



**Verified Carbon
Standard**

18 MW KEMPHOLE MINI HYDEL SCHEME (KMHS), BY INTERNATIONAL POWER CORPORATION LIMITED, INDIA



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Project Title	18 MW Kemphole Mini Hydel Scheme (KMHS), by International Power Corporation Limited, India
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

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

In the baseline scenario, the equivalent amount of electricity would have been supplied to grid through the grid connected power plant which is dominated by fossil fuel based power plants. In the project scenario the renewable power is supplied to grid that replaces the electricity produced from fossil fuel based power plant and thereby avoid associated greenhouse gas emission.

Relevant dates

KMHS project was completed in two stages; in first stage 2X6 MW units were installed (20th Oct 2003, 20th Nov 2003), in second stage 6 MW was installed (10th Jan 2005). The project activity utilises the water flow and fall available in the Kemphole stream. The project location is situated in dense forests of the Kemphole reserve forest and there is no habitation in the nearby area. The project does not involve any displacement of local population and associated rehabilitations. The project uses horizontal Francis turbines for power generation.

The project is registered under CDM (Ref no. 0312) on 25-May-2006 with the following crediting period:

1st crediting period: 20-October-2003 to 19-October-2010

2nd Crediting period: 20-October-2010 to 19-October-2017

3rd Crediting period: 20-October-2017 to 19-October-2024

The project is also registered under I-REC (Device ID: KEMPHOLE¹) and claimed REC during the year 2019 & 2020. The period and REC volume claimed are provided in the Appendix IV. The total REC claimed during the period is 55,756 MWh which is excluded from the emission reduction calculation to avoid double counting.

Emission reduction:

¹ <https://evident.services/device-register/KEMPHOLE>

This is the second monitoring period (20-October-2017 to 30-September-2021) in VCS. And the actual emission reduction achieved in this monitoring period is 112,482tCO_{2e}.

1.2 Sectoral Scope and Project Type

Sectoral Scope: 01- Energy Industries (Renewable/Non-Renewable Sources)

Project Type: Type I

Methodology: ACM0002: Grid-connected electricity generation from renewable sources, version 20.0

The project is not a grouped project

1.3 Project Proponent

Organization name	International Power Corporation Private Limited
Contact person	B P Ramesh
Title	Director
Address	#19, 3 rd floor, Shivashankar Plaza, Lalbagh road Bangalore, Karnataka- 560 027 India
Telephone	+91 80 22100052
Email	info@internationalpower.in

1.4 Other Entities Involved in the Project

Organization name	Kosher Climate India Private Limited
Role in the Project	Authorized Representative
Contact person	Vamsi Krishna
Title	Global Business Head
Address	#109, 2 nd Floor, 27 th Main, HSR Layout, Bangalore- 560102
Telephone	+91-99453 43475
Email	vamsi@kosherclimate.com

1.5 Project Start Date

20-October-2003 (date of commissioning of first unit)

1.6 Project Crediting Period

Start date of crediting period: 01-December-2014

End date of crediting period: 19-October-2024

Length of crediting period: 9 years, 10 months, 19 days

Note: The current VCS monitoring period (20/10/2017 to 30/09/2021) lies within the CDM 3rd Crediting period (20/10/2017 to 19/10/2024) which is in line with the requirements of para 3.8.7 of VCS Standard, version 4

1.7 Project Location

Village: Heggadde

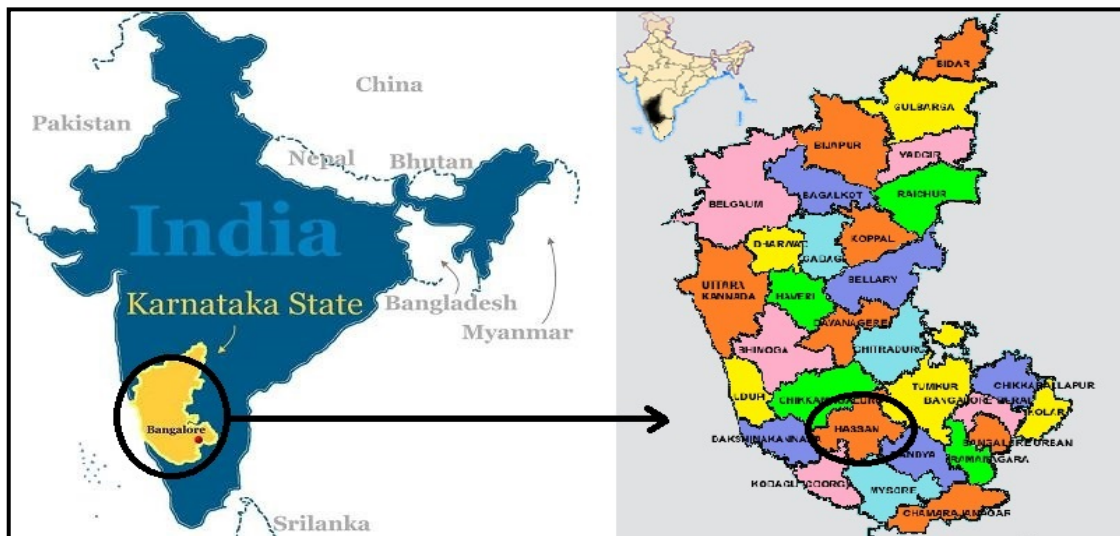
Taluk: Sakaleshpura

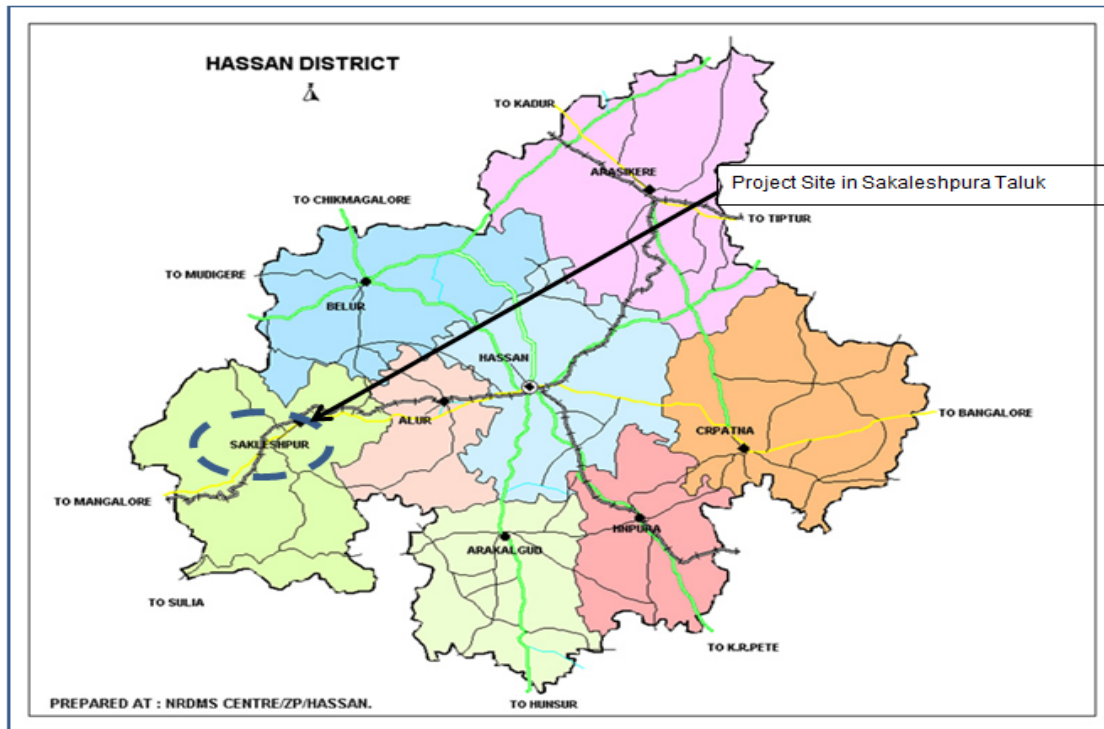
District: Hassan

State: Karnataka

Geographical coordinates of weir site of KMHS project activity is Latitude 12°50'32"N and Longitude 75°40'38"E and of the power house is Latitude 12°50'17.98 "N and Longitude 75°40'11.88"E

Location of project activity is follows:





1.8 Title and Reference of Methodology

The methodology applied for the project is Approved Large Scale Consolidated Methodology: ACM0002 “Grid-connected electricity generation from renewable sources” (Version 20.0)² (As per the CDM PDD applicable for 3rd crediting period)

1.9 Participation under other GHG Programs

Project is registered under Clean Development Mechanism (CDM) with UNFCCC on 25-May-2006. Project reference number is 0312³

The project CDM 1st crediting period is from 20-October-2003 to 19-October-2010 and the 2nd crediting period is from 20-October-2010 to 19-October-2017. The CERs are issued up to 30-November- 2014.

In VCS, the issuance is requested only from 01-December-2014 and PP will not claim CERs for the reported monitoring period. Hence there is no double counting of carbon credits

²<https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG>

³ <https://cdm.unfccc.int/Projects/projsearch.html>

1.10 Other Forms of Credit

The project is also registered under I-REC (Device ID: KEMPHOLE⁴) and claimed REC during the year 2019 & 2020. The total REC claimed during the period is 55,756 MWh which is excluded from the emission reduction calculation to avoid double counting

The GHG emission reductions from the project activity are not included in any emissions trading program or any other mechanism that includes GHG allowance trading. Also the project has not sought or received any other form of GHG-related environmental credit during this monitoring period

1.11 Sustainable Development

Environmental wellbeing: In India coal is the primary source of energy for power generation and production processes. The demand for electrical energy has been steadily increasing. Expansion of the electrical supply to new areas and rapid industrialization are the main reasons for the growth in demand for power. The project activity contributes to the welfare of environment at large considering the carbon emissions that would have been generated by a thermal plant of equal capacity. The project hence decreases the future needs for coal based power generation by the grid and thereby reducing the CO₂ emissions from the electricity sector. Associated SPM, SO_x, NO_x emissions and emissions related to transportation and excavation of fossil fuel are also avoided.

Since the project is a Run-of-the-River project and there are no major irrigation works across the stream and has no pondage of water, there are no negative environmental impacts.

Social Wellbeing: Karnataka is witnessing major shortage of power. On an average there was a shortage of supply over demand by 15 per cent during 1994-2000. The project activity is augmenting grid supply that is necessary for the sustenance and development of the society.

Economic Wellbeing: The project activity provides a fillip to economic activity in the region. Direct & Indirect Employment has been generated in the plant for the project implementation & management.

Technological Wellbeing: The project uses well established horizontal Francis turbines for power generation. The project activity is the first hydel power project in the Netravathi river basin. The success of the project activity has catalysed more hydel power projects to come in the basin/region. Therefore the project is contributing to the sustainable development in following manner.

- Generating 51.08 million units of electricity on an annual basis
- Reducing electricity consumption required for auxiliary consumption to generate equivalent amount of electricity in thermal power plants

⁴ <https://evident.services/device-register/KEMPHOLE>

- Conservation of natural resources like coal/gas/oil, this makes natural resources available for other important applications
- Reducing GHG emissions
- Reducing pollution of other kind (like SO_x, NO_x) which happen in thermal power plants

2 SAFEGUARDS

2.1 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: <https://cdm.unfccc.int/Projects/DB/SGS-UKL1142326439.29/view?cp=1>

The project activity does 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

2.2 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: <https://cdm.unfccc.int/Projects/DB/SGS-UKL1142326439.29/view?cp=1>

On-going communication with local stakeholders

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. No grievances received during the monitoring period.

2.3 AFOLU-Specific Safeguards

Not Applicable

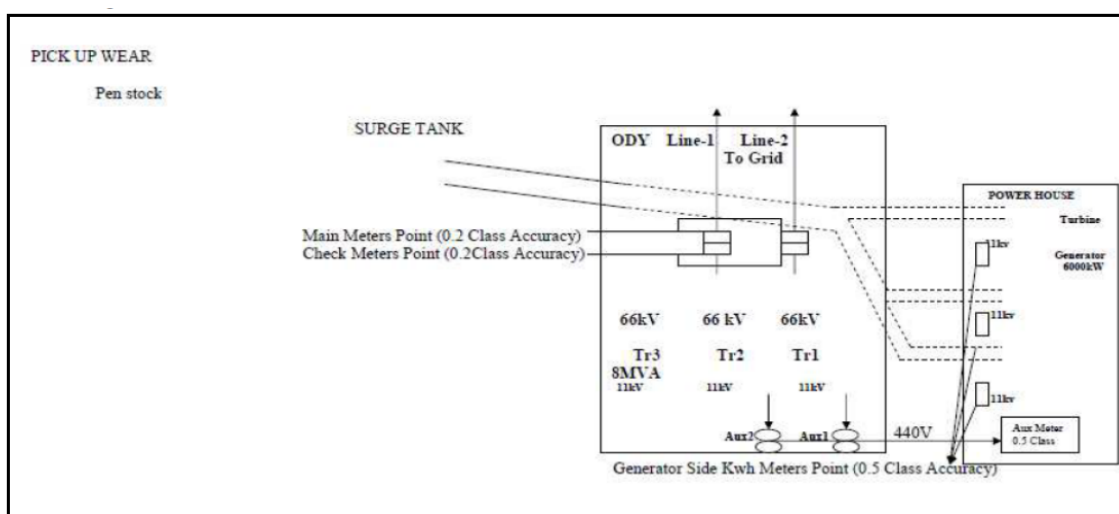
3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

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

A gated weir across Kemphole, downstream of confluence of Kadumanehole with Kemphole is constructed. The river bed level at the gated weir site is 319 m and the full reservoir level of the weir is 340 m. Three horizontal Francis turbines of 6 MW capacity each coupled with horizontal 3 phase, 50 Hz, 500 rpm synchronous generators are used. The gross head available for the project is 68 meter. A 66 KV double circuit transmission line (total 124 towers over 29 KMs) from the switchyard to the 11/66 KV sub-station at Sakaleshpura is used for power evacuation from the project activity.

Line diagram



The technical specifications are mentioned here under:

S. No	Parameters	Specifications
Generator		
1	No of Generating Units	3
2	Capacity of Each Generating Units	7059 kVA/6000 kW (+10% overload)
3	Total Capacity of this project activity	18000 kW

4	Type of generator	3 phase, Synchronous Generator
5	Excitation Voltage & Current	110 Volts (dc), 5.2 Amps (dc)
6	Power Factor	0.85
7	Rated Frequency	50HZ
8	Synchronous Speed	500 RPM
9	Over speed	850 RPM for 15 mins
10	Generation Voltage	11kV
11	Generator Current	371 Amps
Turbine		
12	Type of Turbine	Hydraulic Turbine
13	No of Turbines	3
14	Turbine Speed	500 RPM
15	Continuous Over Load Capacity	115%
16	Rated Net Head in (m)	58 m
17	Flow	12020 Lit/sec

During the monitoring period) the project activity was operated and monitored in accordance with the applicable baseline and monitoring methodology ACM0002, Version 20 and registered PDD.

All the three units were in operation and no abnormal circumstance occurred during this monitoring period. All the events are recorded in the log book available at the project site. As a part of regular maintenance the machines are stopped for mechanical and electrical maintenance

3.2 Deviations

2.3.1 Methodology Deviations

There is no methodology deviations applied during this monitoring period.

2.3.2 Project Description Deviations

There is no project description deviations applied during this monitoring period or in previous monitoring reports.

3.3 Grouped Projects

The project is not a grouped project

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	EF _{grid,CM,y}
Data unit	tCO ₂ /MWh
Description	Combined margin CO ₂ emission factor of INDIAN grid
Source of data	Central Electricity Authority:CO ₂ Emission Database CEA CO ₂ Baseline database Version 15 & PDD of 2nd crediting period (version 8, dated 11/03/2011)
Value applied	0.8555
Justification of choice of data or description of measurement methods and procedures applied	The date has been considered in accordance to the Tool to calculate emission factor of an electricity system (version 7). The tool guides to take 25% weightage of EF _{grid,OMsimple} , &75% weightage of EF _{grid,BM,y} for the 3 rd crediting period for hydro project
Purpose of Data	Baseline Emission calculation
Comments	The combined margin is calculated ex-ante and fixed for the entire crediting period and the combined margin thus calculated is 0.8555 tCO ₂ /MWh.

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	Methodology
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	For new hydro power plants, this value is zero.
Purpose of Data	-
Comments	-

Data / Parameter	ABL
Data unit	m ²
Description	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
Source of data	Methodology
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	For new reservoirs, this value is zero.
Purpose of Data	-
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	EG facility, export, y
Data unit	MWh
Description	Quantity of electricity supplied by the project plant/unit to the grid in year y
Source of data	From the Joint Meter Reading (JMR)
Description of measurement methods and procedures to be applied	The power generated in three generators has been evacuated through Line 1 and Line 2 and both the Lines are having separate Main and Check meter. The electricity imported from the grid is monitored by the Main meter and the Check meter in Line 1 and Line 2 installed in the switchyard area near the plant.
Frequency of monitoring/recording	Continuous monitoring and monthly recording
Value monitored	187,964.71
Monitoring equipment	The data is accurately measured by high quality and high accuracy meters installed. Every month these readings are recorded by plant personnel and KPTCL, which are archived for cross-checking. These meter readings in Line1 and Line 2 are used to determine the electricity supplied to the grid by the project activity and are used to raise invoice. The meters are in the custody of KPTCL. The meters are calibration at least once a year. Details of the energy meters are given below: Meter type: Trivector Make: L&T Accuracy Class: 0.2s Meter Serial No: <u>Main Meters:</u> Line1: 02048056 (Till 31/10/2019) & 18148113 (From 31/01/2019 onwards)

	Line 2: 03129375 (Till 06/01/2020) & 18153040 (From 06/01/2020 onwards) <u>Check Meters:</u> Line1: 03129382 (Till 31/10/2019) & 18148129 (From 31/01/2019 onwards) Line 2: 03129379 (Till 06/01/2020) & 18158317 (From 06/01/2020 onwards)
QA/QC procedures to be applied	As per CDM PDD, the calibration frequency of the energy meters is once in a year. The actual calibration dates are mentioned in Appendix Also the energy meter readings crosschecked with the electricity invoices raised to DISCOM. No calibration delay in the monitoring period.
Purpose of the data	Calculation of baseline emissions
Calculation method	Every month, the energy export reading will be recorded. And the difference between the current month export and previous month export reading will provide the respective month export units. Since this monitoring period starts on 20-October-2017, the export data in the JMR for the month of October is apportioned for 12 days as below: $= (\text{Export value for the month of October} \times 12) / 31$
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	EG _{facility, Import, y}
Data unit	MWh
Description	Quantity of electricity imported by the project plant/unit from the grid in year y
Source of data	From the Joint Meter Reading (JMR)
Description of measurement methods and procedures to be applied	The power generated in three generators has been evacuated through Line 1 and Line 2 and both the Lines are having separate Main and Check meter. The electricity imported from the grid is monitored by the Main meter and the Check meter in Line 1 and Line 2 installed in the switchyard area near the plant.
Frequency of monitoring/recording	Continuous monitoring and monthly recording
Value monitored	724.5
Monitoring equipment	The data is accurately measured by high quality and high accuracy meters installed. Every month these readings are recorded by plant personnel and KPTCL, which are archived for cross-checking. These meter readings in Line1 and Line 2 are used to determine the electricity supplied to the grid by the project activity and are used to raise invoice. The meters are in the custody of KPTCL. The meters are calibration at least once a year.

	Details of the energy meters are given below: Meter type: Trivector Make: L&T Accuracy Class: 0.2s Meter Serial No: <u>Main Meters:</u> Line1: 02048056 (Till 31/10/2019) & 18148113 (From 31/01/2019 onwards) Line 2: 03129375 (Till 06/01/2020) & 18153040 (From 06/01/2020 onwards) <u>Check Meters:</u> Line1: 03129382 (Till 31/10/2019) & 18148129 (From 31/01/2019 onwards) Line 2: 03129379 (Till 06/01/2020) & 18158317 (From 06/01/2020 onwards)
QA/QC procedures to be applied	As per CDM PDD, the calibration frequency of the energy meters is once in a year. The actual calibration dates are mentioned in Appendix Also the energy meter readings crosschecked with the electricity invoices raised to DISCOM. No calibration delay in the monitoring period.
Purpose of the data	Calculation of baseline emissions
Calculation method	Every month, the energy export reading will be recorded. And the difference between the current month export and previous month export reading will provide the respective month export units. Since this monitoring period starts on 20-October-2017, the export data in the JMR for the month of October is apportioned for 12 days as below: $= (\text{Export value for the month of October} \times 12) / 31$
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	$EG_{\text{facility},y}$
Data unit	MWh
Description	Quantity of net electricity supplied to the grid in the year y
Source of data	Monthly Energy meter reading
Description of measurement methods and procedures to be applied	The power generated in three generators has been evacuated through Line 1 and Line 2 and both the Lines are having separate Main and Check meter. The electricity supplied to the grid is monitored by main and check meter in Line 1 and Line 2
Frequency of monitoring/recording	Continuous monitoring and monthly recording
Value monitored	187,240 MWh (without adjusting IREC claim) 131484 MWh (After adjusting IREC claim)

Monitoring equipment	The data is accurately measured by high quality and high accuracy meters installed. Every month these readings are recorded by plant personnel and KPTCL, which are archived for cross-checking. These meter readings in Line1 and Line 2 are used to determine the electricity supplied to the grid by the project activity and are used to raise invoice. The meters are in the custody of KPTCL. The meters are calibration at least once a year. Details of the energy meters are given below: Meter type: Trivector Make: L&T Accuracy Class: 0.2s Meter Serial No: <u>Main Meters:</u> Line1: 02048056 (Till 31/10/2019) & 18148113 (From 31/01/2019 onwards) Line 2: 03129375 (Till 06/01/2020) & 18153040 (From 06/01/2020 onwards) <u>Check Meters:</u> Line1: 03129382 (Till 31/10/2019) & 18148129 (From 31/01/2019 onwards) Line 2: 03129379 (Till 06/01/2020) & 18158317 (From 06/01/2020 onwards)
QA/QC procedures to be applied	As per CDM PDD, the calibration frequency of the energy meters is once in a year. The actual calibration dates are mentioned in Appendix Also the energy meter readings crosschecked with the electricity invoices raised to DISCOM. No calibration delay in the monitoring period.
Purpose of the data	Calculation of baseline emissions
Calculation method	Every month, the energy export reading will be recorded. And the difference between the current month export and previous month export reading will provide the respective month export units. Since this monitoring period starts on 20-October-2017, the export data in the JMR for the month of October is apportioned for 12 days as below: $= (\text{Export value for the month of October} \times 12) / 31$
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years. The project claimed 55,756 MWh under I-REC during the monitoring period the same is adjusted in the net electricity for the calculation of emission reduction,

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	Project site
Description of measurement methods and procedures to be applied	Determine the installed capacity based on recognized standards. The project capacity is fixed at the time of installation of the project and the capacity has to be checked every year to ensure that there is no change from the value as mentioned during the registration of the project
Frequency of monitoring/recording	Once at the beginning of each crediting period
Value monitored	18,000,000
Monitoring equipment	
QA/QC procedures to be applied	-
Purpose of the data	Calculation of Project emissions
Calculation method	NA
Comments	No change in the installed capacity observed.

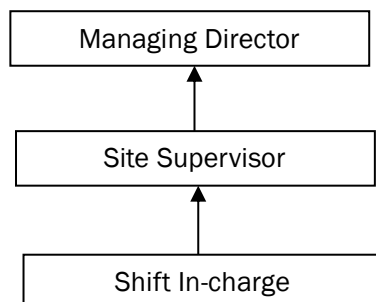
Data / Parameter	A _{PJ}
Data unit	m ²
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data	Project site
Description of measurement methods and procedures to be applied	Measured from topographical surveys, maps, satellite pictures, etc. The same has to be checked with the data available during the registration of the project.
Frequency of monitoring/recording	Once at the beginning of each crediting period
Value monitored	40,000
Monitoring equipment	
QA/QC procedures to be applied	-
Purpose of the data	Calculation of Project emissions
Calculation method	NA
Comments	As per latest satellite picture, there is no change in the reservoir capacity.

4.3 Monitoring Plan

A CDM project team is constituted with participation from relevant departments. People are trained on CDM concept and monitoring plan. This team will be responsible for data collection and archiving. This team will meet periodically to review CDM project activity check data collected, emissions reduced etc. On a weekly basis, the monitoring reports are checked and discussed by the seniors CDM team members/managers. In case of any irregularity observed by any of the CDM team member, it is informed to the concerned person for necessary actions. On monthly basis, these reports are forwarded at the management level.

Project Management Plan:

For the purpose of internal audit, PP has formulated Project Management plan. A CDM project team is constituted with participation from relevant departments. People are trained on CDM concept and monitoring plan. This team will be responsible for data collection and archiving. This team will meet periodically to review CDM project activity check data collected, emissions reduced etc. On a weekly basis, the monitoring reports are checked and discussed by the seniors CDM team members/managers. In case of any irregularity observed by any of the CDM team member, it is informed to the concerned person for necessary actions. Once in six months the report of Internal Auditor is forwarded to the management level.



Managing Director: MD has the responsibility to comply with the CDM monitoring plan. Site Supervisor: Responsibility for completeness of data, reliability of data (calibration of meters), and monthly report generation .

Shift In-charge: Responsibility of daily report generation.

Parameters requiring monitoring:

The power generated in three generators has been evacuated through Line 1 and Line 2 and both the Lines are having separate Main and Check meter. Beginning of every Month a Joint Meter Reading (JMR) of Line 1 and Line 2 (which will contain the export and import of both the main meter and check meter separately) will be jointly taken by KPTCL and Project Proponent. Based on this JMR a summation sheet will be attached along with the Invoice where in summation of Net Electricity Exported(difference of export and import as per JMR) is calculated and the value of the same is used while raising the Invoice. The parameter required for the estimation of emission reductions is the net electricity exported to the KPTCL grid, which is taken from the Invoice.

Completeness:

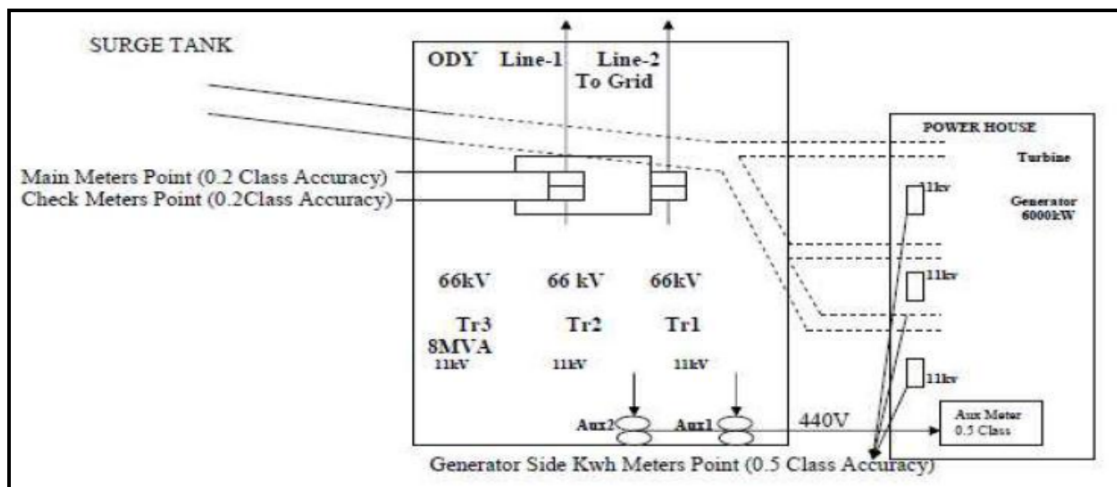
For Electricity generation data: The project activity has installed the latest state of art monitoring and control equipment that measure, record, report, monitor and control various key parameters. Real time data collection happens using these control systems. An hourly log of data is also prepared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

Reliability:

For Electricity generation data automatic control meters regarding power generation and exports are regularly maintained. The regular plant operating & maintenance procedures also include process of regular meter testing, calibration & maintenance.

A Joint Monitoring Report (JMR) is prepared on the basis of the joint meter reading taken by the plant personnel and KPTCL. Actual power generation data is also metered using power output meter maintained by KPTCL. Every year KPTCL calibrates these meters.

The receipt of sales shall be used to validate the data accuracy. Frequency- Net energy supplied is measured continuously and recorded monthly A monthly Joint Monitoring Report (JMR) is prepared. Positioning of Meters and Details of equipment to be monitored.



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

Accuracy: The meters are all tri vector L&T make. The meters have high accuracy level of 0.2%.

Calibration of meters: Calibration of main meters and check meters is done on yearly by KPTCL people.

Dealing with uncertainty: Check meters are provided in line with main meters to take care of any uncertainty related to electricity measurement.

Data storage and Archiving

All the data items monitored under the monitoring plan will be kept for 2 years after the end of crediting period or till the last issuance of CERs for this project activity whichever occurs later. The monitored data will be presented to an independent verification agency or DOE to whom verification of emission reductions will be assigned.

Training of Operators- Since there are no major changes in the production technology, no extensive initial training is required. The operator's team is trained on CDM concepts. Operators are also trained on monitoring of data and record keeping (part of usual plant performance data monitoring).

Emergency Preparedness Plan: Plant has a documented Emergency Preparedness plan. This plan covers operating procedures, Do's and Don't' during emergency.

Monitoring of sustainable development indicator: The project activity contributes to sustainable development of the region. GHG reduction, power generation and employment generation are the main benefits arising from the project implementation. GHG reduction and power generation are monitored regularly as explained in the above monitoring plan. The project activity also keeps a record of number of people employed directly in the project activity

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per section B.6.1 of CDM PDD, the baseline emission shall be estimated using the below formula:

$$BE_y = EG_{\text{facility}, y} * EF_{\text{grid}, \text{CM}, y}$$

BE_y	Baseline emissions in year y (t CO ₂ /yr)
$EG_{\text{facility}, y}$	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)
$EF_{\text{grid}, \text{CM}, y}$	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO ₂ /MWh)

$EF_{\text{grid}, \text{CM}, y}$ is fixed ex-ante (i.e, 0.8555 tCO₂/MWh).

The $EG_{\text{facility}, y}$ is monitored using energy meter. It shall also be noted that the project is also registered under I-REC mechanism and claimed RECs during the monitoring period which are excluded from the baseline emission calculation. The vintage wise calculation of baseline emission are given below:

Year	EGy	Electricity Generation claimed under I-REC	Net Electricity considered for VCU Claim	Emission Factor	BEy
	MWh	MWh	MWh	tCO2/MWh	tCO2
2017	5963	0	5963	0.8555	5101
2018	51713	0	51713	0.8555	44240
2019	46527	35006	11521	0.8555	9856
2020	47114	20750	26364	0.8555	22554
2021	35923	0	35923	0.8555	30731
Total	187240	55756	112482	0.8555	112482

5.2 Project Emissions

As per section B.6.1 of CDM PDD, If the power density (PD) of power plant is greater than 4 W/m² and less than or equal to 10 W/m²:

$$PE_y = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Where,

PE_y = Emission from reservoir expressed as tCO₂e/year

ES_{Res} = The default emission factor for emissions from reservoirs, and the default value (as per EB 23) is 90 Kg CO₂e /MWh.

TEG_y = Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh).

b) If the power density of the project is greater than 10 W/m², $PE_y = 0$.

Since the KMHS project activity is a run-of-river hydro project with power density of 450 W/m²,

(greater than the threshold value of 10 W/m² as calculated below), hence according to the chosen baseline methodology ACM0002, project emissions are nil i.e. $PE_y = 0$.

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

PD = Power density of the project activity, in W/m².

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.

For the project activity:

$$Cap_{PJ} = 18,000,000 \text{ W}$$

$$CAP_{BL} = 0$$

$$A_{PJ} = 40,000 \text{ sq m}$$

$$PD = (18,000,000 - 0) / (40,000 - 0) = 450 \text{ W}/m^2$$

So the emissions from the project are zero.

5.3 Leakage

No leakage emissions have been considered and hence the leakage emission is zero.

5.4 Net GHG Emission Reductions and Removals

As per the applied methodology, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where,

ER_y = Emission Reduction in $tCO_2e/year$

BE_y = Baseline emission in $tCO_2/year$

PE_y = Project emissions in $tCO_2e/year$

LE_y = Project Leakage emission in $tCO_2e/year$

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2017	5,101	0	0	5,101
2018	44,240	0	0	44,240
2019	9,856	0	0	9,856
2020	22,554	0	0	22,554
2021	30,731	0	0	30,731
Total	112,482	0	0	112,482

APPENDIX I: COMPARISON OF ACTUAL ER WITH ESTIMATED ER

Monitoring Period	2 nd Monitoring Period
Start Date of Monitoring Period	20/10/2017
End Date of Monitoring Period	30/00/2021
Days in this Monitoring Period	1442
Representation in Year Form	3.95
Annual Emission Reduction Estimated in the PDD (tCO2)	46,687
Estimated Emission Reductions as per PDD for the current Monitoring Period (tCO2)	184,446
Actual Emission Reduction Achieved during the Monitoring Period* (tCO2)	1,60,184
Difference %	-13.15%

*Note: Though the claimed emission reduction under VCS is only 112,482 tCO2, the actual emission reduction is considered here which is appropriate for comparison purpose

The actual emission reduction is 13.15% is less than the estimated emission reduction. Hence no justification is required.

APPENDIX II: CALIBRATION DETAILS

S.No.	Equipment type and identification	Old/New Meter Sr No	Calibration dates					
1	Line 1- Main Meter	Old Meter -Sr No: 02048056	27.06.2017	28.11.2018				
		New Meter Sr No: 18148113*			31.10.2019	25.06.2020	29.01.2021	27.07.2021
2	Line 1- Check Meter	Old Meter -Sr No: 03129382	27.06.2017	28.11.2018				
		New Meter Sr No: 18148129*			31.10.2019	25.06.2020	29.01.2021	27.07.2021
3	Line 2- Main Meter	Old Meter -Sr No: 03129375	27.06.2017	28.11.2018	31.10.2019			
		New Meter Sr No: 18153040**				06.01.2020	29.01.2021	27.07.2021
4	Line 2- Check Meter	Old Meter -Sr No: 03129379	27.06.2017	28.11.2018	31.10.2019			
		New Meter Sr No: 18158317**				06.01.2020	29.01.2021	27.07.2021

* Old meter is removed and replaced with new meter on 31st October 2019

** Old meter is removed and replaced with new meter on 06th January 2020

APPENDIX III: PLANT OUTAGE DETAILS

Month	Unit # 1						
	Running Hrs	Stoppage Hrs	Planned Outage Hrs	Un Planned Outage Hrs	Less Discharge	Trash cleaning Hrs	KPTCL
Oct'17	467:50:00	276:10:00	0:00:00	0:00:00	272:15:00	0:00:00	3:55:00
Nov'17	0:15:00	719:45:00	0:00:00	0:00:00	719:45:00	0:00:00	0:00:00
Dec'17	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Jan'18	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Feb'18	0:20:00	671:40:00	0:00:00	0:00:00	671:40:00	0:00:00	0:00:00
March'18	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'18	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'18	42:15:00	701:45:00	0:00:00	0:00:00	701:45:00	0:00:00	0:00:00
June'18	483:15:00	236:45:00	0:00:00	0:00:00	226:40:00	4:40:00	5:25:00
July'18	726:20:00	17:40:00	0:00:00	1:50:00	10:25:00	2:30:00	2:55:00
August'18	721:55:00	22:05:00	0:00:00	8:55:00	0:00:00	12:20:00	0:50:00
Sept'18	659:40:00	60:20:00	0:00:00	0:00:00	56:55:00	1:05:00	2:20:00
Oct'18	580:55:00	163:05:00	0:00:00	5:15:00	144:35:00	0:00:00	13:15:00
Nov'18	277:50:00	442:10:00	0:00:00	0:00:00	442:10:00	0:00:00	0:00:00
Dec'18	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Jan'19	8:40:00	735:20:00	0:00:00	0:00:00	735:20:00	0:00:00	0:00:00
Feb'19	0:00:00	672:00:00	0:00:00	0:00:00	672:00:00	0:00:00	0:00:00
March'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'19	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
June'19	22:20:00	697:40:00	0:00:00	0:00:00	697:40:00	0:00:00	0:00:00
July'19	605:45:00	138:15:00	0:00:00	0:10:00	115:55:00	12:40:00	9:30:00
August'19	641:00:00	103:00:00	0:00:00	15:45:00	0:00:00	6:40:00	80:35:00
Sept'19	697:40:00	22:20:00	0:00:00	0:00:00	0:00:00	2:35:00	19:45:00
Oct'19	593:50:00	150:10:00	2:25:00	1:15:00	144:15:00	0:00:00	2:15:00
Nov'19	160:05:00	559:55:00	0:00:00	0:00:00	559:55:00	0:00:00	0:00:00
Dec'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Jan'20	88:05:00	655:55:00	0:00:00	0:00:00	655:55:00	0:00:00	0:00:00
Feb'20	0:00:00	696:00:00	0:00:00	0:00:00	696:00:00	0:00:00	0:00:00
March'20	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'20	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'20	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
June'20	21:30:00	698:30:00	0:00:00	0:00:00	698:30:00	0:00:00	0:00:00
July'20	294:05:00	449:55:00	0:00:00	0:00:00	440:30:00	3:10:00	6:15:00

August'20	645:55:00	98:05:00	0:00:00	0:00:00	41:30:00	7:45:00	48:50:00
Sept'20	683:25:00	36:35:00	0:00:00	0:25:00	24:45:00	1:50:00	9:35:00
Oct'20	602:55:00	141:05:00	0:00:00	62:20:00	78:45:00	0:00:00	0:00:00
Nov'20	53:20:00	666:40:00	0:00:00	0:00:00	665:45:00	0:00:00	0:55:00
Dec'20	49:35:00	694:25:00	0:00:00	0:00:00	694:25:00	0:00:00	0:00:00
Jan'21	171:35:00	572:25:00	0:00:00	0:00:00	572:25:00	0:00:00	0:00:00
Feb'21	0:00:00	672:00:00	0:00:00	0:00:00	672:00:00	0:00:00	0:00:00
March'21	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'21	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'21	78:30:00	665:30:00	0:00:00	0:00:00	665:30:00	0:00:00	0:00:00
June'21	265:30:00	454:30:00	0:00:00	0:00:00	438:10:00	7:50:00	8:30:00
July'21	383:35:00	360:25:00	0:00:00	194:30:00	155:45:00	7:40:00	2:30:00
August'21	551:15:00	192:45:00	9:15:00	175:05:00	0:00:00	1:10:00	7:15:00

Month	Unit # 2						
	Running Hrs	Stoppage Hrs	Planned Outage Hrs	Un-Planned Outage Hrs	Less Discharge	Trash cleaning Hrs	KPTCL
Oct'17	298:15:00	445:45:00	0:00:00	0:00:00	441:50:00	0:00:00	3:55:00
Nov'17	421:35:00	298:25:00	0:00:00	0:00:00	298:25:00	0:00:00	0:00:00
Dec'17	23:55:00	720:05:00	0:00:00	0:00:00	720:05:00	0:00:00	0:00:00
Jan'18	49:00:00	695:00:00	0:00:00	0:00:00	695:00:00	0:00:00	0:00:00
Feb'18	84:50:00	587:10:00	0:00:00	0:00:00	587:10:00	0:00:00	0:00:00
March'18	5:40:00	738:20:00	0:00:00	0:00:00	738:20:00	0:00:00	0:00:00
April'18	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'18	90:45:00	653:15:00	0:00:00	0:00:00	653:15:00	0:00:00	0:00:00
June'18	555:25:00	164:35:00	0:00:00	0:00:00	154:50:00	4:30:00	5:15:00
July'18	728:40:00	15:20:00	2:00:00	8:25:00	0:00:00	2:15:00	2:40:00
August'18	719:30:00	24:30:00	0:00:00	11:30:00	0:00:00	12:00:00	1:00:00
Sept'18	715:25:00	4:35:00	0:00:00	0:00:00	1:00:00	0:55:00	2:40:00
Oct'18	254:35:00	489:25:00	0:00:00	0:00:00	480:50:00	0:00:00	8:35:00
Nov'18	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
Dec'18	145:45:00	598:15:00	0:00:00	0:00:00	598:15:00	0:00:00	0:00:00
Jan'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Feb'19	40:00:00	632:00:00	0:00:00	0:00:00	632:00:00	0:00:00	0:00:00
March'19	19:25:00	724:35:00	0:00:00	0:00:00	724:35:00	0:00:00	0:00:00
April'19	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
June'19	106:40:00	613:20:00	0:00:00	0:00:00	612:40:00	0:00:00	0:40:00
July'19	646:00:00	98:00:00	0:00:00	0:00:00	73:35:00	12:30:00	11:55:00

August'19	646:20:00	97:40:00	0:00:00	7:50:00	0:00:00	6:20:00	83:30:00
Sept'19	703:05:00	16:55:00	0:00:00	0:00:00	0:00:00	2:30:00	14:25:00
Oct'19	190:15:00	553:45:00	0:00:00	32:45:00	521:00:00	0:00:00	0:00:00
Nov'19	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
Dec'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Jan'20	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Feb'20	35:55:00	660:05:00	0:00:00	0:00:00	660:05:00	0:00:00	0:00:00
March'20	23:35:00	720:25:00	0:00:00	0:00:00	720:25:00	0:00:00	0:00:00
April'20	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'20	35:00:00	709:00:00	0:00:00	0:00:00	709:00:00	0:00:00	0:00:00
June'20	247:55:00	472:05:00	0:00:00	19:45:00	452:20:00	0:00:00	0:00:00
July'20	455:25:00	288:35:00	2:55:00	0:00:00	276:35:00	2:55:00	6:10:00
August'20	703:40:00	40:20:00	0:00:00	0:00:00	0:00:00	7:35:00	32:45:00
Sept'20	708:25:00	11:35:00	0:00:00	0:00:00	0:00:00	1:55:00	9:40:00
Oct'20	687:10:00	56:50:00	18:05:00	0:00:00	38:45:00	0:00:00	0:00:00
Nov'20	664:10:00	55:50:00	0:00:00	0:00:00	54:00:00	0:00:00	1:50:00
Dec'20	138:15:00	605:45:00	0:00:00	0:00:00	605:45:00	0:00:00	0:00:00
Jan'21	230:05:00	513:55:00	0:00:00	0:00:00	513:55:00	0:00:00	0:00:00
Feb'21	203:45:00	468:15:00	0:00:00	0:00:00	468:15:00	0:00:00	0:00:00
March'21	31:55:00	712:05:00	0:00:00	0:00:00	712:05:00	0:00:00	0:00:00
April'21	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'21	44:00:00	700:00:00	0:00:00	0:00:00	700:00:00	0:00:00	0:00:00
June'21	374:30:00	345:30:00	0:00:00	0:00:00	333:10:00	7:45:00	4:35:00
July'21	521:30:00	222:30:00	5:40:00	0:00:00	206:00:00	7:50:00	3:00:00
August'21	723:10:00	20:50:00	9:05:00	0:00:00	0:00:00	1:05:00	10:40:00

Month	Unit # 3						
	Running Hrs	Stoppage Hrs	Planned Outage Hrs	Un Planned Outage Hrs	Less Discharge	Trash cleaning Hrs	KPTCL
Oct'17	517:45:00	226:15:00	0:00:00	0:00:00	222:05:00	0:00:00	4:10:00
Nov'17	268:45:00	451:15:00	0:00:00	0:00:00	437:25:00	0:00:00	13:50:00
Dec'17	447:25:00	296:35:00	0:00:00	0:00:00	296:35:00	0:00:00	0:00:00
Jan'18	228:05:00	515:55:00	0:00:00	0:00:00	515:55:00	0:00:00	0:00:00
Feb'18	16:30:00	655:30:00	0:00:00	0:00:00	655:30:00	0:00:00	0:00:00
March'18	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'18	40:05:00	679:55:00	0:00:00	0:00:00	679:55:00	0:00:00	0:00:00
May'18	70:10:00	673:50:00	0:00:00	0:00:00	673:50:00	0:00:00	0:00:00
June'18	552:30:00	167:30:00	0:00:00	0:00:00	157:30:00	4:40:00	5:20:00
July'18	729:10:00	14:50:00	0:00:00	2:15:00	7:15:00	2:25:00	2:55:00

August'18	714:35:00	29:25:00	8:50:00	7:25:00	0:00:00	12:15:00	0:55:00
Sept'18	544:40:00	175:20:00	0:00:00	0:00:00	173:55:00	1:00:00	0:25:00
Oct'18	183:05:00	560:55:00	0:00:00	6:00:00	549:35:00	0:00:00	5:20:00
Nov'18	368:55:00	351:05:00	0:00:00	0:00:00	351:05:00	0:00:00	0:00:00
Dec'18	292:15:00	451:45:00	0:00:00	0:00:00	451:45:00	0:00:00	0:00:00
Jan'19	240:20:00	503:40:00	8:00:00	0:00:00	495:40:00	0:00:00	0:00:00
Feb'19	83:30:00	588:30:00	0:00:00	0:00:00	588:30:00	0:00:00	0:00:00
March'19	1:20:00	742:40:00	0:00:00	0:00:00	742:40:00	0:00:00	0:00:00
April'19	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'19	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
June'19	137:15:00	582:45:00	0:00:00	0:00:00	582:10:00	0:00:00	0:35:00
July'19	465:00:00	279:00:00	0:00:00	0:00:00	254:55:00	12:35:00	11:30:00
August'19	653:10:00	90:50:00	0:40:00	0:00:00	0:00:00	6:20:00	83:50:00
Sept'19	690:45:00	29:15:00	0:00:00	0:05:00	0:00:00	2:35:00	26:35:00
Oct'19	739:20:00	4:40:00	2:10:00	0:00:00	0:00:00	0:00:00	2:30:00
Nov'19	714:40:00	5:20:00	0:00:00	0:00:00	0:00:00	0:00:00	5:20:00
Dec'19	659:00:00	85:00:00	0:00:00	0:00:00	84:05:00	0:00:00	0:55:00
Jan'20	267:50:00	476:10:00	0:00:00	0:00:00	476:10:00	0:00:00	0:00:00
Feb'20	122:25:00	573:35:00	0:00:00	0:00:00	573:35:00	0:00:00	0:00:00
March'20	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'20	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'20	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
June'20	200:50:00	519:10:00	0:00:00	0:00:00	519:10:00	0:00:00	0:00:00
July'20	497:40:00	246:20:00	3:00:00	0:00:00	231:30:00	3:10:00	8:40:00
August'20	664:50:00	79:10:00	0:00:00	13:55:00	24:00:00	8:10:00	33:05:00
Sept'20	679:05:00	40:55:00	0:00:00	0:00:00	29:05:00	2:00:00	9:50:00
Oct'20	715:35:00	28:25:00	1:25:00	0:00:00	27:00:00	0:00:00	0:00:00
Nov'20	330:15:00	389:45:00	0:00:00	0:00:00	388:50:00	0:00:00	0:55:00
Dec'20	465:55:00	278:05:00	0:00:00	0:00:00	277:20:00	0:00:00	0:45:00
Jan'21	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
Feb'21	0:00:00	672:00:00	0:00:00	0:00:00	672:00:00	0:00:00	0:00:00
March'21	0:00:00	744:00:00	0:00:00	0:00:00	744:00:00	0:00:00	0:00:00
April'21	0:00:00	720:00:00	0:00:00	0:00:00	720:00:00	0:00:00	0:00:00
May'21	64:55:00	679:05:00	0:00:00	0:00:00	679:05:00	0:00:00	0:00:00
June'21	302:00:00	418:00:00	0:00:00	0:00:00	404:55:00	8:15:00	4:50:00
July'21	578:40:00	165:20:00	6:00:00	2:10:00	146:05:00	8:25:00	2:40:00
August'21	718:50:00	25:10:00	9:10:00	0:00:00	0:00:00	1:15:00	14:45:00

APPENDIX IV: DETAILS OF I-REC CLAIMED

Period -Vintage 2019	I-REC Claimed (kWh)
01/01/2019 to 31/01/2019	763200
01/02/2019 to 28/02/2019	358200
01/03/2019 to 31/03/2019	43200
01/06/2019 to 30/06/2019	979200
01/07/2019 to 31/07/2019	8350200
01/09/2019 to 30/09/2019	11536200
01/10/2019 to 31/10/2019	7101900
01/11/2019 to 30/11/2019	3732300
01/12/2019 to 31/12/2019	2142000
Total (kWh)	35006400
Total (MWh)	35006
Period -Vintage 2019	I-REC Claimed (kWh)
01/01/2020 to 31/01/2020	1117800
01/02/2020 to 29/02/2020	477000
01/03/2020 to 31/03/2020	62100
01/05/2020 to 31/05/2020	99000
01/06/2020 to 30/06/2020	1781100
01/07/2020 to 31/07/2020	6022800
01/08/2020 to 31/08/2020	11190600
Total (kWh)	20750400
Total (MWh)	20750