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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Agrawal RE Project
Version 2, 28/12/2005

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

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The project is located at the Agrawal Vidhyut (A division of Agrawal Oil Extractions Ltd) biomass based power plant. The plant will be commissioned in early 2006 and will utilise rice husk as the primary fuel for the generation of electricity for supply to the grid.

In India, the supply of electricity to the state electricity boards is primarily from their existing thermal and hydro based power plants. Where additional generation capacity is planned it will generally be thermal. The proposed CDM project - installing power generation, leading to exports of power to the grid - will therefore supplement current and planned electricity generation from traditional fossil fuel based power plants. As the project utilises rice husk for the generation of electricity it will qualify as a renewable source of electricity.

The project involves the installation of a high pressure boiler (67 kg/cm^2, 495^{o}C, 40 tonnes per hour capacity) and condensing turbine generator (8.5MW capacity). The project activity is expected to provide 8.5 MW of electrical power to the Chhattisgarh State Electricity Board (part of the Indian Western regional grid) at 33 kV through the local substation. Other on-site generation units consist of one 380 kVA Kirloskar Cummins diesel generation set. This unit will be used for back up power in emergencies and for maintenance work when the power plant is not operating. This unit will not supply electricity to the grid and will therefore remain outside the boundary.

The plant will collect and utilise local biomass sources, predominantly rice husk but the boiler has also been designed to burn wood chips. Rice husk is in abundance in Chhattisgarh as 82% of the agricultural land within a radius of 75km of the plant is grown to paddy. The collection of this surplus material will reduce emissions of methane that would occur through the natural decay of the rice husk.

The plant will make a significant contribution to sustainable development not just directly through the provision of renewable electricity but also through the establishment of an industrial unit in a rural area. This will lead to the expansion of existing markets as well as the creation of new markets – new markets will mainly revolve around labour markets and the demand for skilled and semi-skilled labour whilst the rice husk market will be developed as will the infrastructure associated with the transport of rice husk. The on-going labour demand of the plant is estimated at 55 permanent staff and 35 temporary staff whilst the construction of the plant has involved more than 150 people.

There are also plans to build a primary school for local villagers near the site, which will be completed once the plant is up and running satisfactorily. This will meet the needs of those children whose parents are working at the plant as well as the children of local villagers.

The generation of renewable electricity will also reduce the dependence on existing and planned fossil fuel based generation. This will have a positive impact not only through the reduction in emissions of greenhouse gases associated with such generation, which is predominantly coal based (see section on determination of the baseline), but also through a reduction in the emissions of other harmful gases (NOx and SOx) that arise from the combustion of coal.

A.3. Project participants:

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Name of Party involved	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as a project participant
India (host)	Private entity: Agrawal Vidhyut (A division of Agrawal Oil Extractions Ltd) Public entity: Ministry of Environment and Forests	No
United Kingdom	Private entity: Agrinergy Ltd. Public entity: Department of Environment, Food and Rural Affairs	No

Agrinergy is the designated official contact for the CDM project activity.

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

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The project involves the installation of a 40 tph 67 kg/cm^2 495^{o}C Cethar Vessels AFBC boiler and an 8.5MW condensing STC China turbine generator. The turbine generator will produce electricity at 11 kV which will be supplied to the grid via the Simga substation. These technologies are readily available locally and have been supplied to other small power producers.

The project will also entail investment in environmental technologies to mitigate the risks of ash, boiler flue gases and fugitive dust generated during the combustion of the fuel.

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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Chhattisgarh state, Raipur District, Post Neora

A.4.1.3. City/Town/Community etc:

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Billari village

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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The project is readily identifiable as it is the only rice husk based power plant at Billari village but may be further identified through the following GAT Nos: 116/5 village Billari, Tahsil Tilda.

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

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The project activity is a bundled project activity comprising two distinct project activities. The bundle conforms to the "General Principles for Bundling" issued as Annex 21 of the 21st CDM Executive Board meeting.[1]

Type I – Renewable Energy Projects
I D – Grid connected renewable electricity generation[2]
The project produces renewable energy from the combustion of rice husk. The project falls within the small scale rating as the total generation capacity of the new unit is 8.5MW, i.e. below the 15MW outlined in section ID of Appendix B of the simplified modalities and procedures for small-scale CDM project activities. The project will invest in a grid connection at the plant and the electricity supplied from the project activity to the grid would be expected to replace existing and planned generation from the grid, the majority of which is fossil fuel based. Any increase in the scale of power generation would require additional investment throughout the plant as the current equipments are scaled for 8.5MW, therefore any new capacity installed at the site would result in a new distinct project activity.

Type III – Other Project Activities
III E – Avoidance of methane production from biomass decay through controlled combustion[3]
The project will result in the collection and controlled combustion of rice husk. The rice husk would be left to decay as a result of rice milling activities in the surrounding region if not collected by the project activity. The natural decay of rice husks would lead to emissions of methane and these are abated through the project activity. Project emissions will arise from the combustion of rice husk, namely methane and nitrous oxide emissions (in line with the methodology carbon dioxide emissions are excluded as biomass is carbon neutral under IPCC guidelines). The project emissions are estimated at 4.512kt CO_2e, this is below the 15kt CO_2e limit for qualification as a small scale project activity under the project category.

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 emission reductions from the project will arise two routes; the direct substitution of existing grid based generation capacity and planned expansions to the grid and the avoidance of methane from the decay of biomass. Grid based generation in Chhattisgarh is comprised of coal and hydro based generation, in Chhattisgarh 96% of generation capacity is coal based and in the Western region as a whole 80% of generation capacity is thermal based.

The collection of rice husks and their combustion in a controlled manner will reduce emissions of methane that would arise through their natural decay. Chhattisgarh is a major rice growing region and is commonly known as "*Dhan Ka Katora*", the rice bowl. A study of the rice husk available within the

[1] http://cdm.unfccc.int/EB/Meetings/021/eb21repan21.pdf
[2] Version 07: 28 November 2005
[3] Version 07: 28 November 2005

local area arrived at rice husk generation of 820,890 tonnes per annum. The plant is expected to consume 74,000 tonnes of rice husk once it has stabilised. Within the study area there are also a number of other types of biomass available – crop residues, fuel wood and bushes – which account for a further supply of 1,947,985 tonnes of biomass per annum as shown in the following table.

Table 1: Supply of biomass

Biomass type	Tonnes
Crop residue	887,317
Fuel wood	1,000,620
Bushes	60,048
Rice husk	820,890
Total	2,768,875

The licensing of rice husk based power plants in Chhattisgarh has been undertaken by the Chhattisgarh Renewable Energy Development Authority (CREDA) whose policy has been to issue licences given the surplus of rice husk in the state. See http://chhattisgarhserc.org/pdf/7-05%20Order.pdf, page 2, which states that there is capacity for 180MW of power generation from rice husk in the state.

Within the study area it has been estimated that the current consumption of rice husk is 214,586 tonnes per annum, yielding a surplus of 606,304 tonnes. Assuming that the annual requirement for 1MW of power generation is 8,560 tonnes of rice husk this results in a potential power generation capacity of 71MW within the study area. One more rice husk based power plant, with a capacity of 8MW, will be commissioned in 2006 in the study area but apart from this there are no other planned power plants that will draw on the surplus rice husk. It may therefore be concluded that there is substantial surplus of rice husk in close proximity to the plant and furthermore that there is an even greater surplus of biomass (wood chips) which may be combusted in the boiler.

There are no policies that set minimum standards on the combustion efficiency of rice husk or that mandate the use of rice husk in power generation. The current surplus rice husk is left to decompose at existing rice mills or in some cases may be dumped in nearby areas[4]. Whilst there has been an advised Ministry of Non-Conventional Energy Sources tariff for renewable energy, states have now adopted their own tariff structures for renewable energy regulated through the state Electricity Regulatory Commissions.

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

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A ten year crediting period has been chosen.

Year	Annual estimation of emission reductions in tonnes of CO_2e from power generation	Annual estimation of emission reductions in tonnes of CO_2e from biomass collection
Year 1	28,864	121,113
Year 2	31,867	124,116
Year 3	31,867	124,116
Year 4	31,867	124,116

[4] Given the small scale and dispersed nature of rice milling, the disposal of rice husk does not pose a problem for existing millers who typically have sufficient space to leave the husk to decompose at their site.

Year 5	31,867	124,116
Year 6	31,867	124,116
Year 7	31,867	124,116
Year 8	31,867	124,116
Year 9	31,867	124,116
Year 10	31,867	124,116
Total estimated reductions (tonnes CO_2e)	315,664	1,238,158
Total number of crediting years	10	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	31,566	123,816

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

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The project has not received any public funding.

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

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Appendix C, paragraph 2 of the Simplified Modalities and Procedures for Small-Scale CDM project activities states:

> "A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:
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> - With the same project participants;
> - In the same project category and technology/measure; and
> - Registered within the previous 2 years; and
> - Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point."

As there is currently no registered CDM project at the site either large scale or small scale, the project will meet the criteria on debundling.

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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Type I – Renewable Energy Projects
I D – Grid connected renewable electricity generation

Type III – Other Project Activities
III E – Avoidance of methane production from biomass decay through controlled combustion

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

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Grid connected renewable electricity generation

The project activity will establish a grid connection and the electricity supplied from the project activity, through the combustion of rice husk, would be expected to supplement existing and planned electricity generation from the grid, the majority of which is fossil fuel based. The project activity therefore satisfies the applicability condition relating to renewable biomass and supply of electricity to a distribution system that is currently operating on fossil fuel.

The project activity has the capacity to produce 8.5MW of renewable energy from the combustion of rice husk. Permission has been granted for the use of 20% coal in the boiler which may be burnt in the rainy season and at start up, we assume that 50:50 coal:husk mix will be burnt during the rainy season which lasts for about three months in Chhattisgarh, therefore 10% of total generation will arise from coal. The project activity therefore meets the eligibility limit of 15MW.

The project is not a co-generating system and therefore the $45MW_{th}$ condition will not apply.

Avoidance of methane production from biomass decay through controlled combustion

The project activity will reduce emissions of methane that would have occurred through the decay of rice husks. These emissions are reduced through the controlled combustion of rice husk in boilers for power generation. The project activity will not recover or combust methane and is therefore not applicable under project category III.D.

The applicability condition on project scale, 15kt of CO_2e annually, is met as the project emissions will be 4.2 kt.

The baseline for the grid connected renewable electricity generation project assumes that in the absence of the project activity expansion of grid based generation sources would take place through predominantly fossil fuel based plants, this is demonstrated through the average of the "approximate operating margin" and the "build margin". The baseline for the avoidance of methane production from biomass decay through controlled combustion assumes that in the absence of the project the rice husk would remain unused and decay naturally. This is demonstrated through an analysis of the current supply situation of rice husk in the area surrounding the plant.

Table 2: Data used to determine the baseline scenario

Baseline data	Key information	Source
Grid generation	Generation data of grid based generating units	Central Electricity Authority
Grid emissions	Fossil fuel consumption of grid	Central Electricity

	based generating units	Authority
Capacity expansions	Timing of expansions to determine build margin	State electricity boards and generating companies
Net calorific value of fossil fuel used in grid plants		Indian National Communication
Emissions factor of fossil fuel used in grid plants		IPCC
Oxidation factor of fossil fuel used in grid plants		IPCC
Quantity of biomass combusted to determine CH_4 decay and CH_4 and N_2O combustion emissions		Factory records
CH_4 emission factor for biomass decay		IPCC
CH_4 emission factor for biomass combustion		IPCC
N_2O emission factor for biomass combustion		IPCC

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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In line with attachment A to appendix B of the simplified M&P for small-scale CDM project activities, demonstration of additionality focuses on the barriers facing the project - technological barriers, investment barriers and a brief analysis of prevailing practice in the state. In showing that the project is additional we demonstrate that it is not part of the baseline scenario, which in the case of the Agrawal RE is that the grid continues to operate and expand based on predominantly fossil fuel generation and that the rice husk remains uncollected and decays naturally.

The main risk to the operation of the plant is the supply of rice husk. The majority of paddy in Chhattisgarh is grown under rain-fed rather than irrigated conditions. The yields of paddy are therefore weather related and there is a high production risk associated with the crop. The project owner is a rice miller and therefore there is a certain hedge against this risk given that a small amount of rice husk will be available from own plants (around 7,000 tonnes) and existing relationships with other rice millers should permit some preferential sourcing.

Added risks on the availability of paddy and hence rice husk revolve around the policy of the state government – paddy is a heavily regulated crop with about 75% being procured by the state, the remaining paddy is purchased through "*krishi upaj mandi*" (local agricultural markets). The government policy has to date been to mill the paddy within the state and the "*mandis"* are not permitted to sell paddy outside the state. Any reversal in this policy would impact the milling of paddy and hence the availability of rice husk within the state. This is crucial as the milling of paddy outside the state will increase the price of rice husk price as this is primarily a function of the transport cost. Whilst these factors pose a risk to the project in relation to the likely plant load factor and hence returns there is also a more serious risk inherent in the Power Purchase Agreement (PPA).

There is currently uncertainty surrounding the received price in the power purchase agreement. Whilst there is a Ministry of Non-conventional Energy Sources advised tariff, this is not applied in Chhattisgarh and the project has received a signed PPA with a price of Rs 2.25/kWh. However the Chhattisgarh State Electricity Regulatory Commission (CSERC) has issued a tariff order for biomass based plants based on a two part tariff that equates to Rs 2.67/kWh in the first year of operation[5]. The project has applied for the higher tariff but as yet has not received any confirmation from the CSEB that this will be the prevailing rate. The financial analysis has been conducted under the higher tariff but if the lower tariff is enforced the project IRR falls dramatically to negative 7%. More generally there has been instability in the renewable energy tariffs issued by the state electricity boards across India and this poses a serious risk to the viability of the project.

More generally there is a clause in the tariff order which will result in a reduction of between 32 to 47% in the tariff if the supplier delivers less that 70% or more than 105% of the scheduled energy. The PPA price is therefore not assured for all electricity delivered and low generation will not only impact the returns through a low PLF but also through a reduction in the PPA price. Likewise if the project owner sells electricity volumes conservatively any generation in excess of 105% of the scheduled energy will attract the reduced tariff. In summary the terms of the PPA present a number of risks to the project and the CER revenue will act as a financial buffer that can alleviate the impact of these risks.

All assumptions inherent in the financial analysis will be made available to the validator but the following is a summary of the main points and results which demonstrate the importance of CER revenue. We have worked on the new PPA price of Rs 2.67/kWh as issued by the CSERC. The revenue streams associated with the project are the sale of electricity to the grid and the CERs resulting from registering the project as a CDM. The costs revolve around the use of rice husk and coal as a fuel (the latter which we assume will be burnt during the permissible period under the PPA) which are Rs 1,000/mt and Rs 1,200/mt respectively. We have also included costs for operation and maintenance, personnel employed at the site[6], stores and spares. Analysing the project IRR in the light of these revenues and costs we arrive at a project IRR of 9.2% without CER revenues and 30.1% when the expected CER revenue is included.

The financing of the project provides some idea of the risks associated with the project, the total project cost is Rs 279m of which a loan has been sanctioned for Rs 160m. The gearing on the project is therefore very low, the promoters have had to provide over 40% of the funding of the project as equity or quasi equity[7]. The CDM revenues will therefore reduce the risks of undertaking the project and also allow the promoters to repay the unsecured loans taken against the project at the end of the first year of operation.

To provide an idea of prevailing practice in the region, there are two existing rice husk plants, Vandana Vidhyut and Indolahri in Chhattisgarh. The Vandana Vidhyut project has been proposed as a Clean Development Mechanism (the Indolahri plant started in the 1990s and therefore does not qualify as a CDM). There are two further plants that will be commissioned in the area in the first half of 2006 – Neeraj Power Pvt Ltd and the project activity, both of which will be proposed as Clean Development Mechanism projects. To provide an idea of the risks associated with such projects since 2002 24 licences have been given by Chhattisgarh State Renewable Energy Development Agency and not a single project has been commissioned from those that have obtained licences.

Whilst there have been other biomass based power plants commissioned outside the state, given that the tariff is state specific, these other plants operate under a very different set of circumstances and are therefore not comparable. In line with the small scale guidance the national policies relevant to the project have been included and revolve around the power tariff. These have been incorporated into the financial analysis and are therefore explicitly presented.

[5] http://chhattisgarhserc.org/pdf/7-05%20Order.pdf

[6] The project will invest in local agents to secure rice husk throughout the surrounding area and the infrastructure to transport the husk to the plant, these costs have not been included in the financial analysis.

[7] Typically infrastructure projects will receive 75% of the investment cost as a loan.

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:

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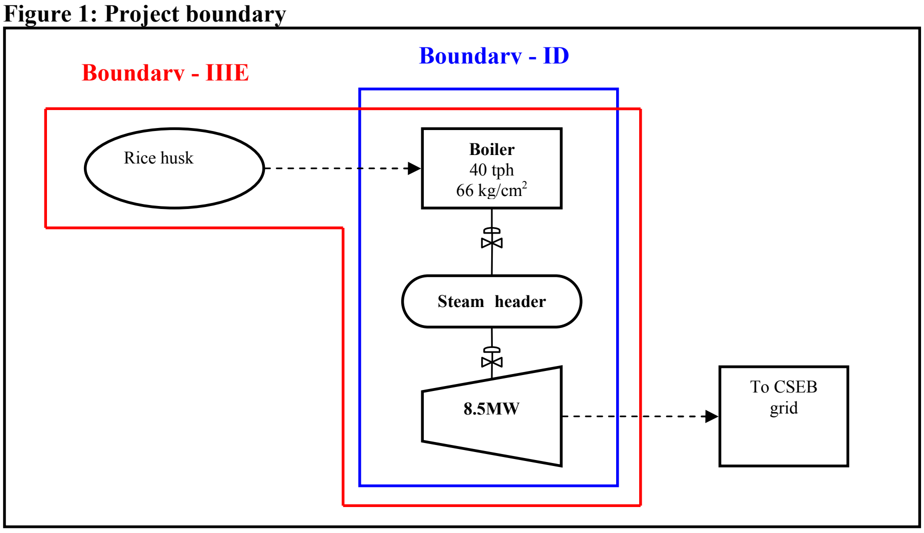
In line with the guidance in "Appendix B of the simplified modalities and procedures for small-scale CDM project activities" the boundary for category I.D. projects "encompasses the physical, geographical site of the renewable generation source". In the case of category III.E. projects the boundary is the "physical, geographical site where the treatment of biomass takes place." These boundaries are shown in the following figure, the category III.E boundary encompasses the category I.D boundary.

For the purposes of the project activity the relevant grid is defined by the power generating units serving the same grid as the project activity. In the case of India there are regional grids which facilitate the transfer of electricity between states and which are supplied by central sector power stations operating in the region. Chhattisgarh is part of the Western Region (along with Gujarat, Madhya Pradesh, Maharashtra and Goa) and we have therefore undertaken an analysis of the Western grid. This provides a complete analysis of the power plants that the project will affect. We do not believe that the national grid is appropriate given the limited interconnectivity of the regional grids and the size of the project relative to national power generation capacity.

Figure 1: Project boundary



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

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Type I – Renewable Energy Projects

I D – Grid connected renewable electricity generation

Referring to Appendix B of the simplified modalities and procedures for small-scale CDM project activities the baselines specified in point 5 and/or 6[8] are not applicable and we have therefore chosen

[8] Recovered methane is not used for electricity generation and all existing generators use exclusively fuel oil and/or diesel fuel.

approach 7 (a), the kWh produced by the renewable generating unit multiplied by the average of the "approximate operating margin" and "build margin".

In order to determine the CO_2 emissions coefficient we are required to calculate the approximate operating margin and the build margin where the approximate operating margin is defined as:

> "the weighted average emissions (in $kgCO_2equ/kWh$) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;"

and the build margin is defined as:

> "the weighted average emissions (in $kgCO_2equ/kWh$) of recent capacity additions to the system, which capacity additions are defined as the greater of most recent[9] 20%[10] of existing plants or the 5 most recent plants;"

Approximate Operating Margin

The approximate operating margin is calculated directly from actual Central Electricity Authority (CEA) data on generation and fuel consumption, combined with data from the IPCC on net calorific values and emission factors. The CEA provides coal consumption data for individual coal based power plants, and these data are therefore used. In the case of gas and lignite stations, aggregate consumption at the state and regional level is provided and these data are then used to derive an average emission factor for these fuels. The approximate operating margin data are outlined below:

The CO_2 emission coefficient $COEF_i$ is obtained from the following equation:

$$COEF_i = NCV_i . EF_{CO2,i} . OXID_i$$

Where:

NCV_i is the net calorific value (energy content) per mass unit of a fuel i,
$OXID_i$ is the oxidation factor of the fuel,
$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel i.

If available local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values should be used. The following table shows the NCV and EF factors used in the calculation of the Western Region emission factor.

Deleted: In the case of the project activity these are not available and therefore IPCC country-specific values have been used.

Deleted: calculation of the carbon dioxide emission factors for the fuels under consideration.¶

Table 3: Factors used in calculation of the CO_2 emission coefficient

	NCV_i,		**$OXID_i$, %**		**$EF_{CO2,i}$, tC/TJ**	
	Factor	Source	Factor	Source	Factor	Source
Coal	19.59 TJ/kt	India's initial national communication to the UNFCCC, 2004 (lower bound)[11]	98	IPCC	25.8	IPCC
Gas	37.68 TJ/cbm	Gail and IPCC	99.5	IPCC	15.3	IPCC
HSD	43.33	IPCC	99	IPCC	20.2	IPCC
Naptha	45.01	IPCC	99	IPCC	20	IPCC

[9] Generation data available for the most recent year.
[10] If 20% falls on part capacity of a plant, that plant is included in the calculation.
[11] This is lower than IPCC value for Indian coal of 19.98

Lignite	9.65	India's initial national communication to the UNFCCC, 2004 (lower bound)[12]	98	IPCC	25.8	IPCC

Gas Stations Emission Factor

In the case of gas stations, individual fuel consumption for each plant is not available. Aggregate consumption at the state and regional level is instead provided by the CEA. These data are only available for 2003-4 and therefore we use these data to derive an average emission factor for gas stations in the Western Region. The average emission factor is then applied to 2004-5 generation data in the calculation of the relevant emission coefficient. The data on fuel consumption and generation for gas stations in the Western Region is outlined below:

Table 4: Fuel Consumption and generation from gas stations in the Western Region, 2003-4

State	Natural gas consumption (mcbm)	HSD consumption (kl)	Naptha consumption (kl)	Total generation (GWh)
Gujarat	1574	2166	405808	8764.71
Maharashtra	1217			5432.23
Goa	36			202.27
Central Sector	894	601	676628	7108.91
Total				**21508.12**

Source: Source: CEA General Review 2005, Table 6.1, pp. 117

These data are combined with the above data on fuel specific gravities, calorific values, emission factors and oxidation factors to determine total emission from the above gas stations:

Table 5: Total emissions from gas stations in Western Region 2003-4

State	Emission from Nat. Gas (tCO_2)	Emissions from HSD (tCO_2)	Emissions from Naptha (tCO_2)	Total Emissions (tCO_2)
Delhi	3310666	6056	1034334	4351056
Jammu & Kashmir	2559772			2559772
Rajasthan	75720			75720
Central Sector	1880391	1680	1724607	3606679
Total	**7826550**	**7736**	**2758941**	**10593227**

Dividing total emissions (10593227 (tCO_2)) by total generation from gas stations (21508.12 GWh) gives an average emission factor for gas stations in the Western Region of **0.493** tCO_2/MWh.

Lignite Stations Emission Factor

Similarly, in the case of lignite stations, individual fuel consumption for each plant is not available from the CEA. As above, lignite consumption in steam stations is provided in the CEA General Review 2005. Lignite is only used in stations in Gujarat, and the generation of these stations is provided by the CEA. The following table outlines lignite consumption in Gujarat, generation from lignite stations and associated emissions:

[12] This is lower than IPCC value for Lignite of 9.8

Deleted: Indian coal

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Table 6: Lignite consumption, generation and emissions in Western Region, 2003-4

State	Lignite Consumption	Emissions	Generation
Gujarat	2560 kt	2450044 tCO2	2623 GWh

Dividing total emissions (2450044 tCO_2)from lignite stations by generation (2623 GWh) gives an average emission factor for lignite stations of **0.934** tCO_2/MWh. In addition to gas and lignite stations, the CEA does not provide fuel consumption for Tata Trombay plants. We derive plant specific emission factors for the Tata Trombay units as outlined below:

Table 7: Calculation of Emission Factors for Tata Trombay Units

Unit	Capacity	Fuel	Generation (04-05)	Heat Rates (kCal/KWh) (04-05)	Emission Factor (tCO_2/MWh
4	150	LSHS	869	2602	
5	500	Coal	3808	2447	**0.860**
6	500	LSHS	3028	2376	
7	180	Gas	1197	2019	**0.474**

Source: http://www.tatapower.com/regfilling/ARR2004_05.pdf

Annual generation data for each power plant in the Western Region is provided by the CEA[13]. http://cea.nic.in/god/opm/Monthly_Generation_Report/18col_05_03.pdf

Coal consumption data for thermal power plants is also provided by the CEA report "Performance Review of Thermal Power Stations". (http://cea.nic.in/Th_per_rev/start.pdf). The CEA year runs from April to March.

Combining the above emission factors for coal and for gas based stations, with generation data (and in the case of coal plants fuel consumption data) from the CEA provides the following[14]:

Table 8: Calculation of the Simple OM

State	Monitored capacity	Fuel type	Generation, GWh 2004-5	Emissions, tCO_2 2004-5
Gujarat				
Dhuvaran	534	Gas	2,110	1,039,168
Ukai	850	Coal	5,063	6,247,555
Gandhi Nagar	660	Coal	3,416	5,735,401
Wanakbori	1,260	Coal	9,224	13,446,773
Sikka Rep	240	Coal	1,408	1,816,150
Kutch Lig.	215	Lignite	831	776,401
Akrimota Lig	125	Lignite	0	-
G.S.E.C.L.(G.5)	210	Coal	1,561	Inc. in Ganghi Nagar
G.S.E.C.L.(W.7)	210	Coal	1,656	Inc. in Wanakbori
Dhuvaran GT	27	Gas	0	-
Utran GT	144	Gas	1,176	579,088

[13] http://cea.nic.in/god/opm/Monthly_Generation_Report/18col_05_03.pdf and http://cea.nic.in/god/opm/Monthly_Generation_Report/18col_04_03.htm

[14] It should be noted that the CEA also provide data on specific secondary fuel oil consumption in coal plants. For conservativeness we have no included these emissions in calculation of the OM and BM.

Dhuvaran CCPP	106	Gas	702	345,578
Hazira CCPP	156	Gas	1,151	566,987
Ukai	305	Hydro	466	
Kadana	240	Hydro	362	
S.Sarovar RBPH	200	Hydro	111	
S.Sarovar CHPH	200	Hydro	150	
Torr Power AEC	60	Coal	449	2,998,463
Torr Pow VAT GT	100	Gas	557	274,192
Torr Power SAB	330	Coal	2,590	Inc. above
Essar GT IMP	515	Gas	1,516	746,890
G.I.P.C.L. GT	305	Gas	2,258	1,112,027
Surat LIG	250	Lignite	1,806	1,687,186
G.T.E. CORP	655	Gas	3,633	1,789,314
Kawas GT	644	Gas	2,824	1,390,784
Gandhar GT	648	Gas	4,033	1,986,244
Kakrapara	440	Nuclear	2,514	
Madhya Pradesh				
Satpura	1,143	Coal	7,684	12,264,459
Amar Kantak	50	Coal	172	1,910,590
Amar Kantak Ext	240	Coal	1,025	Inc. above
Sanjay Gandhi	840	Coal	5,478	7,349,958
Gandhi Saga	115	Hydro	343	
Bargi	90	Hydro	489	
Pench	160	Hydro	233	
Rajghat (MP)	45	Hydro	87	
Bansagar (I)	315	Hydro	888	
Bansagar (II)	30	Hydro	66	
Bansagar (III)	60	Hydro	79	
Birsinghpur	20	Hydro	39	
Tawa	14	Hydro	30	
Vindh_Chal STPS	2,260	Coal	17,822	19,723,386
Indira Sagar	875	Hydro	1,349	
Chhattisgarh				
Korba-II	160	Coal	1,582	4,062,727
Korba-III	240	Coal	902	Inc. above
Korba-West	840	Coal	5,442	7,360,855
Hasdeobango	120	Hydro	382	
Gangrel	5	Hydro	4	
Korba STPS	2,100	Coal	17,049	22,498,463
Maharashtra				
Nasik	910	Coal	5,693	6,636,211
Koradi	1,080	Coal	6,445	9,031,713
K_Kheda II	840	Coal	6,287	8,915,479
Paras	58	Coal	393	588,433
Bhusawal	478	Coal	3,295	4,253,423
Parli	690	Coal	4,895	6,018,720
Chandrapur	2,340	Coal	15,923	22,218,776
Uran GT	672	Gas	2,667	1,313,616
Uran WHP	240	Gas	1,446	712,064
Koyna	1,920	Hydro	3,347	
Vaitarna	62	Hydro	107	

Tillari	60	Hydro	10	
Bhira Tail Race	80	Hydro	85	
Eldari	23	Hydro	7	
Veer	9	Hydro	40	
Bhatgarh	16	Hydro	34	
Paithon	12	Hydro	3	
Bhandardhara	44	Hydro	35	
Pawana	10	Hydro	11	
Radhanagri	5	Hydro	9	
Kvasla (Panshet)	16	Hydro	37	
K_Vasla (Varsa)	8	Hydro	25	
Bhatsa	15	Hydro	66	
Kanher	4	Hydro	8	
Ujjaini	12	Hydro	25	
Surya	6	Hydro	13	
Manikdoh	6	Hydro	4	
Dhom	2	Hydro	7	
Dimbe	5	Hydro	9	
Warna	16	Hydro	64	
Dudh Ganga	24	Hydro	62	
Dhanu	500	Coal	4,440	4,384,185
Dhabol GT	740	Coal	0	
Trombay	1,150	Coal	8,175	7,026,998
Trombay GT	180	Gas	1,335	633,057
Bhira	132	Hydro	337	
Bhira PSS	150	Hydro	580	
Bhivpuri	72	Hydro	236	
Khopoli	72	Hydro	286	
Tarapur	320	Nuclear	2,587	
Goa				
Reliance Energy	48	Gas	336	165,473
Total			**166,451**	**189,606,784**
Approximate operating margin	**1.139**			

The approximate operating margin based on the most recently available data is therefore 1.139 tCO_2/MWh.

Calculation of Build Margin
In considering the BM we are required to calculate the carbon emissions factor based on an examination of recent capacity additions to the Western region grid. These capacity additions should be chosen from the greater generation accounted for:

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The total generation of the grid under consideration is 182,073 GWh, 20% of which is 36,415 GWh. The five most recent plants only account for 582 GWh and therefore the sample to determine the build margin is selected on the basis of the "power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently". The following table shows in chronological order the commissioning of plants and the total generation they supply.

Table 9: Identification of plants in BM

	Type	Capacity addition	Date
Dhanu	Thermal	250	Mar-95
Kakrapara	Nuclear	220	Sep-95
Kutch Lig.	Lignite	75	Mar-97
Essar GT IMP	Gas	515	Jul-97
Chandrapur	Thermal	500	Oct-97
G.I.P.C.L. GT	Gas	160	Nov-97
Kadana	Hydro	60	Feb-98
Manikoh	Hydro	6	Feb-98
Gandhi Nagar	Thermal	210	Mar-98
Kadana	Hydro	60	May-98
Warna	Hydro	16	Sep-98
Dimbe	Hydro	5	Oct-98
Dhabol GT	Thermal	480	Oct-98
Wanakbori	Thermal	210	Dec-98
GTEC	Gas	655	Dec-98
Dhabol GT	Thermal	260	Dec-98
Surya	Hydro	6	Jan-99
Sanjay Gandhi	Thermal	210	Feb-99
Vindh_Chal STPS	Thermal	500	Mar-99
Bhandardhara	Hydro	34	May-99
Reliance Energy	Gas	48	Jul-99
Rajghat (MP)	Hydro	15	Sep-99
Rajghat (MP)	Hydro	15	Oct-99
Surat Lig	Lignite	125	Nov-99
Sanjay Gandhi	Thermal	210	Nov-99
Rajghat (MP)	Hydro	15	Nov-99
Koyna	Hydro	500	Nov-99
Surat Lig	Lignite	125	Jan-00
Vindh_Chal STPS	Thermal	500	Feb-00
Dudh Ganaga	Hydro	12	Feb-00
Koyna	Hydro	500	Mar-00
K_Kheda II	Thermal	210	May-00
Dudh Ganga	Hydro	12	Jul-00
K_Kheda II	Thermal	210	Jan-01
Bansagar (III)	Hydro	20	Jul-01
Bansagar (III)	Hydro	20	Aug-01
Bansagar (II)	Hydro	15	Aug-02
Bansagar (II)	Hydro	15	Sep-02
Bansagar (III)	Hydro	20	Sep-02
Dhuvaran CCPP	Gas	68	Jun-03
Dhuvaran CCPP	Gas	38	Sep-03
Gangrel	Hydro	2.5	Apr-04
Gangrel	Hydro	2.5	Jun-04
Indira Sagar	Hydro	875	Dec-04
S.Sarovar CHPH	Hydro	*250*	Dec-04
S.Sarovar RBPH	Hydro	200	Feb-05
Akrimota Lig	Lignite	125	Mar-05

Source: CEA, state electricity board and NTPC website.

The calculation of the BM requires us to undertake a generation weighted average of the emissions factors of the individual plants, this is shown in the following table. We have chosen to calculate the BM using Option 1 therefore the BM emission factor will be held constant over the crediting period chosen.

Table 10: Calculation of the BM

	Type	Generation, GWh (2004-5)	CEF, tCO_2/MWh	Emissions, tCO_2
Dhanu	Thermal	2,220	0.988	2,192
Kakrapara	Nuclear	1,257	0.000	0
Kutch Lig.	Lignite	290	0.934	271
Essar GT IMP	Gas	1,516	0.493	747
Chandrapur	Thermal	3,402	1.395	4,748
G.I.P.C.L. GT	Gas	1,184	0.493	583
Kadana	Hydro	91	0.000	0
Manikdoh	Hydro	4	0.000	0
Gandhi Nagar	Thermal	1,561	1.152	1,799
Kadana	Hydro	91	0.000	0
Warna	Hydro	64	0.000	0
Dimbe	Hydro	9	0.000	0
Dhabol GT	Thermal	0	0.000	0
Wanakbori	Thermal	1,318	1.236	1,629
GTEC	Gas	3,633	0.493	1,789
Dhabol GT	Thermal	0	0.000	0
Surya	Hydro	13	0.000	0
Sanjay Gandhi	Thermal	1,369	1.342	1,837
Vindh_Chal STPS	Thermal	3,943	1.107	4,364
Bhandardhara	Hydro	27	0.000	0
Reliance Energy	Gas	336	0.493	165
Rajghat (MP)	Hydro	29	0.000	0
Rajghat (MP)	Hydro	29	0.000	0
Surat Lig	Lignite	903	0.934	844
Sanjay Gandhi	Thermal	1,369	1.342	1,837
Rajghat (MP)	Hydro	29	0.000	0
Koyna	Hydro	872	0.000	0
Surat Lig	Lignite	903	0.934	844
Vindh_Chal STPS	Thermal	3,943	1.107	4,364
Dudh Ganga	Hydro	31	0.000	0
Koyna	Hydro	872	0.000	0
K_Kheda II	Thermal	1,572	1.418	2,229
Dudh Ganga	Hydro	31	0.000	0
K_Kheda II	Thermal	1,572	1.418	2,229
Bansagar (III)	Hydro	26	0.000	0
Bansagar (III)	Hydro	26	0.000	0
Bansagar (II)	Hydro	33	0.000	0
Bansagar (II)	Hydro	33	0.000	0
Bansagar (III)	Hydro	26	0.000	0
Dhuvaran CCPP	Gas	451	0.493	222
Dhuvaran CCPP	Gas	252	0.493	124
Gangrel	Hydro	2	0.000	0
Gangrel	Hydro	2	0.000	0
Indira Sagar	Hydro	1,349	0.000	0
S.Sarovar CHPH	Hydro	150	0.000	0
S.Sarovar RBPH	Hydro	111	0.000	0
Akrimota Lig	Lignite	0	0.934	0

		36,944	32,816,162
Build margin	**0.888**		

Source: CEA, state electricity board and NTPC website.

The weights applied to the operating and build margin are fixed at 0.5, therefore in order to calculate the combined margin we apply these to the approximate operating margin and the build margin as calculated above. The following table shows this calculation arriving at the combined margin of 1.013 tCO_2/MWh.

Table 11: Calculation of the combined margin

	tCO_2/MWh
Approximate operating margin	1.138
Build margin	0.888
Combined margin, EF_y	1.013

Type III – Other Project Activities
III E – Avoidance of methane production from biomass decay through controlled combustion

The baseline scenario is that the rice husk is left to decay naturally and methane is emitted. The baseline is therefore the quantity of methane emitted from the rice husk treated by the project activity. There are no national or local safety requirements that require the removal of methane for safety or other reasons and therefore there we do not have to make any adjustments in the determination of baseline methane emissions. The following equations are provided in the Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

The baseline emissions are the product of the quantity of biomass treated and the IPCC methane emissions factor for decaying biomass converted to a carbon dioxide equivalent.

$$BE_y = Q_{biomass} * CH_4\_IPCC_{decay} * GWP\_CH_4$$

Where:

$Q_{biomass}$ = Quantity of biomass treated under the project activity, tonnes
$CH_4\_IPCC_{decay}$ = IPCC CH_4 emissions factor for decaying biomass in the region of the project activity, tonnes CH_4/tonne biomass
GWP_CH_4 = GWP for CH_4, tonnes of CO_2e/tonne CH_4 (CH_4_GWP = 21)
BE_y = Baseline methane emissions from biomass decay, tCO_2e

The determination of the methane decay factor is given by the following equation, where all the variables are set at the default values.

$$CH_4\_IPCCdecay = (MCF * DOC * DOC_F * F * 16/12)$$
$$CH_4\_IPCCdecay = 0.4 * 0.3 * 0.77 * 0.5 * 16/12$$

Where:

MCF = Methane correction factor, fraction (default 0.4)
DOC = Degradable organic carbon, fraction (default 0.3)
DOC_F = Fraction of DOC dissimilated to landfill gas, fraction (default 0.77)
F = Fraction of CH_4 in landfill gas, fraction (default 0.5)

CH_4_IPCCdecay = IPCC CH_4 emissions factor for decaying biomass in the region of the project activity, tonnes CH_4/tonne biomass

The guidance in Appendix B of the simplified modalities and procedures for small-scale CDM project activities does provide an equation for the determination of the degradable organic carbon, DOC, based on the make up of the waste that is combusted. We have used the default value of 0.3 as rice husk is not specifically mentioned and this is reinforced as the material that is most similar in type (wood and straw) has a DOC of 0.3. Even though we use the default value the following equation however shows the determination of DOC.

$$DOC = 0.4(A) + 0.17(B) + 0.15(C) + 0.30(D)$$

Where:

A = per cent waste that is paper and textiles
B = per cent waste that is garden waste, park waste, or other non-food organic putrescibles
C = per cent waste that is food waste
D = per cent waste that is wood or straw

Baseline section completed: 05/12/2005
Completed by Robert Taylor, Agrinergy Ltd, contact details as per Annex I.

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:

>>

An letter of intent for the turbine was issued by Agrawal Oil Extractions Ltd on 1st May 2004 and a letter of intent for the boiler on 13th July 2004. These LOIs were secured by the issuance of a letter of credit for 10% of the final amount payable.

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

>>

20y-0m

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

>>

A fixed ten year crediting period has been chosen.

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:

>>

Applicable crediting period.

C.2.2.1. Starting date:

>>

15/03/2006

C.2.2.2. Length:

>>

10y-0m

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:

>>

Type I – Renewable Energy Projects
I D – Grid connected renewable electricity generation
"Monitoring shall consist of metering the electricity generated by the renewable technology. In the case of co-fired plants, the amount of biomass and fossil fuel input shall be monitored."

Type III – Other Project Activities
III E – Avoidance of methane production from biomass decay through controlled combustion
"The amount of biomass and/or other organic matter combusted by the project activity in a year shall be monitored". Furthermore the "Total annual project activity related emissions will be monitored and should be less than or equal to 15 kt of CO2 equivalent".

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

>>

The project activity will provide electricity to the Chhattisgarh grid. This electricity will displace existing grid generation capacity and future planned grid capacity additions.

The main variable in determining the volume of emission reductions is the sale of power to the grid. Project emissions will also be calculated annually, should they arise, through the monitoring of any fossil fuels that are combusted to generate electricity. Therefore the monitoring methodology outlined in the small scale rules and procedures is appropriate for the project activity.

Sales of power will be measured by automated sensors (current transformers) installed at the 33kV step up plant for exports to the grid. Monthly readings from CSEB meters installed at the plant will be taken jointly by personnel from CSEB and the plant and form the basis for payments of power sold. This data will be the primary source for the monitoring plan but may be cross checked against the meters at the step up plant.

The combustion of rice husk by the project activity will reduce emissions of methane that would have occurred through the decay of rice husk.

The monitoring of methane emissions will revolve around the quantity of biomass combusted by the project activity. This will be recorded through a weighbridge at the site. Again the monitoring methodology outlined in the small scale rules and procedures is appropriate for the project activity.

The other variables used to determine methane emissions are taken from the most recent IPCC default emissions factors.

D.3 Data to be monitored:

>>

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
1.	*Electrical power*	P_y	*MWh*	*m*	*Monthly*	*100%*	*Electronic*	*2 yr or end of crediting period*	*Continuous recording but will be taken from CSEB sales receipts*
2.	*Mass*	Q_i	*t*	*m*	*Monthly*	*100%*	*Electronic*	*2 yr or end of crediting period*	*Purchased fossil fuels*
3.	*Carbon emission factor*	$COEF_i$	*tC/TJ*	*m*	*Annually*	*100%*	*Electronic*	*2 yr or end of crediting period*	*IPCC data*
4.	*Energy content*	NCV_i	*TJ/kt*	*m*	*Monthly*	*100%*	*Electronic*	*2 yr or end of crediting period*	*Taken from sales contract, if this source not available IPCC or local data will be used*
5.	*Oxidation*	*OXID*	*%*	*m*	*Annually*	*100%*	*Electronic*	*2 yr or end of crediting period*	*IPCC data*
6.	*Mass*	$Q_{biomass}$	*t*	*m*	*Monthly*	*100%*	*Electronic*	*2 yr or end of crediting period*	*From weighbridge receipts*
7.	*Energy content*	$E_{biomass}$	*TJ/t*	*m*	*Monthly*	*100%*	*Electronic*	*2 yr or end of crediting period*	*IPCC data*
8.	*Emissions*	PE_y	tCO_2e	*c*	*Annually*	*100%*	*Electronic*	*2 yr or end of crediting period*	*Project emissions from Type III.E. projects which must be less than 15 kt* CO_2 *equivalent annually*

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

>>

Quality assurance for the data is high due to the commercial importance associated with electricity exports and the use of biomass. The revenue associated with the sale of electricity will be recorded in financial statements and is therefore readily verifiable. The costs associated with the use of rice husk will also be recorded in financial statements. Any usage of fossil fuel will be monitored through purchase receipts and may again be cross checked against financial statements.

The monthly CSEB reading will form the basis of the invoices raised by the factory for the sale of electricity to the grid. These invoices will be generated by the accounts department of the factory and form a further QA/QC check.

The quantity of biomass received by the project will be recorded for each delivery at the weighbridge installed at the site. These weighbridge receipts will be used as the basis of the monitoring of the quantity of biomass.

The quantity of fossil fuel received by the project will also be recorded for each delivery at the weighbridge installed at the site. These weighbridge receipts will be used as the basis of the monitoring of the quantity of fossil fuel but may be cross checked against financial statements as these will provide a direct cost to the project activity.

The DOE used to verify the emission reductions from the project activity is required to ensure that the monitoring plan has been implemented correctly and is required to appraise the data according to accuracy, comparability, completeness and validity. In performing verification, the DOE should conduct regular on-site inspections that may comprise; interviews with managers and operators and observation of processes and controls. The project operator will make available all relevant data as outlined in the above table in a timely manner as and when requested by the verifier.

All data will be kept for a minimum of 2 years following issuance of certified emission reductions or the end of the crediting period, whichever is later, and the storage of this data will be the responsibility of the project developers.

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:

>>

The CDM project data will be collected monthly as per the guidance in the “Agrawal monitoring plan” and will then be collated through the use of the attached spreadsheet tool which has been designed for the project activity. This will permit the monitoring and reporting of emission reductions on a monthly basis. Data input is required in the blue cells with resultant calculations of the emission reductions performed automatically.

The generation data from the turbine will however be continuously recorded by current transformers and a manual hourly record will be made by the turbine operator. This data will be collated at the end of each day and reported in the daily operating report to the factory management, the responsibility for which will be with the GM (Power). This data will form the basis of the ongoing calculation which will then be tallied against the monthly recordings taken by the CSEB and a representative of the plant. The consumption of biomass and purchase of fossil fuel will be reported monthly by the Manager Purchase (Power). The plant will implement a DCS system which will electronically monitor the main performance and output variables of the power plant, the systems for monitoring the CDM aspect of the project will draw extensively from the DCS system.

MVP - ***to be completed monthly***

Data in blue should be entered by project administrator in a timely manner, data in yellow is fixed.

Static data			
Type ID project		**Type III E project**	
CEF, tonnes CO_2e/MWh	1.0137	MCF	0.40
NCV, TJ/kt	19.59	DOC	0.30
EF, tC/TJ	25.80	DOC_F	0.77
Oxidation, %	0.98	F	0.50
		CH_4bio_comb	300
		CH_4_GWP	21
		N_2Obio_comb	4
		N_2O_GW	
		P	310

	Type I D project			Type III E project			
	P_y, MWh	Q_i, t	**Total, ER**	$Q_{biomass}$, t	$E_{biomass}$, TJ/t	**Total, ER**	**Total, ER**
Month 1			0			0	0
Month 2			0			0	0
Month 3			0			0	0
Month 4			0			0	0
Month 5			0			0	0
Month 6			0			0	0
Month 7			0			0	0
Month 8			0			0	0
Month 9			0			0	0
Month 10			0			0	0
Month 11			0			0	0
Month 12			0			0	0
Total			0			0	0

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

>>

Robert Taylor, Agrinergy Ltd, contact information as listed in annex I.

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

>>

Type I – Renewable Energy Projects

I D - Renewable electricity generation for a grid

The guidance indicates that the formula to calculate baseline emission is the kWh produced by the renewable generating unit multiplied by an emission coefficient. As there are no explicit equations these have been developed in section E.1.2.

Type III – Other Project Activities

III E – Avoidance of methane production from biomass decay through controlled combustion

The guidance provides explicit equations to determine the baseline and project emissions. These are therefore highlighted in section E.1.1.

E.1.1 Selected formulae as provided in appendix B:

>>

$$BE_y = Q_{biomass} * CH_4\_IPCC_{decay} * GWP\_CH_4$$

Where:

$Q_{biomass}$ = Quantity of biomass treated under the project activity, tonnes
$CH_4\_IPCC_{decay}$ = IPCC CH_4 emissions factor for decaying biomass in the region of the project activity, tonnes CH_4/tonne biomass
GWP_CH_4 = GWP for CH_4, tonnes of CO_2e/tonne CH_4 ($CH_4\_GWP = 21$)
BE_y = Baseline methane emissions from biomass decay, tCO_2e

$$CH_4\_IPCCdecay = (MCF * DOC * DOC_F * F * 16/12)$$

Where:

MCF = Methane correction factor, fraction (default 0.4)
DOC = Degradable organic carbon, fraction (default 0.3)
DOC_F = Fraction of DOC dissimilated to landfill gas, fraction (default 0.77)
F = Fraction of CH_4 in landfill gas, fraction (default 0.5)
$CH_4\_IPCCdecay$ = IPCC CH_4 emissions factor for decaying biomass in the region of the project activity, tonnes CH_4/tonne biomass

$$PE_y = Q_{biomass} * E_{biomass}(CH_4bio\_comb * CH_4\_GWP + N_2Obio\_comb * N_2O\_GWP)/10\text{^}6$$

Where:

$Q_{biomass}$ = Quantity of biomass treated under the project activity, tonnes
$E_{biomass}$ = Energy content of biomass, TJ/tonne
CH_4bio_comb = CH_4 emission factor for biomass and waste combustion, kg CH_4/TJ (default is 300)
CH_4_GWP = GWP for CH_4, tonnes of CO_2e/tonne CH_4 ($CH_4\_GWP = 21$)
N_2Obio_comb = N_2O emission factor for biomass and waste combustion, kg N_2O/TJ (default is 4)
N_2O_GWP = GWP for N_2O, tonnes of CO_2e/tonne N_2O ($N_2O\_GWP = 310$)

PE_y = Project activity emissions, kt CO_2e

In line with the guidance we do not have to consider leakage and therefore the emissions reductions are given by the following equation:

$$ER_y = BE_y - (PE_y * 1000)$$

Where:
ER_y = Emission reductions resulting from the project activity, tCO_2e

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 emissions will arise from the combustion of coal in the boilers and we use the following equation to determine these:

$$PE_y = Q_i.COEF_i.NCV_i.OXID$$

Where:
PE_y = project emissions in year y, tCO_2e
Q_i = mass of fossil fuel combusted, t
$COEF_i$ = emissions factor of fossil fuel combusted, tCO_2/TJ
NCV_i = net calorific value of fossil fuel combusted, TJ/t
OXID = oxidation factor, %

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
>>
The project will not give rise to leakage as the equipment used for power generation is not transferred from another activity

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

$$PE_y = Q_i.COEF_i.NCV_i.OXID$$

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:
>>

$$BE_y = CEF.P_y$$

$$BE_y = 1.013.P_y$$

Where:
BE_y = Baseline emission, tCO_2e
CEF = constant representing the carbon emissions factor, tCO_2e/MWh (1.013 tCO_2/MWh as arrived at in section B5.1)
P_y = exported power in MWh

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:

>>

$$ER_y = BE_y - PE_y$$

Where:
ER_y = Emission reductions resulting from the project activity, tCO_2e

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

>>

The baseline emissions, project emissions and total emission reductions of each project are shown in the following table. Once the plant has stabilised the total emission reductions from both projects will be 103,262 tCO_2e per annum.

	Type ID project			Type IIIE project			Total
	BE_y	PE_y	ER_y	BE_y	PE_y	ER_y	tER_y
Year 1	48,043	12,786	35,257	96,761	4,512	92,249	121,113
Year 2	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 3	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 4	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 5	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 6	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 7	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 8	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 9	51,045	12,786	38,260	96,761	4,512	92,249	124,116
Year 10	51,045	12,786	38,260	96,761	4,512	92,249	124,116

SECTION F.: Environmental impacts:

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

>>
In relation to the baseline scenario no negative environmental impacts will arise as a result of the project activity.

The positive environmental impacts arising from the project activity are:

- A reduction in carbon dioxide emissions from the replacement of fossil fuels which would be generated under the baseline scenario
- A reduction in the emissions of other harmful gases (NOx and SOx) that arise from the combustion of coal in power generation
- A reduction in ash in comparison to the baseline scenario due to the lower ash content of rice husk relative to coal (15% versus 45% respectively).
- A reduction in methane emissions through the controlled combustion of rice husks

The factory will meet all environmental legislations as set out by the state Chhattisgarh Environment Conservation Board (the State Pollution Control Board) and there will be on-going monitoring of the plant by this state body. A "Consent to Establish" was issued to the plant on 5th October 2004 and a "Consent to Operate" will be obtained prior to commissioning of the plant.

The plant will install an electrostatic precipitator at the exit of the boiler to limit suspended particulate matter in the flue gases to less than 75 mg/Nm^3. There will also investment in waste water systems to treat the water de-mineralisation plant effluent and also the blow down water from the cooling tower and steam generator.

Monitoring of air and water quality will be undertaken on a regular basis as per PCB guidelines after the plant is commissioned.

SECTION G. Stakeholders' comments:

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

>>
The stakeholder review has been conducted on three levels:

- A local stakeholder review
- A national stakeholder review which will be undertaken through the approval by the Ministry of Environment and Forests (the Indian DNA) and consent to operate from the Chhattisgarh Pollution Control Board.
- An international stakeholder review which will be conducted at the time of validation.

The institutions are already in place for the national and international stakeholder review and any comments arising from these processes will be incorporated prior to registration. The project was submitted to the Indian designated national authority (the Ministry of Environment and Forests) in January 2006 and is awaiting their approval.

The *"Gram panchayat"* (a locally elected representative) has been approached and informed of the project, a no objection certificate was issued by the "*panchayat"* on 22nd February 2004.

Other stakeholders that have been notified of the project, through consents and approvals required for the investment, are the Chhattisgarh State Electricity Board, the Chhattisgarh Renewable Energy Development Authority, the Ministry of Commerce and Industry and the State Boiler Inspectorate. These parties have approved the project and provided the necessary approvals required to date.

G.2. Summary of the comments received:

>>
No comments have been received to date.

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

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project has not received any public funding.

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