MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	A.T. Biopower Rice Husk Power Project in Pichit, Thailand
Reference number of the project activity	1026
Version number of the monitoring report	01
Completion date of the monitoring report	31/08/2012
Registration date of the project activity	18/06/2007
Monitoring period number and duration of this monitoring period	Monitoring period 03 and duration of this monitoring period 01/01/2011-31/12/2011(first and last days included)
Project participant(s)	• A.T Biopower Co., Ltd • Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. • Gazprom Marketing & Trading Singapore Pte. Ltd.
Host Party(ies)	Thailand
Sectoral scope(s) and applied methodology(ies)	Sectoral scope 1: ACM0006 Version04 "Consolidated methodology for grid-connected electricity generation from biomass residues"
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	70,772 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	39,832 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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This project activity is designed to reduce the Greenhouse gas emission from replacing some amount of the electricity in the national grid system which mostly generated from the fossil fuel. Since the electricity produced from the project activity is generated from rice husk that would be otherwise be burned in the open air or left to decay.

The project involves the construction and operation of new rice husk power plant in Pichit province with gross generating capacity of generator at 22.5 MWe. The plant operates using suspension-fired boilers, design to burn ground rice husk in suspension. The main equipment has been installed provided in Table 1

Table 1: The main equipment installed in the project activity

Main equipment	Supplier
Boiler	Electrowatt-Ekono (Thailand) Ltd.
Turbine and Generator	Electrowatt-Ekono (Thailand) Ltd.
Balance of Plant	Electrowatt-Ekono (Thailand) Ltd.
Fuel Handling System	Electrowatt-Ekono (Thailand) Ltd.

The project activity has been introduced since 2007. The relevant dates for project activity are provided in Table 2.

Table 2: Relevant dates for the project activity

Activity	Relevant dates for project activity
Construction	05/01/2004
Commissioning	20/09/2005
Commercial operation	21/12/2005
Continued operation periods	21/12/2005 until now

A.2. Location of project activity

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Thailand
Pichit province
Bang Moon Nak city/ Horkai sub-district
Physical location: 96 Moo 2, Horkai sub-district of Ampur Bang Moon Nak, Pichit province, Thailand
Geographical location: Latitude: 16^{o} 04’ 16.67” N; Longitude: 100^{o} 23’ 47.73” E

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Thailand (host)	A.T. Biopower Co., Ltd	No
Japan	Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.	No
United Kingdom of Great Britain and Northern Ireland	Gazprom Marketing & Trading Singapore Pte. Ltd.	No

A.4. Reference of applied methodology

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(a) ACM0006 "Consolidated methodology for grid-connected electricity generation from biomass residues" (Version 04)
(b) "Tool for the demonstration and assessment of additionality" (Version 02)

The applied methodology and tool refer to UNFCCC website as below;
http://cdm.unfccc.int/methodologies/DB/U3THXNPFFSPP2WO1MFB20DXU1444S5/view.html

A.5. Crediting period of project activity

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Type of crediting period: Renewable crediting period for 7 years.

Starting date and length of the crediting period corresponding to this monitoring period:

Starting date of the crediting period: 21/12/2005
Length of the crediting period: 21/12/2005-20/12/2012(first and last days included)

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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This section will provide the information on the implementation status of the project activity during monitoring period in accordance with the applicable provision for description of implemented registered CDM project activity in the Project standard. Also, the installed technology, technical process and equipment, include diagrams will be provided appropriately.

The technology employed into the project activity is a simple power cycle consisting of boiler, turbine, and generator which can be presented as a diagram below.

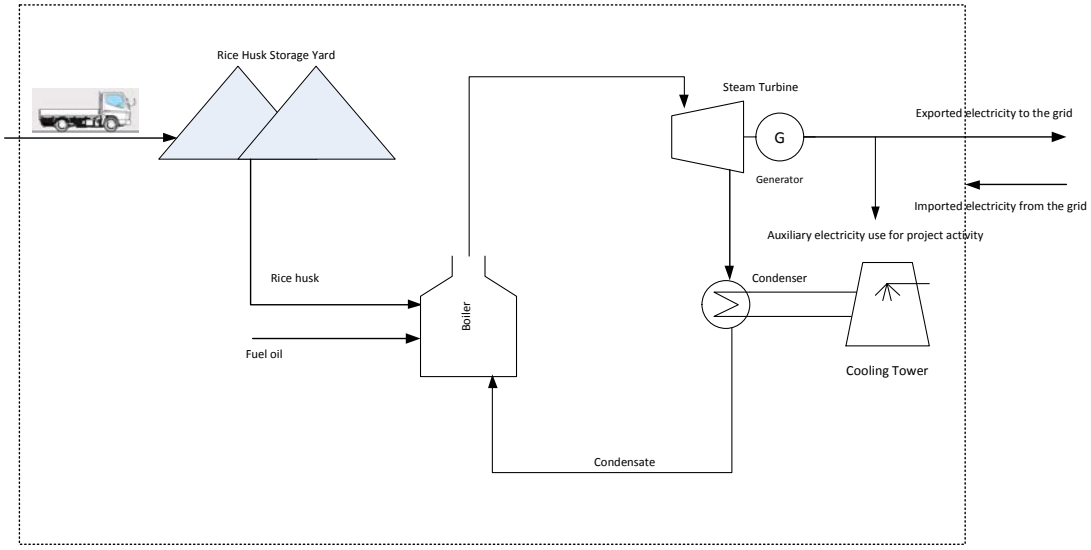

Figure 1: The project activity simple diagram

As per Figure 1, the rice husk is transported from rice mills to the power plant by truck and then stored in the rice husk storage yard preparing to feed to the boiler. Before feeding the rice husk to the boiler, the rice husk are grounded by a grinding machine so that the finely ground rice husk in small fragments will be increased surface areas for combustion, resulting in rapid combustion and at the same time have lighter weight suitable burned during subject to suspension-fired combustion in the furnace while light-weight fly as which occurs in the combustion will be blown away by air pressure.

In details of technical process, after the combustion chamber is started up by using diesel oil reaching a temperature of 700-800^{o}C; then grounded rice husk will be fed from a service silo while the use of diesel oil is gradually decreased until all rice husk ignite continuously. The combustion system is a suspension-fired combustion, where grounded rice husk from a service silo are fed to a fuel-air mixing system and are compressed by air from a primary air fan. The burner has adjustable vanes to force the fuel-air mixture to circulate for proper combustion in the combustion chamber at temperature around 800-900^{o}C.

The feed water is fed to the boiler to become a hot steam. Hot steam is transferred to a steam turbine where thermal energy of the steam is converted to mechanical energy. In the turbine, a governor is fitted to

regulate the steam flow rate and the speed of rotors and the speed or the rotor is reduced by a reduction gear unit to turn to 11.5 KV turbine generator. Then the mechanical energy is converted to electricity which is transmitted by a generator breaker and a step-up transformer to generate a voltage of 115 KV for subsequent distribution through the transmission line of the Provincial Electricity Authority (PEA).

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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In this section, the temporary deviation applied during this monitoring period will be indicated and provided a description of the deviation in accordance with applicable provision for temporary deviations from the registered monitoring plan or applied methodologies in the project standard. Also, the date of approval and reference number will be provided.

The deviation period covers from 01/07/2007 to 06/11/2008 which is accepted by CDM-EB at 16/11/2011 and the reference number is I-DEV0439 (http://cdm.unfccc.int/Projects/DB/DNV-CUK1174909241.2/iProcess/SGS-UKL1216027750.38/view). However, this deviation is only applied from 01/01/2008 to 06/11/2008 in this monitoring period.

The deviation request is for the parameter "On-site fossil fuel consumption of diesel for start-up/auxiliary use, $FF_{project\ plant}$". This parameter ($FF_{project\ plant}$), in absence of the continuous monitoring (as required by the registered PDD, page 38), was calculated using alternative methods. Therefore, this request has been made for the approval of the alternative calculation method, as detailed below, of the estimation of $FF_{project\ plant}$. Following the registered PDD, a fuel meter was installed to continuously measure the quantity of diesel oil consumption in the boiler. However, during 01/07/2007 to 06/11/2008 the fuel meter malfunctioned and underwent maintenance. Therefore, the deviation is only requested for the period 01/07/2007 to 06/11/2008, when the fuel pump meter malfunctioned.

As stated above, the new fuel pump meter has been installed onsite for the purpose of measuring the diesel consumption in the boiler. Thus from 07/11/2008 onwards, the monitoring $FF_{project\ plant}$ is in accordance with the applied methodology ACM0006 Version04. In this monitoring period, only from 01/01/2008 to 06/11/2008 was monitored by considering the fuel stocks at the beginning and at the end of the verification period and cross checked with the fuel purchase receipts.

This deviation request is found in accordance with the applied methodology accordingly. Thus, the deviation result is no significant impact on the emission reductions from the project activity. The conservativeness of the method ($FF_{project\ plant}$ = Initial stock inventory – End stock inventory + Total fuel purchase receipts – F_{trans}) used for calculating the parameter $FF_{project\ plant}$ can be justified through the following points:

- All diesel coming in the project activity is accounted for project emissions;
- The entire diesel inventory is available. The stock inventory can be read on the screen of DCS in the control room and is also recorded by the Shift Operator on a monthly basis;
- All fuel purchase invoices and sales receipts for the entire period of deviation are available;
- The parameter F_{trans} is being monitored correctly as per monitoring methodology and registered monitoring plan.

Since all the diesel oil is accounted for the calculation of project emissions, hence the alternative method for calculation of $FF_{project\ plant}$ is conservative.

B.2.2. Corrections

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During this monitoring period, there are no any corrections to project information or parameters fixed at validation.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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During this monitoring period, there are no any permanent changes from registered monitoring plan or applied methodology.

B.2.4. Changes to project design of registered project activity

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This section the changes to project design of registered project activity will be indicated. The gross electricity generation has been changed from 22 MWe which is mentioned in registered PDD to 22.5 MWe according to name plate of generator inspected by DOE. However, this change does not effected to the additionality of the project activity. Hence, the revised PDD is requested.

The version number of PDD and the completion date of the revised PDD are provided instance of the approval date and reference number since the change is in the process regarding to the "Guidelines for completing the monitoring report form" EB66, Annex 20. Therefore, the completion date of the revised PDD is 12/12/2011 in Version 04.

B.2.5. Changes to start date of crediting period

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During this monitoring period, there are no any changes to start date of crediting period.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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N/A

SECTION C. Description of monitoring system

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The diagram of the monitoring system has been provided in this section according to monitored parameters. Also the description of monitoring system in the project standard will be justified in this section.

The monitored parameters has been measured and monitored according to the diagram below. Firstly, the quantity of rice husk (BF) is measured and recorded when it arrived to the power plant as same as moisture content, the number of truck and the average distance from rice mill to power plant. Also, the sample of rice husk will be taken for heating value measurement according to the method mention in section D. The consumption of diesel oil using in the boiler and onsite transportation are separately measured as shown in the diagram; moreover the heating value of diesel oil is measured follow the measurement method mention in section D. The electricity imported from the national grid and export to the national grid are also measured shown in the diagram. For more detail on each parameter measurement, it is provided in section D.

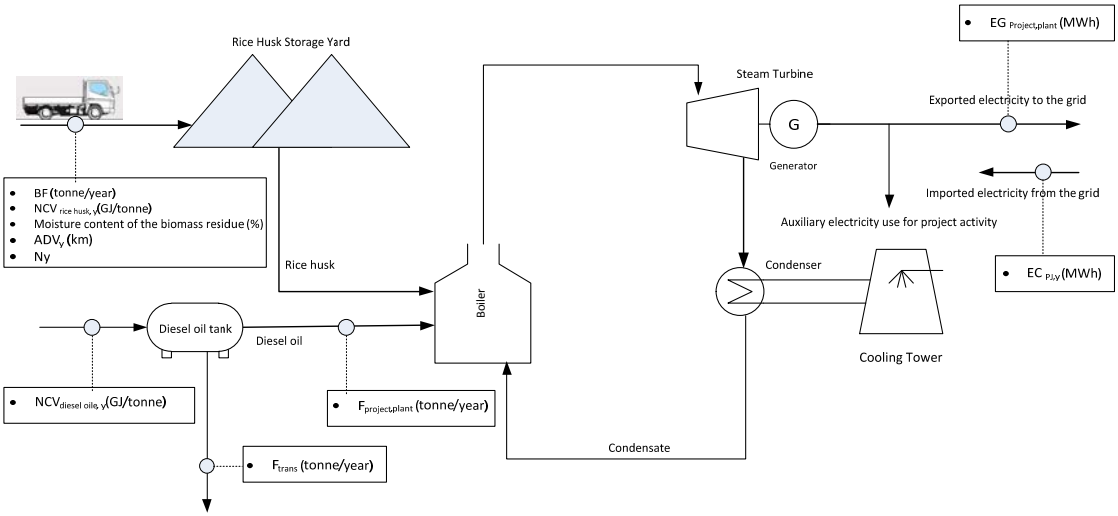

Figure 2: The monitoring system diagram for project activity

In order to monitor emission reduction and any leakage effects generated by the project activity. The information flow has been set up a well-defined management and operational system. This system includes the operation and management of the monitoring plan, which specifies the requirements and procedures for parameters monitoring data recording and data archiving.

The plant manager and operators are responsible for the execution of the monitoring plan. Based on the modern system it intends to use for control and reporting, they collect and archive relevant data in a systematic and reliable way, evaluate them regularly, generate reports, and ensure the availability of pertinent information for verification. For the ease of understanding, ATB outlines the general guidance on performing the monitoring plan in the following areas:

- Establishment of a transparent system for the data monitoring, collection, computation, and recording;
- Development of a protocols that provide routines procedures for electronic based data monitoring and record keeping processes, which must be fitting for independent auditing;

- Development of an "Equipment Calibration Procedures" booklet, which delineates the frequency and detail of each equipment calibration and maintenance; and
- Production and internal verification of monitoring are reported in a regular basis throughout the verification period.

Apart from internally verification done by the plant manager and ATB's board of directors, an independent verifier, DOE, also periodically audits the monitoring results and its management systems in order to ensure credibility and transparency of the reported emission reductions and other performance indicators of the ATB Project.

To ensure that the operators enable to undertake the tasks as per monitoring plan, internal on-the-job training is provided. The staff training programs are carried out before the initial verification with the supports of technical assistants, professionals and system contractors.

The description of the monitoring system which includes data collection procedure, organization structure, roles and responsibility of personnel, and emergency procedures for the monitoring system are provided in CDM manual which is controlled by ISO9001. The CDM manual can be provided during verification to DOE.

SECTION D. Data and parameters
D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/Parameter	GWP_{CH4}
Unit	tCO_2e / tCH_4
Description	Global warming potential for CH_4
Source of data	IPCC
Value(s) applied	21
Purpose of data	Calculation of baseline emission
Additional comment	-

Data/Parameter	EF_{grid}
Unit	tCO_2 / MWh
Description	CO_2 emission factor of the grid
Source of data	Registered PDD
Value(s) applied	0.51
Purpose of data	Calculation of baseline emission
Additional comment	Once upon renewal of a crediting period

Data/Parameter	EF_{OM}
Unit	tCO_2 / MWh
Description	CO_2 Operating margin emission factor of the grid
Source of data	Registered PDD
Value(s) applied	0.60
Purpose of data	Calculation of baseline emission
Additional comment	Once upon renewal of a crediting period

Data/Parameter	EF_{BM}
Unit	tCO_2 / MWh
Description	CO_2 emission factor of the grid
Source of data	Registered PDD
Value(s) applied	0.42
Purpose of data	Calculation of baseline emission
Additional comment	Once upon renewal of a crediting period

D.2. Data and parameters monitored

<table>
<tr><td>Data/Parameter</td><td>BF</td></tr>
<tr><td>Unit</td><td>tonne / yr</td></tr>
<tr><td>Description</td><td>Quantity of rice husk combusted in the ATB plant</td></tr>
<tr><td>Measured/Calculated /Default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Monthly report at site</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>85,844 (tonne/yr at dry basis)</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>Manufacturer</td><td>Commandor</td><td>Commandor</td></tr>
<tr><td>Serial number</td><td>0000700</td><td>0000701</td></tr>
<tr><td>Calibration frequency</td><td>Every 2 years</td><td>Every 2 years</td></tr>
<tr><td>accuracy</td><td>±20 kg.</td><td>±20 kg.</td></tr>
<tr><td>Calibration year 2010</td><td>29/07/2010</td><td>29/07/2010</td></tr>
<tr><td>Calibration year 2011</td><td>13/07/2011</td><td>13/07/2011</td></tr>
<tr><td>Validity</td><td>12/07/2013</td><td>12/07/2013</td></tr>
</table>
</td></tr>
<tr><td>Measuring/Reading/ Recording frequency</td><td>Measuring - Measured by a weighting meter each time truck arrived
Reading - Reading each time that truck arrives.
Recording frequency - Record each time that truck arrive, aggregated monthly and yearly and will be archived electronically</td></tr>
<tr><td>Calculation method (if applicable)</td><td>BF on dry basis = BF wet basis – (1-%moisture)</td></tr>
<tr><td>QA/QC procedures</td><td>Trucks carrying rice husk has been weighted twice, upon entry and exit. Meters at the weighing station was undergo maintenanced subject to appropriate industry standard. The amount of rice husk combusted is estimated from the amount of rice husk delivered to the project site considering the stocks of biomass at the beginning and end of each monitoring period. The rice husk combusted in the power plant has been cross checked with an annual energy balance that is based on purchased quantities and stock changes. The result from the comparison between rice husk combusted and stock changes is less than 5%. Detail of the comparison is provided in ER calculation sheet.</td></tr>
<tr><td>Purpose of data</td><td>Calculating of baseline emission</td></tr>
<tr><td>Additional comment</td><td>The quantity of rice husk weighted by weighting meter is reported on wet basis. Before taking it for calculation, the quantity of rice husk is converted to dry basis the converting equation is mentioned above.</td></tr>
</table>

Data/Parameter	$NCV_{rice\ husk,\ y}$
Unit	GJ / tonne
Description	Net calorific value of rice husk
Measured/Calculated /Default	Measured
Source of data	NCV testing report from external laboratory
Value(s) of monitored parameter	16.13
Monitoring equipment	Laboratory testing
Measuring/Reading/ Recording frequency	**Measuring** - The NCV of rice husk will be measured at least every six months, taking at least three samples for each measurement **Reading -** Every six months **Recording frequency -** Every six months
Calculation method (if applicable)	-
QA/QC procedures	The net calorific value of rice husk has been measured on a half yearly basis according to the national or international approved standards and procedures through a qualified laboratory. Cross checked of the NCV of rice husk from measurement with local figure and IPCC default value are provided in ER calculation sheet. The result is the NCV from measurement and local value are within the range of NCV from IPCC.
Purpose of data	Calculation of project emission
Additional comment	The testing result will be in unit of kcal/tonne and will be converted to GTJ/tonne with simple conversion factor by multiplied 0.41868 x 10-6 as mention in Table 1-3 and Table 1-5 of Perry's Chemical Engineers' Handbook 7th Edition. For the conversion factor of diesel from Btu/lb to GJ/ton is taken from Table 1-4 Perry's Chemical Engineers' Handbook 7th Edition (1Btu/lb = 2,326 kJ/kg = 2.32 x 10-3 GJ/tonne.

Data/Parameter	$NCV_{diesel\ oil,\ y}$
Unit	GJ / tonne
Description	Net calorific value of diesel oil
Measured/Calculated /Default	Default
Source of data	2006 IPCCC Guidelines
Value(s) of monitored parameter	45.65
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Using reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available). The conservative value will be chosen.
Calculation method (if applicable)	-
QA/QC procedures	Check consistency of the reliable local or national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information. Cross checked of the NCV of diesel oil from supplier with local figure and IPCC default value are provided in ER calculation sheet. The conservative figure (hightest) of NCV from fuel supplier is selected to calculate of project emission.
Purpose of data	Calculation of project emission
Additional comment	-

Data/Parameter	Moisture content of the biomass residue
Unit	%
Description	Moisture content of the biomass combusted at ATB plant
Measured/Calculated /Default	Measured
Source of data	Monthly report at site
Value(s) of monitored parameter	8.38
Monitoring equipment	**Manufacturer**: METTLER TOLEDO **Serial number**: 1126400006 **Calibration frequency**: Yearly **accuracy**: ±3% **Calibration year 2010**: 24/09/2010 **Calibration year 2011**: 20/12/2011 **Validity**: 27/10/2012
Measuring/Reading/ Recording frequency	**Measuring –** The measurement has been done for each truck that delivers rice husk to the site by moisture analyser continuously. **Reading -** Each truck that delivers rice husk to the site **Recording frequency** – Each truck that delivers rice husk to the site. Data is to be aggregated monthly and will be archived electronically.
Calculation method (if applicable)	-
QA/QC procedures	Moisture content of the rice husk will be cross checked with the result from the external laboratory with international testing standard at least annually, taking at least three samples for each
Purpose of data	Calculating baseline emission
Additional comment	-

Data/Parameter	$EC_{PJ,y}$
Unit	MWh
Description	Onsite electricity import attributable to the project activity
Measured/Calculated /Default	Measured
Source of data	Monthly report at site
Value(s) of monitored parameter	711.077
Monitoring equipment	**Manufacturer**: EDMI (MK6E) **Serial number**: 23047080 **Calibration frequency**: 1 year **accuracy**: ± 0.5% **Calibration year 2010**: 09/11/2010 **Calibration year 2011**: 15/02/2011 **Validity**: 14/02/2012
Measuring/Reading/ Recording frequency	**Measuring –** Continuous **Reading** - Continuous **Recording frequency –** Monthly to MR
Calculation method (if applicable)	-
QA/QC procedures	Onsite electricity import has been monitored by electricity meter, which was undergo calibration annually by PEA. The consistency of the data has checked against electricity receipt from PEA. The electricity import to project activity is the same as electricity invoice from PEA. The comparison is provided in ER calculation sheet.
Purpose of data	Calculating of project emission
Additional comment	

Data/Parameter	EF_{CH4}
Unit	tCH4 / TJ
Description	Methane emission factor for combustion of rice husk at ATB plant
Measured/Calculated /Default	Default
Source of data	2006 IPCC Guideline for National Greenhouse Gas Inventory
Value(s) of monitored parameter	0.03
Monitoring equipment	-
Measuring/Reading/ Recording frequency	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable)	-
QA/QC procedures	IPCC default values will be used where appropriate.
Purpose of data	Calculation of baseline emission
Additional comment	-

Data/Parameter	AVD_y
Unit	Km
Description	Average return distance between rice millers and ATB plant
Measured/Calculated /Default	Measured
Source of data	Monthly report at site
Value(s) of monitored parameter	85
Monitoring equipment	-
Measuring/Reading/ Recording frequency	**Measuring -** Each truck that delivers rice husk to the site. This will be taken from the transport measurement when the suppliers agree to provide the rice husk to the site. **Reading –** Every time that each truck delivers rice husk to the site. **Recording frequency -** Every time that each truck delivers rice husk to the site.
Calculation method (if applicable)	-
QA/QC procedures	The consistency of distance records will be checked against with maps from the rick husk sources to the site.
Purpose of data	Calculation for project emission
Additional comment	-

Data/Parameter	N_y
Unit	-
Description	Number of truck trips for the transportation of rice husk
Measured/Calculated /Default	Measured
Source of data	Monthly report at site
Value(s) of monitored parameter	4,523
Monitoring equipment	-
Measuring/Reading/ Recording frequency	**Measuring –** Continuously (each time trucks arrive) **Reading -** Continuously (each time trucks arrive) **Recording frequency -** Eeach time trucks arrive
Calculation method (if applicable)	-
QA/QC procedures	The consistency of the number of truck trips with the quantity of biomass combusted will be checked and compared by the relation with previous years.
Purpose of data	Calculation of project emission
Additional comment	-

Data/Parameter	$EF_{km,CO2}$
Unit	tCO_2 / km
Description	Average CO_2 emission factor for transportation of rice husk
Measured/Calculated /Default	Default
Source of data	2006 IPCC Guideline for National Greenhouse Gas Inventory
Value(s) of monitored parameter	0.001097
Monitoring equipment	-
Measuring/Reading/ Recording frequency	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable)	-
QA/QC procedures	IPCC default values will be used where appropriate
Purpose of data	Calculation of project emission
Additional comment	-

Data/Parameter	F_{trans}
Unit	tonne / yr
Description	Fossil fuel consumption for onsite transportation of rice husk
Measured/Calculated /Default	Measured
Source of data	Monthly report at site
Value(s) of monitored parameter	79
Monitoring equipment	**Manufacturer**: TATSUNO **Serial number**: 05010024 **Calibration frequency**: Every 2 years **accuracy**: ± 0.25% **Calibration year 2009**: 03/09/2009 **Calibration year 2012**: 06/02/2012 **Validity**: 15/02/2014
Measuring/Reading/ Recording frequency	**Measuring –** Measured continuously **Reading –** Reading continuously **Recording frequency –** Monthly recorded
Calculation method (if applicable)	-
QA/QC procedures	The amount of fuel consumption will be monitored by fuel pump meters, which will undergo calibration and maintenance regularly. The consistency of the data will be checked against fuel purchase invoices.
Purpose of data	Calculation of project emission
Additional comment	-

<table>
<tr><td>Data/Parameter</td><td>$FF_{project, plant}$</td></tr>
<tr><td>Unit</td><td>tonne / yr</td></tr>
<tr><td>Description</td><td>Onsite fossil fuel consumption for start-up/auxiliary use</td></tr>
<tr><td>Measured/Calculated /Default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Monthly report at site</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>116</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>Manufacturer</td><td>Oval</td></tr>
<tr><td>Serial number</td><td>78043</td></tr>
<tr><td>Calibration frequency</td><td>1 year</td></tr>
<tr><td>accuracy</td><td>±0.25%</td></tr>
<tr><td>Calibration year 2010</td><td>26/03/2010</td></tr>
<tr><td>Calibration year 2011</td><td>20/03/2011</td></tr>
<tr><td>Validity</td><td>19/03/2012</td></tr>
</table>
</td></tr>
<tr><td>Measuring/Reading/ Recording frequency</td><td>Measuring – Measured continuously
Reading - Reading continuously
Recording frequency - Monthly recorded</td></tr>
<tr><td>Calculation method (if applicable)</td><td>-</td></tr>
<tr><td>QA/QC procedures</td><td>The amount of fuel consumption will be monitored by fuel pump meters, which will undergo calibration and maintenance regularly. The consistency of the data will be checked against fuel purchase invoices.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emission</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data/Parameter	$EG_{project\ plant}$
Unit	MWh
Description	Net quantity of electricity generated in the ATB plant
Measured/Calculated /Default	Measured
Source of data	Monthly reported at site
Value(s) of monitored parameter	76,333
Monitoring equipment	**Manufacturer**: Landis&Gyr **Serial number**: 83448562 **Calibration frequency**: 1 year **accuracy**: ±0.2% **Calibration year 2010**: 09/11/2010 **Calibration year 2011**: 06/07/2011 **Validity**: 05/07/2012
Measuring/Reading/ Recording frequency	**Measuring -** Measured continuously by electricity meters (main meter and backup meter). **Reading -** continuously **Recording frequency -** continuously
Calculation method (if applicable)	-
QA/QC procedures	The amount of the electricity generated by the Project will be monitored by electricity meters (main meter and backup meter), which will be calibrated in accordance with the strict standards set by EGAT. The consistency of the data will be verified through the actual sale records between ATB and EGAT.
Purpose of data	Calculating of baseline emission
Additional comment	-

Data/Parameter	$EF_{burning, CH4,k,y}$
Unit	tCH_4 / GJ
Description	CH4 emission factor for uncontrolled burning of the biomass residue
Measured/Calculated /Default	Default
Source of data	2006 IPCC Guideline for National Greenhouse Gas Inventory
Value(s) of monitored parameter	3×10^5
Monitoring equipment	-
Measuring/Reading/ Recording frequency	This parameter will be reviewed yearly. Data will be kept in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable)	-
QA/QC procedures	IPCC default values will be used where appropriate
Purpose of data	Calculation of baseline emission
Additional comment	-

Data/Parameter	EF_{CO2}
Unit	tCO_2 / GJ
Description	CO_2 emission factor of the diesel
Measured/Calculated /Default	Default
Source of data	2006 IPCC Guideline for National Greenhouse Gas Inventory
Value(s) of monitored parameter	0.0741
Monitoring equipment	-
Measuring/Reading/ Recording frequency	This parameter will be reviewed yearly. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the end of the crediting period.
Calculation method (if applicable)	-
QA/QC procedures	IPCC default values will be used where appropriate.
Purpose of data	Calculation of project emission
Additional comment	-

D.3. Implementation of sampling plan

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There are no any data and parameter monitored described in section D.2 are determined by a sampling approach. Then this section is not applicable for this project activity.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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This section will provided sample calculations for all formulae used and calculation of baseline emission, applying actual values. The electronic spreadsheets to present full calculations will be attached in the monitoring report as annex 1.

In term of baseline emission, the main sources are through the exported electricity to the national grid and CH_4 emission from uncontrolled burning of rice husk.

$$BE = ER_{electricity,y} + BE_{biomass,y}$$

Period	BE	$ER_{electricity,y}$	$BE_{biomass,y}$
	tCO_2e	tCO2e	tCO2e
01/01/2011-31/12/2011	42,482	38,929	3,553

(i) Emission reductions due to displacement of electricity

Emission reduction due to the displacement of electricity are calculated by multiplying the net quantity of increased electricity generated with biomass residues as a result of the project activity (EG_y) with the CO2 baseline emission factor for the electricity displaced due to the project ($EF_{electricity,y}$) as follows:

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y}$$

Period	$ER_{electricity,y}$	EG_y	$EF_{electricity,y}$
	tCO_2e	MWh	tCO_2/MWh
01/01/2011-31/12/2011	38,929	76,333	0.51

(ii) Emission of methane emissions, from uncontrolled burning or aerobic decay of the biomass residues

Baseline emissions are calculated by multiplying the quantity of biomass residues that would not be used in the absence of the project activity with the net calorific value and an appropriate emission factor, as follows:

$$BE_{biomass,y} = GWP_{CH4} \cdot \sum_k BF_{PJ,k,y} \cdot NCV_k \cdot EF_{burning,CH4,k,y}$$

To determine the CH_4 emission factor, the level of conservativeness factor depends on the uncertainty rage of the estimate for the CH_4 emission factor. Appropriate conservativeness factor from Table 5 in ACM0006 Version04 is chosen and multiplied with the estimate for the CH_4 emission factor. The default CH_4 emission factor of 0.0027 tCH_4/t biomass is used, the uncertainty can be deemed to greater than 100%, resulting in a conservativeness factor of 0.73. Thus, in this case an emission factor of 0.001971 tCH_4/t biomass is used. However, the $EF_{burnin,CH4,y}$ is calculated by dividing the CH_4 emission factor with the net calorific value in GJ/t biomass.

Period	$BE_{biomass,y}$	GWP_{CH4}	$BF_{PJ,k,y}$	NCV_k	$EF_{burning,CH4,y}$
	tCO_2e/y	tCO_2e/tCH_4	tons dry	GJ/ton dry	tCH_4/GJ
01/01/2011-31/12/2011	3,553	21	85,844	16.13	0.00012

E.2. Calculation of project emissions or actual net GHG removals by sinks

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This section provides the sample calculation for all formulae used and calculation of project emission. The electronic spreadsheets to present full calculations will be attached in the monitoring report as annex 1.

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} \cdot PE_{biomass,CH4,y}$$

Period	PE_y	PET_y	PEFFy	$PE_{EC,y}$	GWP_{CH4}	$PE_{biomass,CH4,y}$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e/tCH_4	tCO_2/yr
01/01/2011-31/12/2011	2,650	431	659	363	21	57

(i) CO_2 emissions from combustion of fossil fuels for transportation of biomass residues to the project plant (PET_y)

In this project activity, the approach based on distance and vehicle type (option 1) is chosen to determine emission from transportation of biomass residues to project plant. Emissions are calculated on the basic of distance and the number of trips as follows:

$$PET_y = N_y \cdot AVD_y \cdot EF_{km,CO2,y}$$

Period	PET_y	$Ny \times AVD_y$	$EF_{km,CO2,y}$
	tCO_2e	km	tCO_2/km
01/01/2011-31/12/2011	431	392,578	0.001097

(ii) CO_2 emissions from onsite consumption of fossil fuels ($PEFF_y$)

CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFF_y = \sum_i (FF_{projectplant,i,y} + FF_{projectsite,i,y}) \cdot NCV_i \cdot COEF_i$$

Period	$PEFF_y$	$FF_{project\ plant,\ i,y}$	$FF_{project\ site,\ i,\ y}$	NCV_i	$COEF_i$
	tCO_2e	tone	tone	GJ/tone	tCO2/GJ
01/01/2011-31/12/2011	659	115.85	78.94	45.65	0.0741

(iii) CO_2 emissions from electricity consumption ($PE_{EC,y}$)

CO_2 emissions from onsite electricity consumption ($PE_{EC,y}$) are calculated by multiplying the electricity consumption by an appropriate grid emission factor, as follows:

$$PE_{EC,y} = EC_{PJ,y} \cdot EF_{grid,y}$$

Period	$PE_{EC,y}$	EC_{PJy}	$EF_{grid,y}$
	tCO_2e	MWh	tCO_2/MWh
01/01/2011-31/12/2011	363	711	0.51

(iv) Methane emissions from combustion of biomass residues

Emissions are calculated as follows:

$$PE_{biomass,CH4,y} = EF_{CH4,BF} \cdot \sum_k BF_k \cdot NCV_k$$

Period	$PE_{biomass,CH4,y}$	$EF_{CH4,BF}$	BF_k	NCV_k
	tCH_4	tCH_4/GJ	ton/yr	GJ/ton
01/01/2011-31/12/2011	57	41.1×10^{-6}	85,844	16.13

The default CH_4 emission factor of 30 kg CH_4/TJ from Table 3 in methodology ACM0006 Version is used, the uncertainty is estimated to be 300%, resulting in a conservativeness factor of 1.37. Thus, in this case a CH_4 emission factor of 41.1 kg CH_4/TJ is used.

E.3. Calculation of leakage

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This section provides sample calculation for all formulae used and calculation of leakage, applying actual values.

As identified in the registered PDD, a leakage assessment was carried out as part of monitoring the supply situation for the rice husk. To demonstrate that the use of rice husk by the project does not result in increased fossil fuel consumption elsewhere, a leakage assessment is carried out. Of the three options provided in the baseline methodology, leakage assessment L_2 is used:

"Demonstrate that there is an abundant surplus of the biomass residue in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residue of type k in the region is at least 25% larger than the quantity of biomass residue of type k that is utilized (e.g. for energy generation or as feedstock), including the project plant."

The baseline methodology stipulates that in defining that geographical boundary of the region for the leakage assessment, the usual distances for biomass transport should be taken into account, and the region may cover a radius around the project activity of at least 20 km but no more than 200 km. Due to the large number of rice millers in the region, it is not possible to isolate public data according to distance. Instead, based on the project's planned procurement area, the geographical boundary was defined in line with the registered PDD as Pichit and the surrounding provinces of Kamphaeng Phet, Phitsanulok, Nakhon Sawan, Uthai Thani, Petchabun and Chainart. These provinces cover an area of roundly 100 km in radius.

The percentage of rice husk in surplus will be calculated by the formulas presented below:

$$\text{Percent of rice husk in surplus } [RH_s] \ (\%) = \left(\text{Amount of available rice husk in the region (tonne/yr)} - \text{Amount of rice husk that is utilized (tonne/yr)}\right) \times 100\%$$

Leakage 2011 (01/01/2011 – 31/12/2011)

1. Rice Production and Rice Husk Production in 2011

Province	Rice Production (Tonnes) 2011			Production of Rice Husk (tonne)
	Major Rice	Second Rice	Total	
Kamphaeng Phet	596,329.00	445,250.00	1,041,579	239,563.17
Phitsanulok	537,862.00	616,220.00	1,154,082	265,438.86
Phichit	706,176.00	620,988.00	1,327,164	305,247.72
Nakhon Sawan	860,564.00	647,496.00	1,508,060	346,853.80
Uthai Thani	219,741.00	194,904.00	414,645	95,368.35
Phetchabun	542,289.00	46,077.00	588,366	135,324.18
Chai Nat	416,188.00	452,192.00	868,380	199,727.40
Total	**3,879,149.00**	**3,023,127.00**	**6,902,276.00**	**1,587,523.48**

Source: Office of Agricultural Economics
http://www2.oae.go.th/mis/Forecast/06_JUNE2555/Thai/table/tbl_t_01.htm
http://www2.oae.go.th/mis/Forecast/06_JUNE2555/Thai/table/tbl_t_02.htm

Based on information from the Office of Agricultural Economics, rice production in the 7 provinces totalled 6,902,276 tonnes, translating to a total rice husk of some 1.59 Million tonnes in 2011.

Husk Use
The major traditional uses of rice husk were identified as the use in chicken farm, brick plants and cement plants, in additional to rice millers' own consumption for rice milling and parboiling. This demand has been relatively stable as mentioned in the PDD. Another source of rice husk is the use for grid connected power plants. The amount of rice husk used for each proposed was estimated base on official data together with survey result obtained by ATB. This information is summarized below.

A. Rice Milling and Parboiling
The quantity of rice husk consumed by rice millers for rice milling and parboiling is calculated 17.11% of total rice husk. This information is based on interview with the Rise Engineering Supply Company, and Ruam Charn Rice Miller.

B. Chicken farms
According to the information from Office of Agricultural Economics, the chicken populations in the 7 provinces total approximately 44.94 million in 2011.

Chicken population in procurement area

Province	Broiler Chicken 2011	Native Chicken 2011	Total	Rice Husk Demand (tonne)
Kamphaeng Phet	1,518,084	862,734	2,380,818	2,856.98
Phitsanulok	4,309,443	482,098	4,791,541	5,749.85
Phichit	1,565,192	553,718	2,118,910	2,542.69
Nakhon Sawan	9,415,015	522,117	9,937,132	11,924.56
Uthai Thani	4,700,766	465,969	5,166,735	6,200.08
Phetchabun	14,572,091	1,930,946	16,503,037	19,803.64
Chai Nat	3,799,412	244,446	4,043,858	4,852.63
Total	**39,880,003**	**5,062,028**	**44,942,031**	**53,930.44**

Source: Office of Agricultural Economics
http://www2.oae.go.th/mis/Forecast/06_JUNE2555/Thai/table/tbl_t_22.htm

Of these, only broiler farms which use evaporator-controlled system need to use rice husk to lay the floor. For conservative estimation, it is assumed that all broiler farms use the evaporator-controlled system. Therefore, the chicken population requiring rice husk is deemed as 53,930.44 tonne in 2011.
In order to ascertain the amount of rice husk used per chicken, ATB conducted an interview as part of an EIA in 2004. Two farmers, one with a small farm of 10,000 chickens and another with a medium farm of 140,000 chickens, gave figures of 1.21 kg and 0.54 kg rice husk requirement per chicken, respectively. Based on the assumption that the difference reflected small farms tending to use a larger amount of rice husk per chicken, the figure of 1.2 kg per chicken per year was determined to be the appropriate and conservative value to use for the estimation of rice husk used in chicken farms. Thus,

$$\text{Rice husk used in chicken farms in the Project's procurement area} = \text{Total chicken population in the Project's procurement area} \times \text{Rice husk demand per chicken (t rice husk/chicken/yr)}$$

C. Brick plants

Data on the number of brick plants in the project's procurement area of 7 provinces and their production capacities were obtained from the Department of Industrial Works. The number of brick plant is the same as for year 2005, as provided in PDD, because the Department of Industrial Works has not registered any new brick plants since 2005. In an interview with one major brick supplier, it transpired that the demand for brick in this region has decreased by 5-10%, which accounts for no new brick plants being set up.

Brick plants in procurement area

Province	Number of brick plants	Total Capacity (piece/year)	Rice Husk Demand (tonne)
Kampaeng Phet	17	26,590,000.00	6,647.50
Phitsanulok	24	30,550,000.00	7,637.50
Pichit	4	1,650,000.00	412.50
Nakhon Sawan	17	19,585,000.00	4,896.25
Uthai Thani	14	58,680,000.00	14,670.00
Phetchabun	14	45,315,000.00	11,328.75
Chainart	13	14,990,000.00	3,747.50
Total	**90**	**197,360,000.00**	**49,340.00**

Source: Department of Industrial Work. Latest data available for 2006; accessed on 28 May 2008.

ATB conducted an interview with 4 brick makers in 2004. The brick makers gave rice husk consumption figures of between 0.18 kg and 0.25 kg for production of one piece of brick, with the smaller brick makers requiring more rice husk per piece of brick. For the purpose of a conservative, the 0.25 kg figure was used for the estimation of rice husk used in brick plants. Also for conservatism, it is assumed that all brick plants use rice husk for their energy requirement.

$$\text{Rice husk used in brick plants in the Project's procurement area} = \text{Total bricks produced in the Project's procurement area (bricks/year)} \times \text{Rice husk demand per piece of brick produced (t rice husk/brick)}$$

According to the formula above the rice husk use in brick plants in the project procurement area is around 49,340 tonnes annually.

D. Cement plants

There is one known cement manufacturer in the procurement area that uses rice husk as part of its fuel mix. ATB conducted an interview with the manufacturer in order to obtain the consumption volume of rice husk. Based on the interview, the rice husk use for cement plants was determined to be 10,600 tonne.

E. Grid-connected power plant

There are currently four power plants by the Thai Power Supply Company totaling an approximately 14 MW gross located approximately 100 km from the project site.
Based on ATB's interview with the power company, the total rice husk use for the four plants is approximately 81,136 tonnes per year. Therefore, it is assumed that 81,136 tonnes, are procured from within the project's leakage assessment area.

Rice husk surplus

The following table summarizes that supply and demand situation of rice husk in the 7 provinces – Pichit, Kamphaeng Phet, Phitsanulok, Nakhon Sawan, Uthai Thani, Petchabun and Chainart. – that comprise the project's procurement area.

2. Supply and demand of rice husk in procurement area

	Tonnes
Supply	**2011**
Rice husk production	1,587,523
[A] Total Supply	**1,587,523**
Demand	
Rice milling and parboiling	271,625
Chicken farms	53,930
Brick plants	49,340
Cement plants	10,600
Grid-connected power plants	81,136
ATB Project's fuel requirement	95,153
[B] Total Demand	**561,784**
Surplus [A] - [B]	**1,025,739**
Surplus as defined by ACM0006 ([A]-[B])/[B]	**183%**

It can be seen from the table above that the quantity of available rice husk in the region is approximately 183 in 2011 which is larger than the quantity of rice husk that is used, for all purposes including the ATB plant. This is significantly higher than the 25% threshold given in the baseline methodology. Therefore, the project does not bead to any leakage.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
Total	42,482	2,650	0	39,832

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	70,772	39,832

E.6. Remarks on difference from estimated value in registered PDD

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The actual monitored values are lower over the monitoring period from 01/01/2011-31/12/2011 than those estimated in the PDD. It is because of back down and shut down time in this period is higher than expected.

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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