HYDROELECTRIC PROJECT IN KINNAUR DISTRICT IN HIMACHAL PRADESH

Document Prepared By EKI Energy Services Limited

Project Title	Hydroelectric Project in Kinnaur District in Himachal Pradesh
Version	02
Report ID	NA
Date of Issue	17-April-2018
Project ID	PL1742
Monitoring Period	01-September-2015 to 31-December-2017 (Inclusive of first and last days)
Prepared By	Ramkrishna Patil
Contact	EKI Energy Services Limited Email ID : ramkrishna.patil@enkingint.org T +91 731 42 89 086, M +91 9096562065 Address: Office no. 201, Plot 48, Scheme 78 part 2 Vijay Nagar, Near Brilliant Convention Centre Indore - 452010 (M.P, India) Website www.enkingint.org

Table of Contents

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The Government of India and the Government of Himachal Pradesh (GOHP) identified the Sutlej River as an important source of hydropower and have initiated hydroelectric projects along Sutlej and its Tributaries. Since commissioning, the project has been executed by Jaypee Karcham Hydro Corporation Limited (JKHCL), a special purpose vehicle formed by the promoter group Jaiprakash Associates Limited (JAL)[1].

From 01/09/2015 onwards, the Himachal Baspa Power Company Ltd. (HBPCL) has owned the power plant and thus new owner is acting as project proponent for the proposed project activity. The ownership transfer documents are being submitted to DOE for validation purpose.

Prior to the start of the project activity the existing demand in the Northern Region Grid was met through its existing fossil fuel based (coal, gas and diesel), nuclear, hydro and renewable energy based power plants.

The project activity has been devised to alleviate acute shortage of electricity generation capacity in the Northern Region of India especially at the time of system peak load by developing a 4 X 250 MW renewable and versatile run of the river hydro power project at Karcham & Wangtoo on the river Satluj in Himachal Pradesh. The project activity includes a concrete gravity diversion dam at Karcham; power intakes and 4 underground desilting chambers to exclude all particles above 0.2 mm size; 10.48 m diameter and 17 km long head race tunnel; an underground power house complex at Wangtoo to generate 4 X 250 MW power and 1.3 km long tail race tunnel to discharge the water back into river Satluj. In doing so, it delays the necessity of construction of either a coal or gas or oil fired thermal power plant of similar capacity to supply to the primarily fossil fuel based regional grid, leading to reduction of Carbon Dioxide (CO_2) emissions in the atmosphere.

This is a new hydroelectric project, with a small reservoir of area 588400 m^2 having a power density of 1699.52 W/m^2 (1000*10^6 W / 588400 m^2). Construction work at project site started from 18th November 2005 and the project activity has started generation of power from 26 May 2011.

Total emission reductions achieved in this monitoring period:

During the reported monitoring period 01/09/2015 to 31/12/2017 (First and last date included) the project activity has supplied 9943136.45 MWh of electricity, and thus contributing to the GHG reductions of 7,985,332 tCO_2e.

[1] The project was initially executed by Jaypee Karcham Hydro Corporation Limited (JKHCL), a special purpose vehicle (SPV) by the promoter group Jaiprakash Industries Limited (formally Jaiprakash Associated Limited). Thereafter, SPV Jaypee Karcham Hydro Corporation Limited was merged to newly formed Jaiprakash Power Ventures Ltd (JPVL), thus ownership document refers transfer of ownership from Jaiprakash Power Ventures Ltd (JPVL) to Himachal Baspa Power Company Ltd (HBPCL).

1.2 Sectoral Scope and Project Type

Project type: Renewable energy projects

Sectoral Scope: 1- Energy Industries (renewable/non-renewable sources).

1.3 Project Proponent

Organization name	Himachal Baspa Power Company Ltd.
Contact person	Mr Rajarshi Bera
Title	Sr. Manager (Tech)
Address	Karcham- Wangtoo H.E. Project, Sholtu Colony, P.O. Tapri, Sholtu, Himachal Pradesh 172104, India
Telephone	-
Email	rajarshi.bera@jsw.in

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Ramkrishna Patil
Title	General Manager-Operations
Address	EnKing Embassy, Office no 201, Plot 48, Scheme 78, Part 2, Vijay Nagar, Indore- 452010, Madhya Pradesh, India
Telephone	+91 9096562065
Email	ramkrishna.patil@enkingint.org

1.5 Project Start Date

The start date of the project activity is the earliest date of commissioning of the 1st 250 MW plant unit (unit-1) involved in the project activity i.e. on 26-05-2011.

1.6 Project Crediting Period

The crediting period of the project activity is for 10 years which will be fixed in line with CDM crediting period.

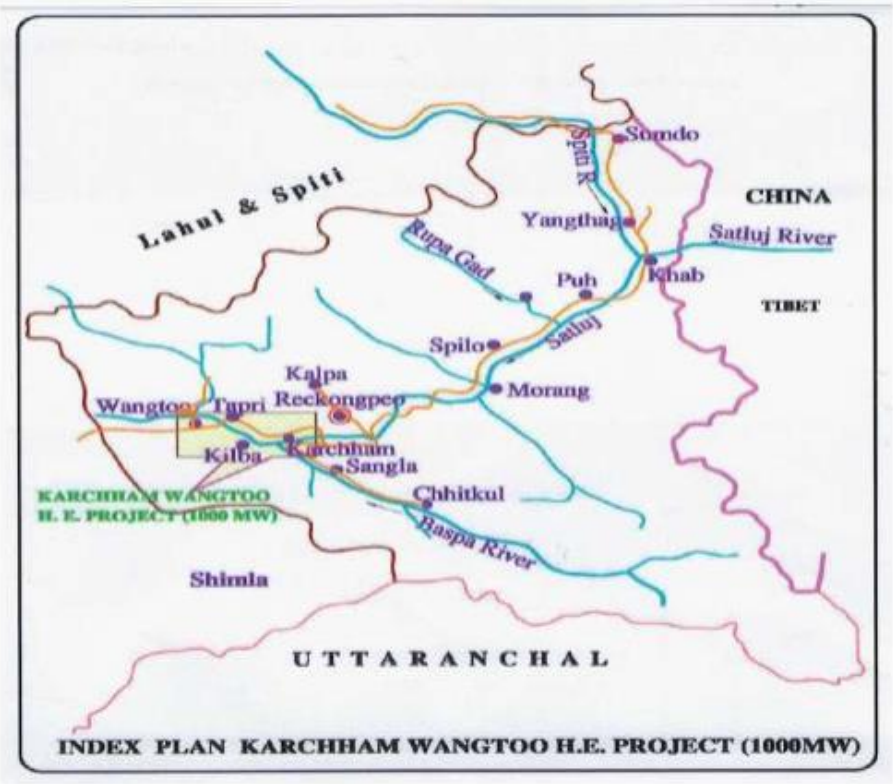
Thus PP chosen the fixed crediting period from 01-01-2013 to 31-12-2022.

1.7 Project Location

The project activity is located on the stretch of Satluj River between Karcham and Wangtoo in the District of Kinnaur of Himachal Pradesh. The geographic coordinates of the project area are the following:

Latitude - 31°30'50'' - 31°32'10'' N
Longitude - 78°11'15'' - 78°01'05'' E

Nearest broad gauge railway station is Kalka under Northern Railway, which is 290 kms from the project site. The nearest airport to the project site is Shimla, which is 210 km from Karcham Wangtoo site. The airport is connected to the project site by a paved road. The location is further depicted in the following map:



1.8 Title and Reference of Methodology

Title of the baseline methodology: "Consolidated Baseline Methodology for grid connected electricity generation from renewable sources"

Reference: ACM0002, Version 12.3.0 , **Sectoral scope:** 1

It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC CDM website

(http://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83).

1.9 Other Programs

Project has been registered with UNFCCC under Clean Development Mechanism program. Registration reference number is 4993[2].

1.10 Sustainable Development

Ministry of Environment and Forests, Govt. of India has stipulated following indicators for sustainable development in the interim approval guidelines for CDM projects:

Social well being

[2] http://cdm.unfccc.int/Projects/DB/RWTUV1310469729.49/view

The project activity raised the medium term employment opportunities for the local people during construction phase. Further on continuous basis, employment opportunities are available for local inhabitants during life time of the project for operation and maintenance of the project. The project activity supports the northern regional grid for sustained and quality supply of power for the local community. It involve interalia construction of a 10+2 grade school, an industrial training institute, a 40 bedded hospital besides up-gradation of existing roads and bridges in the hilly terrain which would uplift the social life of the surrounding villages.

Economic well-being

The northern grid was facing acute shortage of electrical power and thereby, stunting the economic growth of the region. The project activity is a move towards bridging the gap in supply and demand. During construction and operation phases of the project, employment were generated for the local population. Further, the business opportunities also enhanced by the project activity for local stakeholders such as consultants, suppliers, manufacturers, contractors etc during the implementation phase. The project activity contribute to the economic well-being in the region over its entire life time.

Environmental well-being

The project activity utilizes hydro resource for generating electricity which otherwise would have been generated through alternate fossil fuel based power plants, thereby contributing to reduction in specific emissions (emissions of pollutant/unit of energy generated) including GHG emissions.

Furthermore, as hydro power projects produce no end products in the form of solid waste (ash etc.) during operation, they address the problem of solid waste disposal encountered by most other sources of power. A comprehensive catchment area treatment plan has been formulated comprising of plantation, construction of check walls, pasture improvement etc.

Technological well-being

The project activity envisages installation of high efficiency turbines and generators and the power is transmitted at high voltage to ensure low losses. Moreover, the technology being used is well established, most updated and environmentally safe.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The 1st unit of 250 MW got commissioned on 26/05/2011, the second unit on 23/06/2011, third unit on 08/09/2011 and the project got fully commissioned, i.e. the fourth unit got commissioned on 13/09/2011.

The power generating equipment installed in the project activity is:

4 Francis turbines, 255 MW/347000MHP

Make: Andritz VA Tech Hydro

Generators: 4 semi-umbrella vertical synchronous generators, 277.70 MVA

Speed: 214.30 rpm

The Project activity is a run-of-river hydropower project that utilizes the natural flow of Satluj to generate electricity and the major components involved are as following:

1. River diversion works
2. Diversion dam
3. Intake and sedimentation chambers
4. Head race tunnel
5. Surge shaft
6. Pressure shafts and penstocks
7. Power house complex for housing 4 x 250 MW generating units
8. Tail race Tunnel

The design features of the project components are presented in the following table

LOCATION

1.	State	Himachal Pradesh
2.	District	Kinnaur
3	River	Satluj
4.	Vicinity	Dam near village Karcham and Power House near village Wangtoo on NH-22 about 186 km from Shimla, immediately U/S of 1500 MW Nathpa Jhakri H.E.P.

HYDROLOGY

1.	Catchment area at Dam site	48755 Sq.Km
2.	Snow catchment	38760 Sq. Km
3.	Max. observed av. 10 days discharge	1870.48 cumec
4.	Design Flood : PMF	6744 cumec
5.	Average run off in 90% availability year	9413m cum
6.	Average run off in 50% mean year	12148m cum
7.	Discharge for 90% availability	80.8 cumec
8.	Discharge for 50% availability	176.0 cumec
9.	Percent availability corresponding to design discharge of 421 cumec	32.38%

RIVER DIVERSION WORKS

1.	Diversion tunnel	
	i) Size	10.15m (lined) and10.75m (unlined) with invert lining modified horse shoe section
	ii) Length	541m (i/c 93m inlet & outlet structure)
2.	Coffer Dams	Rock fill with concrete wall
	i) Upstream	16.50m high

	ii) Downstream	5.50m high

DIVERSION DAM

1.	Type	Concrete gravity
2.	Top of dam	EL. 1813.00m
3.	Height	88.00m
4.	Total length at top	182.00m
5.	No. of blocks	10
6	Minimum river bed level at dam axis	EL.1777.00m
7.	Deepest foundation level	EL.1725.00m
8.	Maximum pond level (FRL)	EL.1810.00m
9.	Minimum pond level (MDDL)	EL.1799.00m
10.	Maximum water level (MWL)	1812.40m
11.	Live storage capacity	544.97 Ha-m

STILLING BASIN (ENERGY DESPINES)

1.	Length	95.00m
2.	Floor level	1765.00m
3.	Sill elevation	1776.50m

MAIN SPILLWAY (SLUICES)

1.	Location	Block no. 4 to 7 of Dam
2.	No. of bays	4
3.	Crest elevation	1778.00m
4.	Thickness of intermediate piers	8m
5.	Size of each gate	10m (W) x 10.50M (H)
6.	Type of gates	Radial Gates (Top sealing type)
7.	Discharge capacity of Sluices	8123 cumec at FRL with all gates Fully raised

AUXILIARY SPILLWAY

1.	Location	Block nos. 5 & 6
2.	No. of bay	1
3.	Width of bay	6.00m
4.	Crest elevation	1807.00m
5.	Size of gate	6m (W) x 3.30m (H)
6.	Type of gate	Fixed wheel gate
7.	Maximum discharge capacity	150 cumec at EL. 1813.00m 53 cumec at EL. 1810.00m
8.	Ski-jump bucket lip elevation	1788.843m

INTAKE

1.	No. of intake bays	4
2.	Size of each bay at trash racks	16m (W) x 18.50m (H)
3.	Orientation with respect to Dam axis	110˚
4.	Crest elevation	1793.00m
5.	Invert Level of Intake	1789.00m
5.	Discharge through each intake bay	126.25 cumec for 1000 MW output
6.	No. of gates	4
7.	Size of each gate	7.5m (W) x 4.0m (H)
8.	Size of intake tunnels	6.0m dia circular concrete lined
9.	Length of intake tunnels	317m, 365m, 414m & 462m

SEDIMENTATION CHAMBERS

1.	Particle size to be excluded	+ 0.2 mm and above	
2.	No. of chambers	4	
3.	Width of each chamber	18.00m	
4.	Depth of each chamber	30.25m	
5.	Length of each chamber	424m + 70m transitions	
6.	Flushing discharge for 1000 MW	84.2 cumec	
7.	Fall velocity of 0.2mm particles	2.3 cm/sec.	
8.	Size of flushing duct at start	1.0m (W) x 0.80m (H) steel lined	
9.	Size of flushing duct at end	2.0m (W) x 2.3m (H) steel lined	
10.	Design discharge & average Velocity through	**Q (cumec)**	**V (m/sec.)**
	Each chamber for 1000 MW output	126.25	0.235

LINK TUNNELS / CONNECTING TUNNELS

1.	Size	Four link tunnels & two connecting Tunnels of 6.0 / 8.0m dia circular respectively
2.	Length of tunnels	91m & 133m each respectively
3.	Gates at start of link tunnels	4 nos.
4.	Size of gate	6.0m (W) x 6.0m (H)
5.	Gate operating gallery	217.0m (L) x 7.5M (W) x 9.0m (H)

LINK FLUSHING DUCTS / COMBINED FLUSHING DUCTS

1.	Size	Four link flushing ducts & two combined Flushing ducts 2.0m (W) x 2.3m (H)

		& 3.2m (W) x 3.85m (H)	
2.	Length of link flushing ducts	142m, 159m, 123m & 177m	
3.	Length of combined flushing ducts	75m & 147m	

FLUSHING TUNNEL

1.	Size	5.0m (W) x 7.3 (H) & 5.0m (W) x 5.5 (H)	
2.	Length	5261 (including 8.0 m outlet structure) + 60.0 m channel	
3.	Invert level at outfall	1741.50m	

HEAD RACE TUNNEL

1.	Size	10.48m dia circular	
2.	Length	16.925Km.	
3.	Design discharge & velocity for 1000 MW	**Q (cumec)**	**V (m / sec.)**
		421	4.88
4.	Invert level at inlet end	1780.283m	
5.	Invert level at surge shaft end	1699.944m	
6.	Slope	1:210	
7.	Adits	Ch. at HRT Jn. (m)	Length (m)
	Inlet adit	15	280
	Adit – 1	1779	372
	Adit - 2	4891	310
	Adit – 3	7142	532
	Adit – 4	10676	371
	Adit – 5	13283	793
	Adit near surge shaft	16897	466

SURGE SHAFT

1.	Type	Restricted Orifice
2.	Size	16m dia up to EL.1730.00M, 27m dia from 1730.00m to EL.1850.30m and open pond from EL.1850.30 to 1858 m
3.	Bottom elevation	EL.1710.80m
4.	Top elevation	EL.1858.00m
5.	Maximum upsurge	EL.1855.17m
6.	Minimum down surge	EL.1741.54m
7.	Top	Open to Sky

PRESSURE SHAFTS

1.	Size	4 nos., 5.0m dia circular steel lined
2.	Length of Penstocks	P.S. I & IV – (2x 347.50m) =695m P.S. II & III – (2x 328.50m) =657m
3.	Type of steel for penstock liners	ASTM A517 – Grade F

VALVE CHAMBER

1.	Location	Downstream of surge shaft
2.	Size of chamber	104m (L) x 10m (W) x 19m (H)
3.	Type of valves	Butterfly valves
4.	Diameter of each valve	U/S – 4.90m, D/S – 4.60m
5.	E.O.T. Crane	1 x 80 / 10 t

POWER HOUSE / TRANSFORMER HALL

1.	Type	Under ground	
2.	Installed capacity	1000 MW (4 x 250 MW)	
3.	Size of machine hall	121.0m (L) x 22.0m (W) x 52.90m (H)	
4.	Size of control block	20.0m (L) x 22.0m (W) x 41.70m (H)	
5.	Size of service bay & level	47.0m (L) x 22.0mx 24.10 & EL.1512.90m	
6.	Size of transformer hall	162.0m (L) x 16.0m (W) x 22.20m (H)	
7.	Approach adit to machine hall	8.5m D-shaped, 727.0m long	
8.	Length of Cable tunnel	171.0m	
9.	Average gross head,		
	Net head for 1000 MW (421 Cumec)	**Ave. gross head (m)**	**Net head (m)**
		293.43	269.15

SURGE CHAMBER CUM SURGE GALLERY

1.	Size of surge chamber	220.0m (L) x 12.50m (W) x 13.50m (H)
2.	Surge gallery	10.48m Dia Circular, 530m long
3.	D/T gate operating galley	107m (L) x 7.5m (W) x 10m (H)
4.	Maximum surge level	1532.29m
5.	Minimum surge level	1502.12m

TAIL RACE TUNNEL

1.	Size & type	10.48m dia circular	
2.	Length	1285.0m (including 12 m outlet Structure) + 119.0m channel	
3.	Invert level of outfall	1502.50m	
4.	Tail water levels	River	D/T gate shaft

	1 Unit at 50% loading (65 cumec)	1504.25	1505.98
	1Unit running 100% (105.25 cumec)	1504.50	1507.03
	2 Unit running (210.5 cumec)	1505.00	1509.32
	3 Unit running (315.75 cumec)	1505.50	1511.46
	4 unit running (421 cumec)	1506.00	1513.67
	Maximum flood (6744 cumec)	1512.10	1516.55
	POWER GENERATION		
1.	Installed capacity	1000 MW	
2.	Annual generation		
	90% dependable year	4131.06 GWH	
3.	Plant load factor		
	90% dependable year	47.16%	

2.2 Deviations

2.2.1 Methodology Deviations

Not Applicable for the current monitoring period.

2.2.2 Project Description Deviations

The below deviation is requested for the current monitoring period.

The project activity ownership has been changed. From 01/09/2015 onwards, the Himachal Baspa Power Company Ltd has owned the power plant and thus new owner Himachal Baspa Power Company Ltd is acting as project proponent for the proposed project activity. The ownership transfer documents are being submitted to DOE for validation purpose.Not Applicable for the current monitoring period.

2.3 Grouped Project

Not Applicable, as this not under grouped project.

2.4 Safeguards

2.4.1 No Net Harm

Please refer to the Section D of the registered CDM PDD, wherein the details regarding the Environmental Impact has been detailed out.

Web-link: http://cdm.unfccc.int/Projects/DB/RWTUV1310469729.49/view

The project activity do not have any negative impact to stakeholders and running satisfactorily since commissioning. The Environment Impact Assessment study was conducted for the project

activity and judicious efforts to cause minimal impacts on the surrounding environment and to maintain the natural balance.

2.4.2 Local Stakeholder Consultation

Stakeholder Meeting was conducted by the PP during the CDM registration. Please refer to the Section E of the registered CDM PDD, wherein the details regarding the Stakeholder Meeting has been detailed out.

Web-link: http://cdm.unfccc.int/Projects/DB/RWTUV1310469729.49/view

The PP also placed a grievance register onsite where the stakeholder can put down his/her complain and the same if found genuine will be addressed immediately.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{OM,y}$
Data unit	tCO_2/GWh
Description	Operating Margin emission factor for NEWNE regional grid
Source of data	Referred from CO_2 Baseline Database for the Indian Power Sector prepared by Central Electricity Authority Version 4.0
Value applied	1.0086
Justification of choice of data or description of measurement methods and procedures applied	It is calculated in accordance with the Tool to calculate the emission factor for an electricity system with 3years vintage data (2005-06, 2006-07, 2007-2008) on Net Generation provided by CEA with an option of ex ante calculation based on Simple Operating Margin Method. Computed once during PDD finalization.
Purpose of the data	For the purpose of baseline emission calculation
Comments	The data will be archived for two years beyond the crediting period.

Data / Parameter	$EF_{BM,y}$
Data unit	tCO_2/GWh
Description	Build Margin emission factor for NEWNE regional grid
Source of data	Referred from CO_2 Baseline Database for the Indian Power Sector prepared by Central Electricity Authority Version 4.0
Value applied	597.7
Justification of choice of data or description of measurement methods and procedures applied	CEA has Calculated it as per ACM0002 for the year 2007-08. The build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation and option of ex ante calculation. Computed once during PDD finalization.

Purpose of the data	For the purpose of baseline emission calculation
Comments	The data will be archived for two years beyond the crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/GWh
Description	Combined Margin CO_2 emission factor for NEWNE regional grid
Source of data	Estimated figure based on 50% of OM and 50% of BM values
Value applied	803.1 tCO_2/GWh
Justification of choice of data or description of measurement methods and procedures applied	It is calculated it as per Tool to calculate the emission factor for an electricity system (Version 02) with 3years vintage data and option of ex ante calculation based on 50% of OM and 50% of BM values approach. Computed once during PDD finalization.
Purpose of the data	For the purpose of baseline emission calculation
Comments	The data will be archived for two years beyond the crediting period.

Data / Parameter	A_{BL}
Data unit	m^2
Description	Area of the reservoir (m^2) measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new reservoirs, this value is zero.
Source of data	Project Site.
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Measured from topographical surveys, maps, satellite pictures, etc.
Purpose of the data	-
Comments	-

Data / Parameter	Cap_{BL}
Data unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project Site.
Value applied	0
Justification of choice of data or description of measurement methods	Determine the installed capacity based on recognized standards.

and procedures applied	
Purpose of the data	-
Comments	-

3.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Meters are installed at the Pothead yard for export/import to Abdullahapur grid and Jhakri grid. There are two lines for each grid through which the electricity is exported / imported. Apart from this the energy generated by the BASPA-II – 300 MW project (upstream of the Karcham Wangtoo Hydro-electric Plant) is also being supplied to grid through the same sub- station under a Loop-in-loop-out (LILO) arrangement.
Description of measurement methods and procedures to be applied	Measured at the project site (Pothead Yard)
Frequency of monitoring/recording	Monitoring frequency: Hourly measurement Recording frequency: Monthly in the ER calculation sheet
Value monitored	9,943136. 45
Monitoring equipment	The metering system includes a main meter and a back-up check meter of accuracy class 0.2%. All meter data is automatically recorded and is submitted to Northern Region Load Dispatch Centre (NRLDC) on weekly basis.
QA/QC procedures to be applied	The meters shall be calibrated on 2 year basis. The value shall be cross checked with value obtained by subtracting Auxiliary consumption from gross generation. The net electricity export value has been cross checked with invoices and found to be consistent.
Purpose of the data	For calculation of baseline emissions
Calculation method	The net electricity generation is directly monitored on hourly basis from the meters.
Comments	The data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter	TEG_y

<table>
<tr><td>Data unit</td><td>MWh</td></tr>
<tr><td>Description</td><td>Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y.</td></tr>
<tr><td>Source of data</td><td>Daily progress report</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>The meter reading of the electricity generated is being monitored on hourly basis.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Monitoring frequency: Hourly measurement
Recording frequency: Monthly in the ER calculation sheet</td></tr>
<tr><td>Value monitored</td><td>10,008849.2</td></tr>
<tr><td>Monitoring equipment</td><td>Unit – 1 (Main Meter)
<table>
<tr><td>Meter No</td><td>LT0175B</td></tr>
<tr><td>Model</td><td>ER300P</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td>Date of Calibration</td><td>09/01/2015</td></tr>
<tr><td>2nd date of calibration</td><td>08/01/2017</td></tr>
<tr><td>Next date of Calibration</td><td>07/01/2019</td></tr>
</table>
Unit – 1 (Check Meter)
<table>
<tr><td>Meter No</td><td>LT0176B</td></tr>
<tr><td>Model</td><td>ER300P</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td>Date of Calibration</td><td>09/01/2015</td></tr>
<tr><td>2nd date of calibration</td><td>08/01/2017</td></tr>
<tr><td>Next date of Calibration</td><td>07/01/2019</td></tr>
</table>
Unit – 2 (Main Meter)
<table>
<tr><td>Meter No</td><td>LT0177B</td></tr>
<tr><td>Model</td><td>ER300P</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td>Date of Calibration</td><td>09/01/2015</td></tr>
<tr><td>2nd date of calibration</td><td>08/01/2017</td></tr>
<tr><td>Next date of Calibration</td><td>07/01/2019</td></tr>
</table>
Unit – 2 (Check Meter)
<table>
<tr><td>Meter No</td><td>LT0178B</td></tr>
<tr><td>Model</td><td>ER300P</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td>Date of Calibration</td><td>09/01/2015</td></tr>
<tr><td>2nd date of calibration</td><td>08/01/2017</td></tr>
</table></td></tr>
</table>

	Next date of Calibration | 07/01/2019

Unit – 3 (Main Meter)

Meter No	LT0179B
Model	ER300P
Class	0.2s
Date of Calibration	09/01/2015
2nd date of calibration	08/01/2017
Next date of Calibration	07/01/2019

Unit – 3 (Check Meter)

Meter No	LT0180B
Model	ER300P
Class	0.2s
Date of Calibration	09/01/2015
2nd date of calibration	08/01/2017
Next date of Calibration	07/01/2019

Unit – 4 (Main Meter)

Meter No	LT0181B
Model	ER300P
Class	0.2s
Date of Calibration	09/01/2015
2nd date of calibration	08/01/2017
Next date of Calibration	07/01/2019

Unit – 4 (Check Meter)

Meter No	LT0182B
Model	ER300P
Class	0.2s
Date of Calibration	09/01/2015
2nd date of calibration	08/01/2017
Next date of Calibration	07/01/2019

QA/QC procedures to be applied	The meters shall be calibrated on 2 year basis.
Purpose of the data	For cross check of net generation
Calculation method	Not Applicable
Comments	The data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter	Cap_{PJ}

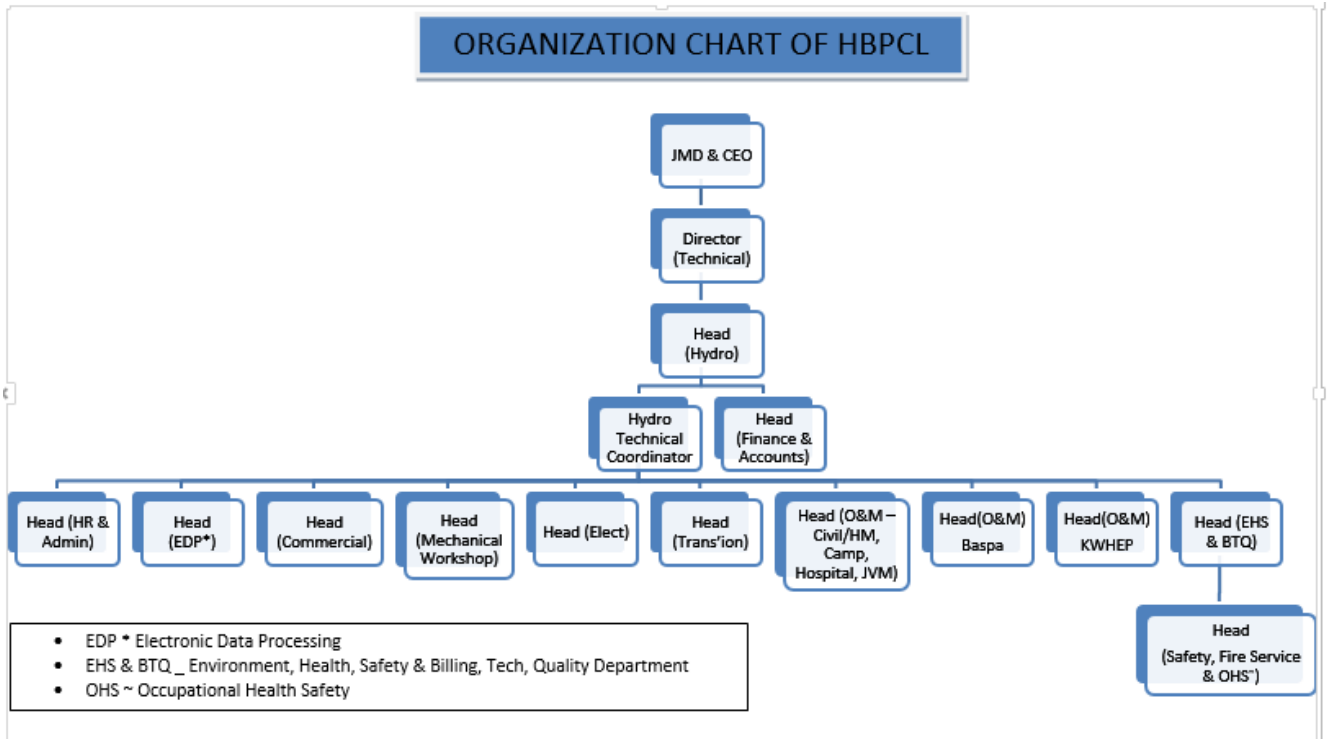
Data unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Commissioning certificates
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	-
Value monitored	$250 * 4 * 10^6$
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	-
Calculation method	-
Comments	-

Data / Parameter	A_{PJ}
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Measured by actual surveys conducted at project site PP
Description of measurement methods and procedures to be applied	Calculated from measured values
Frequency of monitoring/recording	-
Value monitored	526,976 on Oct 2016 529,258 on Sept 2017
Monitoring equipment	Topographic survey
QA/QC procedures to be applied	As per IS 5477 (Part 1): 1999 (reaffirmed 2004) – Fixing the capacities of reservoirs – Methods – Part I – General Requirements (1st revision)
Purpose of the data	-
Calculation method	Calculated using stream profile and valley cross sections
Comments	The data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity,

	whichever occurs later.

3.3 Monitoring Plan

The O&M structure for the CDM project activity is shown as below:



The above organization chart is followed by new owner Himachal Baspa Power Company Ltd.
A project team is constituted with participation from relevant departments. Personnel are trained on concept and monitoring plan. This team is responsible for data collection and archiving. This team meets periodically to review project activity, check data collected, emissions reductions etc. On a weekly basis, the monitoring reports are checked and discussed by the senior team members/managers. In case of any irregularity observed by any of the team member, it is informed to the concerned person for necessary action. On monthly basis, these reports are forwarded at the management level.

The metering and monitoring procedures are in accordance with the Power Purchase Agreement (Article 8), and an excerpt of the same is presented below:
Metering
Installation of Meters
All meters are installed by the Company at its own cost. Each meter shall be of static type, conforming to latest IEC-687/IEC-62053-22, and shall meet the requirements of IEGC. Each Meter shall be capable of displaying the following parameters by turn on demand and storing all such parameters for a period of ten (10) days:

i. Average frequency for each successive 15 minute block, as a two digit code (00 to 99 for frequency from 49.0 to 51.0 Hz),
ii. Net Wh transmittal during each successive 15 minute block, up to second decimal, with plus/minus sign,
iii. Cumulative Wh transmittal at each midnight, in six digits including one decimal,
iv. Cumulative VArh transmittal at voltages above 103% of the nominal voltage at Interconnection point, at each midnight, in six digits including one decimal,
v. Cumulative VArh transmittal at voltages below 97% of the nominal voltage at Interconnection point, at each midnight, in six digits including one decimal,
vi. Date and time blocks of failure of voltage transformer supply on any phase, as star (*) mark.

A set of Meters comprising (a) a set of Main Meters and (b) a set of Check Meters are installed by the Company on each circuit of the outgoing transmission lines so as to record frequency quantities of both Active energy and reactive energy for (a) energy exported by the Project to the Grid during each settlement period and (b) energy imported by the Project from the Grid during each settlement period.

One such set of meters shall be installed by the company at the Interconnection Point and one complete set of tested, calibrated and sealed Meters shall be kept as spare in safe custody of the Company. All such meters shall be sealed in the presence of CTU (Project State Utility) and the Company, which seal shall remain intact unless it is broken by the Testing Laboratory for testing and calibration.
Accuracy class, Testing and Calibration of Meters
The accuracy class of measuring instruments shall be equal or better than:
a) 0.2% for Wh measurement of Meters,
b) 2% for KVArh measurement of Meters; and
c) 0.5% for current transformers and voltage transformers;

All the Main Meters and Check Meters shall be tested and calibrated by a reputed Testing laboratory. The Meters (and associated circuits, if necessary) shall be tested and calibrated I accordance with the provisions set out in the Connection Agreement and the IEGC, at least once in two (2) Tariff years, or at any time when the difference between the readings of the Main Meter and the corresponding Check Meter is found to exceed zero point four percent (0.4%). The company shall bear the cost of testing and calibration of the Meters. A notice of seven (7) days shall be issued by the Party which arranges for such testing and calibration, to enable authorized representatives of the other parties to witness the testing and calibration.

Inaccuracy of Meters

If during any testing and calibration, a Main Meter is found to be within zero point two percent (0.2%) permissible limit of error and the corresponding Check Meter is found to be beyond such limit of error, the Monthly bill shall be as per the reading of the Main Meter. The corresponding Check Meter shall be repaired and calibrated by the Testing Laboratory or replaced by a new and tested meter.

If during any testing and calibration, a Main Meter is found to be beyond zero point two percent (0.2%) permissible limit of error but the corresponding Check Meter is found to be within limit of

error, the monthly bill shall, for that Month and till the date and time of the repair and calibration or replacement of the defective Main Meter, be as per the reading of the Check Meter. The corresponding Main Meter shall be replaced forthwith with a spare tested and calibrated meter, and the defective Main Meter shall be repaired and calibrated by the Testing Laboratory or replaced by a new and tested Meter.
If during any testing and calibration, a Main Meter and corresponding Check meter are both found to be beyond zero point two percent (0.2%) permissible limit of error, both the Meters or at least the Main meter shall be replaced forthwith with a spare tested calibrated meter.

The project activity does not involve any such inaccuracy of meters during current monitoring period.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The data used for the calculation of the baseline emission factor was obtained from the baseline calculations published by the CEA, Baseline Carbon Dioxide Emissions from Power Sector – Version 4.0 which uses ACM0002

The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$BEy = EG_{PJ,y} \text{ X } EF_{grid,CM,y}$

Where:

BEy = Baseline emissions in year y (tCO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced 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 version 02 of the “Tool to calculate the emission factor for an electricity system”

BEy = EGPJ,y X EFgrid,CM, y

= 9,943136.45 * 0.8031

= 7,985,332 tCO_2e (round down value)

4.2 Project Emissions

The power density of the project activity is 1699.52 W/m^2. Since the power density of the project is greater than 10 W/m^2: PEy = 0.

4.3 Leakage

According to ACM0002, leakage emissions are nil.

4.4 Net GHG Emission Reductions and Removals

Emissions Reduction (ERy) = BEy – PEy – Ly

= 7,985,332 – 0 – 0

= 7,985,332 t CO_{2e}

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2015	832,649	0	0	832,649
2016	3,504,652	0	0	3,504,652
2017	3,648,031	0	0	3,648,031
Total	7,985,332	0	0	7,985,332

APPENDIX 1: CALIBRATION DETAILS

The calibration details of meters installed by Power Grid for measurement of net electricity export are as below. There are six feeder lines involved for the electricity export. Considering the two years calibration frequency, there is no delay in calibration for current monitoring period.

Sr No	Location	Type	Serial Number	Make	Accuracy Class	Calibration date	Validity of calibration	Delay in Calibration
1	Feeder-1	Main	NP8526A	M/s L & T	0.2s	08/01/2015 16/12/2016	07/01/2017 15/12/2018	No No
2	Feeder-2	Main	NP8530A	M/s L & T	0.2s	08/01/2015 16/12/2016	07/01/2017 15/12/2018	No No
3	Feeder-3	Main	NP8528A	M/s L & T	0.2s	08/01/2015 16/12/2016	07/01/2017 15/12/2018	No No
4	Feeder-4	Main	NP8529A	M/s L & T	0.2s	08/01/2015 15/12/2016	07/01/2017 14/12/2018	No No

5	Feeder-5	Main	NP8527A	M/s L & T	0.2s	08/01/2015 16/12/2016	07/01/2017 15/12/2018	No No
6	Feeder-6	Main	NP8546A	M/s L & T	0.2s	08/01/2015 16/12/2016	07/01/2017 15/12/2018	No No
7	Feeder-1	Check	NP8400A	M/s L & T	0.2s	07/01/2015 17/12/2016	06/01/2017 16/12/2018	No No
8	Feeder-2	Check	NP8401A	M/s L & T	0.2s	07/01/2015 17/12/2016	06/01/2017 16/12/2018	No No
9	Feeder-3	Check	NP8402A	M/s L & T	0.2s	07/01/2015 17/12/2016	06/01/2017 16/12/2018	No No
10	Feeder-4	Check	NP8403A	M/s L & T	0.2s	07/01/2015 15/12/2016	06/01/2017 14/12/2018	No No
11	Feeder-5	Check	NP8548A	M/s L & T	0.2s	07/01/2015 16/12/2016	06/01/2017 15/12/2018	No No
12	Feeder-6	Check	NP8547A	M/s L & T	0.2s	07/01/2015 17/12/2016	06/01/2017 16/12/2018	No No