}}{\sum_{j} GEN_{j,2004}} \therefore EF_{OM,simple\_adjusted,2004} = 0.4346 \text{ tCO}_2\text{/MWh}$$

Finally, to determine the baseline *ex-ante*, the full generation weighted-average among the three years is calculated, finally determining the $EF_{OM,simple\_adjusted}$.

$$EF_{OM,simple\_adjusted\,2002\_2004} = \frac{EF_{OM,simple\_adjusted,2002} * \sum_{j} GEN_{j,2002} + EF_{OM,simple\_adjusted,2003} * \sum_{j} GEN_{j,2003} + EF_{OM,simple\_adjusted,2004} * \sum_{j} GEN_{j,2004}}{\sum_{j} GEN_{j,2002} + \sum_{j} GEN_{j,2003} \sum_{j} GEN_{j,2004}} = 0.4332$$

According to the methodology used, a Build Margin emission factor also needs to be determined.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Electricity generation in this case means 20% of total generation in the most recent year (2004), as the 5 most recent plants built generate less than such 20%. If 20% falls on part capacity of a plant, that plant is fully included in the calculation. Calculating such factor one reaches:

$$EF_{BM,2004} = 0{,}0962 \text{ tCO}_2\text{/MWh}$$

Finally, the electricity baseline emission factor is calculated through a weighted-average formula, considering both the OM and the BM, being the weights 50% and 50% by default. That gives:

$$EF_{electricity,2002-2004} = 0{,}5 * 0{,}4332 + 0{,}5 * 0{,}0962 = 0{,}2647 \text{ tCO}_2\text{/MWh}$$

It is important to note that adequate considerations on the above weights are currently under study by the Meth Panel, and there is a possibility that such weighing changes in the methodology here applied.

The baseline emissions would then be proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{electricity,2002-2004}$) with the electricity generation of the project activity.

$BE_{electricity,y} = EF_{electricity,2002-2004} . EC_{y.}$

Therefore, for the first crediting period, the baseline emissions will be calculated as follows:

$BE_{electricity,y}$ = 0.2647 tCO_2/MWh . EC_y (in tCO_2e)

The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.

The natural evolution of both systems continues to demonstrate that integration will happen in the future. In 1998, the Brazilian government announced the first leg of the interconnection line between S-SE-CO and N-NE. With investments of around US$700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S-SE-CO region could supply the N-NE in case it was necessary and vice-versa.

Nevertheless, even after the interconnection was established, technical papers continue to divide the Brazilian system in três (Bosi, 2000)[10]:

"… where the Brazilian Electricity System is divided into three separate subsystems:

(i) The South/Southeast/Midwest Interconnected System;
(ii) The North/Northeast Interconnected System; and
(iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

Moreover, Bosi (2000) gives a strong argumentation in favor of having so-called *multi-project baselines*:

> *"For large countries with different circumstances within their borders and different power grids based in these different regions, multi-project baselines in the electricity sector may need to be disaggregated below the country-level in order to provide a credible representation of 'what would have happened otherwise."*

Finally, one has to take into account that even though the systems today are connected, the energy flow between N-NE and S-SE-CO is heavily limited by the transmission lines capacity. Therefore, only a fraction of the total energy generated in both subsystems is sent one way or another. It is natural that this fraction may change its direction and magnitude (up to the transmission line's capacity) depending on the hydrological patterns, climate and other uncontrolled factors. But it is not supposed to represent a significant amount of each subsystem's electricity demand.

The Brazilian electricity system nowadays comprises of around 101.3 GW of installed capacity, in a total of 1 482 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 4.5% are diesel and fuel oil plants, 3.2% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1.4% are coal plants, and there are also 8.17 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid[11]. This latter capacity is in fact comprised by mainly 5.65 GW of the Paraguayan part of *Itaipu Bi-national*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

The approved methodology ACM0002 asks project proponents to account for "all generating sources serving the system". In that way, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

However, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – National System Operator – argues that dispatching information is strategic to the power agents and therefore cannot be made available. On the other hand, ANEEL, the electricity agency, provides information on power capacity and other legal matters on the electricity sector, but no dispatch information can be got through this entity.

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was specifically contacted and the reason for data collection was explained. After

[10] Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study.* International Energy Agency. Paris, 2000.
[11] www.aneel.gov.br

several months of talks, plants' daily dispatch information was made available for years 2002, 2003 and 2004 by ONS.

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75 547 MW of installed capacity by 31/12/2004, out of the total 98 848.5 MW installed in Brazil by the same date[12], which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Such capacity in fact is constituted by plants with 30 MW installed capacity or above, connected to the system through 138 kV power lines, or at higher voltages. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study "Road-Testing Baselines for Greenhouse Gas Mitigation Projects in the Electric Power Sector", published in October 2002. Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only, as the table below shows the build margin in both cases.

IEA/ONS Merged Data Build Margin (tCO_2/MWh)	**ONS Data Build Margin (tCO_2/MWh)**
0.205	0.0962

Therefore, considering all the rationale explained, the project developers selected to use ONS information only, as it was capable of properly addressing the issue of determining the emission factor and doing it in the most conservative way.

The fossil fueled plants efficiencies were also taken from the IEA paper. This was done considering the lack of more detailed information on such efficiencies from public, reliable and credible sources.

From the mentioned reference:

> *"The fossil fuel conversion efficiency (%) for the thermal power plants was calculated based on the installed capacity of each plant and the electricity actually produced. For most of the fossil fuel power plants under construction, a constant value of 30% was used as an estimate for their fossil fuel conversion efficiencies. This assumption was based on data available in the literature and based on the observation of the actual situation of those kinds of plants currently in operation in*

[12] www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf

Brazil. The only 2 natural gas plants in combined cycle (totaling 648 MW) were assumed to have a higher efficiency rate, i.e. 45%."

Therefore only data for plants under construction in 2002 (with operation start in 2002, 2003 and 2004) was estimated. All others efficiencies were calculated. To the best of our knowledge there was no retrofit/modernization of the older fossil-fuelled power plants in the analyzed period (2002 to 2004). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

The aggregated hourly dispatch data received from ONS was used to determine the lambda factor for each of the years with available data (2002, 2003 and 2004). The Low-cost/Must-run generation was determined as the total generation minus the generation from fossil-fuelled thermal plants generation, this one determined through daily dispatch data provided by ONS. All this information has been provided to the validators, and extensively discussed with them, in order to make all points crystal clear.

On the following pages, a summary of the analysis is provided. First, the Tables 2 and 3 with the 126 plants dispatched by ONS are provided. Then, the Table 4 presents the summarized conclusions of the analysis of the emission factor calculation and Figures 14 to 16 present the load duration curves for the S-SE-CO subsystem.

Table 2. ONS Dispatched Plants -1/2

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
1	S-SE-CO	G	Termo Rio	Nov-2004	423,3	0,30	15,3	99,5%	0,670
2	S-SE-CO	H	Candonga	Sep-2004	140,0	1,00	0,0	0,0%	0,000
3	S-SE-CO	H	Queimado	May-2004	105,0	1,00	0,0	0,0%	0,000
4	S-SE-CO	G	Norte Fluminense	Feb-2004	860,2	0,30	15,3	99,5%	0,670
5	S-SE-CO	H	Jauru	Sep-2003	121,5	1,00	0,0	0,0%	0,000
6	S-SE-CO	H	Gauporé	Sep-2003	120,0	1,00	0,0	0,0%	0,000
7	S-SE-CO	G	Três Lagoas	Aug-2003	306,0	0,30	15,3	99,5%	0,670
8	S-SE-CO	H	Funil (MG)	Jan-2003	180,0	1,00	0,0	0,0%	0,000
9	S-SE-CO	H	Itiquira I	Sep-2002	156,1	1,00	0,0	0,0%	0,000
10	S-SE-CO	G	Araucária	Sep-2002	484,5	0,30	15,3	99,5%	0,670
11	S-SE-CO	G	Canoas	Sep-2002	160,6	0,30	15,3	99,5%	0,670
12	S-SE-CO	H	Piraju	Sep-2002	81,0	1,00	0,0	0,0%	0,000
13	S-SE-CO	G	Nova Piratininga	Jun-2002	384,9	0,30	15,3	99,5%	0,670
14	S-SE-CO	O	PCT CGTEE	Jun-2002	5,0	0,30	20,7	99,0%	0,902
15	S-SE-CO	H	Rosal	Jun-2002	55,0	1,00	0,0	0,0%	0,000
16	S-SE-CO	G	Ibirité	May-2002	226,0	0,30	15,3	99,5%	0,670
17	S-SE-CO	H	Cana Brava	May-2002	465,9	1,00	0,0	0,0%	0,000
18	S-SE-CO	H	Sta. Clara	Jan-2002	60,0	1,00	0,0	0,0%	0,000
19	S-SE-CO	H	Machadinho	Jan-2002	1.140,0	1,00	0,0	0,0%	0,000
20	S-SE-CO	G	Juiz de Fora	Nov-2001	87,0	0,28	15,3	99,5%	0,718
21	S-SE-CO	G	Macaé Merchant	Nov-2001	922,6	0,24	15,3	99,5%	0,837
22	S-SE-CO	H	Lajeado (ANEEL res. 402/2001)	Nov-2001	902,5	1,00	0,0	0,0%	0,000
23	S-SE-CO	G	Eletrobolt	Oct-2001	379,0	0,24	15,3	99,5%	0,837
24	S-SE-CO	H	Porto Estrela	Sep-2001	112,0	1,00	0,0	0,0%	0,000
25	S-SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	529,2	0,30	15,3	99,5%	0,670
26	S-SE-CO	G	W. Arjona	Jan-2001	194,0	0,25	15,3	99,5%	0,804
27	S-SE-CO	G	Uruguaiana	Jan-2000	639,9	0,45	15,3	99,5%	0,447
28	S-SE-CO	H	S. Caxias	Jan-1999	1.240,0	1,00	0,0	0,0%	0,000
29	S-SE-CO	H	Canoas I	Jan-1999	82,5	1,00	0,0	0,0%	0,000
30	S-SE-CO	H	Canoas II	Jan-1999	72,0	1,00	0,0	0,0%	0,000
31	S-SE-CO	H	Igarapava	Jan-1999	210,0	1,00	0,0	0,0%	0,000
32	S-SE-CO	H	Porto Primavera	Jan-1999	1.540,0	1,00	0,0	0,0%	0,000
33	S-SE-CO	D	Cuiaba (Mario Covas)	Oct-1998	529,2	0,27	20,2	99,0%	0,978
34	S-SE-CO	H	Sobragi	Sep-1998	60,0	1,00	0,0	0,0%	0,000
35	S-SE-CO	H	PCH EMAE	Jan-1998	26,0	1,00	0,0	0,0%	0,000
36	S-SE-CO	H	PCH CEEE	Jan-1998	25,0	1,00	0,0	0,0%	0,000
37	S-SE-CO	H	PCH ENERSUL	Jan-1998	43,0	1,00	0,0	0,0%	0,000
38	S-SE-CO	H	PCH CEB	Jan-1998	15,0	1,00	0,0	0,0%	0,000
39	S-SE-CO	H	PCH ESCELSA	Jan-1998	62,0	1,00	0,0	0,0%	0,000
40	S-SE-CO	H	PCH CELESC	Jan-1998	50,0	1,00	0,0	0,0%	0,000
41	S-SE-CO	H	PCH CEMAT	Jan-1998	145,0	1,00	0,0	0,0%	0,000
42	S-SE-CO	H	PCH CELG	Jan-1998	15,0	1,00	0,0	0,0%	0,000
43	S-SE-CO	H	PCH CERJ	Jan-1998	59,0	1,00	0,0	0,0%	0,000
44	S-SE-CO	H	PCH COPEL	Jan-1998	70,0	1,00	0,0	0,0%	0,000
45	S-SE-CO	H	PCH CEMIG	Jan-1998	84,0	1,00	0,0	0,0%	0,000
46	S-SE-CO	H	PCH CPFL	Jan-1998	55,0	1,00	0,0	0,0%	0,000
47	S-SE-CO	H	S. Mesa	Jan-1998	1.275,0	1,00	0,0	0,0%	0,000
48	S-SE-CO	H	PCH EPAULO	Jan-1998	26,0	1,00	0,0	0,0%	0,000
49	S-SE-CO	H	Guilmam Amorim	Jan-1997	140,0	1,00	0,0	0,0%	0,000
50	S-SE-CO	H	Corumbá	Jan-1997	375,0	1,00	0,0	0,0%	0,000
51	S-SE-CO	H	Miranda	Jan-1997	408,0	1,00	0,0	0,0%	0,000
52	S-SE-CO	H	Noav Ponte	Jan-1994	510,0	1,00	0,0	0,0%	0,000
53	S-SE-CO	H	Segredo (Gov. Ney Braga)	Jan-1992	1.260,0	1,00	0,0	0,0%	0,000
54	S-SE-CO	H	Taquaruçu	Jan-1989	554,0	1,00	0,0	0,0%	0,000
55	S-SE-CO	H	Manso	Jan-1988	210,0	1,00	0,0	0,0%	0,000
56	S-SE-CO	H	D. Francisca	Jan-1987	125,0	1,00	0,0	0,0%	0,000
57	S-SE-CO	H	Itá	Jan-1987	1.450,0	1,00	0,0	0,0%	0,000
58	S-SE-CO	H	Rosana	Jan-1987	369,2	1,00	0,0	0,0%	0,000
59	S-SE-CO	N	Angra	Jan-1985	1.874,0	1,00	0,0	0,0%	0,000
60	S-SE-CO	H	T. Irmãos	Jan-1985	807,5	1,00	0,0	0,0%	0,000
61	S-SE-CO	H	Itaipu 60 Hz	Jan-1983	6.300,0	1,00	0,0	0,0%	0,000
62	S-SE-CO	H	Itaipu 50 Hz	Jan-1983	5.375,0	1,00	0,0	0,0%	0,000
63	S-SE-CO	H	Emborcação	Jan-1982	1.192,0	1,00	0,0	0,0%	0,000
64	S-SE-CO	H	Nova Avanhandava	Jan-1982	347,4	1,00	0,0	0,0%	0,000
65	S-SE-CO	H	Gov. Bento Munhoz - GBM	Jan-1980	1.676,0	1,00	0,0	0,0%	0,000

* Subsystem: S - south, SE-CO - Southeast-Midwest

** Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

[1] Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004).

[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. *Road testing baselines for GHG mitigation projects in the electric power sector.* OECD/IEA information paper, October 2002.

[3] Intergovernamental Panel on Climate Change. *Revised 1996 Guidelines for National Greenhouse Gas Inventories.*

[4] Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. *Acompanhamento Diário da Operação do SIN* (daily reports from Jan. 1, 2001 to Dec. 31, 2003).

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. *Resumo Geral dos Novos Empreendimentos de Geração* (http://www.aneel.gov.br/, data collected in november 2004).

Table 3. ONS Dispatched Plants -2/2

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
66	S-SE-CO	H	S.Santiago	Jan-1980	1.420,0	1,00	0,0	0,0%	0,000
67	S-SE-CO	H	Itumbiara	Jan-1980	2.280,0	1,00	0,0	0,0%	0,000
68	S-SE-CO	O	Igarapé	Jan-1978	131,0	0,30	20,7	99,0%	0,902
69	S-SE-CO	H	Itauba	Jan-1978	512,4	1,00	0,0	0,0%	0,000
70	S-SE-CO	H	A. Vermelha (Jose E. Moraes)	Jan-1978	1.396,2	1,00	0,0	0,0%	0,000
71	S-SE-CO	H	S.Simão	Jan-1978	1.710,0	1,00	0,0	0,0%	0,000
72	S-SE-CO	H	Capivara	Jan-1977	640,0	1,00	0,0	0,0%	0,000
73	S-SE-CO	H	S.Osório	Jan-1975	1.078,0	1,00	0,0	0,0%	0,000
74	S-SE-CO	H	Marimbondo	Jan-1975	1.440,0	1,00	0,0	0,0%	0,000
75	S-SE-CO	H	Promissão	Jan-1975	264,0	1,00	0,0	0,0%	0,000
76	S-SE-CO	C	Pres. Medici	Jan-1974	446,0	0,26	26,0	98,0%	1,294
77	S-SE-CO	H	Volta Grande	Jan-1974	380,0	1,00	0,0	0,0%	0,000
78	S-SE-CO	H	Porto Colombia	Jun-1973	320,0	1,00	0,0	0,0%	0,000
79	S-SE-CO	H	Passo Fundo	Jan-1973	220,0	1,00	0,0	0,0%	0,000
80	S-SE-CO	H	Passo Real	Jan-1973	158,0	1,00	0,0	0,0%	0,000
81	S-SE-CO	H	Ilha Solteira	Jan-1973	3.444,0	1,00	0,0	0,0%	0,000
82	S-SE-CO	H	Mascarenhas	Jan-1973	131,0	1,00	0,0	0,0%	0,000
83	S-SE-CO	H	Gov. Parigot de Souza - GPS	Jan-1971	252,0	1,00	0,0	0,0%	0,000
84	S-SE-CO	H	Chavantes	Jan-1971	414,0	1,00	0,0	0,0%	0,000
85	S-SE-CO	H	Jaguara	Jan-1971	424,0	1,00	0,0	0,0%	0,000
86	S-SE-CO	H	Sá Carvalho	Apr-1970	78,0	1,00	0,0	0,0%	0,000
87	S-SE-CO	H	Estreito (Luiz Carlos Barreto)	Jan-1969	1.050,0	1,00	0,0	0,0%	0,000
88	S-SE-CO	H	Ibitinga	Jan-1969	131,5	1,00	0,0	0,0%	0,000
89	S-SE-CO	H	Jupiá	Jan-1969	1.551,2	1,00	0,0	0,0%	0,000
90	S-SE-CO	O	Alegrete	Jan-1968	66,0	0,26	20,7	99,0%	1,040
91	S-SE-CO	G	Campos (Roberto Silveira)	Jan-1968	30,0	0,24	15,3	99,5%	0,837
92	S-SE-CO	G	Santa Cruz (RJ)	Jan-1968	766,0	0,31	15,3	99,5%	0,648
93	S-SE-CO	H	Paraibuna	Jan-1968	85,0	1,00	0,0	0,0%	0,000
94	S-SE-CO	H	Limoeiro (Armando Salles de Olivie	Jan-1967	32,0	1,00	0,0	0,0%	0,000
95	S-SE-CO	H	Caconde	Jan-1966	80,4	1,00	0,0	0,0%	0,000
96	S-SE-CO	C	J.Lacerda C	Jan-1965	363,0	0,25	26,0	98,0%	1,345
97	S-SE-CO	C	J.Lacerda B	Jan-1965	262,0	0,21	26,0	98,0%	1,602
98	S-SE-CO	C	J.Lacerda A	Jan-1965	232,0	0,18	26,0	98,0%	1,869
99	S-SE-CO	H	Bariri (Alvaro de Souza Lima)	Jan-1965	143,1	1,00	0,0	0,0%	0,000
100	S-SE-CO	H	Funil (RJ)	Jan-1965	216,0	1,00	0,0	0,0%	0,000
101	S-SE-CO	C	Figueira	Jan-1963	20,0	0,30	26,0	98,0%	1,121
102	S-SE-CO	H	Furnas	Jan-1963	1.216,0	1,00	0,0	0,0%	0,000
103	S-SE-CO	H	Barra Bonita	Jan-1963	140,8	1,00	0,0	0,0%	0,000
104	S-SE-CO	C	Charqueadas	Jan-1962	72,0	0,23	26,0	98,0%	1,462
105	S-SE-CO	H	Jurumirim (Armando A. Laydner)	Jan-1962	97,7	1,00	0,0	0,0%	0,000
106	S-SE-CO	H	Jacui	Jan-1962	180,0	1,00	0,0	0,0%	0,000
107	S-SE-CO	H	Pereira Passos	Jan-1962	99,1	1,00	0,0	0,0%	0,000
108	S-SE-CO	H	Tres Marias	Jan-1962	396,0	1,00	0,0	0,0%	0,000
109	S-SE-CO	H	Euclides da Cunha	Jan-1960	108,8	1,00	0,0	0,0%	0,000
110	S-SE-CO	H	Camargos	Jan-1960	46,0	1,00	0,0	0,0%	0,000
111	S-SE-CO	H	Santa Branca	Jan-1960	56,1	1,00	0,0	0,0%	0,000
112	S-SE-CO	H	Cachoeira Dourada	Jan-1959	658,0	1,00	0,0	0,0%	0,000
113	S-SE-CO	H	Salto Grande (Lucas N. Garcez)	Jan-1958	70,0	1,00	0,0	0,0%	0,000
114	S-SE-CO	H	Salto Grande (MG)	Jan-1956	102,0	1,00	0,0	0,0%	0,000
115	S-SE-CO	H	Mascarenhas de Moraes (Peixoto)	Jan-1956	478,0	1,00	0,0	0,0%	0,000
116	S-SE-CO	H	Itutinga	Jan-1955	52,0	1,00	0,0	0,0%	0,000
117	S-SE-CO	C	S. Jerônimo	Jan-1954	20,0	0,26	26,0	98,0%	1,294
118	S-SE-CO	O	Carioba	Jan-1954	36,2	0,30	20,7	99,0%	0,902
119	S-SE-CO	O	Piratininga	Jan-1954	472,0	0,30	20,7	99,0%	0,902
120	S-SE-CO	H	Canastra	Jan-1953	42,5	1,00	0,0	0,0%	0,000
121	S-SE-CO	H	Nilo Peçanha	Jan-1953	378,4	1,00	0,0	0,0%	0,000
122	S-SE-CO	H	Fontes Nova	Jan-1940	130,3	1,00	0,0	0,0%	0,000
123	S-SE-CO	H	Henry Borden Sub.	Jan-1926	420,0	1,00	0,0	0,0%	0,000
124	S-SE-CO	H	Henry Borden Ext.	Jan-1926	469,0	1,00	0,0	0,0%	0,000
125	S-SE-CO	H	I. Pombos	Jan-1924	189,7	1,00	0,0	0,0%	0,000
126	S-SE-CO	H	Jaguari	Jan-1917	11,8	1,00	0,0	0,0%	0,000
				Total (MW) =	**66.007,1**				

* Subsystem: S - south, SE-CO - Southeast-Midwest

** Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

[1] Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004).

[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. *Road testing baselines for GHG mitigation projects in the electric power sector.* OECD/IEA information paper, October 2002.

[3] Intergovernamental Panel on Climate Change. *Revised 1996 Guidelines for National Greenhouse Gas Inventories.*

[4] Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. *Acompanhamento Diário da Operação do SIN* (daily reports from Jan. 1, 2001 to Dec. 31, 2003).

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. *Resumo Geral dos Novos Empreendimentos de Geração* (http://www.aneel.gov.br/, data collected in november 2004).

Table 4: Summary of the emission factor calculation

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [GWh]	Imports [MWh]
2002	0,8548	275.402.896	258.720	1.607.395
2003	0,9421	288.493.929	274.649	459.586
2004	0,8763	297.879.874	284.748	1.468.275
	Total (2002-2004) =	861.776.699	818.118	3.535.256
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2004}$	Lambda	
	0,4332	0,0962	λ_{2002}	
	Alternative weights	Default weights	0,5053	
	w_{OM} = 0,75	w_{OM} = 0,5	λ_{2003}	
	w_{BM} = 0,25	w_{BM} = 0,5	0,5312	
	Alternative EF_{CM} [tCO2/MWh]	Default EF_{OM} [tCO2/MWh]	λ_{2004}	
	0,3490	0,2647	0,5041	

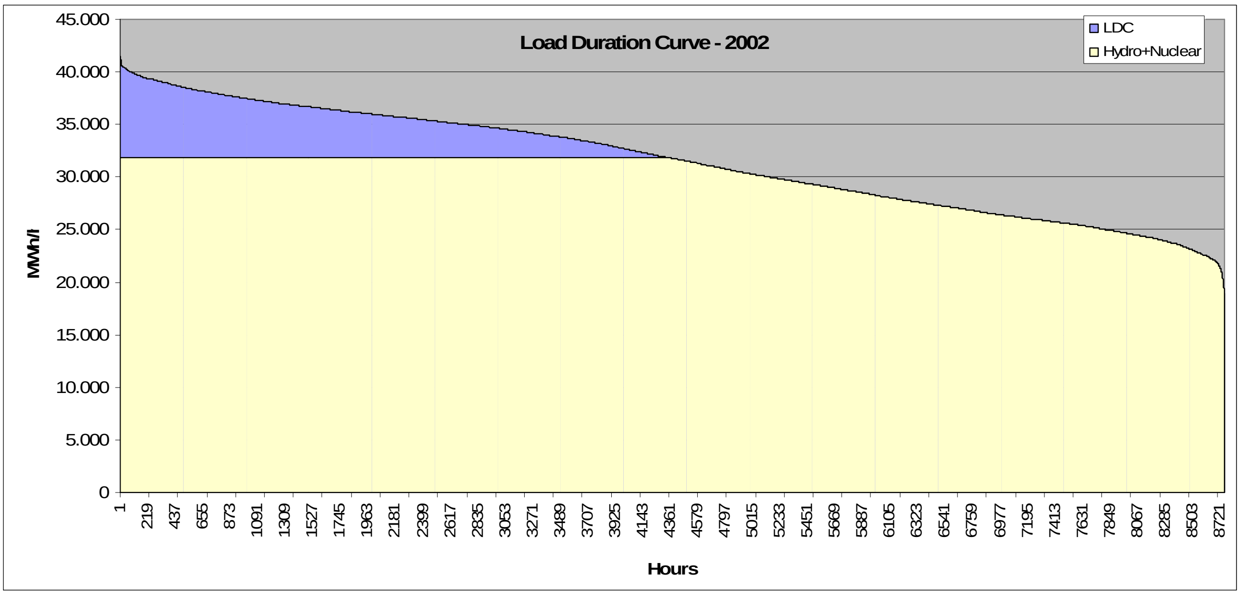

Figure 14. Load duration curve for the S-SE-MW system, 2002

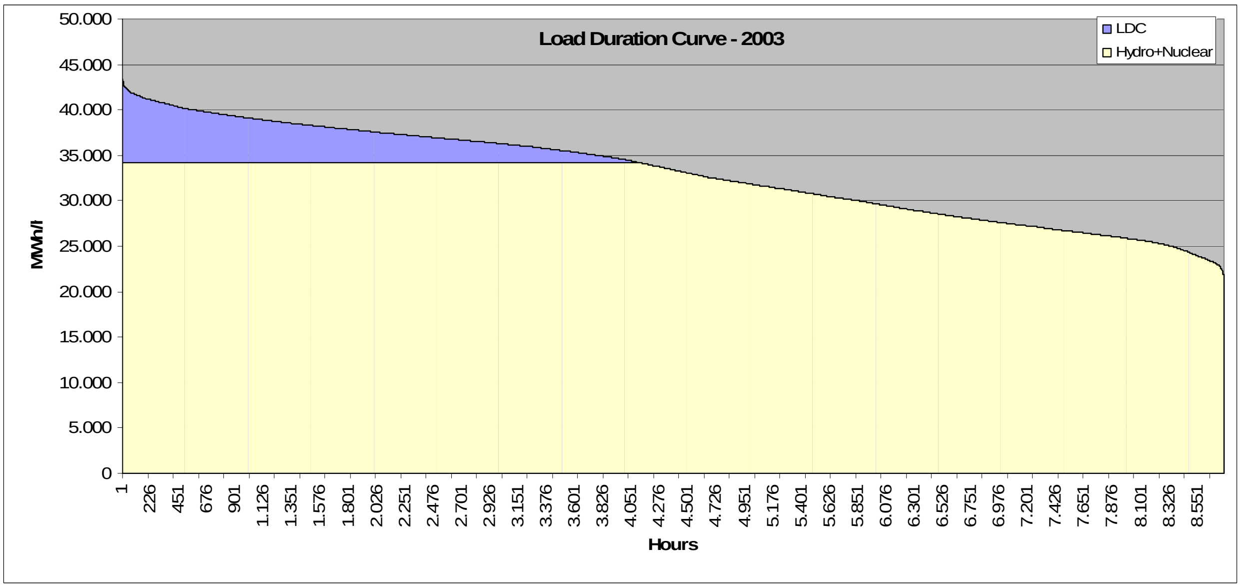

Figure 15. Load duration curve for the S-SE-MW system, 2003

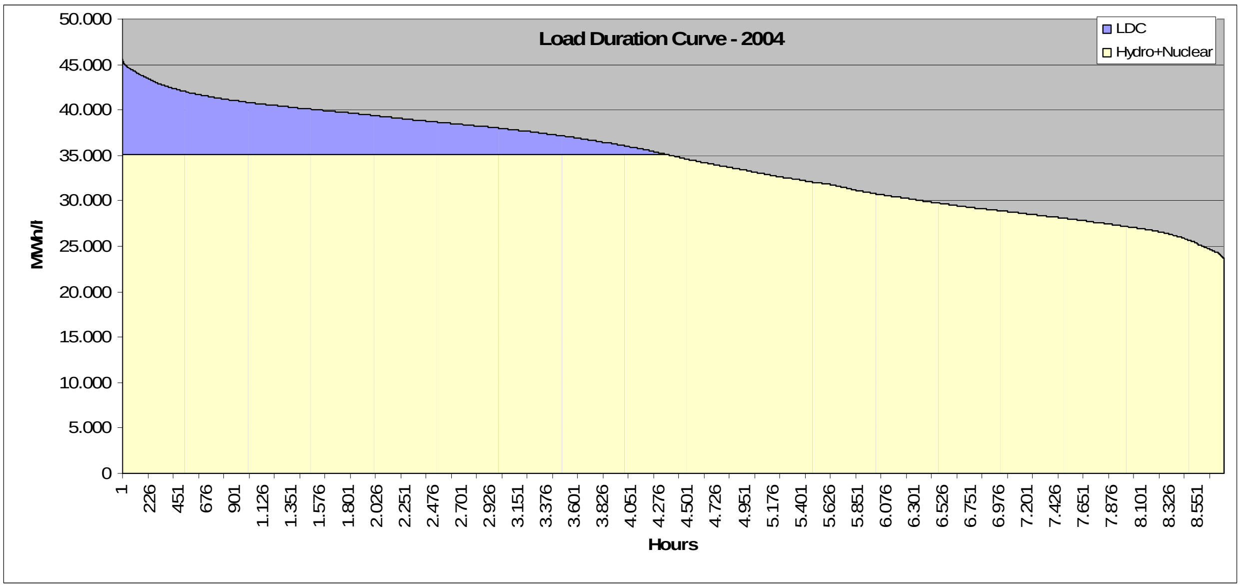

Figure 16. Load duration curve for the S-SE-MW system, 2004

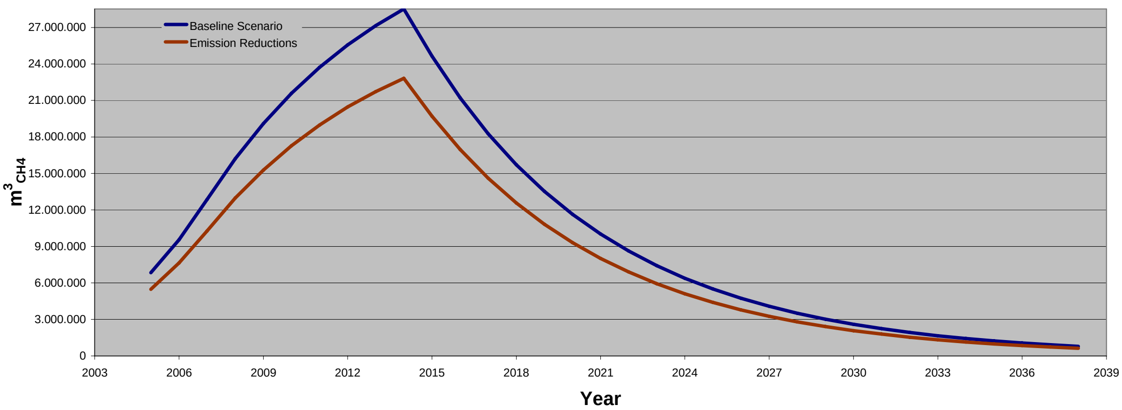

Figure 17. Baseline Emission and Emission Reductions from TALGP

Annex 4

MONITORING PLAN

As stated in section D of this document, the following variables need to be measured as to determine and account for emission reductions due to TALGP.

- The amount of landfill gas being sent to flares;
- The amount of methane in the landfill gas;
- The flares' efficiencies.
- The pressure of the gas;
- The temperature of the gas; and
- The electric consumption of the blower, in MWh.

Except from the flare efficiency, all other data need to be monitored continuously, through proper meters or analyzers. The flare efficiency will be measured continuously (by the operating hours of the flare and by the average temperature of the combustion chamber) and quarterly or monthly (if instable) through the percentage of methane in the biogas.

Considering TALGP's facilities will have computer-based equipment and generate continuous data, such equipment will be used for generating data relevant for the annual emission reduction verification report. The summary table (Table 5) for such report will be filled in, with the metered data provided as background.

Table 5. Summary worksheet for TALGP

Date	LFG Collected (m3)	LFG to flare #1 (m3)	Methane on LFG (%)	Hours of flare operation	Average temperature of the combustion chamber (^{o}C)	LFG Pressure (mbar)	Blower's Electricity Consumption (MWh)
1/1/2007							
2/1/2007							
3/1/2007							
4/1/2007							
5/1/2007							
6/1/2007							
7/1/2007							
8/1/2007							
9/1/2007							

Landfill gas into flares and methane content in the landfill gas are metered through a flow meter and a gas analyzer installed at the facility and monitored electronically through a programmable logic control system. After that, once the flow, as well as flares' efficiencies, become inputs for the sheet, the amount flared is calculated. The sum of both quantities is the total methane destroyed. Discounting such number by 20% (Effectiveness Adjustment Factor), the emission reductions from the project are determined.

There will be similar sheets for the three crediting periods. They will be presented to the verifier as the collected and stored data for verification purposes. The workbook will also keep electronic information on the flares' efficiencies, as tests are carried out accordingly. The Table 6 shows how the flares' data are to be archived.

Table 6. Flare efficiency data

Flares' Efficiency Tests				
Flare #	Test Date	Methane Content in Exhaust Gas	Test Carried Out by	Approved by

As mentioned in D.2.2.1, the Emission Factor will be determined using the *ex-ante* approach. In the renewal of the baseline, EF will be recalculated using the most appropriate methodology.

The calculation of emission reductions will be made using the following formulae:

A	The lowest value between “Total LFG collected” and the baseline estimative for the year in question.	m^3
B	Methane content on LFG	$\%_{methane}$
C	Pressure of the LFG	bar
D	Temperature of the LFG	K
$E = B \times \frac{C \times A}{D} \times \frac{273}{1.013} \times 0.0007168$	Methane collected	$t_{methane}$
F	Flare Efficiency	%
G = E . F	Total methane destroyed	$t_{methane}$
H	CH_4 Global Warming Potential	tCO_2/tCH_4
I = H . 21	Total CO_2e destroyed	tCO_2e
J = J . 0.2	Total CO_2e destroyed in the baseline	tCO_2e
K = J – I	CO_2e destroyed by the TALGP	tCO_2e
L	Total electricity imported	MWh
M	Emission factor of the grid which the TALGP is connected	tCO_2e/MWh
N = L . M	Emissions due to the import of electricity	tCO_2e
O = J – N	Emissions reductions due to the TALGP	tCO_2e

The CH_4 Global Warming Potential (variable **H**) will be monitored according with the most recent version of IPCC’s Guideliness.