Mukkudam Electroenergy Pvt. Ltd.
11/569, Muringothil,
Kambilikandam, Parathodu-Idukki Post,
Idukki District, Kerala – 685 571
Tel: 04868 – 261 090 | Mob: +91-97412 99011
Website: https://www.meplpower.com/

MEPL/MSHEP/2023-158 **14.11.2023**

Kind Attn: The Secretary,
Kerala State Electricity Regulatory Commission,
Thiruvananthapuram.

Sir,

Sub: Mukkudam Small Hydroelectric Project – Tariff Petition for Determining Project Specific Tariff, Allowing Interim Tariff and Approving the initialled PPA with KSEB Ltd - Reg: -

Ref:

1. IDBI Bank Ltd Cheque number: 063344 for INR 1,00,000.00, dated: 14.11.2023
2. Tariff Petition, dated: 14.11.2023
3. Form-1 & Form-2, dated: 14.11.2023

Kindly see the above references.

We have completed the construction of our project Mukkudam SHP and successfully synchronized both the generating units with the grid on 21.10.2023 and has been injecting power since then.

We are hereby submitting you the tariff petition for Determining Project Specific Tariff for this project, Allowing Interim Tariff till the project specific tariff is determined and approving the initialled PPA with KSEB Ltd.

We request you to kindly do the further needful in this regard.

MUKKUDAM ELECTROENERGY PVT LTD * KERALA * KAMBILIKANDAM

Yours Sincerely,
For Mukkudam Electroenergy Pvt. Ltd.,

Rakesh Roy
Managing Director

FORM1
[See Regulation 24(3)]

General Heading for petitions

BEFORE THE KERALA STATE ELECTRICITY REGULATORY COMMISSION

PETITIONNO:

(TobefilledbytheOffice,ifnumberhasnotearlierbeenassigned)

IN THE MATTEROF: DETERMINIATION OF PROJECT SPECIFIC TARIFF, ALLOWING INTERIM TARIFF AND APPROVING THE INITIALED PPA FOR MUKKUDAM SHP (4 MW)

(Gist of the purpose of the petition or application)

NAME(S)ANDFULLADDRESS(ES)OF
PETITIONER(S)/APPLICANT(S)

M/S MUKKUDAM ELECTROENERGY PRIVATE LIMITED,
11/569, MURINGOTHIL, KAMBILIKANDAM,
PARATHODU-IDUKKI P.O., IDUKKI DISTRICT,
KERALA – 685 571

NAME(S) AND FULL ADDRESS(ES) OF RESPONDENT(S)

KERALA STATE ELECTRICITY BOARD LIMITED,
VYDYUTHI BHAVANAM, PATTOM,
THIRUVANANTHAPURAM – 695004

MUKKUDAM ELECTROENERGY PVT. LTD. KERALA KAMBILIKANDAM

For MUKKUDAM ELECTROENERGY PVT.LTD.

Managing Director

FORM 2
[See Regulation 24(5)]

BEFORE THE KERALA STATE ELECTRICITY REGULATORY COMMISSION

PETITION NO:
(TobefilledbytheOfficeifnumberhasnotearlierbeenassigned

INTHE MATTEROF: DETERMINIATION OF PROJECT SPECIFIC TARIFF, ALLOWING INTERIM TARIFF AND APPROVING THE INITIALED PPA FOR MUKKUDAM SHP (4 MW)

(Gist of the purpose of the petition or application)

Name(s) and Full address(es) of the Petitioner(s) / name(s) and full address(es) of the respondent(s)

M/S MUKKUDAM ELECTROENERGY PRIVATE LIMITED,
11/569, MURINGOTHIL, KAMBILIKANDAM,
PARATHODU-IDUKKI P.O., IDUKKI DISTRICT,
KERALA – 685 571

KERALA STATE ELECTRICITY BOARD LIMITED,
VYDYUTHI BHAVANAM, PATTOM,
THIRUVANANTHAPURAM – 695004

AFFIDAVIT VERIFYING THE TARIFF PETITION

I, Rakesh Roy, son of M V Roy, aged 39 years, residing at 11/569, Muringothil, Kambilikandam, Parathodu-Idukki P.O., Iduki District, Kerala – 685571, do solemnly affirm and state as follows:

1. I am an authorized representative of the petitioner in the above matter and I am a directorof the petitioner in the above matter and am duly authorized by the said petitioner to make this affidavit on its behalf.

NOTARY
RADHAKRISHNAN P
Thiruvananthapuram
District
REG. No. 7062
Expiry Date 02.11.2028
GOVT. OF INDIA

14/11/2023

RADHAKRISHNAN. P.
ADVOCATE & NOTARY
THIVANDRUM DISTRICT
KERALA STATE, INDIA

2. The statements made in paragraphs**1 to 16** of the petition application herein now shown to me and marked with the letter "A" are true to my knowledge and the statements made in paragraphs **1 to 16**are based on information received and I believe them to be true.

3. Solemnly affirmed at .....Nemchingam.....on this day of ...14th Nov: 2023 that the contents of the above affidavit are true to my knowledge, no part of it is false and nothing material has been concealed therefrom.

Petitioner / Deponent

14/11/2023
RADHAKRISHNAN. P.
ADVOCATE & NOTARY
TRIVANDRUM DISTRICT
KERALA STATE, INDIA.

Notarial Register Particulars
Sl. No. 1 Vol. XI Page No. 1
Date 14/11/2023
My Commission Expires on 02 - 11- 2028

KERALA STATE ELECTRICITY REGULATORY COMMISSION

PETITION NO. OF 2023

IN THE MATTER OF:

PETITION UNDER SECTION 86 OF THE ELECTRICITY ACT, 2003 READ WITH THE PROVISIONS OF THE KERALA STATE ELECTRICITY REGULATORY COMMISSION (RENEWABLE ENERGY AND NET METERING) REGULATIONS, 2020 FOR DETERMINING THE PROJECT SPECIFIC TARIFF AND APPROVAL OF THE POWER PURCHASE AGREEMENT WITH KSEB LTD. FOR THE 4 MW MUKKUDAM SMALL HYDROELECTRIC PROJECT DEVELOPED BY M/S MUKKUDAM ELECTROENERGY PRIVATE LIMITED ATPANAMKUTTY IN PERIYAR BASIN IN IDUKKI DISTRICT OF KERALA STATE

AND IN THE MATTER OF:

M/s Mukkudam Electroenergy Private Limited,
11/569, Muringothil, Kambilikandam,
Parathodu-Idukki P.O., Idukki District,
Kerala – 685 571 **.....PETITIONER**

VERSUS

Kerala State Electricity Board Limited,
Vydyuthi Bhavanam, Pattom,
Thiruvananthapuram, Kerala – 695004 **.....RESPONDENT**

PETITION FOR DETERMINING THE PROJECT SPECIFIC TARIFF AND APPROVAL OF POWER PURCHASE AGREEMENT UNDER SECTION 86 OF THE ELECTRICITY ACT, 2003 READ WITH THE PROVISIONS OF THE KERALA STATE ELECTRICITY REGULATORY COMMISSION (RENEWABLE ENERGY AND NET METERING) REGULATIONS, 2020.

MOST RESPECTFULLY SHOWETH:

1. The Petitioner i.e., M/s Mukkudam Electroenergy Private Limited is a company registered under the Companies Act, 2013 and having its registered office at 11/569, Muringothil, Kambilikandam, Parathodu-Idukki P.O., Idukki District, Kerala – 685 571. The Petitioner is a power generating company under the Section 2(28) of the Electricity Act, 2003 (hereinafter referred to as the 'Act'.). The petitioner has developed a Small Hydroelectric Project with installed capacity 4 MW at Panamkutty, in Periyar River basin in Idukki district and started injecting power to KSEBL grid from 21.10.2023.

2. The Respondent, the Kerala State Electricity Board Limited (hereinafter referred to as the 'Respondent/KSEBL'), is the successor entity of Kerala State Electricity Board (KSEB), which was constituted by the Government of Kerala, as per order no. EL1-6475/56/PW, dated: 07-03-1957 of the Kerala State Government, under the Electricity (Supply) Act, 1948 for carrying out the business of Generation, Transmission and Distribution of electricity in the state of Kerala.

3. The Petitioner had identified this project site of Mukkudam SHP in 2014 and approached the Secretary, Department of Power, Government of Kerala and the Director, Small Hydro Cell of Energy Management Centre under the Power Department, Government of Kerala with a proposal for implementing a Small Hydroelectric Project. The Director, Energy Management Centre had issued the Petitioner a consent letter on 20.11.2014 to conduct a Detailed Engineering Study and prepare the Detailed Project Report for the consideration of the Technical Committee, constituted by the Government. A copy of this letter is annexed herewith and marked as **ANNEXURE-1**

4. The Petitioner submitted a Detailed Project Report with installed capacity as 1 MW to the Government on 19.12.2015. It was mentioned in the Original DPR that there is scope for capacity enhancement as it is a high-head project and that may be decided after gauging the stream for some 3 years as none of the Government Departments had done any hydrology study of this hill stream.

5. The Government of Kerala accorded Administrative Sanction for Mukkudam SHP with installed capacity of 1 MW on 09.03.2018. A copy of this order is annexed herewith and marked as **ANNEXURE-2**

6. The Petitioner had made a payment of INR 15.00 Lakhs to Energy Management Centre as the Project Premium to the Government and subsequently the petitioner had been issued the Letter of Allotment, dated: 21.03.2018. A copy of this Letter of Allotment is annexed herewith and marked as **ANNEXURE-3**

7. As the daily stream gauge data collected from the project site suggested for a higher installed capacity, the petitioner informed this matter to the Government in February 2019 and expressed their willingness to conduct a revised detailed engineering study and also to prepare a Revised Detailed Project Report. Further to this, the Government accorded the petitioner the sanction to prepare a Revised Detailed Project Report on 15.02.2020. A copy of this letter is annexed herewith and marked as **ANNEXURE-4**

8. The Petitioner submitted the Revised Detailed Project Report with installed capacity 4 MW in October 2020 to the Government of Kerala. A copy of this revised DPR is annexed herewith and marked as **ANNEXURE-5**

9. The Government of Kerala Accorded Administrative Sanction for the capacity enhancement of Mukkudam SHP to 4 MW on 23.02.2021. A copy of this order is annexed herewith and marked as **ANNEXURE-6**

10. The Petitioner achieved financial closure with Indian Renewable Energy Development Agency (IREDA) Ltd., New Delhi on 03.09.2021 and with IFCI Venture Capital Funds Ltd, New Delhi on 26.11.2021. The loan sanction letters are annexed herewith as **ANNEXURE-7& ANNEXURE-8**

11. The KSEB Ltd issued the Petitioner a Provisional Letter of Comfort regarding power procurement from Mukkudam SHP, dated: 01.01.2022. A copy of this letter is annexed herewith and marked as **ANNEXURE-9**

12. The Petitioner remitted the additional project premium of INR 45 Lakhs to EMC and EMC issued the Letter of Allotment for the enhanced capacity of 4 MW on 08.04.2022. A copy of this letter is annexed herewith and marked as **ANNEXURE-10**

13. The Petitioner requested KSEB Ltd to initial the Draft Power Purchase Agreement on 17.05.2022. A copy of this letter is annexed herewith and marked as **ANNEXURE-11**

14. A Draft Power Purchase Agreement has been initialled between the Petitioner and the Respondent on 24.03.2023. The clause 5.4 of this agreement states that *"....Tariff for Power Generated from the project shall be lower of Project Specific Tariff or the tariff of any SHP commissioned in Kerala during 2021-22 or Mutually Agreed tariff."* A copy of this agreement is annexed herewith and marked as **ANNEXURE-12**

15. For arriving a Mutually Agreed Tariff, the Petitioner and the Respondent held three meeting on 24.04.2023, 26.09.2023 and 13.11.2023. Unfortunately, both the parties could not arrive on a Mutually Agreed Tariff.

16. The Petitioner signed connectivity agreement with the Respondent on 21.10.2023 and synchronized both the generating units (of 2 MW each) to the grid on the same day and has been injecting power since then.

PRAYER

In light of the above-mentioned facts and circumstances, this Hon'ble Commission may most graciously be pleased to:

1) *Admit this present Petition*
2) *Approve the Draft Power Purchase Agreement, with necessary modifications of clauses 5.4, 6.4 & 6.5, initialled between the Petitioner and the Respondent for purchasing the entire energy generated from the project.*
3) *Determine the project specific tariff for this project as per the prevailing norms of the commission*
4) *Allow an interim tariff till the project specific tariff is determined and pass an order to the Respondent to make us payments on a monthly basis for the entire energy injected into the grid so as to enable the Petitioner to serve the interest to their lenders and also to meet the O&M expenses of the Power Plant.*
5) *Pass any such further order or orders as this Hon'ble Commission may deem just and proper in the facts and circumstances of the case.*

AND FOR THIS ACT OF KINDEDNESS, YOUR HUMBLE PETITIONER AS IN DUTY BOUND SHALL EVER PRAY.

PETITIONER

PLACE: THIRUVANANTHAPURAM

DATE: 14/11/2023

MUKKUDAM ELECTROENERGY PVT. LTD. KERALA KAMBILIKANDAM

For MUKKUDAM ELECTROENERGY PVT.LTD.

Managing Director

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4	Sanction from Govt. Of Kerala for preparing Revised Detailed Project Report for Mukkudam SHP, 15.02.2020	11 to 12
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10	Revised Letter of Allotment from EMC, dated: 08.04.2022	160 to 161
11	Petitioner's Request for initialling Draft PPA with KSEB Ltd, dated 17.05.2022	162 to 162
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Energy Management Centre
(State Designated Agency to enforce Energy Conservation Act 2001)
Department of Power, Government of Kerala
Sreekrishna Nagar, Sreekariyam. P.O
Thiruvananthapuram 695 017
Tel: 0471-2594922, 2594924 Fax: 0471-2594923
E-mail : emck@keralaenergy.gov.in
Website: www.keralaenergy.gov.in

EMC/SHP/Panamkutty/DPR/2/14 20.11.2014

Mr. Rakesh Roy
Muringothil
Kambilikandam
Parathodu-Idukki Post
Idukki District – 685571.

To whomsoever it may concerned

Sir,

Sub: Proposal to generate hydroelectric power at Panamkutty, Idukki District.
Ref: NOC from Konnathady Grama Panchayath –A5-3394/14 dated 15.11.14 and your request dated 8.10.2014 to Power Department with a copy to this office and your request for NOC to Konnathady Grama Panchayath on 5.8.2014

This is with reference to your letter to the Government for exploring the possibility of preparing a project report of a small hydro power generation scheme at Panamkutty, Konnathady Grama Panchayath in Idukki District.

The Government policy for Small Hydro Power - 2012, clause 7.3 states – "" Small hydro Power projects identified by private persons on their own land will be assigned to the owner of the land subject to payment of the upfront premium specified …"". The current upfront premium per MW is Rs.15 lakhs. The promoter will have to take NOC from the Local Body first and for implementation of the project, the proponent will have to take approvals from Power, Irrigation, forest, etc. as the case may be.

This is to inform that you may proceed with the preparation of Project Report of the small hydroelectric scheme at Panamkutty, Konnathady Grama Panchayath in Idukki District at your risk and cost. After the submission of the project report to the Government and based on the recommendations of the Technical Committee, Government may take suitable decision as per prevailing norms.

Thanking you,

Yours faithfully,

Director

5420
15/3/18

GOVERNMENT OF KERALA

Abstract

Power Department – Allottment of Mukkudam Mini Hydro Electric Projects (1MW) identified at Mukkudam in Konnathady Panchayath, Devikulam, Idukki District to M/s Mukkudam Electro Energy Pvt. Ltd. Idukki - Sanction Accorded- Orders issued.

POWER (B) DEPARTMENT

G.O.(Ms)No.05/2018/PD Dated, Thiruvananthapuram, 09/03/2018.

Read:- 1. G.O.(P)No.25/2012/PD dated 03/10/2012.
2. Letter No. MEPL/MMHP:03-12/2015 dated 18.12.2015 from the Managing Director, Mukkudam Electro Energy Pvt.Ltd, Kambilikandam, Idukki.
3. Letter No.EMC/SHPC/Panamkutty/DPR/3/14 dated 18.06.2016 from the Director, Energy Management Centre, Thiruvananthapuram.

ORDER

The Managing Director, Mukkudam Electro Energy Pvt.Ltd as per letter read as 2nd paper above has requested for allotment of Mukkudam Mini Hydro Electric Project (1MW) identified at Mukkudam in Konnathady Gramapanchayath, Devikulam, Idukki District.The Director, Energy Management Centre vide letter read as 3rd paper above has recommended for the allotment of Mukkudam Mini Hydro Electric Project (IMW) at Mukkudam to Mukkudam Electro Energy Pvt.Ltd subject to the payment of minimum premium of Rs.15 lakhs as per the Small Hydro Power Policy, 2012 issued vide G.O read as 1st paper above.

Government have examined the matter in detail and are pleased to accord sanction for the allotment of Mukkudam Mini Hydro Electric Projects (1MW) identified at Mukkudam in Konnathady Panchayath, Devikulam, Idukki District to M/s Mukkudam Electro Energy Pvt.Ltd. Idukki as per clause 8.3 of the Small Hydro Power Policy, 2012 issued vide G.O read as 1st paper above subject to the payment of minimum premium of Rs.15 lakhs

and subject to the conditions that the necessary clearances / permissions/NOC are to be obtained by the allottee Company from the concerned Government Departments like Irrigation, Forest etc as the case may be as per the Small Hydro Power Policy, 2012 .

(By Order of the Governor)
BISHWANATH SINHA IAS
PRINCIPAL SECRETARY

To

The Managing Director, M/s Mukkudam Electro Energy Pvt.Ltd. Idukki.
The Chairman & Managing Director, Kerala State Electricity Board Limited.
The Director, Energy Management Centre.
The Accountant General (A&E), Thiruvananthapuram.
The Principal Accountant General (Audit), Thiruvananthapuram.
The Law Department (vide U.O (25142/ F2/2017/Law dated 30-08-17).
The GA (SC) Department (vide item No.1968 dated 07.03.2018) .
The Information and Public Relations Department (Web and new media division).
Stock File/Office Copy.

Forwarded/By Order

Section Officer

Energy Management Centre
(State Designated Agency to enforce Energy Conservation Act 2001)
Department of Power, Government of Kerala
Sreekrishna Nagar, Sreekariyam P.O.
Thiruvananthapuram 695 017
Tel: 0471-2594922, 2594924 Fax: 0471-2594923
E-mail: emck@keralaenergy.gov.in
Website: www.keralaenergy.gov.in

EMC/SHPC/Mukkudam/1/18 21-03-2018

The Managing Director
Mukkudam Electro Energy P Ltd
11/569, Muringothil
Kambilikandam, Parathodu - 685571
Idukki District
(04868 261090/ 9741299011)

Sir,

Sub: Letter of Allotment [LOA] of 1 MW Mukkudam SHP Projects in Kerala
Ref: 1. Allotment of 1MW Mukkudam SHP to Mukkudam Electro Energy Private Ltd vide G.O.(MS)No.05/2018/PD dated 09.03.2018.
2. Your letter No. MEPL/MMHP/2018-18 dated 15.03.2018.

Letter of Allotment (LOA)

We are very glad to convey that the Government have allotted 1 MW Mukkudam Small Hydro Power Scheme to M/s Mukkudam Electro Energy Private Ltd vide G.O.(MS)No.05/2018/PD dated 09.03.2018 under the own land category as per the SHP Policy 2012 of the Government.. The allotted project is as detailed.

Sl. No.	Project Name	Capacity (MW)	District
1	Mukkudam SHP	1 MW	Idduki

The allotment of the project is subjected to the remittance of minimum premium of Rs. 15 lakhs/MW. M/s Mukkudam Electro Energy Private Ltd had remitted the total premium i.e., Rs. 15 lakhs through RTGS on 17.03.2018. On getting approval of the concerned Departments, you may enter into an Implementation Agreement with the Government before starting the work.

The developer shall submit TEFR/DPR for the above allotted project within 18 months incorporating all the salient levels, layouts, location and installed capacity.

Kindly acknowledge the receipt of LoA and forward the acceptance of the same. We wish you all the best in this endeavor.

Thanking you,

ENERGY MANAGEMENT CENTRE, KERALA
EMC
(Under the Dept. of Power)
Govt. of Kerala
THIRUVANANTHAPURAM

Yours faithfully,

Director & Head SHP Cell

GOVERNMENT OF KERALA

No.16/B1/2019/PD.

Power (B) Department,
Thiruvananthapuram,
Dated: 15.02.2020.

From

Secretary to Government.

To,

Sri. Rakesh Roy,
Managing Director
Mukkudam Electroenergy Pvt. Ltd.,
11/569, Muringothil,
Kambilikandam, Parathodu-Idukki Post
Idukki District, Kerala - 685 571.

Sir,

Sub:- Power Department –Application for preparing a revised Detailed Project Report for Mukkudam Small Hydroelectric Project - reg.

Ref:- Your Letter No.MEPL/SHEP/2019-08 dated 06.02.2019.

I am to invite your attention to the reference cited and to inform you that you are allowed to prepare revised Detailed Project Report for Mukkudam Small Hydroelectric Project at your own risk and cost subject to the following conditions.

1. Project may be considered for capacity enhancement only after the TEFR is submitted by the investor at his own risk and cost and hereafter approved by the Technical Clearance Committee.
2. Once the revised PFR/DPR is prepared, the same may be made available to KSEB Ltd to undertake a detailed analysis whether the proposal would have any impact on upstream/downstream riparian rights.
3. While preparing revised DPR, comply with the relevant directions of National Green Tribunal with respect to maintaining the minimum ecological flow in the water course and it should be ensured that revised DPR is prepared only for Power Generation & be followed in to and there shall be no change in usage pattern.

4. Sanction for preparation of the revised DPR would not confer any right on the firm to proceed with the project or hold KSEB Ltd. or Government liable for any financial loss sustained in this regard.

Yours faithfully,
SREEJA.V
JOINT SECRETARY
for Secretary to Government.

Approved for issue,

Section Officer.

Mukkudam Electroenergy Pvt. Ltd.

11/569, Muringothil, Kambilikandam, Parathodu - Idukki P.O., Idukki Dist. Kerala 685 571
Tel: 04868 – 261090, Cell: +91-97412 99011
Website: https://www.meplpower.com/

MUKKUDAM SHP (4.0 MW)

DETAILED PROJECT REPORT

(REVISED)

August, 2020

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3.	Vetting of Hydrology data derived from the gauging weir – Report by EMC
4.	Minutes of Meeting of the technical committee (Small Hydro Power – SHP) convened on 07.06.2018
5.	Letter of Concurrence from Kerala Dam Safety Authority, dated: 13.09.2018
6.	Affidavit furnished before the Asst. Executive Engineer, Minor Irrigation, Adimaly Section, dated: 01.02.2017 – regarding the maintenance of Environmental Flow from the weir of Mukkudam SHP
7.	Letter of Sanction from Department of Power, Government of Kerala for preparing a revised DPR for Mukkudam SHP, dated: 15.02.2020
8.	Appraisal Letter from Sri. V V Nair, Chief Engineer (Rtd.) KSEB Ltd and Technical Committee Member, EMC, dated: 29.03.2016
9.	Report of Geotechnical Investigation conducted at the weir site
10.	Original DPR - Mukkudam MHP (1 MW)

Foreword

The Government of Kerala had awarded Administrative Sanction for the Mukkudam Mini Hydroelectric Project (1 MW) to M/s Mukkudam Electroenergy Pvt. Ltd., Idukki, on 09.03.2018 vide G.O.(Ms) No.05/2018/PD, as an ”Own-Land Category Scheme” under the ‘Kerala Small Hydro Power Policy 2012’. This project is envisaged to be developed as an Independent Power Project (IPP).

This site was lying unidentified by Government agencies and KSEBL and the developer happened to recognize its power potential in June 2014 and subsequently approached the Energy Management Centre and the state Government with an intention to implement a small hydro project here. As none of the Government agencies nor the KSEBL had conducted a hydrology analysis of this site, the project consultant established a hydrology model from the rainfall data of IMD’s Idukki station since 1996 till 2012. From this vague data, the original DPR was prepared and submitted to the Government in December 2015 with installed capacity as 1 MW, with provisions provided for a possible capacity enhancement in future.

Mukkudam SHP is conceptualized as a run-of-the-river scheme to operate continuously during monsoon season and intermittently in lean flow period. The proposal is to harness the power potential from the mountain stream *Parathodu* flowing towards *Muthirapuzha* by creating a small pond with a broad crested weir at Mukkudam village of Idukki District. This is a typical high-head scheme with a gross head of 321 meters and this high head is the major advantage of this scheme as the catchment area is only about 8.85 square kilometers. After power generation, the water will be let back into the *Muthirappuzha* and hence there is no net water diversion occurs as far as the downstream Lower Periyar HEP of the KSEBL is concerned.

The developer established a river gauging mechanism at the weir site of this project in June 2016 and daily stream flow has been recorded since then. Year 2016 was a drought year, year 2017 was a normal monsoon year and the year 2018 was a flood year. The analysis of the hydrology data of these three years clearly suggests that the optimum power potential of this site is 4 MW. The hydrology vetting report furnished by the Energy Management Centre too suggests for a higher installed capacity and hence this revised DPR has been prepared with installed capacity 4 MW.

EXECUTIVE SUMMARY & SALIENT FEATURES

EXECUTIVE SUMMARY

Mukkudam SHP is conceptualized as a run-of-the-river scheme to operate continuously during monsoon season and intermittently in lean flow period.

The key details of the project are:

1. Gravity weir across the stream with non-overflow portion having top EL 630.00m, crest EL 628.00m & MWL EL 629.36m. The deepest bed level is at EL 616.00m. The overflow section is 10.50m long with a depth of 2.0m and can carry a discharge of 35.94 m^3/sec. The catchment area is 8.85 Km^2.
2. An intake and scour sluice block with gated arrangements for allowing water for power and scour pipe for disposal of silt.
3. A water conductor pipe (penstock) made of mild steel 0.85 m diameter and shell thickness varying from 6 mm to 12 mm; 1339 m long from weir up to power house.
4. Anchor blocks are provided at each bend of penstock.
5. A surface powerhouse of size 21.00 m x 15 m, capable of housing 2 Nos of 2 MW Pelton turbines, both with 10% Continuous Overload Capacity. The substructure will be excavated up to EL 305.50 m. Unit machine floor is kept at EL 307.00 m and service bay level at EL 311 m, outside the machine floor. Existing public road nearby the powerhouse area can be extended for approach road to Powerhouse and Switchyard.
6. The E & M equipment mainly consists of two units of 2 MW Pelton turbines, both with 10% Continuous Overload Capacity coupled directly to their respective generators having 600 rpm synchronous type and other auxiliaries.
7. A small tailrace channel to lead the discharge from the machines, back into the Muthirappuzha.
8. A switchyard of size 10 m x 10 m is located near the powerhouse at EL 316.00 m to accommodate the Generator Transformer, Auxiliary Transformer and other Switchyard equipments for stepping up the voltage from 3.30 kV to 11.0 kV.
9. An 11 kV covered conductor dedicated transmission line will evacuate the power from the switchyard to the nearest substation at the Neriamangalam Power Station, owned by KSEBL.
10. The estimated average annual generation with 10% COL is 11.09 Mu
11. The total cost of the project is estimated to be Rs. 27.80 Crores without IDC and Rs. 29.99 Crores with IDC

12. The cost of generation in the 1st year is Rs. 5.53 (reducing to Rs.3.57 in the 13th year) and the present generic tariff is Rs.5.91 per unit and is likely to increase when project is commissioned.
13. This project does not interfere with any of the existing or future planned projects of KSEBL
14. The developer has furnished an undertaking to the department of Irrigation that a minimum flow will be let out from the diversion weir to the downstream as environmental flow.

SALIENT FEATURES

1. LOCATION

Sl. No.	Description	Particulars
1	State	Kerala
2	District	Idukki
3	Taluk	Idukki and Devikulam
4	Panchayath	Konnathady and Vellathooval
5	Village	Konnathady and Vellathooval
6	Access	Road
7	Nearest Railway Station	Aluva (98 Km)
8	Nearest Airport	Nedumbassery (102 Km)
9	Nearest Harbour	Kochi (124 Km)
10	Nearest Substation	Neraiamangalam Power Station (KSEBL)

Note: The diversion weir and major portion of the penstock are located in Konnathady Grama Panchayath (Konnathady village, Idukki Taluk) and the Power House and Power Evacuation systems are located in Vellathooval Grama Panchayath (Vellathooval village, Devikulam Taluk).

2. GEOGRAPHICAL CO-ORDINATES

Sl. No.	Description	Particulars
1	Longitude	77° 00’ 8.26”
2	Latitude	9° 57’ 16.06”

3. RIVER BASIN / CATCHMENT

Sl. No.	Description	Particulars
1	Stream	Parathodu
2	River basin	Periyar
3	Catchment area	8.85 Sq. Km
4	Submerged area at MWL	0.097 Ha

4. HYDROLOGY

a. CATCHMENT DETAILS

Sl. No.	Description	Particulars
1	Total Catchment area	8.85 Sq. Km
2	Free Catchment area	8.85 Sq. Km
3	Flood discharge	35.94 m^3/sec

b. RAIN FALL DATA

Sl. No.	Description	Particulars
1	Maximum rain fall	4906.80 mm
2	Minimum rainfall	2601.50 mm
3	Average annual run - Off	2632.43 mm

c. HEAD

Sl. No.	Description	Particulars
1	Gross Head	321.00 m
2	Net rated Head	312.00 m

5. WEIR

a. GENERAL

Sl. No.	Description	Particulars
1	Type of weir	Concrete gravity weir
2	Length	29.50 m
3	MWL	+ 629.36 m
4	Max. flood discharge	35.94 m^3/sec
5	F.R.L	+ 628.00 m
6	Bed Level	+ 618.00 m
7	Deepest foundation level	+ 616.00 m
8	Height above lowest foundation	14.00 m
9	Scour sluice	1 No. - 0.5 m dia.
10	Gate size	0.9 m x 0.9 m
11	Sill level of scour sluice	+ 618.00 m

b. SPILLWAY PORTION

Sl. No.	Description	Particulars
1	Type	Ogee
2	Length	10.50 m
3	Crest level	+ 628.00 m
4	Max. flood	35.94 m^3/sec
5	No of openings	1
6	Bottom Width	9.396 m
7	D/s Slope	0.7 in 1

c. NON OVERFLOW SECTION

Sl. No.	Description	Particulars
1	Total Length	19.00 m
2	Left Bank	15.66 m
3	Right Bank	3.34 m
4	Top Width	2.0 m
5	Bottom Width	9.860 m
6	D/s Slope	0.7 in 1

6. INTAKE ARRANGEMENTS

a. TRASH RACK

Sl. No.	Description	Particulars
1	Location	Left bank
2	Width	1.50 m
3	Height	4.50 m
4	Type of trash rack	Rectangular
5	Bottom of trash rack	+ 618.50 m
6	Top of trash rack	+ 623.00 m
7	No. of panels	3
8	Size of panels	1.5 m x 1.50 m

b. INTAKE GATE

Sl. No.	Description	Particulars
1	Sill Level	+ 619.40 m
2	No. of gate	1
3	Size of gate	1.50 m x 1.50 m
4	Location	Left bank non overflow section

c. PENSTOCK

Sl. No.	Description	Particulars
1	No. of pipes	1
2	Length	1339 m
3	Diameter	0.85 m
4	Shell thickness	Varying from 6 mm to 14 mm
5	Design Discharge	1.68 m^3/sec

7. POWER HOUSE

Sl. No.	Description	Particulars
1	Type	Surface
2	Size	21.00 x 15 m
3	Installed capacity	2 x 2000 kW + 10% COL
4	Gross head	321 m
5	Net head	312 m
6	Type of turbine	Pelton Wheel
7	Machine centre line	+ 307.50 m

8. TAIL RACE CHANNEL

Sl. No.	Description	Particulars
1	Type	Rectangular
2	Width	2m
3	Length	25m (Approx)
4	Bed Slope	1 in 500
5	Max. TWL	+ 304.50

9. LAND REQUIREMENT

Sl. No.	Description	Particulars
1	Water spread	0.097 Ha
2	Weir	0.085Ha
3	Penstock, Power House & Switchyard	0.80 Ha
4	Total Land Required	1.00 Ha

10. TURBINE

Sl. No.	Description	Particulars
1	Type of turbine	Pelton Wheel
2	No of units	2
3	Runner diameter	2 x 800 mm
4	Rated capacity	2 x 2000 kW with 10 % COL

11. GENERATOR

Sl. No.	Description	Particulars
1	Type	Synchronous
2	No of units	2
3	Rated capacity	2 x 2000 kW with 10 % COL
4	Power factor	0.85
5	Voltage	3.3 kV
6	Frequency	50 Hz
7	Speed	600 rpm

12. POWER HOUSE CRANE

Sl. No.	Description	Particulars
1	Type	HOT
2	Capacity	12/4T
3	Type of girder	Double Girder
4	Operation	Hand Operation

13. SWITCHYARD

Sl. No.	Description	Particulars
1	Generator transformer capacity	6000kVA (6 MVA)
2	Voltage	3.3/11 kV
3	No .of generator transformers	1
4	Capacity of auxiliary transformer	100kVA
5	No of auxiliary transformer	1

14. POWER EVACUATION

Sl. No.	Description	Particulars
1	Type of transmission lines	11 kV
2	Length	2 Km
3	Structure	Pole Structure
4	Conductor	Covered Conductor
5	Substation location	Neriamangalam Power Station

15. GENERATION AND COST

Sl. No.	Description	Particulars
1	Annual generation	11.09 Mu
2	Total Project cost	Rs. 27.80 Crores
3	Total cost including IDC	Rs. 29.99 Crores
4	Cost/MW installed	Rs. 7.50 Crores
5	Loan Repayment Period	12 years
6	Cost of energy in the first year after commissioning of the project	Rs. 5.53/Unit
7	Tariff (Replacement Cost)	Rs. 5.91/Unit
8	Internal Rate of Return	15.09%

ABBREVATIONS / SYMBOLS USED IN DPR

EMC	-	Energy Management Centre
CEA	-	Central Electricity Authority
IMD	-	India Meteorological Department
SAIL	-	Steel Authority of India Ltd.
ACC	-	Associated Cement Company
IEC	-	International Electro- Technical Commission
IS	-	Indian Standards
IREDA	-	Indian Renewable Energy Development Agency
NGO	-	Non-Government Organization
USBR	-	United States Bureau of Reclamation
CWC	-	Central Water Commission
kW	-	Kilo Watt
MW	-	Mega Watt
kV	-	Kilo Volt
KVA	-	Kilo Volt Ampere
kWh	-	Kilo Watt Hour (1 kWh = 1 Unit of Electrical Energy)
LT	-	Low Tension
HT	-	High Tension
P.O.L	-	Petrol Oil Lubricants
H.E	-	Hydroelectric
T- G	-	Turbine – Generator
E & M	-	Electrical and Mechanical
H & M	-	Hydro Mechanical
DG Set	-	Diesel Generating Set
PLF	-	Plant Load Factor
km	-	Kilometre (s)
m	-	Metre (s)
cm	-	Centimetre (s)

mm	-	Millimetre(s)
km/hr	-	Kilometre Per Hour
Cumecs	-	Cubic Meters per Second
Cusecs	-	Cubic Feet per Second
m^3/ sec	-	Cubic Metre per Second
Sq.km	-	Square Kilometre
NA	-	Not Applicable
MDDL	-	Minimum Draw Down Level
HFL	-	High Flood Level
EL	-	Elevation (Above Mean Sea Level)
°C	-	Degree Celsius
RCC	-	Reinforced Cement Concrete
RD	-	Reduced Distance
FSL	-	Full Supply Level
DPR	-	Detailed Project Report
U/S	-	Upstream
D/S	-	Downstream
GTS	-	Great Trigonometrical Survey of India
G-D	-	Gauge – Discharge
RG	-	Rain gauge
T & P	-	Tools & Plants
IDC	-	Interest During Construction
Rs.	-	Indian Rupees
O & M	-	Operation and Maintenance
%	-	Percent
WDV	-	Written Down Value
SLD	-	Single line diagram

CHECK LIST AS PER C.E.A

1.	**Name of the Project**	Mukkudam Small Hydroelectric Project
a.	State	Kerala
b.	District/ Taluk	Idukki / Idukki & Devikulam
2.	**Category of the Project**	Small Hydroelectric Scheme (2 x 2000 kW)
3.	**Planning**	
a.	Has the overall development of the stream/canal been prepared and stages of development discussed briefly?	Not applicable being diversion of water proposed is through circular conduits, for a limited length of the stream flowing along mostly private land
b.	Have the alternative proposals been studied and their merits and demerits discussed?	Yes.
c.	Have the detailed topographical surveys been carried out for the following items and drawings prepared as per prescribed scales? • Stream - canal surveys • Head works surveys (weir or • diversion structure) • Plant site and camp site • Water conductor system • Powerhouse; Switchyard, • Tailrace • Penstock, surge shaft • Communication, etc.	Yes. Yes, as necessary.
4.	**Geology** Have the geological surveys for Head works, powerhouse and tail-race, etc. been carried out and report on general geology of the area and on geology of the sites of principal structures appended?	Exposed rock is seen at weir, near power house and tailrace. Water conductor system is through circular steel pipes of small size fully on surface.
5.	**Foundation Investigation** Have the foundation investigations	Yes. Foundation investigation up to a depth of

	for the major civil structures and of the schemes, etc. been carried out?	10 meter was carried out at the weir site by drilling bore holes and the collected rock cores were subjected to Unconfined Compressive Strength (UCS) test and found that the rock foundation is of good quality rock. Surface investigation was done for penstock route and power house site which shows good quality exposed rock at these areas.
6.	**Material Surveys**	
	Have the surveys and laboratory tests for construction material, like pervious and im-pervious soils, sand, aggregate, etc. been carried out?	Being small quantities, it can be bought from nearby sources.
7.	**Hydrological & Meteorological Investigations**	
	Have the hydrological and meteorological investigations been carried out and status of data discussed in report?	Yes. Available data from Govt. & Private agencies collected. Hydrology data collected from the weir site since June 2016 has been considered for this revised DPR.
8.	**Hydrology**	
	Have hydrological studies been carried out to establish the availability of water for the benefits envisaged, and what is the depen-dability of the potential?	Yes. Conducted analysis of all data collected since June 2016 at the gauging station of the developer, situated at the weir site of this project.
9.	**Land Acquisition and Resettlement**	
	Have the provision for land acquisition and resettlement been considered?	NA. Major part of land for this project is owned privately.
	Have the socio-economic problems involved in resettlement been investigated and discussed?	Not applicable.
10.	**Design**	
	Has the layout of the project area,	

	viz. location of diversion structure, workshop sheds, offices camps, etc. been finalized?	Yes
11.	**Have the preliminary designs prepared for the following components?**	
	a. Diversion structure/ weir, etc.	
	b. Penstocks and water conductor system, etc.	
	c. Powerhouse & Switchyard.	
	d. Powerhouse equipment, LT/HT switching equipment and control and protection equipment.	Yes,
12.	**Power benefits**	
	Have the following points been discussed?	
	a. Total energy production and installed capacity of the grid system.	This is a very small project contributing a very small portion of grid capacity
	b. How does the scheme fit into overall development of power of the region?	This is an IPP Scheme, power will be sold to KSEBL.
	c. Energy generated from the project, firm power, seasonal power and total power.	Yes
	d. Proposal for transmission and / or connecting the existing systems, etc. (wherever applicable).	Yes
	e. Cost of generation per kW installed / as per Kwh generated, as compared to the various micro-hydel projects and various services in the region to justify the economic viability of the scheme.	Yes
13.	**Construction Program**	
	a. Are the major components of work proposed to be done departmentally or through contractor?	Through contractors.

	b. Have the year/month-wise quantities of the various items been worked out for various components of the project?	Total quantities worked out.
14.	**Estimate**	
	Is the estimate prepared?	Yes.
	Have the analysis of rates for various major items of works for the major components of the project been furnished with the basis of analysis and the price index at which the estimate is based?	Yes, based on current budgetary Quotations.
15.	**Ecological & Environmental aspects**	
	Is the area likely to have any environmental and ecological problems due to the altered surface water pattern and preventive corrective measures discussed?	No Environmental or Ecological Problem is involved.
16.	**Camps and Buildings**	
	Have the planning of the camps buildings been done?	Not applicable – Staff to take rented accommodation.
17.	**Soil Conservation**	
	Is the need for soil conservation measures in the project discussed?	Not applicable. Almost 90% of the project area is exposed rock terrain.

CHAPTER - 1

INTRODUCTION

Since there is no change to sections 1.1 to 1.6 of this chapter from the original DPR, they have been excluded in this revised DPR. Kindly refer the original DPR in annexure for these sections.

1.7 Project Proposal

Mukkudam Small Hydro Project (SHP) is conceptualized as a run-of-the- river scheme to operate continuously during monsoon season and intermittently in lean flow period. Project is envisaged to develop as IPP as per the Central and State Govt. policy of involving private sector participation in power development under the self identified schemes category. The proposal is to harness the power potential from the stream flowing towards Muthirapuzha by creating a small pond with a concrete gravity weir near Mukkudam village of Idukki District. The Government of Kerala has already awarded administrative sanction for the original proposal (1 MW) of this project in March 2018. This revised DPR is for the capacity enhancement of the project to 4.0 MW.

1.8 Promoters

Mukkudam Electroenergy Private Limited has been incorporated with a vision to harness the Renewable Energy resources available in Kerala, particularly Small Hydroelectric Projects. All the six promoters of the Company are B.Tech graduates and classmates from a prestigious institution in Kerala and each one is having more than 13 years of experience in different technological domains such as Small Hydro Projects, Thermal Power Projects, Oil & Gas Projects, IT projects and Mechanical Structure Projects.

The hometown of the Managing Director is very close to the project location of Project; hence he happened to identify the potential for a small Hydro Project here and subsequently approached the state Energy Management Centre and power Department for the approval to set up the same.

Since energy plays a crucial role in any modern society's prosperity and its demand is climbing new heights day by day, it is the need of the hour to ensure energy security for our state. Mukkudam Electroenergy Private Limited envisages to extract the power potential available at this project site in an environmental friendly manner and it can provide minute contribution to Kerala's electricity demand which will be beneficial for the Kerala State Electricity Board Limited as well and in turn, beneficial to each citizen of our state.

CHAPTER - 2

SURVEY AND INVESTIGATION

The promoters have done the reconnaissance survey and identified the potential in the stream Parathode. Locations for weir and power house were also identified considering accessibility from road. The power house site is close to the existing Panamkutty Power House of KSEB and two transmission lines are also passing not far from the power house site. Thus the site was prima facie suitable for hydro power development with a fairly high head.

Detailed topographic survey with total station was carried out as required by the consultant and contours were plotted at 1m intervals. More spot levels were taken near weir site and power house site. As there was no nearby GTS Bench mark available fly level was taken from the nearby Kallarkutty dam of KSEB Ltd. This is considered reasonable and sufficient as the relative levels only are needed for a hydel project.

Hydrological data model was developed for original DPR, viz rainfall data from IMD's Idukki station, as obtained for Keerithode SHP which is the nearest rain gauge station, was collected for 18 water years from 1995-96 to 2012-13. 17 calendar years 1996 to 2012 was analyzed from standard formulae to arrive at water availability.

A gauging station was established at the weir site in the summer of 2016 and daily stream flow has been recorded since June 2016. The analysis of this gauge data for the three seasons 2016-17, 2017-18 and 2018-19 has been carried out and its details are given in Chapter 3.

Regarding geological investigation, bore holes were drilled at the weir site up to a depth of 10 meters from the deepest foundation and rock cores were collected. Randomly selected rock core samples were subjected to Geo Technical Investigation in a geotechnical lab at Cochin and the test results were very much satisfactory. The details of this are given in Annexure-9.

Exposed rock is found at almost all the penstock route and at shallow depth at the Power House site. The structures being small, and as good rock is exposed at many places, it is felt adequate to create suitable foundations for the works.

It is also found that the project does not involve any rehabilitation as it is located in a very less inhibited area. There is no forest land involved in this project.

CHAPTER - 3

HYDROLOGY

3.1 General

The hydrological input plays a vital role in planning, execution and operation of any water resources development project. For assessing the hydro power potential, having arrived at the possibility of head from topographical surveys, water availability is the second component. The hydrological studies are carried out at all the project stages starting from the pre-feasibility stage and are continued even during the operation of the project. Hydrological studies usually cover the assessment of quantities of available water and its time variation, estimation of design flood usually required for the hydraulic design as well as safety of the structures. It is now intended to prepare and update the hydrology of the project considering the site specific available data.

Mukkudam Mini Hydroelectric project is located in Konnathady Grama Panchayat, Mukkudam village in a hill stream called *Parathode* that joins *Muthirapuzha* just 2km upstream of the existing Panamkutty Power House of Neriyamangalam HEP of KSEB. Project Hydrology studies for establishing various parameters that are basic inputs for project planning and design are presented in this chapter. Relevant meteorological & hydrological data collected from various sources are discussed below. Hydrological analysis has been carried out to:

i) Assess the availability of water for power generation & establishing long term stream flow series.
ii) Assess design floods.
iii) Assess sediment exclusion needs.

3.2 River Basin

Muthirapuzha is a major stream joining *Periyar* River. There are various hydro electric projects upstream of this location belonging to KSEB Ltd established over last 80 years. Lower Periyar HEP of KSEB Ltd is located about 4 Km downstream of this proposed scheme. Mukkudam Small HEP is however tapping a minor hill stream called *Parathodu* having a catchment area of 8.85 Sq km up to the proposed weir site. There is no net water diversion occurs as far as the downstream Lower Periyar HEP is concerned.

3.3 Data

The topographic survey establishes the difference in elevation between the diversion site location and the power house site chosen from reconnaissance, considering the accessibility and facilities for construction etc as well as power evacuation.

Regarding hydrologic data, this stream was being studied for the first time and no river gauging was done earlier at the time the original DPR was prepared. Hence the project consultant was forced to depend only on rainfall data. Therefore, the nearest available rainfall data of IMD's Idukki rain gauge

station, obtained for Keerithode SHP was made use for this scheme. 17 years of rainfall data from 1996 to 2012 were collected for finding out flow available for power generation with a reasonable plant load factor. Hydrology assessment of this project site was done using Inglis formula and modified Inglis formula and the installed capacity was fixed as 1 MW with provisions provided for capacity enhancement in future.

A gauging station was established just downstream of the weir location of Mukkudam SHP in the summer of 2016 and daily stream flow was recorded for the three water years 2016-17, 2017-18 and 2018-19. Because of site restrictions, the gauging weir was constructed at a non-ideal location and hence the approach velocity of the stream was very high and the gauge post was located very close to the weir crest. See the photos below for more details:

A team of Energy Management Centre Kerala had visited this gauging station in April 2018 and in their report (Annexure-3) on vetting this gauging station, the above mentioned drawbacks are clearly mentioned. Hence it is just to believe that the flow recorded at this gauging station was much conservative than the actual flow of the stream. However, the original hydrology data collected for 2016-17, 2017-18 and 2018-19 have been analyzed here for determining the power potential of this project so as to be on safer side.

3.4 Hydrology Data Analysis and Power Potential Estimation:

The hydrology data derived from the river gauge records, the power potential of the site with net head 312 meter and estimated generation for 1 MW, 2 MW, 3 MW, 4 MW and 4 MW+10% COL since June 2016 to March 2019 are presented below:

2016 June									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.06.01	0.7	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.06.02	0.4	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.06.03	1.1	0.04	0.064532076	169.1257	4059.015934	4059.015934	4059.015934	4059.015934	4059.015934
2016.06.04	0.3	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.06.05	0.6	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.06.06	0.1	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.06.07	2.7	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.06.08	1.2	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.06.09	0.8	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.06.10	0.2	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.06.11	4.1	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.06.12	1.7	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.06.13	0.7	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.06.14	0.2	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.06.15	0.1	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2016.06.16	0.1	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.06.17	1.2	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.06.18	5.4	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.06.19	5.2	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.06.20	0.2	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2016.06.21	0.2	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.06.22	3.7	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.06.23	1.2	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2016.06.24	0.7	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.06.25	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.06.26	2.1	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.06.27	5.4	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.06.28	8.4	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2016.06.29	3.4	0.34	1.604746498	4205.72	24000	48000	72000	96000	100937.2709
2016.06.30	0.1	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
Total	**52.2**			**Total**	**545886.6568**	**798061.7955**	**874941.1947**	**902464.0487**	**907401.3196**

2016 July									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.07.01	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.02	0.1	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.07.03	0.9	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.07.04	1.1	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.05	1.2	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.07.06	1.4	0.15	0.471221566	1234.977	24000	29639.45954	29639.45954	29639.45954	29639.45954
2016.07.07	1.1	0.15	0.471221566	1234.977	24000	29639.45954	29639.45954	29639.45954	29639.45954
2016.07.08	4.9	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.07.09	3.7	0.32	1.465874586	3841.764	24000	48000	72000	92202.33879	92202.33879
2016.07.10	3.4	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2016.07.11	5.9	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2016.07.12	1.1	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2016.07.13	0.5	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2016.07.14	0.4	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2016.07.15	0.2	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.07.16	0.9	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.17	3.2	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.18	2	0.42	2.198954765	5763.021	24000	48000	72000	96000	105600
2016.07.19	0	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2016.07.20	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.07.21	0.9	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.22	2.8	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.23	2.3	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2016.07.24	1.5	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2016.07.25	0.5	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2016.07.26	0.4	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.07.27	2.2	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.07.28	1	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.07.29	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2016.07.30	0.8	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.07.31	1.8	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
Total	**46.2**			**Total**	**744000**	**1293932.398**	**1513268.869**	**1596721.703**	**1615921.703**

2016 August									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.08.01	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2016.08.02	0.5	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.03	2.1	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.04	0.5	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.05	0.5	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.08.06	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.07	0.4	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.08	0.2	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.09	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.08.10	0.9	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.11	1.2	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.12	1	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.13	1	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.14	0.5	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.08.15	1.9	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.08.16	2.4	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.17	4.5	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.18	3	0.42	2.198954765	5763.021	24000	48000	72000	96000	105600
2016.08.19	0	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2016.08.20	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.08.21	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.22	0.5	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.23	0.9	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.24	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.25	0.5	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.26	1.9	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.08.27	2.4	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.08.28	0.4	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2016.08.29	0.7	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2016.08.30	1.9	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2016.08.31	0.4	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
Total	**30.2**			**Total**	**744000**	**1217788.468**	**1294362.336**	**1330089.977**	**1339689.977**

2016 September									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.09.01	0.5	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.09.02	0.2	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2016.09.03	0	0.17	0.568594001	1490.171	24000	35764.10777	35764.10777	35764.10777	35764.10777
2016.09.04	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.09.05	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.09.06	0.2	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.09.07	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2016.09.08	0	0.15	0.471221566	1234.977	24000	29639.45954	29639.45954	29639.45954	29639.45954
2016.09.09	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.09.10	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.09.11	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.09.12	0.3	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2016.09.13	0	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2016.09.14	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2016.09.15	0.5	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2016.09.16	0.5	0.11	0.295726161	775.0391	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2016.09.17	0.1	0.11	0.295726161	775.0391	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2016.09.18	1.6	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.19	0	0.11	0.295726161	775.0391	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2016.09.20	0.2	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.21	0.5	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.22	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.23	0.1	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.24	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.25	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.09.26	0.4	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.09.27	0.7	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.09.28	2	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.09.29	0.4	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.09.30	0	0.11	0.295726161	775.0391	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
Total	**8.2**			**Total**	**596471.2534**	**686592.3646**	**686592.3646**	**686592.3646**	**686592.3646**

2016 October									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.10.01	0.4	0.11	0.295726161	775.0391	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2016.10.02	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.10.03	0	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.10.04	0	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.10.05	0	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.10.06	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.07	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.08	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.09	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.10	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.11	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.12	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.10.13	3.6	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.10.14	2.1	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2016.10.15	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2016.10.16	0	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.10.17	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.18	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.19	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.10.20	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.10.21	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.10.22	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.10.23	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.10.24	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.10.25	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.10.26	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.10.27	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2016.10.28	0.2	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2016.10.29	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.10.30	0.2	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.10.31	0	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
Total	**6.5**			**Total**	**350661.767**	**353384.6314**	**353384.6314**	**353384.6314**	**353384.6314**

2016 November									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.11.01	0.4	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.11.02	0.2	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.11.03	0.2	0.09	0.218707541	573.1887	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2016.11.04	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.11.05	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2016.11.06	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.11.07	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2016.11.08	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.11.09	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.11.10	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2016.11.11	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2016.11.12	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2016.11.13	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2016.11.14	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.11.15	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.11.16	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.11.17	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.11.18	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.11.19	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.20	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.21	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.23	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.24	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.25	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.26	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.27	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.28	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.29	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.11.30	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
Total	**0.8**			**Total**	**145599.6591**	**145599.6591**	**145599.6591**	**145599.6591**	**145599.6591**

2016 December									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2016.12.01	0.6	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.02	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.12.03	0.2	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2016.12.04	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2016.12.05	1	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.06	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2016.12.07	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2016.12.08	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2016.12.09	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2016.12.10	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2016.12.11	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2016.12.12	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2016.12.13	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.14	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.15	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.16	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.17	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.18	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2016.12.19	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.20	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.21	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.23	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.24	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.25	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.26	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.27	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.28	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.29	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.30	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2016.12.31	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
Total	**1.8**			**Total**	**88758.69313**	**88758.69313**	**88758.69313**	**88758.69313**	**88758.69313**

2017 January									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.01.01	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.01.02	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.01.03	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.01.04	0	0	0	0	0	0	0	0	0
2017.01.05	0	0	0	0	0	0	0	0	0
2017.01.06	0	0	0	0	0	0	0	0	0
2017.01.07	0	0	0	0	0	0	0	0	0
2017.01.08	0	0	0	0	0	0	0	0	0
2017.01.09	0	0	0	0	0	0	0	0	0
2017.01.10	0	0	0	0	0	0	0	0	0
2017.01.11	0	0	0	0	0	0	0	0	0
2017.01.12	0	0	0	0	0	0	0	0	0
2017.01.13	0	0	0	0	0	0	0	0	0
2017.01.14	0	0	0	0	0	0	0	0	0
2017.01.15	0	0	0	0	0	0	0	0	0
2017.01.16	0	0	0	0	0	0	0	0	0
2017.01.17	0	0	0	0	0	0	0	0	0
2017.01.18	0	0	0	0	0	0	0	0	0
2017.01.19	0	0	0	0	0	0	0	0	0
2017.01.20	0	0	0	0	0	0	0	0	0
2017.01.21	0	0	0	0	0	0	0	0	0
2017.01.22	0	0	0	0	0	0	0	0	0
2017.01.23	0	0	0	0	0	0	0	0	0
2017.01.24	0	0	0	0	0	0	0	0	0
2017.01.25	0	0	0	0	0	0	0	0	0
2017.01.26	0	0	0	0	0	0	0	0	0
2017.01.27	0.3	0	0	0	0	0	0	0	0
2017.01.28	0.3	0	0	0	0	0	0	0	0
2017.01.29	0	0	0	0	0	0	0	0	0
2017.01.30	0	0	0	0	0	0	0	0	0
2017.01.31	0	0	0	0	0	0	0	0	0
Total	**0.6**			**Total**	**4088.006371**	**4088.006371**	**4088.006371**	**4088.006371**	**4088.006371**

2017 February									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.02.01	0	0	0	0	0	0	0	0	0
2017.02.02	0	0	0	0	0	0	0	0	0
2017.02.03	0	0	0	0	0	0	0	0	0
2017.02.04	0	0	0	0	0	0	0	0	0
2017.02.05	0	0	0	0	0	0	0	0	0
2017.02.06	0	0	0	0	0	0	0	0	0
2017.02.07	0	0	0	0	0	0	0	0	0
2017.02.08	0	0	0	0	0	0	0	0	0
2017.02.09	0	0	0	0	0	0	0	0	0
2017.02.10	0	0	0	0	0	0	0	0	0
2017.02.11	0	0	0	0	0	0	0	0	0
2017.02.12	0	0	0	0	0	0	0	0	0
2017.02.13	0	0	0	0	0	0	0	0	0
2017.02.14	0	0	0	0	0	0	0	0	0
2017.02.15	0	0	0	0	0	0	0	0	0
2017.02.16	0	0	0	0	0	0	0	0	0
2017.02.17	0	0	0	0	0	0	0	0	0
2017.02.18	0	0	0	0	0	0	0	0	0
2017.02.19	0	0	0	0	0	0	0	0	0
2017.02.20	0	0	0	0	0	0	0	0	0
2017.02.21	0	0	0	0	0	0	0	0	0
2017.02.22	0	0	0	0	0	0	0	0	0
2017.02.23	0	0	0	0	0	0	0	0	0
2017.02.24	0	0	0	0	0	0	0	0	0
2017.02.25	0	0	0	0	0	0	0	0	0
2017.02.26	0	0	0	0	0	0	0	0	0
2017.02.27	0	0	0	0	0	0	0	0	0
2017.02.28	0	0	0	0	0	0	0	0	0
Total	**0**			**Total**	**0**	**0**	**0**	**0**	**0**

2017 March									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.03.01	0	0	0	0	0	0	0	0	0
2017.03.02	0	0	0	0	0	0	0	0	0
2017.03.03	0.2	0	0	0	0	0	0	0	0
2017.03.04	3.9	0	0	0	0	0	0	0	0
2017.03.05	0.2	0	0	0	0	0	0	0	0
2017.03.06	0.1	0	0	0	0	0	0	0	0
2017.03.07	0.2	0	0	0	0	0	0	0	0
2017.03.08	0.1	0	0	0	0	0	0	0	0
2017.03.09	0.2	0	0	0	0	0	0	0	0
2017.03.10	0.5	0	0	0	0	0	0	0	0
2017.03.11	0	0	0	0	0	0	0	0	0
2017.03.12	0	0	0	0	0	0	0	0	0
2017.03.13	2.1	0	0	0	0	0	0	0	0
2017.03.14	0	0	0	0	0	0	0	0	0
2017.03.15	0	0	0	0	0	0	0	0	0
2017.03.16	0	0	0	0	0	0	0	0	0
2017.03.17	3.7	0	0	0	0	0	0	0	0
2017.03.18	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2017.03.19	0.7	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.03.20	2.8	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.03.21	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.03.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2017.03.23	0	0	0	0	0	0	0	0	0
2017.03.24	0	0	0	0	0	0	0	0	0
2017.03.25	0	0	0	0	0	0	0	0	0
2017.03.26	0	0	0	0	0	0	0	0	0
2017.03.27	0	0	0	0	0	0	0	0	0
2017.03.28	0	0	0	0	0	0	0	0	0
2017.03.29	0	0	0	0	0	0	0	0	0
2017.03.30	0	0	0	0	0	0	0	0	0
2017.03.31	0	0	0	0	0	0	0	0	0
Total	**14.7**			**Total**	**14876.4563**	**14876.4563**	**14876.4563**	**14876.4563**	**14876.4563**

Conclusion for 2016-17	
Total Rainfall of 2016-17 (Cm)	**161.2**
Estimated power generation @ 1 MW	32,32,390.86
Estimated power generation @ 2 MW	46,01,130.84
Estimated power generation @ 3 MW	49,73,920.58
Estimated power generation @ 4 MW	51,20,623.91
Estimated power generation @ 4 MW + 10% COL	51,54,361.18

2017 April									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.04.01	0	0	0	0	0	0	0	0	0
2017.04.02	0	0	0	0	0	0	0	0	0
2017.04.03	0	0	0	0	0	0	0	0	0
2017.04.04	0	0	0	0	0	0	0	0	0
2017.04.05	0	0	0	0	0	0	0	0	0
2017.04.06	2.1	0	0	0	0	0	0	0	0
2017.04.07	0.9	0	0	0	0	0	0	0	0
2017.04.08	0	0	0	0	0	0	0	0	0
2017.04.09	0	0	0	0	0	0	0	0	0
2017.04.10	0	0	0	0	0	0	0	0	0
2017.04.11	0	0	0	0	0	0	0	0	0
2017.04.12	0	0	0	0	0	0	0	0	0
2017.04.13	0.4	0	0	0	0	0	0	0	0
2017.04.14	0	0	0	0	0	0	0	0	0
2017.04.15	0	0	0	0	0	0	0	0	0
2017.04.16	0	0	0	0	0	0	0	0	0
2017.04.17	0	0	0	0	0	0	0	0	0
2017.04.18	0	0	0	0	0	0	0	0	0
2017.04.19	0	0	0	0	0	0	0	0	0
2017.04.20	0	0	0	0	0	0	0	0	0
2017.04.21	0	0	0	0	0	0	0	0	0
2017.04.22	0	0	0	0	0	0	0	0	0
2017.04.23	0	0	0	0	0	0	0	0	0
2017.04.24	0	0	0	0	0	0	0	0	0
2017.04.25	0	0	0	0	0	0	0	0	0
2017.04.26	0	0	0	0	0	0	0	0	0
2017.04.27	0	0	0	0	0	0	0	0	0
2017.04.28	0	0	0	0	0	0	0	0	0
2017.04.29	0	0	0	0	0	0	0	0	0
2017.04.30	1.9	0	0	0	0	0	0	0	0
Total	**5.3**			**Total**	**0**	**0**	**0**	**0**	**0**

2017 May									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.05.01	0.5	0	0	0	0	0	0	0	0
2017.05.02	0	0	0	0	0	0	0	0	0
2017.05.03	0	0	0	0	0	0	0	0	0
2017.05.04	0	0	0	0	0	0	0	0	0
2017.05.05	0	0	0	0	0	0	0	0	0
2017.05.06	0	0	0	0	0	0	0	0	0
2017.05.07	0	0	0	0	0	0	0	0	0
2017.05.08	0.2	0	0	0	0	0	0	0	0
2017.05.09	0	0	0	0	0	0	0	0	0
2017.05.10	0.5	0	0	0	0	0	0	0	0
2017.05.11	0	0	0	0	0	0	0	0	0
2017.05.12	9.1	0	0	0	0	0	0	0	0
2017.05.13	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2017.05.14	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	4059.015934
2017.05.15	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1428.512946
2017.05.16	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1428.512946
2017.05.17	0	0	0	0	0	0	0	0	0
2017.05.18	0	0	0	0	0	0	0	0	0
2017.05.19	0.4	0	0	0	0	0	0	0	0
2017.05.20	2	0	0	0	0	0	0	0	0
2017.05.21	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	4059.015934
2017.05.22	0.2	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1428.512946
2017.05.23	0	0	0	0	0	0	0	0	0
2017.05.24	0.8	0	0	0	0	0	0	0	0
2017.05.25	0.3	0	0	0	0	0	0	0	0
2017.05.26	0	0	0	0	0	0	0	0	0
2017.05.27	0	0	0	0	0	0	0	0	0
2017.05.28	0.2	0	0	0	0	0	0	0	0
2017.05.29	1.6	0	0	0	0	0	0	0	0
2017.05.30	1.1	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1428.512946
2017.05.31	4.5	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1428.512946
Total	**21.4**			**Total**	**22031.34401**	**22031.34401**	**22031.34401**	**22031.34401**	**22734.74758**

2017 June									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.06.01	1.6	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.06.02	2.1	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.06.03	3.1	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.06.04	0	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.06.05	1	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.06.06	1.4	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.06.07	0.8	0.06	0.118827441	311.4229574	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2017.06.08	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.06.09	0	0.06	0.118827441	311.4229574	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2017.06.10	3.8	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.06.11	0.8	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.06.12	0.6	0.11	0.295726161	775.039122	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2017.06.13	0.9	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.06.14	0.1	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.06.15	0.2	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.06.16	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.06.17	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.06.18	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.06.19	0.1	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.06.20	0.3	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.06.21	0.4	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.06.22	1.6	0.06	0.118827441	311.4229574	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2017.06.23	3	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.06.24	4.1	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.06.25	6.2	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.06.26	7.6	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.06.27	3.1	0.55	3.282819811	8603.61416	24000	48000	72000	96000	105600
2017.06.28	1.9	0.4	2.044834464	5359.102162	24000	48000	72000	96000	105600
2017.06.29	2.7	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.06.30	2.9	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
Total	**50.3**			**Total**	**462394.6741**	**597717.8467**	**681684.586**	**753684.586**	**782484.586**

2017 July									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.07.01	1.2	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.07.02	0.6	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.07.03	1.4	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.07.04	0.2	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.07.05	0.2	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.07.06	0.6	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.07.07	1	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.07.08	0.2	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.07.09	0.3	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.07.10	0.6	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.07.11	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.12	0.2	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.13	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.14	0.6	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.15	0.4	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.16	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.17	1.6	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.07.18	2	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.07.19	4.3	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
2017.07.20	2	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.07.21	2.2	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.07.22	0	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.07.23	0.2	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.07.24	0	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.07.25	0	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.07.26	0.6	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.07.27	0.5	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.07.28	2.7	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
2017.07.29	2.3	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.07.30	2.2	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.07.31	3.4	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
Total	**31.5**			**Total**	**606049.4131**	**766067.3121**	**778034.0514**	**778034.0514**	**778034.0514**

2017 August									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.08.01	1.8	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.08.02	1.4	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.08.03	2.1	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
2017.08.04	6.9	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.08.05	5.3	0.38	1.894350904	4964.714849	24000	48000	72000	96000	105600
2017.08.06	0.9	0.5	2.84983143	7468.838212	24000	48000	72000	96000	105600
2017.08.07	3.4	0.3	1.331140006	3488.651728	24000	48000	72000	83727.64148	83727.64148
2017.08.08	1.1	0.48	2.682134781	7029.338835	24000	48000	72000	96000	105600
2017.08.09	2.2	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.08.10	2.6	0.34	1.604746498	4205.719622	24000	48000	72000	96000	100937.2709
2017.08.11	1	0.38	1.894350904	4964.714849	24000	48000	72000	96000	105600
2017.08.12	0	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.08.13	0	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.08.14	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.08.15	2.6	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.08.16	0.8	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.08.17	1.7	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.08.18	5.8	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
2017.08.19	5	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.08.20	3.2	0.5	2.84983143	7468.838212	24000	48000	72000	96000	105600
2017.08.21	4.5	0.42	2.198954765	5763.020649	24000	48000	72000	96000	105600
2017.08.22	1.6	0.6	3.734547665	9787.50252	24000	48000	72000	96000	105600
2017.08.23	1.1	0.4	2.044834464	5359.102162	24000	48000	72000	96000	105600
2017.08.24	0.1	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.08.25	0	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.08.26	2.8	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.08.27	4.4	0.34	1.604746498	4205.719622	24000	48000	72000	96000	100937.2709
2017.08.28	6.3	0.5	2.84983143	7468.838212	24000	48000	72000	96000	105600
2017.08.29	2.2	0.6	3.734547665	9787.50252	24000	48000	72000	96000	105600
2017.08.30	0.6	0.46	2.517698645	6598.384608	24000	48000	72000	96000	105600
2017.08.31	0	0.42	2.198954765	5763.020649	24000	48000	72000	96000	105600
Total	**71.4**			**Total**	**744000**	**1474234.749**	**2040328.405**	**2487304.094**	**2641178.635**

2017 September									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.09.01	3.3	0.38	1.894350904	4964.714849	24000	48000	72000	96000	105600
2017.09.02	1.8	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.09.03	0	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.09.04	0.6	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.09.05	3.1	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.09.06	0.5	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.09.07	0.3	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.09.08	2.8	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.09.09	0	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.09.10	3.7	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.09.11	0	0.42	2.198954765	5763.020649	24000	48000	72000	96000	105600
2017.09.12	0	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.09.13	2.1	0.3	1.331140006	3488.651728	24000	48000	72000	83727.64148	83727.64148
2017.09.14	0.3	0.3	1.331140006	3488.651728	24000	48000	72000	83727.64148	83727.64148
2017.09.15	3.3	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.09.16	6.1	0.42	2.198954765	5763.020649	24000	48000	72000	96000	105600
2017.09.17	8.3	0.58	3.5516752	9308.230365	24000	48000	72000	96000	105600
2017.09.18	2.6	0.55	3.282819811	8603.61416	24000	48000	72000	96000	105600
2017.09.19	1.3	0.5	2.84983143	7468.838212	24000	48000	72000	96000	105600
2017.09.20	0.2	0.42	2.198954765	5763.020649	24000	48000	72000	96000	105600
2017.09.21	0.4	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.09.22	0	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.09.23	2.8	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.09.24	0	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.09.25	1.7	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.09.26	0.8	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.09.27	0.9	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.09.28	1.9	0.27	1.13713625	2980.206683	24000	48000	71524.96039	71524.96039	71524.96039
2017.09.29	2.1	0.3	1.331140006	3488.651728	24000	48000	72000	83727.64148	83727.64148
2017.09.30	0	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
Total	**50.9**			**Total**	**720000**	**1440000**	**2137518.066**	**2551529.293**	**2647529.293**

2017 October									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.10.01	0	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.10.02	0	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.03	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.04	0	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.05	1.3	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.06	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.07	1.5	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.08	0.3	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.09	0	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.10	0.8	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.11	1.8	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.12	2.6	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.13	6	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.14	0.9	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.15	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.16	1.4	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.17	1.5	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.18	0	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.19	0	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.10.20	2	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.21	2.1	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.22	0	0.28	1.200696574	3146.785582	24000	48000	72000	75522.85397	75522.85397
2017.10.23	0	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.24	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.25	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.26	6.9	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.10.27	2.1	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.10.28	1.2	0.32	1.465874586	3841.764116	24000	48000	72000	92202.33879	92202.33879
2017.10.29	1.4	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.10.30	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.10.31	0.9	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
Total	**34.7**			**Total**	**744000**	**1488000**	**1906621.243**	**1961392.143**	**1970992.143**

2017 November									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.11.01	3.7	0.3	1.331140006	3488.651728	24000	48000	72000	83727.64148	83727.64148
2017.11.02	3.2	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.11.03	0	0.36	1.747615062	4580.149554	24000	48000	72000	96000	105600
2017.11.04	0	0.26	1.074713529	2816.609216	24000	48000	67598.62118	67598.62118	67598.62118
2017.11.05	0.2	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.11.06	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.11.07	0	0.24	0.95337841	2498.614138	24000	48000	59966.73931	59966.73931	59966.73931
2017.11.08	1.9	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.11.09	0	0.22	0.836900772	2193.349543	24000	48000	52640.38903	52640.38903	52640.38903
2017.11.10	0	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
2017.11.11	0.9	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.11.12	0	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.11.13	0	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.11.14	0	0.18	0.619497021	1623.577792	24000	38965.86702	38965.86702	38965.86702	38965.86702
2017.11.15	0	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.11.16	0	0.17	0.568594001	1490.171157	24000	35764.10777	35764.10777	35764.10777	35764.10777
2017.11.17	0	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.11.18	0	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.11.19	0	0.15	0.471221566	1234.977481	24000	29639.45954	29639.45954	29639.45954	29639.45954
2017.11.20	0.4	0.15	0.471221566	1234.977481	24000	29639.45954	29639.45954	29639.45954	29639.45954
2017.11.21	0.3	0.15	0.471221566	1234.977481	24000	29639.45954	29639.45954	29639.45954	29639.45954
2017.11.22	0	0.15	0.471221566	1234.977481	24000	29639.45954	29639.45954	29639.45954	29639.45954
2017.11.23	0	0.15	0.471221566	1234.977481	24000	29639.45954	29639.45954	29639.45954	29639.45954
2017.11.24	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.11.25	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.11.26	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.11.27	0.4	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.11.28	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.11.29	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.11.30	2.6	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
Total	**13.6**			**Total**	**717199.3344**	**1096958.748**	**1233738.365**	**1293466.007**	**1312666.007**

2017 December									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential, P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2017.12.01	0	0.2	0.725517037	1901.43505	24000	45634.44119	45634.44119	45634.44119	45634.44119
2017.12.02	0.9	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.12.03	1	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.12.04	0	0.16	0.519152933	1360.596007	24000	32654.30418	32654.30418	32654.30418	32654.30418
2017.12.05	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.12.06	0	0.14	0.424852214	1113.452682	24000	26722.86437	26722.86437	26722.86437	26722.86437
2017.12.07	0	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.12.08	0	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.12.09	0	0.12	0.337036631	883.3056019	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2017.12.10	0	0.11	0.295726161	775.039122	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2017.12.11	0	0.11	0.295726161	775.039122	18600.93893	18600.93893	18600.93893	18600.93893	18600.93893
2017.12.12	0	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.12.13	0	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.12.14	0	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.12.15	0	0.1	0.256252222	671.5858233	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2017.12.16	0	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.12.17	0	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.12.18	0	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.12.19	0	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.12.20	0	0.09	0.218707541	573.1887239	13756.52937	13756.52937	13756.52937	13756.52937	13756.52937
2017.12.21	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.22	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.23	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.24	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.25	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.26	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.27	0	0.08	0.183199642	480.1296223	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2017.12.28	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.12.29	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.12.30	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2017.12.31	0	0.07	0.149855342	392.7408808	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
Total	**1.9**			**Total**	**496419.6682**	**549462.7507**	**549462.7507**	**549462.7507**	**549462.7507**

2018 January									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.01.01	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.01.02	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.01.03	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.01.04	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.01.05	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.01.06	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.01.07	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.08	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.09	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.10	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.11	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.12	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.13	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.01.14	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.01.15	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.01.16	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.01.17	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.01.18	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.01.19	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.01.20	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.21	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.22	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.23	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.24	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.25	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.26	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.27	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.28	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.29	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.30	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.01.31	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
Total	**0**			**Total**	**187846.716**	**187846.716**	**187846.716**	**187846.716**	**187846.716**

2018 February									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.02.01	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.02.02	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.02.03	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.02.04	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.02.05	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.02.06	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.02.07	1.9	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.02.08	2.5	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.02.09	3.2	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.02.10	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2018.02.11	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.02.12	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.02.13	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.02.14	0	0.07	0.149855342	392.7409	9425.781138	9425.781138	9425.781138	9425.781138	9425.781138
2018.02.15	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.02.16	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.02.17	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.02.18	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.02.19	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.02.20	0	0.05	0.090305216	236.6719	5418.312968	5418.312968	5418.312968	5418.312968	5418.312968
2018.02.21	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.02.22	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.02.23	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.02.24	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.02.25	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.02.26	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.02.27	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.02.28	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
Total	**7.6**			**Total**	**167190.4304**	**167190.4304**	**167190.4304**	**167190.4304**	**167190.4304**

2018 March									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.03.01	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.02	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.03	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.04	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.05	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.06	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2018.03.07	0	0	0	0	0	0	0	0	0
2018.03.08	0	0	0	0	0	0	0	0	0
2018.03.09	0	0	0	0	0	0	0	0	0
2018.03.10	0	0	0	0	0	0	0	0	0
2018.03.11	0	0	0	0	0	0	0	0	0
2018.03.12	0	0	0	0	0	0	0	0	0
2018.03.13	0	0	0	0	0	0	0	0	0
2018.03.14	0	0	0	0	0	0	0	0	0
2018.03.15	0	0	0	0	0	0	0	0	0
2018.03.16	1.2	0	0	0	0	0	0	0	0
2018.03.17	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.03.18	0.6	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.19	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.03.20	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.21	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.23	0.2	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.24	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.03.25	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.26	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.03.27	0	0	0	0	0	0	0	0	0
2018.03.28	0	0	0	0	0	0	0	0	0
2018.03.29	0	0	0	0	0	0	0	0	0
2018.03.30	0	0	0	0	0	0	0	0	0
2018.03.31	0	0	0	0	0	0	0	0	0
Total	**2**			**Total**	**34080.32241**	**34080.32241**	**34080.32241**	**34080.32241**	**34080.32241**

Conclusion for 2017-18	
Total Rainfall of 2016-17 (Cm)	**290.6**
Estimated power generation @ 1 MW (kWh)	49,01,211.90
Estimated power generation @ 2 MW (kWh)	78,23,590.22
Estimated power generation @ 3 MW (kWh)	97,38,536.28
Estimated power generation @ 4 MW (kWh)	1,07,86,021.74
Estimated power generation @ 4 MW + 10% COL	1,10,94,199.68

2018 April									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.04.01	0	0	0	0	0	0	0	0	0
2018.04.02	0	0	0	0	0	0	0	0	0
2018.04.03	0	0	0	0	0	0	0	0	0
2018.04.04	0	0	0	0	0	0	0	0	0
2018.04.05	0	0	0	0	0	0	0	0	0
2018.04.06	0.9	0	0	0	0	0	0	0	0
2018.04.07	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.08	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.09	0	0	0	0	0	0	0	0	0
2018.04.10	0	0	0	0	0	0	0	0	0
2018.04.11	0	0	0	0	0	0	0	0	0
2018.04.12	0.9	0	0	0	0	0	0	0	0
2018.04.13	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.14	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.15	0	0	0	0	0	0	0	0	0
2018.04.16	1.3	0	0	0	0	0	0	0	0
2018.04.17	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.18	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.19	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.20	1.1	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.21	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.04.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.23	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.24	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.25	0	0	0	0	0	0	0	0	0
2018.04.26	0.9	0	0	0	0	0	0	0	0
2018.04.27	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.28	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.29	0.2	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.04.30	0	0	0	0	0	0	0	0	0
Total	**5.3**			**Total**	**22949.28761**	**22949.28761**	**22949.28761**	**22949.28761**	**22949.28761**

2018 May									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.05.01	0	0	0	0	0	0	0	0	0
2018.05.02	0.2	0	0	0	0	0	0	0	0
2018.05.03	1.2	0	0	0	0	0	0	0	0
2018.05.04	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.05	2.4	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.06	1.2	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.07	0.2	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.05.08	0.1	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.09	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.10	0.2	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.11	1	0	0	0	0	0	0	0	0
2018.05.12	1.6	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.05.13	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.05.14	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2018.05.15	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.16	0.4	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.17	2.8	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.18	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.05.19	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.20	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.21	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2018.05.23	0	0	0	0	0	0	0	0	0
2018.05.24	0.4	0	0	0	0	0	0	0	0
2018.05.25	0	0	0	0	0	0	0	0	0
2018.05.26	0	0	0	0	0	0	0	0	0
2018.05.27	0.2	0	0	0	0	0	0	0	0
2018.05.28	8.3	0	0	0	0	0	0	0	0
2018.05.29	2.1	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.05.30	2.8	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.05.31	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
Total	**25.1**			**Total**	**124023.6748**	**177955.4088**	**179051.7678**	**179051.7678**	**179051.7678**

2018 June									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.06.01	0.4	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.06.02	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.06.03	0.6	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.06.04	1.6	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.06.05	0.3	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.06.06	2.4	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.06.07	2.9	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.06.08	6.6	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.06.09	14.6	0.32	1.465874586	3841.764	24000	48000	72000	92202.33879	92202.33879
2018.06.10	13.4	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.06.11	10.6	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.06.12	3.9	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.06.13	5.8	0.45	2.436729746	6386.181	24000	48000	72000	96000	105600
2018.06.14	0.4	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2018.06.15	0.3	0.32	1.465874586	3841.764	24000	48000	72000	92202.33879	92202.33879
2018.06.16	4.1	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.06.17	0	0.34	1.604746498	4205.72	24000	48000	72000	96000	100937.2709
2018.06.18	2	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.06.19	3.6	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.06.20	3.5	0.32	1.465874586	3841.764	24000	48000	72000	92202.33879	92202.33879
2018.06.21	1.7	0.34	1.604746498	4205.72	24000	48000	72000	96000	100937.2709
2018.06.22	0.6	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.06.23	0.7	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.06.24	0.3	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.06.25	2.1	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.06.26	1.6	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.06.27	1.4	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.06.28	1.5	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.06.29	1.3	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.06.30	2	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
Total	**90.2**			**Total**	**720000**	**1293508.674**	**1817107.295**	**2141899.218**	**2199773.76**

2018 July									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.07.01	0.3	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.07.02	2.6	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.07.03	0	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.07.04	0	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.07.05	0	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.07.06	0.7	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.07.07	2.7	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.07.08	6.9	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.07.09	7.1	0.34	1.604746498	4205.72	24000	48000	72000	96000	100937.2709
2018.07.10	4.6	0.38	1.894350904	4964.715	24000	48000	72000	96000	105600
2018.07.11	4.2	0.34	1.604746498	4205.72	24000	48000	72000	96000	100937.2709
2018.07.12	6.7	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2018.07.13	4.5	0.44	2.356608395	6176.199	24000	48000	72000	96000	105600
2018.07.14	5.3	0.42	2.198954765	5763.021	24000	48000	72000	96000	105600
2018.07.15	11.8	0.46	2.517698645	6598.385	24000	48000	72000	96000	105600
2018.07.16	4.1	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.07.17	5.8	0.5	2.84983143	7468.838	24000	48000	72000	96000	105600
2018.07.18	2.7	0.56	3.371700347	8836.552	24000	48000	72000	96000	105600
2018.07.19	5.2	0.5	2.84983143	7468.838	24000	48000	72000	96000	105600
2018.07.20	2.3	0.54	3.194688421	8372.639	24000	48000	72000	96000	105600
2018.07.21	1.4	0.48	2.682134781	7029.339	24000	48000	72000	96000	105600
2018.07.22	2.9	0.42	2.198954765	5763.021	24000	48000	72000	96000	105600
2018.07.23	5.8	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2018.07.24	13.9	0.44	2.356608395	6176.199	24000	48000	72000	96000	105600
2018.07.25	4.4	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.07.26	0.9	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.07.27	0.1	0.5	2.84983143	7468.838	24000	48000	72000	96000	105600
2018.07.28	7.3	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2018.07.29	1.2	0.46	2.517698645	6598.385	24000	48000	72000	96000	105600
2018.07.30	8.7	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2018.07.31	0.9	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
Total	**125**			**Total**	**744000**	**1488000**	**2214394.485**	**2796895.476**	**3008370.017**

2018 August									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.08.01	0.1	0.4	2.044834464	5359.102	24000	48000	72000	96000	105600
2018.08.02	0.2	0.36	1.747615062	4580.15	24000	48000	72000	96000	105600
2018.08.03	0	0.32	1.465874586	3841.764	24000	48000	72000	92202.33879	92202.33879
2018.08.04	0.4	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.08.05	0.2	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.08.06	4.4	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.08.07	5.9	0.34	1.604746498	4205.72	24000	48000	72000	96000	100937.2709
2018.08.08	23	0.36	1.747615062	4580.15	24000	48000	72000	96000	105600
2018.08.09	9.3	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.10	6.2	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.11	1.1	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.12	6.9	0.54	3.194688421	8372.639	24000	48000	72000	96000	105600
2018.08.13	10.5	0.56	3.371700347	8836.552	24000	48000	72000	96000	105600
2018.08.14	17.1	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.15	24.5	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.16	9.8	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.17	7.4	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.18	3.7	0.6	3.734547665	9787.503	24000	48000	72000	96000	105600
2018.08.19	2.1	0.58	3.5516752	9308.23	24000	48000	72000	96000	105600
2018.08.20	1.3	0.5	2.84983143	7468.838	24000	48000	72000	96000	105600
2018.08.21	0.4	0.42	2.198954765	5763.021	24000	48000	72000	96000	105600
2018.08.22	0.2	0.38	1.894350904	4964.715	24000	48000	72000	96000	105600
2018.08.23	0	0.36	1.747615062	4580.15	24000	48000	72000	96000	105600
2018.08.24	0	0.32	1.465874586	3841.764	24000	48000	72000	92202.33879	92202.33879
2018.08.25	0	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.08.26	0	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.08.27	2.1	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.08.28	0.4	0.3	1.331140006	3488.652	24000	48000	72000	83727.64148	83727.64148
2018.08.29	0	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.08.30	0	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.08.31	0	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
Total	**137.2**			**Total**	**744000**	**1488000**	**2232000**	**2953214.033**	**3708874.199**

2018 September									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.09.01	0	0.28	1.200696574	3146.786	24000	48000	72000	75522.85397	75522.85397
2018.09.02	0	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.09.03	0	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.09.04	0	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.09.05	0	0.26	1.074713529	2816.609	24000	48000	67598.62118	67598.62118	67598.62118
2018.09.06	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2018.09.07	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2018.09.08	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2018.09.09	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2018.09.10	0	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2018.09.11	0	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2018.09.12	0	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2018.09.13	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.09.14	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.09.15	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.09.16	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.09.17	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.09.18	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.09.19	1.8	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.09.20	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.09.21	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.09.22	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.09.23	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.09.24	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.09.25	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.09.26	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.09.27	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.09.28	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.09.29	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.09.30	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
Total	**1.8**			**Total**	**720000**	**1267664.795**	**1431847.404**	**1435370.258**	**1435370.258**

2018 October									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.10.01	0.3	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.02	0.2	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.03	0.9	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.04	2.7	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.05	1.3	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.06	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.07	0.1	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.08	1.8	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.09	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.10	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.11	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.12	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.13	2.4	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.14	0.1	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.15	1.6	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.16	4.9	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.17	0	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2018.10.18	0.9	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.19	1.9	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.20	3.3	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.21	0	0.24	0.95337841	2498.614	24000	48000	59966.73931	59966.73931	59966.73931
2018.10.22	1.4	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.10.23	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.10.24	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.25	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.10.26	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.27	0.4	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.28	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.10.29	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.30	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.10.31	0.9	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
Total	**25.1**			**Total**	**744000**	**1066044.64**	**1082651.768**	**1082651.768**	**1082651.768**

2018 November									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.11.01	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.02	0.3	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.03	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.04	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.05	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.06	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.07	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.08	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.09	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.10	0.2	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.11	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.12	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.13	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.14	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.15	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.16	13.6	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.11.17	0	0.22	0.836900772	2193.35	24000	48000	52640.38903	52640.38903	52640.38903
2018.11.18	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.11.19	0	0.2	0.725517037	1901.435	24000	45634.44119	45634.44119	45634.44119	45634.44119
2018.11.20	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.11.21	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.11.22	0	0.18	0.619497021	1623.578	24000	38965.86702	38965.86702	38965.86702	38965.86702
2018.11.23	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.11.24	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.11.25	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.11.26	0	0.16	0.519152933	1360.596	24000	32654.30418	32654.30418	32654.30418	32654.30418
2018.11.27	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.28	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.29	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.11.30	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
Total	**14.1**			**Total**	**697594.6756**	**877052.7482**	**881693.1372**	**881693.1372**	**881693.1372**

2018 December									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2018.12.01	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.12.02	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.12.03	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.12.04	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.12.05	0	0.14	0.424852214	1113.453	24000	26722.86437	26722.86437	26722.86437	26722.86437
2018.12.06	0	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2018.12.07	0	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2018.12.08	0	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2018.12.09	0	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2018.12.10	0	0.13	0.380102553	996.1728	23908.1465	23908.1465	23908.1465	23908.1465	23908.1465
2018.12.11	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.12.12	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.12.13	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.12.14	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.12.15	0	0.12	0.337036631	883.3056	21199.33444	21199.33444	21199.33444	21199.33444	21199.33444
2018.12.16	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2018.12.17	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2018.12.18	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2018.12.19	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2018.12.20	0	0.1	0.256252222	671.5858	16118.05976	16118.05976	16118.05976	16118.05976	16118.05976
2018.12.21	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.22	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.23	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.24	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.25	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.26	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.27	0	0.08	0.183199642	480.1296	11523.11094	11523.11094	11523.11094	11523.11094	11523.11094
2018.12.28	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.12.29	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.12.30	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2018.12.31	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
Total	**0**			**Total**	**536686.084**	**550300.4059**	**550300.4059**	**550300.4059**	**550300.4059**

2019 January									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2019.01.01	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2019.01.02	0	0.06	0.118827441	311.423	7474.150978	7474.150978	7474.150978	7474.150978	7474.150978
2019.01.03	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.04	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.05	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.06	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.07	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.08	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.09	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.10	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.11	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.12	0	0.05	0.090305216	236.6719	5680.125851	5680.125851	5680.125851	5680.125851	5680.125851
2019.01.13	0	0.04	0.064532076	169.1257	4059.015934	4059.015934	4059.015934	4059.015934	4059.015934
2019.01.14	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.15	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.16	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.17	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.18	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.19	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.20	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.21	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.22	0	0.04	0.064532076	169.1257	3871.92454	3871.92454	3871.92454	3871.92454	3871.92454
2019.01.23	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.24	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.25	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.26	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.27	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.28	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.29	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.30	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.01.31	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
Total	**0**			**Total**	**133248.5691**	**133248.5691**	**133248.5691**	**133248.5691**	**133248.5691**

2019 February									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2019.02.01	0	0.03	0.041838281	109.6498	2510.296868	2510.296868	2510.296868	2510.296868	2510.296868
2019.02.02	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.03	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.04	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.05	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.06	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.07	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.08	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.09	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.10	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.11	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.12	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.13	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.14	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.15	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.16	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.17	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.18	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.19	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.20	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.21	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.22	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.23	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.24	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.25	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.26	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.27	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
2019.02.28	0	0.02	0.022711147	59.52137	1362.66879	1362.66879	1362.66879	1362.66879	1362.66879
Total	**7.6**			**Total**	**39302.35421**	**39302.35421**	**39302.35421**	**39302.35421**	**39302.35421**

2019 March									
Date	Rainfall (Cm)	River Gauge Reading, h (m)	Discharge Q = 1.842(b-0.2h)h^1.5079 (m^3/sec), b= 4.5 m	Power Potential , P = 8.4 x 312 x Q	Estimated Generation @ 1 MW (kWh)	Estimated Generation @ 2 MW (kWh)	Estimated Generation @ 3 MW (kWh)	Estimated Generation @ 4 MW (kWh)	Estimated Generation @ 4 MW + 10% COL (kWh)
2019.03.01	0	0	0	0	0	0	0	0	0
2019.03.02	0	0	0	0	0	0	0	0	0
2019.03.03	0	0	0	0	0	0	0	0	0
2019.03.04	0	0	0	0	0	0	0	0	0
2019.03.05	0	0	0	0	0	0	0	0	0
2019.03.06	0	0	0	0	0	0	0	0	0
2019.03.07	0	0	0	0	0	0	0	0	0
2019.03.08	0	0	0	0	0	0	0	0	0
2019.03.09	0	0	0	0	0	0	0	0	0
2019.03.10	0	0	0	0	0	0	0	0	0
2019.03.11	0	0	0	0	0	0	0	0	0
2019.03.12	0	0	0	0	0	0	0	0	0
2019.03.13	0	0	0	0	0	0	0	0	0
2019.03.14	0	0	0	0	0	0	0	0	0
2019.03.15	0	0	0	0	0	0	0	0	0
2019.03.16	0	0	0	0	0	0	0	0	0
2019.03.17	0	0	0	0	0	0	0	0	0
2019.03.18	0	0	0	0	0	0	0	0	0
2019.03.19	0	0	0	0	0	0	0	0	0
2019.03.20	0	0	0	0	0	0	0	0	0
2019.03.21	0	0	0	0	0	0	0	0	0
2019.03.22	0	0	0	0	0	0	0	0	0
2019.03.23	0	0	0	0	0	0	0	0	0
2019.03.24	0	0	0	0	0	0	0	0	0
2019.03.25	0	0	0	0	0	0	0	0	0
2019.03.26	0	0	0	0	0	0	0	0	0
2019.03.27	0	0	0	0	0	0	0	0	0
2019.03.28	0	0	0	0	0	0	0	0	0
2019.03.29	0	0	0	0	0	0	0	0	0
2019.03.30	0	0	0	0	0	0	0	0	0
2019.03.31	0	0	0	0	0	0	0	0	0
Total	**0**			**Total**	**0**	**0**	**0**	**0**	**0**

Conclusion for 2018-19	
Total Rainfall of 2018-19 (Cm)	**423.8**
Estimated power generation @ 1 MW	52,18,059.74
Estimated power generation @ 2 MW	83,74,624.72
Estimated power generation @ 3 MW	1,05,54,047.95
Estimated power generation @ 4 MW	1,20,37,520.87
Estimated power generation @ 4 MW + 10% COL	1,24,84,607.23

3.5 Rainfall – Runoff Relationship:

The basic Inglis formula for annual runoff is R = 0.85 P – 305 mm. Where R = annual runoff in mm and 'P' is annual rainfall in mm. This means that, 15% of the annual rainfall plus 305 mm is allowed for evaporation and groundwater recharging. Only the remaining part of the annual rainfall will be drained as runoff and only that can be utilized for power generation.

The annual runoff in mm is multiplied by the catchment area to get the annual inflow in Million Cubic Meters (MCM), which is further divided by the quantity of water required for generating one Million unit electricity in Million Cubic Meters to assess the annual power generation potential.

The quantity of water required to generate 1000 kW with net head 312 meters is,

Q = 1000/(8.4 x 312) = 0.3815 m^3/sec ~ 0.4 m^3/sec.

Water required for generating 1000 kWh electricity = 0.4 m^3/sec x 60 x 60 seconds

= 0.4 m^3/sec x 3600 = 1440 m^3

This means that 1.44 m^3 water is required for generating 1 unit of electricity and it further means that 1.44 million cubic meter (MCM) water is required for generating 1 million unit of electricity at this site.

Case Study-1:

For the year 2016-17, the annual rainfall recorded at the catchment area of this project was 1612 mm – almost 50% lower than the long-term average.

By Inglis formula, the annual runoff, R = 0.85 x 1612 – 305 = 1065.2 mm

The catchment area is 8.85 km^2; Hence the annual inflow = 1.0652 m x 8.85 x 1000 m x 1000 m

= 9.427 Million Cubic Meter (MCM)

Power Generation Potential for 2016-17 = 9.427 MCM/1.44 MCM = 6.54 million units

The estimated generation for 2016-17 from the river gauge data at 4 MW+10 COL is 5.15 million units which indicates the power potential estimation from the river gauge data is in to the safer side and a part of this difference between these two estimations shall be accounted for the spillage in high flow days during peak monsoon.

Case Study-2:

For the year 2017-18, the annual rainfall recorded at the catchment area of this project was 2906 mm

By Inglis formula, the annual runoff, R = 0.85 x 2906 – 305 = 2165.1 mm

The catchment area is 8.85 km²; Hence the annual inflow = 2.1396 m x 8.85 x 1000 m x 1000 m

= 19.16 Million Cubic Meter (MCM)

Power Generation Potential for 2017-18 = 19.16 MCM/1.44 MCM = 13.30 million units

The estimated generation for 2017-18 from the river gauge data at 4 MW+10 COL is 11.09 million units which again indicates the power potential estimation from the river gauge data is in to the safer side and a part of this difference between these two estimations shall be accounted for the spillage in high flow days during peak monsoon.

Case Study-3:

For the year 2018-19, the annual rainfall recorded at the catchment area of this project was 4238 mm

By Inglis formula, the annual runoff, R = 0.85 x 4238 – 305 = 3297.3 mm

The catchment area is 8.85 km²; Hence the annual inflow = 3.2973 m x 8.85 x 1000 m x 1000 m

= 29.18 Million Cubic Meter (MCM)

Power Generation Potential for 2018-19 = 29.18 MCM/1.44 MCM = 20.26 million units

The estimated generation for 2018-19 from the river gauge data at 4 MW+10 COL is 12.48 million units

As 2018-19 was a flood year, the power potential of the site was 6-7 MW in many days and since the calculations have been restricted to 4 MW+10% COL, this variation has arisen between the two methods.

3.5 Environmental flow:

Necessary arrangements shall be made to let out a minimum environmental flow from the reservoir to the downstream. The developer has already furnished an Affidavit in this regard to the Department of Irrigation, Government of Kerala on 01.02.2017 (Annexure-6)

Case Study-4: Analysis of monthly rainfall data between 1995-96 and 2013-14:

MONTHLY RAINFALL DATA – INDIA METEOROLOGICAL DEPARTMENT, IDUKKI DISTRICT														
Sl.No.	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
1	1999	0	99.6	40	133.6	572.6	512.6	1105	449	149.7	518.2	67.5	5	3652.7
2	2000	2.5	136.1	0	66.5	202.4	1032	482.5	1108	257.6	127.2	70	30.4	3515.6
3	2001	31	23.6	3	221.8	167.1	1001	1012	625.1	156.8	632.4	128.6	0	4002.3
4	2002	0	8.2	71	60.4	339.7	534.8	793.7	689.6	106.1	395	128.8	0	3127.3
5	2003	0	25.2	91.4	153	114	467.2	730.8	721.8	163.4	518.2	37.1	8.1	3030.2
6	2004	0	4.2	42	129.5	550.5	752.9	703.4	660.4	319.9	276.1	52.8	0	3491.7
7	2005	25.7	14	75.1	185.3	145	545.9	1316	633.3	829.7	245.9	269.3	49.4	4334.1
8	2006	2.8	0	88.7	83.1	458.7	586	833	516.4	481.7	319.7	225.5	0	3595.6
9	2007	2	2.2	18.8	126.6	127	711.7	1156	575.5	783.9	419.3	72.1	49	4043.7
10	2008	0	46.9	230.5	105.4	15.3	547.3	656.2	660.6	404.6	288.8	35	0	2990.6
11	2009	0	0	109.8	65.8	154.4	411.5	1010	464.8	515.4	306.6	246.5	58.9	3343.9
12	2010	18.4	0	24.3	160.7	150.8	675.8	767.6	552	310	401.6	265.2	8.6	3335
13	2011	65.2	43.2	1.4	210.9	73.7	835.6	719.2	724.2	314.2	306.8	126.6	32.6	3453.6
14	2012	8.8	2.6	47.2	277	106.4	423.9	501	606.1	273.1	202.4	147.7	5.3	2601.5
15	2013	0.3	15.1	51.7	109.9	95.5	1123	1026	688.7	507.3	229.9	199.2	13.6	4060.4
16	2014	7.9	14.1	27.1	86.8	237.2	493	898.7	904.7	410.4	421.6	127.1	54.4	3683
17	2015	1.4	14.4	78.4	280.6	165.9	644.9	436.3	271.3	344	253.6	248.1	127.6	2866.5
18	2016	5.1	5.1	26.4	39.1	292.7	586.3	540.8	322.6	119.8	117.1	37.9	19.1	2112
19	2017	12.8	1.1	122.2	71.1	210	517.9	293.4	713.1	534.5	285.3	117.1	91	2969.5
20	2018	1.8	41.5	52.6	134.8	356	806.4	1296	1479	212.4	325.6	194.3	6.5	4906.8
													Average	3455.8

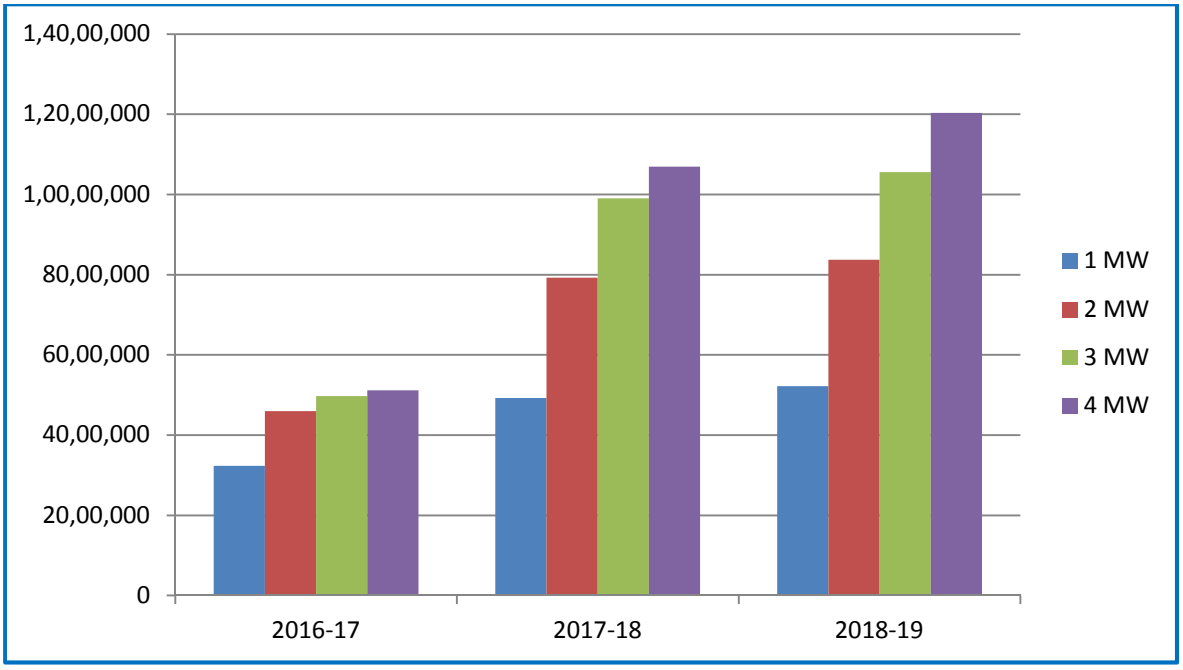
The rainfall data of these 19 years indicates that the average annual rainfall was 3455.8 mm and average annual power generation potential as 16.16 Mu. However, the amount of average annual rainfall has been reduced over these years and what we can expect is around 3000 mm annually for this catchment area.

In this context, it is wise to choose the year 2017-18 as a benchmark year for the actual hydrology analysis of this site.

The annual rainfall received at the catchment area of this project in 2017-18 was 2906 mm and the power potential estimation by Inglis formula for this catchment area of 8.85 Sq. Km is 13.30 Mu. However, it is to be noted that the excess inflow above 1.68 cumecs (for 4 MW + 10% COL) during heavy rainfall days cannot be utilized for power generation and this excess water will be spilled as the reservoir has very little storage capacity. Hence the actual annual power generation will be 10-15% lower than this estimation by Inglis formula.

The hydrology analysis of the river gauge data for this corresponding period, with installed capacity as 4 MW + 10% COL yields the estimated annual power generation as 11.09 million units. Hence it is just to believe that the optimum installed capacity of this site shall be 4 MW and the annual power generation potential is somewhere around 11 million units.

The graphical presentation of estimated power generation for installed capacities of 1 MW to 4 MW for 2016-17, 2017-18 and 2018-19 is as follows:



CHAPTER - 4

POWER POTENTIAL AND INSTALLED CAPACITY

4.1 General

As the project is a 'Run of the river' scheme, the installed capacity will be optimum with reference to the cost of generation or cost per MW installed. In most of the cases the variation in cost of civil works will be nil or very little compared to the equipment cost, which again will not increase in proportion to the increase in installed capacity because many auxiliary equipment cost may remain more or less same. Thus, for such schemes, the optimization results in maximizing the installed capacity so that more generation is possible during the rainy season; with this in mind, the optimum installed capacity is arrived at as follows:

4.2 Design Head

Studying the survey data, the gross head from the weir to the power house site now is 321 m. For this range of head Pelton turbine is suitable and hence recommended. A Pelton turbine has to discharge in atmospheric conditions and hence the setting has to be above HFL of the river at the powerhouse area. Considering this setting, the unit centerline is kept at EL 307.00, as the maximum tail water level is EL 304.00.

The flood level of *Muthirappuzha* was noted during the 2018 floods while all the five spillway gates of Kallarkutty reservoir, which is located 2.8 Km upstream from the power house site of Mukkudam SHP, were opened fully to release the flood waters released from the upstream dams – Kundala, Mattuppetty, Head Works dam at Munnar, Anayirankal and Ponumudi - and it was EL 303.00

The FRL at the diversion weir is EL 628.0 and thus the gross head is 628.00 – 307.00 = 321.00 m; allowing for friction losses in the water conveyor system, the net head is taken as 312 m for energy calculation.

4.3 Discharge

The rated discharge for 4000 kW + 10% overload is given as 1.68 Cumecs (1680 lit/sec). During actual final equipment selection this may slightly vary depending on the selected equipment considering economic evaluation by loading for differences in efficiency, etc.

4.4 Power Potential Study

The power rating is given by the equation 'P' = C x Q x H where 'P' is in kW, 'C' is a constant considering the overall efficiency of turbine, generator and gear box if any, 'Q' is flow in cumecs and 'H' is head in meters. For impulse turbines the 'C' value can be from 8 to 9. In this case, adopted is a 'C' value of 8.4 Hence for power potential study this 'C' value is taken for daily power generation with respect to water availability. When water available is more than that for 4400 kW, the surplus is taken as spill and not

available for power generation as there is only a small storage of about 4100 m³, which is of some use only during low flow season. The above 'C' value indicates an overall efficiency of 85.62% which is on the conservative side and on actual offers one can expect a higher efficiency resulting in some more generation.

Summary of hydrology analysis of river gauge records for 2016-17, 2017-18 and 2018-19:

Table 4.1

Conclusion for 2016-17	
Total Rainfall of 2016-17 (Cm)	**161.2**
Estimated power generation @ 1 MW (kWh)	32,32,390.86
Estimated power generation @ 2 MW (kWh)	46,01,130.84
Estimated power generation @ 3 MW (kWh)	49,73,920.58
Estimated power generation @ 4 MW (kWh)	51,20,623.91
Estimated power generation @ 4 MW + 10% COL (kWh)	51,54,361.18

Table 4.2

Conclusion for 2017-18	
Total Rainfall of 2016-17 (Cm)	**290.6**
Estimated power generation @ 1 MW (kWh)	49,01,211.90
Estimated power generation @ 2 MW (kWh)	78,23,590.22
Estimated power generation @ 3 MW (kWh)	97,38,536.28
Estimated power generation @ 4 MW (kWh)	1,07,86,021.74
Estimated power generation @ 4 MW + 10% COL (kWh)	1,10,94,199.68

Table 4.3

Conclusion for 2018-19	
Total Rainfall of 2018-19 (Cm)	**423.8**
Estimated power generation @ 1 MW (kWh)	52,18,059.74
Estimated power generation @ 2 MW (kWh)	83,74,624.72
Estimated power generation @ 3 MW (kWh)	1,05,54,047.95
Estimated power generation @ 4 MW (kWh)	1,20,37,520.87
Estimated power generation @ 4 MW + 10% COL (kWh)	1,24,84,607.23

As 2016-17 being a rainfall-deficit year, 2017-18 a normal monsoon year and 2018-19 a flood year, 2017-18 is considered as a benchmark year for the hydrology analysis.

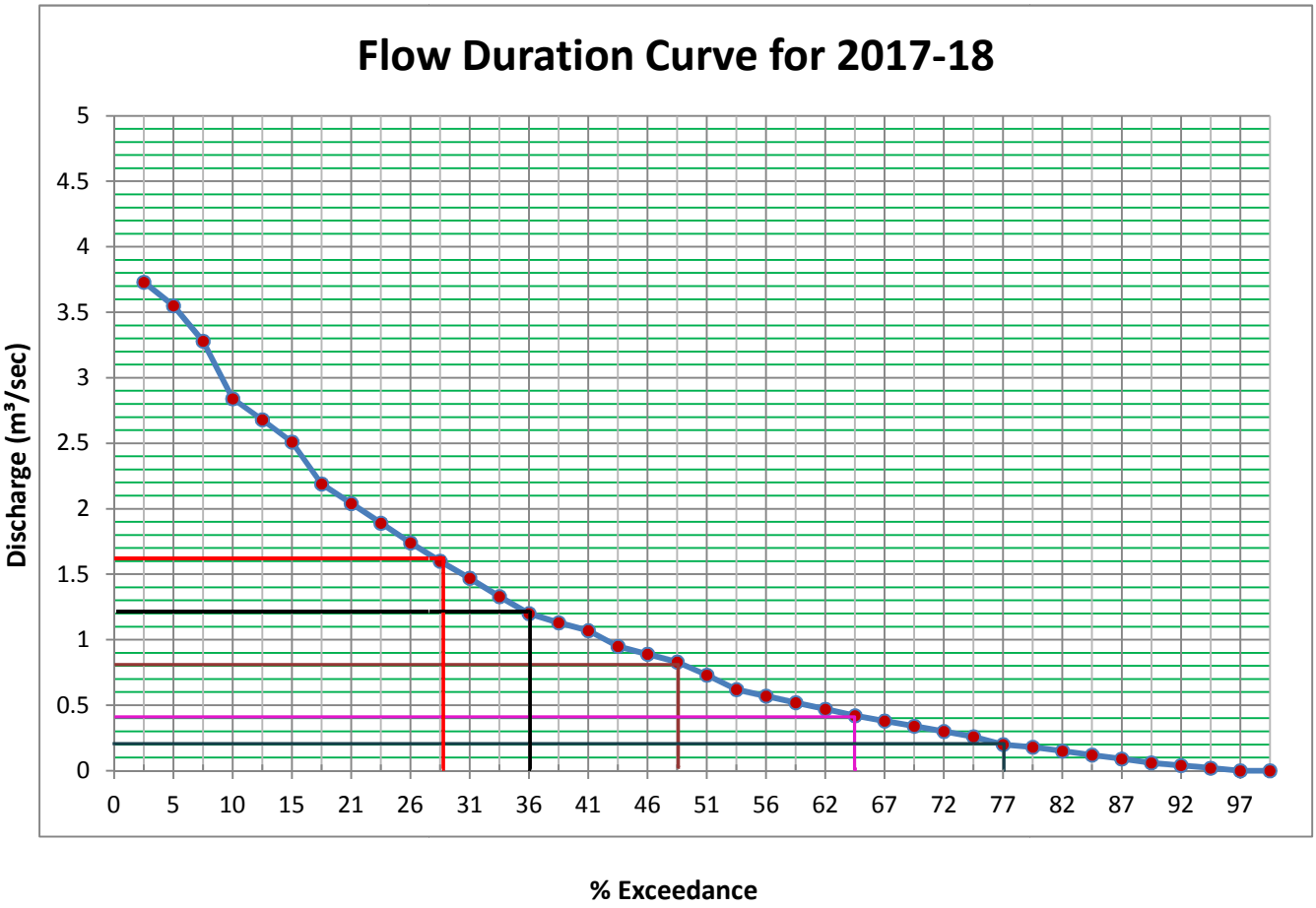
Summarizing the analysis for 2017-18, for 4000 kW – the estimated annual power generation is 10.79 Mu.

For 4000 kW+10% overload, the estimated annual power generation is 11.09 Mu.

4.5 Flow Duration Analysis

Apart from the hydrology analysis described above, a check is made by flow duration analysis. The flow as for the year 2017-18 is compiled as one set and the water availability at different flows and corresponding percentage time of excess is tabulated. This is given in Table below and the same is represented as a 'Flow duration curve' afterwards.

Flow	Rank	%
3.73	1	2.56
3.55	2	5.13
3.28	3	7.69
2.84	4	10.26
2.68	5	12.82
2.51	6	15.38
2.19	7	17.95
2.04	8	20.51
1.89	9	23.08
1.74	10	25.64
1.6	11	28.21
1.47	12	30.77
1.33	13	33.33
1.2	14	35.90
1.13	15	38.46
1.07	16	41.03
0.95	17	43.59
0.89	18	46.15
0.83	19	48.72
0.73	20	51.28
0.62	21	53.85
0.57	22	56.41
0.52	23	58.97
0.47	24	61.54
0.42	25	64.10
0.38	26	66.67
0.34	27	69.23
0.3	28	71.79
0.26	29	74.36
0.2	30	76.92
0.18	31	79.49
0.15	32	82.05
0.12	33	84.62
0.09	34	87.18
0.06	35	89.74
0.04	36	92.31
0.02	37	94.87
0	38	97.44



From these it can be seen that the flow exceeds the minimum flow required for 4 MW (1.6 Cumecs) for 28% of time; exceeds 1.2 cumecs (3 MW) for 36% of time; 0.8 cumecs (2 MW) for 48.5% of time, 0.40 cumecs (1 MW) for 64.5% of time and 0.2 cumecs (0.5 MW) for 77% of the time.

Even though the water availability for 4 MW is available only for few days (30 – 50 days) in a year, it is wise to go for 4 MW for the following reasons:

1. The pattern of monsoon distribution in Kerala has been changed significantly over the past two decades. The number of rainy days per year has been come down from 200 – 220 days to 150 – 180 days and number of heavy to very heavy rainfall days has been increased significantly during July – August months. A higher installed capacity is proposed to tap the additional power generation potential during these heavy rainfall days.
2. The cost/ MW comes down when the installed capacity is enhanced and the cost for additional civil work and additional penstock size are negligible compared to the additional revenue being generated.

3. The reservoir has a live storage of 4100 m³, which can cater to operate one unit of 2 MW for 1.5 hours at 100% load and for 3 plus hours at 50% load. During lean flow season, water shall be stored during day time to cater the peak-load demand during evening hours.
4. There is an opportunity to increase the reservoir capacity by 1000 m³ by installing an inflatable rubber spillway in future. Also, capacity can be enhanced further by 1000-1500 m³ by excavating the rock at the upstream end of the reservoir.
5. The gauging station was not a standard one because of site restrictions and it has been confirmed that the flow measured was much conservative than the actual flow. Hence we can definitely expect more generation than what is estimated.
6. In his appraisal letter of Sri. V V Nair on the Original DPR, dated: 29.03.2016 (Annexure-8), it had been instructed: "*Maximum utilization of power potential is envisaged as per the SHP Policy 2012 of Govt. of Kerala. Hence the prospective investor is advised to augment the proposed first stage capacity of 1MW to the maximum viable installed capacity in future in a phased manner based on the actual flow data measurement by establishing a gauging weir..*". Since the high head of this site is the major contributor of power potential, it is ideal to keep the installed capacity on the higher side so as to tap the power generation potential in high flow days during monsoon.

4.6 Selection of units

As seen from water availability it was possible to provide the installed capacity to 4000 kW with 10% overload also and budgetary offers were invited and obtained.

The discharge required for 4000 kW is given as 1530 lt/sec, reflecting better efficiency.

Considering the fluctuations in the flow, it is proposed to adopt two units of 2000kW each so that one unit is available for operation during low flow season and each can be serviced one after the other. Nowadays, generating units with Continuous Over Load capacity up to 25% is available in market and hence excess power can be generated during high flow seasons. The sizing of the penstock is designed accordingly to accommodate this excess flow.

As seen from the Table 4.2 and 4.3, the most conservative average annual generation is 10.79 Mu with the hydrology data of this site without overloading which gives a PLF of 30.78%. With overloading during monsoon season, the estimated generation is 11.09 Mu and hence this value is taken for financial analysis.

4.7 Generation with different reliability

From the abstract of the power generation tables 4.1, 4.2 and 4.3, the annual generation with installed capacity 4 MW is arranged in decreasing order and is given in Table 4.4 below:

Table 4.4

Rank	Year	Estimated Generation @ 4 MW (Mu)
1	2018-19	12.04
2	2017-18	10.79
3	2016-17	5.12

From this it can be seen that,

25% reliable year generation is 12.04 Mu

50% reliable year generation is 10.7 Mu

75% reliable year generation is 5.12 Mu.

CHAPTER - 5

GEOLOGY

The project area belongs to the typical formation of Western Ghats. The rock type in these ranges is of metamorphic nature, with more presence of Granitic Gneiss and Charnokite.

The dominant rock type at all the sites is gneiss. Exposed rock is seen at weir site and also the whole length of the Penstock portion. The bed of the waterfall is solid rock with small potholes due to the effect of falling water. Geological exploration by core boring will be done at the weir site before the commencement of detailed design. At the location of anchor blocks where there is no exposed blocks, trial pits will be taken. The powerhouse is proposed on the right bank of the stream.

Parathodu joins *Muthirapuzha* just a little after the powerhouse site. Being a bigger river as part of Periyar Basin, the river flows through a moderately level bed. Hence the river bank is formed by the accumulation of river cobbles and pebbles carried through the water in flood. In powerhouse area also rock is expected at reasonable depth as seen from the exposed rocks in left bank and river bed, where the penstock is proposed to cross the stream to reach the powerhouse.

Though there is cultivation and overburden in this area, rock is expected at shallow depth. Even otherwise the loads in powerhouse are not high and therefore suitable foundation can be designed to suit the strata after trial pits are taken to find the subsurface condition of about 3m below riverbed.

General Geology is suitable for weir; powerhouse sites and penstock system.

CHAPTER - 6

DETAILED DESCRIPTION OF CIVIL WORKS

Since there is no change to this chapter from the original DPR, this chapter has been excluded in this revised DPR. Kindly refer the original DPR in annexure for this chapter

CHAPTER - 7

POWER PLANT ELECTRICAL AND MECHANICAL WORKS

A. Mechanical Equipment

7.1. General

The mechanical equipment will consist of turbine, governor, oil pumping units, inlet butterfly valves/ gates and other auxiliaries like HOT crane; dewatering and drainage system; circulating water system, etc.

7.2 Turbine

As the head is 312 m, a Pelton turbine is proposed. Two identical units of 2000 kW rating with 10% overload capacity are considered. As per the budgetary offer, the turbines have double jet arrangement and are mounted on the horizontal extended shaft of the generator. The turbine wheel is integrally cast with ground finished buckets and the central hub is machined. The basic parameters of turbines are:

For 2000 kW + 10% COL

Rated discharge	760 lit/sec
Rated head	312 m
Rated power	2000 kW + 10% OL
Rated Speed	600 rpm
Elevation	308 m above MSL
Runner diameter	800 mm

7.2.1 Runner

Runner is made of cast stainless steel (13% Chromium and 6% Nickel) as per ASTM A743 CA6NM or equivalent. The runner housing is a casing; its top cover shall be bolted on the bottom casing embedded in foundation concrete.

7.2.2. Shaft

The turbine shaft shall have adequate diameter to operate safely and shall be designed to withstand vibration and distortion at maximum runaway speed. The material of shaft shall consist of carbon steel forging.

7.2.3 Shaft Sleeves

Stainless steel sleeves shall be provided at locations of packing / seals.

7.2.4 Shaft Seal

The shaft seal shall be designed so that the sealing elements can be inspected or replaced without disturbing the main guide bearing. This shall be of synthetic rubber rings.

7.2.5 Guide Bearings

The turbine guide bearings shall be of the tilting pad type or antifriction self lubricating type.

7.2.6 Inlet pipe and Jets

This is fabricated of cast steel. Nozzle tip and needle spear shall be of stainless steel. The nozzle opening and closing shall be by operation of hydraulic cylinder.

7.2.7 Jet Deflectors

For emergency conditions like line trip, provision of auto closing of turbine shall be by operation of jet deflector actuated by spring. During normal operation the deflector shall be kept away by oil pressure system and poppet valve.

The above sub paras are as per budgetary offer of Pelton turbine.

7.2.8 Turbine Inlet Valve

A butterfly valve hydraulically operated for isolation for maintenance.

7.2.9 Governor

Electronic type governor shall be provided to respond to changes in system frequency and / or load. The governor shall control the flow of water to the turbine to match the load by adjusting the position of the needle spear. The governor shall perform the following functions:

a. Control turbine generator
b. Isolated operation of set
c. Parallel operation with other set
d. Emergency shut down
e. Black start of turbine generator

7.2.10 OPU

It is proposed to have a common pressure oil system for the unit. Nitrogen balloon system will be used to maintain the pressure.

7.2.11 Drainage and Dewatering System

Being set above the graded level, no pumped drainage is needed. This will be by gravity flow through tailrace channel.

7.2.12 Cooling water System

It is proposed to have a cooling water system for generator air coolers, turbine shaft seals and lubricated oil exchangers. Water required for cooling and sealing of the machine will be tapped from the penstock and connected to a common header. Booster pumps (1 working, 1 standby) will supply water to each machine.

7.2.13. Crane

A HOT crane of adequate capacity shall be provided for facilitating erection and maintenance as required.

7.2.14 Ventilation System

For adequate ventilation and exhaust of hot air, rows of windows and ventilators shall be provided. Exhaust fans shall be provided at suitable locations.

B. Electrical System

7.3 Proposed System

The scheme of electrical generation of the proposed mini hydel plant will consist of 2 Nos x 2000 kW synchronous generators, connections, 3.3 kV and 11 kV systems, auxiliary power and interconnections

7.3.1 Generator

The parameters of the synchronous generator shall be as follows:

Quantity	: 1 No.
Rated Output	: 2000 kW
Rated Voltage	: 3.3 kV
Voltage Variation	: ± 10%
Rated Power Factor	: 0.8 lag /0.85 depending on grid PF
Rated Frequency	: 50 Hz
Frequency Variation	: ± 5%
Speed	: 800 rpm
Cooling System	: Closed Circuit, Air cooled
Neutral Earthing	: NGR

The generator shall be suitable for parallel operation between the generator units and the KSEB grid. The generator windings shall be of Class 'F' insulation with temperature rise limited to that of class 'B'. The generator windings shall be of star connected and the neutral shall be earthed by neutral grounding resistor to limit the earth fault current to about 100 Amps and provision shall be made for isolating the neutral of the generator. All six terminals of the generator shall be brought out for external connection.

7.3.2 Excitation System

The excitation system shall be of static or brushless type and shall be suitable for parallel operation of the generators with the grid. The system shall include AVR, field suppression equipment, field circuit breaker, converters for static excitation system or PMG for brushless excitation system, field flashing unit, etc. The ceiling voltage of the excitation system shall be at least 200% of the normal field voltage and response ratio shall be at least 2.0. The excitation system shall have the following features:

a. Maximum and minimum excitation limiter.
b. Resistive / reactive drop compensators.
c. V / Hz limiter.
d. Over current limiter.

Excitation system shall have both auto and manual mode and the above mentioned features shall be available in both the modes.

7.3.3 Power Transformer

One (1) No. Power Transformer with parameters as indicated below is envisaged for this new hydel power plant.

Rating	:	6000 kVA
Cooling	:	ONAN
Ratio	:	3.3 / 11 kV
Taps and Range	:	OLTC / ± 10% in Steps of 1.25%
Vector Group	:	YNd 1
Impedance	:	6.25%
Neutral Earthing	:	Solid Earthing

7.3.4 Station Auxiliary Transformer

One (1) No. Station Auxiliary Transformer with parameters as mentioned below is required to feed the station auxiliary loads such as lubricating oil pumps, governor oil pumps, dewatering and drainage pumps, crane, ventilation, lighting, etc.

Rating	:	100 KVA
Cooling	:	ONAN
Ratio	:	3.3 / 0.433 kV
Taps and Range	:	off circuit tap changer ± 7.5% in steps of 1.25%
Vector Group	:	DYn 11
Impedance	:	5%
Neutral Earthing	:	Solid Earthing

The station auxiliary transformer shall be pedestal mounted and shall be suitable for cable connection on both H.V. and L.V. sides.

7.3.5 Distribution Transformer It is proposed to install one (1) No. 11/0.433 kV, 100 KVA Distribution Transformer for construction power supply. The supply will be drawn from the nearby 11 kV grid. The same transformer shall be used as standby for station Auxiliary Transformer.

The distribution transformer shall be mounted on a 4 pole structure and will be provided with bushings on the HV side for terminating 11 kV line. The 11 kV line shall be provided with air break switch, metering facility, lightning arrester, isolator and dropout fuses for protecting the transformer. The LV side of the transformer shall be suitable for cable connection.

7.3.6 Diesel Generator

A diesel generator set of rating 63 KVA, 415 V is proposed to cater to the essential loads in case of emergency.

7.3.7 Electrical Protection System

The panels will house the CTs and PTs for measurement and protection with suitable accuracy limits.
The 3.3 kV breakers will consist of O/C, E/F relays, directional earth fault relays, trivector meter, kW meter, PF meter, etc.
The generator panel suitable for synchronous generator will consist of O/C, E/F relays, reverse power relays, over /under speed relays, differential current relays, KW meter, KVAR meter, KWH meter, PF meter, Voltmeter, ammeter, temperature scanner, alarm, annunciator, etc.
The transformer panel will consist of O/C, E/F relays, differential current relays, restricted earth fault relays, over voltage relay, buchholz, winding temperature, oil temperature, etc. kW meter, ammeter, etc.

7.3.8 3.3 kV Switchgear

The 3.3 kV Switchgear shall be VCB/ SF6 type and able to withstand a current of 16 KA for 1 sec.
This switchgear system is designed for:

a. Electrical control of equipment and indications on the control panel.
b. Power supply to the essential auxiliaries of the turbine in case of AC power failure.
c. Power supply for the following services in case of the total AC power failure
    i. Communication System
    ii. DC lightning of strategic areas for safe personnel movement

The battery sizing will be done to cater to the following type of loads:

a. Momentary load for 1 minute
b. Emergency load for 2 hours
c. Continuous load for 10 hours

Under normal conditions, the battery will be on float charger. The float charger is connected to a distribution board and meets the requirements of DC board. In case of additional demand of load or AC supply failure, the battery will meet the requirement of DC loads.
The boost charger will be designed to charge the fully discharged battery in 12 hours before putting it back on float charge.
One (1) No. 110 V battery bank of 300 AH with one float and boost charger and a direct current switchboard will meet the DC load. The batteries would be stationary lead acid type, complete with racks, porcelain insulator and intercell and inter tier connectors. The charger will be of silicon rectifier type with automatic voltage control and load limiting features.

The uninterrupted power supply shall be provided for the control system and data acquisition system and will be designed for 10 hours backup time; indoor type. The 3.3 kV Switchgear shall consist of generator breakers, generator transformer breakers and auxiliary transformer breakers, bus PT, metering and control CTs, etc.

7.3.9 LT Distribution Board

The 415 V distribution board will be of metal enclosed construction with single main bus bar and will be equipped with fixed type switchgear modules for the following:

a. Incomers with MCCB
b. Outgoing feeders to switchboards/ lightning panels with MCCB / switch fuse units.
c. Motor feeders fitted with air break contractors, high rupturing capacity fuses, thermal overload relays, etc.

7.3.10 Auxiliary Electrical System

Separate MCCs will be provided for the auxiliary power supplies for each machine. Motor starting would be direct on line. Motors would be controlled by air break, electromagnetic type contactors provided with ambient temperature compensated, time lagged, hand reset type thermal overload relays, having adjustable settings and backed up by HRC fuses for protection against short circuits. The switchgears will be located in the control room.

7.3.11 Data Acquisition Systems

It is proposed to install microprocessor based sequential start / stop PLC system with data acquiring capabilities. All the analog and digital parameters will be monitored through this system.

7.3.12 Battery Backed DC and Uninterrupted Power Supply System

The direct current (DC) system supplied by the batteries is the most reliable source of supply in the stations and will be used for the control and protection of the power plant equipment.

DC system will be used for the following:

7.3.13 Control and Protection System

7.3.13.1 Generators

The following protections will be provided for the generators:

a. Differential
b. Over current
c. Earth Fault
d. Reverse Power
e. Reverse Reactive Power
f. Negative Phase Sequence
g. Loss of Excitation
h. Under Frequency
i. Under Voltage
j. Over Voltage
k. Overload
l. Back up Impedance
m. Rotor E/F Protection

7.3.13.2 Power Transformer

The following protections will be provided for the step up generator transformer:

a. Differential
b. Over Current
c. Earth Fault
d. Instantaneous Over Current
e. Over Fluxing
f. Buchholz, oil and winding temperature alarm/ trip

7.3.13.3 11 kV Lines

The following protection will be provided for the 11 kV lines:
Distance (Switched, reactance type in line with protection provided by KSEB at their end).

7.3.13.4 Relay and control panel

The relay and control panel for the generators, transformers and line will house all the protective relays as indicated in the electrical schematic diagram.

7.3.14 Lighting System

The power station lighting system would comprise of normal and emergency power supplies as described below:

a. Normal AC Lighting System

The lighting circuit in the normal 1 phase 240 V AC would be fed through 415 / 433 Volts, 3 phase, 4 wire lighting transformers connected to the auxiliary distribution system.

b. Direct Current Emergency Lighting

Direct current emergency lights would be provided at strategic points in the power station viz., near entrances, intake gates, the unit control rooms, etc. These would be fed from the station 110 V DC system and would be off when the normal AC power supply is available. They would be automatically switched on when the normal AC supply fails.

The proposed illumination levels for various areas are given below:

Area	Illumination Level
Control Room	500 Lux.
Switchgear / MCC rooms	200 – 250 Lux.
TG hall	200 Lux.
Switchyard and Transformer yard	
General	10 -20 Lux
On Equipment	30 -35 Lux

7.3.15 Cabling

All cables will be selected to carry the load current under site conditions, with permissible voltage drop. In addition, high voltage cables would be sized to withstand the short circuit current. The following types of cables will be used:

a. For 3.3 kV System : XLPE insulated Aluminum cables confirming to IS: 7098
b. For medium & Low Voltage : PVC insulated Aluminum cables confirming to IS: 1554
c. Control, protection:
   PVC insulated cables with annealed high conductivity stranded copper conductor
d. Signaling, instrumentation and supervisory:
   PVC insulated with copper conductor in twisted pairs and screened.

7.3.16 Lightning Protection System

Building lightning protection system would be provided as per IS: 2309 and Indian Electricity Rules. The protections by roof conductors, air terminals and down comers will be provided for the powerhouse structure.

7.3.17 Fire Containment and Fire Fighting

Strategic areas in the plant would be separated by adequately rated firewalls. All openings for switchgears and cable entry would be sealed by fireproof seals to prevent spread of fire from one area to another. Fire detection system with suitable alarms will be provided. CO_2 gas fire extinguishers shall be provided in the turbine hall; also Halon fire extinguishers in the control room.

7.3.18 Communication System

The station will be connected by the P & T lines. It is also proposed to connect the power plant and the KSEB load dispatch centre by PLCC.

7.3.19 Safety Earthing System A safety earthing system consisting of a buried mild steel conductor earthing grid would be provided for the power plant building, the switchyard and other outlying areas. In the switchyard area the touch potential and step potential shall be limited to the safe values. The earthing design shall be as per IEEE 80 recommendations.

These will be connected to the earth grids in various parts of the powerhouse/switchyard complex. The buried earthing grid would be further connected to earthing electrodes buried underground and located at representative points. All the earthing conductors above the ground shall be either GI or copper.

7.4 Power Evacuation

The KSEBL has agreed for the following power evacuation arrangement for this project:

- 2 Km 11 kV covered conductor dedicated feeder shall be constructed up to Neriamangalam Power Station to evacuate the power generated at Mukkudam SHP.

CHAPTER - 8

CONSTRUCTION MATERIALS

Since there is no change to this chapter from the original DPR, it has been excluded in this revised DPR.

Kindly refer the original DPR in annexure for this chapter.

CHAPTER – 9

CONSTRUCTION PROGRAMME

Since there is no change to this chapter from the original DPR, it has been excluded in this revised DPR.

Kindly refer the original DPR in annexure for this chapter

Construction program is given in Exhibit No.14 of the original DPR.

CHAPTER – 10

ORGANIZATION FOR CONSTRUCTION / MAINTENANCE

Since there is no change to this chapter from the original DPR, it has been excluded in this revised DPR.

Kindly refer the original DPR in annexure for this chapter.

CHAPTER-11

ENVIORMENTAL AND ECOLOGICAL ASPECTS

Since there is no change to this chapter from the original DPR, it has been excluded in this revised DPR.

Kindly refer the original DPR in annexure for this chapter.

CHAPTER - 12

BASIC DESIGNS

12.1. General

This chapter deals with the basic design of preliminary nature, to obtain the overall size of various civil structures to enable the approximate quantity and cost estimation. If there is no adverse topographic/subsurface stratum occurring during excavation for construction, the quantities envisaged would be reasonably close to the actual requirement. However, during'Detailed Engineering' stage, necessary design modification will be carried out for better construction procedure and design improvement to arrive at maximum possible alternatives. The following paragraphs discuss the various important aspects from their design angle.

12.2 Diversion Weir

Since there is no change to this chapter from the original DPR, this chapter has been excluded in this revised DPR. Kindly refer the original DPR in annexure for this chapter.

12.3 Surface profile of the over flow section Equation of spillway curve: - Excluded in this document as there is no change from the original DPR

12.3.3. Overflow section - Stability analysis - Excluded in this document as there is no change from the original DPR

12.3.3. Non overflow section - Stability analysis - Excluded in this document as there is no change from the original DPR

12.3.3. Intake Trash Rack

Trash rack structure is provided on the upstream mouth of power intake.

Design discharge = 1.68 m^3/sec (with 10% Overload)

As per IS 11388 – 2012 (Clause 6.1), Max velocity = 0.75 m/sec

Net Area required = $\frac{1.68}{0.75}$ = 2.24 m^2

Assuming 30% obstruction due to steel racks.

Area required = 2.24 x 1.3 = 2.9 m^2

With 40% allowance for clogging.

Gross Area required = 2.9 x 1.4 = 4.06 m^2

Providing a width of 1.50 m,

Height = $\frac{4.06}{1.50}$ = 2.71 m, Height provided = 4.5 m

Gross area provided = 1.50 x 4.5 = 6.75 m^2 > Gross Area required, OK

Net area provided =

6.75 x 0.70 x 0.60 [30% obstruction by steel racks and 40% by clogging] = 2.84 m^2

Velocity through trash rack = $\frac{1.68}{2.84}$ = 0.59 < 0.75 m/sec, OK.

Provide two panels of 2.25 x 1.50 m.

12.4. Hydraulic losses in the system

A. Losses from weir intake to power house

a) **Trashrack loss** (IS 4880 – 1976 Part III)

R = $\frac{\text{Net area}(a_n)}{\text{Gross area}(a_t)}$ = $\frac{2.84}{6.75}$ = 0.42 say 0.60.

K_1 =1.45 - 0.45R - R^2 =1.45 - 0.45 x 0.60 - 0.60^2 = 0.82

H_t = $\frac{k_1 v^2}{2g}$ = $\frac{0.82 \text{ x } 0.59^2}{2 \text{ x } 9.81}$ = **0.02m**

b) ***Loss at pipe entry***

Inside Diameter of pipe = 0.85 m

Velocity through pipe V = $\frac{1.68}{\frac{\pi}{4} \text{x } 0.85^2}$ = 2.963 m/s

H_e = $\frac{0.5\ v^2}{2g}$ = $\frac{0.5 \text{ x } 2.963^2}{2 \text{ x } 9.81}$ = **0.22m**

c) **Loss in Penstock**

L = 1339m, R = $\frac{d}{4}$ = $\frac{0.85}{4}$ = 0.213, n = 0.011

h_t = $\frac{v^2 n^2 L}{R^{\frac{4}{3}}}$ = $\frac{2.963^2 \text{ x } 0.011^2}{0.213^{4/3}}$ x 1339 = **11.12 m**

d) Bend loss

Considering 20 Vertical bends and 13 Horizontal bends,

From IS: 11625-1986, $\frac{R}{D}$ = 4

Sum of k_b = 0.793

$$h_t = 0.793 \times \frac{v^2}{2g} = \frac{0.793 \times 2.963^2}{2 \times 9.81} = \mathbf{0.35\ m}$$

e) Loss in Butterfly valve

$$h_{bu} = 0.20 \times \frac{v^2}{2g} = \frac{0.20 \times 2.963^2}{2 \times 9.81} = \mathbf{0.09\ m}$$

Total Loss = 0.02 + 0.22 + 11.12 + 0.35 + 0.09 = **11.8 m**

Allowing for losses in valve chamber, bifurcation, etc. = 1.2 m (say).

Total system loss = 11.8 + 1.2 = **13 m**

Normal Water Level = 628.0 at weir;

Gross Head = 628.0 – 307.0 = 321.00, Net Head = 321.0 – 13.0 = 308.0m

However, total head loss is 13 m only for 4 MW + 10% COL. Head loss for various installed capacities are furnished below (all with 10% COL):

Installed Capacity	Rated Flow (m3/sec)	Penstock Diameter (m)	Penstock Cross Sectional Area (m2)	Velocity of Water through penstock (m/sec)	Trash Rack Loss =k1r2/2g; k1 = 0.82, r=0.6	Loss at Pipe entry = 0.5v2/2g	Loss in penstock = (v2n2L)/(R^4/3). R=d/4, n=0.011, L=1321	Bend Loss = KbV2/2g; Kb=0.793	Loss in butterfly valve = 0.20V2/2g	Losses in Bifurcation, valve chamber etc.	Total Head Loss
1 MW	0.42	0.85	0.5671625	0.740528508	0.02	0.0139751	0.697047107	0.022164	0.00559004	1.2	1.958777
2 MW	0.84	0.85	0.5671625	1.481057016	0.02	0.0559004	2.788188428	0.088658	0.02236014	1.2	4.175107
3 MW	1.26	0.85	0.5671625	2.221585524	0.02	0.1257758	6.273423963	0.19948	0.05031032	1.2	7.86899
4 MW	1.68	0.85	0.5671625	2.962114033	0.02	0.2236014	11.15275371	0.354632	0.08944057	1.2	13.04043

It is to be noted that the total head loss for 4 MW + 10% COL is 13.04 m, but for 3 MW + 10% COL, 2 MW + 10% COL and 1 MW + 10% COL, it is 7.87 m, 4.18 m and 1.96 m respectively.

The average of these figures is 6.76 m.

However, 9 m is adopted as average head loss and the net head for the project is 312 m.

12.5. Penstock

12.5.1. Water hammer analysis

Discharge 'Q' = 1.68 m^3/s Diameter of pipe = 0.85 m

$$V = \frac{1.68}{\frac{\pi}{4} \times 0.85^2} = 2.963\ m/s,\ \text{Net Head} = 312.00m$$

Length of pipe, L = 1339.00m

Velocity of pressure wave, $a = \frac{4660}{\sqrt{1+\frac{d}{100b}}}$ ft/sec (Refer CWC Manual, fig.: 22)

Where'd' = diameter of pipe in inches and 'b' = average thickness in inches

$$d = \frac{0.85 \times 100}{2.54} = 33.46"$$

$b = \frac{0.009 \times 100}{2.54} = 0.35"$

$a = \frac{4660}{\sqrt{1+\frac{33.46}{0.35\times100}}}$ = 3328.57 ft /sec = 1014.80 m/s

Pipeline constant, $k = \frac{aV_0}{2gH_0} = \frac{1014.8 \times 2.963}{2 \times 9.81 \times 312} = 0.49$

Pressure rise for instantaneous closure

$h_{max} = \frac{aV_0}{g} = \frac{1014.8 \times 2.963}{9.81} = 306.51$ m

Trial 1: For time of closure (T) = 6 sec: Time constant, $N = \frac{aT}{2L}$

Where, 'T' = time of closure in sec 'L' = length of pipe in m

'N' = $\frac{1014.8 \times 6}{2 \times 1339} = 1.52$

From the Allevi's chart (refer CWC Manual, fig: 22), for 'N' = 2.27 and 'K' = 0.49

h/h_{max} = 0.39, ➔ h = 0.39 x 306.51 = 119.54 m i.e. $\left(\frac{119.54}{312} = \mathbf{38.31\%}\right)$

Trial 2: For time of closure 8 sec, $N = \frac{1014.8 \times 8}{2 \times 1339} = 3.03$

From Allevi's chart, for N = 3.03 and K = 0.49

h/h_{max} = 0.26, ➔ h = 0.26 x 306.51 = 79.69 i.e. $\left(\frac{79.69}{312} = \mathbf{25.54\%}\right)$

Trial 3: For time of closure 10 sec, $N = \frac{1014.8 \times 10}{2 \times 1339} = 3.79$

From Allevi's chart, for N = 3.79 and K = 0.49

h/h_{max} = 0.2, ➔h = 0.2 x 306.51 = 61.3 i.e. $\left(\frac{61.3}{312} = \mathbf{19.65\%}\right)$

Hence ten seconds recommended for valve closure for a safe stoppage of the unit. However for Pelton wheel, normally the deflector acts immediately during an emergency situation like grid failure; the valve closes slowly (20 – 30 seconds for various vendors) and then water hammer will be much less. Moreover, as the flow reverses into the reservoir surge height will be insignificant.

12.5.2. Thickness of penstock shell

Gross Head = 321 m, Minimum Yield strength of Mild Steel is 30,000 Psi = 2109 kg/cm²

A design factor of 0.70 shall be adopted so as to be on safer side.

Hence the Limiting hoop stress is taken as 2109 x 0.7 = 1370 kg/cm^2 for design purpose.

Maximum pressure head near powerhouse

= 321 m + Water hammer pressure head (20% of gross head)

= 321.0 + (0.20 x 321.0) = 385.20m = 38.52 kg/cm^2

Pressure limit for 6 mm thick penstock pipe,

$$P = \frac{f \times 2t}{d} = \frac{1370 \times 2 \times 0.6}{85} = 19.34 \text{ kg/cm}^2$$

Hence maximum allowable pressure head (120% of gross head) for 6 mm thick pipe is 193.4 m and gross head limit is 161.16 m.

Pressure limit for 8 mm thick penstock pipe,

$$P = \frac{f \times 2t}{d} = \frac{1370 \times 2 \times 0.8}{85} = 25.78 \text{ kg/cm}^2$$

Hence maximum allowable pressure head (120% of gross head) for 8 mm thick pipe is 257.8 m and gross head limit is 214.83 m.

Pressure limit for 10mm thick penstock pipe,

$$P = \frac{f \times 2t}{d} = \frac{1370 \times 2 \times 1.0}{85} = 322.35 \text{ kg/cm}^2$$

Hence maximum allowable pressure head (120% of gross head) for 10 mm thick pipe is 322.35 m and gross head limit is 268.62 m.

Pressure limit for 12mm thick penstock pipe,

$$P = \frac{f \times 2t}{d} = \frac{1370 \times 2 \times 1.20}{85} = 38.68 \text{ kg/cm}^2$$

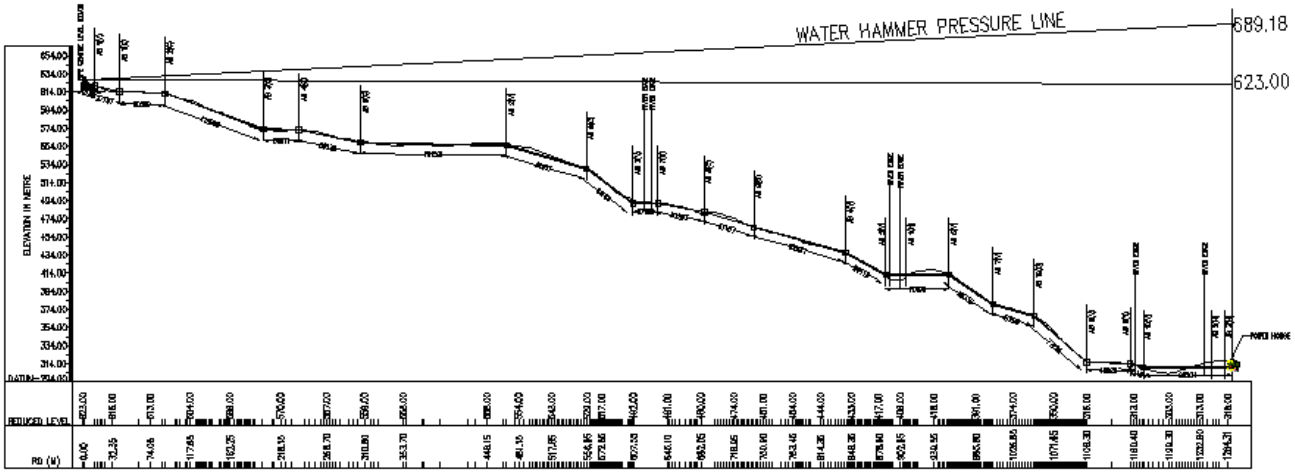
Hence maximum allowable pressure head (120% of gross head) for 12 mm thick pipe is 386.8 m and gross head limit is 322.33 m. However, the gross head of the project is 321 m only, hence this falls well within the safety limits.

Weight of penstock

= Π x 0.85 x 7.85 x ((737.0 x 0.006) + (148.0 x 0.008) + (166.0 x 0.010) + (288.0 x 0.012))

= 224.64 T

Add branches, bends, wastage etc. Say **230.00 T**



12.5.2. Penstock Support for River Crossing

As the weir and major portion of this scheme are located on the left bank and Power House on the right bank of *Muthirappuzha*, penstock has to cross the river to reach the power house. A 54 meter long N-girder steel bridge is to be built to carry the penstock. The bridge will be built at least 3 meter above the maximum flood level recorded in the 2018 floods.

12.6. Powerhouse

The dimensions are fixed based on data bank available for other projects already implemented in recent past. Minor changes will occur depending on E&M supplier's requirement. The machine floor level is given as EL 307.0 m. Hence the service bay is fixed at 311.0 m. The switchyard level is kept at EL 317.0 m. Being Pelton turbine units, the setting is kept higher above the HFL of the river at the site, which was 303.50 m (noted during 2018 floods).

CHAPTER – 13

COST ESTIMATES (Revised as on 31.07.2020)

13.1 GENERAL

The quantity estimates are taken based on the drawings and are given in the following headings, for clear identification.

1) Diversion weir including Intake block, Stilling Basin & Scour sluice
2) Penstock civil works
3) Power House
4) Tail race channel
5) Switchyard civil works

The rates of civil works are based on the lowest quotation received for the civil works tender of this project.

13.2 HYDRO MECHANICAL WORKS

Hydro Mechanical items comprises of the following

1) Intake gate – 1No.
2) Power intake, Stop log gate– 1No.
3) Scour sluice gate -1No.
4) Scour sluice, Stop log gate - 1No.
5) Trash rack
6) Penstock pipe

The quantities for civil works and Hydro Mechanical works are given in the schedules vide tables 13.2 to 13.9. The format of an item rate tender is followed to facilitate the tendering process. The rates for various works are based on the present market rate.

13.3 ELECTRO MECHANICAL WORKS

The cost of electro-mechanical equipment including switchyard equipment as a package is arrived at based on recent tenders floated elsewhere and budgetary offers received allowing for Steel and Copper price variations. Since a turnkey concept is proposed, split up of cost in to various elements is not made at this stage.

13.4 TRANSMISSION LINE

This project is proposed to connect to the 11kV grid of KSEBL available nearby and provision is made for converting this 2 Km OH feeder to Covered Conductor type feeder.

13.5 OTHER WORKS AND SERVICES

a) Land – Provision is made for purchase of private land and lease of Govt land. Preliminaries – Like Survey, investigations etc L.S provision is made.

b) Provision for Consultancy charges and site supervision is made as per normal practice.

13.6 The abstract of the total cost is given in Table 13.1.

Table 13.1

ABSTRACT OF COST ESTIMATE (Revised as on 30.07.2020)

Item	Description	Rs. in Lakhs
A.	**Preliminary Works**	
i	Survey and sub – surface investigation	10
ii	Land	79
iii	Premium for the project	64
B	**Civil Works of the Project**	
i	Diversion weir including Intake block, Stilling Basin & Scour sluice	305
ii	Penstock civil work	290
iii	Power House Building	196
iv	Tailrace channel	13
v	Switchyard Civil Works	14
C	**Hydromechanical Equipment**	548
D	**Electro Mechanical Equipment**	
i	Indoor Equipment & Outdoor Equipment	1037
	Transmission Line	80
E	**Butterfly valve 0.75m Φ and Valve Chamber**	5
F	**Other works and services (Salary during construction, travel, consultancy fees etc.)**	93
G	**Tools and Equipments @ 1 % of work (1 % of Item D)**	14
	Vehicles for Project Construction and Operation	12
	Contingencies	20
	Total in Lakhs	2780
	Total in crores	27.80

Table 13.2

B. CIVIL WORKS OF THE PROJECT
i. SCHEDULE OF ITEM FOR DIVERSION WEIR INCLUDING INTAKE BLOCK,STILLING BASIN & SCOUR SLUICE

Sl. No.	Particulars	Quantity	Unit	Rate (Rs)	Amount (Lakhs)
1	Clearing site for barrage	L.S		100000	1
2	Excavation including all leads & lifts conveying the excavated material (in excess of back filling Qty) up to a lead of 1 Km, stacking the useful materials and dumping the spoil in low lying areas, diversion road areas etc as directed at site as per relevant clause of general technical specifications.				
	a. Ordinary Soil	200	Cum	500	1
	b. hard Rock & Boulders requiring blasting	1200	Cum	1500	18
	c. hard Rock & Boulders requiring safe excavation	900	Cum	2200	19.8
3	Backfilling with excavated soil behind training wall consolidated and finished to road level as specified in relevant clause of general technical specification.	100	Cum	200	0.2
4	Chiselling, etc. and preparing foundation for weir	260	Sqm	400	1.04
5	Providing anchor bars (25mm Φ) in rock foundation 3 m long, including drilling, placing in cement mortar as specified in relevant clause of general technical specification @ 3m c/c grid	78	Nos.	1200	0.94
6	PCC M-15 with 40 mm metal for levelling course.	120	Cum	7900	9.48
7	Mass concrete in dam ,M - 20 grade with max size of aggregate 40mm, including form work, with 20% plums upto 150mm size	2019	Cum	8800	177.67
8	Surface reinforcement work on the top of the overflow section complete as per relevent clause of general technical specification	2.4	T	62000	1.49
9	RCC M 20 with max. 20 mm aggregate for dam foundation, training wall, intake works, energy dissipation works, slab, column etc.	270	Cum	8900	24.03
10	Reinforcement work complete as per relevant clause of general technical specification	6.2	T	62000	3.85
11	GI pipe handrails Dia. 40 mm over top of weir & intake as specified in relevant general technical specifications	85	m	600	0.51

12	Drilling 40mm holes for Curtain and Consolidation grouting. Grout holes for curtain grouting of 5.0m depth and consolidation grouting for 3.0m depth as per relevant clause of general technical specification.	110	m	200	0.22
13	Grouting the foundation with cement as specified in relevant clause of general technical specification	80	Bags	1100	0.88
14	Providing steel pipe 6mm thick, 500mm Φ for scour pipe with bell mouth entry including fabrication & erection.	0.9	T	120000	1.2
15	Providing steel pipe 6mm thick, 850mm Φ for penstock starting with bell mouth entry including fabrication & erection.	1.9	T	270000	2.7
16	Gate guides for penstock intake gate and scour sluice control gate	LS		500000	5
17	Providing arrangement for trash capturing mechanism at the upstream end of the reservoir	LS		200000	2
18	Providing trash preventive screen around the intake block	LS		300000	3
	Miscellaneous Items				
19	Providing lamp posts, wiring and bulbs for illumination @ 10.00 m intervals	3		5000	0.15
20	Providing and maintaining coffer dams for carrying out the works of dam structure including dismantling & removing the coffer dam after entire work is completed.	LS			0.5
21	Charges for dewatering (rate only)				
22	a. Using Electricity driven pump sets	LS			0.25
23	b. Using Diesel Engine driven pump set as per relevant special technical specification	LS			0.25
24	Extra for haulage and disposal of excavated material beyond 2 km as specified in relevant general technical specifications (rate Only)	LS		600000	6
25	Road to weir site (Excavation of ordinary soil and hard rock)	LS		150000	1.5
	Road to downstream side of the weir site	LS		150000	1.5
	Material yard near the weir site - excavation and levelling	LS		600000	6
	Sub Total				**290.16**
26	Add for contingencies @ 5%				14.508
				TOTAL	**304.668**
				Say Rs. In Lakhs	**305**

Table 13.3

ii. SCHEDULES OF ITEMS FOR PENSTOCK CIVIL WORK

Sl. No.	Particulars	Quantity	Unit	Rate (Rs)	Amount (Lakhs)
A	**PENSTOCK CIVIL WORK**				
1	Excavation including all leads & lifts, conveying the excavated material (in excess backfilling qty.) up to a lead of 2 km stacking the useful materials and dumping the soil in low lying areas, diversion road areas, etc.				
	a. Ordinary Soil	1650	Cum	500	8.25
	b. hard Rock & boulders requiring blasting	2200	Cum	1500	33
	c. hard Rock & boulders requiring safe excavation	1400	Cum	2200	30.8
2	Backfilling with excavated soil in trenches and finished to required level as specified in relevant clause of general technical specification.	800	Cum	200	1.6
3	PCC M15 using 40 mm aggregates for levelling coarse	480	Cum	8000	38.4
4	RCC M 20 with max. 20 mm aggregate for anchor block & saddle support	1410	Cum	9000	126.9
6	Reinforcement work	60	T	62000	37.2
	Sub Total				**276.15**
7	Contingencies @ 5%				13.8075
				TOTAL	**289.9575**
				Say Rs. In Lakhs	**290**

Table 13.4

iii. SCHEDULES OF ITEMS FOR POWER HOUSE

Sl. No.	Particulars	Quantity	Unit	Rate (Rs)	Amount (Lakhs)
A	**Power house**				
1	Providing ring bund with sand bags etc complete.	LS		100000	1
2	Dewatering with sufficient capacity pump etc complete.	LS		100000	1
3	Excavation including all leads & lifts, conveying the excavated material (inexcess of backfilling qty.) up to a lead of 2 Kms, stacking the useful materials and dumping the spoil in low lying areas, diversion road areas etc.,				
	a. Ordinary Soil	400	Cum	500	2
	b. hard Rock & boulders requiring blasting	600	Cum	1500	9
	c. hard Rock & boulders requiring safe excavation	400	Cum	2200	8.8
4	PCC M-15 for levelling course with 100mm thick with max. size of 40 mm aggregate.	120	Cum	7900	9.48
5	RCC mass work in M-20/max size of 40 mm aggregate for sub-structure main blocks as including form works.	260	Cum	8900	23.14
6	RCC work in M-20/max. 20 mm size aggregate for all works for machine foundations and super structure including form works.	95	Cum	9000	8.55
7	Reinforcement work complete as per relevant clause of general technical specification.	26	T	62000	16.12
8	Structural steel work for ladders cable tray supports stairs and rails chequered plates etc including painting	LS			2
9	Structural steel work for crane girder and building super structure	45	T	95000	42.75
10	Providing and fixing steel doors/windows/ ventilators including glazing.	280	Sq.m	1800	5.04
11	Structural steel fabrication and erection for roof trusses, purilins etc incl. all fittings and painting.	15	T	75000	11.25
12	Roofing with CGI sheets, complete.	310	Sq.m	1000	3.1
13	Drilling 40mm holes and grouting if required in foundation including cost of cement etc complete.	LS			1
14	Covering the sides of the building with industrial grade CGI sheets	680	Sq.m	900	6.12
15	Corrosion resistant painting on structural steel fabrication	120	Sq.m	400	0.48
17	Tiles in office area and control room.	160	Sq.m	2000	3.2

18	Hard surfacing for floors with ironite in CM 1:3, 20 mm thick.	120	Sq.m	1200	1.44
19	Acid resistant tile flooring in battery room and charge room	20	Sq.m	3000	0.6
20	Ceramic tiles in toilet floor / walls	25	Sq.m	2000	0.5
21	Providing and fixing water supply and sanitary fittings.	LS			1
22	Internal illumination in Power House.	LS			1
23	False ceiling for office area and control room.	160	Sq.m	600	0.96
24	Providing and fixing Rolling shutter	30	Sq.m	4000	1.2
25	Backfilling with excavated soil	400	Cum	200	0.8
26	Road in Power house	LS			3
	Stone masonry retaining wall inside the power plant premises	2500	Cum	260	6.5
27	Protecting wall on river side	195	Cum	7900	15.405
	Sub Total				**186.435**
29	Contingencies @ 5%				9.32175
				TOTAL	**195.7568**
				Say Rs. In Lakhs	**196**

Table 13.5

iv. SCHEDULES OF ITEMS FOR TAILRACE CHANNEL

Sl. No.	Particulars	Quantity	Unit	Rate (Rs)	Amount (Lakhs)
1	Excavation including all leads & lifts, conveying the excavated material (inexcess of backfilling qty.) up to a lead of 2 Kms, stacking the useful materials and dumping the spoil in low lying areas, diversion road areas etc.,				
	a. Ordinary Soil	140	Cum	500	0.7
	b. hard Rock & boulders requiring blasting	45	Cum	1500	0.675
	c. hard Rock & boulders requiring safe excavation	40	Cum	2200	0.88
2	PCC M-15 for levelling course with 100mm thick with max. size of 40 mm aggregate.	15	Cum	7900	1.185
3	RCC M 20 with max. 20 mm aggregate for inclined floor and walls including formwork.	65	Cum	9000	5.85
4	Reinforcement work complete as per relevant clause of general technical specification.	5	T	62000	3.1
	Sub Total				**12.39**
5	Contingencies @ 5%				0.6195
				TOTAL	**13.0095**
				Say Rs. In Lakhs	**13**

Table 13.6

v. SCHEDULES OF ITEMS FOR SWITCHYARD CIVIL WORKS

Sl. No.	Particulars	Quantity	Unit	Rate (Rs)	Amount (Lakhs)
1	Excavation including all leads & lifts, conveying the excavated material (inexcess of backfilling qty.) up to a lead of 2 Kms, stacking the useful materials and dumping the spoil in low lying areas, diversion road areas etc.,				
	a. Ordinary Soil	200	Cum	500	1
	b. hard Rock & boulders requiring blasting	55	Cum	1500	0.825
	c. hard Rock & boulders requiring safe excavation	30	Cum	2200	0.66
2	PCC M-15 with max size of 40 mm aggregate for Switchyard structure for levelling course	25	Cum	7900	1.975
3	RCC M-20 grade with 20 mm max size aggregate for all switchyard structures & cable trenches.	20	Cum	9000	1.8
4	Reinforcement work complete as per relevant clause of general technical specification.	2.5	MT	62000	1.55
5	Supplying & filling 40mm size aggregates and spreading evenly 150mm thick.	50	Cum	2500	1.25
6	Supplying & filling river sand and spreading evenly 100mm thick.	40	Cum	5000	2
7	Protective fencing around the switch yard	LS			2
	Sub Total				**13.06**
8	Contingencies @ 5%				0.653
				TOTAL	**13.713**
				Say Rs. In Lakhs	**14**

C. SCHEDULE FOR HYDRO MECHANICAL WORKS

Table 13.7

a . SCHEDULE OF SUPPLY AND ERECTION OF INTAKE GATE

SL. No	Particulars	Qty.	Units	Rate (Lakhs)	Amount (Lakhs)
1	Fixed wheel type intake gate leaf with rubber seals and bearings of clear opening Size 1.50 m wide x 1.50 m high.	1	Nos.	4	4
2	1st and 2nd stage embedded parts for the above intake gates.	1	Sets	0.5	0.5
3	Electrically operated hoist for the above intake gates of suitable capacity.	1	Nos.	1	1
4	Erection of embedded parts, gates and hoist arrangement.	LS		0.5	0.5
5	Spares for above gates and hoist for 5 years requirements for normal operation.	1	Set	0.5	0.5
				Total in Lakhs	**6.5**

Table 13.8

b. SCHEDULE OF SUPPLY AND ERECTION OF INTAKE STOPLOG GATE

SL. No	Particulars	Qty.	Units	Rate (Lakhs)	Amount (Lakhs)
1	Fixed wheel type stoplog gate leaf with rubber seals and bearings of clear opening Size 1.50 m wide x 1.50m high.	1	Nos.	4	4
2	1st and 2nd stage embedded parts for the above intake gates.	1	Sets	0.5	0.5
3	Electrically operated hoist for the above intake gates of suitable capacity.	1	Nos.	1	1
4	Erection of embedded parts, gates and hoist arrangement.	LS		0.5	0.5
5	Spares for above gates and hoist for 5 years requirements for normal operation.	1	Set	0.5	0.5
				Total in Lakhs	**6.5**

Table 13.9

c . SCHEDULE OF SUPPLY AND ERECTION OF SCOUR SLUICE GATE

SL. No	Particulars	Qty.	Units	Rate (Lakhs)	Amount (Lakhs)
1	Fixed wheel type Scour sluice Gate leafs with rubber seals and bearings of clear opening Size 0.90 m wide x0.90 m high.	1	Nos.	1	1
2	1st and 2nd stage embedded parts for the above Gate.	1	Sets	0.5	0.5
3	Manually operated screw hoist for the above gate of suitable capacity.	1	Nos.	0.5	0.5
4	Erection of all the above item.	LS		0.5	0.5
5	Spares for above gates and hoist for 5 years requirements for normal operation.	1	Set	0.5	0.5
				Total in Lakhs	**3**

Table 13.10

d . SCHEDULE OF SUPPLY AND ERECTION OF SCOUR SLUICE STOPLOG GATE

SL. No	Particulars	Qty.	Units	Rate (Lakhs)	Amount (Lakhs)
1	Fixed wheel type Scour sluice stoplog Gate leafs with rubber seals and bearings of clear opening Size 0.90 m wide x 0.90 m high.	1	Nos.	1	1
2	1st and 2nd stage embedded parts for the above Gate.	1	Sets	0.5	0.5
3	Manually operated screw hoist for the above gate of suitable capacity.	1	Nos.	0.5	0.5
4	Erection of all the above item.	LS		0.5	0.5
5	Spares for above gates and hoist for 5 years requirements for normal operation.	1	Set	0.5	0.5
				Total in Lakhs	**3**

Table 13.11

e . SCHEDULE OF SUPPLY AND ERECTION OF TRASH RACK

SL. No	Particulars	Qty.	Units	Rate (Lakhs)	Amount (Lakhs)
1	Trashracks with embedded parts and clear to center opening 50 mm size 1.5m wide X 4.5m high in three panels of 1.5m height each	1.5	T	1	1.5
2	Erection of embedded parts, trashrack and hoist arrangement	LS		0.5	0.5
3	Electrically operated raking mechanism with suitable hoist capacity (optional).	1	Set	1	1
				Total in Lakhs	**3**

Table 13.12

g . SCHEDULE OF PENSTOCK

SL. No	Particulars	Qty.	Units	Rate (Lakhs)	Amount (Lakhs)
1	Fabrication, sand blasting, painting, testing and supply of surface penstock including bends, dia 0.85 m and varying thickness.	240	T	1.2	288
2	Erection, testing and commissioning of surface penstock including bends, dia 0.85 m and varying thickness.	240	T	0.6	144
3	Pad plate supports for penstock	170	No.	0.1	17
4	Expansion joints	27	No.	1	27
5	Supply, erection and commissioning of structural steel bridge of length 80 meters for penstock crossing including concrete piers	25	T	1.6	40
6	Miscellaneous like manholes, drain valves, paintings as per specifications etc.,	LS			10
				Say Rs. In Lakhs	**526**
				T OTAL FOR HYDRO MECHANICAL WORKS	**548**

Table 13.13

G. SCHEDULES OF ITEMS FOR OTHER WORKS AND SERVICES

Sl. No.	Particulars	Amount in Lakhs
1	Consultancy fees including site supervision	15
2	Company overheads – staff salaries, travel	35
3	Vehicles for project - fuel and O&M costs	5
4	Medical facilities and post office	0.5
5	Security arrangements	0.5
6	Level gauge at the diversion weir and cabling till power house	0.5
7	Construction Power Supply	2
8	Boundary walls/ fencing - for the premises of diversion weir, penstock and power house	8
9	CCTV arrangements for the premises of diversion weir, penstock and power house	3
10	Ware house near power house	2
11	Miscellaneous – Pamphlets , inaugural ceremony	2
12	Training of maintenance Engineers	1
13	Environmental recovery	1.5
14	Guest House & First Aid Centre	15
15	Landscaping etc	2
	Total in Lakhs	**93**

CHAPTER 14

FINANCIAL ANALYSIS

14.1 GENERAL

The total cost of the project is Rs. 29.99 crores including IDC. It is proposed to avail the loan from IREDA of Government of India or from a commercial bank for the Implementation of the project. Usually loan up to an extent of 70% of the cost of the project is being offered by IREDA and similar financial instituitions. The balance cost is proposed to be met from own funds. The average annual generation as estimated by working tables is 11.09 Mu. The components of the cost of generation are operating and maintenance expenses, depreciation and interest. The analysis is made as per KSERC guidelines.

Assumptions

The financial analysis is based on the pattern of funding as if the loan is from financial institutions, with the following assumptions.

1. Interest rate – 11.00 % for IDC and 11.00 % for repayment of debt
2. Term loan Repayment period – 2 years of IDC, 0 year of Moratorium and 12 years of repayment.
3. Debt: Equity ratio - 70: 30 effective
4. Provision for IT at 25 % for total 30 years.
5. Depreciation based on lease period of 30 years, @ 5.28 % for 12 years & 0.97% from 13th year.
6. Tariff for IPP @ Rs.5.91/- per unit (Replacement Cost)
7. O&M charges @ Rs. 32.41 Lakhs per MW with 5.72% annual escalation

We have considered the capital subsidy of Rs 100 lakhs as per the latest MNRE guide lines vide order No. 14(03)2014-SHP dt 2/7/2014 of Govt of India, MNRE. Out of this 50% (Rs 2 Crores) will be released during execution and the balance Rs. 2 Crores will be released after the completion of the project. This is considered for the financial analysis. No carbon trade credit is considered for financial analysis, which will provide added cushion for this project.

14.2 CONCLUSION

The cost of generation in first year is Rs. 5.53 /- per kWh reducing to Rs.3.57/- per kWh in 13th Year. The DSCR on an average is 1.71 and the IRR is 15.09 %.

SUMMARY OF FINANCIAL ANALYSIS

SL.No	Particulars	Value	Unit
1	Project Name	Mukkudam SHP	
2	Project Capacity	4	MW
3	Machine Rating	2 x 2000	kW
4	Construction period for Project including testing & commissioning	24	months
5	Capital Cost of the Project (Without IDC)	2780	lakhs
6	Equity	30%	
7	Debt (term loan)	70%	
8	Energy Generated (in Million Units)	11.2	Mu
9	Auxillary consumption & other losses	1.00%	per Annum
10	Net Saleable Units	11.09	Mu
11	Rate of Sale of Power (Replacement cost)	5.91	Rs. Per kWh
12	O & M including Insurance	Rs. 32.41 lakh / MW	per Annum
13	Escalation in O & M Cost	5.72 % annual escalation after very 1st year	
14	Depreciation	5.28% for 1st 13 years & 0.97 % from 14th year	
15	Return on equity	14%	
16	Interest on term loan	11.00%	per annum
	a Total Repayment Period in years	12	years
	b Start of Repayment in years (Moratorium)	0	
17	Financial Evaluation Period	13	years
	Financial Results		
	IRR (0-30 years)	**15.09%**	
	DSCR (Avg for 0-12 years)	**1.71**	

Table 14.1

Cost of Project and Means of Finance

Sl. No	Particulars	Amount (in Lakhs)
1	Total Project Cost without IDC	2780
2	Interest During Construction	219
3	Total Project Cost including IDC	2999
	say	**2999**
4	Means of Finance for cost Including IDC	
	Promotor Equity	900
	Loan	2099
5	Total Project Completion Cost	**2999**

Table 14.2

Interest During Construction

Installed Capacity	4	MW
Total cost of Project with out IDC	2780	Lakhs
Means of Finance		
Interest Rate	11	%
Promotor (without IDC)		
Equity @ 30%	834	
Loan @ 70% (without IDC)	1946	
Loan Repaymnet Period	12	Yrs
Moratorium	0	Yrs

Interest During Construction for 2 Yrs

Interest rate @ 13%

Term	1st Half yr	2nd Half yr	3rd Half yr	4th Half yr	Total
% of Payment	20%	30%	35%	15%	
Amount	389.2	583.8	681.1	291.9	1946
Amount of Interest	10.70	37.46	72.25	99.00	219

Total cost of project including IDC = **2999**

Note 1: The half yearly interest is calculated on the average amount spent during the half year and the interest of previous amount already spent for half year

Note 2: Tarrif rate of Rs.5.91 per unit is adopted based on the Regulation No. 1204/D(T)/2019/KSERC dated 7th February 2020 of KSERC

Note 3. As per MNRE Guide lines the capital subsidy eligible for 4 MW is 4 Crores. Half the amount is to be utilized for repaying Interest During Construction

Table 14.3

Loan Repayment Schedule

Inst. No	Op. Bal.	Principal Repayment	Cl. Bal.	IDC @ 11%	Inst. @ 11%	Interest	Principal	Total
	IREDA					Lakhs		
0				219		200.00		200.00
1	1946	50	1896	19	104.28			
2	1896	50	1846		101.53	224.81	100.00	324.81
3	1846	55	1791		98.51			
4	1791	55	1736		95.48	193.99	110.00	303.99
5	1736	60	1676		92.18			
6	1676	60	1616		88.88	181.06	120.00	301.06
7	1616	65	1551		85.31			
8	1551	65	1486		81.73	167.04	130.00	297.04
9	1486	70	1416		77.88			
10	1416	70	1346		74.03	151.91	140.00	291.91
11	1346	80	1266		69.63			
12	1266	80	1186		65.23	134.86	160.00	294.86
13	1186	90	1096		60.28			
14	1096	90	1006		55.33	115.61	180.00	295.61
15	1006	100	906		49.83			
16	906	100	806		44.33	94.16	200.00	294.16
17	806	110	696		38.28			
18	696	110	586		32.23	70.51	220.00	290.51
19	586	120	466		25.63			
20	466	120	346		19.03	44.66	240.00	284.66
21	346	130	216		11.88			
22	216	130	86		4.73	16.61	260.00	276.61
23	86	86	0		0.00			
24	0	0	0		0.00	0.00	86.00	86.00
Total		**1946**			**1376.21**			**3341.21**

COST OF GENERATION AND CASH FLOW **Table - 14.4(1/3)**

A. Total cost of the project (incl IDC)		Rs.	2780.00	Lakhs							
B. Equity		Rs.	834.00	Lakhs		Sale price: Rs. 5.91/ Unit					
C. Term Loan		Rs.	1946.00	Lakhs							
Sale Rate of Rs./ unit (IPP)		5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
Sl. No	**Particulars / Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Annual Charges										
a	Interest on loans @ 11%	205.81	193.99	181.06	167.04	151.91	134.86	115.61	94.16	70.51	44.66
b	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78
c	Amortization of Preliminary Expenditure	14.80	14.80	14.80	14.80						
d	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	129.64	137.06	144.89	153.18	161.95	171.21	181.00	191.35	202.30	213.87
e	Return on Equity @ 14%	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76
	Total annual charges (a+b+c+d+e)	613.79	609.38	604.30	598.56	577.40	569.61	560.16	549.06	536.35	522.08
2	Revenue										
i	saleable unit (Mu)	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09
ii	cost of generation in Rs./ KWH at Busbar (T.A.Chrg/i*10)	5.53	5.49	5.45	5.40	5.21	5.14	5.05	4.95	4.84	4.71
iii	Average cost of generation				5.47				5.09		
iv	Total revenue @Rs. 5.91/unit	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
v	capital subsidy		200.00								
vi	Total sales revenue (iv+v)	655.42	855.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
vii	Total Operating Exp. (1a to 1d)	613.79	609.38	604.30	598.56	577.40	569.61	560.16	549.06	536.35	522.08
viii	Profit before Tax	41.63	246.04	51.12	56.86	78.02	85.81	95.26	106.36	119.07	133.34
ix	Provision for income tax @25%	10.41	61.51	12.78	14.21	19.51	21.45	23.82	26.59	29.77	33.34
x	profit after tax	31.22	184.53	38.34	42.64	58.52	64.36	71.45	79.77	89.30	100.01
xi	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78
xii	Funds from operations (x+xi)	178.00	331.31	185.12	189.43	205.30	211.14	218.23	226.55	236.08	246.79
xiii	Less: Loan repayment	100.00	110.00	120.00	130.00	140.00	160.00	180.00	200.00	220.00	240.00
xiv	Net cash surplus (xii-xiii)	78.00	221.31	65.12	59.43	65.30	51.14	38.23	26.55	16.08	6.79
xv	Cumulative Net cash Surplus	78.00	299.31	364.44	423.87	489.17	540.31	578.54	605.09	621.18	627.97

COST OF GENERATION AND CASH FLOW **Table - 14.4(2/3)**

A. Total cost of the project (incl IDC)		Rs.	2780.00	Lakhs							
B. Equity		Rs.	834.00	Lakhs		Sale price: Rs. 5.91/ Unit					
C. Term Loan		Rs.	1946.00	Lakhs							
Sale Rate of Rs./ unit (IPP)		5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
Sl. No	**Particulars / Year**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
1	Annual Charges										
a	Interest on loans @ 11%	16.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	146.78	146.78	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
c	Amortization of Preliminary Expenditure										
d	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	226.11	239.04	252.71	267.17	282.45	298.60	315.68	333.74	352.83	373.01
e	Return on Equity @ 14%	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76
	Total annual charges (a+b+c+d+e)	506.26	502.58	396.44	410.89	426.17	442.33	459.41	477.47	496.56	516.74
2	Revenue										
i	saleable unit (Mu)	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09
ii	cost of generation in Rs./ KWH at Busbar (T.A.Chrg/i*10)	4.57	4.53	3.57	3.71	3.84	3.99	4.14	4.31	4.48	4.66
iii	Average cost of generation		4.66								
iv	Total revenue @Rs. 5.91/unit	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
v	capital subsidy										
vi	Total sales revenue (iv+v)	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
vii	Total Operating Exp. (1a to 1d)	506.26	502.58	396.44	410.89	426.17	442.33	459.41	477.47	496.56	516.74
viii	Profit before Tax	149.16	152.84	258.98	244.53	229.25	213.09	196.01	177.95	158.86	138.68
ix	Provision for income tax @25%	37.29	38.21	64.75	61.13	57.31	53.27	49.00	44.49	39.72	34.67
x	profit after tax	111.87	114.63	194.24	183.40	171.93	159.82	147.01	133.46	119.15	104.01
xi	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	146.78	146.78	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
xii	Funds from operations (x+xi)	258.65	261.41	221.20	210.36	198.90	186.78	173.97	160.43	146.11	130.98
xiii	Less: Loan repayment	260.00	86.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
xiv	Net cash surplus (xii-xiii)	-1.35	175.41	221.20	210.36	198.90	186.78	173.97	160.43	146.11	130.98
xv	Cumulative Net cash Surplus	626.62	802.04	1023.24	1233.60	1432.50	1619.28	1793.26	1953.69	2099.80	2230.78

COST OF GENERATION AND CASH FLOW **Table - 14.4(3/3)**

A. Total cost of the project (incl IDC)		Rs.	2780.00	Lakhs							
B. Equity		Rs.	834.00	Lakhs		Sale price: Rs. 5.91/ Unit					
C. Term Loan		Rs.	1946.00	Lakhs							
Sale Rate of Rs./ unit (IPP)		5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
Sl. No	**Particulars / Year**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
1	Annual Charges										
a	Interest on loans @ 11%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
c	Amortization of Preliminary Expenditure										
d	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	394.35	416.91	440.75	465.97	492.62	520.80	550.59	582.08	615.37	650.57
e	Return on Equity @ 14%	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76	116.76
	Total annual charges (a+b+c+d+e)	538.08	560.63	584.48	609.69	636.34	664.52	694.31	725.81	759.10	794.30
2	Revenue										
i	saleable unit (Mu)	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09
ii	cost of generation in Rs./ KWH at Busbar (T.A.Chrg/i*10)	4.85	5.06	5.27	5.50	5.74	5.99	6.26	6.54	6.84	7.16
iii	Average cost of generation										
iv	Total revenue @Rs. 5.91/unit	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
v	capital subsidy										
vi	Total sales revenue (iv+v)	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
vii	Total Operating Exp. (1a to 1d)	538.08	560.63	584.48	609.69	636.34	664.52	694.31	725.81	759.10	794.30
viii	Profit before Tax	117.34	94.79	70.94	45.73	19.08	-9.10	-38.89	-70.39	-103.68	-138.88
ix	Provision for income tax @25%	29.34	23.70	17.73	11.43	4.77	-2.28	-9.72	-17.60	-25.92	-34.72
x	profit after tax	88.01	71.09	53.20	34.30	14.31	-6.83	-29.17	-52.79	-77.76	-104.16
xi	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
xii	Funds from operations (x+xi)	114.97	98.06	80.17	61.26	41.27	20.14	-2.20	-25.82	-50.79	-77.19
xiii	Less: Loan repayment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
xiv	Net cash surplus (xii-xiii)	114.97	98.06	80.17	61.26	41.27	20.14	-2.20	-25.82	-50.79	-77.19
xv	Cumulative Net cash Surplus	2345.75	2443.81	2523.98	2585.24	2626.51	2646.65	2644.45	2618.62	2567.83	2490.64

Table - 14.5

COST OF ENERGY FOR FIRST YEAR

Sl. No	Description	Amount (in Lakhs)
1	Project Construction cost	2780.00
	Equity (30%)	834.00
	Debt (70%)	1946.00
2	Interest during construction	219.00
3	Project completion cost	2999.00
	Operating Expenses	
4	Interest @ 11% on term loan	205.81
5	Depreciation @5.28% for 12 yrs. & 0.97 % from 13th yr.	146.78
6	Amortization of Preliminary Expenditure	14.80
7	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	129.64
8	Return on Equity @14%	116.76
	Total	**613.79**
9	Gross Energy Production in MU	11.20
10	Design Energy at Busbar	11.20
11	Less Aux consm & transmission losses (1%)	0.11
12	Net saleable energy in MU	11.09
13	**Cost of Energy generation in Rs. /kWh**	**5.53**

PROFITABILITY STATEMENT **Table - 14.6 (1/3)**

Sl. No	Particulars / Year	1	2	3	4	5	6	7	8	9	10
1	Sale Energy (Mu)	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09
2	Sale Rate	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
3	Sale Value	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
	Capital Subsidy		200.00								
	Total income (including subsidy)	655.42	855.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
4	Operating Exp.										
a	Interest on Loan	205.81	193.99	181.06	167.04	151.91	134.86	115.61	94.16	70.51	44.66
b	Depreciation @ 5.28% for 12 Yrs & 0.97% from 13th Yr	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78
c	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	129.64	137.06	144.89	153.18	161.95	171.21	181.00	191.35	202.30	213.87
d	Amortization of Preliminary Expenditure	14.80	14.80	14.80	14.80	14.80					
5	Total Operating Expense (4 a to c)	497.03	492.62	487.54	481.80	475.44	452.85	443.40	432.30	419.59	405.32
6	Profit before Tax	158.39	362.79	167.88	173.62	179.98	202.57	212.02	223.12	235.82	250.10
7	Provision for tax @25%	39.60	90.70	41.97	43.40	44.99	50.64	53.01	55.78	58.96	62.53
8	Profit after Tax	118.79	272.10	125.91	130.21	134.98	151.93	159.02	167.34	176.87	187.58
9	ADD - Non Cash Expenditure and Finance Costs										
i	Depreciation as above	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78
ii	Amortization of Preliminary Expenditure	14.80	14.80	14.80	14.80	14.80	0.00	0.00	0.00	0.00	0.00
iii	Finance Costs	205.81	193.99	181.06	167.04	151.91	134.86	115.61	94.16	70.51	44.66
10	Operating Cash Inflow	486.18	627.66	468.55	458.83	448.48	433.57	421.41	408.28	394.16	379.02
11	Cumulative Cash Inflow	486.1828	1113.85	1582.40	2041.23	2489.71	2923.28	3344.69	3752.98	4147.14	4526.16

PROFITABILITY STATEMENT **Table - 14.6 (2/3)**

Sl. No	Particulars / Year	11	12	13	14	15	16	17	18	19	20
1	Sale Energy (Mu)	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09
2	Sale Rate	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
3	Sale Value	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
	Capital Subsidy										
	Total income (including subsidy)	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
4	Operating Exp.										
a	Interest on Loan	16.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b	Depreciation @ 5.28% for 12 Yrs & 0.97% from 13th Yr	146.78	146.78	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
c	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	226.11	239.04	252.71	267.17	282.45	298.60	315.68	333.74	352.83	373.01
d	Amortization of Preliminary Expenditure										
5	Total Operating Expense (4 a to c)	389.50	385.82	279.68	294.13	309.41	325.57	342.65	360.71	379.80	399.98
6	Profit before Tax	265.92	269.60	375.74	361.29	346.00	329.85	312.77	294.71	275.62	255.44
7	Provision for tax @25%	66.48	67.40	93.94	90.32	86.50	82.46	78.19	73.68	68.91	63.86
8	Profit after Tax	199.44	202.20	281.81	270.96	259.50	247.39	234.58	221.03	206.72	191.58
9	ADD - Non Cash Expenditure and Finance Costs										
i	Depreciation as above	146.78	146.78	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
ii	Amortization of Preliminary Expenditure	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iii	Finance Costs	16.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Operating Cash Inflow	362.83	348.98	308.77	297.93	286.47	274.35	261.54	248.00	233.68	218.55
11	Cumulative Cash Inflow	4889.00	5237.98	5546.75	5844.68	6131.15	6405.50	6667.04	6915.04	7148.73	7367.27

PROFITABILITY STATEMENT **Table - 14.6 (3/3)**

Sl. No	Particulars / Year	21	22	23	24	25	26	27	28	29	30
1	Sale Energy (Mu)	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09
2	Sale Rate	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
3	Sale Value	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
	Capital Subsidy										
	Total income (including subsidy)	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42	655.42
4	Operating Exp.										
a	Interest on Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b	Depreciation @ 5.28% for 12 Yrs & 0.97% from 13th Yr	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
c	O&M charges 32.41 Lacs/MW (5.72 % annual escalation)	394.35	416.91	440.75	465.97	492.62	520.80	550.59	582.08	615.37	650.57
d	Amortization of Preliminary Expenditure										
5	Total Operating Expense (4 a to c)	421.32	443.87	467.72	492.93	519.58	547.76	577.55	609.05	642.34	677.54
6	Profit before Tax	234.10	211.55	187.70	162.49	135.83	107.66	77.87	46.37	13.08	-22.12
7	Provision for tax @25%	58.53	52.89	46.92	40.62	33.96	26.91	19.47	11.59	3.27	-5.53
8	Profit after Tax	175.58	158.66	140.77	121.87	101.88	80.74	58.40	34.78	9.81	-16.59
9	ADD - Non Cash Expenditure and Finance Costs										
i	Depreciation as above	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97	26.97
ii	Amortization of Preliminary Expenditure	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iii	Finance Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Operating Cash Inflow	202.54	185.63	167.74	148.83	128.84	107.71	85.37	61.75	36.78	10.38
11	Cumulative Cash Inflow	7569.81	7755.44	7923.18	8072.01	8200.85	8308.56	8393.93	8455.67	8492.45	8502.82

Table 14.7

DSCR STATEMENT														
Sl. No	**Particulars/ Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
A	**Service**													
1	Profit after Tax	118.79	272.10	125.91	130.21	134.98	151.93	159.02	167.34	176.87	187.58	199.44	202.20	281.81
2	Depreciation	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	146.78	26.97
3	Interest on Term Loan	205.81	193.99	181.06	167.04	151.91	134.86	115.61	94.16	70.51	44.66	16.61	0.00	0.00
4	Amortization of Preliminary Expenditure	14.80	14.80	14.80	14.80									
	Net cash available	486.18	627.66	468.55	458.83	433.68	433.57	421.41	408.28	394.16	379.02	362.83	348.98	308.77
B	**Debt**													
1	Term Loan Payment	100.00	110.00	120.00	130.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	86.00	0.00
2	Interest on Term Loan	224.81	193.99	181.06	167.04	151.91	134.86	115.61	94.16	70.51	44.66	16.61	0.00	0.00
Total (B)		324.81	303.99	301.06	297.04	291.91	294.86	295.61	294.16	290.51	284.66	276.61	86.00	0.00
DSCR		1.50	2.06	1.56	1.54	1.49	1.47	1.43	1.39	1.36	1.33	1.31	4.06	0.00
Average DSCR		**1.71**												

Table 14.8

Calculation of IRR			
No. of Years after Commissioning	Cash Outflow (Cost of Project)	Cash Inflow (Return on Project)	Net Cash Flow
0	(2,780)		(2,780)
1		486.18	486.18
2		627.66	627.66
3		468.55	468.55
4		458.83	458.83
5		448.48	448.48
6		433.57	433.57
7		421.41	421.41
8		408.28	408.28
9		394.16	394.16
10		379.02	379.02
11		362.83	362.83
12		348.98	348.98
13		308.77	308.77
14		297.93	297.93
15		286.47	286.47
16		274.35	274.35
17		261.54	261.54
18		248.00	248.00
19		233.68	233.68
20		218.55	218.55
21		202.54	202.54
22		185.63	185.63
23		167.74	167.74
24		148.83	148.83
25		128.84	128.84
26		107.71	107.71
27		85.37	85.37
28		61.75	61.75
29		36.78	36.78
30		10.38	10.38
		IRR	15.09%

ANNEXURES

GOVERNMENT OF KERALA

Abstract

Power Department – Enhancement of capacity of Mukkudam SHP from 1MW to 4MW - Approved - Orders issued.

POWER (B) DEPARTMENT

G.O.(Ms)No. 7/2021/PD Dated, Thiruvananthapuram, 23/02/2021.

Read:- 1. G.O.(MS)No.05/2018/PD dated 09.03.2018.
2. Government Letter No.16/B1/2018/PD dated 15/02/2020.
3. Minutes of the Meeting of the Technical committee for TEFR clearance dated 28.01.2021.

ORDER

Government vide G.O read as 1st paper above allotted Mukkudam Small Hydro Electric Project to M/s Mukkudam Electroenergy Pvt. Ltd as 'Projects identified by private persons on their own land' (own land category) as per the provisions of SHP Policy 2012 with an installed capacity of 1MW.

Further, on request from M/s Mukkudam Electroenergy Pvt. Ltd, Government vide letter read as 2nd paper above had accorded sanction to prepare revised Detailed Project Report for Mukkudam SHP at their own risk and cost of the investor. In continuation, M/s Mukkudam Electroenergy Pvt. Ltd had furnished revised DPR for capacity enhancement to 4 MW. The Technical committee for TEFR clearance vide Minutes of the meeting read as 3rd paper above have recommended to approve enhancement of capacity of Mukkudam SHP from 1MW to 4MW at the Developer's own risk and cost after they remit the requisite premium amount of Rs.15 Lakhs/MW to the Government for the capacity addition of 3 MW, subject to the developer receiving all necessary clearances from different Departments and LSGs. Also Committee member from KSEBL has confirmed that no upstream or downstream projects will get affected by the proposed capacity enhancement from 1 MW to 4 MW of Mukkudam', SHP project.

Government examined the matter in detail and are pleased to approve enhancement of capacity of Mukkudam SHP from 1MW to 4MW at the Developer's own risk and cost after they remit the requisite premium

amount of Rs.15 Lakhs/MW to the Government for the capacity addition of 3 MW, subject to the condition that developer receiving all necessary clearances from different Departments and LSGs.

By Order of the Governor,
SAURABH JAIN IAS
SECRETARY

To

Director, Energy Management Centre, Thiruvananthapuram.

Managing Director, M/s Mukkudam Electroenergy Pvt. Ltd (Through Director, Energy Management Centre).

The Chairman & Managing Director, Kerala State Electricity Board Limited.

The Accountant General (A&E), Kerala, Thiruvananthapuram.

The Principal Accountant General (Audit), Kerala, Thiruvananthapuram.

The Information and Public Relations Department (Web and new media division).

Stock File/Office Copy.

Forwarded / By Order

Section Officer

भारतीय अक्षय ऊर्जा विकास संस्था लिमिटेड
Indian Renewable Energy Development Agency Limited
(भारत सरकार का प्रतिष्ठान / A Government of India Enterprise)
कॉर्पोरेट कार्यालय : तीसरा तल, अगस्त क्रांति भवन, भीकाएजी कामा प्लेस, नई दिल्ली–110066
Corporate Office : 3rd Floor, August Kranti Bhawan, Bhikaiji Cama Place, New Delhi-110066
दूरभाष / Tel. : +91 -11-26717400, 26717412 फैक्स / Fax : +91-11-26717416
ई–मेल / E-mail : cmd@ireda.in वैबसाईट / Website : www.ireda.in
CIN : U65100DL1987GOI027265

इरेडा IREDA
(A Mini Ratna Category-I PSU)

150 YEARS OF CELEBRATING THE MAHATMA

Speed post

TS-13/14/2021-IREDA/754 Dated: 03.09.2021

M/s MUKKUDAM ELECTROENERGY PVT LTD.
11/569, Muringothil,
Kambilikandam, Parathodu-Idukki Post,
Idukki District, Kerala - 685571

Sub: Sanction a term loan of Rs. 1416.00 Lakhs to M/s. Mukkudam Electroenergy Pvt Ltd, for setting up 4.00 MW Mukkadam SHP at Mukkadam Village, Idukki District, Kerala **(Project No 2554).**

Dear Sir,

Please refer to your loan application and subsequent correspondence & discussions, your representative(s) had with us, regarding term loan of 1416.00 Lakhs towards setting up of 4.00 MW Mukkadam SHP at Mukkadam Village, Idukki District, Kerala (Project No 2554).

1. The application has been considered and Indian Renewable Energy Development Agency Ltd (IREDA) is agreeable to provide your Organisation, as Borrower, Term Loan of Rs. 1416.00 Lakhs (Rupees Fourteen Crores Sixteen Lakhs only).
2. The sanctioned loan is subject to following:
   i. Terms and conditions as detailed in Annexure-I
   ii. Formalities to be complied with for execution of loan documents as detailed in Annexure- II.
   iii. The steps / formalities required to be complied with and / or documents required to be submitted for the securities stipulated as detailed in Annexure-III
   iv. Sample Standard Legal Documentation formats are available on IREDA's website (www.ireda.in) for your reference. However, the same will be modified as applicable and as per the present guidelines of IREDA.
3. Please note that this communication should not in any way be construed as giving rise to any binding obligation on the part of IREDA, unless the borrower communicates to IREDA, within 30 days from the date of receipt of this letter that the terms and conditions set out herein are acceptable and unless the Loan

Agreement and other documents relating to the above loan are executed by the borrower within the prescribed period, the loan sanction shall be considered withdrawn automatically without any further reference and obligation on the part of IREDA.

4. The execution of Loan Agreement and other documents is scheduled for 03/10/2021. In case you wish to sign the documents earlier, you are welcome to do so with prior intimation. This is, however, subject to submission of documents, as detailed in the letter.

5. Mr Puran Mal Meena is Nodal Officer for your Project.

6. All the annexures are deemed to be part of this letter.

Thanking You

Yours faithfully

FOR INDIAN RENEWABLE ENERGY
DEVELOPMENT AGENCY LIMITED

Sushant Kumar Dey
Addl. General Manager (TS)

ANNEXURE-I

TERMS AND CONDITIONS

GENERAL CONDITIONS:

1. Term Loan Amount: Rs. 1416.00 Lakhs (Rupees Fourteen Crores Sixteen Lakhs only).

Project Cost Break-up

(Rs. in lakhs)

Particulars	Total project cost
Land & Site Development	153.00
Civil Works	875.00
H & M Equipment	587.00
E & M Equipment including switchyard, erection, etc.	910.00
Project Management (incl. front end fee)	105.00
Others including Transmission lines	130.00
Contingency	20.00
Interest during Construction	150.00
Total	2930.00

Means of Finance:

(Rs. lakhs.)

	Particulars	Amount	% of Project Cost
1	Promoter's Contribution	1014.00	34.61%
a)	Equity or internal accruals from the company	880.20	30.04%
b)	Unsecured Loans	133.80	4.57%
2	Term Loan	1916.00	65.39%
a)	IREDA Loan	1416.00	48.33%
b)	IFCI Venture Capital Fund/ other FI/Bank	500.00	17.06%
	Total	2930.00	100%

2. Interest:

10.95% p.a. – During Construction

10.45% p.a. – After Commissioning

[As applicable for Internal Rating Grade-IV]

The Interest shall be payable on monthly basis by the Company.

The effective interest rate will be the rate prevailing at the time of each disbursement. The interest rate will be subject to revision on the expiry of every 1 year as per the interest reset guidelines notified by IREDA. The first interest reset shall be on the date of commissioning of the project or 1 year from the date of first disbursement, whichever is earlier.

3. Front End Fee:

Front end fee will be payable at the rate 1.00% of loan amount plus GST, as applicable.

i. The 50% of the applicable "Front End Fee" shall be paid within 3 months from the date of issue of sanction letter otherwise sanction letter be cancelled.

ii. Remaining amount shall be paid within the validity period of signing of loan agreement as per sanction i.e. 6 months from the date of issue of sanction letter and is normally non-refundable.

iii. 20% rebate in Front End Fee shall be applicable if paid within 60 days from the date of IREDA's Sanction Letter.

LLC Fees: IREDA will appoint Lenders Legal Counsel (LLC) for loan documentation and security creation and the charges towards LLC shall be borne by the company.

4. Liquidated Damages:

In case of default in payment of installments of principal, interest and all other monies (except liquidated damages) on due dates, liquidated damages, at the rate of 2.00% p.a. over and above the applicable rate of interest for the projects shall be payable. Liquidated damages shall be payable in manner and on the dates specified in the Loan Agreement for payment of interest. Arrears of liquidated damages shall carry interest at the rate applicable to loan. The additional interest by way of liquidated damages for non-payment of interest and repayment of principal is calculated on daily basis. The number of days in a year being calculated as 365.

1) Terminal Dates:

I.	Last date to sign Loan Agreement	-	Within six months from the date of loan sanction letter
II.	Last date to draw first installment of Loan	-	Within 6 months from the date of signing of loan agreement.
III.	Last date to draw final installment of Loan	-	Within 15 months from the date of first Disbursement.

2) Repayment of Loan:

I	Tenure of the Loan	-	12 years.
II	Construction Period	-	18 Months
III	Grace Period	-	1 Year, from COD
IV	Mode of Repayment	-	48 structured quarterly installments with seasonal variation as detailed below and interest shall be payable on monthly basis.

March quarter	5%
June quarter	5%
Sept quarter	45%
Dec quarter	45%

V. Tentative repayment schedule - Enclosed at Annexure I-A

3) Security:

i. Mortgage of all Immovable properties/ Assets pertaining to 4 MW (2 X 2 MW) Mukkudam at Mukkudam village, district -Idduki, Kerala.

(For the Government land of about 0.190 Ha out of total project land of 0.412 Ha, which is not mortgageable, Comfort letter from concerned authority to be submitted to the satisfaction of IREDA).

ii. Hypothecation of all Movable Assets; Both Existing and Future pertaining to this project

iii. Personal Guarantee of following

- Rakesh Roy
- Faris E M
- Nitish S J
- Rijo Joseph
- Renjini M
- Cyriac Jose.

iv. Pledge of 76% Equity Shares of M/s. Mukkudam Electroenergy Pvt Ltd.

v. NACH mandate /any similar instrument as per requirement towards repayment schedule.

vi. Conditional assignment by way of undertaking of: All the rights, title, interest, benefits, claims, demands, O&M Contract, Insurance Contracts, and project documents all as amended, varied or supplemented from time to time.

vii. Company shall open a Trust & Retention Account to the satisfaction of IREDA with scheduled Bank as per IREDA's format for depositing project revenues and disbursement and execute a suitable Trust and Retention Account agreement to the satisfaction of IREDA.

viii. Cash Sweep In: up to 50% surplus fund after creation of DSRA as per the waterfall arrangement as defined in TRA.

4) Conditions to be complied before execution of Loan Agreement.

i. The company shall submit front-end fee as per IREDA financing norms.
ii. Company shall have the full debt tie-up and submit sanction letter for the same.
iii. The company shall submit undertaking agreeing that the original KYC documents verification before disbursement.
iv. The Company shall give an undertaking that if there is any cost over run in the project, the same should be brought in by the promoter's contribution/equity.
v. The Company shall give an undertaking to IREDA that it shall not take any loan from any other Banks / FIs over and above the loan considered for the project during currency of loan for this project without written IREDA's permission.

vi. The company shall give an undertaking that they will note and ensure that the Debt-Equity Ratio of the project would be maintained at not more than 1.89:1 during the tenure of IREDA loan.
vii. Assignment of all the project related documents such as PPA, TRA, Allotment letter, Contracts, etc., to IREDA by way of undertaking.
viii. Undertaking that none of its director's name appear in RBI/CIBIL Defaulters list ECGC Caution List.
ix. The company shall submit an undertaking that they shall comply with all the Anti-Money Laundering (AML) requirements.
x. The company shall submit an undertaking that any insurance claim received by the company shall be deposited in the TRA account.
xi. The Borrower shall disclose all pending or threatened litigations which will incur liability exceeding INR 30,00,000 or above against the Borrower/ Promoter/ Promoter Group / Sponsor to the Lender in a form and manner as mentioned in the Disclosure Schedule provided herein below.

Litigation	Date	Details

5. **Terms and Condition to be complied before availing first disbursement**
i. The Company shall utilize 70% of promoter contribution upfront towards the implementation of the project which shall include at least 25% of the proposed unsecure loan of Rs 133.80lakhs.
ii. Company shall take appropriate steps/approval to increase authorized capital to Rs 8.80 Cr.
iii. The Company shall achieve full financial tie up with other lenders, IFCI Venture Capital Fund Ltd and submit the supporting document to this effect, to the satisfaction of IREDA.
iv. IREDA will be disburse on pro-rata share with other lenders
v. Company shall submit comfort letter from KSEB towards power purchase of 4MW Mukkudam SHP.
vi. Company shall execute and submit connectivity agreement with KSEB.
vii. Company shall submit Copy of Insurance Cover for the project.
viii. Company shall submit Blasting and Explosive License, if any from the concerned Authority.
ix. The Company shall submit copy of contracts (Civil, H&M, E&M and transmission line) awarded for the project indicating the contract value for each contract and duly vetted by the LIE, appointed by lender.
x. The company shall submit the latest net-worth certificate of all the personal guarantors in IREDA format.

6. **Important Conditions**
i. The Company shall maintain DSRA equivalent to two (2) quarters of lenders dues in the Trust and Retention Account (TRA) to be built-up as per waterfall arrangement of TRA. 1 quarter DSRA to be built up before SCOD and another one quarter to be build up within 12 months from COD from cash flows. The Company shall ensure maintenance of 2 quarter DSRA during the tenor of the Loan.

ii. The Company shall be allowed to withdraw from TRA, Rs 6.00 lakhs per month plus insurance in first year of operation with 5.00% annual escalation. (maximum Rs. 87.90 lakhs/annum) towards O&M expenditure
iii. Company shall submit PPA on or before availing disbursement beyond 60%. However, the last 5% loan shall be released upon submission of PPA ratified with a tariff of minimum Rs 5.53/unit by KSERC.
iv. The company will submit a letter from the power purchaser in IREDA's format that all the sale proceeds of the project shall be deposited in TRA account, before last 25% of disbursement.
v. The disbursement will be regulated as per prevailing IREDA guidelines.
vi. IFCI Venture Capital fund Ltd (IFCI VCFL) is expected to sanction Term loan/OCD of Rs 5.00 Cr with a 5-year tenor along with 1 year moratorium period from COD and same has been considered in the appraisal. Accordingly, Securities are proposed to be shared on Pari Passu basis.
vii. In the Event of Default, IREDA is of the reasonable opinion, that the security created has become inadequate to cover the outstanding under Facility, then on the IREDA advising the Borrower to that effect, the Borrower shall provide and furnish to the IREDA, to their satisfaction, such additional security as may be acceptable to IREDA to cover such deficiency.
viii. The term loan from IFCI VCFL is considered as 5.00 Cr, in case the same is less than Rs. 5.00 Cr, the difference shall be brought in by the promoter's contribution.

7. General Terms and Conditions

i. Company shall obtain prior permission of IREDA in case any change in promoter contribution towards the project,
ii. Company shall submit power purchase agreement (PPA) with KSEB at a tariff of at least Rs.5.53 per unit for a period of more than 15 years, otherwise IREDA reserves right to reappraise the project.
iii. Any other better term s & conditions and security stipulated by other lender shall be applicable for IREDA loan mutatis mutandis.
iv. The rate of interest on unsecured loan shall be less than the IREDA interest rate and any unsecured loan shall be served only after the repayment of entire loan along with other dues of the lenders with consent of the lenders.
v. The Company shall submit project expenditure statement duly certified by statutory auditor as per IREDA format.
vi. The Company shall obtain necessary clearances/approvals for creating the securities proposed above from the State Govt. / GOI etc. on their own, if required.
vii. The Company shall give updated implementation schedule giving PERT chart and project progress every 3 months clearly indicating the milestone, dates for completion of various activities.
viii. The company shall submit certificate from its Statutory auditor on an annual basis to the effect that all the statutory dues including EPF dues has been paid by the company
ix. The company shall submit net-worth certificate for all the personal guarantors, audited annual reports for the company and corporate guarantors/ promoter companies annually

x. In case of any change in technical design made subsequently to the project, approval for the same may be obtained from the concerned authority of the State Government under intimation to IREDA.

xi. Valuation report in respect Land & Building / Plant & Machinery, other immovable property charged / securities should be obtained from Any nationalized Bank approved valuer registered with CBDT once in every 3 year. Fee for the same shall be borne by the company.

xii. The Company shall place appropriate display board at the project site & project office giving the project details and contribution of IREDA/MNRE & direction board for showing site approach.

xiii. The Company should not undertake any new project/ expansion/ loan or make any investment without prior approval of IREDA.

xiv. IREDA will appoint Lenders Legal Counsel (LLC) for loan documentation and security creation and the charges towards LLC shall be borne by the company.

xv. The Company shall obtain prior approval/ NOC from IREDA for sale of CERs IVERs, if any of the project and shall inform IREDA on issuance of CERs by UNFCCC.

xvi. The company will give an undertaking that the sale proceeds of CERs /VERs, if any shall be deposited in the Trust and retention Account (TRA) and shall also submit a copy of the 'Emission Reduction Purchase Agreement' (ERPA) to IREDA.

xvii. The Borrower shall undertake to address satisfactorily, the suggestions that may be made by the Lender's Consultants on the Project and incorporate the necessary changes in the Project Documents to the satisfaction of the Lenders.

xviii. The company shall reimburse all other expenses incurred, including expenses towards security trustee fee, independent engineer/consultant, concurrent auditor/ CA, legal counsel, lender's financial advisor, insurance advisors, consortium meetings, service tax, travel lodging, boarding, etc.

xix. The appraisal has been made as per the present applicable guidelines governing the rate of interest, its applicability, reset etc. However, changes if any, effected in these guidelines on the date of disbursement shall be applicable and IREDA reserves its right to reappraise the project, if so required.

xx. The Company shall install the projects with adequate measures like earthquakes resistant design structure, resistant against high wind speed/ storm, flood as applicable to the site conditions of the project to minimize the disaster risks.

xxi. In case any capital subsidy is sanctioned and released by MNRE/ any other Govt. Agency central and state, IREDA's principal loan amount shall be reduced and adjusted as per the prevailing policy.

xxii. The company will give an undertaking that all receivables including Subsidy from State/Central/any Govt. Agency including MNRE Subsidy shall be routed through TRA.

xxiii. IREDA shall have the right to appoint Nominee Director/ Concurrent Engineer/ Lenders Financial Advisor (LFA)/ Concurrent Auditor/ Lender Insurance Agent (LIA) for concurrent monitoring of the physical and financial progress of the project. The Borrower hereby agrees to provide all the required support to Lenders' Engineer and Concurrent Auditor appointed by the Lenders, to enable them to submit their report.

xxiv. The Company shall use Energy Efficient Appliances for the plants and its auxiliaries.

xxv. The Company shall ensure that necessary personal protective equipment (PPE) will be provided to all the personnel at site during the execution and operation of the plant.

xxvi. The Company shall explore and use Smart Grid wherever feasible while implementing IREDA supported projects.

:xvii. The annualized Interest rate shall be as notified by IREDA.

xviii. The Project/Security charged should be insured against fire, earth quack and other risks with banker name as Indian Renewable Energy Development Agency, New Delhi

xxix. The Borrower shall also arrange for an undertaking / certificate from promoter/promoter group/sponsor that on the date thereof, there are no litigation, arbitration, administrative or other proceedings pending or threatened against the promoter/promoter group/sponsor, which, if adversely determined, might have a material adverse effect.

xxx. The Borrower further agrees, declares, confirms and undertakes as under,

a. The Borrower, its representatives, agents, employees have not indulged in and shall not indulge in any "corrupt practice" meaning the offering, giving, receiving or soliciting of anything of value to influence the action of officials of Lender in the sanction of and in availing Loans.

b. In the event of occurrence of the above and IREDA having come to the knowledge of the same, without prejudice to other rights of IREDA, IREDA may, by notice in writing to the Borrower, terminate the right of the Borrower to make withdrawal of the Loans. Upon such notice, the undrawn amount of the Loan shall stand cancelled, and Loan already disbursed shall become due and payable immediately, irrespective of Amortization Schedule in the Loan Agreements as amended from time to time, without any liability on the part of IREDA for any consequences. Subject to the same notwithstanding any cancellation, suspension or termination pursuant to the aforesaid provisions, all the provisions of the Loan Agreement shall continue to be in full force and effect as herein specifically provided.

Tentative Repayment Schedule of Rs 1416.00 Lakhs

ANNEXURE-I A

S.No.	Instalment
1	2.83
2	2.83
3	25.49
4	25.49
5	2.83
6	2.83
7	25.49
8	25.49
9	2.83
10	2.83
11	25.49
12	25.49
13	2.83
14	2.83
15	25.49
16	25.49
17	3.54
18	3.54
19	31.86
20	31.86
21	5.66
22	5.66
23	50.98
24	50.98

S.No.	Instalment
25	5.66
26	5.66
27	50.98
28	50.98
29	5.66
30	5.66
31	50.98
32	50.98
33	8.50
34	8.50
35	76.46
36	76.46
37	8.50
38	8.50
39	76.46
40	76.46
41	10.62
42	10.62
43	95.58
44	95.58
45	11.33
46	11.33
47	101.95
48	101.95
Total	1416.00

Note: First repayment shall fall due tentatively from Sept 2024, considering SCOD June 2023 and actual repayment shall be re-drawn based on the actual COD.

ANNEXURE-II

FORMALITIES TO BE COMPLIED WITH FOR EXECUTION OF LOAN DOCUMENTS

1) Resolutions passed at a regularly convened meeting of the Board / Governing Council authorising the borrowing of loan and execution of loan documents in the case of Companies, Co-operative Societies, Societies and other Bodies registered under the Societies Registration Act in IREDA format
2) Borrowing power Certificate in respect of a Public Limited Company pursuant to provisions of Section 180 (1) (c) of the Companies Act, 2013 or Cooperative Society as applicable in IREDA format
3) Demand Draft / Multi-City Cheque / Cheque at par for the Front-End Fee
4) Certificate from an Advocate that the Borrower has acquired the land and it has prima facie good and marketable title
5) Search Report from a practicing Company Secretary from the Office of Registrar of Companies, in case the Borrower is a Company under the Companies Act
6) Furnish photographs / photocopy of Passport / PAN & DIN of the Directors / Executives who would execute documents with IREDA on behalf of the Borrower
7) No lien Account opening letter from a Scheduled Bank foregoing right of set off on the said Account as per the draft enclosed

ANNEXURE-III

REQUIREMENTS TO BE COMPLIED WITH FOR COMPLETION OF SECURITY

<u>Exclusive First charge by way of Mortgage</u>

1) Board Resolution passed by Company under Section-180 (1) (a) Companies Act, 2013 for creation of mortgage in case Borrower is a Public Company or a Private Company which is a subsidiary of a Public Company Registered under the Companies Act
2) Copy(ies) of property papers.
3) Investigation of Title of Project properties.
4) No Objection Letters from all existing lenders for term loan and working capital limits having omnibus clause in the documents executed in their favour of charge on all present and future assets. In case of consortium financing, a certificate issued by consortium bank leader / institution on its own behalf and on behalf of other member banks / institutions will be acceptable
5) Non-Judicial Stamp Papers for preparation of documents. The Borrower has to pay Stamp Duty as per Policy on creation of mortgage. Stamp papers as per Delhi laws will be arranged by IREDA at the cost of borrower.

6) Deposit at New Delhi all Original documents of title and copy of plan / Map for the land / Project site issued by the concerned Revenue Officer / other authority through their Authorised Director/s.
7) Registration of Charge with Registrar of Companies in case borrower is a Company Registered under the Companies Act.
8) Income Tax Clearance Certificate u/s 281 of the Income Tax Act issued by the concerned Assessing Officer confirming no dues and proceedings pending and giving No Objection for availing IREDA loan and creation of charge on movable and immovable assets of the Borrower.
9) Insurance Policy on immovable assets covering all risks obtained in the joint names of Borrower and IREDA with Bank Clause covering all usual risks.
10) Compliance of Conditions related to creation of security
11) Photographs of Executant/s

Exclusive First charge by way of hypothecation

1) Execution of Deed of Hypothecation, as prepared by IREDA.
2) Non-Judicial Stamp Papers for preparation of documents. The Borrower has to pay Stamp Duty on advelorem basis as applicable on Deed of Hypothecation at the place where the Borrower's Registered Office and / or project are situated over and above the Delhi Stamp papers. Stamp papers as per Delhi laws will be arranged by IREDA at the cost of borrower.
3) Registration of Charge with Registrar of Companies in case borrower is a Company Registered under the Companies Act.
4) Income Tax Clearance Certificate u/s 281 of the Income Tax Act issued by the concerned Assessing Officer confirming no dues and proceedings pending and giving No Objection for availing IREDA loan and creation of charge on movable and immovable assets of the Borrower.
5) Submission of Insurance Policy on immovable assets covering all risks obtained in the joint names of Borrower and IREDA with Bank Clause covering all usual risks.
6) No Objection Letters from all existing lenders for term loan and working capital limits having omnibus clause in the documents executed in their favour of charge on all present and future assets. In case of consortium financing, a certificate issued by consortium bank leader / institution on its own behalf and on behalf of other member banks / institutions will be acceptable.
7) Photographs of the executants.

Personal Guarantee

1) Names, age, father's name, and residential addresses with telephone numbers of promoters / directors and for identification, photograph and copy of PAN, Passport, DIN who are to give personal guarantees for preparation of documents by IREDA.
2) Execute Personal Guarantees.

NACH Mandate/ Any Similar Instrument (NACH)

1) The NACH will be drawn in the name of Indian Renewable Energy Development Agency Ltd / IREDA Ltd as per repayment schedule of principal loan amount and interest.
2) An undertaking in IREDA format (enclosed) on Letter Head of the borrower confirming cheques are drawn on the main account of the Company and that the operational instructions will not be changed by Borrower.
3) Confirmation from Bank by way of a certificate in IREDA format (enclosed) attesting the signature of the signatories of the mandate and indicating mode of operation of the account.

Pledge of shares:

1) Resolutions to be passed by Board of Directors.
2) Share Certificates issued by the Company along with a valid transfer deeds for each certificate.
3) Attestation of signatures of allottee/s on transfer deed by Notary Public or his/their Nominee(s)
4) In case, the pledge is to be created through an Attorney, a valid Power of Attorney will be executed by the allottee/s as per IREDA format.
5) If the Power of Attorney is executed by a Company registered under the Companies Act, it will bear the Common Seal of the Company.
6) Compliance of Sections 185 & 186 of the Companies Act 2013 along with suitable certificate from its Auditors as per the format of IREDA
7) Pledge of Shares can be created by a Company through its Authorised representative as per its Board Resolutions.
8) Noting of pledge in favour of IREDA by Company issuing shares.

Pledge of Insurance Policy/ies :

1) Submission of original Insurance Policy/ies.
2) Signing of Pledge Agreement.
3) Submission of surrender value certificate from insurance company.
4) Change of nomination / entry of IREDA nomination on Insurance Policy

IFCI VENTURE

Ref. No./IFCI Venture/VCFBC/2021-22/207483 **26th November, 2021**

M/s Mukkudam Electroenergy Pvt. Ltd.
No.11/569 Muringothil Kambilikandom,
Parathodu, Idukki Post Idukki,
Kerala – 685571.

Kind Attn: Mr. Rakesh Roy

Re: Sanction of financial assistance to M/s Mukkudam Electroenergy Pvt. Ltd. (MEPL) from IFCI Venture under "Venture Capital Fund for Backward Classes" (VCFBC).

1. Please refer to your Application No. VCFBCOL00085 dated 22nd September 2021, seeking financial assistance under Venture Capital Fund for Backward Classes (hereinafter referred to as 'VCFBC') and the subsequent correspondence / discussions you had exchanged with us regarding the project to develop a 4 MW (2 X 2MW) small hydro power project named **"Mukkudam Small Hydroelectric Project"** at Konnathady Grama Panchayat, Mukkudam Village, Idduki District, Kerala. The proposed hydro project is based on run-of-the-river scheme to harness the power potential of hill stream called Parathode that joins Muthirapuzha, which is a major stream joining Periyar River by creating a small pondage with a raised concrete gravity weir near Mukkudam village.

2. In this connection, we hereby advise that your proposal has been considered and the Investment Committee of VCFBC is agreeable "in-principal" to provide financial assistance of Rs.5,00,00,000 (Rupees Five Crore Only) to M/s Mukkudam Electroenergy Pvt. Ltd. (hereinafter referred to as 'The Company' or 'MEPL') under VCFBC by way of subscription to:

   - **Optionally Convertible Debentures (OCDs):** 4,99,000 OCDs of Rs. 100/- each, at par, aggregating to Rs.4,99,00,000 (Rupees Four Crore Ninety Nine Only);
   - **Equity Shares:** 10,000 equity shares of Rs.10 each, at par, aggregating to Rs.1,00,000 (Rupees One Lakh Only).

3. The aforesaid facilities are subject to the terms and conditions as set out in Appendix-I hereto. The above facility is also subject to such other additional condition(s) as may be

आईएफसीआई वेंचर कैपिटल फण्ड्स लि०
(A Subsidiary of IFCI Ltd.)
(भारत सरकार का उपक्रम)
आईएफसीआई टावर, 61 नेहरू प्लेस, नई दिल्ली – 110 019
दूरभाष : +91-11-26453343, 26453346
फैक्स : +91-11-26453348
वेबसाईट : www.ifciventure.com
सी.आई.एन : U65993DL1988G0I030284

IFCI Venture Capital Funds Ltd.
(A Subsidiary of IFCI Ltd.)
(A Government of India Undertaking)
IFCI Tower, 61 Nehru Place, New Delhi-110019
Phone : +91-11-26453343, 26453346
Fax : +91-11-26453348
Website : www.ifciventure.com
CIN : U65993DL1988G0I030284

stipulated by IFCI Venture Capital funds Limited (IFCI Venture) under VCFBC from time to time.

4. The Company viz. M/s Mukkudam Electroenergy Pvt. Ltd. shall enter into legal agreements and other documents with IFCI Venture under VCFBC to its satisfaction with respect to subscription of equity and OCDs.

5. The drafts of the agreements and other legal documents, as applicable, covering the said facilities, would be forwarded to the Company by IFCI Venture after the Company accepts the terms and conditions of this "Letter of Intent" and the "Term Sheet" (hereinafter together referred to as 'LOI').

6. In case the terms and conditions of this Letter of Intent are acceptable to you:

   a) You may furnish to us, two certified copies of the resolution duly passed by the Board of Directors of your Company as per the Performa given in **Appendix -II**. This resolution must provide that the Company is agreeable to enter into Agreement in the manner and form(s) as mentioned above within the time stipulated by IFCI Venture and that till such Agreement is executed, there is no obligation or commitment on the part of IFCI Venture under VCFBC to advance any money.

   b) You will, within the same time as in (a) above, furnish to us a statement of anticipated drawal of funds indicating probable dates and amount of drawal.

7. Please note that this communication should not be construed as giving rise to any binding obligation on the part of IFCI Venture under VCFBC, till such time the Company communicates to VCFBC/ IFCI Venture within 15 days from the date of receipt of this letter that the terms and conditions set out herein are acceptable to it and the legal documents and other documents relating to the above facility are executed by the Company in such manner and form as may be required by IFCI Venture under VCFBC within 3 months from the date of this "Letter of Intent" or such further time as may be allowed by IFCI Venture under VCFBC in its absolute discretion. Further, the general checklist (Legal) for completing the legal compliances is enclosed in **Appendix-III** and other required compliance formats are enclosed at **Appendix-IV** and **Appendix-V**.

8. The validity period of the sanction to avail disbursement of the sanctioned financial assistance shall expire after six months from the date of this Term Sheet or within such extended period as IFCI Venture may decide at its sole discretion. Disbursement can only be availed by the Company within the validity period of sanction.

9. Meanwhile please acknowledge receipt of this Letter of Intent along with the appendix as mentioned and return duplicate copy of this letter & term sheet duly signed & stamped by your authorised signatory.

10. You are also advised to submit all necessary documents as per **Annexure-III (Legal Checklist)** to IFCI Venture within 15 days of acceptance of this Letter of Intent and Term Sheet to expedite the legal compliances.

Yours Sincerely,

Poonam

(Poonam Garg)
General Manager

Enclosures:

1. **Appendix-I:** Term Sheet
2. **Appendix-II:** Format of Board Resolution
3. **Appendix-III:** General Checklist (Legal)
4. **Appendix-IV**: Affidavit for Backward Classes (Format)
5. **Appendix:-V:** Bankers Signature Verification Letter (Format)

We accept all the terms & conditions as contained in this LOI & Term Sheet enclosed herewith.

For and On behalf of – M/s Mukkudam Electroenergy Pvt. Ltd.

_____ _____

Annexure-I

TERM SHEET

The Company	M/s Mukkudam Electroenergy Pvt. Ltd. (MEPL)
Registered Office	No.11/569 Muringothil Kambilikandom, Parathodu, Idukki Post Idukki, Kerala – 685571.
Investor/ Fund	Venture Capital Fund for Backward Classes (VCFBC) through IFCI Venture Capital Funds Ltd. (IFCI Venture)
Promoters	• Mr. Rakesh Roy • Mr. Nitish S J • Mr. Faris E M Basheer • Ms. Renjini M • Mr. Rijo Joseph • Mr. Cyriac Jose
Proposed Project	To develop a 4 MW (2 X 2MW) small hydro power project named ***"Mukkudam Small Hydroelectric Project"*** at Konnathady Grama Panchayat, Mukkudam Village, Idduki District, Kerala. The proposed hydro project is based on run-of-the-river scheme to harness the power potential of hill stream called **Parathode** that joins **Muthirapuzha**, which is a major stream joining **Periyar River** by creating a small pondage with a raised concrete gravity weir near Mukkudam Village.
Project Location	Konnathady Grama Panchayat, Mukkudam Village, Idduki District, Kerala.
Financial Assistance under VCFBC	IFCI Venture under VCFBC proposes to invest Rs.5,00,00,000 (Rupees Five Crore Only) to MEPL by way of subscription to: • **Optionally Convertible Debentures (OCDs):** 4,99,000 OCDs of Rs. 100/- each, at par, aggregating to Rs.4,99,00,000 (Rupees Four Crore Ninety-Nine Lakh Only) • **Equity Shares:** 10,000 equity shares of Rs. 10 each, at par, aggregating to Rs.1,00,000.
Tenure of Investment	8 Years from the date of first disbursement
Moratorium Period	30 months from the date of first disbursement
Validity period of the sanction	The validity period of the sanction to avail disbursement of the sanctioned financial assistance under VCFBC shall expire after six months from the date of this Term Sheet or within such extended period as IFCI Venture may decide at its sole discretion.
Repayment	Post Dated Cheques/ECS Mandate for coupon payment and redemption of OCDs as per the redemption schedule.

TERMS & CONDITIONS

I. PROJECT COST

a. The total cost of the project proposed by **M/s. Mukkudam Electroenergy Pvt. Ltd.** (herein referred to as **'the Company' / 'MEPL'**) promoted by Mr. Rakesh Roy, Mr. Nitish S J, Mr. Faris E M Basheer, Ms. Renjini M, Mr. Rijo Joseph and Mr. Cyriac Jose, is **Rs.29,30,00,000 (Rupees Twenty Nine Crore Thirty Lakh Only)** to develop a 4 MW (2 X 2MW) small hydro power project named **"Mukkudam Small Hydroelectric Project"** at Konnathady Grama Panchayat, Mukkudam Village, Idduki District, Kerala. The proposed hydro project is based on run-of-the-river scheme to harness the power potential of hill stream called Parathode that joins Muthirapuzha, which is a major stream joining Periyar River by creating a small pondage with a raised concrete gravity weir near Mukkudam village.

b. The Company/ Promoters shall make arrangements to raise funds through equity shares to the tune of at least **Rs.880.20 Lakh (Rupees Eight Crore Eighty Lakh Twenty Thousand Only)** by subscribing to **88,02,000** equity shares of Rs. 10/- each at Par and unsecured loans in the Company to the tune of a least **Rs.133.80 Lakh (Rupees One Crore Thirty Three Lakh Eighty Thousand Only)** i.e. 34.61% of the total project cost, (**Annexed as Appendix-A**), as per the sanctioned project of MEPL to the satisfaction of IFCI Venture.

c. The Indian Renewable Energy Development Agency Limited (IREDA) has accorded a sanction of Rs.1416 Lakh as term loan for the project, i.e. 48.33% of the total project cost, as per the submitted business plan of MEPL.

d. As per the terms of sanction, it has been mentioned that IREDA will appoint Lenders Legal Counsel (LLC) for loan documentation and security creation and the charges towards LLC shall be borne by the Company. The same condition shall be applicable to the sanctioned project under VCFBC.

e. The balance approx. 17.06% of the total project cost i.e. **Rs.500 Lakh (Rupees Five Crore Only)** is proposed to be financed through the financial assistance from IFCI Venture Capital Funds Limited (hereinafter referred as 'IFCI Venture') under Venture Capital Fund for Backward Classes (hereinafter referred as 'VCFBC').

f. The disbursement of Rs.500 Lakh shall be in tranches and shall not at any point of time be more than two times the net worth of the Company. The Disbursement shall not at any point of time be more than 17.06% of the total project cost as per the sanctioned plan, i.e. Rs.500 Lakh (approx. 17.06% of Rs.2930 Lakh) and shall be in proportion to promoter's contribution and term loan from IREDA towards the project.

g. The disbursement of IFCI Venture's contribution towards the total project cost shall be done through an Escrow Account with a Scheduled Commercial Bank. The terms of such Escrow Account pursuant shall be in accordance with the terms and conditions of this term sheet.

h. IFCI Venture reserves the right of withholding the full/part sanctioned financial assistance in case the Company / promoters fail to raise their full/part contribution through equity shares and/or unsecured loan and/or arrange for the required working capital. The Promoters shall arrange the funds on their own without any recourse to further financial assistance from IFCI Venture.

i. The Company should strictly adhere to the implementation schedule (**Annexed as Annexure-C**). The delay in implementation of the proposed project may delay the disbursement and in such case the disbursement will be subject to availability of funds.

II. PRE-DISBURSEMENT CONDITION

a) The Company shall utilize 70% of promoter's contribution upfront towards the implementation of the project which shall include at least 25% of the proposed unsecured loan of Rs.133.80 Lakh.

b) The Company shall arrange to submit a confirmation letter from the local concerned authority regarding the name mismatch in the Caste Certificate of Mr. Faris E M Basheer and his KYC documents.

c) The Company should submit comfort letter from KSEB towards power purchase of 4 MW Mukkudam SHP.

d) The Company shall execute and submit connectivity agreement with KSEB.

e) The Company shall submit copy of Insurance Cover for the project.

f) The Company shall submit Blasting and Explosive License, if any from the concerned Authority.

g) The Company shall submit copy of contracts (Civil, H&M, E&M and transmission line) awarded for the project indicating the contract value for each contract and duly vetted by the LIE, appointed by the lenders.

h) The Company shall submit the latest net worth certificate of all the personal guarantors.

i) The Company shall agree and provide an undertaking that all that all memorandum/agreements/arrangements entered into by the company with the plant & machinery suppliers/vendors and any other agencies/vendors (contractors, etc.) shall hold good and the terms and conditions of the said agreement/memorandum/arrangement are binding and not diluted, which can adversely affect the project implementation and its costing.

j) Company shall agree and confirm that it shall indemnify IFCI Venture under VCFBC from any loss/damage, etc arising out of non-fulfilment of contractual obligations with any vender/suppliers, etc. including invocation of force majure clause.

k) The Company shall arrange to conduct title search & valuation of the securities offered by the Company under the sanctioned project to the satisfaction of IFCI Venture.

l) The Company shall arrange to provide comfort letter/NOC from IREDA for sharing pari-pasu charge on all the securities offered to IREDA in favour of IFCI Venture.

III. IMPORTANT CONDITIONS

a. The Company shall maintain DSRA equivalent to two (2) quarters of lenders dues in the Trust and Retention Account (TRA) to be built-up as per waterfall arrangement of TRA. 1 quarter DSRA to be built up before SCOD and another one quarter to be build up within 12 months from COD from cash flows. The Company shall ensure maintenance of 2 quarter DSRA during the tenor of the financial assistance under VCFBC.

b. The Company shall be allowed to withdraw from TRA, Rs.6 Lakh per month plus insurance in first year of operation with 5% annual escalation. (Maximum of Rs.87.90 Lakh/annum towards) O&M expenditure.

c. The Company shall submit Power Purchase Agreement (PPA) on or before availing disbursement beyond 60%. However, the last 5% loan shall be released upon submission of PPA ratified with a tariff of minimum Rs.5.53/unit by KSERC.

d. The Company shall undertake to extend the applicability of all the terms & conditions as mentioned in the sanction letter of IREDA to IFCI Venture under VCFBC.

e. The Company shall provide all necessary documents/information as provided to IREDA from time to time or on as and when required basis.

IV. SUBSCRIPTION TO EQUITY SHARES

f. Subject to satisfaction of terms & conditions of this term sheet, IFCI Venture under VCFBC will subscribe to 10,000 (Ten thousand only) equity shares of Rs.10/- (Rupees Ten Only) each in MEPL, aggregating to Rs.1,00,000 (Rupees One Lakh only) as part of overall assistance provided under VCFBC.

g. The equity shares subscribed by VCFBC in the Company would rank pari-pasu to the other equity shares constituting the paid-up capital of the Company, including issue of bonus shares, distribution of dividends and voting rights etc.

h. The entire equity shares shall be bought back by the Company/ Promoters after 30th September 2028 and on/or before 31st December 2029 at an IRR of 8% p.a. compounded annually.

V. SUBSCRIPTION TO OPTIONALLY CONVERTIBLE DEBENTURES

a. Subject to satisfaction of terms & conditions of this term sheet, IFCI Venture under VCFBC will subscribe to 4,99,000 (Four Lakh Ninety Nine Thousand Only) nos. of OCDs of Rs.100/- each aggregating to **Rs.4,99,00,000/- (Rupees Four Crore Ninety Nine Lakh Only)** in MEPL. The OCDs shall carry coupon rate of 8% per annum to be payable on quarterly basis to VCFBC, starting from the date of disbursement of the assistance under the fund. **In case of any delay in the payment of the coupon on OCDs and/or redemption of OCDs, there shall be a default coupon rate @ 10% per annum chargeable for the delayed period of payment.**

b. The OCDs shall be convertible into equity shares of the Company or redeemed/bought back by Company/Promoters as per terms contained hereinafter.

c. The Company/ Promoters shall redeem/ buy back up to **4,05,000 (Four Lakh Five Thousand Only) nos. of OCDs of Rs.100/- each aggregating to Rs.4,05,00,000/- (Rupees Four Crore Five Lakh Only)** held by IFCI Venture under VCFBC after 31st June 2024 and on/or before 30th September 2028 in the quarterly manner. In case of buyback of OCDs by promoter, the amount brought in by promoter shall remain in the Company till the exit of IFCI Venture. This amount shall remain as equity share capital or any other non-interest-bearing instrument, at the option of the promoter, with prior approval of IFCI Venture.

d. The redemption/ buyback shall take place as per the below given schedule:

Sl.	Repayment Date	No. of OCD's to be redeemed	Outstanding No. of OCDs of Face Value Rs. 100 /- Each
1.	31-Mar-22	-	4,99,000
2.	30-Jun-22	-	4,99,000
3.	30-Sep-22	-	4,99,000
4.	31-Dec-22	-	4,99,000
5.	31-Mar-23	-	4,99,000

6.	30-Jun-23	-	4,99,000
7.	30-Sep-23	-	4,99,000
8.	31-Dec-23	-	4,99,000
9.	31-Mar-24	-	4,99,000
10.	30-Jun-24	-	4,99,000
11.	30-Sep-24	25,000	4,74,000
12.	31-Dec-24	25,000	4,49,000
13.	31-Mar-25	5,000	4,44,000
14.	30-Jun-25	5,000	4,39,000
15.	30-Sep-25	45,000	3,94,000
16.	31-Dec-25	45,000	3,49,000
17.	31-Mar-26	5,000	3,44,000
18.	30-Jun-26	5,000	3,39,000
19.	30-Sep-26	45,000	2,94,000
20.	31-Dec-26	45,000	2,49,000
21.	31-Mar-27	5,000	2,44,000
22.	30-Jun-27	5,000	2,39,000
23.	30-Sep-27	45,000	1,94,000
24.	31-Dec-27	45,000	1,49,000
25.	31-Mar-28	5,000	1,44,000
26.	30-Jun-28	5,000	1,39,000
27.	30-Sep-28	45,000	94,000
No. of OCDs to be bought back		**4,05,000**	
28.	31-Dec-28	45,000	49,000
29.	31-Mar-29	5,000	44,000
30.	30-Jun-29	5,000	39,000
31.	30-Sep-29	25,000	14,000
32.	31-Dec-29	14,000	-
No. of OCDs to be bought back		**94,000**	
Total OCDs to be bought back		**4,99,000**	

Important Note: *The above redemption schedule has been drawn based on the assumption that the Company shall avail the first disbursement in March 2022 due to* ***COVID 19 Pandemic situation across the globe.*** *Therefore, all the dates mentioned in this term sheet shall get changed as per the actual date of first disbursement.*

e. The outstanding OCDs as on 30th September 2028 shall be converted into equity shares at the sole discretion of IFCI Venture, after reviewing the performance of MEPL as per audited annual accounts of the Financial Year 2027-28 compared with the projections submitted by MEPL **(annexed as Appendix-B).** The resultant shares after opting for conversion of debenture into equity shares, shall rank pari-pasu with the existing equity shares of the Company. The conversion shall be exercised by VCFBC after the audited annual accounts are approved by the shareholders in the Annual General Meeting of the Company for the Financial Year 2027-28 and on/before November 30, 2028.

f. The conversion of OCDs into equity shares of MEPL as per the above clause may take place after giving an opportunity to the Company/ Promoters to redeem/ buyback the outstanding OCDs as per the redemption/ buyback schedule given at clause (d) above along with coupon

rate of 8% p.a. after 30th September 2028 and on/ or before 31st December 2029. The Company shall give its written consent to IFCI Venture within a period of 30 days after 30th September 2028.

g. Such conversion of OCDs into equity shares shall be at the sole discretion of IFCI Venture and in the manner as decided by IFCI Venture. Also, such equity shares held by VCFBC shall carry an IRR of 8% p.a. from the date of conversion.

h. In case IFCI Venture decides not to convert the OCDs into equity shares of MEPL or till such time the outstanding OCDs are not converted into equity shares of MEPL, the Company / Promoters shall continue to redeem / buyback the outstanding OCDs as per the redemption / buyback schedule given at clause (d) above along with coupon rate of 8% p.a.

VI. SECURITY FOR INVESTMENT

The redemption/buyback of OCDs & equity, along with redemption / coupon by VCFBC, would be secured by the following. IFCI Venture under VCFBC shall have the following securities in Pari passu with IREDA:-

I. Pari-pasu Securities with IREDA:-

a) Mortgage of all Immovable properties/Assets pertaining to 4 MW (2 X 2 MW) Mukkudam at Mukkudam Village, District – Idduki, Kerala;

(For the Government land of about 0.190 Ha out of total project land of 0.412 Ha, which is not mortgageable. Comfort letter from concerned authority to be submitted to the satisfaction of IREDA and IFCI Venture)

b) Hypothecation of all Movable Assets. Both existing and future pertaining to this project;

c) Pledge of 76% Equity Shares of M/s Mukkudam Electroenergy Pvt. Ltd.;

d) Conditional assignment by way of undertaking of: all the rights, title, interest, benefits, claims, demands, O&M Contract, Insurance Contracts, and project documents all as amended, varied or supplemented from time to time;

e) Company shall open a Trust & Retention Account to the satisfaction of IREDA with scheduled Bank as per IREDA's format for depositing project revenues and disbursement and execute a suitable Trust and Retention Account agreement to the satisfaction of IREDA and IFCI Venture;

f) Cash Sweep In: Up to 50% surplus fund after creation of DSRA as per the waterfall arrangement as defined in TRA

II. Personal Guarantee of following:-

i. Mr. Rakesh Roy
ii. Mr. Nitish S J
iii. Mr. Faris E M Basheer
iv. Ms. Renjini M
v. Mr. Rijo Joseph
vi. Mr. Cyriac Jose

III. NACH mandate/any similar instrument as per requirement towards repayment schedule;

Note: Separate valuation shall be carried out by empanelled valuer of IFCI Ltd., for the above-mentioned securities.

VII. EXIT FROM INVESTMENT

a. The Company / Promoters shall redeem / buy back **4,05,000** nos. of OCDs of Rs.100/- each aggregating to **Rs.4,05,00,000** held by IFCI Venture under VCFBC along with coupon rate of 8% per annum after 30th June 2024 and on/or before 30th September 2028 in quarterly manner as specified at clause V (d) above.

b. In the event of conversion of OCDs into equity shares of the Company taking place as per clause V of this term sheet as referred above, the Company/ Promoter(s) shall ensure that the converted equity shares shall be bought back after 30th September 2028 and on/ or before 31st December 2029 at an IRR of 8% p.a. from the date of conversion.

c. For providing exit for the outstanding equity shares held by IFCI Venture as on 30th September 2028, the Company shall approach strategic investors/ other Venture Capital/ Private Equity Funds or Financial Institutions or bring out public issue of its equity shares and get its equity shares listed on a recognized stock exchange, to the satisfaction of IFCI Venture, latest by 31st December 2029 or within such extended period as IFCI Venture may decide at its sole discretion. Such an exit shall be at a price which gives a net return of 8% p.a. compounded annually to IFCI Venture. The exit plan shall be finalised with written approval from IFCI Venture.

d. In the event of Company failing to provide a suitable exit option to IFCI Venture by 31st December 2029, IFCI Venture shall exercise Put Option on the Promoters of the Company at any time thereafter to immediately buy-back the equity shares of the Company held by IFCI Venture on demand and at sole option of IFCI Venture, within a period of 60 days from such demand at the highest of:
   i) Book value of share of the Company as per latest Balance Sheet of the Company; or
   ii) Fair price as determined by Merchant Banker/ Valuer/ Independent firm of Chartered Accountants appointed by IFCI Venture; or
   iii) Price that gives a net return of 8% p.a. compounded annually net of dividend receipt, if any.

e. In the event of default by the promoters in their obligation as above, IFCI Venture under VCFBC, at its sole discretion, will be free to sell equity shares held in MEPL to any person(s) to recover its dues ensuring the return as per the above clause. Any shortfall in sale proceeds shall be made good by the promoters. For recovering its financial assistance amount along with return, IFCI Venture will have right to enforce security available with it by way of charge on assets, pledge of shares and guarantee of promoters etc.

f. **Tag along rights:** In case the promoters, with consent of IFCI Venture, wish to transfer part of their shareholding in Company to any third party, IFCI Venture will have right at its sole discretion to tag along and exercise the option to sell part or whole of its shareholding to same party at the same price to which promoters are selling equity shares held by them. The Company shall give offer of such tag along right to IFCI Venture for giving its consent within a period of 30 days.

g. **Drag along rights:** If none of the exit options including buyback of equity by Promoters materializes by 31st December 2029 or such extended period as IFCI Venture may decide at its sole discretion, IFCI Venture shall have right to drag along the promoters and require them to sell such number of their shares as specified by IFCI Venture along with it to a third party purchaser at the same price at which IFCI Venture is selling equity shares of MEPL held by it. IFCI Venture shall give 30 days' notice of such drag along rights to the Company.

h. In the event of default by the promoters in their obligation as above, IFCI Venture, at its sole discretion, will be free to sell equity shares held in MEPL to any persons and recover shortfall, if any, in the assured return.

i. In case the Promoters of MEPL, with the consent of IFCI Venture, wish to transfer their shareholding in the Company or part thereof, to any third party, IFCI Venture, at its sole discretion, notwithstanding any provision contained in letter of intent or any other legal agreement executed with MEPL or its Promoters, will reserve the right to convert OCDs subscribed by it or any part thereof into equity shares of MEPL at face value of Rs.100/- per share. Simultaneously, IFCI Venture will have the right to tag along with the promoters and exercise the option to sell such number of equity shares of MEPL held by it, as it deems fit to the same party.

VIII. EVENTS OF DEFAULT

a. Two consecutive defaults at any stage of payment of coupon and / or redemption / buyback of OCDs / Equity as per the schedule given above;
b. Invalidity or unenforceability of any security;
c. Non-compliance of regulatory and statutory compliances and corporate governance;
d. Implementation of the project not achieved by the date as specified in the business plan submitted by the Company or such date as extended by IFCI Venture;
e. Failure by the promoters to contribute their share as per the approved means of finance;
f. Any action detrimental to the scheme of the Government;
g. Abandonment of the project;
h. Any event which threatens the continuation of the project;
i. Sale of existing shareholding by Guarantor/Promoter(s) in the Company/ or any other Company/ group Company without prior written permission from IFCI Venture;
j. Any representation, warranty or statement made or deemed to be made is /or proved to be incorrect or misleading in any manner;
k. Any event which, in the opinion of IFCI Venture, is likely to constitute Material Adverse Change to the Company;
l. All or substantially all of the undertaking, assets or properties of the Company or any of its subsidiaries, associates, affiliates or holding Company are seized, expropriated or compulsorily acquired by the authority of Government;
m. Any step is taken or proceedings started for dissolution or winding-up or for the appointment of a receiver, judicial manager, trustee or similar officer;
n. Any change in material ownership/control of the Company/or group Company/connected Company without prior permission of IFCI Venture;
o. Failure to provide latest Net Worth Certificate of Guarantors & Audited annual accounts of the Company;
p. Any change in Key Management Personnel(s), which in the opinion of IFCI Venture, is likely to constitute Material Adverse Change to the Company/Project;
q. Failure to provide TDS certificates;
r. Failure to provide fresh valuation of mortgaged properties & insurance certificate for building and plant & machinery with an endorsement to VCFBC;
s. Failure to perform or comply with any other obligations or terms and conditions;
t. In case the Company becomes ineligible as per the scheme of the fund during the tenure of IFCI Venture's assistance.
u. Failure to provide insurance of factory building, plant & machinery, etc. and making endorsement of the same in favour of VCF-SC.
v. Failure to perform the contract obligations with machine vendor or any other vendor that will jeopardise the implementation of said financed project.

w. Alienate/transfer/create any third party right in any of the project assets/security of the company/promoter/guarantor without prior written approval of IFCI Venture.

IX. RIGHTS IN THE EVENT OF DEFAULT

During the currency of financial assistance under VCFBC if any event of default or potential event of default as mentioned aforesaid has occurred, IFCI Venture shall have the right to:

a. Cancel undisbursed financial assistance;
b. Call off the investment and/or recall the said financial assistance/ invoke guarantee(s)/ and/ or take any other appropriate legal actions;
c. Charge default coupon @ 10% (including coupon @8%) compounded annually from the date of disbursement on the entire outstanding amount for OCDs;
d. Convert the entire outstanding OCDs including default coupon @10% p.a. into equity shares at the sole discretion of IFCI Venture under VCFBC. Such equity shares shall be bought back by the Company/ Promoters on/ or before 31st March 2032 at an IRR of 8% p.a. compounded annually.
e. Enforcement of the security of properties mortgaged/assets hypothecated/ Shares pledged/ invoke guarantees given to IFCI Venture;
f. Appoint special auditor in the Company for verification of financials or any other purposes. All expenses related to such appointment shall be borne by the Company;
g. Stipulate additional conditions in its absolute discretion, etc.
h. Security Cheque/ECS shall be presented and encashed towards the outstanding dues.

X. PROTECTION OF IFCI VENTURE'S INTEREST

a. IFCI Venture shall have the right to conduct an independent secretarial and financial audit of the Company at any time before and after the sanction of financial assistance under VCFBC. IFCI Venture under VCFBC shall have the right to take opinion/review and stipulate any other suitable term(s) for undertaking financial assistance in, as it may deem fit for protecting its interest. The fees & expenses of such opinion/review shall be borne by the Company or its Promoters. IFCI Venture shall reserve the right to cancel the financial assistance sanctioned to the Company in case the opinion/review is not found suitable for the project implementation.
b. The Promoters shall submit their latest CA certified Net worth certificate for the assets held by the Promoters before the disbursement under VCFBC to the Company.
c. The Company shall not pay any interest on the unsecured loans/ any other investment raised from the promoters/promoter family & friends without written consent of IFCI Venture.
d. The Promoters shall undertake that they will not dispose and dilute their stake as detailed out in the Net worth certificate till IFCI Venture under VCFBC holds financial assistance in the Company. In case of any dilution the promoters have to take prior written approval from IFCI Venture. The promoters shall submit a CA certified Net worth certificate to IFCI Venture, latest by 30th June of every year till IFCI Venture under VCFBC holds financial assistance in the Company.
e. The Company shall not provide permission to shareholders to dilute their shareholding without taking prior written consent from IFCI Venture.
f. The Company will confirm and undertake that there are no law suits/ legal cases pending against the Company or its Directors. The Company/Promoter shall disclose the details of law suits/ legal cases filed/ decided if any.
g. The Company/Promoter(s) may raise fresh Equity Capital from recognised Private Equity Investors at a fair price determined for the purpose at a valuation increasing @15% per annum compounded annually from the date of first financial assistance in the Company by IFCI Venture under VCFBC or at such rate to the satisfaction of IFCI Venture.

h. The Company will not transfer/sell the intellectual property rights or franchised production /sale to any party without the prior approval of IFCI Venture. Such approval shall be subject to terms and conditions as may be stipulated by IFCI Venture at that time.
i. The Company will undertake that it will not increase the rent /other salaries/sitting fees etc. payable to the family members/relatives of the promoters for next two years. Further, on completion of two years, the expenses as stated above can be increased as may be approved by IFCI Venture at that time.
j. The Company shall maintain systematic and detailed records of development work carried out as well as efforts in securing market acceptance of his product and the documentation will be open to IFCI Venture's inspection and periodical review.
k. IFCI Venture will have the right to review the cost of the project, before the final disbursement of the funds.
l. IFCI Venture will have the right to stop further disbursement and/ or call off the assistance/ recall the assistance within the investment period, if in IFCI Venture's opinion, the assistance / the proposed project is either unsuccessful or the results are unsatisfactory and are not likely to lead to the success of the project/ the Company.
m. The Promoters will undertake to meet the overrun, if any, in the project cost on their own without any recourse to further assistance from IFCI Venture under VCFBC.
n. The Company / Promoters shall not undertake any major project or expansion or make any investment/ extra ordinary business expenditure without prior written approval of VCFBC/ IFCI Venture.
o. The equity shares held by IFCI Venture under VCFBC at any period shall rank pari-pasu with the existing issued equity shares with respect to all activities including but not limited to voting rights, dividends and rights issue of the Company.
p. The Promoter(s) and the Company shall undertake to allot equity shares and OCDs within the time permissible by law to VCFBC. IFCI Venture should receive the related certificates of OCDs and Equity within 30 days from the date of disbursement.
q. The Company shall further undertake to dematerialise the shares/ debentures including pledged shares within 90 days from the date of sanction of such financial assistance by VCFBC/ IFCI Venture.
r. In case of any delay/default, IFCI Venture shall have the right to rescind the financial assistance as per terms contained herein and recall the entire financial assistance amount, made so far in to the Company along with a penalty @ 10% p.a.
s. The Company shall confirm firm marketing tie up with job work providing companies, product buyers and shall submit the copies of the signed / executed agreements / MOUs with other firms to IFCI Venture.
t. The promoters shall make necessary changes (if required) in the MOA & AOA of the Company so as to make the Company enable to carry on the proposed business model from every aspect and as per applicable laws and further to avail the financial assistance under VCFBC.
u. Company shall not submit any resolution plan individually or jointly for any Corporate Insolvency Resolution process before NCLT.
v. Company shall inform IFCI Venture in case any Bank / FIs / Operational Creditors serves any notice for filing of application under Insolvency & Bankruptcy code, 2016.
w. Company shall take written permission from IFCI Venture before bringing any strategic investor(s) & also before appointing him on the Board of MEPL.
x. The Company shall submit the latest Audited Annual Reports of the Company latest by 31 October/30 November every year.

XI. NOMINEE DIRECTOR

a. The Company shall have no provisions in MOA/AOA which restricts the appointment/nomination of officers of IFCI Venture as Nominee Director(s) on Board of MEPL & if required shall make

necessary modification in its MOA & AOA, to enable IFCI Venture under VCFBC to appoint Nominee Director(s) on the Board of the Company.

b. IFCI Venture under VCFBC reserves the right to appoint one or more Nominee Director(s) on the Board of Directors of MEPL at any time during the period of the financial assistance under VCFBC and/or so long as VCFBC holds equity shares or OCDs or both in MEPL.
c. The Nominee Director(s) by IFCI Venture shall not be required to hold any qualification shares and not be liable to retire on rotation.
d. The Nominee Director(s) shall be entitled to all the rights and privileges of other Directors, including the sitting fees and expenses as payable to other Directors but if any other fees, commission, monies or remuneration in any form is payable to the Directors the same shall accrue to IFCI Venture and shall be paid by MEPL directly to IFCI Venture.
e. IFCI Venture shall have the liberty and discretion to appoint such Nominee Director(s) immediately after the acceptance of the Letter of Intent by MEPL, but such appointment shall not be construed as any commitment on the part of IFCI Venture to disburse the financial assistance unless IFCI Venture is fully satisfied that MEPL has complied with all the stipulated terms & conditions precedent to such disbursement.
f. The Company shall indemnify the nominee director(s) of IFCI Venture from all legal actions arising out of the day-to-day affairs of the Company.

XII. MONITORING

a. The Backward Classes promoters of the Company viz. Mr. Rakesh Roy, Mr. Nitish S J and Mr. Faris E M Basheer will not leave/resign from the Company during the entire tenure of financial assistance by IFCI Venture.
b. The Backward Classes promoters of MEPL viz. Mr. Rakesh Roy, Mr. Nitish S J and Mr. Faris E M Basheer shall not dilute their stake below 51% in the Company till the exit of IFCI Venture's financial assistance under VCFBC. However, in the event of any conversion of OCDs held by IFCI Venture under VCFBC, strategic investments, buyouts etc. which result into dilution of stake of the promoters, a prior written approval from IFCI Venture would be required;
c. MEPL will satisfy IFCI Venture that it has appointed sufficient technical, financial and commercial personnel of proper qualification and experience for the key posts and that its organisational setup is adequate enough to ensure smooth implementation and operations of the proposed project.
d. MEPL shall satisfy IFCI Venture that the physical progresses as well as expenditure incurred on the project are as per the original schedule. To this end, MEPL shall agree and undertake to furnish to VCFBC/ IFCI Venture such information and data as may be required including CA certified certificate of utilization.
e. MEPL shall keep IFCI Venture informed about its operations/progress in such manner and in such form as may be prescribed by IFCI Venture i.e., every month or time to time from the date of financial assistance during the implementation of the project and every quarter on commencement of commercial operations as long as IFCI Venture under VCFBC holds any equity shares or OCDs or both in the Company.
f. MEPL will also furnish to IFCI Venture such additional information, data, documents and explanation as may be called by IFCI Venture in relation to its working and affairs of the Company and other proprietorship firms of the promoters and the directors of the Company as and when required.
g. MEPL / Promoters shall appoint/re-appoint the statutory auditors to the satisfaction of IFCI Venture if any misconduct or negligence, as defined by the Institute of Chartered Accountants of India, is observed in the working of statutory auditors of the Company.

XIII. NON-COMPETE UNDERTAKING

Without prior written permission of IFCI Venture, the promoters shall not sponsor/ promote directly or indirectly any other Company or entity or engage in any activities and business, that would be in direct or indirect competition or carrying out any business in the industry, in which the Company operates or is detrimental to the interest of the Company, except, otherwise such activities/business are carried out by the Company or its subsidiary (ies).

XIV. ADHERENCE TO BUSINESS PLAN

a. MEPL/promoters will make best efforts to ensure that implementation of the proposed project progresses as per the implementation schedule indicated in the business plan submitted to IFCI Venture for sanction of financial assistance.
b. The Company will submit anticipatory drawl of funds at the time of signing of investment agreement.
c. IFCI Venture, in its sole & absolute discretion, may cancel the sanction of balance financial assistance or part thereof, in case MEPL delays the drawal of funds beyond a period of 90 days from the date of anticipated drawals as submitted at the time of investment agreement.
d. IFCI Venture, if deem fit at its sole discretion, may charge commitment charges @ 5% p.a. on amount(s) of anticipated drawals for extension period beyond 90 days as mentioned at para (c) above. Such commitment charges will be charged to the Company at a sole discretion of IFCI Venture.
e. The Company shall comply with pre-disbursement conditions as per the Letter of Intent & this Term sheet and draw financial assistance from VCFBC as per statement of anticipated drawals of funds.

XV. MISCELLANEOUS

a. Change in the Board of Directors and/ or any change in the position of the Chairman & Managing Director shall be done after seeking prior written approval from IFCI Venture.
b. It shall be the sole responsibility of the Company /associates to ensure that the services developed with IFCI Venture's assistance under VCFBC do not infringe any existing patents.
c. The Company shall make arrangements to get required approvals/clearances/licenses from various statutory Authorities for undertaking its activities.
d. The Company shall make adequate arrangements for utilities at site including water, electricity, communication etc. and shall ensure that suitable manpower is displayed for smooth running of the project.
e. The Company shall adhere to the rules, regulations and guidelines issued by the Government of India/other statutory authorities relating to the project.
f. Company and Promoters shall ensure due compliances of all the applicable statutory and legal Provisions/ Acts. Default in compliance, if any, shall have to be set right in 30 days failing which IFCI Venture shall have the right to treat it as event of default and invoke security/ guarantee for recovery of its dues.
g. All assets of the Company including building constructed in favour of IFCI Venture shall be fully insured by the borrower against fire, lighting, riot, strikes, floods, cyclones, earthquakes, civil commotion and other natural calamities, etc. with the insurance Company approved by IFCI Venture with an endorsement to VCFBC. The policies should be kept alive till IFCI Venture's assistance remains in the Company and the copy of insurance certificate with endorsement to VCFBC shall be provided to IFCI Venture.
h. The Company should have firm marketing tie up to the satisfaction of IFCI Venture and should be able to produce requisite proofs to IFCI Venture whenever asked for such proofs.
i. Company shall carry out valuations of the properties to be mortgaged and Title Search Report (TSR) of such property(s) from IFCI Empanelled Valuers & Advocates (if required for leasehold

land also) respectively. The charges for Valuation & Title Search shall be borne by the Company.

j. IFCI Venture has a right to visit the property/project in every six months or as when required by IFCI Venture & the charges of the same shall be borne by Company.
k. The Company shall provide insurance of the building constructed on the project/property charged to IFCI Venture.
l. IFCI Venture has a right to publish the audit reports of the Company at a public domain.
m. Issue of sanction letter to Company does not give any right to Company/Promoters to avail disbursement. The legal documentation and disbursement post sanction of the project is subject to the completion of sanctioned terms & conditions to the satisfaction of IFCI Venture.
n. In case, any discrepancy is found in the sanctioned project, the sanction is liable to be cancelled at any time at the sole discretion of IFCI Venture. Any investment by the Promoter/Company during the appraisal/sanction period does not give right to the Company/Promoter for claiming disbursement from IFCI Venture under VCFBC.

XVI. OTHER MATTERS

MEPL will require prior written consent from IFCI Venture under VCFBC for taking the following decisions during currency of IFCI Venture's assistance in MEPL:

i. Carrying out an IPO;
ii. Approval of annual accounts of the Company;
iii. Approval for taking loan/ any other type of funding in the Company;
iv. For issuing any Rights, Bonus and Preferential issues of equity shares or issue any convertible securities in the Company;
v. Increase, decrease, buyback or other alteration or modification of authorized or issued share capital;
vi. Change in the Board of Directors and any change in the position of the Chairman & Managing Director and key managerial persons in the Company;
vii. Amendments to the Memorandum or Articles of Association (including, without limitation, change in the number of members of the Board stated therein);
viii. Approval or amendment of annual business plan;
ix. Entering into any related party transactions between MEPL and its Promoters, Shareholders, Directors or their relatives or its associate and group companies;
x. Any and all mergers, restructurings, arrangements, amalgamations, consolidations and divestments of MEPL, acquisition of other businesses/ companies, creation of a subsidiary or Joint Venture, sale or disposal or encumbrance of all or a material part of MEPL's assets or closure of an existing business or commencement of any new business;
xi. Voluntary commencement of winding up proceeding for insolvency or bankruptcy by MEPL or initiation of any legal suits by MEPL against any party;
xii. Any appointment, engagement or increase in compensation of any person (other than promoters) with total compensation above Rs.10 lakh per annum;

XVII. BREACH OF TERMS AND CONDITIONS

In the event of breach of any of the terms and conditions contained hereinabove, IFCI Venture shall reserve the right to call off the venture and recall the financial assistance and the promoters / MEPL would be liable to pay the financial assistance amount along with default coupon of 10% p.a. on the OCDs and 8% p.a. on the equity shares from the date of first disbursement.

Appendix - A

➢ **Project Cost:-**

Sl.	Particulars	Amount (In Rs. Lakh)
1.	Land & Site Development	153.00
2.	Civil Works	875.00
3.	Hydro & Mechanical Equipment	587.00
4.	Electro & Mechanical Equipment including switchyard, erection, etc.	910.00
5.	Miscellaneous Expenditure	105.00
6.	Transmission lines	130.00
7.	Contingency	20.00
8.	Interest During Construction for 15 months	150.00
Total		**2930.00**
Project cost per MW		**Rs.7.32 Crore**

It is to mention here that the above project cost has been certified by IIT Roorkee, who has done the financial & technical evaluation of the project. Also, the same cost has been considered by IREDA for its sanction.

Notes to the Project Cost

a. Land & Site Development:

The proposed project is envisaged to be set up on a land admeasuring 0.412 Hectares, out of which 0.19 hectare is owned by the State Govt. and the same has been given on long term lease of 30 Years to the Company for developing the proposed project. The balance portion of 0.22 hectares has been purchased by the Company at a combined sale deed value of Rs.79 Lakh. Also, the Company was required to pay Rs.64 Lakh to the State Govt. towards premium for the project. The Company has also paid Rs.10 Lakh towards survey and sub-surface investigation of the project land. Thus, the total cost considered for land & site development is Rs.153 Lakh.

b. Civil Works:

Civil Works of the Project	Amount (In Lakh)
Diversion weir including Intake block, Stilling Basin & Scour sluice	317.00
Penstock civil work	316.00
Power House Building, site store building, road to power house and retaining wall along the river side	216.00
Tailrace channel	14.00
Switchyard Civil Works	12.00
Total Civil Works	**875.00**

The civil work is being executed by M/s T N R Constructions and Developers, proprietor Mr. RAGHAVAN NAIR T N who has more than 20 years' experience in hydro projects execution. The component wise civil contract details are as below:

- Dam: The works for Dam was awarded to TNR Constructions and Developers on Oct 1, 2018 at a value of Rs. 2.57 Cr. excluding applicable taxes which is fully constructed.
- Penstock Civil Work: The management has received quotes for Penstock Civil Works and is under evaluation for finalization of vendors.
- The Powerhouse, tail race channel and switch yard were awarded to TNR Constructions and Developers on 3 June 2021 at a value of Rs. 2.05 Cr. (GST Extra), the work is under progress.

c. Hydro & Mechanical Equipment

The Company is negotiating two vendors viz. Bhushan Tubes Pvt. Ltd., New Delhi and Wellspun Corp Ltd, Mumbai for the supply of penstock pipe and E. M. Fabricators & Erectors, Calicut, Kerala and Techs India Engineers & Contractors, Cochin, Kerala for the erection of penstocks.

d. Electro & Mechanical Equipment including switchyard, erection, etc.

The work has been awarded to ANDRITZ Hydro Private Limited for a value of Rs. 6.81 Cr. plus GST.

e. Miscellaneous Expenditure

The details of the Miscellaneous Expenditure of Rs.105 Lakh considered in the project cost are as follows:-

Sr. No.	Particulars	Amount In Lakhs
1	Consultancy fees including site supervision	15.00
2	Company overheads – staff salaries, travel	35.00
3	Vehicles for project - fuel and O&M costs	5.00
4	Medical facilities and post office	0.50
5	Security arrangements	0.50
6	Level gauge at the diversion weir and cabling till power house	0.50
7	Construction Power Supply	2.00
8	Boundary walls/ fencing - for the premises of diversion weir, penstock and power house	8.00
9	CCTV arrangements for the premises of diversion weir, penstock and power house	3.00
10	Ware house near power house	2.00
11	Miscellaneous – Pamphlets , inaugural ceremony	2.00
12	Training of maintenance Engineers	1.00
13	Environmental recovery	1.50
14	Guest House & First Aid Centre	15.00
15	Landscaping etc	2.00
16	Vehicles for project	12.00
	Total in Lakhs	105.00

f. Transmission Line:

The works of 2 Km 11 kV transmission line will be executed as depository basis by KSEB Ltd.

g. Contingency:

The proposed project involves procurement of specialized equipment and services. The Company is negotiating with different vendors for the various costs involved with the project. However, for smooth implementation of the project without any hindrance, a provision of Rs.20 Lakh has been considered towards contingency cost. The same may be required in case there is any upward revision in the cost of any equipment/services.

h. Interest During Construction:

IDC has been considered for 15 M for the loan of IREDA and assistance of IFCI Venture under VCF-BC.

Note:- It is to mention that during implementation, the project vendors may change. Any change in the vendors has to be considered in consultation with IREDA as both IFCI Venture and IREDA are co-lenders for the project.

➢ **Means of Finance:-**

Particulars	Amount (In Rs. Lakh)	% Contribution
Promoter's Contribution - Equity	880.20	34.61%
Unsecured Loan from Promoters	133.80	
Term Loan from IREDA	1416.00	48.33%
VCFBC - Equity	1.00	17.06%
VCFBC - OCDs	499.00	
Total	**2930.00**	**100%**

***Notes**: 1) As per the sanctioned means of finance with IREDA, the Promoters are required to bring atleast Rs.880.20 Lakh in equity and the balance portion in the form of unsecured loans. Accordingly, the means of finance under VCFBC has been designed.*

Appendix - B

➢ **Profit & loss Statement**

Amount (In Rs. Milliion)

Particulars	2024	2025	2026	2027	2028	2029	2030
Production (million Kwh)	9.693	9.693	9.693	9.693	9.693	9.693	9.693
Available (million kWh)	9.402	9.402	9.402	9.402	9.402	9.402	9.402
Net Generation (million kWh)	9.402	9.402	9.402	9.402	9.402	9.402	9.402
Actual Power sold (million kWh)	9.402	9.402	9.402	9.402	9.402	9.402	9.402
Sale Price (Rs/Unit)	5.53						
Sales revenue (Rs. million)	51.994	51.994	51.994	51.994	51.994	51.994	51.994
Total Revenues	**51.994**	**51.994**	**51.994**	**51.994**	**51.994**	**51.994**	**51.994**
Annual Operating Costs	8.790	9.156	9.541	9.945	10.369	10.814	11.281

Total Interest	18.797	18.554	17.162	15.610	14.218	12.800	11.523
Depreciation	15.199	15.199	15.199	15.199	15.199	15.199	15.199
Profit Before Tax (PBT)	**9.208**	**9.085**	**10.093**	**11.241**	**12.209**	**13.181**	**13.991**
Tax	2.318	2.287	2.540	2.829	3.073	3.317	3.521
Profit After Tax (PAT)	**6.89**	**6.80**	**7.55**	**8.41**	**9.14**	**9.86**	**10.47**

Appendix – C

- **Implementation Schedule:-**

a. The Company shall avail the first disbursement under VCFBC within six months from the date of issue of this LOI.
b. The sanctioned project shall be implemented as per the schedule given below:

Sl.	Particulars	Time Period
1.	Land & Land Development	Under Progress
2.	Technical Civil Work	6-8 Months
3.	Installation of Hydro-Mechanical Instruments/Equipment	3-4 Months
4.	Installation of Electro-Mechanical Instruments/Equipment	2-3 Months
5.	Construction of Transmission Line	1-2 Months
6.	Trial Production	1 Month
Total		**18 Months**

*The above completion period starts from the date of first disbursement under VCFBC.

KERALA STATE ELECTRICITY BOARD LIMITED
(Incorporated under the Indian Companies Act, 1956)
Office of the Chief Engineer (Commercial & Tariff)
8th Floor, Vydyuthi Bhavanam, Pattom, Thiruvananthapuram - 695 004,
Kerala
Phone: +91 471 2514554 Fax: 0471 2514405
E-mail:dceplg@kseb.in, dce.cp@kseb.in

No. CML-EE2- AEE-2/MSHEP/2021-22 CE(C&T)/ 297 Dated: 01 .01.2022

To

The Managing Director,
M/s Mukkudam Electro Energy Pvt. Ltd,
11/569, Muringothil, Kambilikandam,
Parathodu-Idukki Post, Idukki,
Kerala.

Sub: Issual of revised Letter of Comfort for purchase of power from 4MW Mukkudam SHEP of M/s Mukkudam Electro Energy Pvt Ltd.- reg:-

Ref:- 1. G.O.(Ms.)No.05/2018/PD dated Thiruvananthapcuram 09.03.2018
2. G.O.(Ms.)No.07/2021/PD dated Thiruvananthapuram 23.02.2021
3. This Office letter No. CML-EE2-AEE-2/MMHEP-SHEP/2017-18/CE(C&T)/158 dated 07.07.2018
4. Your Letter No.MEPL/MSHEP/2021-63 dated 29.11.2021

Please refer to the above. Based on your request referred (4), please find enclosed the revised Letter of Comfort on procuring power from Mukkudam SHEP (4MW).

Yours faithfully,

Chief Engineer (Commercial & Tariff)

KERALA STATE ELECTRICITY BOARD LIMITED
(Incorporated under the Indian Companies Act, 1956)
Office of the Chief Engineer (Commercial & Tariff)
8th Floor, Vydyuthi Bhavanam, Pattom, Thiruvananthapuram - 695 004,
Kerala
Phone: +91 471 2514554 Fax: 0471 2514405
E-mail:dceplg@kseb.in, dce.cp@kseb.in

No. CML-EE2- AEE-2/MSHEP/2021-22 CE(C&T)/ 297 Dated: 01 .01.2021

Provisional Letter of Comfort

To

M/s Mukkudam Electro Energy Pvt. Ltd,
11/569, Muringothil, Kambilikandam,
Parathodu-Idukki Post, Idukki,
Kerala.

KSEB Ltd is willing to procure the additional 3 MW power generated from the Mukkudam Small Hydro Electric Project (capacity enhancement from 1 MW to 4 MW) identified at Mukkudam in Konnathady Panchayath, Devikulam, Idukki District subject to the following terms and conditions:

A. the developer has to limit the capital cost within the regulatory norms reduced by the eligible MNRE grant.

B. Treatment for over generation as per CERC Renewable Energy Tariff norms shall be included in the PPA.

C. Tariff is lower of the Project specific tariff determined by KSERC or at the mutually agreed tariff or the tariff of any SHEP commissioned in Kerala during the year 2021-22. Provided that the allotee company (i) obtains necessary clearances/ permissions/NOC from the concerned Government Departments like irrigation, forest etc as the case may be as per the Small Hydro Power Policy 2012 (ii) executes connectivity agreement with KSEB Ltd, for the grant of connectivity for the project to the grid of KSEB Ltd.

This provisional Letter of Comfort is issued as per letter No. EMC/48/2020-PE7(SHP) dated 23.07.2021 of the Director & Head, SHP Cell, Energy Management Centre to the undersigned. This provisional letter of Comfort is issued for the purpose of facilitating

M/s Mukkudam Electro Energy Pvt Ltd, Idukki in achieving financial closure. Final Letter of Comfort for the enhanced capacity upto 4 MW will be issued after the remittance of the requisite premium amount for the capacity addition of 3 MW and confirmation of remittance of the same from Energy Management Centre.

Yours faithfully,

Chief Engineer (Commercial & Tariff),
For Kerala State Electricity Board Ltd.

Date: 01-01-2022

Energy Management Centre
(State Designated Agency to enforce Energy Conservation Act 2001)
Department of Power, Government of Kerala
Sreekrishna Nagar, Sreekariyam P.O.
Thiruvananthapuram 695 017
Tel: 0471-2594922, 2594924 Fax: 0471-2594923
E-mail: emck@keralaenergy.gov.in
Website: www.keralaenergy.gov.in

EMC/48/2020-PE7(SHP) 08-04-2022

Sub: Mukkudam SHEP- 4 MW allotment to Mukkudam Electroenergy Pvt. Ltd - reg

Ref: 1. G.O.(P)No.25/2012/PD dated 03-10-2012
2. G.O.(MS)No.05/2018/PD dated 09-03-2018
3. G.O.(Ms)No. 7/2021/PD dated 23-02-2021
4. Letter No. MEPL/MSHEP/2022-39 dated 31-03-2022

To whomsoever it may concern

Government vide G.O read as ref (2) above allotted Mukkudam Small Hydroelectric Project identified at Mukkudam in Konnathady Panchayath, Devikulam, Idukki District to M/s Mukkudam Electroenergy Pvt. Ltd as 'Projects identified by private persons on their own land' (own land category) as per the provisions of SHP Policy 2012 clause 7.3 (vide G.O ref (1) above) with an installed capacity of 1MW.

Further, as per G.O ref (3) above, Government had accorded sanction for the capacity enhancement of Mukkudam Small Hydroelectric Project from 1 MW to 4 MW to M/s Mukkudam Electroenergy Pvt Ltd at their own risk and cost after the investor remit the requisite premium amount of Rs. 15 Lakhs/MW to the Government for the capacity addition of 3 MW.

Now, M/s Mukkudam Electroenergy Pvt Ltd had remitted the requisite premium amount to EMC SHP Cell as per the directions of G.O ref (3) above. This is to inform you that M/s Mukkudam Electroenergy Pvt. Ltd may move ahead with

the development works of the proposed Mukkudam SHEP with enhanced capacity of 4 MW after getting necessary clearances from departments/offices concerned.

Thanking you,

Yours faithfully,

Director

Mukkudam Electroenergy Pvt. Ltd.
11/569, Muringothil,
Kambilikandam, Parathodu-Idukki Post,
Idukki District, Kerala – 685 571
Tel: 04868 – 261 090 | Mob: +91-97412 99011
Website: https://www.meplpower.com/

MEPL/MSHEP/2022-42 **17.05.2022**

Kind Attn: The Chief Engineer – Commercial & Tariff,
Kerala State Electricity Board Limited,
Thiruvananthapuram.

Sir,

Sub: Mukkudam SHP (4 MW) – Application for Initiating Draft Power Purchase Agreement – reg: -

Ref:-

1. Provisional Letter of Comfort from KSEB Ltd for Mukkudam SHP (4 MW): CML-EE2-AEE-2/MSHEP-SHEP/2021-22/CE(C&T)/297, dated: 01.01.2022
2. KSEB Board Order: BO (FTD) No.972/2021/CML-EE2-AEE-2/ Mukkudam SHEP/2021-22/CE(C&T)/TVM dated 31.12.2021
3. Letter of Allotment for Mukkudam SHP (4 MW) from Energy Management Centre: EMC/48/2020-PE7(SHP) dated: 08.04.2022
4. Connection Agreement for Mukkudam SHP with KSEB Ltd: Agreement No: ECT/MukkudamHydro/22/2021-22, dated: 25.01.2022

I invite your attention into the above references.

Please note that we have remitted the additional premium of Rs. 45 Lakhs to Energy Management Centre for the capacity enhancement of additional 3 MW and the latter has issued us the Letter of Allotment for Mukkudam SHP (4 MW) vide Ref.03. Also please note that we have signed the connection agreement with KSEB Ltd, vide Ref.04.

Hence in this regard, we request you to kindly do the needful to initiate Draft Power Purchase Agreement (PPA without Tariff) for our project as the same is a requisite pit forwarded by our lending Institutions – IREDA & IFCI Venture Capital Funds Ltd for availing loan disbursement above 60% of the sanctioned amount.

MUKKUDAM ELECTROENERGY PVT. LTD. KERALA KAMBILIKANDAM

Thanking you,
For Mukkudam Electroenergy Pvt. Ltd.,

Rakesh Roy
Managing Director

POWER PURCHASE AGREEMENT
BETWEEN
KERALA STATE ELECTRICITY BOARD LIMITED
AND
MUKKUDAM ELECTROENERGY PRIVATE LIMITED
FOR SALE OF POWER FROM MUKKUDAM SMALL HYDRO ELECTRIC PROJECT (4 MW)

Dated 24 day of March 2023

This Power Purchase Agreement, hereinafter called Agreement entered into on this.....24th.....day of March 2023

Between

Kerala State Electricity Board Limited a company incorporated under the Companies Act, 1956 and having its registered office at Vydyuthi Bhavanam, Pattom, Thiruvananthapuram represented by Sri./Smt. .....(here enter Name and Designation), hereinafter referred to as **'KSEB Ltd'** (which expression shall, unless repugnant to the context or meaning thereof, include its successors and assignees) as a party of the **First Part** and Mukkudam Electroenergy Private Limited, 11/569, Muringothil, Kambillikandam, Parathodu, Idukki District, Kerala- 685 571 represented by Sri./Smt .....(here enter Name and Designation), hereinafter referred to as the**'Developer'**(which expression, shall unless repugnant to the context or meaning thereof, include its successors and assignees) as a party of the **Second Part.**

Whereas Government of Kerala has accorded approval to Mukkudam Electroenergy Private Limited for setting of Mukkudam Small Hydro Electric Project of capacity 1 MW at Mukkudam in konnathady Grama Panchayath, Devikulam, Idukki District, vide G.O. (MS) No. 05/2018/PD/dtd,TVM,09.03.2018 of Government of Kerala as per the provisions of Kerala Small hydro power policy 2012 clause 7.3 'Projects identified by private persons on their own land'. Later vide G.O. (MS)No. 07/2021/PD/dtd,TVM,23.02.2021 Government of Kerala approved enhancement of capacity of Mukkudam SHEP from 1MW to 4 MW herein after referred to as the 'Project'.

AND WHEREAS the project is fully built, owned, operated, maintained by Mukkudam Electroenergy Pvt Ltd AND WHEREAS KSEB Ltd is desirous of purchasing all the energy generated from declared capacity of the Project, in accordance with terms and conditions of this agreement and Kerala Small hydro power policy 2012 of GoK, vide G.O. (P) No.25/2012/PD dated 03.10.2012 and the Developer is willing to sell the same to KSEB Ltd, on mutually agreed terms and conditions.

The terms and conditions of the Power Purchase Agreement are as per prevailing KSERC Regulations and any changes that may occur in future shall be applicable for all operating norms or any other parameters.

MUKKUDAM ELECTROENERGY PVT. LTD. KERALA KAMBILIKANDAM

VYDYUTHI BHAVANAM PATTOM THIRUVANANTHAPURAM 695 004 KERALA STATE ELECTRICITY BOARD LTD

NOW, THEREFORE, in consideration of the premises and mutual covenants set forth herein, it is hereby agreed by and between the Parties hereto as follows.

1.0 Definitions:

In this Agreement unless the context otherwise requires

a.	Agreement	means this Power Purchase Agreement dated as of the date hereof, as the same may be amended, supplemented or modified from time to time in accordance with mutually agreed terms and conditions thereof.
b.	Authority	means the Central Electricity Authority
c.	Billing Date	means the 5th business day after the metering date.
d.	Billing month	means the calendar month starting with the metering date.
e	Change in Law	Means the occurance or coming into force of any of the following (1) the enactment of any new Indian law or legislation passed by the state legislature or (2) the repeal ,modification or re-enactment of any existing Indian law provided that change in law shall not include (i) coming into effect after the date of signing this agreement of any provision of a statute which is already in place as of the date of signing this agreement or (ii) any new law or any change in existing law under the active consideration of or in the contemplation of any government as of the date of signing this agreement, which is a matter of public knowledge.(iii) Any change in the rates of any of the taxes
f.	Commission	means the Kerala State Electricity Regulatory Commission referred to in sub-section (1) of Section 82 of the Electricity Act 2003.
g.	Contracted Capacity	capacity contracted by KSEB Ltd under Article 3.1 of this Agreement.
h.	Co-ordination Committee	means a committee constituted by the parties comprising of members of both the Developer and KSEB Ltd for the purpose of co-ordination of the commissioning and operation of the interconnection and transmission facilities and the power station and their co-ordination with the grid system.
i.	Commercial Operation Date (CoD)	means in relation to unit or block, the date declared by the Developer after demonstrating the maximum installed capacity through a successful trial run after notice to the beneficiaries and in relation to the generating station as a whole the date of commercial operation of the last unit or block of the generating station.

HUKKUDAM ELECTROENERGY PVT. LTD. KERALA KAMBILIKANDAM

OFFICE OF THE CHIEF ENGINEER (COMMERCIAL & TARIFF) VYDYUTHI BHAVANAM THIRUVANANTHAPURAM 695 004 KERALA STATE ELECTRICITY BOARD LTD.

j	Day	shall mean 24 (twenty four) hour period beginning and ending at 12.00 midnight, Indian Standard Time (IST).
k	Due date of Payment	means the 30th day on receipt of bill. If such day is not a Business day ,the due date will be the next Business day.
l	Evacuation facilities	shall mean transmission facilities built from the interconnection point in the Developer's switch yard up to the existing transmission line of KSEB Ltd which will be constructed by the Developer and transferred to KSEB Ltd.
m	Force Majeure	shall have the meaning set forth in article 7 hereof.
n	Generating Unit	means one set of hydro turbine generator and auxiliary equipment and facilities forming part of the Project.The project comprises 2 units each having 2 MW capacity.
o	Grid Code	means the Kerala State Electricity Grid Code specified by the Commission from time to time
p	Inter connection Point	Shall mean gantry point in the project switch yard from where the evacuation system starts.
q	Inter connection facility	shall mean such facilities installed by the Developer to enable grid system of KSEB Ltd to receive the delivered energy from the Project at the interconnection point.
r	Maintenance Outage	shall mean an interruption or reduction of the generating capability of the Project for the purpose of performing work on specific components of the Project, the work which should not, in the reasonable opinion of the Developer be postponed until the next scheduled outage.
s	Metering Date	shall mean the first working day of each calendar month for a scheduled time mutually agreed between the parties. However the metering date of the financial year ends at 24:00 hrs on 31st March of subsequent year and so on.
t	Metering point	shall mean the point located at the interconnection point at which the energy delivered is metered.
u	Main meter, Check meter and Standby Meter	shall mean ABT compatible energy meter of 0.2S class accuracy and with applicable IEC/BIS standards for measurement and checking of import/export of energy on the outgoing feeders for Deviation charges/Energy account. Check Meter means a meter, which shall be connected to the same core of the Current transformer (CT) and Voltage

		transformer (VT) to which main meter is connected and shall be used for accounting and billing of electricity in case of failure of main meter. Standby meter means a meter connected to CT and VT, other than those used for main meter and check meter/ associated equipments (CT& VT). If both main meter and check meter are not working, the reading of stand by meter is used for accounting and billing of electricity.
v	Open Access Facility	means the non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission.
w	Prudent Electrical Practices	means the use of equipment, practices and methods, as required to comply with applicable codes, standards and regulations in India to protect the electrical system, employees, agents and customers of KSEB Ltd from malfunctioning by the Project and to protect the Project and Developer's employees and agents from malfunctioning by the grid system of KSEB Ltd.
x	Prudent Utility Practices	mean those practices, methods, techniques and standards as changed from time to time that are generally accepted internationally for use in electric utility and power generation industries (taking into account conditions in India), and used in prudent electric utility engineering and operations to design, engineer, construct, test, operate and maintain equipments lawfully, safely, efficiently and economically, as applicable to the power station of the size, service and type of the Project and that generally conform to the manufacturer's operation and maintenance guidelines.
y	Performance tests	shall mean the tests specified by the Co-ordination Committee.
z	Project facilities	shall mean buildings, diversion structure, dam/weir, water conductor systems, fore bay, powerhouse, switchyard, tailrace, all energy producing equipment and its auxiliary equipment, switchgear, transformer, protection equipment, access road and evacuation line up to Inter connection Point to inject the electrical energy of the powerhouse to grid of KSEB Ltd
aa	Reactive Energy	means the integral reactive power with respect to time and measured in the unit of Volt Ampere hours Reactive (VARh) or standard multiples thereof.

HUKKUDAH ELECTROENERGY PVT LTD KERALA KAMBILIKANDAH

OFFICE OF THE CHIEF ENGINEER (COMMERCIAL & TARIFF) KERALA STATE ELECTRICITY

ab	Scheduled Outage	means a planned interruption or reduction of the generating capability of a unit or the power station for inspection, testing, preventive maintenance, corrective maintenance, repairs, replacement or improvements which has been scheduled by the Developer after receiving concurrence from SLDC.
ac	Synchronisation Date	shall mean the date on which the Project starts delivering electrical energy generated from the Project into the system of KSEB Ltd for testing and initial start up.
ad	State Transmission Utility (STU)	means Kerala State Electricity Board Ltd or a Government Company notified by the Government of Kerala under sub-section (1) of Section 39 of the Electricity Act 2003.
ae	State Load Despatch Centre (SLDC)	means the Centre established under Section 31 of the Electricity Act 2003.
af	Termination Notice	means the notice of Termination by either party to the other party in accordance with the provisions of this agreement.
ag	Termination	means the early termination of this Agreement pursuant to the Termination Notice or otherwise in accordance with the provisions of this Agreement but shall not unless the context otherwise requires include the expiry of this Agreement due to efflux of time in the normal course.
ah	Termination Date	means the date on which the Termination occurs, which shall not be less than 60 days from the date of Termination Notice.

2.0 Effective date and Term of Agreement :

This Agreement shall come into force at once and remain operative for *tariff period of 15 years from the date of CoD*. The term of the Agreement may be extended for a further period by mutual agreement with modification as considered necessary and mutually agreed.

3.0 Installed Capacity :

Installed capacity or IC means the summation of the name plate capacities of all the units of the generating station or the capacity of the generating station (reckoned at the generator terminals) approved by the Commission from time to time.

3.1 The installed capacity of the project is 4 MW and the contracted capacity to KSEB Ltd is also 4 MW.

3.2 The project is being developed as a Small Hydro Electric Project, in accordance with terms and conditions of this agreement and Kerala Small hydro power policy 2012 .Since the project is being implemented in own land category on the complete risk and cost of the investor, Implementation Agreement is not insisted vide Govt letter No. 84/B1/19/PD dated 18.03.2020 of Power(B) Department, Government of Kerala.

4.0 Plant Operation and Maintenance, Evacuation facilities:

4.1 The Developer shall construct the Project as per the technical standards prescribed by the Authority and operate the Project in a safe manner during the term of the Agreement in accordance with the Kerala State Electricity Grid code in force and its amendments from time to time. It shall comply with the statutory/regulatory measures applicable to the construction and operation of the project promulgated by the Government of Kerala /Government of India/KSERC (Commission).

4.2 The Developer shall be responsible for designing, implementing and maintaining protection system of the entire equipment for safe operation of the Project/project facilities as per the Prudent Utility Practices, Prudent Electrical Practices and KSEGC(Kerala State Electricity Grid Code) and its amendments from time to time.

4.3 Energy sold from the project, shall be metered at the interconnection point.

4.4 The developer shall declare the date of commercial operation (CoD), considering the proposal and result of the performance test furnished by the Co-ordination Committee.

4.5 The Project shall maintain the standards as per CEA (Technical Standards of Connectivity to the Grid) Regulations in force and as amended from time to time.

5.0 Metering, Tariff and Energy Accounting

The Developer shall provide to the State Load Despatch Centre (SLDC), the generation summation outputs. The Developer shall provide other logged readings, which the SLDC may reasonably require for monitoring purposes.

5.1 Metering: Both meters (main and check) and associated equipments (CT & VT) shall be of ABT compatible 0.2S class accuracy. The parties shall undertake a joint reading of the meters on the metering date. A standby meter also to be installed by the Developer to take readings in case of failure of Main and Check meters.

The main and check meters shall be checked jointly at the installation as per CEA (Installation and Operation of Meters) Regulations in force and as amended from time to time. Data shall be downloaded from the meters at regular intervals as decided by SLDC for preparation of energy account. If the main meter or check meter is found to be not working at the time of

meter readings or at any other time, the Developer shall inform SLDC of the same.

Periodic testing of both main and check meters shall be carried out in the presence of representatives of Developer and KSEB Ltd as per procedure laid out in CEA (Installation and Operation of Meters) Regulations in force and as amended from time to time. For any testing and/ or replacement, notice of seven days shall be given. Calibration of main and check meters shall be done as per the CEA (Installation and Operation of Meters) Regulations in force and as amended from time to time. Cost of calibration of the meters and associated equipments shall be borne by the Developer. The faulty metering equipments shall be replaced by the Developer at their cost. The accuracy class of the meter shall be as per the CEA standards in force and as amended from time to time.

5.2 Energy Accounting: Both the parties agree to facilitate issue of energy accounts by 1st day of every month. Developer shall prepare and submit bills to KSEB Ltd. on the basis of such energy accounts. The energy accounts so prepared shall be binding on all the parties for billing and payment purposes. Any change in the methodology of energy accounting shall be done only as per the decisions taken in the appropriate fora and both the parties agree to abide by the methodology so finalized.

5.3 From and after the CoD of the Project/ generating unit, the Developer agrees to sell the contracted energy to KSEB Ltd and KSEB Ltd agrees to purchase energy from the Developer at the interconnection point, subject to the terms and conditions of this Agreement, during the term of this Agreement or till the termination date in the event of termination.

5.4 Tariff for power generated from the project shall be lower of project specific tariff or the tariff of any SHEP Commissioned in Kerala during 2021-22 or Mutually agreed tariff subject to the following conditions

(a) The developer has to limit the capital cost within regulatory norms reduced by the eligible MNRE grant/Subsidy/Any other benefits.

(b) Tariff applicable to excess generation over designed energy must be as per KSERC regulation. In the event of any conditions not specified in the KSERC Regulation, the relevant clauses of CERC regulation shall be applicable.

(c) The benefit of infirm power injected in to the grid by the developer prior to CoD shall be passed on to the consumer while determining the tariff as the tariff period is computed from date of CoD.

5.5 The charges for power drawn by the Developer from the grid of KSEB Ltd during construction period, testing and pre-commissioning period, maintenance/ shutdown period of the plant shall be billed by KSEB Ltd on monthly basis at the tariff decided by the Commission.

5.6 The Developer shall ensure reactive power generation/ absorption as per the terms laid out in KSEGC . In the event of any conditions not specified in the KSEGC, the relevant clauses of Indian Electricity Grid Code (IEGC) shall

MUKKUDAM ELECTRO ENERGY PVT. LTD. KERALA KAMBILIKANDAM

THIRUVANANTHAPURAM

be applicable. Reactive power transaction shall be billed as per the relevant regulations.

5.7 Benefits, if any offered for the renewable power project such as tax holiday benefits, benefits accruing on account of carbon credit, grant, subsidy, Viability Gap Fund (VGF) etc. may be shared between the Developer and KSEB Ltd as per the norms of the Commission, amended from time to time.

5.8 Renewable Purchase Obligation (R P O):
The entire energy procured by KSEBL will be accounted against RPO of KSEBL and the developer will not have any claim with respect to such power for renewable energy certificates or any such instruments.

6.0 Billing and Payment

6.1 Billing date is the 5th business day after the metering date. Due Date of payment is the 30th day from the date of receipt of bill. Business day means a day other than Sunday or a statutory holiday on which banks remain open for business in the state of Kerala. The Developer shall furnish a bill to KSEB Ltd on the billing date in such a form as may be mutually agreed by KSEB Ltd and the Developer for the billing month. Each bill for a billing month shall be payable by KSEB Ltd on or before the Due Date of Payment, in Indian Rupees by transferring credit / cheque to the account of Developer with State Bank of India at .....If the Due Date is a not a business day, the next business day both for the Bank and KSEBL shall be the Due Date. The Developer shall provide proper receipt to KSEB Ltd for the amount credited to their account within 5 days of credit.

6.2 The monthly bill will be assumed as undisputed unless KSEB Ltd informs the Developer within 5 days of receipt, that the bill is disputed with the reasons thereof. In any event ,KSEB Ltd shall pay the Bill on the Due Date of Payment and in case of any dispute, 90% of the total bill amount shall be paid and in the event of resolution of dispute the balance amount shall be released/ recovered with interest, if it exceeds 60 days of time.

6.3 The adjustments, if any, on account of any additional claims or errors in the billing for a month shall be made through a supplementary bill and shall also be paid / adjusted with the bill of the next month.

6.4 If KSEB Ltd pays the monthly bill amount due within 10th calendar days of presentation of bills by the renewable generator, a rebate of 2% shall be given to KSEB Ltd by the Developer. If KSEB Ltd pays the monthly bill amount due within a period of one month of presentation of bills by the renewable generator, a rebate of 1% shall be given to KSEB Ltd by the Developer.

The corresponding rebates shall be availed in advance at the time of payment.

6.5 If KSEB Ltd does not pay the amount due within 60 days from the date of billing, then KSEB Ltd shall pay interest @ 1.25% per month for such belated

payment from the date on which payment was due until the payment is made in full.

7.0 Force Majeure -

Neither party shall be liable for any claim for any loss or damage whatsoever arising out of failure to carry out the terms of the Agreement to the extent that such a failure is due to force majeure events such as war, rebellion, mutiny, civil commotion, riot, strike, lock-out, forces of nature, accident, act of God, emergency shutdown of the line for immediate maintenance or repairs, or any other such reason beyond the control of party concerned. Any party claiming the benefit of this clause shall reasonably satisfy the other party of the existence of such an event and give written notice as soon as reasonably practicable, but not later than 10 (Ten) days after the date on which such party knew or should reasonably have known of the commencement of the event of force majeure to the other party to this effect. Generation/ drawal of power shall be started as soon as practicable by the parties concerned after such eventuality has come to an end or ceased to exist.

8 In case KSEBL is not in a position to absorb the energy generated from the project for reasons such as high level of storage in reservoirs, breakdown of transmission lines , the generation from the project will have to be restricted as directed from SLDC. Also the pattern of power generation from the project shall be as directed by SLDC and KSEBL shall not be responsible for compensation in any manner. The Developer undertakes that in case of emergency in KSEBLs evacuation system, it will backdown the generation till such time normalcy is restored. The developer would abide by the decision of SLDC regarding scheduling of generation.

9 Dispute Resolution:

All disputes or differences of any kind between the parties arising out of or in connection with this Agreement including any issue on the interpretation and scope of the terms of this Agreement shall be mutually discussed and amicably resolved within 90 days. In the event that the parties are unable to resolve the disputes as stated above, the same shall be referred to the Commission by either party.

10 Termination:

In the event of a continuing default by way of violations of the terms and conditions of the Agreement by either party lasting for more than 60 days, except in force majeure conditions, the other party shall issue a termination notice to the defaulting party. If the defaulting party does not cure the default within 30 days from the date of termination notice, the other party shall have the right to seek termination of the Agreement on a date, which shall not be less than 60 days from the date of Termination Notice. In case, an agreement for the purchase of electricity is terminated before the expiry of agreement period, the generator or purchaser shall not be eligible for any incentives

under the regulation approved by the Commission till the date of expiry of original period of the power purchase agreement or till the completion of 3 years from the date of termination of the power purchase agreement whichever is later.

11 Miscellaneous Provisions

11.1 The obligations of the Developer under this Agreement shall become effective on fulfillment of conditions specified below and on due intimation to KSEB Ltd:

(i) Received all clearances, statutory or otherwise required to execute and operate the Project.

(ii) Obtained approval of the Commission for the terms and conditions of this Agreement.

11.2 Procurement of power from the Project shall be as per the applicable rules and regulations in this regard.

11.3 The Developer represents and warrants to KSEB Ltd that the Developer is duly organised and validity existing under laws of India and has all requisite legal power and authority to execute this Agreement and carry out the terms and conditions and provisions thereof.

11.4 In case of change in law or restriction imposed by Regulator (Central or State) and Appellate Tribunal on any aspect for purchase of power, the same shall be binding on both the parties.

11.5 The Developer shall at his cost and expenses, purchase and maintain by re-instatement or otherwise, during the operations period insurance against any loss, damage or destruction of the Project facilities, at replacement value; the Developer's general liability arising out of the License; liability to third parties; Fire protection coverage insurance; and any other insurance that may be necessary to protect the Developer, his employees and his assets against loss, damage, destruction, business interruption or loss of profit including insurance against all Force Majeure Events that are insurable till the end of PPA.

11.6 Under no circumstances KSEB Ltd shall undertake any contingent liability by way of providing guarantee etc. for Developer for implementing the Project.

11.7 Any variation, waiver or modification of any of the terms of this Agreement shall be valid and signed by/or on behalf of the parties hereto and agreed by the Commission.

11.8 All notices required or referred to under this Agreement shall be in writing and signed by the respective authorized signatories of the parties mentioned herein above, unless otherwise notified. Each such notice shall be deemed

to have been duly given if delivered or served by registered Mail/Speed Post of Department of Posts with an acknowledgement due to the other parties in terms of implementation of the Agreement.

IN WITNESS whereof the Parties have executed this agreement at Thiruvananthapuram on the date above mentioned.

For and on behalf of
Mukkudam Electro Energy Private Limited

MUKKUDAM ELECTROENERGY PVT. LTD. * KAMBILIKANDAM * KERALA

Rakesh Roy
(Managing Director)

Signature with seal
Witness:

1.

2.

For and on behalf of
Kerala State Electricity Board Limited

RAJEESH. D. S,
Deputy Chief Engineer
(Commercial)

OFFICE OF THE CHIEF ENGINEER (COMMERCIAL & TARIFF) VYDYUTHI BHAVANAM PATTOM THIRUVANANTHAPURAM 695 004 KERALA STATE ELECTRICITY BOARD LTD.

Signature with seal
Witness:

1.

EXECUTIVE ENGINEER
O/o the CE Commercial & Tariff
Kerala State Electricity Board Ltd.
Vydyuthi Bhavanam, Pattom,
Thiruvananthapuram-4

2.

Rajeesh. S.k
AE, Commercial.