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

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.

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

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

- 7.5 MW Biomass (Mustard crop residue) based Power Project at RIICO Industrial area, Rajasthan by M/s Amrit Environmental Technologies Pvt. Ltd.

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

- The Amrit Environmental Technologies Private Limited (AETPL) proposes to implement the project with the purpose of utilizing the mustard crop residue (MCR) in the region to effectively generate electricity considering that the Rajasthan State has abundant availability of MCR, which is usually wasted as it does not have much commercial use.

The generated electricity will be exported to state grid for further distribution to end-users. The objective of the project activity would be to contribute to the sustainable economic growth of the rural region and conserve the environment through use of renewable biomass fuel. The project will also help to bridge the ever-increasing demand and supply gap of electricity in the region.

This project proposes to use biomass, which is sufficiently available within 25 km radius of selected location. Biomass, being a renewable energy source and considering the established fact that there would be no net emissions of CO_2 from such renewable energy projects, this 'project activity' will also lead to no net onsite green house gas (GHG) emissions in comparison to the emissions from the alternative fossil fuel based power plants.

The following are some additional benefits of the project:

- Appropriate utilisation of surplus biomass which is otherwise wasted
- Avoidance of burning the wasted agricultural residues
- Generation of environment friendly green power with lesser air pollutants and better utilisation of waste
- Reduction in green house gas (GHG) i.e. CO_2 emissions

AETPL perceive that by setting up the biomass-based power plant, they will be participating in contributing to power generation in the region, using non-conventional energy resources, and will avoid equivalent power generation from fossil fuel plants in the region.

The MCR based power plant, comprising a single boiler of 40 tons per hour (TPH) capacity and condensing steam turbo generator set of 7.5 MW capacity. The boiler will generate steam

of 67 kg/cm^2(g) pressure and 435 ^{0}C. The power generated at 11 kV and would be stepped up to 33 kV for synchronising with the Rajasthan Vidyut Prasaran Nigam (RVPN) grid.

AETPL has signed the power purchase agreement with RVPN for the project activity and the project is likely to export power to RVPN after meeting in-house auxiliary demand (of about 700 kW).

Biomass availability - The fuel for the proposed power plant is Mustard Crop Residue (MCR). Biomass assessment studies / reports in the State conducted by different state agencies in collaboration with the Ministry of Non-conventional Energy Sources (MNES), Government of India (GoI) indicates that mustard residue is abundantly available in Rajasthan and this residue is wasted as it is not suitable for commercial disposal as either fodder or domestic fuel. A very small portion is used commercially as industrial fuel (around 10%), while the balance of MCR is burnt in the field causing local pollution.

AETPL proposes to utilize the fuel (biomass) available at Kotputli *Tehsil* which is in the midst of the mustard growing belt. As per the biomass availability studies carried out by AETPL in March 2003 in the command area of 25 km radius, available MCR can support a power plant of over 10 MW capacity generation. In the survey conducted for the project activity at Keshwana Rajput covering 25 km radius of plant site, 52 villages were covered and in each village about 2 – 4 farmers were interviewed on the area of their land holdings, crop yield, water availability, disposal of crop residue, transportation availability, residue availability in the surrounding area, sourcing of MCR supply to the proposed plant, and availability of stock for the project location. The collected data was verified by means of field visit, discussion with *Tehsil* officials, and interaction with other farmers. The summary of the MCR availability carried out by AETPL and the *taluka* level survey carried out in 2001 are as follows:

Particulars	**Units**	**AETPL Survey**	**Kotputli Base (*Taluka* level survey)**
Area under cultivation	Hectare (ha)	117,750	117,750
Area under mustard	%	56.4	40
Mustard crop yield	MT/ha	1.5	1.2

Residue : crop yield	Times	1.5	2.79
Overall availability	Mt/year	149,424	157,690
Total usage (sale + own use)	%	40	35
Surplus	MT/year	89,654	102,498

The AETPL survey also captures the severe drought conditions faced by the entire region due to failure of monsoon in the year 2002. Thus it was found that the overall availability of MCR would be in excess of 150,000 MT/year under drought circumstances.

The project activity, power generation capacity of 7.5 MW will consume biomass of about 71,449 MT annually. Therefore auxiliary fuel will not be required for the project. Although in case of extreme emergency arising from shortage of biomass supply, lignite can be used as auxiliary fuel.

Proposed biomass collection strategy - The biomass would be supplied directly by the farmers to the plant location and the farmers will be directly involved in the effective collection, storage and transportation of biomass to the plant. AETPL would develop and maintain strong partnership with the farmers, motivate the farmers by means of providing a regular source of income by entering into long-term arrangements for the supply of biomass.

Project's contribution to sustainable development - This project activity will contribute to the Sustainable Development as described below:

Environmental benefits - The project apart from reducing the CO_2 emissions will also conserve the conventional fuels. Therefore, this project activity has good environment benefits in terms of reduction in GHG emissions and also conservation of fossil fuels such as coal.

Socio - economic benefits - The project being located in a rural area will create employment for skilled and unskilled labour. Further the sale of MCR to the project site by the farmers will generate additional revenue stream and would contribute to the rural upliftment of the farmers in the project region, which is consistent with the Government's Rural Development Programme.

In India, coal is the primary fuel and the thermal power plants are the major consumers of coal. Since this project activity utilizes renewable energy source, it will positively contribute towards

the reduction in use of finite natural resources like coal, minimizing depletion and therefore increasing its availability to other important processes/ uses.

The project activity apart from generating employment locally, will provide economic value to the agricultural wastes and will provide stable and quality power to the local industry, farmers and households. The project will also create business opportunity for local stakeholders such as bankers/ consultants, suppliers, manufacturers, contractors etc.

Technical benefits - The project activity will use energy efficient and environment friendly technology in the renewable energy sector which includes a modern boiler designed to operate with biomass like mustard crop residue.

Therefore we may summarize that the project activity, which will be developed in the rural setting will contribute to the environmental and social issues locally and globally through:

- Export of 6.8 MW power, thereby eliminating the generation of equivalent quantity of power using conventional fuel
- Conserving Coal, a non-renewable natural resource and making it available for other important applications
- Reducing GHG (i.e. Carbon Dioxide) emissions
- Creating job opportunities for skilled / unskilled labour towards the operation and maintenance of the power plant and other equipments
- Capacity building of local people in the operation of modern technology power generation.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host party)	Private and/or public entity(ies) Project participants(*) (as applicable)	Party involved wishes to be considered as project participant (Yes/No)
India	Amrit Environmental Technologies Pvt. Ltd.	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM – PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Amrit Environmental Technologies Pvt. Ltd (AETPL) is the official contact for this CDM project activity. The main promoter is Mr. Sharad Maheshwari and his family who have an

experience of more than 50 years in various businesses including cold storages and milk processing plant with a capacity of about 0.3 Million liters of milk per day.

The company shall be managed under the leadership of the Managing Director, Mr. Sharad Maheshwari and Directors Mr. Ram Baboo Maheshwari and Mr. Dhruv Maheshwari. The family set up SM Milkose Ltd in 1996 which commenced operations in the year 1998. SM Milkose is the single largest supplier of skimmed milk powder (SMP) to many leading FMCG companies in India.

Role in the project activity:

Amrit Environmental Technologies Pvt. Ltd (AETPL)- developer and investor in the project activity and supplier of the carbon credits.

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

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

A.4.1.1. Host Party(ies):

- India

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

- Rajasthan State

A.4.1.3. City/Town/Community etc:

- Keshwana Rajput Village, Kotputli *Tehsil*, Jaipur

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

- The project is proposed to be implemented at Keshwana Rajput village, Rajasthan State Industrial Development & Investment Corporation Ltd.(RIICO) Industrial Estate at Kotputli *Tehsil*, about 2 km North of national highway (NH) – 8 connecting Delhi and Jaipur (Rajasthan State).

The village Keshwana Rajput is located within 1 km from the project site and the town of Behror is about 10 km away from the project site.

About 30 acres of land required for the project would be located in RIICO industrial estate in Kotputli *Tehsil*. The nearest grid substation 132 kV Behror is only 11 km away from the project site.

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

- The basic criteria for a small scale CDM project activity of *Type (i) renewable energy project activities* is maximum output capacity of project activity should be equivalent up to 15 megawatts. If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. Since the proposed project activity is biomass (Renewable energy) based power plant of capacity 7.5 MW, it clearly satisfies the required criteria. Hence the project falls under the **Type I - Renewable energy projects** of indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. Further, the project activity will supply power to Northern regional grid, hence it falls under the **Category D - Grid connected renewable electricity generation.**

The MCR based power plant envisages the installation of a single boiler of 40 tons per hour (TPH) capacity with the super heater outlet steam parameters of 67 kg/cm^2(g) pressure and 435 ^{0}C temperature, and one multi-stage bleed condensing steam turbo generator of 7.5 MW capacity, operating with the steam inlet parameters of 63 kg/cm^2(g) pressure and 440 ^{0}C temperature. The alternator is of brushless revolving field.

The mechanical system comprises the boiler plant with its associated fuel, water and ash handling equipments. The fuel burning system is a travelling grate stoker with gravity feed system. Traveling grate type boiler has been selected, primarily due to its flexibility in fuel firing in terms of its capability to burn fuels of practically any type and size and high moisture content. This type of boiler has other incidental advantages like lower power consumption, reduced dust emissions in flue gas, etc.

An overhead bunker of 90 cum is proposed to store fuel for one hour operation and chutes are constructed to enable gravity feed of fuel to the travelling grate. The fuel will flow from the bunker to a distribution trolley by the chute provided at the outlet of the bunker. To ensure uniform distribution of the fuel over the travelling grate,

- A distribution trolley would be driven by a 2 HP reversible driving mechanism, which would travel to and fro at both the ends of the grate,

- The chute will feed at the centre of the grate and the distributor would carry fuel from one end to the other,
- An adjustable leveller would be provided at the discharge point of the trolley to maintain uniform fuel bed on the grate and
- Heat shield plates would be provided to seal the furnace from the fuel feed system.

The water system comprises the make up water for cooling tower, makeup water for blow-down loss from boiler, regeneration for the de-mineralized (DM) water plant, feed water makeup and miscellaneous requirements including ash quenching and for residential colony consumption. The total water requirement for the project activity would be about 1,638 m^3/day.

The ash handling system consists of ash hoppers at the travelling grate discharge, convection bank, economiser and electrostatic precipitator points. Over 70% of the ash shall be collected the travelling grate discharge.

Apart from the above mentioned mechanical systems, other accessories to the proposed project activity include compressed air system, fire fighting system, electrical system and equipments, excitation and AVR panels, generator panels and other electrical items such as export transformer, remote tap changer control (RTCC) panel, 33 kV substation and switchyard, 33 kV transmission line, Earthing, lighting etc.

The power generation would be at 11 kV and would be stepped up to 33 kV for synchronising with the RVPN grid.

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

- The proposed power plant would use eco-friendly sustainable resources such as MCR as fuel and hence the project would lead to GHG on-site emissions in the form CO_2 from combustion of biomass. As CO_2 is sequestered by the plants during their growth so in total life cycle of a plant (biomass) there is no net emission of CO_2. Since the MCR contains only negligible quantities of other elements like nitrogen, sulphur, release of other GHG's is considered to be negligible. From the above we can conclude that the project emissions would be zero. AETPL's project will generate 7.5MW power and export about 6.8 MW to RVPN with only a small part (around 700 kW) used for meeting its auxiliary power needs. Without the proposed project

activity, equivalent energy load would have been supplied to the grid customers from the Northern region grid mix and emission of CO_2 would have occurred.

Although there is no binding on RVPN for power generation with renewable sources, AETPL has taken a pro-active step to develop such technically advanced biomass based renewable power project in the Rajasthan state. The proposed power plant is not only justified in view of shortage both in peak power availability and in energy in the region but also due to eco-friendly power generation. The project will evidently result in a reduction of GHG emissions.

The project will therefore reduce the combined margin carbon intensity of the Northern region grid (i.e. the average carbon intensity of the operating margin and the built margin) given the generation mix of the grid. In the project scenario, conventional electrical energy equivalent of **256.559** Million kWh for the first crediting period of 7 years would be replaced by exporting power from the proposed 7.5 MW non-conventional renewable resource (mustard crop residue) based power plant. The energy generation is based on the assumption as given in Enclosure I. The project activity therefore would enable CO_2 emission reduction of **243,782** tonnes in 7 years.

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

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Years	Annual Estimation of emission reduction in tonnes of CO_2e
2006-2007	26,220
2007-2008	29,185
2008-2009	32,213
2009-2010	35,303
2010-2011	38,456
2011-2012	41,203
2012-2013	41,203
Total estimated reductions (tonnes of CO_2e)	**243,782**
Total number of crediting years	**7 years**
Annual Average over the crediting period of estimated reduction (tonnes of CO_2e)	**34,826**

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

- No public funding from parties included in Annex-I is proposed for the project activity.

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

- The biomass power plant is not a debundled component of a large project activity as the project proponents:

- ♦ do not propose another biomass power plant with higher capacity;
- ♦ have not registered within the previous two years; and
- ♦ Project boundary is not within 1 km radius of any other proposed small-scale activity.

SECTION B. Application of a baseline methodology:

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

- As mentioned in A.4.2, the project activity satisfies the eligibility criteria to use "Simplified modalities and procedures for small-scale CDM project facilities".

The approved baseline methodology has been referred from the Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - version 08 - 3rd march 2006. From this reference, the following category is selected for the project activity:

Type I – Renewable energy projects

Category D – Grid connected renewable electricity generation.

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

- As explained in A4.2, the proposed project activity falls under the Type I Category D – Grid connected renewable electricity generation.

Baseline for projects under Category I.D has been detailed in paragraphs 7, 8, 9, 10 and 11 of "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories" - version 08 - 3rd march 2006. Due to the following reasons, the paragraphs 7, 8 and 11 are not applicable to this project activity:

- the project activity is not a landfill gas, waste gas, waste water treatment and agro industries project
- there is no diesel generator being operated in the pre-project scenario of the project activity
- the project activity does not seek to retrofit or modify an existing facility for renewable energy generation.

The baseline of the project activity would be based on the paragraph 9, which is given as follows.

Paragraph 9 - The baseline is the electricity produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2equ/kWh) calculated in a transparent and conservative manner as:

(a) The average of the "approximate operating margin" and the "build margin", where:

(i) The "approximate operating margin" is the weighted average emissions (in kg CO_2equ/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

(ii) The "build margin" is the weighted average emissions (in kg CO_2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.";

OR,

(b) The weighted average emissions (in kg CO_2equ/kWh) of the current generation mix.

The project activity displaces the grid power. The first step to estimate the baseline emission coefficient is selection of grid boundary. There are five regions in India with respect to electrical transmission systems namely Northern Region, North Eastern Region, Eastern Region, Southern Region and Western Region. Northern region grid comprises of Delhi, Punjab, Haryana, Chandigarh, Rajasthan, Jammu & Kashmir, Uttranchal, Uttar Pradesh and Himachal Pradesh. The project activity is located in Rajasthan state, which falls under Northern region. Hence, Northern region grid is selected as grid boundary to estimate the baseline emission factor.

The baseline emissions are calculated using the average of the approximate operating margin and the build margin, which takes into consideration the trends of future capacity additions. Hence, it would represent the realistic anthropogenic emissions by sources that would occur in absence of the project activity. The details of baseline emission estimation are given in Annex 3..

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

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

AETPL identified plausible project alternatives, which include all possible courses of actions that could be adopted in order to produce equivalent amount of electricity. These plausible alternatives were further analysed to establish project additionality and arrive at an appropriate and conservative baseline scenario. AETPL has excluded alternatives/ options that:

- Do not comply with legal requirements and/or

- Come across barriers considering limited availability of key resources such as fuels, materials, technology, or other circumstances that probably could not be overcome.

Project Alternative 1 – No project scenario

The first alternative considers a situation of 'No project scenario' i.e. the project activity was not considered for implementation. In this alternative, the end user[1] would obtain electricity from the current grid generation mix comprising a mix of thermal (coal and gas), hydro, nuclear and other renewable energy based power plants. Use of fossil fuels like coal and gas, would generate green house gases like carbon dioxide.

Project Alternative 2 - 7.5 MW coal based power plant, supplying power to the current grid mix.

If a 7.5 MW coal based power plant is implemented by the project promoter in place of the biomass (MCR) based power plant, then the end user would obtain power from the grid mix consisting of the current generation mix inclusive of the project alternative 2. With an increased thermal capacity addition of 7.5 MW coal based power plant, there would be an increase in the amount of carbon dioxide generated for equivalent generation of electricity. However it is not a common practice to implement coal based power plants of such small capacities in view of techno-economic circumstances. Therefore, project alternative – 2 is not a prudent option available to AETPL as a developer of small size independent power project and hence excluded from further deliberations.

Project Alternative 3 - 7.5 MW gas based power plant, supplying power to the current grid mix.

If a 7.5 MW gas based power plant is implemented by the project promoter in place of the biomass (MCR) based power plant, then the end user would obtain power from the grid mix consisting of the current generation mix inclusive of the project alternative 3. With an increased thermal capacity addition of 7.5 MW gas based power plant, there would be an increase in the amount of carbon dioxide generated for equivalent generation of electricity.

Considering the limited availability of gas at the project site and also taking into account the techno-economic conditions and locational disadvantage of using gas, it may be concluded that

[1] Consumers of electricity in the state of Rajasthan who import power from RVPN

gas cannot be made available to AETPL as a fuel to generate equivalent quantity of power. Hence project alternative 3 has been excluded from further deliberations.

Project Alternative 4 - 7.5 MW diesel based power plant, supplying power to the current grid mix.

If a 7.5 MW diesel based power plant is implemented by the project promoter in place of the biomass (MCR) based power plant, then the end user would obtain power from the grid mix consisting of the current generation mix inclusive of the project alternative 4. With an increased thermal capacity addition of 7.5 MW diesel based power plant, there would be an increase in the amount of carbon dioxide generated for equivalent generation of electricity.

However, this project alternative would not be an appropriate baseline since the operating costs of this alternative are significantly higher as the diesel oil prices are on an increasing trend[2]. Therefore this option is not economically viable and this is further substantiated by the fact that it is not common practice. This project alternative is not feasible to AETPL - an independent power producer.

Project Alternative 5 – The project activity, supplying power to the current grid mix.

In this case, the project proponent would implement the project activity and would therefore replace 7.5 MW of equivalent power that would otherwise be generated from the Northern region grid mix.

CO_2 that is released from biomass combustion in the project activity will be consumed by the plant species during its growth. The combustion of biomass and CO_2 release, biomass growth and its associated CO_2 absorption/ consumption can be treated as cyclic process resulting in no net increase of CO_2 in the atmosphere. Biomass based power generation is therefore considered as carbon neutral.

From the above assessment of project alternatives it may be concluded that AETPL as a project promoter has only two options available:

Project Alternative 1 – No project scenario

[2] http://164.100.24.167/rsdebate/synopsis/203/08122004.htm

Project Alternative 5 – The Project activity, supplying power to the current grid mix.

AETPL conducts the 'Barrier analysis' for the two options available to them and thereby establishes project additionality.

Barrier analysis

AETPL is aware of the various barriers that prevent implementation of project alternative 5. To overcome these barriers, AETPL has taken the CDM revenues into consideration before initiating the project and proposes to avail carbon credits against the reduction of CO_2 by the project, when compared to the business as usual (BAU) scenario.

Section below addresses the barriers to project implementation

Investment barrier

In order to implement the project, AETPL would need to:

a) Develop adequate infrastructure for improving biomass generation and collection

AETPL has to obtain long – term commitment from the farmers for supply of biomass and also to arrive at mutually beneficial biomass procurement rates for power plant operations. Therefore AETPL is required to develop infrastructure in terms of manpower and financial resources, in order to ensure continuous fuel availability to the project.

Transportation cost of biomass fuels is higher than that of conventional fuels considering lower bulk density of biomass and further the conventional method of transportation is by means of camel carts in the rural areas of Rajasthan. One supplier/ farmer cannot supply the entire fuel required for the project activity and arrangements have to be carried out with at least 30 – 40 suppliers by AETPL. In order to arrive at the biomass collection strategy, AETPL had to consider the following points:

- Whether to have depots or obtain direct delivery at the factory gate
- Financial implications of immediate storage at the site versus additional cost of delayed / staggered delivery from farmers
- Transportation, weighing, unloading, storage and payment related issues for biomass collection from farmers

The company has proposed to collect biomass directly from the farmers (without involvement of middlemen) and the farmer's responsibility would include effective collection, storage and transportation of biomass in their vehicles (camel carts and/or tractors) to the project site. The company shall take initiatives to improve the personal bonding, mutual trust and partnership with the farmers. AETPL also proposes to establish a fuel management team consisting of development officers and agronomists who would act as an interface between the company and the farming community and work with the farmers in planning the fuel procurement exercise.
A separate fuel development organization would undertake the development work with appropriate capital and revenue by increasing the cultivable area, increasing yield of both crop and residue, establish a mechanism for harvesting and transportation for better management of crop residue, developing infrastructure, providing assistance and training manpower.

The above activities which need to be undertaken for project implementation demands rich experience in the rural economics, the inherent advantages of which are that the project will be a source of income to the local rural population and will contribute to sustainable development. Carbon financing will enable the project proponent develop a robust fuel collection system and also promote various initiatives/ schemes to generate biomass.

b) Secure Financial Closure

AETPL project is facing restrictions in the financial closure process and there have been delays in financial closure considering (a) high upfront cost, (b) technological issues to project implementation, (c) institutional aspects related to project cash flows, (d) no prior experience in power generation with MCR as fuel and in selling power to the grid or other users.

Without the proposed carbon revenues securing private financing will be difficult. If the project is taken under CDM and registered as a CDM project activity under the UNFCCC, then AETPL will be in a better position to pay loans considering the fact that carbon financing over the renewable crediting period i.e. 7 years renewed twice (7 x 3 up to 21 years) would be significant in terms of cash in flows. Securing private financing for the project would depend on the proposed carbon financing. AETPL also anticipates better loan repayment terms from the banks/financial institutions who are increasingly becoming aware of this potential revenue stream.

Besides the direct financing risk, AETPL is shouldering the additional transaction costs such as preparing documents, supporting CDM initiatives and developing M&V protocol to fulfill CDM requirements.

Technological barrier

Use of MCR as a fuel has certain problems associated with it – the ash generated by burning of mustard residue contains high percentage of alkali salt. Presence of alkali salt reduces the ash fusion temperature, which causes clinker formation in the furnace. This can also cause severe deposition problem in the convection and super-heater zones requiring frequent stoppage of the boiler for physical cleaning unless combustion and temperature profiles are maintained at the desired levels. So usage of MCR requires – (i) maintenance of low temperature in the furnace (ii) total control of carryover of combustibles from the furnace to avoid secondary combustion (iii) rapid removal of ash from the furnace. These conditions are best managed in a stoker-fired boiler, which has the associated penalty of lower thermal efficiency due to limitation on achievable steam temperature and thereby pressure. The project proposes the use of modern technology with highest possible pressure corresponding to the steam temperature limitation. Where necessary, the project proponent would engage the expertise of scientists to utilize MCR as an effective fuel in boilers.

AETPL has decided to face the risks associated with MCR utilization as fuel and have taken the initiative to implement the project.

Barrier due to prevailing practice

AETPL has conducted a comprehensive analysis on the common practices adopted in Rajasthan for power generation, in order to find out whether the project is a part of the baseline and, if not, then establish the most appropriate baseline for the project.

It can be established that the project is not common practice in both the Rajasthan State as well as the country. The electricity demand met by the Rajasthan State grid (year 2003-04) comprised of:

- ✓ 72.69 % thermal power plants;
- ✓ 10.02 % nuclear plant

- ✓ 16.85 % hydro projects; and
- ✓ 0.44 % wind and biomass projects

In thermal power plant category, coal based plants contribute for 65.91 % and balance 6.78 % is contributed by the gas based power plants.

There has been an increase of 1,242 MW in the installed capacity from 4041 MW in March 1999[3] to 5283 MW in March 2004[4] in state of Rajasthan. The Govt. of Rajasthan had brought out a policy for promoting generation of power from non-conventional energy sources on 11 March 1999. Agreements have been executed for implementation of biomass and waste fuel based power plants totaling 113 MW capacity however till date only about 7 MW[5] capacity has been commissioned. Renewable energy projects form 0.56 % of the total capacity addition during this period.

Considering the above statistics, it is evident that the project activity is not a common practice in the region. In India, till date, only one plant based on MCR as fuel, has been commissioned[6] and one more is presently in project planning stage[7]. Both these projects have been developed under the Clean Development Mechanism. The project activity is likely to be the third project of this type in India as well as the State of Rajasthan. The practice of generating power by using MCR as fuel has not penetrated in the region due to certain prohibitive barriers in project implementation. The comprehensive analysis on the common practices adopted for power generation in Rajasthan further justifies that the project is not a part of the baseline. This project will be the third project of this type (MCR based) to be commissioned in the State and Country, once all the barriers associated to project implementation are overcome. The data on MCR based power projects, suggests that the barriers, which are discussed in this section have hindered the growth of the sector.

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[3] http://www.rajenergy.com/progress.htm

[4] http://www.rajenergy.com/Overview.htm

[5] http://www.rajenergy.com/Policy.htm

[6] Kalpataru Power Transmission Limited commissioned in October 2003 in Rajasthan. The project has been registered at the UNFCCC.

[7] 7.5 MW Alwar Power Company Limited (APCL) proposed to be constructed in Alwar, Rajasthan. The project has been validated and would be submitted for registration at the UNFCCC.

Though the project is not a common practice, AETPL was keen to take up this new initiative of utilizing MCR as fuel by overcoming the barriers to prevailing practices. Reasons for this 'Climate change initiative' are:

- rural development of the region by creating a new demand for the waste biomass thereby carving a source of additional revenue for the farmers involved in sourcing the raw material

- GHG reduction

Although Government of Rajasthan had brought out a policy for promotion of generation of power from non-conventional sources, it is not legally required for AETPL to invest in the high efficiency biomass based power plant. The implementation of the MCR based project activity is a voluntary step undertaken by AETPL.

Institutional barriers

In Rajasthan, there is a need for supportive renewable energy policies in order to encourage private sector participation in the non-conventional power generation. One of the primary reason why entrepreneurs are not keen to take the project are the institutional barriers related to the sale of power.

AETPL has signed a Power Purchase Agreement (PPA) with RVPN. For the cash inflows the project depends on the payments from RVPN against the sale of electricity to the grid. Electricity boards in India are not very financially healthy and the total outstanding due against Rajasthan payable to central power station utilities (CPSUs) as on 31st March 2003 was 480.75 *crores*[8]. This is likely to cause problems with the cash inflows to the project. AETPL is well aware of the situation but with the proposed carbon financing as one of the revenue streams, the management has decided to take this risk and face this institutional barrier on which they have limited or no control.

In view of the above analysis it is understood that the Project Alternative 5 – The Project Activity supplying power to the current grid mix, has its associated barriers to implementation. In spite of these limitations, AETPL has initiated this GHG abatement project under Clean

[8] http://powermin.nic.in/indian_electricity_scenario/pdf/NR1104.pdf

Development Mechanism. Success of overcoming these identified barriers will encourage other entrepreneurs to come up with similar project activities.

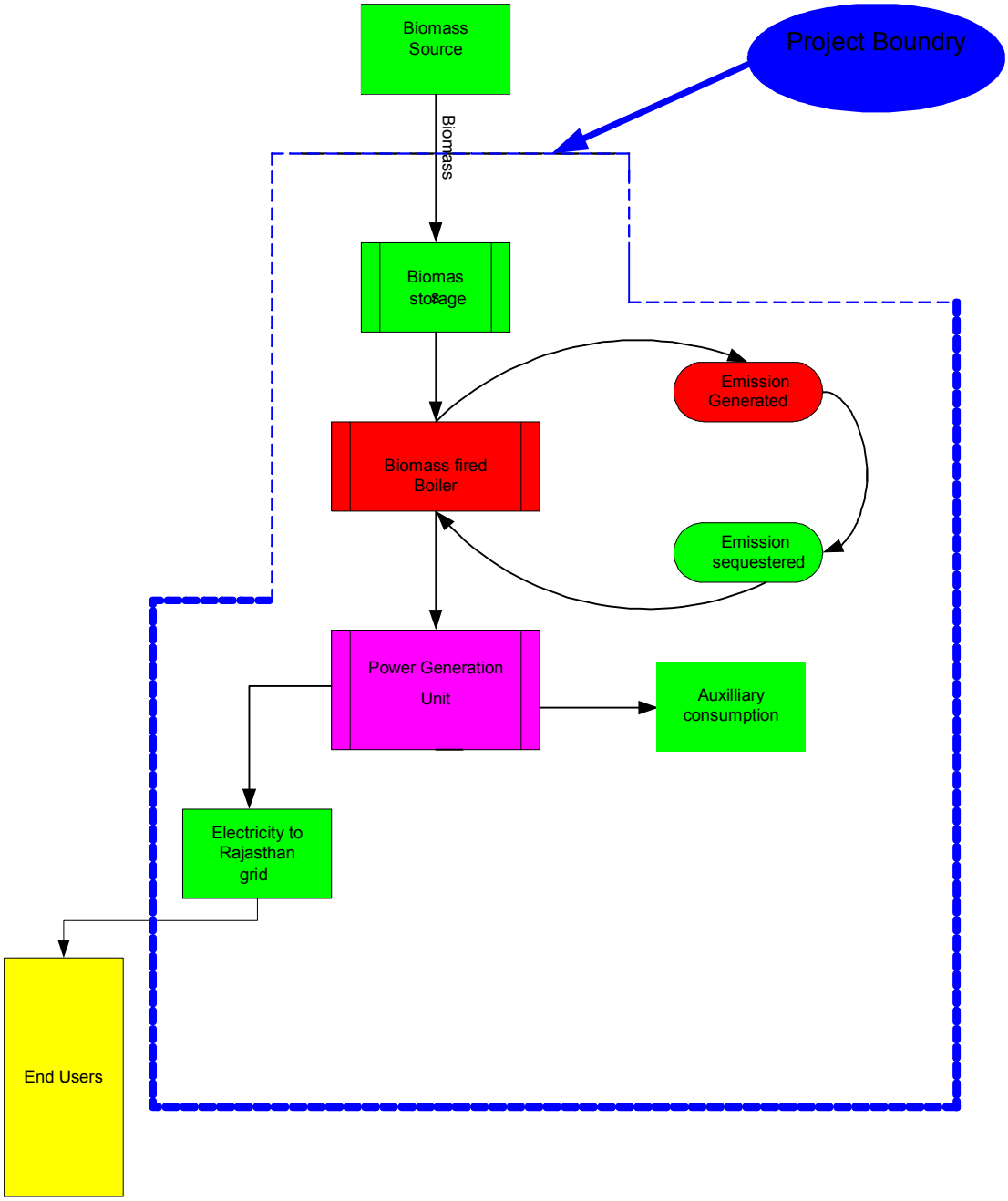
With above discussions it is concluded that the project activity is additional.

The Project Alternative 1 – 'No project scenario' which does not face any of the above-mentioned barriers represents the business-as-usual (BAU) situation that would continue in future and therefore it is the baseline scenario considered for the baseline emission calculations.

With the implementation of the project, 256.556 million kWh of electricity would be generated over the first 7 years crediting period and would enable an equivalent GHG reductions at the Northern region grid end which is dominated by fossil fuel based power generating stations.

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

- As per the guidelines mentioned in project activity category Type I.D., the project boundary covers the physical and geographical site of the renewable generation source. For the proposed project activity the project boundary is from the point of fuel storage to the point of power supply to nearest high tension line where AETPL has a full control. Thus, boundary covers fuel storage, boiler, steam turbine generator and all other auxiliary equipments. For the purpose of calculation of baseline emissions, Northern region grid is also included in the project boundary. The project boundary is as shown in figure below.



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

-

B.5.1 Specify the baseline for the project activity using a methodology specified in the applicable project category for small-scale CDM project activities contained in appendix-B of the simplified M&P for small-scale CDM project activities:

The baseline for this project activity is the function of the generation mix of Northern region grid. As per the guidance provided in Type I.D. methodology available for small-scale project

activities (section B.2), the average of operating and build margin (in $kgCO_2eq/kWh$) of current generation mix is used for the calculation of baseline. Actual CO_2 emission factors are used for the purpose. The project baseline would be revisited every 7 years (twice renewal) to ensure that the assumptions made, still hold true or they would be revised accordingly.

B.5.2 Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

- 05/07/2006

B.5.3 Name of person/entity determining the baseline:

- Amrit Environmental Technologies Pvt. Ltd.

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

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

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

- 01/03/2005

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

- 25 years

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

C.2.1. Renewable crediting period:

- The project activity will use renewable crediting period with twice renewal.

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

- 01/08/2006

C.2.1.2. Length of the first crediting period:

- 7 years

C.2.2. Fixed crediting period:

-

C.2.2.1. Starting date:

- Not applicable

C.2.2.2. Length:

- Not applicable

SECTION D. Application of a monitoring methodology and plan:

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

- The approved monitoring methodology of the project activity is as follows:

Type I – Renewable energy projects

Category D – Grid connected renewable electricity generation.

Reference: The monitoring methodology of the project activity is referred from 'Paragraph 13' of Type I - Category D of indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - version 08 - 03 march 2006'.

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

- As per the paragraph 12 of Simplified Modalities and Procedures for Small Scale CDM project activities, a proposed project activity shall,

(a) Meet the eligibility criteria for small-scale CDM project activities set out in paragraph 6(c) of decision 17/CP.7;

(b Conform to one of the project categories in appendix B to this annex;

(c) Not be a de-bundled component of a larger project activity, as determined through appendix C to this annex.

As explained earlier in section A.4.2, the project activity meets the eligibility criteria for small-scale CDM project activities set out in paragraph 6 (c) of decision 17/CP.7, falls under small-scale CDM project of Type I. Category D and is not a de-bundled component of a larger project activity.

The monitoring plan has been drawn as per the guidance provided in paragraph 13 of 'Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories Type I - Category 1.D - version 08 - 3rd march 2006'.

Description of monitoring plan

The Monitoring and Verification (M&V) procedures define a project-specific standard against which the project's performance (*i.e.* GHG reductions) and conformance with all relevant criteria will be monitored and verified. The aim is to enable this project have a clear, credible, and accurate set of monitoring, evaluation and verification procedures. The purpose of these

procedures would be to direct and support continuous monitoring of project performance/key project indicators to determine project outcomes, greenhouse gas (GHG) emission reductions.

GHG SOURCES

Direct On-Site Emissions - Direct on-site emissions after implementation of the project arise from the burning of biomass in the boiler which mainly includes CO_2. Sequestration of same quantum of CO_2 occurs during the growth of the biomass thus the project is carbon neutral and will not lead to GHG emissions.

Direct Off-Site Emissions - In the proposed project scenario, the direct off-site emissions arise from the transportation of biomass from the field to the project site. The collection of biomass will be done through the farmers who would transport the biomass to the fuel processing centers in their own vehicles. Although some farmers also have tractors, the major means of transporting biomass is the camel cart. However in the baseline scenario (no project scenario), CO_2 emissions will occur during the transportation of coal from the mines to respective coal based power plants. Higher CO_2 emissions would result compared to the project scenario, considering that the distance between the coal mines and the power plants would be much higher when compared to the transportation distance between biomass collection centres and project site. To be on conservative side, these emission due to coal transportation has not been added while calculating the baseline emissions and a small emission from transportation of biomass by tractors has been neglected from the calculations.

Indirect On-Site Emissions - The indirect on site GHG source is the consumption of energy and the emission of GHGs involved in the construction of biomass based power plant. Considering the life of the power plant and the emissions to be avoided in the life span of 15 – 20 years, emissions from the above-mentioned source is too small and hence neglected. No other indirect on-site emissions are anticipated from the project activity.

Indirect Off-Site Emissions - The indirect off-site emissions would include GHG emissions resulting from the process construction and erection of the HT lines from the point of generation to the nearest HT lines. Considering the life of the power plant and the emissions to be avoided in the life span of 15–20 years, emissions from this source is also too small and hence neglected.

Key Project Parameters affecting Emission Reductions

Total Power generated by the project: The total power generated by the project will be measured to the best accuracy and will be recorded, monitored on a continuous basis. The parameter will demonstrate the smooth operations of the power plant.

Auxiliary consumption: The power consumed by plant auxiliaries will also be recorded to the best accuracy and this will be recorded and monitored on a continuous basis. The power consumed by the auxiliaries would affect the net power exported to the grid and therefore the amount of GHG reductions. Therefore any increase in the consumption pattern of the auxiliary system would be attended to.

Net Power exported to the grid: The project revenue is based on the net unit of power exported as measured by main metering system and the backup metering system. The monitoring and verification system would mainly comprise of these meters as far as power export is concerned. RVPN will be billed by AETPL based on joint meter reading recorded at the end of each month for energy supplied during the month.

Other Parameter to be monitored

Quantity and Quality of the biomass used in the boiler as fuel

The biomass received from the farmers/ suppliers will be stored in the plant's overhead bunker (specially designed for such storage) of 90 cum capacity, which shall be constructed in a way to enable gravity feed of fuel to the travelling grate. The fuel will flow from the bunker to the distribution trolley by a chute provided at the outlet of the bunker.

An online weighing system would be provided in order to measure, record and transmit, the actual quantity of the fuel entering into the boiler for online monitoring in the DCS. The weighing system would be calibrated regularly to ensure the accuracy of the measurement. The data will be recorded for further verification. The amount of biomass purchased, will be based on invoices / receipts from fuel contractors.

The main type of fuel proposed for the power generation is only biomass like mustard crop residue and the supplementary fuel will be rice husk. The properties of the biomass from ultimate analysis, calorific value, ash composition etc. will be consistent in the region. However, it is proposed to monitor various properties of biomass used as fuel, by taking samples at random, so that in case of any drastic change in the properties, corrective actions

can be taken. The measurement of fuel properties like calorific value will be conducted as per standard national/international practices and data or documents will be kept open for verifiers.

Quantity and Quality of coal (if any) used in the boiler

Though the project proponent proposes to use 100% biomass for power generation, the project proponent will provide for

- a proper online coal weighing system in order to measure the quantity of coal used
- necessary provisions to measure carbon content of the coal samples

to arrive at project emissions from coal combustion if any.

Verification

The performance of the project can be expressed in terms of CO_2 emission reductions. In other words, the higher the electricity exports to the grid the more would be the emission reductions.

There are two aspects of Verification

[A] Verification of the Monitoring System consists of:

- Verification of various measurement and monitoring methods
- Verification of instrument calibration methods
- Verification of measurement accuracy

[B] Verification of Data collected which includes

- Total generation of power and auxiliary power requirements.
- Quantity and quality of the Biomass
- Coal consumption (if any)

The project proponent will provide the necessary supportive documents to enable verification of both the monitoring system and the data archived as per Section D3.

D.3 Data to be monitored:

-

a) Parameters affecting the emission reduction potential of the project activity

ID Number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	For how long is archived data to be kept?	Comment
1	Power	Electricity generated	kWh	m	Hourly	Total	Electronic	3 years after issue of CERs	
2	Power	Auxiliary consumption	kWh	m	Hourly	Total	Electronic	3 years after issue of CERs	
3	Power	Net Electricity Exported	kWh	m	Hourly	Total	Electronic	3 years after issue of CERs	

b) Fuel related parameters

ID Number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	For how long is archived data to be kept?	Comment
1	Fuel	Biomass Quantity for each type	MT	m	hourly	100%	Electronic	3 years after issue of CERs	
2	Fuel	Biomass – Calorific Value for each type	kcal/kg	m	fortnightly	Actual Sample Tested	Electronic	3 years after issue of CERs	Through sample testing
3	Fuel	Coal Quantity	MT	m	Daily	100%	Electronic	3 years after issue of CERs	
4	Fuel	Carbon content in coal	%	m	For each batch of coal	Actual Sample Tested	Electronic	3 years after issue of CERs	Through sample testing

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

- The general monitoring principles are based on:

- Frequency
- Reliability
- Registration and reporting

Since the emission reduction from the project are determined by the net unit of power exported to the grid (and then multiplying with appropriate emission factor) it becomes important for the project to monitor the net export of power to the grid on real time basis.

Frequency of monitoring: AETPL will carry out hourly data recording. RVPN and AETPL shall jointly read and record the main and backup metering system on the first day of every month.

Reliability: The amount of emission reductions is proportional to the net energy generation from the project. Thus the final kWh meter reading is the final value from project side. The reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result. Electronic trivector meters of accuracy class 0.2 % would be used.

AETPL would also ensure the quality of the equipment used for monitoring.

The RVPN shall own, test and maintain the main metering system. The backup metering system shall be installed, tested, owned and maintained by AETPL. The main and backup metering system shall be sealed in the presence of both parties. Meters shall be calibrated on annual basis so that the accuracy of measurement can be ensured. When the main metering system and/or backup metering system and/or any component is found to be outside the acceptable limits

of accuracy or otherwise not functioning properly, it shall be repaired, re-calibrated or replaced by AETPL and/or RVPN, as soon as possible. Any meter seal shall be broken only by RVPN's representative in the presence of AETPL's representative whenever the main or backup metering system is to be inspected, tested, adjusted, repaired or replaced.

Registration and reporting: The RVPN and AETPL shall jointly read the metering system and shall keep the complete and accurate records for proper administration.

There will be hourly data recording by the shift in-charge. Daily, weekly and monthly reports stating the generation are prepared by the shift incharge and verified by the plant manager. In addition to the records maintained by AETPL, RVPN will also monitor the actual power exported to the grid and provide record of the same.

Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored. (data items in tables contained in section D.3 (a and b) above, as applicable)

Data	Uncertainty level of data (High Medium/Low)	Are QA/QC procedures planned for these data?	I. Outline explanation why QA/QC procedures are or are not being planned.
D.3.(a)1	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)2	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)3	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(b)1	Low	Yes	This data will be used as supporting information to calculate emission reductions by project activity.

Data	Uncertainty level of data (High Medium/Low)	Are QA/QC procedures planned for these data?	I. Outline explanation why QA/QC procedures are or are not being planned.
D.3.(b)2	Low	Yes	This data will be used as supporting information to calculate emission reductions by project activity
D.3.(b)3	Low	Yes	This data will be used as supporting information to calculate emission reductions by project activity
D.3.(b)4	Low	Yes	This data will be used as supporting information to calculate emission reductions by project activity

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

- AETPL would ensure accuracy of the measurement system as follows:

- The shift incharge will be responsible for the hourly data recording and the plant manager will ensure that that the data is properly archived.
- The plant manager will be a qualified engineer with 10-15 year experience in power industry. All the shift incharges will be diploma holders and will undergo an exhaustive training programme, including plant operations, data monitoring, report generation etc.

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

- Amrit Environmental Technologies Pvt. Ltd.

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

- Not applicable.

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

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

- The project proponent in case of exigencies proposes to use lignite/coal as fuel instead of biomass. The CO_2 emissions in case of usage of coal will be calculated in the following manner:

CO_2 Emission [in kgs] = Stoichiometric CO_2 from carbon content of coal [based on total carbon content]

To have an estimate of the project CO_2 emissions due to combustion of coal if any along with the biomass, total carbon content of the coal should be known. Combustion reaction for CO_2 emission is as under.

$C + O_2 = CO_2$

Assuming complete combustion of coal, following formula can be used for conservative estimation of CO_2 emissions.

$$CE_c = (44/12) * C * Q$$

where,

CEc - Stoichiometric carbon-dioxide emission due to coal burning at project, MT

C - Carbon percentage in coal, %

Q - Quantity of coal burned, MT

Although calculation for project emissions has been incorporated in this chapter, carbon-dioxide emissions from coal combustion are considered as zero since AETPL does not propose to use coal as fuel for power generation. AETPL proposes to use 100% biomass since there is surplus crop residue after discounting for various end-uses, available within a radius of 25 km which is estimated to be 1,50,000 MT/annum.

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

There is no transportation of equipment from another activity hence leakage calculation is not required however, the activity identified, which contributes for GHG emissions outside the project boundary is transportation of biomass (MCR) by the farmers from the fields to project site. The collection of MCR will be done through the farmers. They would bring the biomass to the plant site in their own vehicles. Although some farmers also have tractors, the major means of transporting MCR is the camel cart. Rajasthan is a poor State, with fragmented land holdings. Also, there are no tracks through the fields that can be used to transport the MCR to these centers. Therefore, camel cart is the most successful means of transporting the MCR to the collection centers. Calculation of leakage has been carried-out as under:

- Biomass to be procured - 72,000 MT
- Average Distance between project site and biomass collection centers - 12.5 km
- Biomass load per tractor trolley - 2.5 MT
- Number of trips - 28,800
- Average distance covered per litre - 5 km/litre
- Consumption of Diesel trip (to and fro) - 5 litres
- Total Diesel consumption - 1,44,000 litres/annum
- CO_2 emission factor for Diesel (as per IPCC guidelines) - 74.10 tons CO_2/ TJ

- CO_2 emission per annum - 302 tons

The CO_2 emission occurs during the transportation of coal from the mines to respective coal based power plants. The distance between the coal mines and the power plants would be much higher when compared to the transportation distance between biomass collection centers and project site and hence higher CO_2 emissions. To be on conservative side, this emission due to coal transportation has not been added while calculating the baseline emissions and hence a small emission due to transportation of biomass has also been neglected from the calculations.

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

- The carbon-dioxide emissions from coal combustion are considered as zero since the AETPL does not propose to use coal as fuel for power generation. The leakage due to transportation of biomass is very small and hence neglected. Therefore net CO_2 emission by project activity is zero.

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

Northern region grid has been considered as the system boundary for the baseline emission calculations. Northern region's present generation mix, sector wise installed capacities and emission coefficients are used to arrive at the net carbon intensity/baseline factor of the chosen grid. The emission factor has been estimated as per the guidelines given in the paragraph 9 of 'Indicative simplified baseline and monitoring methodology for selected small-scale CDM project activity - Type I - Category D - version 08 - 3rd march 2006'.

The emission coefficient has been calculated as **'***the average of the approximate operating margin and the build margin***'.**

The step-by-step calculation is as follows (for details see Annex 3 – Baseline Data):

STEP 1. Calculation of Operating Margin emission factor (EF_{OM})

$$EF_{OM,y} = \sum_{i,j} F_{i,j} \times COEF_{i,j} / \sum_{j} GEN_{j}$$

Where

$COEF_{i,j}$ - the CO_2 emission coefficient of fuel i (t CO_2 / mass or volume unit of the fuel),

GEN_j - the electricity (MWh) delivered to the grid by source j

$F_{i,j}$ -the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j, calculated as given below

j - the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants

The CO_2 emission coefficient $COEF_i$ is estimated as

$$COEF_i = NCV_i \times EF_{CO_2,i} \times OXID_i$$

Where

NCV_i - the net calorific value (energy content) per mass or volume unit of a fuel i

$EF_{CO2,i}$ - the CO_2 emission factor per unit of energy of the fuel i

$OXID_i$ - the oxidation factor of the fuel

The OM emission factor ($EF_{OM,y}$) has been calculated ex-ante, separately for the most recent three years (2002-2003, 2003-2004 and 2004-2005) and an average value has been considered as the OM emission factor for the baseline ($EF_{OM,}$).

$$EF_{OM} = \sum EF_{OM,y} / 3$$

Where y represents the year

STEP 2. Calculation of the Build Margin emission factor ($EF_{BM,}$)

It is calculated as the generation-weighted average emission factor (t CO_2/MWh) of a sample of power plants m of grid, as follows:

$$EF_{BM} = \sum_{i,m} F_{i,m} \times COEF_{i,m} / \sum_{m} GEN_m$$

Where

$F_{i,m,}$ $COEF_{i,m}$ and GEN_m - are analogous to the variables described in OM method above for plants m.

The Build Margin emission factor EF_{BM} has been calculated as ex-ante based on the most recent information available on plants already built for sample group m of Northern region grid at the time of PDD submission. The sample group m consists of the recent 20 % of power

plants supplying electricity to northern region grid, as it comprises of larger annual power generation.

Further, none of the power plant in the sample group has been registered as CDM project activities.

STEP 3. Calculation of the electricity baseline emission factor (EF_y)

It is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,}$) and the Build Margin emission factor ($EF_{BM,}$):

$$EF_y = W_{OM} \times EF_{OM} + W_{BM} \times EF_{BM}$$

where the weights W_{OM} and W_{BM}, by default, are 50% (i.e., $W_{OM} = W_{BM} = 0.5$), and $EF_{OM,}$ and EF_{BM} are calculated as described in Steps 1 and 2 above and are expressed in t CO_2/MWh.

$$BE_y = EF_y \times EG_y$$

Where

BE_y - are the baseline emissions due to displacement of electricity during the year y in tons of CO_2

EG_y- is the net quantity of electricity generated by the project activity during the year y in MWh, and

EF_y- is the CO_2 baseline emission factor for the electricity displaced due to the project activity in tons CO_2/MWh.

In case, the same amount of electricity is generated by the Northern region grid mix, it adds to the emissions that are ultimately getting reduced by the project activity. Therefore, the baseline estimated using above methods / scenarios would represent the realistic anthropogenic emissions by sources that would have occurred in absence of the project activity.

The uncertainties in the baseline, arising out of capacity additions trends are already taken into consideration during estimation of combined margin factor. The key information and data related to baseline estimation is given in Annex 3.

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

- Following formula is used to determine Emission reduction

CO_2 emission reduction due to project activity = (Baseline emission - Project emission)

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

- Using UNFCCC baseline methodology for small-scale CDM project, emission reductions by project activity for first 7 year crediting period has been calculated and tabulated as under.

Emission Reductions

Sr. No.	Operating Years	Units exported to Grid (Million kWh)	Net Baseline Emission Factor (kg of CO_2 / kWh)	Baseline Emissions (Tons of CO_2)	Project Emissions (Tons of CO_2)	Emission Reductions, ERs (Tons of CO_2)
1.	2006-2007	27.594	0.950	26,220	0	26,220
2.	2007-2008	30.715	0.950	29,185	0	29,185
3.	2008-2009	33.901	0.950	32,213	0	32,213
4.	2009-2010	37.153	0.950	35,303	0	35,303
5.	2010-2011	40.471	0.950	38,456	0	38,456
6.	2011-2012	43.362	0.950	41,203	0	41,203
7.	2012-2013	43.362	0.950	41,203	0	41,203
	Total	**256.559**	**0.950**	**243,782**	**0**	**243,782**

Therefore a conventional energy equivalent of 256.559 Million kWh for the first crediting period of 7 years would be saved by exporting power from the 7.5 MW Biomass based power plant which in turn will reduce 243,782 tons of CO_2 emissions considering baseline calculations.

SECTION F.: Environmental impacts:

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

- The project does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India and therefore EIA is not required by the host party.

However, Rajasthan State Pollution Control Board (RSPCB) has prescribed standards of environmental compliance and monitors the adherence to the standards. RSPCB have issued Consent To Establish (CTE also termed as NOC) to AETPL under the provisions of Water (Prevention and Control of Pollution) Act, 1974 / Air (Prevention and Control of Pollution) Act, 1981, Environment Protection Act, 1986 with following terms and conditions.

1) The treated trade effluent shall confirm to the limits of the general standards prescribed under the provisions of Environmental Protection Act 1986 for discharge of effluent on land (greenbelt, sprinkling water on heaps of biomass). The overall quantity shall not exceed 60 KL/day from the premises.

2) Quantity of domestic waste water shall not exceed 4 KL/day.

3) Air emissions shall confirm to Emission Regulations issued by the Central Pollution Control Board and as adopted by the State Pollution Control Board.

4) The infrastructure facility for monitoring of stack emissions on each stack and flow measuring devices at each unit of effluent treatment plant shall be provided.

The Environmental Impact Assessment Summary has been provided in Enclosure-II

SECTION G. Stakeholders' comments:

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

- The various stakeholders identified for the project are as under.

1. Elected body of representatives administering the local area (village *Panchayat)*
2. Rajasthan Vidyut Prasaran Nigam Ltd (RVPN)
3. Rajasthan State Pollution Control Board (RSPCB)
4. Ministry of Environment & Forest (MoEF), Government of India
5. Consultants
6. Equipment Suppliers

Stakeholders list includes the government and non-government parties, which are involved in the project at various stages. At the appropriate stage of the project development, stakeholders/ relevant bodies were involved to get the project clearance.

AETPL organized stakeholder consultation meetings with individual village *panchayat* (elected body of representatives administering the local area) in the area with the objective to inform the interested stakeholders on the environmental and social impacts of the project activity and discuss their concerns regarding the project activity. Invitation for stakeholder consultation meetings were sent out requesting the members of village *panchayat* to participate in the event. On the day of meeting, AETPL representatives presented the salient features of the company and the project activity to the participants and requested them to provide their suggestions/objections with regard to the project activity verbally and/or in writing. The opinions expressed by them were recorded and will be made available on request.

At the appropriate stage of the project development, these government bodies were involved to get the project clearance. AETPL had sent applications to all the government parties to get their opinions on the project activity and attain the approvals and clearances necessary for project implementation.

G.2. Summary of the comments received:

- Stakeholder's involvement

The village *Panchayat* /local elected body of representatives administering the local area are the true representative of the local population in a democracy like India. Hence, their consent / permission to set up the project is necessary. AETPL has already completed the necessary consultation and documented their approval for the project.

Local population comprises of the local people in and around the project area. The roles of the local people are as a beneficiary of the project. The local population will be involved in the supply of the biomass and hence the project would be a beneficial project for the local population. In addition to this, the project would also lead to local manpower working at the plant site. Since, the project will provide good direct and indirect employment opportunities the local populace is encouraging the project.

The project does not require displacement of any local population. In addition, the local population is also an indirect consumer of the power that is supplied from the power plants. This is essential because the power sold to the grid is expected to improve the stability in the local electricity network. Since, the distance between the electrical substation for power evacuation and the plant is not long (about 11 km), installation of transmission lines will not create any inconvenience to the local population.

Thus, the project will not cause any adverse social impacts on local population. Rather, it will help in improvising their quality of life.

Rajasthan State Pollution Control Board (RSPCB) has prescribed standards of environmental compliance and monitors the adherence to the standards. The project has received the Consent to Establish under the Water Act (1974) and Air Act (1981) from the Rajasthan state pollution control board (RSPCB) to start commissioning of the power plant.

Rajasthan Renewable Energy Corporation Limited (RREC) implements policies in respect of non-conventional renewable power projects in the state of Rajasthan and has accorded approval to the project.

As a buyer of the power, the RVPN is a major stakeholder in the project. They hold the key to the commercial success of the project. RVPN has already cleared the project and AETPL has already signed Power Purchase Agreement (PPA) with RVPN. The government of India, through Ministry of Non-conventional Energy Sources (MNES), has been promoting energy conservation, demand side management and viable renewable energy projects including wind, small hydro and bagasse cogeneration / biomass power. The stakeholder comments are summarized in the table given below:

S.No	Stakeholder	Comments	Remarks
1.	Village *Panchayat*	Refer the attached comments.	The local population will be involved in the supply of the biomass and the project will provide good direct and indirect employment opportunities hence, the local populace is encouraging the project.
2.	Rajasthan Vidyut Prasaran Nigam	No comments	PPA has been signed with RVPN. The initial term of agreement shall be 20 years from commercial operation date. (PPA can be shared with the validator on site visit)
3.	Rajasthan State Pollution Control Board	Treated trade effluent shall conform to limits of EPA, 1986 for discharge on land Domestic waste water shall be treated as per IS: 2470 and treated effluent should conform to standards as prescribed by State Board. The air emission shall conform to emission regulations Part-I, II & IV issued by Central Board and as adopted by State Board.	➢ Electrostatic precipitator (ESP) will be installed at exit of boiler. ➢ There will be no discharge of effluent from plant outside the plant site ➢ Domestic waste will be conveyed through separate drains to septic tank before being discharged. ➢ Consent to establish the proposed power plant has been issued under provisions of Water Act, 1974, Air Act, 1981 and Environment Protection Act (EPA), 1986.
4.	Ministry of	No comments	Host country endorsement has been

S.No	Stakeholder	Comments	Remarks
	Environment & Forest, Government of India		obtained
5.	Consultants	No comments	Project consultants are involved in the project to take care of various pre contract and post contract project activities like preparation of Detailed Project Report (DPR), preparation of basic and detailed engineering documents, preparation of tender documents, selection of vendors / suppliers, supervision of project implementation, successful commissioning and trial runs
6.	Equipment Suppliers	No comments	Equipment suppliers will be supplying the equipments as per the specifications finalized for the project and will be responsible for successful erection & commissioning of the same at the site and for performance.

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

- The relevant comments and important clauses mentioned in the project documents like Detailed Project Report (DPR), Biomass assessment study, environmental clearances, power purchase agreement, local clearance, etc. were considered in the preparation of CDM project development document. Further, the CDM-PDD will be posted on the UNFCCC or validator's web site for public viewing and comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No Public Funding is available to the project.

Annex 3

BASELINE INFORMATION

As explained earlier in B.2, the baseline is estimated based on the methodology mentioned in paragraph 9 of 'Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity category - Type I - Category D - version 08 - 3rd march 2006. **The average of the approximate operating margin and the build margin** (in kgCO_2equ/kWh) of current generation mix of Northern region grid is used for the calculation of baseline.

Baseline data

Carbon emission factor of grid

Northern region's present generation mix, thermal efficiency, and emission co-efficient are used to estimate the net carbon intensity/baseline factor of the chosen grid.

Combined Margin

The baseline methodology indicates that the project activity will have an effect on both the operating margin (i.e. the weighted actual present power generation sources of the grid) and the build margin (i.e. weighted average emissions of recent capacity additions) of the selected grid and the baseline emission factor would therefore incorporate an average of both these elements.

Operating Margin

The "approximate operating margin" is defined as the weighted average emissions (in kg CO_2equ/kWh) of all generating sources serving the Northern region grid, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

The carbon emission factor as per the operating margin takes into consideration the power generation mix of 2002-2003, 2003-2004 and 2004-2005 excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation of the selected grid, and the default value of emission factors of the fuel are used for power generation.

Average efficiency of gas turbines in combined cycle works out to be 50 %[9]. The emission factor for coal and gas (thermal generation) are referred from "Revised 1996 IPCC

[9] Emission Baselines-Estimating the Unknown, page 156: by International Energy Agency (www.iea.org/textbase/nppdf/free/2000/embase2000.pdf)

Guidelines for National Green house Gas Inventories: Reference Manual" and applied over the expected generation mix and net emission factor is determined.

The formulae for the estimation of operating margin are given in E1.2.4. Operating Margin Emission Factor of northern region grid is 1.152 kg CO_2/kWh.

Key elements to determine baseline for the project activity

The key elements such as variables, parameters and data sources used to determine the baseline for the project activity are tabulated below:

S No.	Key Parameters	Data Sources	Reference
1	Generation of power of all the plants for the year 2002-03, 2003-04 and 2004-05	Annual reports of Northern region Electricity Board (NREB)	http://nreb.nic.in/Reports/Index.htm
2	Coal consumption of each coal fired power plant for the year 2002-03, 2003-04 and 2004-05	Annual Performance review of Thermal power plant (CEA)	www.cea.nic.in
3	Calorific value of coal	Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual	
4	Calorific value of gas	Revised 1996 IPCC Guidelines for National Green house Gas Inventories:	

		Reference Manual	
5	Oxidation factors	Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual	
6	Efficiency of gas based power plants supplying power to grid	Emission Baselines-Estimating the Unknown, page 156: by International Energy Agency	(www.iea.org/textbase/nppdf/free/2000/embase2000.pdf)
7	Emission factor of natural gas	Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual	
8	Emission factor of coal	Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual	

Note:

The value of emission factors for coal and natural gas are given in terms of carbon unit in Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual. It is converted in terms of CO_2 as shown below:

Fuel	Emission factor given in IPCC manual	Emission factor
	tC/TJ	tCO_2/TJ
Natural gas	15.3	56.1 (15.3 x 44/12)
Coal	25.8	94.6 (25.8 x 44/12)

Build Margin

The "build margin" emission factor is calculated by taking the weighted average emissions (in kg CO_2equ/kWh) of recent capacity additions to the northern region grid, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the five most recent plants.

The project activity will have some effect on the build margin of the Northern region grid. The build margin emission factor takes into consideration the delay effect on the future projects and assumes that the past trend will continue in the future. Capacity additions of most recent 20 % of existing plants is greater than (in MWh) five most recent plants, hence most recent 20 % of existing plants are considered for calculation. The key parameters for estimating build margin have been assumed same as that for estimating operating margin. Build margin emission factor of Northern region grid is 0.748 kg CO_2/kWh electricity generation.

Net Carbon Emission Factor of Northern region grid for 2004-2005 as per combined margin = (OM + BM)/2 = **0.950 kg of CO_2 / kWh generation**.

Generation details

The power generation of power plants under Northern region grid for the past three years is given below:

Name	Type	Fuel	Generation (2002-03)	Generation (2003-04)	Generation (2004-05)
Anta GPS	Thermal	Gas	2757.73	2775.92	2595.77
Auriya GPS	Thermal	Gas	4268.68	4247.41	4119.47
Badarpur TPS	Thermal	Coal	5267.22	5428.96	5462.78
Bairasiul	Hydro	Hydel	671.67	687.79	689.67
Bhakra Complex	Hydro	Hydel	6531.01	6956.9	4546.01
Chamera HPS	Hydro	Hydel	2253.53	2648.32	3452.25
Dadri GPS	Thermal	Gas	5211.55	5058.66	5527.71
Dadri NCTPS	Thermal	Coal	6041.46	6181.12	6842.52
Dehar	Hydro	Hydel	3253.1	3299.29	3150.52
Delhi	Thermal	Coal	1455.83	1164.11	5203.8
Delhi	Thermal	Gas	2035.15	5159.77	4091.37
Faridabad GPS	Thermal	Gas	2702.02	2792.58	3172.01
H.P.	Hydro	Hydel	1598.25	3666.39	3666.39
Haryana	Thermal	Coal	5867.03	6849.26	7192.41

Haryana	Hydro	Hydel	245.75	251.73	251.73
J&K	Hydro	Hydel	407.09	851.03	851.03
J&K	Thermal	Gas	67.36	15.41	23.51
NAPS	Nuclear	Nuclear	3580.38	2959.44	2760.01
Pong	Hydro	Hydel	763.85	1178.93	882.57
Punjab	Thermal	Coal	13576.98	14118.96	14390.42
Punjab	Hydro	Hydel	3525.55	4420.43	4420.43
Rajasthan	Thermal	Coal	13826.4	15044.48	17330.79
Rajasthan	Thermal	Gas	218.92	201.37	360.7
Rajasthan	Hydro	Hydel	60.78	494.07	494.07
RAPS-A	Nuclear	Nuclear	1439.31	1293.37	1355.2
RAPS-B	Nuclear	Nuclear	3398.83	2904.68	2954.43
Rihand STPS	Thermal	Coal	7734.09	7949.26	7988.06
Salal	Hydro	Hydel	3142.07	3477.42	3443.29
Singrauli STPS	Thermal	Coal	16174.32	15643.4	15803.34
SJVNL	Hydro	Hydel	-	1537.92	1617.45
Tanakpur HPS	Hydro	Hydel	421.56	510.99	495.17
Tanda TPS	Thermal	Coal	2211.46	2872.81	3254.67
U.P.	Thermal	Coal	20426.15	20638.05	19788.21
U.P.	Hydro	Hydel	1391.3	2063.04	2063.04
Unchahar-I TPS	Thermal	Coal	3039.51	3252.14	3342.83
Unchahar-II TPS	Thermal	Coal	3103.97	3187.93	3438.28
Uri HPS	Hydro	Hydel	2448.16	2873.54	2206.71
Uttaranchal	Hydro	Hydel	3426.31	3452.96	3452.96
TOTAL			**154544.3**	**168109.8**	**172681.6**

List of power plants considered for calculating build margin

Total power generation in northern grid region during 2004-05 is 172,681.6 Million kWh. Twenty percent of total generation is about 34,536.3 Million kWh. The recently commissioned power plant whose summation of power generation is about 34,694.1 Million kWh is considered for the calculation of Build margin. The list is given below:

S No.	Plant	Date of commissioning	Installed capacity (MW)	Generation in 2004-2005 (Million kWh)	Fuel Type
1.	Chamera HEP-II (Unit 1)	2003-2004	100	448.02	Hydro
2.	Chamera HEP-II (Unit 2)	2003-2004	100	448.02	Hydro
3.	Chamera HEP-II (Unit 3)	2002-2003	100	448.02	Hydro
4.	SJVPNL	2003-2004	1500	5108.77	Hydro
5.	Baspa-II (Unit 3)	2003-2004	100	398.94	Hydro
6.	Suratgarh-III (Unit-5)	2003-2004	250	1698.37	Coal
7.	Kota TPS-IV (Unit-6)	2003-2004	195	1302.49	Coal
8.	Baspa-II (Unit 1 & 2)	2002-2003	200	797.88	Hydro
9.	Pragati CCGT (Unit II)	2002-2003	104.6	790.21	Gas
10.	Pragati CCGT (Unit III)	2002-2003	121.2	915.61	Gas
11.	Ramgarh CCGT Stage -II (GT-2)	2002-2003	37.5	114.19	Gas
12.	Ramgarh CCGT Stage -II (GT-2)	2002-2003	37.8	115.11	Gas
13.	Upper Sindh Extn (HPS)(1)	2001-2002	35	32.12	Hydro
14.	Suratgarh stage-II (3 & 4)	2001-2002	500	3396.74	Coal
15.	Upper Sindh Stage II (2)	2001-2002	35	32.12	Hydro
16.	Malana-1 & 2	2001-2002	86	266.08	Hydro
17.	Panipat TPS Stage 4 (Unit-6)	2000-2001	210	1269.31	Coal
18.	Chenani Stage III (1,2,3)	2000-2001	7.5	19.1	Hydro
19.	Ghanvi HPS (2)	2000-2001	22.5	74.06	Hydro
20.	RAPP (Unit-4)	2000-2001	220	1309.7	Nuclear
21.	Ranjit Sagar (Unit-1,2,3,4)	2000-2001	600	1131.37	Hydro
22.	Gumma HPS	2000-2001	3	4.35	Hydro
23.	Faridabad CCGT (Unit 1) (NTPC)	2000-2001	144	1030.59	Gas
24.	Suratgarh TPS 2	1999-2000	250	1698.37	Coal
25.	RAPS-B (2)	1999-2000	220	1309.7	Nuclear
26.	Uppersindh-2 HPS #1	1999-2000	35	32.12	Hydro
27.	Faridabad GPS 1 & 2 (NTPC)	1999-2000	286	2046.86	Gas
28.	Unchahar-II TPS #2	1999-2000	210	1559.75	Coal
29.	Unchahar-II TPS #1	1998-1999	210	1559.75	Coal
30.	Suratgarh TPS #1	1998-1999	250	1698.37	Coal
31.	GHGTPLM (Unit 1)	1998-1999	210	1453.23	Coal
32.	GHGTPLM (Unit 2)	1997-1998	210	1453.23	Coal
33.	Tanda TPS (Unit-4)	1997-1998	110	731.54	Coal

Appendix A

ABBREVIATIONS

%	Percentage
AETPL	Amrit Environmental Technologies Private Limited
BM	Build Margin
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reductions
CM	Combined Margin
cm	Centimeter
CO_2	Carbon Di oxide
CPSUs	Central Power Sector Utilities
DPR	Detailed Project Report
GHG	Greenhouse Gas
IPCC	Intra governmental Panel for Climate Change
IPP	Independent Power Producers
IREDA	India Renewable Energy Development Agency
kcal	kilo calories
kg	Kilogram
km	Kilometer
KP	Kyoto Protocol
kW	kiloWatt
kV	kiloVoltage
kWh	kiloWatt hour
LP	Low Pressure
MCR	Mustard Crop Residue
MNES	Ministry of Non-Conventional Energy Sources
MT	Metric Tons
MU	Million Units
MW	Megawatt
NGO	Non Government Organizations
NOC	No Objection Certificate
PDD	Project Design Document
PIN	Project Idea Note
PLF	Plant Load Factor
PPA	Power Purchase Agreement
QA	Quality Assurance

QC	Quality Control
RE	Renewable Energy
RSPCB	Rajasthan State Pollution Control Board
RVPN	Rajasthan Vidyut Prasaran Nigam
RREC	Rajasthan Renewable Energy Corporation Limited
SEB	State Electric Board
STG	Steam Turbine Generator
T&D	Transmission and Distribution
tph	Tonnes Per Hour
TJ	Trillion Joule
UNFCCC	United Nations Framework Convention on Climate Change

Appendix B

REFERENCE LIST

- Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC)
- Website of United Nations Framework Convention on Climate Change, **http://unfccc.int**
- UNFCCC decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol
- UNFCCC, Clean Development Mechanism, Project Design Document (CDM-PDD) version 01 (with effect as of: August 29, 2002)
- UNFCCC document: Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories (Version 5, February 2005)
- Further Clarification on Methodological Issues, EB 10 Report, Annex 1, http://unfccc.int
- Annex 2: Amendment to Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, EB 12 Report. http://unfccc.int
- Detailed project report on 7.5 MW Biomass based power project – Amrit Environmental Technologies Pvt. Ltd.
- Website of Central Electric Authority (CEA), Ministry of Power, Govt. of India- **www.cea.nic.in**
- CEA published document "16th Electric Power Survey of India"
- Website of Department of Energy, Government of Rajasthan - http://www.rajenergy.com
- Website of Ministry Non-Conventional Energy Sources (MNES), Government of India, **www.mnes.nic.in**
- Website of Indian Renewable Energy Development Agency (IREDA), **www.ireda.nic.in**
- Order on Annual Revenue Requirement Filed by Rajasthan Rajya Vidyut Prasaran Nigam Ltd. Dated 31st July 2003
- Power Purchase Agreement between Project Promoter and Rajasthan Vidyut Prasaran Nigam (RVPN)
- ACM0002/Version 01, Sectoral Scope: 1, 3 September 2004 http://unfccc.int

Enclosure I

Baseline and Emission Reduction Calculations

CALCULATION OF BASELINE EMISSION FACTORS-NORTHERN GRID

	2002-03		2003-04		2004-05	
	Million kWh		Million kWh		Million kWh	
Generation by Coal out of Total Generation	98724.42		102704.29		106451.00	
Generation by Gas out of Total Generation	17261.41		20251.12		19890.00	
Estimation of Baseline Emission Factor (tCO_2/GWh)						
Simple Operating Margin						
Fuel 1 : Coal						
Avg. Calorific Value of Coal used (kcal/kg)		4772		4772		4772
Coal consumption (tons/yr)		70,923,000		70,397,000		73,279,000
Emission Factor for Coal-IPCC standard value (tonne CO_2/TJ)		94.6		94.6		94.6
Oxidation Factor of Coal-IPCC standard value		0.98		0.98		0.98
COEF of Coal (tonneCO_2/ton of coal)		1.852		1.852		1.852
Fuel 2 : Gas						
Avg. Efficiency of power generation with gas as a fuel, %		50		50		50
Avg. Calorific Value of Gas used (kcal/kg)		10349		10349		10349
Estimated Gas consumption (tons/yr)		2,868,924		3,365,827		3,305,807
Emission Factor for Gas- IPCC standard value(tonne CO_2/TJ)		56.1		56.1		56.1
Oxidation Factor of Gas-IPCC standard value		0.995		0.995		0.995
COEF of Gas(tonneCO_2/ton of gas)		2.419		2.419		2.419
EF (OM Simple), tCO_2/GWh		**1192.47**		**1126.73**		**1137.64**
Average EF (OM Simple), tCO_2/GWh						**1152.28**

Considering 20% of Gross Generation					**2004-05**	
Sector						
Thermal Coal Based					17821.15	
Thermal Gas Based					5012.58	
Hydro					9240.97	
Nuclear					2619.40	
Total					34694.10	
Built Margin						
Fuel 1 : Coal						
Avg. calorific value of coal used in Northern Grid, kcal/kg						4772
Estimated coal consumption, tons/yr						12924656
Emission factor for Coal (IPCC),tonne CO_2/TJ						94.6
Oxidation factor of coal (IPCC standard value)						0.98
COEF of coal (tonneCO_2/ton of coal)						1.852
Fuel 2 : Gas						
Avg. efficiency of power generation with gas as a fuel, %						50
Avg. calorific value of gas used, kcal/kg						10349
Estimated gas consumption, tons/yr						833113
Emission factor for Gas (as per standard IPCC value)						56.1
Oxidation factor of gas (IPCC standard value)						0.995
COEF of gas(tonneCO_2/ton of gas)						2.419
EF (BM), tCO_2/GWh						**748.12**
Combined Margin Factor (Avg of OM & BM)						**950.20**
Baseline Emissions Factor (tCO_2/Million kWh)						**950.20**

	Measurement unit	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Plant Capacity	kW	7500	7500	7500	7500	7500	7500	7500
Plant Load Factor	%	50	55	60	65	70	75	75
Operating Period	Hours	8760	8760	8760	8760	8760	8760	8760
Gross Power Generation	Million kWh	32.850	36.135	39.420	42.705	45.990	49.275	49.275
Auxiliary Consumption	%	14	13	12	11	10	10	10
Auxiliary Consumption	Million kWh	4.599	4.698	4.730	4.698	4.599	4.928	4.928
T & D Losses	%	2	2	2	2	2	2	2
T & D Losses	Million kWh	0.657	0.723	0.788	0.854	0.920	0.986	0.986
Wheeling & Banking	Million kWh	0	0	0	0	0	0	0
Net Power Generation	**Million kWh**	**27.594**	**30.715**	**33.901**	**37.153**	**40.471**	**43.362**	**43.362**
Emission reduction	**tons of CO2**	**26,220**	**29,185**	**32,213**	**35,303**	**38,456**	**41,203**	**41,203**

Enclosure II

Summary of Environmental Impacts

The proposed project is to establish a 7.5 MW power plant using mustard crop residue (MCR) as main fuel and rice husk as auxiliary fuel.

The environmental impacts can be either categorized as primary or secondary impacts. Primary impacts are those that can be attributed directly to the project itself while secondary impacts are those, which are induced indirectly because of the development activity which may be triggered by the primary impact. The secondary impacts typically include the associated investment and changed patterns of social and economic activity by the project activity

The impact of the project on the environment can occur at two stages:

1. Construction phase
2. Operational phase

Impacts during construction phase

The impacts during construction phase due to the construction of the 7.5 MW MCR based power plant are listed as given here:

Air quality impacts:

- Due to particulate emissions from site clearing
- Due to vehicular emissions from transportation of raw materials such as cement, sand, gravel etc
- Due to particulate emissions from construction activities such as pre-casting, fabrication, welding etc

Noise level increase:

- From construction activities like rock drilling, blasting, hammering etc.
- From earth moving equipments used for site clearing
- From vehicles used for transportation of raw materials such as cement, sand, gravel etc

Land and soil impacts:

- From change/ replacement of existing land-use by site clearing
- From the sanitary wastes
- From soil erosion due to removal of vegetation
- From solid wastes disposed on land from construction activities

Water environment impacts

- From consumption of water for construction purposes
- From wastewater emerging from the construction activities

Impacts on ecology

- Removal of vegetation at the site

Impacts on socioeconomic environment

- Employment opportunities to local people

The above represents a broad range of environmental impacts during the construction phase of the project activity.

It should be noted that the impacts due to construction activities are mostly short-term and will cease to exist beyond the construction phase.

Impacts during operational phase

The operational phase involves power generation from mustard crop residue. The power plant exports power to the grid and indirectly prevents the pollutants otherwise let out into the atmosphere from the thermal power plants (coal and gas based) of the State grid.

Biomass (mustard crop residue) being a renewable fuel does not add any net CO_2 to the atmosphere, as the carbon gets recycled during the crop growth.

Alternative methods of biomass disposal being currently practiced in the villages, includes inefficient burning in fields or letting it to decompose, which would lead to more dust and GHG emissions when compared to the proposed project activity. The impacts during operational phase of the power plant are given below:

Air quality impacts:

The biomass power plant discharges the following pollutants into the air:

- Suspended Particulate Matter (SPM) from fly ash in the flue gas
- Sulphur dioxide (SO_2)
- Carbon dioxide (CO_2)

Biomass contains lesser quantities of sulphur (0.65%) when compared to fossil fuels, and therefore would result in lower SO_2 emissions. Carbon dioxide that is produced by firing biomass would be absorbed by mustard plantation.

The ash content in the biomass is less than 7 %. As the pollution control regulations limit the particulate matter emissions from biomass fired steam generators to 150 mg/ Nm^3, electrostatic precipitators (ESP's η = 99%) are used in the power plant to contain the dust emission from the plant to less than 150mg/Nm^3 during biomass firing. Particulate emissions of the project would be arrested by electrostatic precipitators (ESP).

The fly ash collected from the ESP hoppers and air heater hoppers and the ash collected from the furnace bottom hoppers will be used for land filling. To reduce to ground level air contaminants, 65 m stack is suggested for biomass-fired boiler. This would help in faster dispersion of air pollutants into the atmosphere thus reducing the impact on the project surroundings.

The biomass would be transported from nearby agricultural fields to the project site. However considering transport mostly by means camel carts, the air emissions would result from the transport by tractors which will be very negligible.

The air quality parameters released i.e. SO_2, NOx, CO and SPM emissions from the stacks attached to the boiler of the power plant are to be monitored as per the RSPCB norms.

Noise level increase:

The power plants have most of the fuel and ash handling systems either mechanical or pneumatic. The heavy crushing / impacting or mechanical operations are missing and thus, process noise levels are considerably low. However, the boiler and steam turbine are the equipments causing high noise levels.

The noise pressure levels of boiler are generally felt only inside the boiler house. It is proposed that personnel who have to work in the noise prone areas will be provided with earmuffs. The walls and enclosures for these installations namely boiler, stem turbine will be constructed of heavy block work to reduce traversing of the noise beyond the building. Similarly the air intakes and exhaust systems will be provide with silencers to attenuate the noise transmission to outside.

The vehicular transport of biomass from nearby fields to the power plant will be mostly by means of camel carts and hence the impact is likely to be negligible. The green belt will be provided around the plant area for noise attenuation.

Water quality impacts:

The requirement of water for the project is proposed to be met with from the bore well available at the site as no surface water is available close to the site.

AETPL also proposes to install effluent treatment plant (ETP) system to treat the discharges from the softener, DM plant, cooling tower bleed and boiler blow down.

The treated effluent from the plant would be used for ash quenching, greenbelt development besides being used to sprinkle over heaps of biomass and coal. Most of the water would percolate and recharge the ground water body.

Ecological impacts:

No ecological impacts are envisaged, as the wastewaters from the power plant will be treated appropriately before final disposal.

Also trees are proposed to be planted around the power plant for noise attenuation, it gives a cool atmosphere in the operational area and provides as a barrier for air emissions and noise level increase.

Land and soil impacts:

The solid wastes generated from the power plant are the dry fly ash and wet bottom ash from grate. This ash will be used by farmers as potash supplement for soil.

Socio-economic impacts

The project activity will contribute to socio economic growth in the following ways;

- Generation of employment to technical experts in various fields like mechanical, electrical, electronics, instrumentation, chemical engineering etc
- Exporting power to the grid thereby bridging the gap between demand and supply in a power deficit State
- Offering environmentally friendly solution for additional power generation without using fossil fuels
- Reduction in fuel transportation costs
- Reduction in transmission losses
- Self reliance of power in rural areas

Environmental Management Plan (EMP)

The EMP is prepared to basically manage the various impacts arising from construction and operational phases of the biomass power plant.

Construction phase

Air environment

The following mitigative measures were proposed during construction phase

- Spraying of water at regular intervals to control fugitive dust emissions from construction activities
- Air pollution due to plying of vehicles would also be contained and reduced by constructing proper approach roads and planting green belt alongside roads
- Regular and periodic emission check for transportation vehicles
- Construction and supply contractors will be advised to use vehicles with PUC certificate
- Use of personal protective equipment (PPE) like goggles and nose masks to reduce impact of dust emissions during construction activities

Noise environment

- Prevent transportation and consequent noise generating activities in the night time

- Periodic noise control checks on transportation vehicles
- Provision of ear plugs, work rotation, adequate training

Water environment

- Provision of groundwater supply to the project site for construction activities only and treated water with disinfection for drinking purposes

Land and soil environment

- AETPL shall provide temporary toilets to take care of sanitary wastes.
- All the construction debris and waste material shall be collected and stored in earmarked places.

Socioeconomic environment

- Provision of adequate housing, water, power and sanitation facilities to the construction workers and labour
- Provision of adequate cooking fuel may be arranged by contractor for the labourers

Operational phase

Air environment

- Regular and periodic emission check for transportation vehicles
- Use of personal protective equipment (PPE) like goggles and nose masks to reduce impact of dust emissions
- Provision of electrostatic precipitator (ESP) to control dust emissions
- Periodic monitoring of boiler stack emissions

Noise environment

- Periodic noise control checks on vehicles
- Provision of ear plugs, work rotation, adequate training
- Incorporation of noise control measures at source
- Sound proofing/ glass paneling of critical operating stations
- Regular noise level monitoring at the plant and surrounding area

- Plantation of green belt which acts as a attenuator of noise

Land and soil environment

- Improvement of soil quality and plantation of suitable tolerant species in the study area.

Water environment

- Treatment of power plant discharges from the softener, DM plant, cooling tower bleed and boiler blow down in the effluent treatment plant
- Periodic monitoring of water quality parameters

Ecological environment

- Plantation of greenbelt

Post project monitoring

- The effluent characteristics will be being monitored so as to meet the requirements of the RSPCB norms and the minimum national standards (MINAS) for effluent from thermal power plants
- Air quality monitoring will be done so as to meet the requirements of the RSPCB.
- The air quality parameters to be monitored from the stack emissions are SPM and SO2

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