MONITORING REPORT

"Teesta-V Hydro Power Project in Sikkim by NHPC Limited, India"

Estimation of Voluntary Carbon Units (VCUs) for the monitoring period:
1st April 2008 to 30th September 2009
(Both days included)

Monitoring Report Version: Version 1.1
Date: 25th August 2010.

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Monitoring Report for VERs

1. Title of the project activity

Title: Teesta-V Hydro Power project in Sikkim by NHPC Limited, India.
Version: 1.1
Date: 25th August 2010.

2. Introduction

The purpose of this monitoring report is to calculate the greenhouse gas emission reduction achieved by Teesta V hydro Power project for the period starting from 1st April 2008 to 30th September 2009.

This report covers the activity from 1st April 2008 till 30th September 2009.

3. Type/Category of the Project

Methodology: **"Consolidated baseline methodology for grid-connected electricity generation from renewable sources" Reference:** Approved consolidated baseline methodology ACM0002/Version 10, Sectoral Scope: 1, EB 47.

4. General description of the project

4.1. Project Activity

The Teesta HE project - Stage V is a run of the river scheme connected to the NEWNE grid. Stage V of the Teesta river project has installed a capacity of 510 MW (3×170 MW turbines). The power house is located near Singtam (about 4 km upstream of the confluence of Rongnichu with Teesta). The dependable discharge available throughout the year has been assessed as 60 cumecs and gross head available is 216.73 m; for the installed capacity of 510 MW. The project consists of concrete gravity dam across river Teesta with a 17.2 km long head race tunnel and an underground power housing three generating units of 170 MW capacity each.

The project is located in East district of Sikkim state on the major river system in Teesta in Sikkim. The power house site is located at 88º27´30" E and 27º15´00" N. The project site is accessible from Bagdogra Airport and is situated at a distance of 140 km from the airport (power house site being 110 km away). The nearest railway points are New Jalpaiguri and Siliguri.
Emergent Ventures India Pvt Ltd (EVI) is the project advisor for the VCS project.

4.2. Technical description of the project activity

The Teesta HE project Stage V is a run of the river scheme and will be producing energy to be absorbed into the Eastern region, part of the NEWNE grid. The project consists of 96.45 m high concrete gravity dam across river Teesta with a 17.2 km long head race tunnel and an underground power housing three generating units of 170 MW capacity each. The three tail race tunnels are D-shaped and 155m, 165m, 175m long. The penstock is of vertical pressure shaft type.

The project will provide the state with a clean source of energy which can be utilized not only for meeting the energy demand, but also reducing dependency on fossil fuel or wood but also provide a source of revenue and development opportunities in the state. The catchment area of the project is 4307 sq. km.

Table 1: Details about the units.[1]

S.N.	Technical Description of the Units	Type	Serial number of Turbine	Date of commissioning	Lifetime of the machine	Crediting period	Implementation status
1	Unit 1:	VF-1RS	M223600CR1101	6th February 2008	35 years from COD	10 years	Operational
2	Unit 2:	VF-1RS	M223600CR2101	20th March 2008	35 years from COD	10 years	Operational
3	Unit 3:	VF-1RS	M223600CR3101	28th March 2008	35 years from COD	10 years	Operational

5. Monitoring methodology and plan

The monitoring methodology applied to the project activity is:

Title: "Consolidated monitoring methodology for grid-connected electricity generation from renewable sources"
Reference: Approved consolidated monitoring methodology ACM0002/Version 10, Sectoral Scope: 1, EB 47

Keeping in line with the monitoring methodology, the following parameters are monitored in the specific project situation:

- $EG_{PJ, y}$ Net electricity supplied to the grid by project activity during the year y

The monitoring plan includes monitoring of net energy generation parameter at the substation. The metering system comprises of individual special energy meters (SEMs) for the three generating units of 400 KV generator transformers. These are connected via two transmission

[1] Document submitted : Attachment 1 Page 2,.

lines each having its own SEM meter (main meter and check meter) - Teesta V - Line 1 (400 KV Teesta – Binaguri) and Teesta V - Line 2 (400 KV Teesta – Binaguri). The meters are installed and sealed by the Power Grid Corporation Limited in the presence of the representatives of the power producer. The readings of the power generated (Ex-bus) are taken every month; and this data is used for billing purposes. The check meter shall be used during the period the main metering system is not in service. The meters will be calibrated periodically. The accuracy class of the energy meters is 0.2 s.

The monthly SEM statement is used for the calculation of net power exported from the power station. The proponent shall maintain complete and accurate records and all other data required for the purpose of proper administration and operation of the hydro power plant. The data will be kept for at least 2 years after the end of the crediting period.

Monitored parameters and the procedure followed for monitoring is given below:

Data / Parameter:	**$EG_{PJ, y}$**
Data unit:	MWh
Description:	Net Electricity supplied to the grid by the project activity during the year y
Source of data to be used:	Joint Meter Reading (JMR)/ Monthly Special Energy Meter statement (SEM) from the energy meters
Value of data applied for the purpose of calculating expected emission reductions	2547334* *as given in PD
Description of measurement methods and procedures to be applied:	For the measurement of net energy delivered to the grid, energy meters (SEMs) are provided. The transmission lines have a set of main meter and check meter. Further one standby energy meter at 400 kV side of generator transformer is also provided. All these energy meters are special energy meters (accuracy class 0.2s). The meters are capable of metering export and import data separately. The net electricity delivered to the grid would be the difference of export and import energy. The monthly SEM statement forms the basis for calculation of the emission reductions. The Readings taken at the substation are taken in the presence of SEB officials and the PP representative. Monitoring Frequency: Monitoring is on a

	continuous basis with monthly recording of data.
QA/QC procedures to be applied:	The main meters and the check meters are maintained and will be calibrated at least once in three years.
Any comment:	

Monitoring roles and responsibilities:

A project team is constituted for the monitoring of the project. This team is responsible for data collection and archiving. The team meets periodically to review the data collected as per the monitoring plan. In case of any irregularity observed by any of the team members, the concerned person is informed to take necessary actions. The following is the team structure for project monitoring:

a. *Unit Head:* Overall responsibility of compliance with the monitoring plan.
b. *Power Plant In-charge:* Responsibility for completeness of data, reliability of data (calibration of meters), and monthly report generation
c. *Shift In-charge:* Responsibility of daily report generation from the SCADA system/ log-books

Managing Data Quality : The Power plant In-charge prepares the report pertaining to the recorded values of the monitored parameters as by the shift-in-charge. The day to day records are verified by Unit Head, compiled and documented. The company will safely store the data. NHPC is an ISO – 9000, and ISO – 14000 certified company having an integrated management system. This ensures that management system requirements are met.[2]

6. GHG Emissions calculations

6.1. Project activity emissions (PEy)

There are no project emissions of CH_4 from the reservoir as defined in the PD.

PE_y=0.

6.2. Leakage ($LEy_)$

As specified in the PD leakage is not included for such project activities

LE_y = 0

[2] D2- ISO certificates submitted to DOE with this report.

6.3. Baseline Emissions (BE_y)

As per Section 3.2 of the registered VCS PD, emission reduction estimation is to be carried out as follows :

$$\mathbf{BE_y = EF_{grid,CM,y} X EG_{PJ,y}}$$

Where

BE_y : Baseline emissions in year y (t CO_2)

$EG_{PJ,y}$: Quantity of net electricity generation that is proposed and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$: Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" 0.803 (tCO_2/MWh.)

As defined in section 3.3 of registered PD the parameters to be monitored are:

Net Electricity supplied to the grid by the project activity during the year y ($EG_{PJ,y}$)

The energy supplied to the grid by two transmission line is measured using special energy meters of 0.2s meter accuracy class, installed at the intersection point. The plant is connected to the grid via two transmission lines each having its own SEM meter (main meter and check meter) – Teesta V Line 1 (400 KV Teesta – Binaguri) and Teesta V Line 2 (400 KV Teesta – Binaguri). The meter is installed and sealed by the Power Grid Corporation Limited in the presence of the representatives of the power producer. The readings of the power generated (Ex-bus) are taken every month; and this data is used for billing purposes. The meters record net energy exported to the grid every 15 mins and store the data[3]. This data is uploaded to the Eastern Region Load Dispatch Centre (ERLDC) every week. In case any queries are raised about the main meter readings the check meter reading may be used to check consistency. However in the absence of any queries this uploaded data is considered to be the net energy delivered to the grid. This data is used to calculate Baseline Emissions and is shown below (

TABLE 2).

[3] D.3 Meter reading Teesta V 2008-2010, submitted to DOE with this report.

Table 2:
Calculating Net Electricity supplied to the grid by the project activity during the year y ($EG_{PJ,Y}$), monthly

	Teesta V - Line 1 (400 KV Teesta – Binaguri) .	Teesta V - Line 2 (400 KV Teesta – Binaguri)	$EG_{PJ,y}$
Month	Net Electricity supplied to the grid by the project activity during the year y, through Line 1 (in each month)	Net Electricity supplied to the grid by the project activity during the year y, through Line 2 (in each month)	**Net Electricity supplied to the grid by the project activity during the year y**
Unit	**MWh**	**MWh**	**MWh**
April 2008	134,116.2	1,230.9	135,347.1
May 2008	189,235.4	0.0	189,235.4
June 2008	64,240.8	28,221.8	92,462.6
July 2008	0.0	71,152.3	71,152.3
August 2008	111,778.6	223,332.5	335,111.1
September 2008	166,008.6	161,107.8	327,116.4
October 2008	132,477.0	115,462.1	247,939.1
November 2008	91,412.6	35,713.4	127,126.1
December 2008	64,114.5	31,986.5	96,101.0
January 2009	52,830.9	22,062.2	74,893.0
February 2009	38,279.6	33,912.0	72,191.6
March 2009	71,822.8	31,603.2	103,426.1
April 2009	117,779.5	85,965.7	203,745.3
May 2009	138,374.4	108,057.7	246,432.1
June 2009	165,892.9	168,679.5	334,572.4
July 2009	173,706.0	180,488.2	354,194.2
August 2009	172,725.6	179,071.8	351,797.4
September 2009	168,762.4	167,795.8	336,558.2

Grid Emission Factor ($EF_{grid,CM,y}$)

GEF has been fixed Ex-ante in the PD at 0.803 tCO2/ MWh and the same has been used in the calculation of emission reductions in this Monitoring Report.

Baseline Emission ($BE_{,y}$)

Baseline Emissions are calculated by the following calculations (Table 3):

Table 3: Calculating Baseline Emissions (BE_y)

Month	Net Electricity supplied to the grid by the project activity during the year y ($EG_{PJ,y}$)	Grid Emission Factor ($EF_{grid,CM,y}$)	Baseline Emissions (BE_y)
Unit	**MWh**	**tCO2/MWh**	**tCO2**
April 2008	135,347.1	0.803	108683.72
May 2008	189,235.4	0.803	151956.03
June 2008	92,462.6	0.803	74247.47
July 2008	71,152.3	0.803	57135.30
August 2008	335,111.1	0.803	269094.21
September 2008	327,116.4	0.803	262674.47
October 2008	247,939.1	0.803	199095.10
November 2008	127,126.1	0.803	102082.23
December 2008	96,101.0	0.803	77169.09
January 2009	74,893.0	0.803	60139.10
February 2009	72,191.6	0.803	57969.83
March 2009	103,426.1	0.803	83051.14
April 2009	203,745.3	0.803	163607.44
May 2009	246,432.1	0.803	197884.99
June 2009	334,572.4	0.803	268661.64
July 2009	354,194.2	0.803	284417.94
August 2009	351,797.4	0.803	282493.31
September 2009	336,558.2	0.803	270256.23
Total	**3,699,401.3**		**2970619.24**

BE_y = 2970619.24 tCO_2

6.4. Emission Reductions (ERy):

The emission reductions ER_y by the project activity during a given year y is the difference between baseline emissions (BE_y), project emissions (PE_y) and emissions due to leakage (L_y) as follows.

$$ER_y = BE_y – PE_y - L_y$$

Table 4: Calculating Emission Reductions (ER_y)

Month	Baseline Emissions (BE_y)	Project Emission (PE_y)	Leakage Emission (L_y)	Emission Reductions (ER_y)	Emission Reductions rounded off to the lower value (ER_y)
Unit	**tCO2**	**tCO2**	**tCO2**	**tCO2**	**tCO2**
April 2008	108683.72	0.00	0.00	108683.72	108683
May 2008	151956.03	0.00	0.00	151956.03	151956
June 2008	74247.47	0.00	0.00	74247.47	74247
July 2008	57135.30	0.00	0.00	57135.30	57135
August 2008	269094.21	0.00	0.00	269094.21	269094
September 2008	262674.47	0.00	0.00	262674.47	262674
October 2008	199095.10	0.00	0.00	199095.10	199095
November 2008	102082.23	0.00	0.00	102082.23	102082
December 2008	77169.09	0.00	0.00	77169.09	77169
January 2009	60139.10	0.00	0.00	60139.10	60139
February 2009	57969.83	0.00	0.00	57969.83	57969
March 2009	83051.14	0.00	0.00	83051.14	83051
April 2009	163607.44	0.00	0.00	163607.44	163607
May 2009	197884.99	0.00	0.00	197884.99	197884
June 2009	268661.64	0.00	0.00	268661.64	268661
July 2009	284417.94	0.00	0.00	284417.94	284417
August 2009	282493.31	0.00	0.00	282493.31	282493
September 2009	270256.23	0.00	0.00	270256.23	270256
Total	**2970619.24**	**0.00**	**0.00**	**2970619.24**	**2970612**

Thus a total Emission Reduction of **2970612 tCO_2** (the summation of the monthly value of emission reductions, rounded-off monthly to the lower value for a conservative estimate) is achieved by the project activity from 01st April 2008 to 30th September 2009, inclusive of both days. Thus, **2970612 VCUs** are generated in this period. (Table 4)

A comparison between the estimated Emission Reductions given in the PD, with those calculated in this monitoring report is given below (TABLE 5).

Table 5: Comparison between emission reductions estimated in the PD and those achieved in this verification period.

Detail	Value	Unit
Annual Emission reductions estimated in the PD	2044442	tCO_2/annum
Estimate of Emission reduction for 1.5 years (April 2008 to March 2009, April 2009 to Sep 2009)	3066663	tCO_2
Actual Emission reductions achieved by the Plant	2970612	tCO_2

Difference	-96051	tCO_2
Percentage difference	**-3.13%**	**%**

The Achieved CUF is 3.13% lower than that estimated in the PD, this value is within the 10% variation considered in the PD.

ER_y = 2970612 tCO_2

7. Quality Control (QC) and Quality Assurance (QA)

7.1. Calibration and maintenance of meters.

As described in the PD there are 7 special energy meters installed on site. 3 main meters on each of the three generating units and one main and one check meter on each of the 2 transmission lines (**Teesta V - Line 1 (400 KV Teesta – Binaguri)**) and **Teesta V - Line 2 (400 KV Teesta – Binaguri)**).

The nature of each of these meters (meter numbers) and their location with the calibration details are given below (Table 6).

Table 6: Details of the metering system

Meter number	Model	Accuracy Class	Location	Calibration Details and comments
NP 5895A	ER300P	0.2S	**Teesta V - Line 1 (400 KV Teesta – Binaguri)** check meter	Calibrated on 12thOctober 2006*
NP 5896A	ER300P	0.2S	**Teesta V - Line 1 (400 KV Teesta – Binaguri)** main meter,	Calibrated on 12thOctober 2006*, Data from this meter is used in this report in section 6.3. under the denomination **Teesta V - Line 1 (400 KV Teesta – Binaguri), (**Net Electricity supplied to the grid by the project activity during the year y, through Line 1) in each month, for the calculation of $EG_{PJ,y}$
NP 5897A	ER300P	0.2S	**Teesta V - Line 2 (400 KV Teesta – Binaguri)** check meter	Calibrated on 12thOctober 2006*
NP 5898A	ER300P	0.2S	**Teesta V - Line 2 (400 KV Teesta – Binaguri)** main meter	Calibrated on 12thOctober 2006*, Data from this meter is used in this report in section 6.3. under the denomination **Teesta V -**

				Line 2 (400 KV Teesta – Binaguri), (Net Electricity supplied to the grid by the project activity during the year y, through Line 2) in each month, for the calculation of $EG_{PJ,y}$

*Calibration certificates are submitted to the DOE with this report in Attachment 1 pgs 9 to 15.

As per clause 4.0, Metering Arrangement of the Power Purchase Agreement (PPA) the metering arrangement including its installation, testing, maintenance and collection transportation and processing of data required for energy exchange shall be governed as per the notification/ directives issued/or to be issued by Central Electricity Regulatory Commission and as per relevant provisions contained in IEGC as amended from time to time. The Central Electricity Authority (CEA) notification regarding Installation and Operation of meters regulations, 2006, says that meters are required to be tested once in 5 years (refer clause 18 of the guideline) [4]. The registered PD defines a 3 year calibration regime, which is more conservative, thus this calibration regimen is followed by this project activity.

A simplified single line diagram of the power plant showing the installation of the meters and transformers is given below **Fehler! Verweisquelle konnte nicht gefunden werden..**[5]

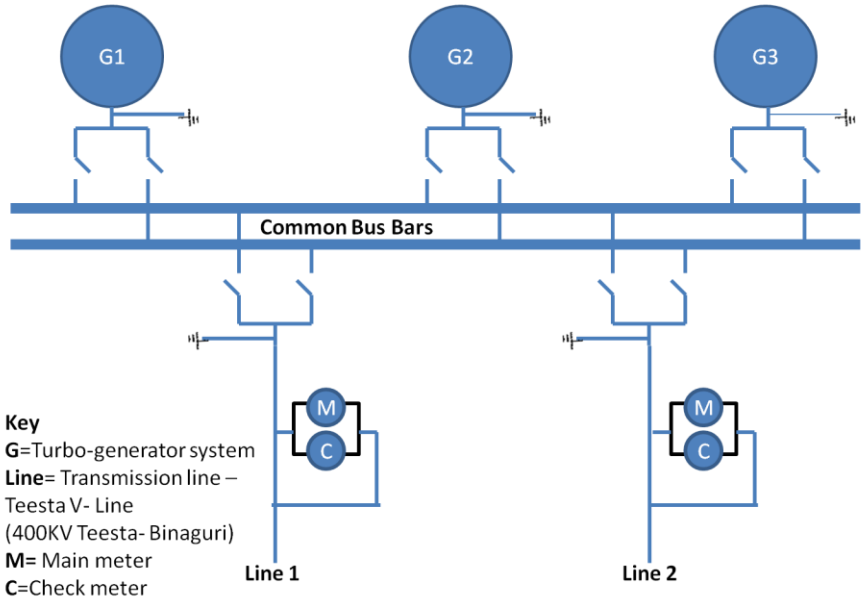

Figure 1: Simplified Single Line Diagram showing the position of the meters.

[4] CEA metering regulation clause 18 on page 12 of the regulation, The regulation is available on http://www.powermin.nic.in/whats_new/pdf/Metering_Regulations.pdf accessed on 8th December 2010.

[5] Also submitted to the DOE as F.1. detailed single line diagram with this report., which was used as reference for the simplified diagram that shows the position of the meters.

7.2 Shut down Details.

7.2.1. Outage Details:

A SUMMARY OF THE OUTAGE DETAILS IS GIVEN BELOW (

TABLE 7). [6]

Table 7 : Outage Details of Teesta V

	Teesta-V Total Outages				
	Total time	**Planned outage**	**Forced outage**	**Miscellaneous outage**	**Total Outage**
	Hr	**Hr**	**Hr**	**Hr**	**Hr**
April 2008	1896	0	753	418	1171
May 2008	2232	0	872	229	1100
June 2008	2160	9	5	1581	1594
July 2008	2232	0	0	1800	1800
August 2008	2232	231	0	13	244
September 2008	2184	199	8	12	219
October 2008	2232	0	2	737	739
November 2008	2160	0	2	1390	1393
December 2008	2232	241	13	1379	1633
January 2009	2232	613	0	1161	1774
February 2009	2016	216	0	1363	1579
March 2009	2232	139	0	1451	1590
April 2009	2160	0	0	946	946
May 2009	2232	0	0	722	722
June 2009	2160	70	1	110	180
July 2009	2232	129	1	0	130
August 2009	2232	40	2	120	162
September 2009	2160	130	2	40	171
Total	39216	2016	1660	13472	17148
% Outages	**44%**				

[6] Submitted to the DOE as document D.4. outage details.

Planned outages are planned in advance for annual maintenance, periodical routine maintenance/ checking, inspection. Any outage planned in advance because of abnormal operating parameters comes under forced outage and not planned outage.

Forced outages occur due to tripping cause by abnormal operating parameters, stopping/closure of units for inspection/investigation/rectification of abnormal operating parameters/behaviors/condition.

Miscellaneous outage occur due to reasons that are beyond the control of generating stations or for which generating stations are not responsible like tripping of units due to failure of grid, line problems etc, backing down due to grid constraints/requirements, closure of units due to high ppm, less availability of water etc. Outage for less than 15min due to tripping and resynchronization should also come under miscellaneous outage.

7.3 Training of staff details.

All the training received by staff is recorded and these records are made available in document **D.7. Staff training details** that is submitted to the DOE.

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Annexure-1:

Definitions in the report

PD: Project Document
GHG: Greenhouse Gases
ERLDC: Eastern Regional Load Dispatch Centre
VCS: Voluntary Carbon Standard
VCU: Voluntary Carbon Unit