Revised Monitoring Plan

18 MW Kemphole Mini Hydel Scheme (KMHS) by International Power Corporation Limited

CDM Project Number 0312

Version: 1.1

Implemented by

International Power Corporation Limited
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Date: 8th February 2008

1. Introduction

1.1 Title of the project activity

18 MW Kemphole Mini Hydel Scheme (KMHS), by International Power Corporation Limited, India

1.2 Introduction

The purpose of the monitoring report is to calculate the Greenhouse Gas emission reductions achieved by this project for periodic verification.

Starting date of the project activity

KMHS project was completed in two stages; in first stage 2X6 MW units were installed (20^{th} Oct 2003, 20^{th} Nov 2003), in second stage 6 MW was installed (10^{th} Jan 2005).

1.3 CDM registration details

Date of registration: 25th May 2006

Reference no.: 0312
(http://cdm.unfccc.int/Projects/DB/SGS-UKL1142326439.29/view.html)

PDD Version and date: PDD version 1/25^{th} October 2005 UNFCCC 00000312

Methodology: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

Reference: Approved consolidated baseline methodology ACM0002/Version 04, Sectoral Scope: 1, 30 September 2005

1.4 Project activity

Kemphole Mini Hydel Scheme (KMHS) is an 18 MW (3 X 6 MW) Run-of-the-River hydro power project located at Kemphole stream in Hassan district of Karnataka in India. The main activity of the project is generation of electricity using hydro potential available in Kemphole stream and exporting the generated power to Karnataka Power Transmission Corporation Ltd. (KPTCL) as per power purchase agreement between two of them.

Three horizontal Francis turbines of 6 MW capacity each coupled with horizontal 3 phase, 50 Hz, 500 rpm synchronous generators are used. The gross head available for the project is 68 meters. A 66 KV double circuit transmission line (total 124 towers over 29 KMs) from the switchyard to the 11/66 KV sub-station at Sakaleshpura is used for power evacuation from the project activity.

2. Need for revision in the monitoring plan

A revision to the monitoring plan is proposed to provide clarity on the following ambiguity raised by the DOE:

The Build Margin emission factor description in the monitoring plan i.e. Section D.2.1.3, Page no. 19 is based on ex-ante approach as the Build Margin emission factor is calculated once at the beginning of crediting period. Whereas, the Build Margin emission factor calculation described in section D.2.1.4, page no. 22 is based on ex-post approach i.e. it will be updated annually.

Hence, the information in Section D.2.1.3 is inconsistent with the information in Section D.2.1.4. This scenario makes it difficult to decide whether ex-ante or ex-post grid emission factor should be used for estimation of emission reduction. To remove this inconsistency, the following revisions are proposed by International Power Corporation Limited:

1. The Build Margin (BM) emission factor and the Operating Margin (OM) emission factor is calculated **ex-ante** (as calculated in the registered PDD) i.e. once at the beginning of the crediting period and is fixed for the entire crediting period i.e. the CO2 emission factor for the Southern Grid (0.814 tCO2/MWh) is fixed ex-ante and the same will be used for the entire crediting period. The baseline information and the calculation of the baseline emission factor is provided the Annex 1.

Justification that the revision does not deviate from the registered PDD

The registered PDD follows the Approved Baseline Methodology ACM0002, Version04. As per Step 2: Calculation of the Build Margin emission factor, the BM should be calculated ex-ante based on the most recent information available on plants already built for sample *m* at the time of PDD submission. And the same is followed in the revised monitoring. Hence, the revision does not deviate from the registered PDD.

2. Data Variables No. 2 to 11 as per the monitoring plan given in the registered PDD (Table D.2.1.3, Page no.18) are proposed to be excluded from the monitoring plan. Hence, the only variable required to be monitored is the net electricity supplied to the grid by the project activity. The net electricity supplied to the grid is the difference of power exported to the grid and power imported from the grid.

Justification that the revision does not deviate from the registered PDD

The data variables mentioned above are required to calculate the emission factor. Since, the emission factor has been fixed ex-ante, they are not required to be monitored by the project proponent every year.
The revised monitoring plan is discussed in the next section.

3. Revised monitoring plan

Monitoring methodology

The project activity meets the applicability criteria of the 'Approved baseline methodology ACM0002 (Please refer to Section B.2. of the PDD for details). The applicability criteria of the 'Approved monitoring methodology ACM0002' are identical to those of the 'Approved baseline methodology ACM0002'. Therefore the project activity has used 'Approved monitoring methodology ACM0002' in conjugation with the 'Approved baseline methodology ACM0002' for the project activity.

Date variables monitored as per the revised monitoring plan

The parameter required for the estimation of emission reductions is the net electricity exported to the KPTCL grid, which is calculated as electricity exported to the grid by the project minus the electricity imported from the grid by the project activity.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	Electricity supplied to the grid by the project activity	KMHS records/ KPTCL records	MWh	Directly Measured	Monthly	100%	Electronic	The net quantity of electricity exported to the KPTCL grid is monitored by the Main meter and the Check meter installed in the switchyard area near the plant. The Main Meter readings are used for the estimation of net export to the KPTCL grid. Joint meter reading is taken by the plant personnel and KPTCL personnel.

2	Electricity imported from the grid by the project activity	KMHS records/KPTCL records	MWh	Directly measured	Monthly	100%	Electronic	The net electricity imported from the grid is monitored by the Main meter and the Check meter installed in the switchyard area near the plant.
3	Net electricity exported to the grid by the project activity	KHMS records	MWh	Calculated		100%		Net electricity exported to the grid is calculated as electricity exported to the grid minus electricity imported from the grid.

Quality control (QC) and quality assurance (QA) procedures being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1-2	*Low*	*The data is accurately measured by high quality and high accuracy meters installed. Every month these meter readings are recorded by plant personnel and KPTCL, which are archived for cross-checking. These meter readings are used to determine the net electricity supplied to the grid by the project activity and determine the extent of mitigation of GHG over the monitoring period.* *The meters are in the custody of KPTCL. Proper maintenance and calibration procedures are followed to ensure accuracy and reliability of the meter.* *Details are provided in the Annex 2.*

Completeness- For Electricity generation data: The project activity has installed the latest state of art monitoring and control equipment that measure, record, report, monitor and control various key parameters. Real time data collection happens using these control systems. An hourly log of data is also prepared by the shift in-charge. A daily report of aggregation of these data is also

prepared. Parameters monitored are power exported to the grid and power imported from the grid (other parameters like head availability, grid issues, frequency etc are also maintained hourly).

Reliability- For Electricity generation data: automatic control meters regarding power generation and exports are regularly maintained. The regular plant operating & maintenance procedures also include process of regular meter testing, calibration & maintenance. A Joint Monitoring Report (JMR) is prepared on the basis of the joint meter reading taken by the plant personnel and KPTCL. Actual power generation data is also metered using power output meter maintained by KPTCL. Every year KPTCL calibrates these meters. The receipt of sales shall be used to validate the data accuracy.

Frequency- The measurement is recorded and monitored on a continuous basis. A monthly Joint Monitoring Report (JMR) is prepared.

4. GHG Emission Reduction Estimation

Estimate of GHG emissions by sources and leakage

There are no project emissions in the project activity. PEy = 0
There are no emission sources as leakage in the project activity. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction. However according to ACM0002 Project participants do not need to consider these emission sources as leakage in applying this methodology.

Calculation of Baseline Emissions

$BEy = EFy \times EGy$

Where
BE_y : Baseline emissions due to displacement of electricity during the year y in tons of CO_2
EG_y : Electricity supplied to the grid by the project activity during the year y in MWh, and
EF_y : CO_2 baseline emission factor for the electricity displaced due to the project activity in during the year y in tons CO_2/MWh.

Annex 1

Baseline Information

Grid Emission Factor calculation

The CO_2 emission factor of KPTCL grid has been calculated as per the guidance provided in the Approved Consolidated Methodology ACM0002

STEP 1 Calculation of Operating Margin emission factor

Simple OM approach is the most appropriate calculations method because in the KPTCL grid mix, the low-cost/must runs resources constitutes less than 50% of total grid generation. Simple OM factor is calculated as under.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \, x \, COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where

$GEN_{j,y}$: The electricity (MWh) delivered to the grid by source j

$COEF_{i,j\,y}$: The CO_2 emission coefficient of fuel i (t CO_2 / mass or volume unit of the fuel), calculated as described below and

$F_{i,j,y}$: The amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y , calculated as described below

J, Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid

The CO_2 emission coefficient $COEF_i$ is obtained as

$$COEF_{\ i} = NCV_{\ i} \otimes EF_{CO\,2,i} \otimes OXID_{\ i}$$

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 (IPCC default value)

$OXID_i$: The oxidation factor of the fuel (IPCC default value)

The Fuel Consumption $F_{i,j,y}$ is obtained as

$$\sum_{i} F_{i,j,y} = \left(\sum_{j} GEN_{j,y} \otimes 860 \Big/ NCV_i \otimes E_{i,j} \right)$$

Where

$GEN_{j,y}$: The electricity (MWh) delivered to the grid by source j

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

$E_{i,j}$: The efficiency (%) of the power plants by source j

STEP 2 Calculation of Build Margin emission factor as the generation-weighted average emission factor (t CO_2/MWh) of a sample of power plants m of KPTCL grid, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \, x \, COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ - Are analogous to the variables described for the simple OM method above for plants m.

STEP 3 Calculation of baseline emission factor

Electricity baseline emission factor is calculated as the weighted average of the Operating Margin emission factor (*EFOM,y*) and the Build Margin emission factor (*EFBM,y*) where the weights *wOM* and *wBM*, by default, are 50% (i.e., *wOM* = *wBM* = 0.5).

Source	MoU	OM (2002-03)	OM (2003-04)	OM (2004-05)
Year-wise OM	tCO2/ MWh	0.952	0.978	0.992
OM	tCO2/ MWh	0.974		
BM	tCO2/ MWh	0.655		
Emission Factor-CM	tCO2/ MWh	**0.814**		

Southern Grid Power Generation [2004-05]

Source	MoU	Thermal	Diesel	Gas	
Gross Generation	MU	97964.3	2364.1	12276.6	
Net Generation	MU	90018.2	2293.2	11966.5	104278.0
Heat Rate	kcal/kWh	2490.0	2062.0	2000.0	
Fuel CV	kcal/kg	4171.0	10186.0	10750.0	
Fuel Consumption	Tonnes per annum	58482667.6	478582.0	2284018.6	

Total Emissions	tCO2/ annum	96187754.9	1497326.0	5738481.7	103423562.7
Emission Factor-OM	tCO2/ MWh	**0.992**			

Southern Grid Power Generation [2003-04]

Source	MoU	Thermal	Diesel	Gas	
Gross Generation	MU	96664.0	3225.0	16183.0	
Net Generation	MU	87938.6	3128.3	15770.3	106837.2
Heat Rate	kcal/kWh	2490.0	2062.0	2000.0	
Fuel CV	kcal/kg	4171.0	10186.0	10750.0	
Fuel Consumption	Tonnes per annum	57706391.8	652852.0	3010790.7	
Total Emissions	tCO2/ annum	94910996.6	2042559.6	7564460.0	104518016.3
Emission Factor-OM	tCO2/ MWh	**0.978**			

Southern Grid Power Generation [2002-03]

Source	MoU	Thermal	Diesel	Gas	
Gross Generation	MU	93350.1	4457.0	15138.0	
Net Generation	MU	85119.8	4323.3	14753.2	104196.2
Heat Rate	kcal/kWh	2425.0	2062.0	2000.0	
Fuel CV	kcal/kg	4171.0	9760.0	10750.0	
Fuel Consumption	Tonnes per annum	54273297.1	941632.6	2816372.1	
Total Emissions	tCO2/ annum	89264508.9	2822849.1	7075993.1	99163351.0
Emission Factor-OM	tCO2/ MWh	**0.952**			

Region-wise Design Station Heat Rate for Thermal Power Plants

Region/ Grid	2000-01	2001-02	2002-03	2003-04	2004-05
Northern	2483	2483	2491	2484	2484
Southern	**2434**	**2434**	**2425**	**2490**	**2490**
Western	2347	2347	2341	2357	2357
Eastern	2383	2383	2368	2365	2365

unit: Kcal/ Kwh

Source www.cea.nic.in

Parameters	2002-03			2003-04			2004-05			Source
	Coal	Natural Gas	Diesel	Coal	Gas	Diesel	Coal	Gas	Diesel	
NCV_i (kcal/kg)	4171	10750	9760	4171	10750	10186	4171	10750	10186	Coal: General Review 2003-04 (CEA) Gas: IPCC-Good Practice Guidance Diesel: General Review 2003-04 (CEA)
Heat Rate; (kcal/kWh)	2425	2000	2062	2490	2000	2062	2490	2000	2062	Coal: Performance review of Thermal Power Stations 2004-05, 2003-04; Gas: Petition 22/99 before CERC
$EF_{CO2,i}$ (tonne CO_2/TJ)	96.1	56.1	74.1	96.1	56.1	74.1	96.1	56.1	74.1	IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
$OXID_i$	0.980	0.995	0.990	0.980	0.995	0.990	0.980	0.995	0.990	Revised 1996 IPCC Guidelines
$COEF_{i,y}$ (tonne of CO_2/tonne of fuel)	**1.645**	**2.512**	**2.998**	**1.645**	**2.512**	**3.129**	**1.645**	**2.512**	**3.129**	Calculated as per ACM0002/ version03

Annex 2

Meter Details

The meter specifications are as below

SN	Line Details	Make	Serial Number of meter
1	Line 1 – (Main)	L& T Make	03129384
2	Line 1 – (Check meter)	L& T Make	03129382
3	Line 2 – (Main)	L& T Make	03129375
4	Line 2 – (Check meter)	L& T Make	03129379

The above Main Meter and Check Meter in the switchyard are sealed by KPTCL and are generally **calibrated once in a year by KPTCL with a pre-calibrated meter.** The installed meters are two-way meter and are used for both export and import. The electricity exported to the grid is sum of export measured by Line 1 and Line 2 and same for import of electricity too.
The energy generation can also be seen through another set of meters kept in the generator control and metering panel in the control room for unit 1 and Unit 2 separately.

The specifications of these meters are as below:

SN	Line Details	Make	Serial Number of meter
1	Generator 1	Enercon	E34/1874 – 703
2	Generator 2	Enercon	E 34 / 1875 -703
3	Generator 3	Enercon	E 58825 /4279 -4404

Accuracy: The meters are all tri vector L&T make. The meters have high accuracy level of 0.2%.
Calibration: Calibration of main meters and check meters is done on yearly by KPTCL people. The documents for the calibration of the meter have already been provided by the client.
Dealing with uncertainty: Check meters are provided in line with main meters to take care of any uncertainty related to electricity measurement.