# HYDROELECTRIC PROJECT IN KINNAUR DISTRICT IN HIMACHAL PRADESH

Document Prepared by EKI Energy Services Limited

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|---|---|
| Project Title | Hydroelectric Project in Kinnaur District in Himachal Pradesh |
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| Prepared By | EKI Energy Services Limited |

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# 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-September-2015 onwards, the Himachal Baspa Power Company Ltd. (HBPCL) has owned this hydro power plant and its name changed to JSW Hydro Energy Limited[2] from 01-September-2018 thus JSW Hydro Energy Limited is the new owner is acting as project proponent for the project activity.

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 (CO2) 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:

[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).

[2] The relevant document for company name change has been provided

During the reported monitoring period 01-January-2018 to 30-April-2018 (Inclusive of start and end dates) the project activity supplied 9032892.69 MWh of electricity, and thus contributing to the GHG reductions of 7,254,300 $tCO_2e$.

## 1.2 Sectoral Scope and Project Type

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

Project type: Renewable energy project

The project activity is not a grouped project

## 1.3 Project Proponent

| | |
|---|---|
| Organization name | JSW Hydro Energy Limited (formerly Himachal Baspa Power Company Ltd) |
| Contact person | Mr. Anil Kumar Thakur |
| Title | Plant Engineer |
| Address | Karcham- Wangtoo H.E. Project, Sholtu Colony, P.O. Tapri,<br>Sholtu, Himachal Pradesh 172104, India |
| Telephone | + 91 7018858819 |
| Email | Anilkumar.thakur@jsw.in |

## 1.4 Other Entities Involved in the Project

| | |
|---|---|
| Organization name | EKI Energy Services Limited |
| Role in the Project | Project Consultant |
| Contact person | Mr. Souvik Mitra |
| Title | Project Manager |
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| Telephone | +91-9109120945 |
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## 1.5 Project Start Date

The project start date is 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 (fixed) in line with CDM crediting period as the project activity is also registered in CDM with UNFCCC reference number 4993[3].

Thus PP chosen the fixed crediting period from 01-January-2013 to 31-December-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:

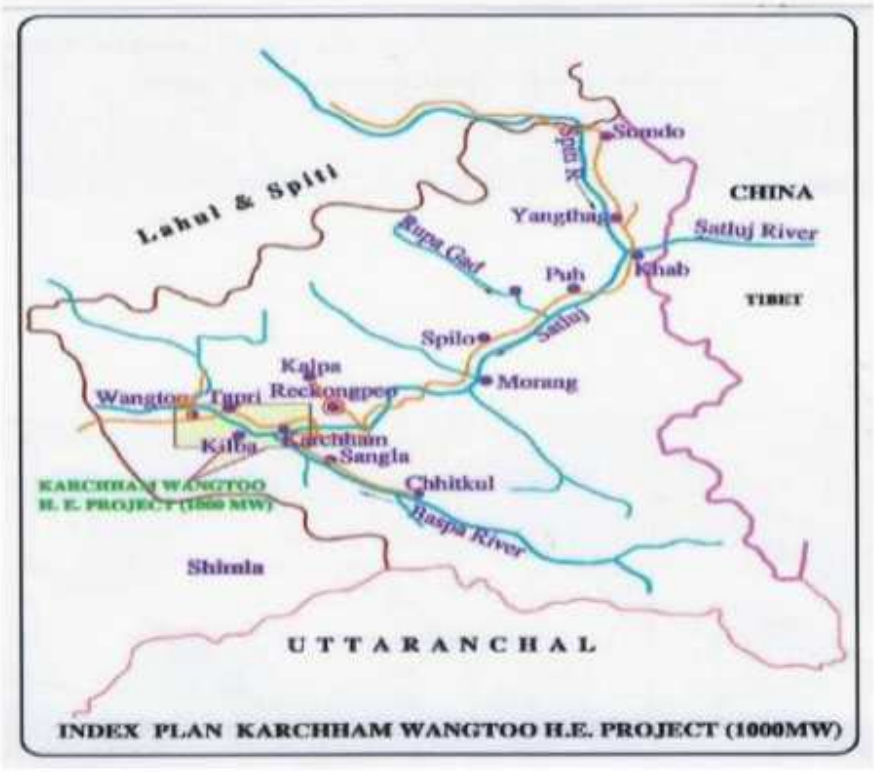
Latitude - 31°30'50'' - 31°32'10'' N

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:

[3] https://cdm.unfccc.int/Projects/DB/RWTUV1310469729.49


Chamba
Keylong
Lahul & Spiti
Dharmasala
Kangra
Kulu
Hamirpur
Una
Mandi
Kinnaur
Bilaspur
Kalpa
Shimla
Solan
Kasumpti
Sirmaur
Nahan


Lahul & Spiti
Shondo
Spiti R.
CHINA
Yangthang
Satluj River
Rupa Gad
Pub
Khab
TIBET
Satluj
Spilo
Kalpa
Reckongpeo
Morang
Wangtoo
Tapri
Karchham
Kilba
Sangla
Chhitkul
Baspa River
Shimla
UTTARANCHAL
INDEX PLAN KARCHHAM WANGTOO H.E. PROJECT (1000MW)

## 1.8 Title and Reference of Methodology

Methodology: ACM0002 ver. 12.1.0
Methodology Title: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC CDM[4].

The methodology also refers to the latest approved versions of:

- Tool for the demonstration and assessment of additionality, Version 05.2
- Tool to calculate the emission factor for an electricity system, Version 02
- Guidance on Assessment of Investment Analysis, Version 03
- Combined tool to identify the baseline scenario and demonstrate additionality, Version 2.2

## 1.9 Participation under other GHG Programs

The project activity has also been registration with UNFCCC under Clean Development Mechanism (CDM) program, Registration reference number is 4993[5]. The project proponent has provided undertaking that it will not claim any GHG credits under UNFCC CDM during the current monitoring period.

## 1.10 Other Forms of Credit

India is Non-annex1 country and there is no compliance with an emission trading program or to meet binding limits on GHG emissions for this project activity. The project is registered under CDM and UNFCCC (Registration ID 4993)[6]. The project proponent (PP) has submitted undertaking that they will not claim GHG emission reductions of the project from CDM and VCS for the same monitoring period. PP would not use net GHG emission reductions by the projects for compliance with emission trading program to meet binding limits on GHG emissions. PP has also submitted undertaking for not availing other forms of environmental credit for the same crediting period under consideration.

## 1.11 Sustainable Development

The National CDM Authority (NCDMA), which is the Designated National Authority (DNA) for the Government of India (GOI) under the Ministry of Environment, Forest and Climate Change (MoEFCC) has mentioned four indicators for the sustainable development. The project participant's view on the contribution of this project activity towards sustainable development is explained below:

**Social well-being:**

[4] https://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83

[5] https://cdm.unfccc.int/Projects/DB/RWTUV1310469729.49

[6] https://cdm.unfccc.int/Projects/DB/RWTUV1310469729.49

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 inter alia 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 erstwhile northern regional grid of India 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.

**Environment 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 SAFEGUARDS

## 2.1 No Net Harm

**Documentation on the analysis of the environmental impacts, including trans-boundary impacts:**

The Environment Impact Assessment (EIA) for the project was done comprehensively by one of the most reputed environment research institute - National Environmental Engineering Research Institute (NEERI), Nagpur, India, to analyse the environmental impacts associated with various activities envisaged by the project proponent against the backdrop of existing environmental quality at the project area and the statutory requirements. This is in compliance with the Environment Impact Notification, 199443 which is the applicable regulation in India.

The report, completed in 2005, reviews the legal and administrative framework for the EIA and then describes the project in all these aspects. The report also describes the quality of air, water, noise, land, socio-economic aspects and environment around the project. Predictive analysis has been done to estimate impacts of the project on the environment. Some of these impacts may affect the environment temporarily but can be countered by safety and environmental stabilization measures.

Description of the plausible environmental impacts predicted in the EIA for the proposed project activity are as follows:

**Air and Noise Environment**

a) The plying of trucks and other transport vehicles and use of construction machinery, marginal increase in the levels of Suspended Particulate Matter (SPM), oxides of nitrogen and sulphur is likely to occur, which will be sporadic and limited to construction phase only.

b) The traffic load on National Highway, NH-22 during construction of Karcham-Wangtoo Project would more or less remain the same as was during construction of Baspa Stage II (300 MW) and Nathpa-Jhakri(1500 MW) H.E. Projects.

c) The vehicular traffic as well as operation of other equipment will get minimised on completion of the construction phase of the project. Therefore, rise in the existing background levels of air pollutants is not expected during operational phase.

d) The noise levels in the nearby human settlements and at quarry and crusher operation sites, dam and power house construction sites will remain within the standards promulgated by the Occupational Safety and Health Administration (OSHA). The noise levels due to noise generating sources at the proposed dam site will be in the range of 80 – 95 dBA during construction activity and workers exposed to these noise levels will not get adversely affected. As the project area is covered with forests and hills, there will be substantial noise attenuation. The nearest habitation sites are more than 1 to 2 km away from the construction sites. Hence, the increase in noise levels during construction phase will not be significant in the habitation zone.

**Water Environment**

a) The flow contribution from tributaries for intervening stretch during lean period begins from 0.59 km of the dam site. The total flow contribution from tributaries in the river stretch from 0.59 km to 18.65 km downstream during lean season is 5.50 cumec. In addition to this, a minimum of 6.8 cumecs44 water shall be released from dam at all times in river Satluj during lean season from environmental consideration.

b) On an average, the per capita domestic water requirement is 70 lpd. Disinfection of water

sources is recommended for safe potable water. Total water requirement for domestic use during the construction phase will be 0.42 mld, of which 0.34 mld will be generated as domestic wastewater from workers' camps of Karcham and Wangtoo.

c) The average slope in the river stretch between Karcham and Wangtoo is about 1:100 with flow velocity of the order of 4 m/sec. The river shall be able to carry the sediments during monsoons and there will be no accumulation of silt in the downstream of dam. The dominant discharge in the Satluj river during monsoons is about 2000 cumecs. The intake will take only 521.25 cumec. Rest will be released through sluice spillway provided in the dam with crest at El.1778.

**Land Environment**

a) The accessibility to the area will improve due to road widening. This may lead to increased tourism activities generating employment and earnings. The movement of local population will be improved.

b) Dumping sites have been identified along the Satluj. These sites will be developed properly before dumping the spoils / debris. Retaining walls corresponding to year 2000 flood level as per design given by Himachal Pradesh Public Works Department (HPPWD) will be constructed to avoid muck spill into the Satluj.

c) Soil erosion, erosion intensity and land-slides in the project area are minimized through site specific engineering measures. Catchment area treatment may also improve land environment leading to combating erosion of the land. Promotion of insitu moisture conservation and increase in productivity of all types of land may be achieved through afforestation.

**Biological Environment**

a) Direct impacts on wild vegetation per se are considered to be of moderate localised significance and is not likely to make adverse impact. At the major construction sites where works on the surface are to be executed, viz. dam, intake, adit portals for head race tunnel and underground power house and pothead yard, the landscape will get changed into a constructed one from the natural one.

b) During all activities of the project, about 1191 number of trees will be felled. The girth of most of these trees is within the range of 10 to 40 cm (classes III-IV). The trees, to be felled, are in the forest ranges Kilba, Kalpa and Nichar under six compartments, of which unprotected forest (UF) Karcham is most conspicuous comprising of 625 trees. No adverse impact due to dust emission during construction phase is anticipated because trees are tall with narrow leaf surface area and mostly dominated by coniferous tree species of Deodar and Pines.

c) Fishing is not practised in the stretch of the river between Karcham and Wangtoo. Hence impact on fisheries is insignificant. Resultant formation of reservoir due to dam will enhance fish production.

d) The floral biodiversity is moderate which is not expected to degrade since submergence area is very small and confined to narrow river stretch. Further Catchment Area Treatment (CAT) plan will improve the biodiversity of the project area.

**Socio-economic Environment**

a) The compensation for private land, private buildings and families rendered homeless and landless would be paid to Project affected persons as per Relief and Rehabilitation (R&R) scheme of Himachal Pradesh Government.

b) There will be some strain on the existing infrastructure facilities, viz. water supply, sanitation, housing, energy etc. due to migration of workers. As the project proponents are to provide these facilities to the workers, the adverse impact will be mitigated.

c) Due to the project activities there will be increased employment both during construction and post construction / operation stages. The employment potential for the construction activity is estimated at about 6000. The breakup of employment is managerial / engineering (370); supervisory (500); skilled (2400); and unskilled (2730). This will have a positive impact on the economy of population, both local and regional.

d) With improved infrastructure facilities, viz. housing, roads, transport facilities, communications, education, water supply, sanitation, health services etc. will improve the quality of life of the population in the area.

e) The construction of power project will trigger an all-round increase in developmental activities such as housing, transport and education and these will have positive impact on the life style of the population.

**Steps taken by the Project Proponent to mitigate the environmental impacts**

Project Proponent devised an Environment Management Plan (EMP) which would combat all the adverse environmental impacts and would ensure environment friendly operation of Karcham-Wangtoo hydroelectric power project.

a) Public consultation, public hearing and opinion survey in more than 40 surrounding villages have focused on requirements / expectations of the people. Accordingly the EMP has been framed to satisfy the local population in the Project area.

b) To minimize the Suspended Particulate Matter (SPM), water sprinkling at construction sites, dumping sites, access roads and stone crushing plants were regularly done. Trucks were covered carrying construction material to minimize spills / accidents.

c) Periodical and preventive maintenance of construction equipment and construction vehicles was done to meet the emission standards. Vehicular traffic on highway (NH 22) was controlled in consultation with police department and transport of construction material and machinery is done during lean traffic period.

d) Noisy construction works were undertaken during day time only and sound barriers installed wherever possible. Personnel protection equipment including ear muffs, plugs were provided to workers working near machines, blasting and drilling sites and crusher operations.

e) Baseline survey of houses / buildings in the villages likely to be affected due to construction activities were carried out by the Committee constituted by Deputy Commissioner, Kinnaur. If any houses / buildings face damage due to dam, tunneling and power house construction activities undertaken by project proponents, suitable remedial measures were taken as mutually agreed.

f) Controlled blasting were resorted to and seismographs shall be installed at all strategic points for monitoring the intensity of the blast on a regular basis.

g) Minimum environmental flow of 6.80 cumec of river water is maintained immediately downstream of the dam during lean season.

h) The project proponent undertook augmentation/restoration of all the water supply schemes to bring the overall water supply to a level equal to or more than the current per capita availability. The names of the schemes, details of works to be undertaken and order of starting the work in each of these schemes are conveyed to the project proponent by the District Administration.

i) Although no rare or endangered plant or animal species are affected by submergence due to dam construction, existing forest cover is increased over a period of time in order to ensure conservation of biodiversity. Special efforts are made to manage bio-conservatory in consultation with forest department. Changes in species composition and diversity both for flora and fauna are conducted through ecological surveys.

j) The fisheries management plan targets overall improvement in aquatic environmental conditions. The plan could incorporate choice of fish species, public participation in the activity and development of fish trade.

k) The project proponent established additional trout seed production center in consultation with State Fisheries Department. They also ensure adequate production and supply of seeds and improve fish processing technology. Harvesting of fishes prior to initiation of de-silting of dam to prevent fish mortality.

l) Work plan has been formulated for re-vegetation of the spoil dumping sites comprising evaluation of physical and chemical properties to ensure supportive and nutritive capacity. - R&R plan has been prepared by the HP State Government as per the State Government guidelines and accepted by the Project proponents.

m) Catchment Area Treatment (CAT) plan is initiated to mitigate adverse impacts due to soil erosion and sediment transport. Restoration of construction sites, filling borrow pits is done through landscaping.

n) Proponents set up a 40 bed hospital to cater to medical needs of the population of about 25000 including local and migrant population.

o) The proponents established a good quality training center near the Project location with relevant trades to provide necessary skills to local inhabitants to increase their employability.

p) Information mechanism is established to report quickly to the villagers about the sudden release of water from the dam.

q) The disinfected drinking water of Bureau of Indian Standards (BIS) standards is provided to the workers with adequate public health facilities. Regular water quality monitoring may be taken up for the safe potable water supply.

r) Wastewater from the permanent workers camps is treated before discharging into the water body.

s) Post construction monitoring activities includes status of muck disposal areas, borrow pits and landfill sites. Change in land use pattern and effectiveness of CAT plan will be monitored using satellite imageries.

t) Post monitoring of environmental indicators like river water quality, sediment transport analysis, land use, soil erosion, ecological changes, aquatic life is conducted periodically as per guidelines issued by the project monitoring committee. Frequency of such monitoring with respect to parameters will be decided by the Project Monitoring Committee.

u) Environmental monitoring is ensured through a District level Inter Departmental Monitoring Committee under the Chairmanship of Deputy Commissioner, Kinnaur with representatives from all the concerned departments and the Proponents. This Committee meets periodically for compliance of the recommendations as detailed in Table 9.1 of Vol. I. of EIA Report.

The Project Proponents made sufficient provision in the Project Cost to carryout CAT Plan and EMP to mitigate adverse impacts and maximize beneficial impacts.

## 2.2 Local Stakeholder Consultation

The Stakeholder Consultation Report primarily deals with socio-economic impact of the project activity and provided an opportunity for the local population to express their viewpoints and comments with respect to the project.

Before implementation of the project activity, the project proponent did thorough consultation with stakeholders – identifying the stakeholders, consultation with the stakeholders in number of phases and through number of media – focus group discussion, detailed social mapping and fieldwork, inclusion of local stakeholders from all sections of community , explanation of project activity – purpose and details to them and resolving the comments/ grievances along with seeking suggestions from them. The PP has engaged a number of local NGOs for local stakeholder consultations by applying various strategies to engage them in project and for taking care of their complaints/grievances/suggestions. The process is ongoing and continuous; this process is undertaken throughout the year.

During the current monitoring period, the project proponent has engaged with the local stakeholders in different ways including various Corporate Social Responsibility (CSR) activities undertaken by the company. Besides, the PP has kept grievance register in plant site office seeking complaints/grievances from local community. There has also been the provision of receiving letters from local community for any suggestion/comment/complaint.

## 2.3 AFOLU-Specific Safeguards

Not applicable to this as this is not an AFOLU project activity

# 3 IMPLEMENTATION STATUS

## 3.1 Implementation Status of the Project Activity

The 1st unit of 250 MW got commissioned on 26-May-2011, the second unit on 23-June-2011, third unit on 08-September-2011 and the project got fully commissioned, i.e. the fourth unit got commissioned on 13-September-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**

| | |
|---|---|
| Stare | Himachal Pradesh |
| District | Kinnaur |
| River | Satluj |

| | |
|---|---|
| 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 WORK**

| | |
|---|---|
| 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<br>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 |
| 6. Discharge through each intake bay | 126.25 cumec for 1000 MW output |
| 7. No. of gates | 4 |
| 8. Size of each gate | 7.5m (W) x 4.0m (H) |
| 9. Size of intake tunnels | 6.0m dia circular concrete lined |
| 10. Length of intake tunnels | 317m, 365m, 414m & 462m |

SEDIMENTATION CHAMBERS

| | |
|---|---|
| 1. Particle size to be excluded | +0.2mm 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 each chamber for 1000 MW output | Q (cumec) : 126.25, V(m/sec) : 0.235 |

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% |

During the current monitoring period, the hydro power project was operating with normal operational schedule including scheduled shut down for maintenance. Details of plant shutdown have been mentioned in APPENDIX 2 of this Monitoring Report.

## 3.2 Deviations

### 3.2.1 Methodology Deviations

No methodology deviation is applied during the monitoring period.

### 3.2.2 Project Description Deviations

Since 01-September-2015, project activity ownership rests on the Himachal Baspa Power Company Ltd. The company name changed to JSW Hydro Energy Limited from 01-September-2018. The relevant document for change in company name and corresponding change in communication agreement to VCS has been provided.

## 3.3 Grouped Project

The project is not a grouped project thus this is not applicable.

# 4 DATA AND PARAMETERS

## 4.1 Data and Parameters Available at Validation

| | |
|---|---|
| **Data / Parameter** | $EF_{OM,y}$ |
| **Data unit** | $tCO_2/MWh$ |
| **Description** | Operating Margin emission factor for erstwhile NEWNE regional grid |
| **Source of data** | Referred from CO2 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 |
| Purpose of Data | Calculation of baseline emissions |
| Comments | The value is fixed and it is same for the entire crediting period |

| | |
|---|---|
| Data / Parameter | $EF_{,BM,y}$ |
| Data unit | $tCO_2/MWh$ |
| Description | Build Margin emission factor for the erstwhile NEWNE regional grid |
| Source of data | Referred from CO2 Baseline Database for the Indian Power Sector prepared by Central Electricity Authority Version 4.0 |
| Value applied | 0.5977 |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated from CEA database in accordance with 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 |
| Purpose of Data | Calculation of baseline emissions |
| Comments | The value is fixed and it is same for the entire crediting period |

| | |
|---|---|
| Data / Parameter | $EF_{grid,CM,y}$ |
| Data unit | $tCO_2/MWh$ |
| Description | Combined Margin $CO_2$ emission factor for erstwhile NEWNE regional grid |
| Source of data | Estimated figure based on 50% of OM and 50% of BM values |
| Value applied | 0.8031 |
| 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. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | The value is fixed and it is same for the entire 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 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 and procedures applied | The installed capacity is determined based on recognized standards |
| Purpose of Data | - |
| Comments | - |

## 4.2 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 |

<table>
<tr><td></td><td>to grid through the same sub- station under a Loopin-loop-out (LILO) arrangement.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Measured at the project site (Pothead Yard)</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuous monitoring and monthly recording</td></tr>
<tr><td>Value monitored</td><td><table>
<tr><td>Year</td><td>Net Electricity Supplied to grid(MWh)</td></tr>
<tr><td>2018</td><td>3938512.98</td></tr>
<tr><td>2019</td><td>4586776.49</td></tr>
<tr><td>2020</td><td>507603.22</td></tr>
<tr><td>Total</td><td>9032892.69</td></tr>
</table></td></tr>
<tr><td>Monitoring equipment</td><td>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.</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>The meters are calibrated once in every 2 years. The value shall be cross checked with value obtained by subtracting Auxiliary consumption from gross generation. The net electricity export value is also cross checked with electricity sales invoices.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>Net electricity is directly monitored on hourly basis from the meters</td></tr>
<tr><td>Comments</td><td>The Monitored Data to be kept for a minimum of two years after the end of the crediting period or the last issuance whichever is later.</td></tr>
</table>

| | |
|---|---|
| Data / Parameter | $TEG_y$ |
| Data unit | MWh |
| Description | Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y. |
| Source of data | Daily progress report |
| Description of measurement methods and procedures to be applied | The meter reading of the electricity generated is being monitored on hourly basis. |

<table>
<tr><td>Frequency of monitoring/recording</td><td>Continuous monitoring and monthly recording</td></tr>
<tr><td>Value monitored</td><td>
<table>
<tr><td>Year</td><td>Net Electricity Supplied to grid(MWh)</td></tr>
<tr><td>2018</td><td>3965050.82</td></tr>
<tr><td>2019</td><td>4618157.34</td></tr>
<tr><td>2020</td><td>511119.95</td></tr>
<tr><td>Total</td><td>9094328.11</td></tr>
</table>
</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>Make</td><td>L&T</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td rowspan="3">Calibration dates</td><td>09/01/2015</td></tr>
<tr><td>08/01/2017</td></tr>
<tr><td>01/12/2018</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>Make</td><td>L&T</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td rowspan="3">Calibration dates</td><td>09/01/2015</td></tr>
<tr><td>08/01/2017</td></tr>
<tr><td>01/12/2018</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>Make</td><td>L&T</td></tr>
<tr><td>Class</td><td>0.2s</td></tr>
<tr><td rowspan="3">Calibration dates</td><td>09/01/2015</td></tr>
<tr><td>08/01/2017</td></tr>
<tr><td>01/12/2018</td></tr>
</table>
</td></tr>
</table>

Unit 2(Check Meter)

| | |
|---|---|
| Meter No. | LT0178B |
| Model | ER300P |
| Make | L&T |
| Class | 0.2s |
| Calibration dates | 09/01/2015 |
| | 08/01/2017 |
| | 01/12/2018 |

Unit 3(Main Meter)

| | |
|---|---|
| Meter No. | LT0179B |
| Model | ER300P |
| Make | L&T |
| Class | 0.2s |
| Calibration dates | 09/01/2015 |
| | 08/01/2017 |
| | 01/12/2018 |

Unit 3(Check Meter)

| | |
|---|---|
| Meter No. | LT0180B |
| Model | ER300P |
| Make | L&T |
| Class | 0.2s |
| Calibration dates | 09/01/2015 |
| | 08/01/2017 |
| | 01/12/2018 |

Unit 4(Main Meter)

| | |
|---|---|
| Meter No. | LT0181B |
| Model | ER300P |
| Make | L&T |
| Class | 0.2s |
| Calibration dates | 09/01/2015 |
| | 08/01/2017 |
| | 01/12/2018 |

| | |
|---|---|
| | Unit 4(Check Meter)<br>Meter No. LT0182B<br>Model ER300P<br>Make L&T<br>Class 0.2s<br>Calibration dates 09/01/2015, 08/01/2017, 01/12/2018 |
| QA/QC procedures to be applied | The meters are calibrated once in every 2 years |
| Purpose of the data | For cross check of net generation |
| Calculation method | Not applicable |
| Comments | The Monitored Data to be kept for a minimum of two years after the end of the crediting period or the last issuance whichever is later. |

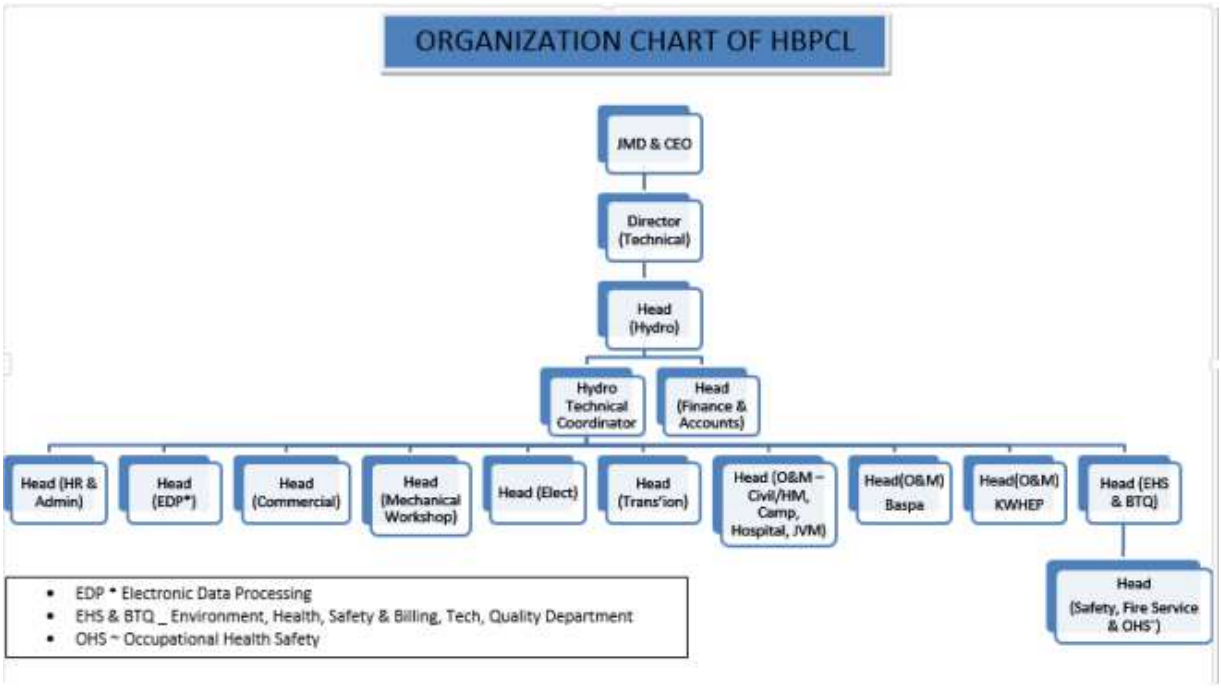
| | |
|---|---|
| Data / Parameter | $Cap_{PJ}$ |
| Data unit | W |
| Description | Installed capacity of the hydro power plant after the implementation of the project activity |
| Source of data | Commissioning Certificate. |
| Description of measurement methods and procedures to be applied | - |
| 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 |
| Description of measurement methods and procedures to be applied | Calculated from measured values |
| Frequency of monitoring/recording | - |
| Value monitored | 529,209in September 2019 (As per PDD: area 588400 $m^2$ having a power density of 1699.52 $W/m^2$.) |
| 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 | -. |

## 4.3 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, either 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.

# 5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

## 5.1 Baseline Emissions

The emission factor value has been fixed Ex-ante and the same shall be used for the monitoring period. Net Electricity Generated is obtained by deducting total import (from grid) from total export (to grid).

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 the methodology 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.

Baseline emissions are calculated by multiplying the Net electricity exported to the grid with net baseline emission factor, as given in the registered VCS PD.

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

Where,

$BE_y$ = Baseline Emissions ($tCO_2$/year)
$EG_{facility,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh/year)
$EF_{grid, CM, y}$ = Baseline Emission Factor (Combined margin $CO_2$ emission factor for grid)

The project activity being a greenfield project, $EG_{PJ, y} = EG_{facility,y}$ = Net electricity exported to grid by the project activity (MWh/year)
The calculation of yearly baseline emissions is provided in the table below:

| Year | Net Electricity | Baseline Emission Factor | Baseline Emissions |
|---|---|---|---|

| | Export (MWh) | (tCO2/MWh) | ($tCO_2$) |
|---|---|---|---|
| 2018 | 3938512.98 | 0.8031 | 3163013 |
| 2019 | 4586776.49 | 0.8031 | 3683633 |
| 2020 | 507603.22 | 0.8031 | 407654 |
| Total | 9032892.69 | - | 7254300 |

Hence the baseline emission calculated for the reported monitoring period i.e. $BE_y$ = 7,254,300 $tCO_2$

## 5.2 Project Emissions

According to the chosen baseline methodology ACM0002, for hydro power project activities that result in new reservoirs and hydro power project activities that result in the increase of existing reservoirs, project proponents shall account for project emissions, estimated as follows: a) If the power density (PD) of power plant is greater than 4 $W/m^2$ and less than or equal to 10 $W/m^2$.

a) Project Emissions ($PE_y$) = ($EF_{RES}$ *$EG_y$ )/1000

Where

$PE_y$ = Emission from reservoir expressed as $tCO_2e$/year

$ES_{RES}$ = Default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg $CO_2e$ /MWh.

$EG_y$ = Electricity produced by the hydroelectric power project in year y, in MWh

b) If the power density of the project is greater than 10 $W/m^2$ , $PE_y$ = 0

The power density of the project activity is calculated as follows:

PD= ($Cap_{PJ}$ – $Cap_{BL}$ ) / ($A_{PJ}$ - $A_{BL}$ )

PD = Power density of the project activity, in $W/m^2$

$Cap_{PJ}$ = Installed capacity of the hydro power plant after the implementation of the project activity (W).

$Cap_{BL}$ = Installed capacity of the hydro power plant before the implementation of the project activity (W).

For new hydro power plants, this value is zero. $A_{PJ}$ = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full ($m^2$). $A_{BL}$ = Area of the reservoir measured in the surface of the water, before the

implementation of the project activity, when the reservoir is full ($m^2$ ). For new reservoirs, this value is zero.

This project activity being a greenfield project , Cap $_{BL}$ = 0 and A $_{BL}$=0

Hence, PD = (1000*1000*1000) /*529209*= 1889.61 W/$m^2$

Since the power density of the project is greater than 10 W/$m^2$, Project Emissions ($PE_y$) = 0.

$PE_y$ = 0 $tCO_2e$

## 5.3 Leakage

According to ACM0002, leakage emissions are nil.

$LE_y$ = 0

## 5.4 Net GHG Emission Reductions and Removals

The Formula used to calculate the net emission reduction for the project activity is

$ER_y = BE_y – PE_y – LE_y$

Where,

$ER_y$ = Emission Reduction in $tCO_2$/year

$BE_y$ = Baseline emission in $tCO_2$/year

$PE_y$ = Project emissions in $tCO_2$/year

$LE_y$ = Leakage Emissions in $tCO_2$/year

For the project activity during the current monitoring period, as per section 5.1, 5.2 and 5.3

$BE_y$ = 7,254,300 $tCO_2e$

$PE_y$ = 0 $tCO_2e$
$LE_y$ = 0 $tCO_2e$

| Year | Baseline emissions or removals ($tCO_2e$) | Project emissions or removals ($tCO_2e$) | Leakage emissions ($tCO_2e$) | Net GHG emission reductions or removals ($tCO_2e$) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 2018 | 3163013 | 0 | 0 | 3163013 |
| 2019 | 3683633 | 0 | 0 | 3683633 |
| 2020 | 407654 | 0 | 0 | 407654 |
| **Total** | 7254300 | 0 | 0 | 7254300 |

The actual VER is about 12% lower than the estimated VER. This variation is majorly due to the variations in water flow which is mainly dependent rainfall and other parameters including grid availability – these factors are not in the control of project proponent. .

# APPENDIX 1: METER 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 | Previous Calibration date | Calibration date | Next due date of calibration |
|---|---|---|---|---|---|---|---|---|
| 1 | Feeder-1 | Main | NP8526A | M/s L & T | 0.2s | 07-January-2017 | 29-November-2018 | 28-November-2020 |
| 2 | Feeder-2 | Main | NP8530A | M/s L & T | 0.2s | 07-January-2017 | 29-November-2018 | 28-November-2020 |
| 3 | Feeder-3 | Main | NP8528A | M/s L & T | 0.2s | 07-January-2017 | 29-November-2018 | 28-November-2020 |
| 4 | Feeder-4 | Main | NP8529A | M/s L & T | 0.2s | 07-January-2017 | 29-November-2018 | 28-November-2020 |
| 5 | Feeder-5 | Main | NP8527A | M/s L & T | 0.2s | 07-January-2017 | 29-November-2018 | 28-November-2020 |
| 6 | Feeder-6 | Main | NP8546A | M/s L & T | 0.2s | 07-January-2017 | 29-November-2018 | 28-November-2020 |
| 7 | Feeder-1 | Check | NP8400A | M/s L & T | 0.2s | 06-January-2017 | 30-November-2018 | 29-November-2020 |
| 8 | Feeder-2 | Check | NP8401A | M/s L & T | 0.2s | 06-January-2017 | 30-November-2018 | 29-November-2020 |
| 9 | Feeder-3 | Check | NP8402A | M/s L & T | 0.2s | 06-January-2017 | 30-November-2018 | 29-November-2020 |
| 10 | Feeder-4 | Check | NP8403A | M/s L & T | 0.2s | 06-January-2017 | 30-November-2018 | 29-November-2020 |
| 11 | Feeder-5 | Check | NP8548A | M/s L & T | 0.2s | 06-January-2017 | 30-November-2018 | 29-November-2020 |
| 12 | Feeder-6 | Check | NP8547A | M/s L & T | 0.2s | 06-January-2017 | 30-November-2018 | 29-November-2020 |

# APPENDIX 2: PLANT OUTAGE DETAILS

Tripping Data

| S.No. | Date | Unit Tripped | System | Time(hours) |
|---|---|---|---|---|
| 1 | 31/05/2018 | Unit-2 | Malfunctioning of Stator Winding RTD | 0:36 |
| 2 | 08-06-18 | Unit-3 | Stator earth fault | 3:36 |
| 3 | 29/08/2018 | Unit-2 | SPS-3 activated from Rampur end | 0:20 |
| 4 | 29/08/2018 | Unit-4 | SPS-3 activated from Rampur end | 0:20 |
| 5 | 09-07-18 | Unit-2 | SPS-1 activated from Rampur end | 0:12 |
| 6 | 26/03/2019 | All units | Flashover in SSB-B MSLB Feeder | 1:30 |

Forced shutdown due to high shift

| S.No. | Date | High Silt / Flushing | Plant m/c Hours |
|---|---|---|---|
| 1 | 27th - 27th July 2018 | HS | 04;08 |
| 2 | 07th - 07th Aug 2018 | HS/flushing | 66;56 |
| 3 | 08th -09th Aug 2018 | HS/flushing | 165:09 |
| 4 | 10th -10th Aug 2018 | HS | 54:29 |
| 5 | 11th -11th Aug 2018 | HS | 27:30 |
| 6 | 13th -13th Aug 2018 | HS | 14:53 |
| 7 | 18th -18th Aug 2018 | HS | 36:42 |
| 8 | 23rd -24th Aug 2018 | HS/flushing | 68:27 |
| 9 | 08-08-19 | HS | 16:47 |
| 10 | 08-09-19 | HS/flushing | 10:11 |
| 11 | 25/8/2019 | HS/flushing | 15:19 |