REVISED MONITORING PLAN

OF

0390: Perpetual 7.5 MW Non-Conventional Renewable Sources Biomass Power Project

April 2009

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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:

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Monitoring methodologies / guidelines mentioned in the UNFCCC document of "Appendix B of the simplified modalities and procedures for small scale CDM project activities" for small scale projects (Type I:D) is considered as basis for monitoring methodology for the activity. The document states that the monitoring shall consist of metering the electricity generated by the renewable technology.

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

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The project activity meets the eligibility criteria to use simplified modalities and procedure for small-scale CDM project activities as set out in paragraph 6 (c) of decision 17/CP.7.

Details of approved methodology for baseline calculations for CDM projects of capacity less than 15 MW is available in the "Appendix B of the simplified modalities and procedure for small scale CDM project activities". As the power plant is of 7.5 MW capacity, reference has been taken from indicative simplified baseline and monitoring methodologies for selected small scale (CDM projects less than 15 MW) project activity categories.

D.3 Data to be monitored:

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ID number *(Please use numbers to ease cross-referencing to table D.6)*	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
D.3.1	Power	Electricity generated	KWh	Measured	Daily	100%	Paper/ Electronic	2 years	Based on energy meter in plant control room
D.3.2	Power	Auxiliary consumption	KWh	Measured	Daily	100%	Paper/ Electronic	2 years	Based on the difference between energy generated and exported
D.3.3	Power	Power export	kWh	Measured	Daily measurement & monthly recording	100%	Paper/ Electronic	2 years	Based on tri-vector energy meter in APTRANSCO sub station
D.3.4	Power	Power Import	kWh	Measured	Daily measurement & monthly recording	100%	Paper/ Electronic	2 years	Based on tri-vector energy meter in APTRANSCO sub station
D.3.5	Fuel	Biomass used	MT	Measured	Daily	100%	Paper	2 years	
D.3.6	Fuel	Avg. calorific value of Biomass used	Kcal/ Kg	Measured	Monthly		Paper	2 years	Through sample testing in lab. Tested as mentioned only if the source of fuel is different.

D.3.7	Fuel	Coal	MT	Measured	Daily	100%	Paper	2 years	
D.3.8	Fuel	Carbon content in coal	%	Measured	For each batch of coal	Grab sample	Paper	2 years	Through sample testing in lab. Tested every batch only if the source of fuel is different.
D.3.9	Fuel	Calorific value of coal	kcal/kg	Measured	For each batch of coal	Grab sample	Paper	2 years	Through sample testing in lab. Tested every batch only if the source of fuel is different.
D.3.10	Fuel	Diesel	Litres	Measured	Daily	100%	Paper	2 years	Measured using Dip Stick Method
D.3.11	Fuel	Avg. calorific value of Diesel	TJ/Gg	Value applied: 43.0, the most recent data published by IPCC at the time of verification.	Annually	-	Paper	2 years	*Source:* 2006 IPCC Guidelines for National Greenhouse Gases Inventories (Volume 2, Table 1.2, Page 1.18) / Local standards (or) the most recent data published by IPCC at the time of verification.
D 3.12	Fuel	Density of Diesel	t/1000 L	Value applied: 0.83	Annually	-	Paper	2 years	*Source:* 2006 IPCC Guidelines for National Greenhouse Gases Inventories (Volume 2, Table 1.2, Page 1.18) / Local standards (or) the

									most recent data published by IPCC at the time of verification.
D 3.13	Fuel	Oxidation factor of Diesel	No unit	Value applied: 1.0	Annually	-	Paper	2 years	*Source:* 2006 IPCC Guidelines for National Guidelines for Greenhouse Gas Inventories(Volume 2, Table 1.2, Page 3.18) / Local standards (or) the most recent data published by IPCC at the time of verification.

Note: Data to be archived is for a period of 2 years during crediting period after issuance of CERs

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

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Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D3.1to 3.10	*Low*	*The data will be directly measured and monitored at the project site. All relevant records will be checked to ensure consistency*

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:

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Project proponent implemented the following operational and management structure in order to monitor emission reductions and any leakage effects, generated by the project activity

Project proponent formed a CDM team/committee comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. In the CDM team, a special group of operators will be formed who will be assigned responsibility of monitoring of different parameters and record keeping. On daily basis, the monitoring reports will be checked and discussed. On monthly basis, these reports will be forwarded at the management level.

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

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Perpetual Energy Systems Private Limited, who is also a project participant

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

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E.1.1 Selected formulae as provided in appendix B:

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

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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:

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The project proponent uses biomass as fuel. However, the project proponent, in case of exigencies proposes to use coal as fuel instead of biomass. The CO_2 emissions during the usage of coal can be calculated in the following manner:

1.Using IPCC standard CO2 emission factor

$$CE_c = Q * CC * EFC$$

where,

CEc - Carbon-dioxide emission due to coal burning at project site, MT

CC - Calorific value of coal, kcal/ton

Q - Quantity of coal burned, MT

EFC - IPCC standard emission factor kg of CO2/kcal

OR

2. Using actual carbon content of the coal

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 emission quantity due to combustion of coal 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

Though project emissions due to the usage of coal will be estimated based on the procedures mentioned above during monitoring and verification stage, for the conservative estimation purpose, 30% of total generation was considered using coal in the baseline calculation sheet.

The Project may import power from the Grid during shut down and start up and emissions due to import will be considered and deducted from baseline emissions accordingly.

Emissions	**Formulae used**
Baseline Emissions	Electricity Exported to the Grid(kWh) x Grid Emission Factor (tCO_2/kWh)
Project Emissions	
Due to Coal Consumption	Actual Coal Consumed in MT x % Carbon in Coal x (44/12)
Due to Diesel Consumption	(Diesel consumed in Litres x Calorific Value (TJ/kg)) x Density of fuel (kg/L) x IPCC Emission Factor(tCO_2/TJ) x Oxidation Factor
Due to import of Power from Grid	Electricity imported from Grid(kWh) x Grid Emission Factor (tCO_2/kWh)

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

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The leakage activity identified, which contributes for GHG emissions outside the project boundary is transportation of biomass from biomass collection centres to biomass power project site. Calculation of leakage has been carried-out as under:

- Biomass to be procured - 71,570 MT
- Average Distance between project site and biomass collection centres - 30 km
- Biomass load per truck - 5 MT
- Number of return trips - 14,314
- Consumption of Diesel per trip 15 liters (4km/litre)
- Total Diesel consumption - 214,710 liters p.a
- CO_2 emission factor for Diesel (as per IPCC guidelines) - 74.10 tons CO_2 / TJ

- CO_2 emission per annum - 640 tons

The CO_2 emission (leakage) 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 is higher as compared to the transportation distance between biomass collection centres to biomass power project site and hence the higher CO_2 emissions. To be on conservative side, this leakage due to coal transportation has not been added while calculating the baseline of southern regional grid and hence a small leakage due to transportation of biomass has been neglected from the calculations and estimations of emission reductions.

In addition to above, project emissions also occur due to transportation of the fly ash for disposal. Plant generates around 10000 tons of fly ash per annum. Number of trips to dispose fly ash to destination is around 3 per day. However, the distance of transport of fly ash from the plant to brick manufacturers in the area is well below 100 km and number of truck trips per annum are less than 1500, hence the emissions due to the same have also been neglected.

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

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Considering the negligible CO_2 emissions due to leakage and remote need to operate the plant using coal as a fuel during non-availability of biomass, net emissions by project activity are considered to be 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:

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Southern Regional grid is considered for baseline analysis and calculation of anthropogenic emissions by fossil fuels during power generation. It is observed that, in the Southern regional grid generation mix, coal, diesel and gas based power projects are responsible for GHG emissions. The following approved methodology has been considered for baseline calculations.

Method: The average of the approximate operating margin and the build margin (Combined margin)

Method: Combined Margin

(a) Baseline Power Generation

$$P_{wlc} = P_{tot} - P_{lrc}$$

Where

P_{wlc} Power generation by all sources, excluding hydro, biomass and nuclear

P_{tot} Power generation by all sources of grid mix

P_{lrc} Power generation by Hydel, nuclear, biomass projects

(b) Sectorwise baseline power generation

$$P_{fuel} = \frac{P_f}{P_{wlc}} x 100$$

Where

P_{fuel} Share (in %) of power generation by each fuel used (coal and gas in present scenario), out of total power generation excluding Plrc

P_f Power generation by fuel used (in million kWh units)

(c) Calculation of Operating Margin emission factor

$$OM_{bef} = \sum P_{fuel} \; x \; E_{fuel} \; for \; base \; year \; for \; Scenario \; 1$$

Where

OM_{bef} OM emission factor of baseline calculated for each year (kg/kWh)

E_{fuel} Emission factor (actual or IPCC) for each fuel type considered (e.g coal, gas)

(d) Calculation of Build margin emission factor for each source of baseline generation mix

BM_{yr} = Weighted average of emissions by recent 20% capacity additions or MWh of five most recent plants, which ever is higher

Where

BM_{yr} = Build margin for base year (kg/kWh) = $\frac{\sum P'_f \; x \; E'_f}{\sum P'_f}$

Where

P'_f Generation capacity from specific fuel in the most recent 20% power plant or five most recently built plants, whichever is higher

E'_f Emission factor for the specific fuel in the most recent 20% power plants built or five most recently build plants

(e) Combined Margin Factor

CMF for each year crediting period

= $(OM_{bef} + BM_{yr}) / 2$ (in kg/kWh)

Final (net) baseline emission factor (NEFB) = 0.830

(Refer to Baseline excel sheet)

(f) Power Generation and Export by project activity

TP_{gen} = $TP_{exp} + TP_{loss}$

Where

TP_{gen}	Total power generared
TP_{exp}	Total clean power export to grid per annum
TP_{loss}	T&D loss

(g) Emission reduction by project activity

$ER = TP_{exp} \times (NEF_B - NEF_p) - EL$

Where

ER	Emission reduction per annum by project activity (tones/year)
TP_{exp}	Total clean power export to grid per annum
NEF_B	Final emission factor of baseline
NEF_p	Net emission factor of project activity (=0)
EL	Emission leakage (tonnes/year) (= 0)

Step by step calculation using combined margin methodology of CO_2 emissions due to burning of coal, diesel and gas for power generation and emission reductions by the project activity is as under.

Step 1	**:**	Net operating emission factor for coal, lignite	=	Actual emission factor for coal/lignite x % of generation by coal/lignite out of total generation excl. RE projects
Step 2	**:**	Net operating emission factor for gas, diesel	=	Step 1 is to be repeated for gas and diesel
Step 3	**:**	Operating margin factor	=	Net emission factor for coal + Net emission factor for gas + Net emission factor for Diesel

Step 4	**:**	Built Margin factor	=	Weighted average of emission factors of most recent 20% plants or 5 most recently built plant, whichever is higher
Step 5	**:**	Average of operating and build margin factor	=	(operating margin factor + built margin factor)/2
Step 6	**:**	Units exported to APTRANSCO		Total Power generation –Total auxiliary consumption.
Step 7	**:**	CO_2 emission reduction	=	Units exported to AP grid x Average of operating and build margin factor

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:

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CO_2 emission reduction due to project activity	=	Net CO_2 baseline emissions x Electricity exported to grid (in kWh)	-	Project emissions
	=	253262	-	110938
	=	142324		

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

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	Operating Years	Net Baseline Emission Factor (kg CO_2 /kWh)	Baseline Emissions (tonnes of CO_2)	Project Emissions (tonnes of CO_2)	Emission Reductions (tonnes of CO_2)
1.	2003-2004	0.830	36180	15848	20332
2.	2004-2005	0.830	36180	15848	20332
3.	2005-2006	0.830	36180	15848	20332
4.	2006-2007	0.830	36180	15848	20332
5.	2007-2008	0.830	36180	15848	20332
6.	2008-2009	0.830	36180	15848	20332
7.	2009-2010	0.830	36180	15848	20332
Total CERs			**253262**	**110938**	**142324**

Therefore, an conventional energy equivalent of 202.2 Million kWh for a period of 7 years (84 months) would be replaced by exporting power from the 7.5 MW Biomass based power plant which in turn will reduce 142,324 tons of CO_2 emissions considering baseline calculations.

Annex 4
Monitoring Plan

All the parameters mentioned in the monitoring plan have been monitoring in the plant but in other formats. The entire process of monitoring has been streamlined and will be made available in the required format during the verification process and for subsequent useful purposes. The Fuel Consumption data, etc are being maintained in different formats. The data formats for CDM have already been finalized and started monitoring accordingly to ensure and demonstrate existence of MVP in the plant.

The calibration of monitoring equipment is being maintained as per the requirement of APTRANSCO and the same is being done regularly. Power Generation, Export, Import & Auxiliary Consumption, fuel consumption are being recorded daily and the same is being verified and approved by General Manager of the plant. These records are being sent to Head Office for review by the Director and for corrective actions if necessary.

The Plant is equipped with energy meters/export and import meters for monitoring and control purpose. There are two energy meters at APTRANSCO sub station to measure the export power, namely main meter and check meter with 0.2 class accuracy. The energy meters shall be tested and calibrated utilizing a standard meter. The standard meter shall be calibrated once in a year at the approved laboratory of Govt. of India or Govt. of AP as per terms and conditions of supply. The tests of meters shall be jointly conducted by authorised representatives of both the parties and the results and correction so arrived at mutually will be applicable and binding on both the parties. The energy meters shall not be interfered with, tested or checked except in the presence of representatives of company and APTRANSCO. If any of the meters is found to be registered inaccurately, the affected meter will be immediately replaced. The meters will be checked in presence of both the parties on mutually agreed periods. If during the test checks both the meters are found beyond permissible limits of error, both the meters shall be immediately replaced and the correction applied to the consumption registered by the main meter to arrive at the correct energy exported for billing purposes for the period of one month up to the time of test check, computation of exported energy for the period thereafter till next monthly reading shall be as per the replaced meter. Corrections in exported energy shall be applicable to the period between the two previous monthly reading and the sate and time of test calibration in the current month when error is observed.

Power generation, export, import and auxiliary consumption are being recorded at the plant from the installed meters. However, for applying monthly bill to APTRANSCO the meter readings will be taken on 24^{th} of every month by APTRANSCO officials in presence of company representatives and readings will be jointly certified.

The following log sheets are being maintained for the critical equipment of the plant and readings are being recorded on day to day basis:

1. Turbine log
2. Boiler log
3. Electrical log

If both the main and check meters fail to record or if any of the PT fuses are blown out, the export energy will be computed on a mutually agreeable basis for the point of defect.

Power generation, export and auxiliary consumption, fuel consumption are being recorded at the plant daily and the same is being verified by Manager of the plant. These records sent to head office for review by the director and for corrective actions if necessary.

Emission levels are being monitored as per the statutory requirement. Plant emission levels are being monitored and the results are being sent to APPCB. For this purpose, the service of external agency is being utilized.

As requested by the board, the project proponent has revised this PDD to incorporate one additional parameter as a part of the monitoring plan, namely, Diesel Consumption at the project facility. Though this parameter did not form a part of the monitoring plan in the registered PDD, the project proponent had already incorporated the same in the previous two monitoring reported submitted for the project activity against which CERs have already been issued. The links to the same have been given below:

1. Monitoring report: 16 Feb 2003 - 31 Mar 2006[1]
2. Monitoring report: 01 Apr 2006 - 31 Mar 2007[2]

In the first monitoring report (16 Feb 2003 - 31 Mar 2006) the DOE issued a Forward Action Request (FAR) which has been given below:

"Southern grid emission factor is calculated based on data from CEA annual reports and fixed for total crediting period. The power exported to the grid is monitored on daily basis by project team and on monthly basis by APTRANSCO officials in presence of plant management. The fuel consumption is done based on daily log books and stores records on daily basis. Monitoring of data pertaining to emissions due to consumption o diesel for DG set operations in case of emergency need to be made part of monitoring plan".

Against the same the project proponent's response which was duly accepted is stated below:

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1 http://cdm.unfccc.int/UserManagement/FileStorage/PGWCMPK4FDZUCXC5JVR10CTZK6Z0JF

2 http://cdm.unfccc.int/UserManagement/FileStorage/JQ7QAC8PF26WE7ACGIUG9HYXFPWC2O

"Though the consumption of diesel in plant during the emergency conditions like black out is being monitored since beginning the same as not included in the monitoring protocol considering consumption in very small quantities. However, the as, will be included in the monitoring plan and separate records for the same will be maintained and the same will be made available during all future verifications as it was done during present verification."

Since then the project proponent is maintaining up to date records pertaining to Diesel consumption and same have been made available during subsequent verifications.

Thus with the incorporation of this monitoring parameter, there would have no impact on the baseline and negligible impact on the emission reductions form the project activity.