PROJECT DESIGN DOCUMENT

Wilmar International Ltd

27 August 2010

Version 1

CONTENTS

ANNEXES

1 Description of Project:

1.1 Project Title

Panjin Rice Husk Thermal Energy Generation Project

1.2 Type/Category of the project

The project falls into Sectoral Scope 1 - Energy Industries (renewable sources) under the Clean Development Mechanism (CDM). The project meets the applicability criteria (refer section 2.2) for thermal energy production as defined in the approved small-scale CDM baseline and monitoring methodology AMS I.C version 16 **"Thermal energy production with or without electricity"**. The project is a stand alone project and is not grouped with any other project.

1.3 Estimated amount of emission reductions over the crediting period including project size:

The estimated total emission reductions over 10 year crediting period are 595,332 tCO_{2e} (with only steam generation) and 334,388 tCO_{2e} (with both steam and electricity generation), respectively. The start date of the crediting period is 19 October 2009.

Years	Estimated emission reductions without electricity generation (in tCO_{2e})	Estimated emission reductions with electricity generation (in tCO_{2e})
2009-2010	33,074	33,074
2010-2011	33,074	33,074
2011-2012	66,148	33,530
2012-2013	66,148	33,530
2013-2014	66,148	33,530
2014-2015	66,148	33,530
2015-2016	66,148	33,530
2016-2017	66,148	33,530
2017-2018	66,148	33,530
2018-2019	66,148	33,530
Total estimated reductions (tCO_{2e})	595,332	334,388
Total number of crediting	10	10

years		
Annual average over the crediting period of estimated reductions (tCO_{2e})	59,533	33,438

Therefore, based on designed outputs/demand for maximum steam or electricity, the annual average emission reductions are expected to vary between 33,438 tCO_{2e} and 59,533 tCO_{2e}. Based on the estimated annual average emission reductions, the project size lies between micro and mega projects.

1.4 A brief description of the project:

The project is a green-field rice husk based thermal energy generation system to produce steam and electricity (potential future plan). The project is owned and operated by Yihai Kerry (Panjin) Bio-cogeneration Co., Ltd. ("Project Proponent" or "PP"), a subsidiary of Wilmar International Ltd.

The PP will purchase rice husks from the 'Yihai Kerry (Panjin) Oils and Grains Industries Co., Ltd' also the consumer of steam ("steam customer") and from the surrounding areas if required. No other co-firing is provided for.

The project comprises two boilers with installed capacity of 15 MT/hour each and one steam turbine with an installed capacity of 6 MW. The project commissioning is expected to be in two phases as per the following:

- Phase I (19 October 2009): 2 boilers each 15 MT/hour capacity capable of generating medium pressure (3.82 MPa) superheated steam at 450^{o}C, with either one of the two boilers likely to operate, and

- Phase II (expected to start from 2011): 6 MW steam condensing turbine that is likely to be optimally run at 3 MW.

The project is designed to generate 15 MT/hour steam at commissioning of Phase I and that could be increased to 30 MT/hour steam by commissioning of Phase II with the flexibility to optimally generate around 3 MW of electricity. The additional 3 MW turbine capacity is intended as a buffer for generation greater than 3 MW of electricity in cases of lower demand from the steam customer or excess availability of rice husk. For the purpose of claiming emission reductions during the crediting period, actual (monitored) steam and electricity outputs will be used.

This means that the primary objective of the PP is to sell the steam to a steam customer. If any excess steam is available, such will be used to generate electricity and sold to the grid. Since the generation and supply of electricity will be variable, the project will act as a peak load plant connected to the grid and not a base load plant. Hence, no obligations are expected to be applicable on the PP to continuously and consistently supply a pre-determined quantity of electricity to the grid. The project contributes to the greenhouse gas (GHG) emission reduction by avoiding potential use of a fossil fuel (in this case, coal) for thermal energy production.

The project will contribute to the sustainable development in China with respect to the following aspects.

- Advantages of utilization of rice husks as energy source has three main perspectives in China:

    - **waste management:** minimizing the environmental problems associated with the prevailing practice of its unplanned disposal including dumping and/or burning in an uncontrolled manner;

    - **energy security:** utilization of rice husks in place of other fossil fuels (in this case, coal) could reduce the rising demand for coal as energy source;

    - **environmental benefits:** avoidance of coal will reduce potential GHG emissions associated with use of coal.

- The project boiler design is a new technology developed in-house by the PP in collaboration with the Harbin Industrial University. Successful application of the new technology will promote its adaptation by other industrial plants in the neighboring cities and even all over China. This is in line with the government's initiative of encouraging renewable energy technologies to create a more sustainable supply of energy for which demand is increasing tremendously in response to the rapid increase in industrialization[1].

- Implementation of the new technology comes with the need for trained manpower to construct, operate, and maintain the system. Thus, the local citizens employed by the project will benefit from additional training and increased job opportunity.

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[1] The Renewable Energy Law for the People's Republic of China

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

The project will be located at at Panjin, Liaoning Province, China. The location GPS coordinates are 41°14'56.87"N and 122° 0'37.56"E. The project site is about 10 km from Panjin town to the north.

Figure 1 and

Figure 2 show the geographical location of Liaoning Province and Panjin in Liaoning Province, respectively.

Figure 1: Geographical Location of Liaoning Province

Figure 2: Geographical Location of Panjin in Liaoning Province

1.6 Duration of the project activity/crediting period:

The PP has proceeded with this project in a phase-wise manner based on the overall plan for phase-wise operational start of the two boilers and a turbine. The initial financial commitment to the project was made on 31 July 2008 based on the 'Authorised Financial Capital Expenditure' ("AFCE") which is a management level approval document to evaluate and authorize initial investments for any new project. Additional financial commitments for the turbine installations will be made in due course.

The operations of the project (Phase I: operation of one 15 MT/hour boiler) started on 19 October 2009. The crediting period is 10 years and the start date will be 19 October 2009. The project is expected to be operational for at least 15 years.

1.7 Conditions prior to project initiation:

The proposed project is a green-field project, where no prior energy generation activity similar to the project had occurred.

In the VCS project, Phase I comprises operation of a 15 MT/hour boiler and Phase II comprises additional operation of another 15MT/hour boiler and a 6 MW steam turbine which is likely to optimally run at 3 MW.

There are two customers for the project output:

(1) grid for electricity and

(2) 'Yihai Kerry (Panjin) Oils, Grains and Foodstuffs Industries Co., Ltd' for steam required in its rice mill related processes.

Prior to the project, grid sourced electricity from connected existing electricity suppliers. The project has not been developed with the objective of displacing any such existing electricity supplier, and it is incidental that the project may have the capability to generate electricity in future.

Prior to the project, the steam requirement did not exist for the steam customers and hence the project does not displace any existing steam generation project.

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

Emission reductions are achieved through avoidance of use of coal (the most commonly used fossil fuel in the region) by using rice husks, a carbon neutral fuel. The proposed project will use approximately 136 tonnes rice husks per day per boiler. Thus, in Phase I, the project is expected to use 136 tonnes of rice husks per day and in Phase II about 272 tonnes per day. The project will achieve GHG emission reductions by avoiding CO_2 emissions from the business-as-usual scenario (use of coal).

1.9 Project technologies, products, services and the expected level of activity:

The project involves installation and operations of two sets of boilers with a total capacity of 30 MT/hour coupled with a 6 MW condensing type steam turbine.

Rice husks will be the only source of energy used to generate the steam and electricity. For start-up operations, fire wood is used; this will not contribute as an energy source.

The project employs a new technology based on the moving chain conveyor concept. The technology comprises a natural circulation steam boiler with 5% continuous rate of blow-down. The treated water is heated to reach its saturated temperature of 104^{o}C in an economizer utilizing the return condensate and hot flue gases (at about 160^{o}C).

Inside the combustion chamber in the boiler, the rice husks are mixed with air at an inlet temperature of 170^{o}C. The rice husks are kept in suspension using circulating fluidized bed mechanism by use of blowers at the bottom and induction fans at the top of the boiler. This feeding system increases the overall boiler efficiency compared to normal feeding system which is a fuel efficient feature in this technology. In order to control the quality of the rice husk ash, temperature inside the boiler needs to be maintained at 450-650^{o}C. This is achieved through the design of internal inclined reciprocating grate which allows the ash to cool down prior to entering the ash collection system at the bottom of the boiler. There will be a provision for then coupling the boiler outputs with a steam condensing turbine to generate electricity.

Figure 3 summarizes the conceptual configuration of the overall system.

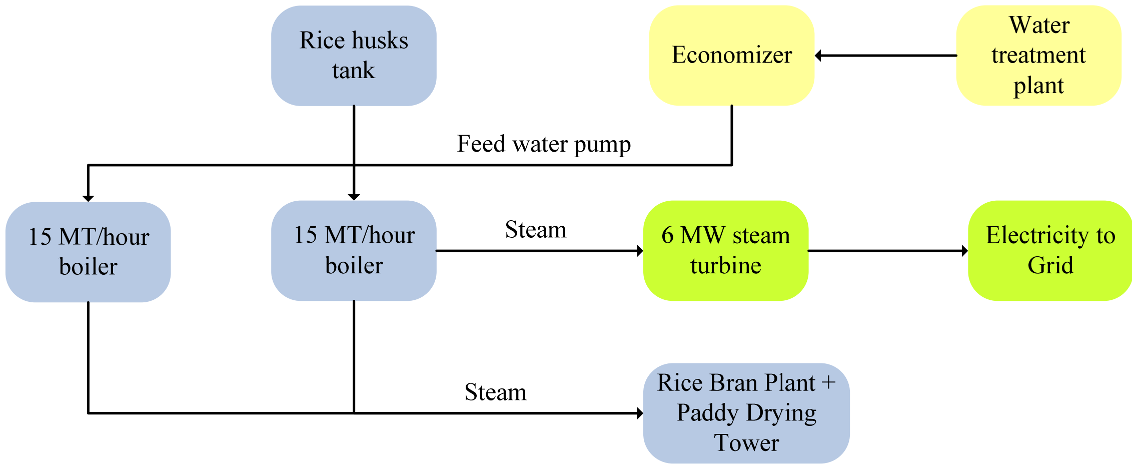

Figure 3: Flow Diagram of the Heat Generation System

The project is expected to be operated for 330 days in a year (or approximately, 8,000 hours) excluding scheduled routine operation and maintenance requirements stoppages. The boiler integrity checks are significantly important as use of rice husk (due to its high silica content) causes higher abrasion as compared with conventional fuels (like coal). As per local regulations, an external integrity check is prescribed once each year and an internal integrity check once in two years. In addition, calibration requirements are prescribed to be conducted once a year for temperature and pressure meters.

Rice husk is procured from a source located close to the project boundary (within 500 meters) and conveyance is by pipeline under suction to an intermediate silo for temporary storage avoiding development of any anaerobic conditions.

The project is in line with environment protection requirements (as per an environmental impact assessment study) and will not affect local environmental safety. With the project technology and associated facilities developed locally, the project involves no technology transfer from abroad. The ash generated from the project will be given away for a third party for use in silica production.

1.10 Compliance with relevant local laws and regulations related to the project:

There are no existing local laws and regulations favouring or restricting the implementation of rice husk based thermal energy production. The local environmental regulations provide requirements for pollution control from the project and an environmental impact assessment (approved by the regulators) have been completed. The PP has provided for various inspections required for the project equipment as per the local regulations (also refer section 1.9).

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

The following risks could substantially reduce the emission reductions.

- The project might be down for a longer than expected period of time due to system unfamiliarity in the new technology and other technical problems (such as higher corrosion) requiring more maintenance than expected. No prior experience of operating and maintaining this new technology is available, resulting in new challenges in case of upsets of the project plant thereby increasing the possibility of extended down time.

- The steam production is dependent upon the uptake rate of the steam consumer. If there be any disruptions/reductions in the steam demand from this consumer, the steam production from the project will be reduced resulting in lower rice husk use and hence lower emission reductions.

- Improper record keeping and/or loss of data would render difficulties in providing documentary evidence on the reductions achieved.

- Problems associated with calibration and operation of the metering instruments at the plant could also give rise to difficulty in accurate record keeping and emission reduction estimations.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The PP has started this green-field project using locally available rice husks. As per current practice in the region, rice husk from different rice mills are normally dumped outside rice mills and/or burnt. Some of the rice husk decays and the rest are taken away by local villagers for various domestic uses such as poultry feed, etc. The PP is an independent organization in the business of thermal energy generation for commercial sale. The project therefore does not create any GHG emissions for subsequent removal.

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

The project has not created any other forms of environmental credits. In China, the other environmental credit that could have been created is Certified Emission Reductions (CER) under the CDM process. The project has not participated in the CDM process.

1.14 Project rejected under other GHG programs (if applicable)

Not applicable, since the project has not participated in any other GHG program.

1.15 Project proponents' roles and responsibilities, including contact information of the project proponent, other project participants:

Role: VCS Project Developer

Responsibility: Undertake all activities leading to registration of VCS project and monitoring, verification and issuance of VCU.

Wilmar International Ltd.
56 Neil Road
Singapore 088830

Contact: Mr. Joshua Lim
Tel: (65) 6216 0244
Fax: (65) 6233 9493
E-mail: joshualim@wilmar.com.sg

Project Host/Project Participant (PP)

Responsibility: Undertake all activities leading to implementation and operation of the project and provision of necessary information to the project developer for registration of VCS project and monitoring, verification and issuance of VCU.

Yihai Kerry (Panjin) Bio-Cogeneration Co., Ltd.
Taiping Town, Panshan County
Panjin City, Liaoning Province, China 124101

Contact: Mr. Li Chao
Tel: +86 10 52177018
Fax: +86 10 52177188
E-mail: lichao8@wilmar-intl.com

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.

All relevant information is captured in other sections of this PD.

1.17 List of commercially sensitive information (if applicable):

The following information is proprietary and confidential:

- Rice husk procurement agreements entered by the PP;
- Steam sale agreement between the PP and the steam customer;
- Contract between the PP and Wuxi Taihu Boiler Company (contractor for boiler installation); and
- Boiler technology concept and design, including contract between the PP and Harbin Industrial University for developing the new technology.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

An approved methodology under the CDM processes has been applied to the project activity as the applicable VCS methodology. This CDM methodology is the 'simplified baseline and monitoring methodology AMS I.C - version 16' "Thermal energy production with or without electricity".

2.2 Justification of the choice of the methodology and why it is applicable to the project activity:

Applicability of AMS I.C (version 16) for the project activity is justified below.

Applicability Requirements	Compliance with Applicability Criteria
Paragraph 1	
This category comprises renewable energy technologies that supply users (residential, industrial or commercial facilities) with thermal energy that displaces fossil fuel use.	The project activity will exclusively use rice husks (with a new renewable energy based technology) to produce thermal energy thereby avoiding the need to use coal as the most likely fossil fuel.
Paragraph 2	
Biomass-based cogenerating systems that produce heat and electricity are included in this category. The cogeneration system may supply one of the following: (a) Electricity to a grid (b) Electricity and/or thermal energy for on-site consumption or for consumption by other facilities (c) Combination of (a) and (b).	The project activity comprises installation of a system to generate and sell thermal energy in the forms of steam, with a future additional provision of electricity. The steam is sold to another facility and electricity will be sold to the local electricity grid. Thus, the project supplies both electricity and heat.

Applicability Requirements	Compliance with Applicability Criteria
Paragraphs 3 and 5	
The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal.	The total energy generated shall be as per the following: • Phase I: 15 MT/hour steam (equivalent to 349.6 TJ thermal energy generated per year) at 3.82 MPa and 450^{o}C, installed thermal energy = [349.6 TJ * (1/(3.6 TJ/GWh*10^9)) * 10^12] / 8000 hours = 12.15 MW; and • Phase II: maximum of 30 MT/hour steam at 3.82 MPa and 450^{o}C, and electricity generated in 6MW turbine. The total installed thermal energy = (2 * 12.15 MW) + (3 * 6MW) = 42.3 MW. Thus, the combined maximum installed energy generation capacity of the project (42.3 MW thermal) is less than 45 MW thermal (limit).
Paragraph 4	
For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel shall not exceed 45 MW thermal.	The project is not a co-fired system. Rice husks will exclusively be used to fire the boilers without the use of other fuels. Wood, which is a carbon neutral fuel, will be used during start-up.
Paragraph 6	
In case electricity and/or steam/heat produced by the project activity is delivered to another facilities or facilities within the project boundary, a contract between the supplier and consumers of the energy will have to be entered into specifying that only the facility	A supplement to the contract between the PP and the "steam customer" provides that only the PP will claim the emission reductions. The electricity generated will be sold to the national grid. In China, the electricity grid is owned by the government that does not

Applicability Requirements	Compliance with Applicability Criteria
generating the energy can claim emission reductions from the energy displaced.	engage in developing emission reduction projects; hence the PP need not enter into any contract on emission reductions exclusivity this with the electricity authority.
Paragraphs 7, 8 and 9	Not applicable.

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

Figure 5 and 5 below show the delineation of the project boundary for the baseline scenario and project.

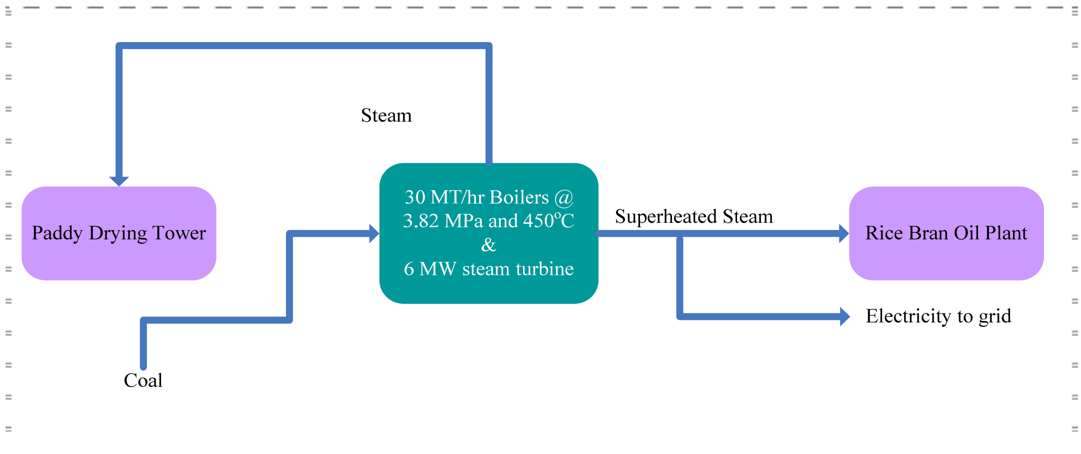

Figure 4: Delineation of the Baseline Scenario

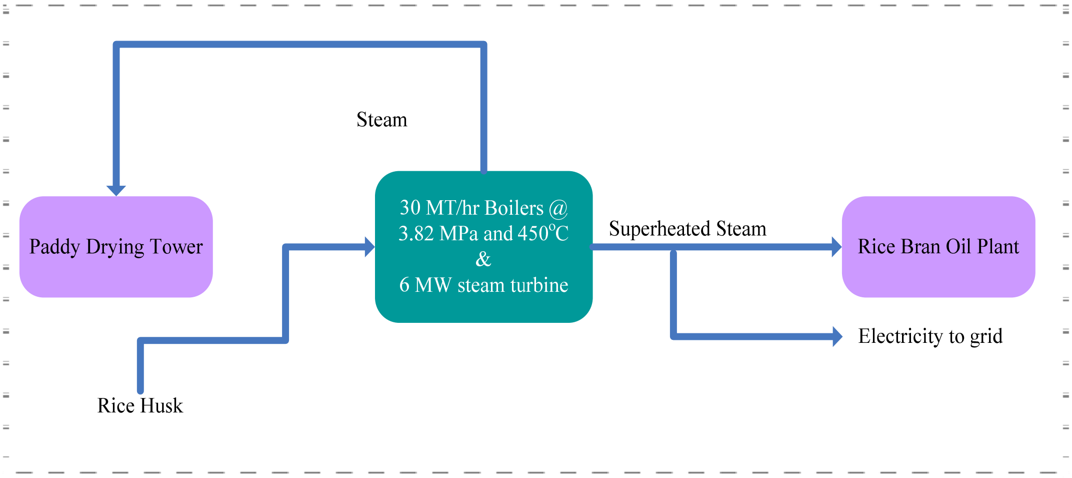

Figure 5: Delineation of the Project Activity

The following table describes the sources of emissions from the project.

Source		Gas	Included?	Justification/ Explanation
Baseline	Fossil fuel (coal) combustion for heat and electricity generation	CO_2	Yes	Major GHG emissions in the baseline.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project Activity	Combustion of biomass residues for heat generation	CO_2	No	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be small.
	Biomass collection, processing and transportation	CO_2	No	The rice husks are procured from sources in proximity to the project and there are no significant collection, processing and

Source		Gas	Included?	Justification/ Explanation
				transportation requirements. Thus, CO_2 emissions associated with collection, processing and transportation are negligible and thus excluded for simplification.
		CH_4	No	Excluded for simplification. Since biomass residues are stored for not longer than one year, this emission source is assumed to be small.
		N_2O	No	Excluded for simplification. This emissions source is assumed to be very small.

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

According to the description of various baseline scenarios in Clause 12, the following table will illustrate the identification and analysis of the baseline for the project activity.

The baseline scenarios according to AMS I.C. (Version 16)	Comments
(a) Electricity is imported from the grid and thermal energy (steam/heat) is produced using fossil fuel.	The project involves the generation of steam for sale to another facility and electricity to be exported to the grid. Thus, in the absence of project, the electricity would be generated by other grid-connected power plant and steam would be produced by coal-fired boiler. The baseline scenario (a) is a possible scenario.
(b) Electricity is produced in an on-site captive power plant using fossil (with a possibility of export to the grid) and thermal energy	According to current China's laws and regulations, in areas covered by major regional power grids, construction of captive thermal power plants with single

The baseline scenarios according to AMS I.C. (Version 16)	Comments
(steam/heat) is produced using fossil fuel.	capacity of 135 MW or below is prohibited by the Chinese Government[2]. Thus the baseline scenario (b) is not applicable.
(c) A combination of (a) and (b).	Since (b) is not applicable, a combination of (a) and (b) is also not applicable.
(d) Electricity and thermal energy (steam/heat) are produced in a cogeneration unit using fossil fuel (with a possibility of export of electricity to the grid/other facilities and/or thermal energy to other facilities).	The project activity involves generation of thermal energy (steam) in Phase I and generation of steam and electricity in Phase II. The steam will be sold to another facility ("steam customer") and electricity will be exported to the grid. The equal amount of thermal energy provided is commonly generated using fossil fuel (coal) in the region. The (d) baseline scenario appropriately describe the likely baseline situation of the project activity, thus (d) is applicable.
(e) Electricity is imported from the grid and/or produced in an on-site captive power plant using fossil fuels (with a possibility of export to the grid); steam/heat is produced from biomass.	The equal amount of heat was commonly generated from the fossil fuel-fired (coal-fired) boilers in the region. So the baseline scenario (e) (steam/heat produced from biomass) is not applicable.
(f) Electricity is produced in an on-site captive power plant using biomass (with a possibility of export to the grid) and/or imported from the grid; steam/heat is produced using fossil fuel.	The equal amount of electricity was commonly generated from the grid-connected fossil fuel-fired plants in the region. Thus the baseline scenario (f) is not applicable.

[2] Notice on Strictly Prohibiting the Installation of Fuel-fired Generation with the Capacity of 135MW or below issued by the General Office of the State Council, Decree No. 2002-6

The baseline scenarios according to AMS I.C. (Version 16)	Comments
(g) Electricity and thermal energy (steam/heat) are produced in a biomass fired cogeneration unit (without a possibility of export of electricity either to the grid or to other facilities and without a possibility of export of thermal energy to other facilities).	The project will export electricity to the grid and thermal energy to other industrial facilities. Therefore, the baseline scenario (g) is not applicable.
(h) Electricity and/or thermal energy produced in a co-fired system.	The common thermal energy (steam and electricity) generation technology used in region is fossil fuel (coal) fired system, not co-fired system. So the (h) baseline scenario is not applicable.

As per the analysis above, the possible baseline scenarios for the project are scenario (a) and (d). To be conservative, the scenario which results in a lower baseline emission value will be used for the project.

Scenario (a)
As per clause 16 of AMS I.C (version 16), for project that supply electricity to the grid, the emission factor of the grid shall be calculated as per the procedures detailed in AMS I.D

Based on the calculations in Annex 1,
$EF_{grid,y}$ = 0.92675 tCO_{2e}/MWh.

Annual quantity of electricity generated (in Phase II),
$EG_{electrical}$ = 3 MW * 8000 hours = 24,000 MWh

Steam required for 3 MW electricity = 18.5 MT

Total available steam from two boilers = 30 MT

Steam sold to steam customer = 30.0 – 18.5 = 11.5 MT

Steam enthalpy (superheated at 3.82 MPa and 450^{o}C) = 3,332.52 kJ/kg

Feed water enthalpy (saturated at 0.103 MPa and 104°C) = 419 kJ/kg

Annual steam quantity = 11.5 MT/hour * 8,000 hours = 92,000 MT

$EG_{thermal,y}$
= (92,000 MT) * (3,332.52 kJ/kg – 419 kJ/kg) * (10^3 kg/MT) * (TJ/10^9 kJ)
= 268.04 TJ

$EF_{FF,CO2}$ = 94.6 tCO_2/TJ, as per IPCC

$\eta_{BL,thermal}$ = 100%, as per Clause 18(c) of AMS I.C (version 16)

$BE_{thermal}$ = (268.04 TJ / 100%) * 94.6 tCO_2/TJ
= 25,357 tCO_{2e}

$BE_{electrical}$ = 0.92675 tCO_{2e}/MWh * 24,000 MWh
= 22,242 tCO_{2e}

Therefore, $BE_y = BE_{thermal} + BE_{electrical}$
= 25,357 tCO_{2e} + 22,242 tCO_{2e}
= 47,599 tCO_{2e}

Scenario (d)

As per clause 17 of AMS I.C (version 16), the baseline emission is calculated as per following.

$BE_{cogen,CO2,y} = [(EG_{PJ,thermal,y} + EG_{PJ,electrical,y} * 3.6)/\eta_{BL,cogen}) * EF_{FF,CO2}$

$EG_{PJ,electrical,y}$ = 24,000 MWh

Annual steam quantity = 92,000 MT
= 268.04 TJ

$EF_{FF,CO2}$ = 94.6 tCO_2/TJ, as per IPCC

$\eta_{BL,cogen}$ = 100%, as per Clause 18(c) of AMS I.C (version 16)

$BE_{cogen,CO2,y}$
= [{(268.04 TJ) + (24 GWh * 3.6 TJ/GWh)}/100%] * (94.6 tCO_2/TJ)
= 33,530 tCO_{2e}

Since the baseline emission for scenario (d) is lower as compared to scenario (a), the baseline scenario that would have otherwise been implemented (most likely) in the absence of the project has been provided in clause 12(d) in the AMS I.C (version 16). Clause 17 has thus been used under section 3 in the estimation of the emission reductions in this PD.

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality):

The project activity's compliance with applicability requirements of AMS I.C (version 16) is described in section 2.2. The assessment and demonstration of additionality is described below using the prescribed 'Project Test' approach provided under clause 5.8 of the Voluntary Carbon Standard 2007.1 (18 November 2008).

Step 1: Regulatory Surplus
The project is not be mandated by any systematically enforced law, statute or other regulatory framework in China.

Step 2: Implementation Barriers
The project faces the following two distinct barriers compared with barriers faced by alternative project (which is implementation use of coal based boilers).

Investment/Institutional barrier
According to an economic report from Hexun News[3], biomass energy generation companies are making loss in China due to high capital investment, lower technological efficiency (as compared to fossil fuel based technologies) and the lack of substantial benefits from implementing such projects. Through the market analysis done in such economic reports, investors have become very unwilling to provide funding to such project (i.e. biomass energy generation industry) due to the high financial risks.

In addition, the PP as a Foreign Invested Enterprise (FIE) faces difficulty in securing bank loans. Such difficulty in securing external loans is demonstrated in a journal written by US International Trade Commission[4] which highlights the challenges due to limited capital access and restrictive foreign exchange control system in China. The

[3] http://news.hexun.com/2010-07-11/124210745.html
[4] http://www.usitc.gov/publications/332/journals/access_to_capital_china.pdf

journal is also supported by a survey study by PricewaterhouseCooper where FIEs confirm the difficulties posed by the foreign exchange control system and limited access to local capital. FIEs have also identified financial and tax issues, and particularly the regulation of capital and earnings, as one of the greatest challenge of investing in China. In addition, the report also cited difficulties in obtaining loans and banking services that are inadequate to meet demand.

Due to the aforesaid financial barriers, the PP sought financial assistance from another independent group company to invest in the project. The investing company provided funding in view of the VCU revenue expected to be generated through VCS registration of the project, as the VCU revenue mitigates some of the project investment risks. Therefore, the VCU revenue helped in overcoming the investment/institutional barrier.

In comparison, a more common alternate for thermal energy generation using coal with conventional technology is expected to be financially more attractive and less risk exposed for commercial lending/external project financing. However, implementation of this type of alternative will result in GHG emissions.

Technological barriers

The rice husk based system is a new technology developed in-house based on commercialization of a new concept established by Harbin Industrial University. The technology development phase required significant engineering efforts that went into the design of the rice husk feeding system, combustion system and temperature control system. The new technology entails the need for developing in-house technical expertise which would not be required if a coal-fired system was implemented.

In addition, there are significant risks associated with commissioning, and operation and maintenance of the newly developed technology on a green-field project site:

- no prior experience to rely upon in case of upsets in operation;

- rice husk feeding system needs to be closely controlled to ensure that the feed is in fluidized bed system at all times maintaining efficient combustion in the combustion chamber;

- should the rice husk feeding system be disturbed, the temperature inside the boiler will drop and it would need up to 4 hours to start up the boiler to meet the steam generation demand and up to 12 hours to reach the optimum temperature of 450 – 650^{o}C; this may lead to loss of revenue as a result of reduced thermal energy production;

- rice husk boilers require more frequent maintenance than coal boilers due to the presence of silica in rice husks that causes faster damage the economizers; this reduces productive hours and causes loss of revenue.

On the manpower side, there was a need to train the local manpower to install, operate, and maintain the project. Due to the new technology, the local availability of skilled manpower was a major challenge and the PP needed to train the local manpower and/or recruit new manpower possessing the necessary skills and knowledge. Therefore, the project faces technology related barriers to its implementation.

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

The monitoring methodology follows CDM baseline and monitoring methodology AMS I.C version 15 "**Thermal energy production with or without electricity**"

3.2 Monitoring, including estimation, modeling, measurement or calculation approaches:

The purpose of monitoring is to ensure the project activity accomplishes the estimated GHG emissions reduction and these are creditable as required in the Voluntary Carbon Standards.

The emissions reduction is calculated as the difference between the baseline emissions and project emissions. The relevant GHG emissions are identified earlier in section 2.3. The PP will form a monitoring team responsible for carrying out the monitoring and maintaining records of all the monitored data. The team will also be responsible to carry out monitoring equipments calibration and maintenance.

The data to be monitored comprise of the following:

(a) Temperature of the feed water to the boilers
(b) Temperature of the steam delivered to the steam customer
(c) Pressure of the steam delivered to the steam customer
(d) Amount of steam delivered to the steam customer
(e) Amount of electricity delivered to grid
(f) Quantity of rice husks used in the two boilers installed in the project

(g) Quantity of rice husk purchased from a nearby rice mill

Detailed list of the parameters that need to be recorded and/or monitored for the purpose of determining the amount of emissions reduction achieved is provided in section 3.3 below.

3.3 Data and parameters monitored/ selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Data / Parameter:	$\eta_{BL,thermal}$, $\eta_{BL,cogen}$
Data unit:	-
Description:	Average net efficiency of a similar thermal heat generation system or a system with both heat and electricity generation, in the baseline using coal
Source of data to be used:	An efficiency of 100% as a conservative default value (refer: clause 18(c) in AMS I.C – version 16
Value of data applied for the purpose of calculating expected emission reductions:	100%
Description of measurement methods and procedures to be applied:	Not relevant
QA/QC procedures to be applied:	Not relevant
Any comment:	-

Data / Parameter:	$EF_{FF,CO2,y}$
Data unit:	tCO_{2e}/TJ
Description:	the CO_2 emission factor of the fossil fuel (in this case, coal) that would have been used in the baseline plant
Source of data to be used:	Since no accurate and reliable local or national data is available, IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances has been used

Value of data applied for the purpose of calculating expected emission reductions:	94.6
Description of measurement methods and procedures to be applied:	Not relevant
QA/QC procedures to be applied:	Not relevant
Any comment:	-

Data / Parameter:	$Temp_{Steam}$
Data unit:	^oC
Description:	Temperature of MP steam delivered to the "steam customer"
Source of data to be used:	On-line data records obtained from PLC readings using temperature sensors on MP steam delivery line attached to the boiler performance monitoring system
Value of data applied for the purpose of calculating expected emission reductions:	450^oC
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Any comment:	-

Data / Parameter:	P_{Steam}
Data unit:	MPa
Description:	Pressure of MP steam delivered to the "steam customer"
Source of data to be used:	On-line data records obtained from PLC readings using pressure sensors on MP steam delivery line attached to the boiler performance monitoring system

Value of data applied for the purpose of calculating expected emission reductions:	3.82 MPa
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Any comment:	-

Data / Parameter:	$Temp_{FeedWater}$
Data unit:	^oC
Description:	Temperature of feed water (at atmospheric pressure) entering each of the 15 MT/hour boiler
Source of data to be used:	On-line data records obtained from PLC readings using temperature sensors on feed water delivery line attached to the boiler performance monitoring system
Value of data applied for the purpose of calculating expected emission reductions:	104^oC
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Any comment:	-

Data / Parameter:	FL_{steam}
Data unit:	MT/hour
Description:	Flow rate of MP steam delivered by the 15 MT/hour boiler
Source of data to be used:	On-line data records obtained from PLC readings

	using flow rate sensors on MP steam delivery line attached to the boiler performance monitoring system
Value of data applied for the purpose of calculating expected emission reductions:	15 MT/hour (for each boiler)
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Any comment:	-

Data / Parameter:	HR
Data unit:	Hours
Description:	Daily operational hours for each of the boilers (2 * 15MT/hour boilers)
Source of data to be used:	Plant operation records
Value of data applied for the purpose of calculating expected emission reductions:	8,000
Description of measurement methods and procedures to be applied:	Plant daily operation records maintained at the project site
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Any comment:	-

Data / Parameter:	EG_{grid}
Data unit:	MWh
Description:	Annual quantity of electricity generated and exported to the electricity grid
Source of data to be used:	As per electricity invoices

Value of data applied for the purpose of calculating expected emission reductions:	Between 0 and 24,000 MWh. This parameter will be monitored *ex-post*.
Description of measurement methods and procedures to be applied:	The total net electricity exported by the project to the grid will be measured using sophisticated energy meters. The data will be measured continuously and aggregated monthly.
QA/QC procedures to be applied:	-
Any comment:	The electricity meters are maintained and export amounts are recorded by the electricity authorities; as such no separate plant level records are used for emission reduction estimations.

Data / Parameter:	$RH_{consumed}$
Data unit:	MT
Description:	Annual quantity of rice husk used in the each of the 15 MT/hour boiler
Source of data to be used:	As per PLC reading for the feeding chambers located before the respective boilers and recorded in the daily production report
Value of data applied for the purpose of calculating expected emission reductions:	Estimated annual value is 44,880 tonnes of rice husk per boiler (i.e. 44,880 tonnes in Phase I and 89,760 tonnes in Phase II)
Description of measurement methods and procedures to be applied:	On-line air-lock system based flow meter (continuous basis) using equipment provider’s empirical formula using input data on mass flow.
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Any comment:	-

Data / Parameter:	$RH_{supplied}$ or $RH_{regional}$
Data unit:	MT
Description:	Annual quantity of rice husk purchased from a rice mill located nearby the project as per dedicated supply contract, which is accounted for as the rice husk procured from the region from a source not affected by any other 'competing demand for the same quantity of rice husk'
Source of data to be used:	As per the invoice for rice husk purchase from the rice mill
Value of data applied for the purpose of calculating expected emission reductions:	Estimated annual value is 44,880 tonnes of rice husk in Phase I and 89,760 tonnes in Phase II
Description of measurement methods and procedures to be applied:	Not required
QA/QC procedures to be applied:	Check of the invoice by the site accounts department prior to payments made
Any comment:	The source of the rice husk is new rice mill that did not provide rice husk to other consumers. Hence, there was no competing demand for the rice husk consumed by the project.

3.4 Description of the monitoring plan:

In relation to information included in sections 3.2 and 3.3, the monitoring plan includes suggested procedures for the estimation of the following using monitored operational data from project records identified in section 3.3.

For Phase I: Thermal energy supplied by the PP

Step 1: Using "Steam Table" and monitored values of steam temperature ($Temp_{Steam}$ in '^{o}C'), pressure (P_{Steam} in 'MPa') and temperature of feedwater ($Temp_{feedwater}$ in '^{o}C'), the enthalpy (in 'kJ/kg') of delivered steam will be determined on an hourly basis for the monitoring period for which emission reductions will be monitored.

Step 2: The hourly steam flow (FL_{Steam} in 'MT/hour' converted to 'kg/hour') delivered to the "steam customer" will be multiplied by the enthalpy of steam delivered (in 'kJ/kg') to obtain the hourly value of thermal energy delivered to the steam consumer ($EG_{thermal}$ in 'kJ/hour').

Step 3: The total thermal energy ($EG_{thermal,y}$ in 'TJ') delivered to the 'steam consumer' will be calculated as the summation of each hourly value of thermal energy delivered to the steam consumer ($EG_{thermal}$ in 'kJ/hour' converted to 'TJ/hour') over the corresponding monitoring period (HR in 'hour').

Step 4: Baseline emissions ($BE_{thermal,CO2,y}$ in 'tCO_{2e}') avoided during the monitoring period 'HR' (or 'y') by virtue of steam delivered to the "steam customer" will be calculated as per the following formula as per clause 15 in AMS I.C (version 16):

$$BE_{thermal,\ CO2,\ y} = (EG_{thermal,y} / \eta_{BL,thermal}) * EF_{FF,CO2}$$

where,

$\eta_{BL,thermal}$	the efficiency of the coal based baseline plant that would have been used in the absence of the project
$EF_{FF,CO2}$	the CO_2 emission factor of the fossil fuel (in this case, coal) that would have been used in the baseline plant; in tCO_2/TJ; this is taken from IPCC.

For Phase II: Thermal energy and electrical energy supplied by the PP

Step 5: Thermal energy ($EG_{thermal,y}$ in 'TJ') supplied will be calculated using same procedures described in steps 1 through 4, using monitored information on $Temp_{Steam}$, P_{Steam}, and FL_{Steam}.

Step 6: Electrical energy ($EG_{PJ,electrical,y}$ in 'GWh') supplied will be calculated using electricity supply records ($EG_{electrical}$ in 'kWh') for the monitoring period.

Step 7: Baseline emissions when the project would operate to deliver both steam and electricity will be calculated using clause 17 in AMS I.C (version 16) as per the following formula.

$$BE_{cogen,CO2,y} = [(EG_{PJ,thermal,y} + EG_{PJ,electrical,y} * 3.6)/\eta_{BL,cogen}) * EF_{FF,CO2}$$

where,

$BE_{cogen,CO2,y}$	the baseline emissions from electricity and thermal energy displaced by the project during the year 'y'; in tCO_2
$EG_{PJ,thermal,y}$	the net quantity of thermal energy (in this case, steam) supplied by the project during the year 'y'; in TJ
$EG_{PJ,electrical,y}$	the amount of electricity supplied by the project during the year 'y'; in GWh
3.6	Conversion factor; TJ/GWh
$\eta_{BL,cogen}$	the total efficiency (including both thermal and electrical) of the plant that would have been used in the absence of the project
$EF_{FF,CO2}$	the CO_2 emission factor of the fossil fuel (in this case coal) that would have been used in the baseline plant; in tCO_2/TJ; this is taken from IPCC

In Phase II, if there is no export of electricity any time during the crediting period, the corresponding values of electrical energy in the above formula will be zero. Hence, the annual quantity of electricity generated will be monitored ex-post and the actual value will be used in the ER calculations.

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

CDM baseline and monitoring methodology AMS I.C version 16 **"Thermal energy production with or without electricity"** is applied for GHG emission reductions estimation of the project activity. The relevant equations are reproduced in this PD from this methodology and appropriate values are used for the estimations.

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

Phase I: Operation of one 15 MT/hour rice husk based boiler

In Phase I, at a minimum, either of the two boilers is expected to be operated with rice husk. The project alternative will be to generate same quantum of thermal energy using coal as the baseline fuel. Thus, the baseline emissions for Phase 1 implementation of the project with 330 days (approximately, 8000 hours) operation per year are calculated using clause 15 in AMS I.C (version 16).

$$BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) * EF_{FF,CO2}$$

where,

$BE_{thermal,CO2,y}$	the baseline emissions from steam/heat displaced by the project during the year 'y'; in tCO_2
$EG_{thermal,y}$	the net quantity of steam/heat supplied by the project during the year 'y'; in TJ
$\eta_{BL,thermal}$	the efficiency of the coal based baseline plant that would have been used in the absence of the project
$EF_{FF,CO2}$	the CO_2 emission factor of the fossil fuel (in this case, coal) that would have been used in the baseline plant; in tCO_2/TJ; this is taken from IPCC

$EG_{thermal,y}$ is calculated based on the difference in total steam enthalpy and total feed water enthalpy times multiplied by annual steam quantity.

Steam enthalpy (superheated at 3.82 MPa and 450^oC) = 3,332.52 kJ/kg

Feed water enthalpy (saturated at 0.103 MPa and 104^oC) = 419 kJ/kg

Annual steam quantity = 15 MT/hour * 8,000 hours = 120,000 MT

$EG_{thermal,y}$
= (120,000 MT) * (3,332.52 kJ/kg – 419 kJ/kg) * (10^3 kg/MT) * (TJ/10^9 kJ)
= 349.62 TJ

$EF_{FF,CO2}$ = 94.6 tCO_2/TJ, as per IPCC

$\eta_{BL,thermal}$ = 100%, as per Clause 18(c) of AMS I.C (version 16)

$BE_{thermal,CO2,y}$ = (349.62 TJ/100%) * (94.6 tCO_2/TJ) = 33,074 tCO_2.

<u>Phase II: Operation of two 15 MT/hour rice husk based boilers with or without electricity generation (3 MW)</u>

The baseline emissions when the project will operate to produce both steam and electricity. For *ex-ante* calculations, the electricity generated (optimally) which will be sold to the grid is 3 MW and the steam will be sold to the steam customer. The baseline emission is calculated using clause 17 in AMS I.C (version 16).

$$BE_{cogen,CO2,y} = [(EG_{PJ,thermal,y} + EG_{PJ,electrical,y} * 3.6)/\eta_{BL,cogen}) * EF_{FF,CO2}$$

where,

$BE_{cogen,CO2,y}$	the baseline emissions from electricity and thermal energy displaced by the project during the year 'y'; in tCO_2
$EG_{PJ,thermal,y}$	the net quantity of thermal energy (in this case, steam) supplied by the project during the year 'y'; in TJ
$EG_{PJ,electrical,y}$	the amount of electricity supplied by the project during the year 'y'; in GWh
3.6	Conversion factor; TJ/GWh
$\eta_{BL,cogen}$	the total efficiency (including both thermal and electrical) of the plant that would have been used in the absence of the project
$EF_{FF,CO2}$	the CO_2 emission factor of the fossil fuel (in this case coal) that would have been used in the baseline plant; in tCO_2/TJ; this is taken from IPCC

$EG_{PJ,electrical,y}$ = (3 MW) * (8,000 hours) * (GW/10^3MW) = 24 GWh

Steam required for 3 MW electricity = 18.5 MT

Total available steam from two boilers = 30 MT

Steam sold to steam customer = 30.0 – 18.5 = 11.5 MT

Steam enthalpy (superheated at 3.82 MPa and 450^{o}C) = 3,332.52 kJ/kg

Feed water enthalpy (saturated at 0.103 MPa and 104^{o}C) = 419 kJ/kg

Annual steam quantity = 11.5 MT/hour * 8,000 hours = 92,000 MT

$EG_{thermal,y}$
= (92,000 MT) * (3,332.52 kJ/kg – 419 kJ/kg) * (10^3 kg/MT) * (TJ/10^9 kJ)
= 268.04 TJ

$EF_{FF,CO2}$ = 94.6 tCO_2/TJ, as per IPCC

$\eta_{BL,cogen}$ = 100%, as per Clause 18(c) of AMS I.C (version 16)

$BE_{cogen,CO2,y}$
= [{(268.04 TJ) + (24 GWh * 3.6 TJ/GWh)}/100%] * (94.6 tCO_2/TJ) = 33,530 tCO_2.

In the case where the project will operate two boilers (i.e., 30 MT/hour) without any electricity generation, the baseline emissions in Phase II will be twice that of Phase I, i.e., 66,148 tCO_2.

4.3 Quantifying GHG emissions and/or removals for the project:

As described in section 2.3, no GHG emissions or removals are applicable in relation to the operation of the project.

4.4 Quantifying GHG emissions reductions and removal enhancements for the GHG project:

As explained in section 4.2, the annual baseline emissions are 33,074 tCO_{2e} in Phase I. In Phase II (refer section 4.2), the annual baseline emissions will range between a lower limit of 33,530 tCO_{2e} with 3 MW electricity generation and steam production, and an upper limit of 66,148 tCO_{2e} with only steam production.

There are no project emissions from use of rice husk, and its collection, processing and transportation (refer section 2.3).

The procurement of rice husk will be from a rice mill located nearby the project and hence within 200km radius from the project. There was no competing use of these rice husk prior to the project. Hence, there will be no leakage emissions as a result of the project.

Therefore, the annual emission reductions (ER_y) are equal to baseline emissions. The annual average emission reductions over the 10-year crediting period will range between 33,438 tCO_{2e} and 59,533 tCO_{2e} (refer section 1.3).

5 Environmental Impacts:

The Environmental Impact Assessment report was approved by the Environmental Protection Bureau. The overall social and environmental impacts of the project activity were deemed to be positive towards the livelihood of the local community. The project proponent included assessment of the environmental impacts in air quality, water quality, noise, and solid waste pollution.

Air Quality
During the operation period, particulates are expected to be generated from burning of rice husks. All process design and concentration of emissions will be consistent with national environment standard.

Water Quality
The major source of waste water will be the chemical water station acid-alkali waste water, boiler-wash water, recycled water station waste water and sanitary waste. The waste water will be treated by local sewage treatment plants and the treated water will be discharged into the city's wastewater treatment system. The main substances contained in the water are COD, BOD_5 and suspended solids, the concentrations of which meet National Standards DB21-60-89 II.

Noise
During the operational period, the noise will be generated from the vibration of machinery equipments such as turbine, and motors. The low noise equipments have been selected during the plant design, and the necessary noise-reducing measurements are going to be implemented as well. The noise level inside and outside the plant boundary is expected to meet the National Standards GB 12348-90III.

Solid Waste

The ash from boiler will be the main source of solid in the plant. The ash will be given away to a third party for use silica processing.

6 Stakeholders comments:

The stakeholder consultation process was part of the environmental impact assessment study before the start of the project. This was done through a questionnaire survey; 50 questionnaires were distributed to the interested survey participants and the following is a summary of the key findings:

- 94% of the respondents supported the construction of the project and believed that the proposed project would improve the local environment, economy and increase job opportunities. 6% of the respondents disagreed with the construction of the project, and believed that the proposed project will affect the local community.

- The main environmental concern about the project was air pollution (20%) and water pollution (72%)

- 56% of respondents indicated that the construction of the project would affect the local environment; 32% believed the project would not affect the environment.

- 62% requested for improvement of waste gas control, 22% requested for solid waste control, 6% requested for improvement of waster water control and protection of surface water, 6% requested for reduction of noise.

In general, most of the respondents supported the construction of the proposed project after the project proponent explained proper protection measures that would be taken.

7 Schedule:

- Budget (AFCE) approval: 31 July 2008

- Date of award of EPC contract: 15 August 2008

- Completion of construction of 1st boiler: 29 August 2009

- Start of operations (Phase I): 19 October 2009

- Start of operations (Phase II): Expected to start from November 2010

- Date of terminating the project: The project is expected to operate for at least 15 years from the date of start of steam delivery in Phase I.

- The monitoring and reporting of parameters for the purpose of emission reduction calculations during the crediting period, including the frequency of monitoring will be as detailed under sections 3.2, 3.3 and 3.4.

8 Ownership:

8.1 Proof of Title:

In respect of the GHG emissions that will be reduced by operation of the project described in this PD, the ‘business license’ available as the proof of project title demonstrates PP’s right of use on the project.

8.2 Projects that reduce GHG emissions form activities that participate in an emissions trading program (if applicable)

Not applicable. The project activity’s emissions reduction is not included in an emissions trading program and do not take place in a jurisdiction with binding limits on GHG emissions.

ANNEX 1

BASELINE INFORMATION[5]

1. Calculation of baseline emission factor $EF_{grid,CM,y}$

CO_2 emission factor of electricity generation from plants of the electricity power system displaced due to the proposes project will be determined according to combined emission factor ($EF_{grid,CM,y}$) calculation procedure in the latest version of "Tool to calculate emission factor for an electricity system" , namely, firstly calculating Operating Margin Emission Factor($EF_{grid,OM,y}$) and Build Margin Emission Factor($EF_{grid,BM,y}$), and then calculating the weighted average of the two factors.

The following seven steps are applied to calculate the emission factor for an electricity system:
STEP 1. Identify the relevant electric power system.
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Identify the group of power units to be included in the build margin (BM).
STEP 6. Calculate the build margin emission factor.
STEP 7. Calculate the combined margin (CM) emission factor.

Step 1. Identify the relevant electric power system

According to the boundary definitions published by the Chinese DNA, the electricity system the proposed project activity connected into is the NECPG which falls into a project electricity system and includes the independent provincial electricity systems of Liaoning, Jilin and Heilongjiang Provincial Power Grids.

For the purpose of determining the operating margin emission factor, the CO_2 emission factor for the net electricity imports from a connected electricity system within the same host country should be determined firstly. There are four alternative options as listed below:
(a) 0tCO_2/MWh, or

[5] http://cdm.unfccc.int/UserManagement/FileStorage/AD7GKULZRFY3P4WET6S5X291CHIMVO

(b) The weighted average operating margin (OM) emission rate of the exporting grid, or
(c) The simple operating margin emission rate of the exporting grid, or
(d) The simple adjusted operating margin emission rate of the exporting gird.

Since no electricity is imported to the NECPG from any other connected electricity systems, the option (a) is chosen for the NECPG.

While for the purpose of determining the build margin emission factor, the spatial extent of the project activity should be defined. Due to no net electricity is imported to the NECPG from other connected electricity systems, the spatial extent of the project activity is limited to the project electricity system, the NECPG, as per the latest version of "Tool to calculate the emission factor for an electricity system".

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

The *Option I: Only grid power plants are included in the calculation* provided in the "Tool to calculate the emission factor for an electricity system" is chosen to calculate the operating margin and build margin emission factor in the PDD.

Step 3. Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

The method to determine $EF_{grid,OM,y}$ of the NECPG is selected based on the following analysis:
(1)Despite the method of dispatch data analysis OM should be preferred, the dispatch data of power grids and power plants operation data are considered as confidential materials in China and cannot be available publicly, so the method is not applicable. Based on the same problem of the grid load duration curve data is also not available, the method (b), simple adjusted OM is also not feasible for the proposed project activity.

(2)From year 2003 to year 2007, for the NECPG the proposed project activity connected to, the low-cost/must-run electric power resources generation accounts for the total grid total are 4.72%, 6.24%, 8.28%, 5.69% and 5.53%[6], respectively, all lower than 50%, which satisfied the applicability of the method (a), therefore, the simple OM method is chosen for the calculation of the OM emission factor $EF_{grid,OM,y}$.

As per the latest version of "Tool to calculate the emission factor for an electricity system", one of the following methods should be chosen to calculate the simple OM emission factor:

●Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or

●Ex post option: The year in which the project activity displaces gird electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year (*y*-1) may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year (*y*-2) may be used. The same data vintage (*y*,*y*-1 or *y*-2) should be used throughout all crediting periods.

The ex ante option is selected for determining the OM emission factor of the NECPG.

Step 4. Calculate the operating margin emission factor according to the selected method

Based on the analysis of the step 3, the simple OM method is used to calculate the NECPG OM emission factor in this step. The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/ units. It may be calculated:

● Based on the net electricity generation and a CO_2 emission factor of each power unit (Option A), or
● Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option B)

[6] *China Electric Power Yearbook* 2004~2008

Option B can only be used if:
(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 2).

Owing to data on fuel consumption, net electricity generation and average efficiency of each power plant/unit is not available; the Option A is not applicable. Meanwhile, only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known from *China Electric Power Yearbook* and *Chinese Energy Statistical Yearbook* and off-grid power plants are not included in the calculation. Therefore, the Option B is used in this PDD and calculates the simple OM emission factor through the following formula:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y})}{EG'_y} \quad (4)$$

Where:

$EF_{grid,OMsimple,y}$ Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)

$FC_{i,y}$ Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)

$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type *i* in year (GJ/mass or volume unit)

$EF_{CO2,i,y}$ CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)

EG'_y Net electricity generated and delivered to the gird by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)

i All fossil fuel types combusted in power sources in the project electricity system in year *y*

y The relevant year as per the data vintage chosen in Step 3.

Data, such as fossil fuel type and its consumption, net calorific value and total net electricity generation, needed to calculate the simple OM emission factor in this PDD can be obtained from *China Electric Power Yearbook 2005~2008* and *China Energy Statistical Yearbook 2006~2008.*

Step 5. Identify the group of power units to be included in the build margin

As per the latest version of "Tool to calculate the emission factor for an electricity system", the sample group of power units *m* used to calculate the build margin consists of either:
(a) The set of five power units that have been most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in WMh) and that have been built most recently.

For the sample group of power units *m*, the set of power units that comprises the larger annual generation should be used. As a general guidance, a power unit is considered to have been built at the date when it started to supply electricity to the grid.

Power plant registered as CDM project activities should be excluded from the sample group *m*. However, if group of power units, not registered as CDM project activity, identified for estimating the build margin emission factor includes power unit(s) that is(are) built more than 10 years ago then:
(i) exclude power unit(s) that is(are) built more than 10 years ago from the group; and
(ii) include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1. For the first crediting period, calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2. For the first crediting period, the build margin emission factor shall be updated annually, *ex-post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, as described in *option 1* above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For the proposed project, *option 1* is chosen to calculate build margin emission factor.

Step 6. Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (5)$$

Where:

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year *y* (tCO_2/MWh)

$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

m Power units included in the build margin

y Most recent historical year for which power generation data is available

For the detailed data on net generation supply and fuel consumption of power plants/units *m* are considered as commercial secrets and are not be available publicly, therefore, the alternative method [7]admitted by CDM EB is used in the calculation. Namely, firstly calculating new addition capacity and makeup of generation technologies, and then calculating the new addition capacity weights of all kinds of generation technologies, finally, determining emission factors using commercially optimal efficiencies of all technologies.

However, since specific data on coal fired capacity, oil fired capacity, and gas fired capacity could not be separated from current statistical data on fossil fuel fired capacity, the following approach was adopted for calculating the emission factor of fossil fuel fired capacity addition: Firstly, using the energy balance sheets in *China Energy Statistical Yearbook* for the most recent year to calculate the respective shares of CO_2 emissions from solid fuel, liquid fuel and gas fuel for power generation against the total

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[7] http://cdm.ccchina.gov.cn/web/index.asp

CO_2 emissions. Secondly, based on the above shares as relevant weights and the corresponding emission factor of commercially optimal efficiency technologies, the thermal power emission factor for the NECPG is determined. Finally, multiply the thermal power emission factor by the weight of the 20% new thermal capacity additions in the NECPG to get the build margin emission factor of the NECPG. The detailed calculation steps and formulas are as follows:

Step a. Calculate the proportion of CO_2 emissions from solid, liquid, and gas fuels used for power generation in total CO_2 emissions.

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j}} \quad (6)$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j}} \quad (7)$$

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j}} \quad (8)$$

Where:

$F_{i,j,y}$ the amount of fuel *i* consumed by province *j* in year *y* (in a mass or volume unit)

$NCV_{i,y}$ Net caloric value of fuel *I* in the year *y* (GJ/t for solid and liquid fuels, and GJ/m^3 for gas fuels)

$EF_{CO2,i,j}$ the CO_2 emission coefficient of fuel *i* (tCO2e/ mass or volume unit of the fuel), taking into account the carbon contents and the percent oxidation of fuels in year(s) *y*

Step b. Calculate corresponding thermal power emission factor

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (9)$$

$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are the emission factors of the best commercially available technology for coal, oil and gas fired power generators, the parameters and calculation procedure can be seen in Annex 3.

Step c. Calculate $EF_{grid,BM,y}$ of the Northeast China Power Grid

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (10)$$

Where:

$CAP_{Total,y}$ the total newly added capacity

$CAP_{Thermal,y}$ the newly added thermal power capacity

Step 7. Calculate the combined margin emission factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (10)$$

Where:

w_{OM} and w_{BM} are the weightings of operating margin emissions factor and build margin emissions factor. For the proposed project activity, values of w_{OM} and w_{BM}, by default, are 0.5 and 0.5, respectively, for the fixed crediting period of 10 years.

Table A15. Baseline Emission Factor of Northeast China Power Grid

	Parameter	Unit	Value
A	Operating Margin Emission Factor	tCO_2e/MWh	1.1293[8]
B	Build Margin Emission Factor	tCO_2e/MWh	0.7242[7]
C	Combined Emission Factor (C=0.5×A+0.5×B)	tCO_2e/MWh	**0.92675**

[8] “关于公布 2009 年中国区域电网基准线排放因子的公告”, NDRC