Monitoring Report

"5 MW Brahm Ganga Hydro – Electric Project"
at Kullu district of Himachal Pradesh, India

At

Manikaran - (Village)
Kullu - (District)
Himachal Pradesh - (State)

Monitoring Period: 2nd April 2008 to 31st March, 2010
(Both dates are included in this Monitoring Report)

Version 02
Date: 30/ 04 / 2010

Contact Information

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Project Activity:

"5 MW Brahm Ganga Hydro – Electric Project" at Kullu district of Himachal Pradesh, India, implemented by M/s. Harisons Hydel Construction Co. Private Limited (HHCCPL), is a small scale, grid connected, run-of-the-river Hydro-electric Project (HEP) and is located on the Brahm Ganga Nallah (Tributary of River Parbati) in Kullu District of Himachal Pradesh, India. The project consists of two 2.5 MW Horizontal axis Francis turbines.

Technical Description of the Project:

The project activity comprises of two units of 2.5 MW capacity each. The construction of a simple diversion weir is carried out to divert the water which is then taken to the turbines after creating the necessary head. Electricity is generated by converting potential energy (available due to head of water) into kinetic energy (through Horizontal Axis Francis Turbines) and is then coupled with generators to further convert this kinetic energy (mechanical energy) into electrical energy. The detailed description of the project components have been described below:

1. Diversion Structure:

    a. Type of Structure : Boulder Type wire
    b. Length : 24 meters
    c. Number of Gates : 2 nos. at inlet and one nos. at bottom outlet

2. Water Conductor System:

    a. Intake and Approach channel:
        i. Length : 5 meters
        ii. Size : 3m X 3.5m
    b. Desilting Tank:
        i. Type : Dufour Type
        ii. Dimension : 45m X 8m X 3.5m

c. Power Tunnel :
   i. Shape : D-shaped tunnel
   ii. Length : 996 meters
   iii. Dimension : 996m X 2m X 2.4m

3. Fore bay :
   a. Size : 15m X 8m
   b. Maximum Discharge Capacity : 2.52 cumecs

4. Penstock:
   a. Number : 01
   b. Length : 330 meters
   c. Diameter : 1000 mm dia

5. Power House:
   a. Type : Surface
   b. Dimension : 24.95m X 9.5m X 11.2m

6. Tail Race Tunnel:
   a. Length : 50 meters
   b. Shape : Two rectangular RCC ducts emanating from each unit & merging together in a rectangular open channel

The electricity is generated at 6.6 kV level and evacuated at 33 kV level. Two step up transformers, 6.6 kV/33 kV, one each for two machines is provided at switchyard near power house[1]. The electricity at 33 kV is transmitted to the Himachal Pradesh State Electricity Board (HPSEB) sub-station.

Project Generation Start Date:

The project generation start date is 02/04/2008 as per the Commissioning certificate for both the turbines. Accordingly, the project start date is 02/04/2008[2].

[1] Source: Detailed Project Report (DPR)

[2] http://www.v-c-s.org/docs/Voluntary%20Carbon%20Standard%202007_1.pdf. As per the Voluntary Carbon Standard 2007.1, page no: 7 "the Project Start Date is the Date on which the project began reducing or removing GHG emissions."

Project Parameters used to determine the Emission Reductions:

The following parameters are required for the estimation of emission reductions:

- Net electricity supplied by the project activity to the Northern Regional Grid which is a part of Integrated (NEWNE) grid as per Baseline Carbon Dioxide Emission Database Version 5.0[3], Central Electricity Authority (CEA), Government of India.:

  This parameter is taken from the Joint Meter Reading (JMR) data. This net supply value from the JMR (covering all the values of the losses, import) will be considered for the calculation of the emission reduction out of the project activity.

  Three phase Four wire Electronic Tri-vector Meters (digital display) are used.

  Monthly Joint Meter Readings (JMRs) as measured from the Interconnection Point (sub-station) are taken by the designated officials of the Himachal Pradesh State Electricity Board (HPSEB) and the project proponent. There is a separate dedicated transmission line connected to Jari substation. The joint meter readings shall be recorded and signed by the authorised representative (s) of both HPSEB & the proponent.

  Same can also be cross checked from invoices raised to HPSEB.

  The total data will be archived on paper and will be kept at least for 2 years after the end of the last crediting period.

- CO_2e emission factor of the NEWNE Grid:

  The CO_2e emission factor (Combined Margin emission factor) of NEWNE Grid has been calculated as the combination

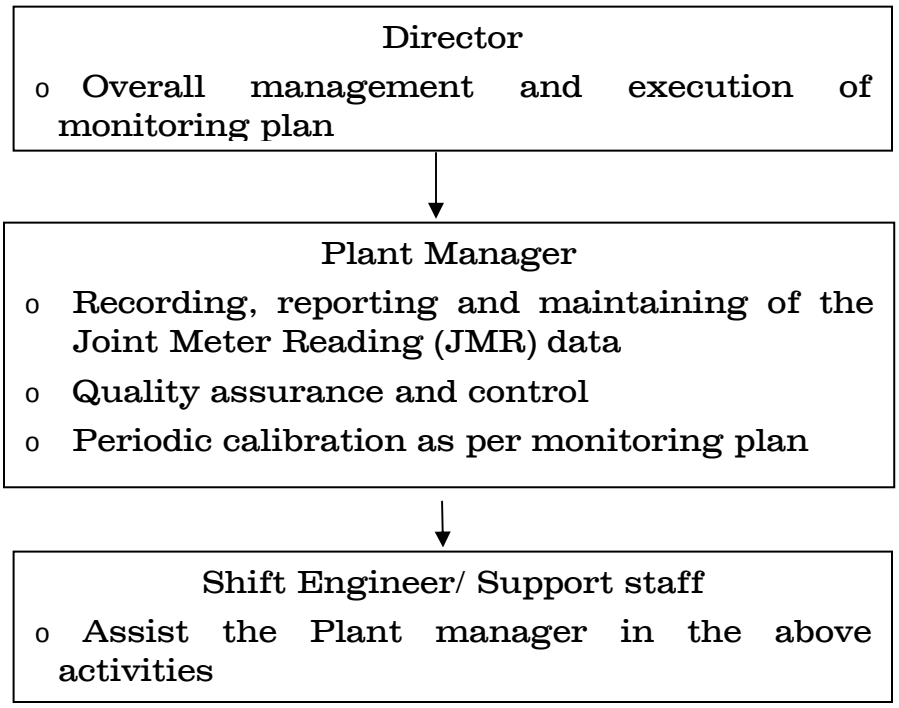
[3] http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

using the weights for Operating Margin emission factor and Build Margin emission factor taking the values of 0.5 each.

Baseline Carbon Dioxide Emission Database/ Version 5 dated 1st November, 2009, which is developed on the basis of "Tool to calculate Emission Factor for an electricity system", as published by Central Electricity Authority of Government of India (http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm) has been taken as reference for the emission factor values. The value has been kept fixed for the whole crediting period as 0.84006 tCO_{2e} / MWh.

Roles and Responsibilities:

The parameter which will be monitored as per the monitoring plan is the net electricity supplied by the project activity to the grid. A hierarchy model based on the responsibilities for executing the Monitoring plan has been shown below:



The Director has the overall responsibility of the successful implementation of the monitoring plan and estimation of the emission reduction.

All the data monitored under the monitoring plan will be kept for two years after the end of crediting period or till the last issuance of Emission Reductions (ERs) for the project activity, whichever occurs later.

Monitoring Period:

From 2nd April, 2008 to 31st March, 2010 (Both dates are included in this Monitoring Report).

Emission Reductions:

The project is a run-of-the-river, small scale hydro - electric project and supplying power to the Northern grid which is part of the integrated grid system, NEWNE Grid[4], which is dominated by fossil fuel based thermal power plants.

Hence, the applicable baseline methodology is "AMS I.D., Version 15 of Sectoral Scope 01, 30th October, 2009[5]".

- **Calculation of Baseline Emission (BE)**

According to AMS-I. D, "*the baseline emission is the product of electrical energy baseline $EG_{BL,y}$ expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor*".

$$BE_y = EG_{BL,y} \times EF_{CO2}$$

Where:

BE_y = Baseline Emissions in year y; t CO_2
$EG_{BL,y}$ = Energy baseline in year *y*; kWh
EF_{CO2} = CO_2 Emission Factor in year y; t CO_2e/kWh

The CO_2 Emission Factor has been calculated following the steps of the "Tool to calculate the emission factor for an electricity

4 http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

5 http://cdm.unfccc.int/UserManagement/FileStorage/7QXAZ5036WN8BEYKUDFRPJGL21V4I9

system, Version 2, 16th October, 2009[6]". The Central Electricity Authority (CEA) of India has published the CO_2 Baseline Database, Version 5, dated 1st November, 2009, on official emission factors for all regional grids in India. Application of this officially published database represents the most accurate approach, hence, has been applied in this project activity.

Therefore, the values of the Operating Margin & Build Margin Emission factor are[7]:

Operating Margin Emission Factor (tCO_2e/ MWh)	1.00493[8]

Year	**2008-09**
Build Margin Emission Factor (tCO_2e / MWh)	0.67518

The CO_2 Emission Factor (i.e. baseline emission factor) in year y has been calculated as the combination of the OM and BM emission factors with the weight age value of 0.5 each. The resulting Combined Margin emission factor is fixed ex ante for the duration of the crediting period:

$$\mathbf{EFy} = W_{OM} \times EF_{OM,y} + W_{BM} \times EF_{BM,y}$$

Where,

EF_y	=	Combined Margin Emission Factor determined above
W_{OM}	=	Weighting of Operating Margin
$EF_{OM,y}$	=	Operating Margin Emission Factor
W_{BM}	=	Weighting of Build Margin
$EF_{BM,y}$	=	Build Margin Emission Factor

As per "Tool to calculate the emission factor for an electricity system", w_{OM} = 0.50 and w_{BM} = 0.50 for hydro electric projects.

The Operating Margin calculated for the NEWNE Grid is 1.00493 tCO_2e /MWh and the Build Margin is 0.67518 tCO_2e/ MWh.

[6] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf

[7] Central Electricity Authority: CO_2 Baseline Database. Version 5, 1st November, 2009

[8] Reference: Emission Reduction Calculation spreadsheet

Therefore, $EFco_2 = EF_y$ $= 0.50 \times 1.00493 + 0.50 \times 0.67518$
$= 0.84006\ tCO_2\ e/\ MWh$

Net Supply to the Grid ($EG_{BL,\ y}$) = EG_y = 45, 895 MWh, therefore,

- Baseline Emission *(BE_y)* $= EF_y \times EG_y$
$= (0.84006 \text{ x } 45, 895)\ tCO_2e$
$= 38{,}554.57\ tCO_2e$
$\sim 38{,}554\ tCO_2e$

Where:

BE_y = Baseline emissions in year *y* (tCO_2)
EG_y = Electricity supplied by the project plant (MWh)
EF_y = Baseline emission factor in year y (tCO_2/MWh)

- **Calculation of the Project Emissions (PEy):**

As per AMS-I.D, Version 15, 30th October, 2009[9], page no. 6, point no. 14 "*for most renewable energy project activities, $PE_y = 0$*". The project activity is a small scale, renewable energy based hydro electric project and does not come under the projects as referred in the methodology, therefore, PEy = 0.

- **Leakage calculation (LEy):**

As per AMS -I. D. Version 15, 30th October, 2009, page no. 6, point no. 15 "*If the energy generating equipment is transferred from another activity, leakage is to be considered*". Therefore, the project activity does not result in any direct or indirect emission of greenhouse gases, or any leakages.

Hence, LEy = 0

- **Net estimated Emission Reduction per year (ERy):**

$ER_y = BE_y – PE_y - LE_y$

Where:
ER_y = Emission reductions in year *y* (t CO_2e/y).
BE_y = Baseline Emissions in year *y* (t CO_2e/y).
PE_y = Project emissions in year *y* (t CO_2e/y).

[9] http://cdm.unfccc.int/UserManagement/FileStorage/7QXAZ5036WN8BEYKUDFRPJGL21V4I9

LE_y = Leakage emissions in year y (t CO_2e/y).

As $\mathbf{PE_y = LE_y = 0; ERy = BEy} = EF_y \times EG_y$

Therefore, ER_y = 38,554 tonnes of CO_2e.

Detailed calculation has been shown in *Table No-3*.

Calibration Details of the Monitoring Equipments:

The amount of the electricity as measured using the meters are duly calibrated once in every year jointly by project proponent and HPSEB professionals. The description of the meters and calibration certificates has been given below:

Table No-1: Energy Meter and Calibration Details

Sl No.	Particulars	Main Meter	Check Meter
1.	Serial No.	07034165 (Type – ER 300 P)	07034167 (Type – ER 300 P)
2.	1st Calibration Date	17/12/2007	17/12/2007
3.	Serial No.	07034165 (Type – ER 300 P)	07034167 (Type – ER 300 P)
4.	2nd Calibration Date	05 / 06/ 08	02/02/09
5.	Serial No.	07034165 (Type – ER 300 P)	07034167 (Type – ER 300 P)
6.	3 rd Calibration Date	02 / 07 / 2009	03/02/2010

The Meter locations of the project activity are as follows:

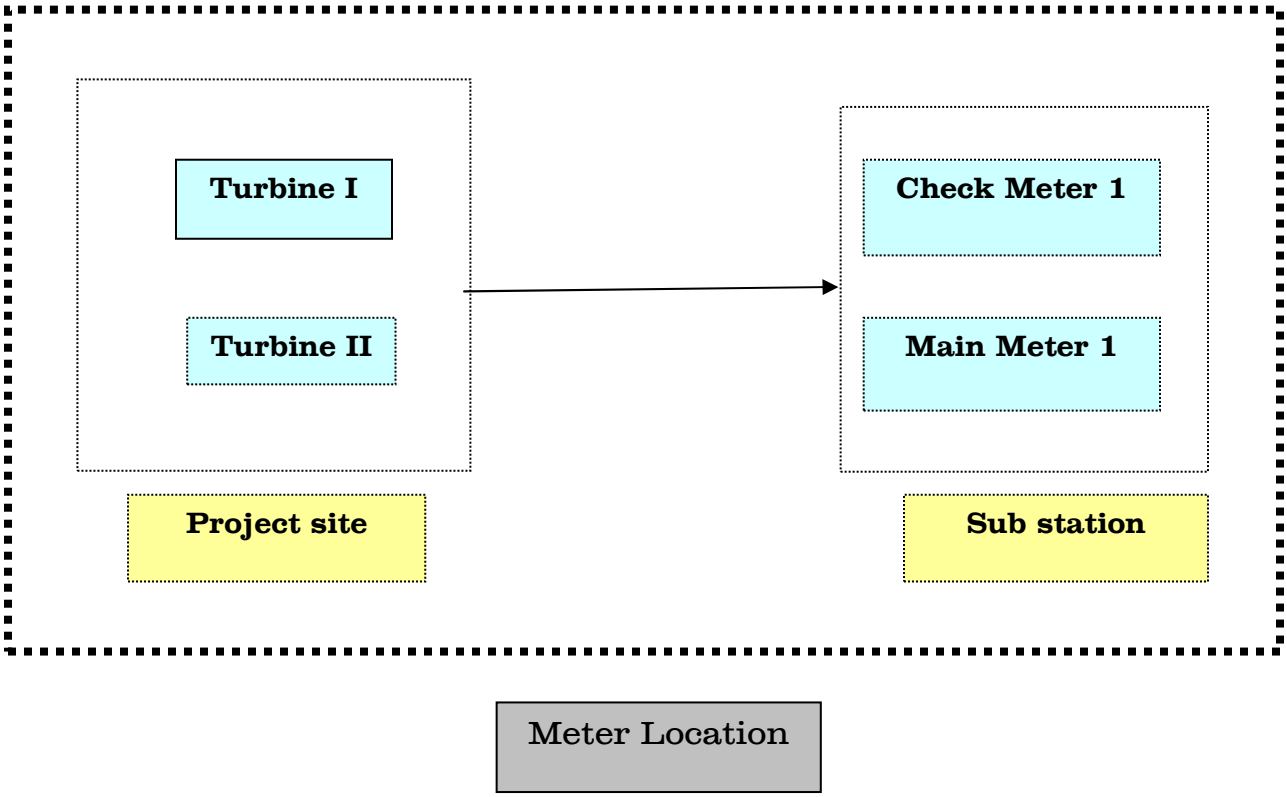


Table No-2: Monitoring of the emission in the project scenario

Parameters	Measured, Calculated, Estimated	Data Unit	Source of data	Recording frequency	Proportion of data to be monitored	How will the data be archived?	Monitoring equipment & Specification of the Monitoring equipment	Calibration of Monitoring Equipment	Uncertainty of Data
Electricity supplied to the Grid by the project activity	Directly Measured	MWh	Joint Meter Readi-ng (JMR) data from the meters at the inter-connec-tion point	Monthly and Hourly basis	100%	Both electroni cally & on paper	3 phase 4 wire Electronic Tri-vector Energy Meter (Digital display) Bi-directional; AC – 3 Phase 4 Wire / Type – ER 300 P with the accuracy class value of 0.2.	The meters are duly calibrated once in every year jointly by project proponent and HPSEB professionals.	One set of main meter and check meter are maintained at the inter-connection point.

Table No-3: Emission Reduction Details

			Export		Import						
Month	Reading Date	Duration	Starting Reading	End Reading	Starting Reading	End Reading	Factor	Total Unit		Total Unit	
April	April 30, 2008	02/04/2008 to 30/04/2008	21.8	774.6	0.9	7.2	2000	1493000	kWh	1493	MWh
May	May 30, 2008	30/04/2008 to 30/05/2008	774.6	1967	7.2	7.2	2000	2384800	kWh	2384.8	MWh
June	June 30, 2008	30/05/2008 to 30/06/2008	1897.7	3728	6.1	6.2	2000	3660400	kWh	3660.4	MWh
July	July 31, 2008	30/06/2008 to 31/07/2008	2814.6	4529.6	8	8.2	2000	3429600	kWh	3429.6	MWh
August	September 1, 2008	31/07/2008 to 01/09/2008	4529.6	6251	8.2	8.6	2000	3442000	kWh	3442	MWh
September	September 30, 2008	01/09/2008 to 30/09/2008	6251	7966.4	8.6	8.6	2000	3430800	kWh	3430.8	MWh
October	October 31, 2008	30/09/2008 to 31/10/2008	7966.4	9157.1	8.6	8.6	2000	2381400	kWh	2381.4	MWh
November	November 30, 2008	31/10/2008 to 30/11/2008	9157.1	9818.8	8.6	8.7	2000	1323200	kWh	1323.2	MWh
December	December 31, 2008	30/11/2008 to 31/12/2008	9818.8	10362.6	8.7	8.8	2000	1087400	kWh	1087.4	MWh
January	January 31, 2009	31/12/2008 to 31/01/2009	10362.6	10694.9	8.8	9.5	2000	663200	kWh	663.2	MWh
February	February 28, 2009	31/01/2009 to 28/02/2009	10694.9	11033.3	9.5	9.6	2000	676600	kWh	676.6	MWh
March	March 31, 2009	28/02/2009 to 31/03/2009	11033.3	11444.7	9.6	10	2000	822000	kWh	822	MWh
April	April 30, 2009	31/03/2009 to 30/04/2009	11444.7	12176.2	10	10.1	2000	1462800	kWh	1462.8	MWh
May	May 31, 2009	30/04/2009 to 31/05/2009	12176.2	12999.5	10.1	10.2	2000	1646400	kWh	1646.4	MWh
June	June 30, 2009	31/05/2009 to 30/06/2009	12999.5	13921.8	10.2	10.2	2000	1844600	kWh	1844.6	MWh
July	July 31, 2009	30/06/2009 to 31/07/2009	14693.5	16131.4	9.4	9.5	2000	2875600	kWh	2875.6	MWh
August	August 31, 2009	31/07/2009 to 31/08/2009	15212.2	16939.0	11.3	11.4	2000	3453400	kWh	3453.4	MWh
September	September 30, 2009	31/08/2009 to 30/09/2009	16939.0	18508.0	11.4	11.5	2000	3137800	kWh	3137.8	MWh
October	October 31, 2009	30/09/2009 to 31/10/2009	18508.0	19393.4	11.5	11.6	2000	1770600	kWh	1770.6	MWh
November	November 30, 2009	31/10/2009 to 30/11/2009	19393.4	19932	11.6	11.8	2000	1076800	kWh	1076.8	MWh
December	December 31, 2009	30/11/2009 to 31/12/2009	19932.0	20367.7	11.8	11.8	2000	871400	kWh	871.4	MWh
January	January 31, 2010	31/12/2009 to 31/01/2010	20367.7	20720.1	11.8	11.9	2000	704600	kWh	704.6	MWh
February	February 27, 2010	31/01/2010 to 27/02/2010	20720.1	21030.3	11.9	11.9	2000	620400	kWh	620.4	MWh
March	March 31, 2010	27/02/2010 to 31/03/2010	21030.3	21848.5	11.9	12	2000	1636200	kWh	1636.2	MWh

Net Supply to the Grid	45,895,000	kWh
Net Supply to the Grid	45,895.00	MWh
Baseline Emission Factor (CM)	0.84006	tCO_2/MWh
Baseline Emission	38554.57	t CO_2
Project emission	0	t CO_2
Leakages	0	t CO_2
Emmission Reduction (CER) till 31st March, 2010	38,554.57	t CO_2e
Rounded off	38,554.00	t CO_2e

Table No-4: Details of Monitoring parameters

Monitoring Parameters for the period of 2nd April, 2008 to 31st March, 2010 (Including both the dates)		
Months	***Net Electricity supplied by the project activity to the Grid (EGy) (KWh)***	***Net Electricity supplied by the project activity to the Grid (EGy) (MWh)***
April, 2008	14, 93, 000	1493
May, 2008	23, 84, 800	2384.8
June, 2008	36, 60, 400	3660.4
July, 2008	34, 29, 600	3429.6
August, 2008	34, 42, 000	3442
September, 2008	34, 30, 800	3430.8
October, 2008	23, 81, 400	2381.4
November, 2008	13, 23, 200	1323.2
December, 2008	10, 87, 400	1087.4
January, 2009	6, 63, 200	663.2
February, 2009	6, 76, 600	676.6
March, 2009	8, 22, 000	822
April, 2009	1, 462, 800	1462.8
May, 2009	1, 646, 400	1646.4
June, 2009	1, 844, 600	1844.6
July, 2009	2, 875, 600	2875.6
August, 2009	3, 453, 400	3453.4
September, 2009	3, 137, 800	3137.8
October, 2009	1, 770, 600	1770.6
November, 2009	1, 076, 800	1076.8
December, 2009	871, 400	871.4
January, 2010	704, 600	704.6
February, 2010	620, 400	620.4
March, 2010	1, 636, 200	1636.2

Table No-5: Comparison of the estimated Emission Reduction of the registered PD and the actual Emission Reduction:

Year	Net estimated supply as per PD (MWh)	Actual electricity supply as per JMR (MWh)	Emission factor (tCO_2/ MWh)	Estimated Emission reduction in tCO_2	Actual Emission reduction in tCO_2 per year	Difference	
April, 2008 - March, 2009	21270	24794.4	0.84006	17,868	20,829	(2,961)	Positive
April, 2009 - March, 2010	21270	21100.6	0.84006	17,868	17,726	142	Negative
Total	42540	45895		35736.17	38554.57	(2,818)	Positive

Explanation on Emission reduction variation:

From the Table 5 above it is evident that in the period April 2008 to March 2009, the actual emission reduction is on the higher side then the estimated emission reduction.

This positive variation in the actual emission reduction for this particular period is predominantly because of higher generation than the DPR generation during the Monsoon period (June, 2008 to October, 2008). The monsoon period in year 2008 has experienced higher & erratic rainfall compared to the normal scenario, which resulted in comparatively higher generation than as expected in the DPR/PD and hence resulted in higher then estimated emission reduction.

The above explanation for the higher emission reduction in the period of April, 2008 to March, 2009 is supported by the following:

1. The spread sheet (Attached as –Rainfall Data_Kullu) specifically depicts rainfall data for district Kullu in Himachal Pradesh for the period 2004 to 2008. The data reveals abrupt high rainfall in the monsoon season in the year 2008, particularly in June & September 2008.

2. Please refer to Indian Meteorological Department Monsoon report, page no. 5; the table is showing the country wise % of excessive rainfall by 24% during month June, 2008

3. Indian Meteorological Department Monsoon report (Page no. 4; point 5; the table is showing 7% excessive rainfalls in North West region specifically during June, 2008 to September 2008

4. The minutes of the Weather Watch group (Government of India, Ministry of Agriculture) meeting, Table-1 clearly indicates excessive rainfall in Northern India in the week ending on 11.06.2008, further supports the above.

5. Please also refer to the following news paper web links:

   http://www.tribuneindia.com/2008/20080629/himachal.htm#2; **the wettest June, Tribune News Service**

&

http://www.tribuneindia.com/2008/20080613/himachal.htm#4; **Rain: Sowing of HPR 2143 paddy variety advised; Tribune News Service**

The above facts and figure suggest that the rainfall in the year 2008 has been more than normal, therefore, has resulted in an increase in the generation of the electricity from the project. This has further resulted in an increase in the emission reductions claimed in the monitoring period i.e. April 2008 to March 2009 as compared to the estimated emission reductions in the PD. The Spreadsheet showing the monthly increased generation as compared to the estimated value from the DPR and subsequent emission reduction, has been provided to the DOE.

Therefore, it can be concluded that the increase in the emission reduction during the monitoring period (April 2008 to March 2009), is a sporadic incident due to the varied weather conditions, which resulted in an increase in the generation.