Kanan Devan Hills
Plantations Company (P) Limited

Annual Energy Audit Report

FY 2022-23

M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited

Reg no: DIS0083KL

KDHP House, Munnar

Idukki District-Kerala -685612.

Prepared by

Centre for Energy Environment & Productivity

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July 2023

ACKNOWLEDGEMENTS

Bureau of Energy Efficiency (BEE) through its extraordinary gazette notification on 06th October 2021 made the regulation: Manner and Intervals for Conduct of Energy Audit in electricity distribution companies) Regulations, 2021. Through this every electricity distribution company shall conduct an annual energy audit for every financial year and submit the annual energy audit report to the Bureau and respective State Designated Agency (Energy Management Centre, Govt of Kerala) within a period of four months from the expiry of the relevant financial year.

Centre for Energy Environment and Productivity (CEEP) places on record its sincere thanks to M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited for entrusting the task of conducting Energy audit for its DISCOM during June – July 2023.

We would also like to thank the following officials of M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited, KDHP House, Munnar Idukki District-Kerala -685612. for their proactive support and courtesy extended to the CEEP team during the study and all other staff for their cooperation and support given during the whole process.

1. Mr. Mathew Abraham — Managing Director
2. Mr. Raju Warrier — Sr. Manager
3. Mr. R. Jayaraman — Executive – Engineering

30/08/2023

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ENERGY AUDIT TEAM

Table 1: Energy audit team

Sr No	Name	Qualification	EM/EA/AEA/ Registration No	Experience (In Years)
Team Leader				
1	Mr. J Nagesh Kumar	• Accredited Energy Auditor	AEA-0133	30
Team Members				
2	Mr. Sunil kumar V K	• Certified Energy Auditor • Sector Expert	EA - 3642	40
3	Mr. Ashok K M P	• Certified Energy Auditor • M. E. (Energy Engineering)	EA- 34760/22	8
4	Ms. Della David	• Certified Energy Auditor • M. Tech (Power electronics)	EA -34867/22	13
5	Ms. Keerthana K	• Project Engineer	NIL	3
6	Ms. Neema Joy	• Project Engineer	NIL	2

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1. PERFORMANCE SUMMARY

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TABLE 2: SUMMARY OF DISCOM – FORM-1

Performance Summary of Electricity Distribution Companies			
1	Period of Information Year of (FY) information including Date and Month (Start & End)	1st Apr, 2022 - 31st March, 2023	
2	**Technical Details**		
(a)	**Energy Input Details**		
(i)	Input Energy Purchase (From Generation Source)	Million kWh	54.118
(ii)	Net input energy (at DISCOM Periphery including sale outside periphery)	Million kWh	59.048
(iii)	Total Energy billed (is the Net energy billed, adjusted for energy traded)	Million kWh	54.011
(b)	Transmission and Distribution (T&D) loss (Billing efficiency)	Million kWh	5.038
		%	8.53
	Collection Efficiency	%	99.673%
(c)	Aggregate Technical & Commercial Loss	%	8.83%

2. ENERGY CONSERVATION MEASURES SUMMARY

The KDHP can consider several possible measures for energy conservation to reduce their distribution loss to their best value as summarised in the executive summary.

TABLE 3: ENERGY CONSERVATION MEASURES

ECM No	Energy Efficiency Measures	Annual Electricity Savings	Annual Financial Savings	Investment	Fixed interest rate	Cash inflow	Net present value	Internal rate of return
		MU	(Rs)	(Rs)	%	Years	Rs	%
1	Reconductoring of HT overhead lines	0.734	35,25,291	4,72,32,000	6	16	12,93,035	6.25%
2	Reconductoring of LT overhead lines	1.275	61,22,303	2,14,14,400	6	5	43,74,967	13.23%

3. GENERAL OBSERVATIONS AND SUGGESTIONS

TABLE 4: GENERAL OBSERVATIONS AND SUGGESTIONS

Observation	Suggestions	Benefits
Some of the HT consumers are having metered at the secondary/LV side.	As per the CEA metering regulation, HT consumers shall meter at the HV side with CT/PT, 0.2s class TOD meter.	The actual transformer loss will get gauged in the bill which will reduce the KDHP overall T&D loss.
Estimated that Distribution transformers are more than 40 years old (Around 30 nos) and re-winded several times during its life time.	If any of failure of transformers in future, the no load loss of the same after rewinding is to be measured and ascertain the life cycle cost with new energy efficient transformers. No load loss of transformers after rewinding shall be logged and records shall be kept for future analysis.	By replacing the old re-winded transformers, with energy efficient ones, the overall T&D loss will reduce.
Registered maximum demand in past months was always above the contract demand (9 MVA) in KDHP. However, with the present 3nos of 11 kV feeders, 9 MVA is maximum allowed demand as per the regulations.	Increase the contract demand to 12 MVA by increasing the voltage level to 33 kV. For this, KDHP is in the process of installing 33 kV substation near to the town.	The HT line loss up to the town area will reduce (exactly 2.8 km) along with the reduction in the excess demand charges. This will also capable to cater the future consumer loads in the Munnar area.

BACKGROUND

1. ABOUT BEE

The Government of India has set up Bureau of Energy Efficiency (BEE) on 1st March 2002 under the provision of the Energy Conservation Act, 2001. The mission of Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles with the primary objective of reducing energy intensity of the Indian economy within the overall framework of the Energy Conservation Act, 2001. This will be achieved with active participation of all stakeholders, resulting into accelerated and sustained adoption of energy efficiency in all sectors.

2. EXTANT OF REGULATIONS - DISCOM

Under the notification S.O. 3445 (E) dated 28 Sept 2020, all entities having distribution license are notified as Designated Consumers. Notification is read as "All entities having issued distribution license by State/Joint Electricity Regulatory Commission under the Electricity Act, 2003 (36 of 2003)" are notified as Designated Consumers (DCs). After this notification, all the DISCOMs will be governed under the various provisions of Energy Conservation Act, such as Appointment of

Energy Manager, Energy Accounting & Auditing, identification of Energy Losses Category wise, Implementation of energy conservation & efficiency measures etc.

The amendment is expected to help DISCOMs to monitor their performance parameters and bring in transparency in the Distribution sector through professional inputs. It will also assist in developing projects for reducing the electricity losses by DISCOMs and implementing effective solutions. The amendment is expected to improve the financial state of the DISCOMs.

In exercise of the powers conferred by clause (g) of sub-section (2) of section 58, read with clause (q) of sub-section (2) of section 13 of the Energy Conservation Act, 2001 (52 of 2001), the Bureau of Energy Efficiency, thus made the following regulations:

3 **Named as** Bureau of Energy Efficiency (Manner and Intervals for Conduct of Energy Audit in electricity distribution companies) Regulations, 2021.

4 These regulations shall apply to all electricity distribution companies specified as designated consumer.

5 They shall come into force on the date of their publication in the Official Gazette. (No: CG-DL-E-08102021-230245 Dated 06 October 2021).

3. PURPOSE OF AUDIT AND ACCOUNTING REPORT

Energy accounting and a consequent annual energy audit would help to identify areas of high loss and pilferage, and thereafter focus efforts to take corrective action. Energy Accounting means accounting of all energy inflows at various voltage levels in the distribution periphery of the network, including renewable energy generation and open access consumers, and energy consumption by the end consumers.

Owing to the impact of energy auditing on the entire distribution and retail supply business and absence of an existing framework with dedicated focus on the same, it was imperative to develop a set of comprehensive guidelines that all Distribution utilities across India can follow and adhere to.

4. PERIOD OF ENERGY AUDIT AND ACCOUNTING

The table below shows the frequency of energy audit and energy accounting as per the BEE guidelines.

Table 5: Period of Energy Audit & Accounting – as per BEE guidelines

Particulars	Frequency	Submission date	Whom to submit	Who should submit
Energy audit	Every year	Within a period of 4 months from the expiry of the relevant financial year	BEE & SDA	Accredited energy auditor
Energy accounting	Quarterly	45 days from the quarter	BEE & SDA	Certified energy manager

KDHP has initiated the energy audit in the month of July 2023 in order to submit the Energy audit report by 31st July 2023 as per the vide notification letter no: 11-10/5/2020-EC dated 27th October 2021 by the Ministry of Power. Thus, the KDHP entrusted the work to CEEP and the latter started the field study by late July - field study for 03 days - and draft report submitted in the month of August 2023.

5. PROGRESS IN COMPLIANCE TO PREREQUISITES TO ENERGY ACCOUNTING

Table 6: Progress in energy accounting

Quarter	Submission date	Ref no
1st Quarter – 1st April 2022 to 30th June 2022	29th Nov 2022	EG-10/3089
2nd quarter – 1st July 2022 to 30th Sept'2022	29th Nov 2022	EG-10/3089
3rd Quarter - 1st Oct'2022 to 31st Dec'2022	15th Feb 2023	EG-10/ 3837
4th Quarter – 1st Jan 2023 to 31st Mar 2023	12th May 2023	EG – 10/394

DISCOM INTRODUCTION AND OVERVIEW

1. NAME AND ADDRESS OF DESIGNATED CONSUMER

Table 7: Name and address of designated consumer

General Details	Description
Registered Office address with telephone, fax nos. & e-mail	**M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited,** KDHP House, Munnar, Idukki District-Kerala -685612. Ph: 04868 255002
Company Chief executive name & details	**Mr. Mathew Abraham** **Managing Director** M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited, KDHP House, Munnar, Idukki District-Kerala -685612 Ph: 04868 255002
Authorized signatory of DC (Nodal Officer)	**Mr. Raju U Warrior** **Head - Engineering department** M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited, KDHP House, Munnar, Idukki District-Kerala -685612 Ph: 04868 255101
Energy Manager's Name, (Designated) Designation, Registration No., Address, Mobile, Telephone, Fax nos. & e-mail	**Mr. R. Jayaraman (Designated)** Executive – Engineering M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited, KDHP House, Munnar, Idukki District-Kerala -685612. Mob: 9446130623 Ph: 04868 255107 Email: jayaraman.r@kdhptea.co.in

2. ENERGY AUDIT CELL

Table 8: Energy audit cell

Sr	Member of EAC	Name	Designation	Mobile number	Email
1	Nodal officer	Raju U Warrior	Head - Engineering department	04868 255101	raju.warriar@kdhptea.co.in
2	Energy manager (designated)	R. Jayaraman	Executive – Engineering	9446130623	jayaraman.r@kdhptea.co.in
3	IT manager	S. Edvin	DGM Systems	9249419895	edwin.s@kdhptea.co.in
4	Financial manager	Sachin Prabu	Deputy manager finance	9072888315	sachin.prabu@kdhptea.co.in

3. SUMMARY PROFILE OF DISCOM – FORM-1

The performance summary of KDHP as DISCOM as per the FY 2022-23 is given in the following table. The table below **incorporates the feedback energy (Energy sold outside the periphery) for the T&D loss calculation**.

Table 9: Summary of DISCOM – Form-1

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		%	8.53
	Collection Efficiency	%	99.673%
(c)	Aggregate Technical & Commercial Loss	%	8.83%

The feeder wise T&D loss of the KDHP distribution system, **while considering the feedback energy (Energy outside the periphery)** is given in the following table:

Table 10: T & D loss – Summarised – feeder wise

Feeder	**Energy transmitted Measured**	**T & D Loss (Estimated)**	**Commercial and other losses (Estimated)**	**Total loss (estimated)**	**Total loss (after error correction)**	**Energy Sales (Measured)**	**T&D loss**
	kWh	**kWh**	**kWh**	**kWh**	**kWh**	**kWh**	**%**
Pullivasal	32,09,760	1,59,394	6,560	1,65,954	1,65,954	30,43,806	4.97
ITD	98,80,776	6,59,446	0	6,59,446	4,96,910	93,83,866	6.67
Town	99,46,400	15,49,173	0	15,49,173	12,90,193	86,56,207	15.58
Nettigudi	1,05,78,900	7,24,538	8,671	7,33,209	7,33,209	98,45,691	6.85
Neyamakad	1,11,24,064	4,69,518	6,61,949	11,31,467	11,31,467	99,92,597	4.22
Madupatty	1,49,80,826	9,77,460	11,04,909	20,82,369	20,82,369	1,28,98,457	6.52
Total	**59.72 MU**	**4.54 MU**	**1.78 MU**	**6.32 MU**	**5.90 MU**	**53.82 MU**	

Note:

- *Considered only 6 feeders for the T&D loss analysis out of 7 feeders.*
- ***The 7th feeder which is called Station, is only having an annual consumption of 0.005MU which is too negligible to have any significant difference, which is being neglected during the T&D loss evaluation.***

- *Total loss = T & D loss + Commercial loss*
- *Total loss corrected = Total loss after including feeder meter error*
- *Therefore: Commercial loss = 2.98% which can be accounted to the following losses:*
    1. *Error in the meter reading,*
    2. *Interruption losses and*
    3. *Tree touching losses in the HT/LT overhead cables.*

Energy flow diagram is given below in figure:

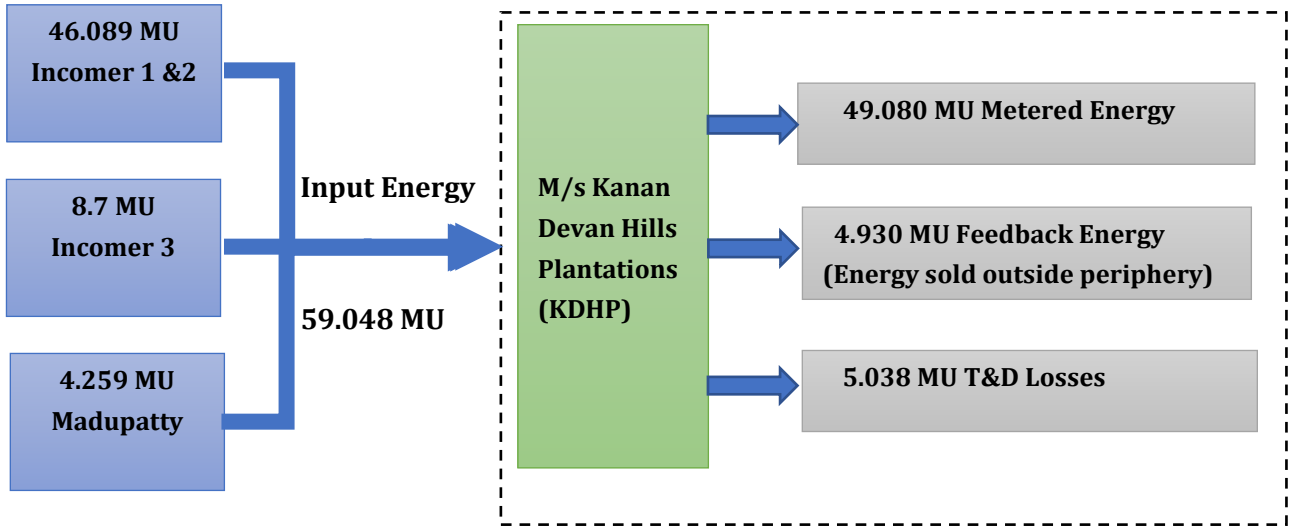


Figure 1: Energy flow diagram - KDHP

- *Input energy = the energy received at the KDHP for distribution including Feedback energy.*
- *Metered energy = energy metered at the consumer end*
- *Feedback energy = Energy sold outside the periphery*
- *T&D losses = Net losses*

FORM INPUT ENERGY

The table below shows the **major energy parameters for the FY 2022-23**

Table 11: Major energy parameters – KDHP DISCOM

Form-Input energy (Details of Input energy & Infrastructure)			
A. Summary of energy input & Infrastructure			
S. No	**Parameters**	**Period from April 2022 to March 2023**	**Remarks (Source of data)**
A.1	Input Energy purchased (MU)	49.080	Electricity bill
A.2	Transmission loss (%)	0%	Metering at the DISCOM periphery
A.3	Transmission loss (MU)	0	
A.4	Energy sold outside the periphery (MU)	4.93	Feedback energy - Tsoft
A.5	Open access sale (MU)	0	
A.6	EHT sale	0	
A.7	Net input energy (received at DISCOM periphery or at distribution point)-(MU)	59.048	Total Feeder Input – from Tsoft
A.8	Is 100% metering available at 66/33 kV (Select yes or no from list)	No	
A.9	Is 100% metering available at 11 kV (Select yes or no from list)	Yes	
A.10	% of metering available at DT	47%	63 out of 133 DT – physically measured
	Total number of DT (Nos)	133	
A.11	Total number of consumers (Nos)	16583	
	Number of HT consumers (Nos)	36	
	Number of LT consumers (Nos)	16547	
A.12	% of metering available at consumer end	100%	
A.13	No of feeders at 66kV voltage level	0	
A.14	No of feeders at 33kV voltage level	0	
A.15	No of feeders at 11kV voltage level	7	
A.16	No of LT feeders' level	0	Not available
A.17	Line length (ckt. km) at 66kV voltage level	0	
A.18	Line length (ckt. km) at 33kV voltage level	0	
A.19	Line length (ckt. km) at 11kV voltage level	180.23	Measured through HT line mapping
A.20	Line length (km) at LT level	193.8	Measured through LT line mapping
A.21	Length of Aerial Bunched Cables	0	
A.22	Length of Underground Cables	4.525	From SLD
A.23	HT/LT ratio	1:1.075	

Table 12: Metered reading of input energy

B. Meter reading of Input energy at injection points																	
S.No	**Zone**	**Circle**	**Voltge Level (KV)**	**Feeder Name**	**Feeder Metering Status (Metered/ unmetered/ AMI/AMR)**	**Status of Meter (Functional/Non-functional)**	**Metering Date**	**Feeder Type (Agri/ Industrial/ Mixed)**	**Status of Communication**			**Period from April 2022 to March 2023**				**Remarks (Source of data)**	
							Date of last actual meter reading/ communication		**% data received through automatically if feeder AMR**	**Number of hours when meter was unable to communicate in period**	**Total Number of hours in the period**	**Meter S.No**	**CT/ PT ratio**	**Import (MU)**	**Export (MU)**		
B.1	KD HP	KD HP	11	HR 1 & 2	AMI	Functioning	31-03-2023	Mixed	0	0	NA	KSE98355	500/5	46.089	-	Switching station records	
B.2		KD HP	11	Pipeline (HR-3)	AMI	Functioning	31-03-2023	Mixed	0	0	NA	16116905	200/5	8.700	-	Switching station	
B.3		KD HP	11	Madupatty	AMI	Functioning	31-03-2023	Mixed	0	0	NA	16088095	200/5	4.259	-	Madupatty hydel	
B.1001	**Total (MU)**													**59.048**	**0.00**		
B.1002	**Net input energy at DISCOM periphery (MU)**													**59.048**			

4. ASSET MAPPING OF DISCOM

MAPPING – DT & 11 KV OH LINE

Mapping of the transformer, pole and 11 kV consumers were done to evaluate the distance which helps to calculate the HT line loss in KDHP.

GPS mapping was made using the Google map/ GPS meter collecting the latitude and longitude, and later projected into the relevant free software by naming the specific pole, DT and 11 kV consumer with serial numbers. The GPS mapping of HT lines done for 6 feeders out of 7, (station feeder was negligible) and the details are analyzed in this section.

FEEDER WISE MAPPING

Feeder wise HT line mapping is given below in charts in representation purpose and the distance of the DT from the switching station is given in the table below.

- **Pullivasal feeder**

The following table shows the HT line distance in the 11 kV lines.

Table 13: HT line distance – Pullivasal feeder

Route (From-To)	Cable type	Distance (km)
Switching station - Attukad	7/14 ACSR	0.999
Switching station - Node-1	7/14 Cu	0.252
Node-1- Divan shrine	7/14 ACSR	0.355
Node-1-Pullivasal packeting	7/14 ACSR	0.447
Pullivasal packeting-Pullivasal factory	7/14 Cu	0.05
Pullivasal packeting - Alla kovil trfr	7/14 ACSR	0.306
Total – 11 KV line length		**2.409**

The following table shows the important geographical location in Pullivasal feeder and its label mapped.

Table 14: Pole mapping – geographical location – Pullivasal feeder

Point (Longitude, latitude)	name	label
POINT (77.056219 10.053957)	Switching station	0
POINT (77.056354 10.054035)	Post 1	P1
POINT (77.063693 10.048943)	Attukad	2
POINT (77.054891 10.052098)	Node-1	N1
POINT (77.056936 10.049611)	Divan shrine	4
POINT (77.052431 10.048873)	Pallivasal Packeting	5
POINT (77.052549 10.048435)	Pallivasal factory	6
POINT (77.04983 10.047851)	Allakovil transformer	7

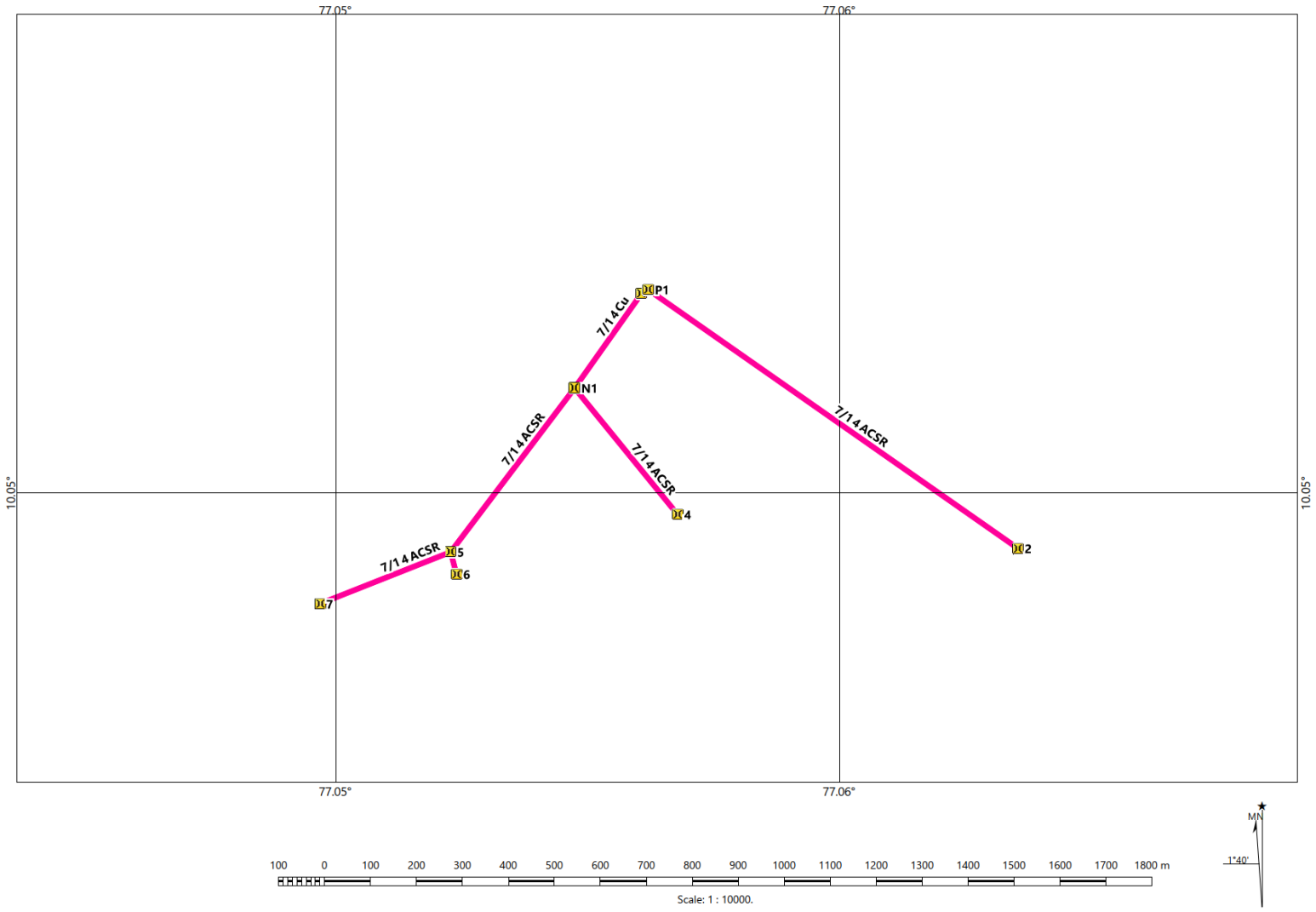


Figure 2: Pullivasal feeder

- **ITD feeder**

The following table shows the 11 kV line distance in the ITD feeder.

Table 15: HT line distance – ITD feeder

Route (From-To)	Cable type	Distance (km)
Switching station-Node-1	Mink	1.597
Node-1-Node-2	Mink	3.931
Node-2-Node-3	Racoon	0.214
Node-3-Tata BSS	Racoon	0.025
Node-3-Nallathani west divsn	Racoon	0.086
Node-2-ITD factory	Mink	0.249
ITD factory - Vermi compost	3/12 Cu	1.035
Vermicompost - Node-4	3/12 Cu	1.24
Node-4-Kallar factory divsn	No-8 Cu	0.17
Node-4- Kallar factory	3/12 Cu	0.0634
kallar factory divsn-Node X	No-8 Cu	1.69
Node X - Hospital bunglow	No-8 Cu	0.295
Node X - JE divsn	No-8 Cu	1.582
Node-1-Node-6	Racoon	1.471
Node-6-Node-7	3/12 Cu	0.533
Node-7-Seven mally godown	3/12 Cu	0.103
Node-7-Parvathi	3/12 Cu	1.015
Parvathi - Node-8	3/12 Cu	0.728
Node-8-nadiar	3/12 Cu	0.272
Node-8-Kurumalai	3/12 Cu	1.042
Kurumalai - ITD pump	3/12 Cu	0.72
Node-6-Node-9	Racoon	0.804
Node-9-Upper seven malai pump	7/12 Cu	0.189
Node-9-Node-10	Racoon	0.351
Node-10-Upper seven malai	7/14 ACSR	0.164
Node-10-Node-11	Racoon	0.493
Node-11-Ottupara	3/12 Cu	0.77
Node-11-Node-12	Racoon	1.046
Node-12-Latchmi east	7/14 ACSR	0.725
Node-12-Node-13	Racoon	1.202
Node-13-Letchmi factory	7/14 ACSR	0.065
Node-13-Letchmi factory divsn	Mink	0.161
Node-13-Node-15	Racoon	1.584
Node-15-Feedback to KSEB	7/14 ACSR	0.119
Node-15-Letchmi viriparrai	7/14 ACSR	3.565
Total – 11 kV line length		**29.2994**

The following table shows the important geographical location in ITD feeder and its label mapped.

Table 16: Pole mapping – geographical location – ITD feeder

Point (Longitude, Latitude)	name	label
POINT (77.056106 10.05425)	Switching station	0
POINT (77.057627 10.060088)	Post-1	P1
POINT (77.058212 10.061171)	Post-2	P2
POINT (77.058529 10.065404)	Post-3	P3
POINT (77.057567 10.068182)	Node 1	N1
POINT (77.051751 10.084131)	Post4	P4
POINT (77.035731 10.093789)	Node-2	N2
POINT (77.036927 10.095325)	Node-3	N3
POINT (77.036954 10.095551)	Tata BSS	1
POINT (77.037657 10.095621)	Nullathanni West Division	2
POINT (77.034114 10.095375)	ITD factory	3
POINT (77.024937 10.097594)	Vermi compost	4
POINT (77.014213 10.094034)	Node-4	N4
POINT (77.01283 10.093331)	Kallar factory divsn	5
POINT (77.013637 10.093973)	Kallar factory	8
POINT (76.997448 10.09229)	Node-X	NX
POINT (76.997184 10.089631)	Hospital bunglow	7
POINT (76.983522 10.088541)	JE Divsn	6
POINT (77.04427 10.06637)	Node 6	N6
POINT (77.04461 10.07118)	Node 7	N7
POINT (77.045553 10.071112)	Seven mally godown	9
POINT (77.043542 10.080295)	Parvathi	10
POINT (77.03961 10.0856)	Node-8	N8
POINT (77.041957 10.086388)	Nadiar	11
POINT (77.030626 10.088698)	Kurumalai	12
POINT (77.024309 10.090491)	ITD pump	13
POINT (77.03694 10.06615)	Node-9	N9
POINT (77.036013 10.064702)	Upper seven malai pump	14
POINT (77.033933 10.065045)	Node-10	N10
POINT (77.033709 10.066515)	Upper seven malai	15
POINT (77.029442 10.065188)	Node-11	N11
POINT (77.028984 10.05825)	Ottupara	16
POINT (77.0199 10.06549)	Node 12	N12
POINT (77.019217 10.072013)	Letchmi east	17
POINT (77.008969 10.066412)	Node-13	N13
POINT (77.008976 10.067004)	Letchmi factory	18
POINT (77.008036 10.067532)	Letchmi factory divs	19
POINT (76.994514 10.066324)	Node-15	N15
POINT (76.994095 10.065336)	Feedback to KSEB	F1
POINT (76.96406 10.07765)	Letchmi viriparrai	20

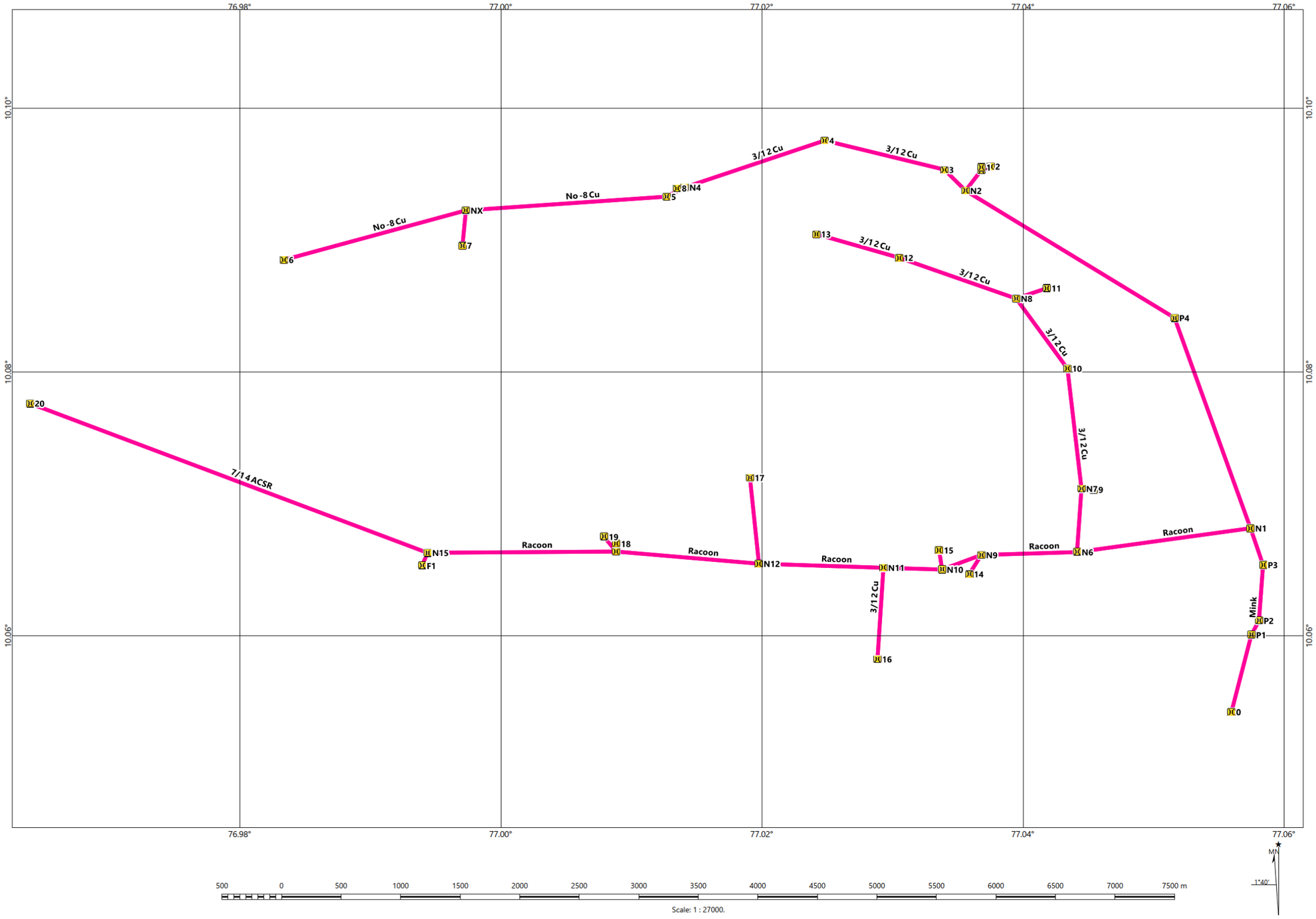


Figure 3: ITD feeder

- **Neyamakad feeder**

The following table shows the 11 kV line distance in the Neyamakad feeder.

Table 17: HT line distance – Neyamakad feeder

Route (From-To)	Cable type	Distance (km)
Node-1- Nallathanni factory	Racoon	0.448
Node-2-Node-3	Dog	0.966
Node-3 - Tea Museum	3/12 Cu	0.093
Node-3- DYSP bunglow	Racoon	0.961
DYSP bunglow- Node-4	Racoon	0.706
Node-4 - Periyavurrai lower	7/14 ACSR	0.991
Node-4- Node-5	Racoon	0.387
Node-5-Node-6	Racoon	0.501
Node-5-Sholamalai	7/14 ACSR	1.201
Node-6-Node-7	3/12 Cu	0.12
Node-7-Periyavurrai factory	3/12 Cu	0.015
Node-7-Anamudi	7/14 ACSR	1.314
Node-6-Node-8	Racoon	0.865
Node-8- Kanniar bunglow	No.8 Cu	0.113
Node-8-Node-9	Racoon	0.949
Node-9-Node-10	7/14 ACSR	0.8
node-10-Kannimalai top	7/14 ACSR	1.613
Node-10-Kannimalai lower	7/14 ACSR	0.009
Node-9-Node-11	Racoon	0.067
Node-11-Kanniamalai factory	7/14 Cu	0.106
Node-12-Node-13	Racoon	0.75
Node-13-Node-14	7/14 ACSR	0.504
Node-14-Nymakad bunglow	7/14 ACSR	0.131
NOde-14 Nyamakad east	7/14 ACSR	0.604
Node-13-Node-15	Racoon	3.466
Node-15- Vagavurrai top	7/14 ACSR	0.104
Node-15-Node-16	Racoon	1.509
Node-16-Vagavurrai lower	7/14 ACSR	0.03
Node-16-Node-17	Racoon	0.843
Node-17-Node-18	3/12 CU	0.132
Node-18-Vagavurrai bazar	Racoon	0.118
Node-18-Node-19	3/12 Cu	0.375
Node-19 - Thaliar bunglow	3/12 Cu	0.207
Node-19-Node-20	3/12 Cu	0.562
Node-20-Thaliar divsn	7/14 ACSR	0.051
Node-20 Thaliar factory	3/12 Cu	0.525
Node-17-Node-21	Racoon	1.011
Node-21-Manager bunglow	3/12 Cu	0.0567
Node-21-Node-22	Racoon	0.267
Node-22-Vagavurrai factory	7/14 ACSR	0.102

Route (From-To)	Cable type	Distance (km)
Vagavurrai factory - factory division	7/14 ACSR	0.22
Vagavurrai factory - vagavurrai naval	7/14 ACSR	1.497
Vagavurrai naval- Vagavurrai luckam	7/14 ACSR	0.733
Node-11-Node-23	3/12 Cu	1.24
Node-23-Rajamalai west BSNL	7/14 ACSR	0.063
Node-12-Node-23	3/12 Cu	0.5
Node-12-Node-24	3/12 CU	0.46
Node-24- Forest	7/14 ACSR	0.235
Node-24-Node-25	3/12 Cu	0.553
Node-25-Node-26	3/12 Cu	0.532
Node-26-Kadalaar bunglow	7/14 ACSR	0.165
Node-26-Node-27	3/12 Cu	1.702
Node-27-Kadalaar hospital	No-8 Cu	0.435
Kadalaar hospital- factory division	3/12 CU	1.338
Kadalaar factory divsn - factory	3/12 Cu	0.028
Node-25-Node-29	3/12 Cu	0.437
Node-29- Rajamalai park	3/12 Cu	0.022
Node-29- Wireless station	3/12 CU	1.004
Wireless station- rajamalai divsn	no-8 Cu	1.685
Rajamalai divsn - pettimudi	3/12 Cu	1.004
Switching station - Node-1	DOG	5.124
Node-1-Node-2	Dog	0.631
Node-2- Srishti	7/14 ACSR	0.261
Total – 11 kV line length		**43.4417**

The following table shows the important geographical location in Neyamakad feeder and its label mapped.

Table 18: Pole mapping – geographical location – Neyamakad feeder

Point (Longitude, latitude)	name	label
POINT (77.035238 10.091585)	Node-1	N1
POINT (77.034228 10.095515)	Nallathani factory	2
POINT (77.040967 10.092189)	Node-2	N2
POINT (77.049583 10.094029)	Node-3	N3
POINT (77.050324 10.094443)	Tea museum	3
POINT (77.0582 10.095645)	DYSP bunglow	4
POINT (77.05812 10.102025)	Node-4	N4
POINT (77.067083 10.100842)	Periyavurrai lower	5
POINT (77.058286 10.105527)	Node-5	N5
POINT (77.058013 10.11005)	Node-6	N6
POINT (77.048316 10.110036)	Sholamalai	6
POINT (77.059078 10.110278)	Node-7	N7
POINT (77.058942 10.110281)	Periyavurrai factory	7
POINT (77.070854 10.108038)	Anamudi	8

Point (Longitude, latitude)	name	label
POINT (77.056598 10.117744)	Node-8	N8
POINT (77.057631 10.117728)	Kanniar bunglow	9
POINT (77.055919 10.1263)	Node-9	N9
POINT (77.063201 10.12684)	Node-10	N10
POINT (77.077876 10.125683)	Kannimalai top	10
POINT (77.063214 10.126921)	Kannimalai lower	11
POINT (77.056089 10.126889)	Node-11	N11
POINT (77.057054 10.126877)	Kannimalai factory	12
POINT (77.053001 10.142317)	Node-12	N12
POINT (77.058432 10.146438)	Node-13	N13
POINT (77.06277 10.144905)	Node-14	N14
POINT (77.063875 10.144442)	Nymakad bunglow	13
POINT (77.067116 10.14154)	Nymakad east	14
POINT (77.083467 10.1656)	Node-15	N15
POINT (77.083976 10.164802)	Vagavurrai top	15
POINT (77.094699 10.173498)	Node-16	N16
POINT (77.094904 10.173315)	vagavurrai lower	16
POINT (77.101003 10.169121)	Node-17	N17
POINT (77.101586 10.168073)	Node-18	N18
POINT (77.102182 10.168967)	Vagavurrai bazar	17
POINT (77.104281 10.165987)	Node-19	N19
POINT (77.102462 10.165477)	Thaliar bunglow	18
POINT (77.104022 10.16091)	Node-20	N20
POINT (77.104477 10.161024)	Thaliar division	20
POINT (77.102165 10.15653)	Thaliar factory	19
POINT (77.103176 10.174948)	Post-4	P4
POINT (77.105765 10.176369)	Node-21	N21
POINT (77.105295 10.176583)	Manager bunglow	21
POINT (77.10614 10.178756)	Feedback-2 marayur	F2
POINT (77.106801 10.178105)	Vagavurrai factory	22
POINT (77.108806 10.178187)	Vagavurrai factory division	23
POINT (77.120471 10.185247)	Vagavurrai naval	24
POINT (77.123458 10.191181)	Vagavurrai luckam	25
POINT (77.053877 10.137877)	Node-23	N23
POINT (77.053298 10.13786)	Rajamalai west BSNL	26
POINT (77.048904 10.14322)	Node-24	N24
POINT (77.050417 10.144732)	Forest	27
POINT (77.043874 10.14277)	Node-25	N25
POINT (77.04138 10.141797)	Post-5	P5
POINT (77.041244 10.139644)	Node-26	N26
POINT (77.040917 10.138187)	Kadalaar bunglow	28
POINT (77.033895 10.126081)	Node-27	N27
POINT (77.032573 10.129793)	Kadalaar hospital	29
POINT (77.020959 10.133532)	Kadalaar factory division	30
POINT (77.021027 10.133285)	Kadalaar factory	31

POINT (77.039931 10.143395)	Node-29	N29
POINT (77.03974 10.143316)	Rajamalai park	32
POINT (77.031271 10.14637)	REP (wireless) stn	33
POINT (77.018922 10.155454)	Rajamalai division	34
POINT (77.012112 10.161538)	Pettimudi	35
POINT (77.056264 10.05429)	Switching station	0
POINT (77.057627 10.060088)	Post-1	P1
POINT (77.058212 10.061171)	Post-2	P2
POINT (77.058529 10.065404)	Post-3	P3
POINT (77.041383 10.094516)	Srishti	1

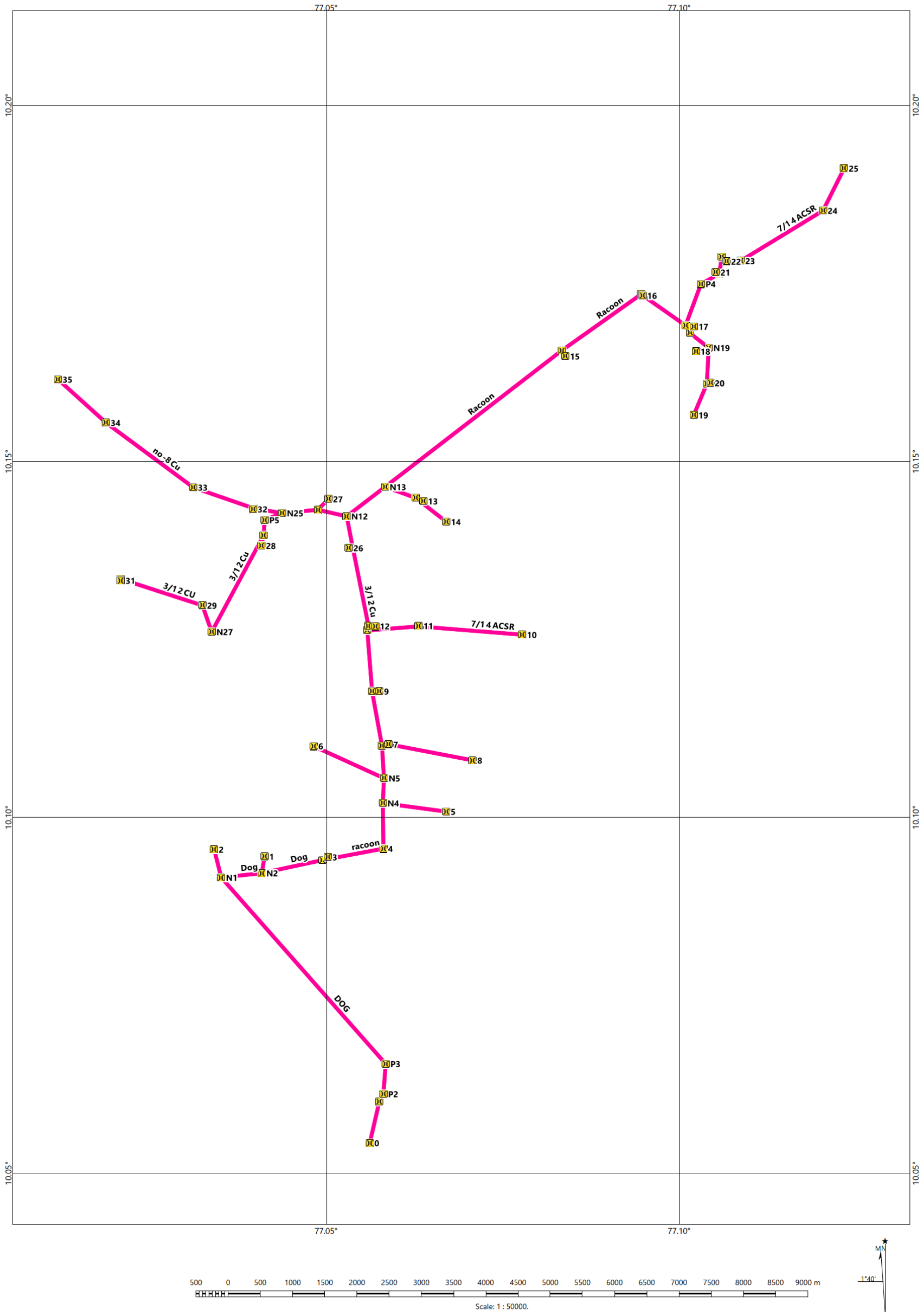


Figure 4: Neyamakad feeder

- **Nettigudi feeder**

The following table shows the 11 kV line distance in the Nettigudi feeder.

Table 19: HT line distance – Nettigudi feeder

Route (From-To)	Cable type	Distance (km)
Switching station- Node-1	Racoon	2.651
Node-1-Node-2	Racoon	0.343
Node-2- Chokanad south	7/12 Cu	0.076
Node-2-Node-3	Racoon	1.101
Node-4-Node-5	Racoon	0.361
Node-5-Node-6	Racoon	0.1024
Node-6-KWA Feedback	Racoon	0.446
Node-3-Chokanad east	N0 8 CU	1.045
Node-4- Chokanad K Kai	7/14 ACSR	0.36
Node-3-Chokanad north	7/14 ACSR	1.107
Node-5-Alisa craig	7/14 ACSR	0.716
Node-6-Ladbrock	7/14 ACSR	0.033
KWA feedback- Node-8	Racoon	0.334
Node-8-Earlston	7/12 Cu	0.226
Node-8-Forest	3/12 Cu	0.13
Forest-Node-9	3/12 Cu	0.884
Node-9-KSEB feedback	3/12 Cu	0.168
Node-9-Node-10	3/12 Cu	1.541
Node-10-Lockhart factory	No-8Cu	0.101
Node-10-Lockhart colony	7/12 ACSR	0.757
Node-11-Node-17	Racoon	0.123
Node-12-Gunderle manager	3/12 Cu	0.01
Node-12-Node-13	3/12 Cu	1.167
Node-13-Gunderle factory divsn	7/14 ACSR	0.0087
Node-13-Node-14	3/12 Cu	0.346
Node-14 - Gunderle factory	3/12 Cu	0.038
Node-14-Node-15	3/12 Cu	1.268
Node-15-BSNL	7/14 ACSR	0.138
Node-15-Node-16	3/12 Cu	0.401
Node-16-Silent valley divsn	7/14 ACSR	0.239
Node-16-Silent valley office	3/12Cu	1.097
Node-17-Gunderle lower	7/14 ACSR	0.0668
Node-17-Node-18	Racoon	0.519
Node-18-Gunderle center	7/14 ACSR	0.059
Node-18-Node-19	Racoon	0.711
Node-19-GUnderle top	7/14 Cu	0.142
Node-19-Node-20	7/14 Cu	1.087
Node-20-Node-21	3/12 Cu	0.799
Node-21-Devikulam middle	7/12 Cu	0.053
Node-21-Node-22	3/12 Cu	0.989
Node-22-Devikulam factory	3/12Cu	0.035
Node-22- Devikulam factory divsn	7/14 ACSR	0.0559
Node-20-Node-23	7/14 Cu	1.871

Node-23-Devikulam ODK	7/14 ACSR	0.09
Node-23-Periyakanal PH divsn	3/12 Cu	1.92
Periyakanal Ph Divsn - Node-24	3/12 Cu	0.629
Node-24-Ayur county	7/12 ACSR	0.183
Node-24-Node-25	7/14 CU	1.191
Node-25-Periyakanal Factory divsn	3/12 Cu	0.077
Node-25-Periyakanal factory	7/14 Cu	0.095
Node-3-Node-4	Racoon	0.239
Node-11-Node-12	3/12 Cu	1.052
Node-8-Node-11	Racoon	3.296
Total – 11 kV line length		**32.4778**

The following table shows the important geographical location in Nettigudi feeder and its label mapped.

Table 20: Pole mapping – geographical location – Nettigudi feeder

Point (Longitude, Latitude)	name	label
POINT (77.073322 10.06827)	Node-1	N1
POINT (77.072928 10.068345)	Chokanad factory	1
POINT (77.056264 10.05429)	Switching station	0
POINT (77.057627 10.060088)	Post-1	P1
POINT (77.058212 10.061171)	Post-2	P2
POINT (77.060037 10.061869)	Post-3	P3
POINT (77.063407 10.063946)	Post-4	P4
POINT (77.066954 10.066567)	Post-5	P5
POINT (77.076409 10.068811)	Node-2	N2
POINT (77.075749 10.069031)	Chokanad south	2
POINT (77.079836 10.069593)	Post-6	P6
POINT (77.086296 10.070569)	Node-3	N3
POINT (77.088449 10.070897)	Node-4	N4
POINT (77.091583 10.071894)	Node-5	N5
POINT (77.092377 10.072382)	Node -6	N6
POINT (77.095981 10.074258)	kWA feedback	F1
POINT (77.086818 10.061129)	Chokanad east	3
POINT (77.088745 10.069228)	Post 8	P8
POINT (77.09022 10.068689)	Chokanad K Kai	5
POINT (77.085672 10.076794)	Post-7	P7
POINT (77.081953 10.077531)	Chokanad north	4
POINT (77.090014 10.078181)	Alisa craig	6
POINT (77.092394 10.072083)	Ladbrock	7
POINT (77.099023 10.074395)	Node-8	N8
POINT (77.101008 10.073823)	Earlston	8
POINT (77.099762 10.073476)	Forest	9
POINT (77.106477 10.069049)	Node-9	N9
POINT (77.107143 10.068293)	Post-9	P9
POINT (77.107205 10.067777)	KSEB feedback	10

POINT (77.109637 10.055465)	Node-10	N10
POINT (77.109169 10.054673)	Lockhart factory	12
POINT (77.112005 10.049033)	Lockhart colony	11
POINT (77.128314 10.081142)	Node-11	N11
POINT (77.137218 10.077591)	Node-12	N12
POINT (77.129124 10.080371)	Node-17	N17
POINT (77.137202 10.07768)	Gunderle manager	13
POINT (77.138827 10.074873)	Post-10	P10
POINT (77.146204 10.073733)	Node-13	N13
POINT (77.146281 10.073755)	Gunderle factory divn	14
POINT (77.148957 10.072203)	Node-14	N14
POINT (77.149057 10.072534)	Gunderle factory	15
POINT (77.160263 10.069767)	Node-15	N15
POINT (77.161501 10.069995)	BSNL	16
POINT (77.163486 10.071498)	Node-16	N16
POINT (77.164028 10.0694)	Silent valley divn	17
POINT (77.170147 10.078903)	Silent valley office	18
POINT (77.128551 10.080578)	Gunderle lower	19
POINT (77.127884 10.07584)	Node-18	N18
POINT (77.127347 10.075901)	Gunderle center	20
POINT (77.126862 10.069493)	Node-19	N19
POINT (77.12683 10.068207)	Gunderle top	21
POINT (77.131116 10.063566)	Post-12	P12
POINT (77.132994 10.061812)	Node-20	N20
POINT (77.129247 10.055611)	Node-21	N-21
POINT (77.129649 10.055342)	Devikulam middle	22
POINT (77.122731 10.049414)	Node-22	N-22
POINT (77.122914 10.049154)	Devikulam factory	24
POINT (77.122229 10.049629)	Devikulam factory divsn	23
POINT (77.144723 10.049517)	Node-23	N23
POINT (77.144768 10.050335)	Devikulam ODK	25
POINT (77.146296 10.04841)	Post 13	P13
POINT (77.15195 10.041476)	Post 14	P14
POINT (77.156208 10.03648)	Periyakanal PH divsn	26
POINT (77.160964 10.0333)	Node-24	N24
POINT (77.160901 10.031759)	Post-15	P15
POINT (77.160787 10.031771)	Ayur county	27
POINT (77.168847 10.025889)	Node-25	N25
POINT (77.169476 10.026206)	Periyakanal factory divsn	28
POINT (77.169368 10.025197)	Periyakanal factory	29

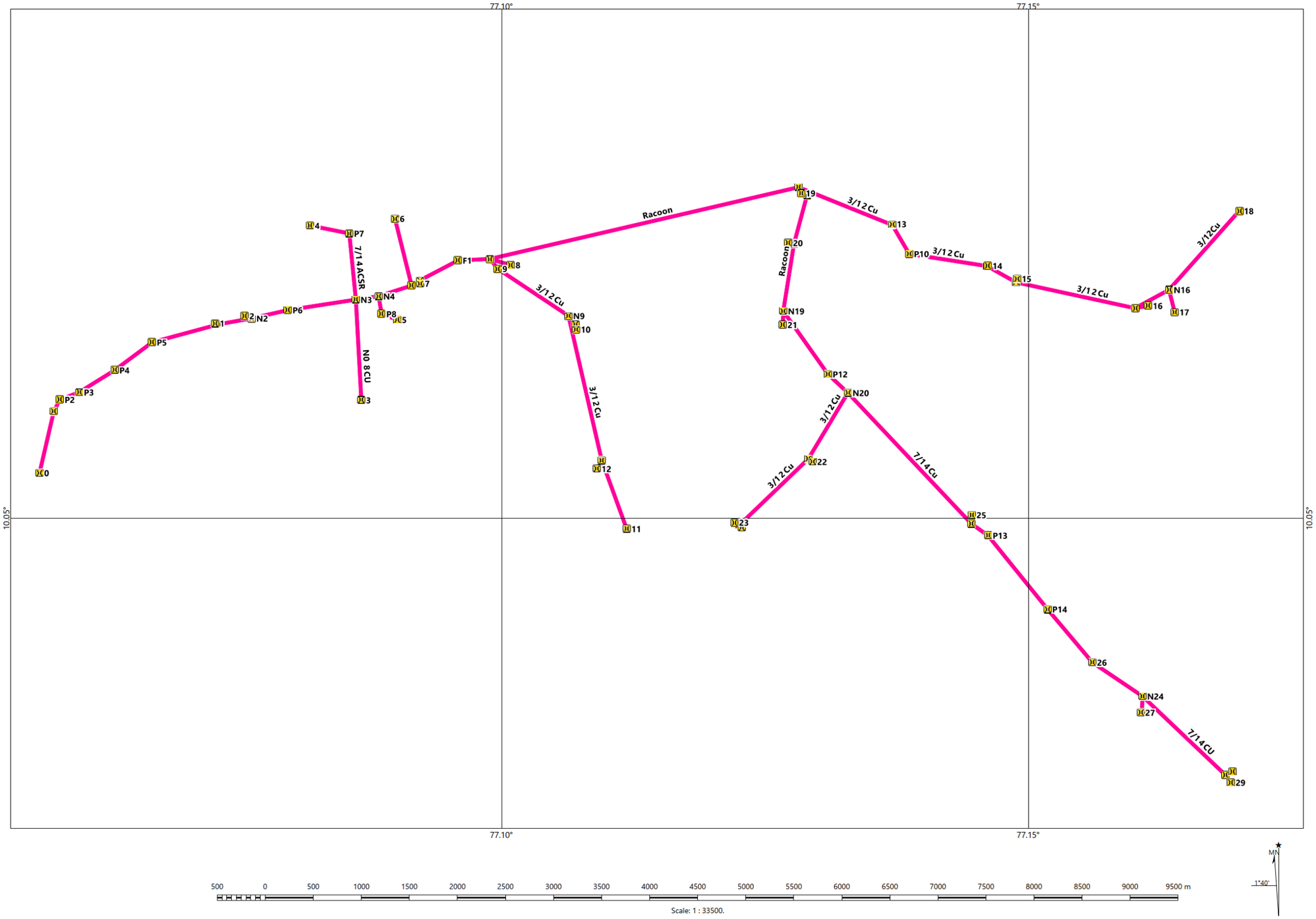


Figure 5: Nettigudi feeder

- **Town feeder**

The following table shows the 11 kV line distance in the Town feeder.

Table 21: HT line distance – Town feeder

Route (From-To)	label	Distance (km)
Switching station - Node-1	Racoon	1.734
Node-1-Old munnar tea testing	3/12 Cu	0.053
Node-1-Node-2	7/14 Cu	0.521
Node-2-Casa montana	7/14 ACSR	0.107
Node-2-Node-3	7/14 Cu	0.094
Node-3-Node-4	7/12 Cu	0.166
Node-4-Munnar palace	7/12 Cu	0.021
Node-4- High range club	7/12 Cu	0.234
Node-3-node-5	7/14 Cu	0.054
Node-5-Node-7	7/14 Cu	0.384
Node-7-Node-8	7/14 Cu	0.047
Node-8-Node-10	7/14 Cu	0.744
Node-5-Node-6	7/14 Cu	0.0467
Node-6-Poopada	7/14 Cu	0.191
Node-6-MS hotel	7/14 Cu	0.0776
Node-7-Workshop club	7/12 ACSR	0.0805
Node-8-EVM	3/12 Cu	0.128
EVM-Node-9	3/12 Cu	0.0609
Node-9-Workshop	3/12 Cu	0.0165
Node-9-Shikshak sadan	7/14 ACSR	0.08
Node-10-RO	3/12 Cu	0.0146
Node-10-Node-11	7/14 Cu	0.141
Node-11-Node-12	7/14 ACSR	0.217
Node-12-Tea County	7/14 ACSR	0.156
Node-12-Node-13	7/14 ACSR	0.401
Node-13-Teachers quarters	7/14 ACSR	0.19
Node-13-Grahamsland pump	7/14 ACSR	1.215
Teachers' quarters KWA pump	7/14 ACSR	0.205
KWA pump-Botanical Garden	7/14 ACSR	0.169
Node-11-Node-14	7/14 Cu	0.111
Node-14-Eastend	7/14 ACSR	0.0567
Node-14-Node-15	7/14 Cu	0.164
Node-15-BSNL	Racoon	0.206
Node-15-Town	7/14 Cu	0.061
Node-15-Node-16	7/14 ACSR	0.149
Node-16-Node-17	7/12 Cu	0.747
Node-17-Nirmala society	7/12 Cu	0.335
Node-17- GH	No-8 Cu	0.231
Node-16 - KSEB	7/14 ACSR	0.339
KSEB - Node-18	7/14 ACSR	0.0265
Node-18- Feedback KSEB	7/14 ACSR	0.036
Node-18-Node-19	7/14 ACSR	0.455
Node-19-OCR	7/14 ACSR	0.026
Node-19- Munnar engineering college	7/14 ACSR	0.147
Total – 11 kV line length		**10.639**

The following table shows the important geographical location in Town feeder and its label mapped.

Table 22: Pole mapping – geographical location – Town feeder

Point (Longitude, Latitude)	name	label
POINT (77.056264 10.05429)	Switching station	0
POINT (77.057627 10.060088)	Post-1	P1
POINT (77.058212 10.061171)	Post-2	P2
POINT (77.059084 10.065243)	Post-3	P3
POINT (77.060096 10.069503)	Node-1	N1
POINT (77.060579 10.069438)	Old munnar tea tasting	1
POINT (77.061854 10.072979)	Post-4	P4
POINT (77.06213 10.073753)	Node-2	N2
POINT (77.061276 10.073722)	Post-5	P5
POINT (77.061275 10.073842)	Casa montana	2
POINT (77.062438 10.074553)	Node-3	N3
POINT (77.063831 10.073963)	Node-4	N4
POINT (77.063958 10.074109)	Munnar palace (Grand plaza)	4
POINT (77.065121 10.072282)	High range club	3
POINT (77.062662 10.074988)	Node-5	N5
POINT (77.063297 10.076859)	Post-6	P6
POINT (77.063415 10.078354)	Node-7	N7
POINT (77.063231 10.078741)	Node-8	N8
POINT (77.062108 10.085379)	Node-10	N10
POINT (77.062297 10.075206)	Node-6	N6
POINT (77.060667 10.075819)	Poopada	5
POINT (77.061718 10.074801)	MS hotel	6
POINT (77.064143 10.078253)	Workshop club	7
POINT (77.062101 10.078431)	EVM	8
POINT (77.061838 10.078916)	Node-9	N9
POINT (77.061949 10.079017)	Workshop	9
POINT (77.061718 10.07963)	Shikshak sadan	10
POINT (77.061987 10.085324)	RO	11
POINT (77.061371 10.086433)	Node-11	N11
POINT (77.063319 10.086054)	Node-12	N12
POINT (77.064673 10.086506)	Tea county	12
POINT (77.066978 10.086149)	Node-13	N13
POINT (77.06745 10.08591)	Post-7	P7
POINT (77.068532 10.085384)	Teachers quarters	14
POINT (77.078061 10.086526)	Grahamsland pump	13
POINT (77.070125 10.084413)	KWA pump	15
POINT (77.071103 10.084187)	Post-8	P8
POINT (77.071386 10.08373)	Botanical garden	16
POINT (77.061953 10.087259)	Node-14	N14
POINT (77.062467 10.087201)	Eastend	17
POINT (77.060454 10.087308)	Node-15	N15
POINT (77.059363 10.086913)	Post-9	P9
POINT (77.059628 10.08625)	BSNL	18
POINT (77.0599 10.087396)	Town	19
POINT (77.061617 10.088009)	Node-16	N16

POINT (77.060492 10.089264)	Post-10	P10
POINT (77.060043 10.090406)	Post-11	P11
POINT (77.058989 10.089915)	Post-12	P12
POINT (77.056435 10.090851)	Node-17	N17
POINT (77.054469 10.092259)	Post-13	P13
POINT (77.054031 10.09181)	Nirmala society	20
POINT (77.05559 10.08894)	GH	21
POINT (77.064652 10.088607)	KSEB	22
POINT (77.064882 10.088683)	Node-18	N18
POINT (77.065181 10.088813)	Feedback KSEB	F1
POINT (77.066098 10.08926)	Post-14	P14
POINT (77.067622 10.091599)	Node-19	N19
POINT (77.067402 10.091684)	OCR	24
POINT (77.067567 10.092932)	Munnar engineering college	25

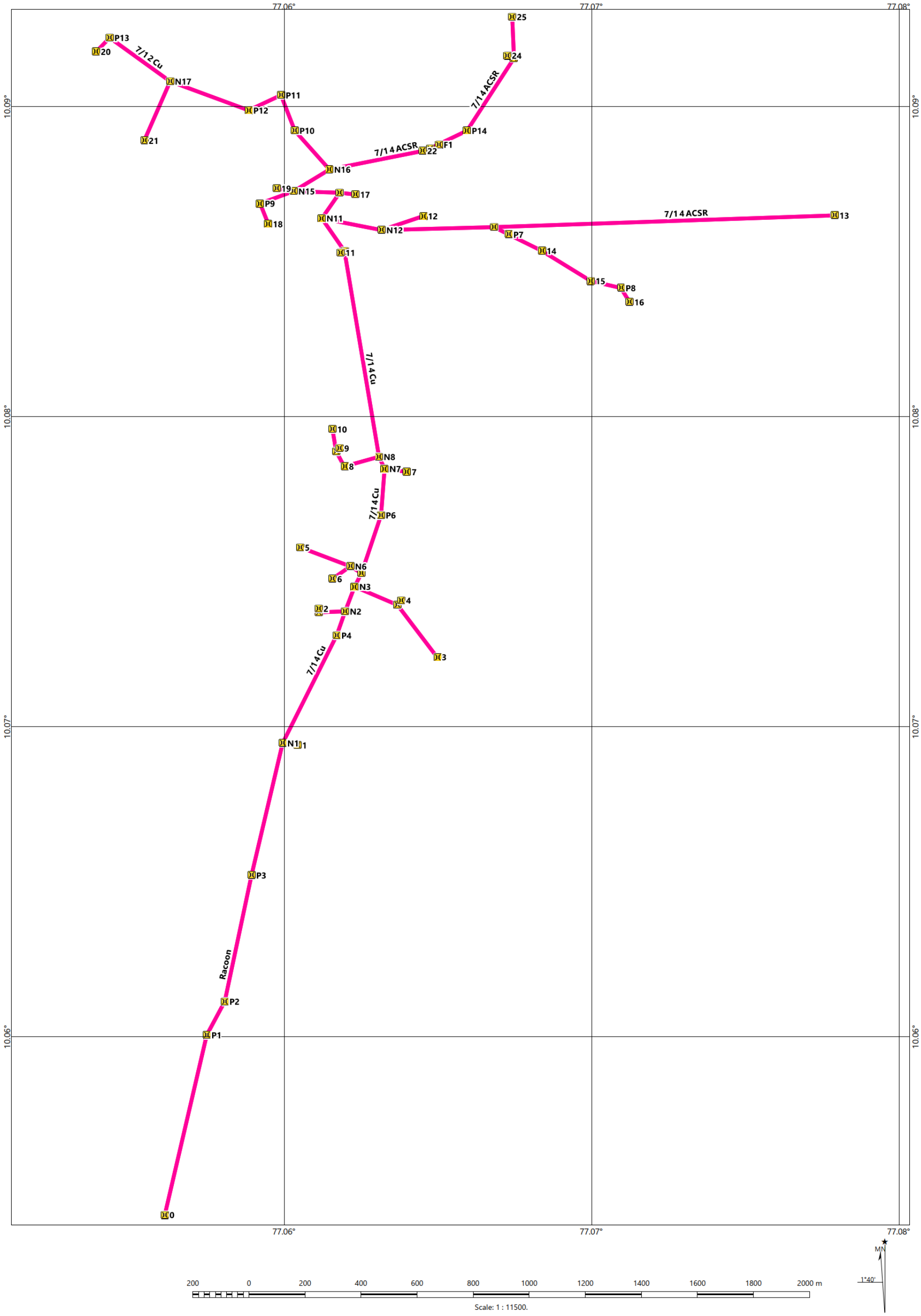


Figure 6: Town feeder

- **MADUPATTI FEEDER**

The following table shows the 11 kV line distance in the Madupatti feeder.

name	label	Distance
Switching station - Node-1	Racoon	2.656
Node-1- Westwood	Racoon	0.228
Node-1-Node-2	Racoon	1.105
Node-2 - Grahmsland office	Racoon	0.921
Grahamslan office - Post11	Racoon	0.064
Post-11 Node-3	Racoon	0.662
Node- Grahmsland bazaar	7/14 ACSR	0.202
Node-4 - Grahamsland bunglows	7/12 ACSR	0.016
Node-5 KKD church	7/14 ACSR	0.0067
Node-6 HR School	7/14 ACSR	0.018
Node-6 - Node-7	Racoon	0.563
Node-7- Node-8	3/12 Cu	0.85
Node-8- Madupatty division	7/14 ACSR	1.088
Node8 - node-9	7/14 ACSR	0.254
Node-9 - R&D complex	7/14 ACSR	0.61
Node-9 - R& D lab	7/14 ACSR	0.971
Node-9 - Node-10	No6 Cu	1.558
Node-10 - Thenmalay asst manager bunglow	7/14 ACSR	0.889
Node-10 - Node-11	No-6 CU	1.093
Node-11 - Thenmalar factory divsn	7/14 ACSR	0.012
Node-11- Node-12	No6 Cu	0.276
Node-12 - Thenmalay new divsn	7/14 ACSR	1.618
Node-12 Tenmalay factory	No-6 Cu	0.067
Node-7 - node-13	Racoon	0.186
Node-13 Madupatty factory	7/14 ACSR	0.045
Node-13- node-14	Mink	0.222
Node-14 - Madupatty divsn	7/14 ACSR	0.012
Node-14- Node-15	Mink	0.372
Node-15 Madupatty dam feedback	Mink	0.025
Node-15 - Madupatty hydel	Mink	0.092
Node-13-Node-16	Racoon	0.155
Node-16 - Nettimadu divsn	7/14 ACSR	0.297
Node-16- Node-17	Racoon	1.839
Node-17 - High tech KLD board	Racoon	0.224
Node-17-Node-18	Racoon	0.34
Node-18 - Indo swiss project	3/12 Cu	0.02
Node-18-Node-19	Racoon	0.451
Node-19-Node-20	3/12 Cu	2.249
Node-20- Gundumalay factory	7/14 ACSR	0.048
Node-20-Node-21	7/14 ACSR	0.362
Node-21 - gundumalay factory divsn	7/14 ACSR	0.032
Node-21-Node-22	3/12 Cu	1.167
Node-22 - Gunduamaly benmore	7/14 ACSR	0.087
Node-22- Node-23	7/14 ACSR	0.817
Node-23-Node-24	7/12 ACSR	0.711

Node-24- Gundumalay southpara	7/14 ACSR	0.038
Node-24- Node-25	7/14 ACSR	0.729
Node-25- Gundumalay new divsn	7/14 ACSR	0.973
Node-25 - Gundumalay BSNL	7/14 ACSR	0.687
Node-23-Node-26	7/14 ACSR	0.936
Node-26- Gundumalay upper	7/14 ACSR	0.072
Node-26-Node-27	7/14 ACSR	0.201
Node-27 - Gundumalay lower	3/12 Cu	0.915
Node-27- Gundumalay kadugu	7/14 ACSR	1.607
Node-19-Node-28	Racoon	0.902
Node-28-Node-29	7/14 ACSR	0.882
Node-29- New pump indo swiss	7/14 ACSR	0.52
Node-29-Node-31	Racoon	0.582
Node-31- Ecopoint	7/14 ACSR	0.121
Node-31-Node-32	Racoon	0.937
Node-32- East divsn pachakkad	7/14 ACSR	0.264
Node-32-Node-33	Racoon	2.23
Node-32-Node-35	Racoon	0.251
Node-35-Pudukkadi	7/14 ACSR	0.007
Node-35-Node-36	Racoon	2.058
Node-36-Feedback dam LT	7/14 ACSR	0.195
Node-36-Node-37	7/14 ACSR	1.702
Node-37- Yelappaty divsn	7/12 ACSR	0.235
Node-37- Yelapatty factory	7/14 ACSR	0.093
Node-36-Node-43	7/14 Cu	1.863
Node-36-Node-38	7/14 ACSR	1.024
Node-38-Kundalay office	7/14 ACSR	0.011
Node-38-Node-39	7/14 ACSR	0.145
Node-39-node-40	7/14 ACSR	1.086
Node-39- Theerthamalay	7/14 ACSR	1.35
Node-33-Node-34	7/14 ACSR	1.031
Node-34-Kundalay colony feedback	7/14 ACSR	0.022
Node-34-Kundalay naturals	7/14 ACSR	0.495
Node-40-Node-41	7/14 ACSR	0.688
Node-41-Old factory	7/14 ACSR	0.117
Node-41- Node-42	7/14 ACSR	0.754
Node-42- Top division	7/14 ACSR	0.667
Node-42-PR divsn	7/14 ACSR	1.937
Node-40-Chunduvarrai factory	7/12 Cu	1.314
Node-43-Kundalay club	No.8 Cu	0.977
Node-43-Node-44	3/12 Cu	0.966
node-44-chittivurrai pump	7/12 ACSR	1.231
Node-44-Node-45	No-6 Cu	0.702
Node-45-Chittivurrai factory	No6 CU	0.04
Node-45-Node-46	7/14 ACSR	0.255
Node-46-Chittivurrai factory divsn	7/12 ACSR	0.325
Node-46-Node-47	7/14 ACSR	0.515
Node-47-Chittivurrai new division	7/14 ACSR	0.035
Node-47-Node-48	7/14 ACSR	0.786

Node-48-Chittivurrai OC divsn	7/14 ACSR	0.0026
Node-48-Vattavada feedback	7/14 ACSR	0.0037
Node-29-Node-30	7/14 ACSR	0.665
Node-30-Aruvikkad Divsn	7/12 ACSR	0.144
Node-30-Aruvikkad factory	7/12 ACSR	0.103
Node-2 - Microwave	7/14 ACSR	0.093
Total – 11 kV line length		61.965

The following table shows the important geographical location in Madupatti feeder and its label mapped.

Point (Longitude, Lattitude)	name	label
POINT (77.056264 10.05429)	Switching station	0
POINT (77.057627 10.060088)	Post-1	P1
POINT (77.058212 10.061171)	Post-2	P2
POINT (77.059084 10.065243)	Post-3	P3
POINT (77.060096 10.069503)	Post-4	P4
POINT (77.061854 10.072979)	Post-5	P5
POINT (77.06213 10.073753)	Post-6	P6
POINT (77.062438 10.074553)	Post-7	P7
POINT (77.062662 10.074988)	Post-8	P8
POINT (77.063603 10.075464)	Post-9	P9
POINT (77.064791 10.075687)	Node-1	N1
POINT (77.065188 10.074352)	Post-10	P10
POINT (77.064567 10.074069)	Westwood	1
POINT (77.073432 10.080844)	Node-2	N2
POINT (77.081062 10.084349)	Grahamsland office	3
POINT (77.081598 10.084594)	Post-11	P11
POINT (77.086002 10.08869)	Node-3	N3
POINT (77.08453 10.088426)	Post-12	P12
POINT (77.084177 10.088462)	Grahamsland bazaar	4
POINT (77.091834 10.090431)	Node-4	N4
POINT (77.09171 10.090348)	Grahamsland bunglows	5
POINT (77.100888 10.095196)	Node-5	N5
POINT (77.100835 10.095226)	KKD church	6
POINT (77.101711 10.095549)	Kuttiyar valley feedback	F1
POINT (77.105147 10.097478)	Post-13	P13
POINT (77.112623 10.101776)	Node-6	N6
POINT (77.112678 10.101617)	HR school	7
POINT (77.116954 10.104515)	Node-7	N7
POINT (77.117494 10.112186)	Node-8	N8
POINT (77.109064 10.117385)	Madupatty top divsn	8
POINT (77.118334 10.114332)	Node-9	N9
POINT (77.123571 10.112446)	R&D complex	9
POINT (77.122733 10.119704)	Post-14	P14
POINT (77.124612 10.119702)	R&D lab	10

POINT (77.119604 10.118725)	Post-15	P15
POINT (77.114646 10.126877)	Node-10	N10
POINT (77.118311 10.131393)	Post-16	P16
POINT (77.120526 10.131872)	Thenmalay Asst manager bunglow	10
POINT (77.106454 10.132515)	Node-11	N11
POINT (77.106456 10.132402)	Tenmalay factory divsb	11
POINT (77.103936 10.132603)	Node-12	N12
POINT (77.097847 10.137271)	Post-17	P17
POINT (77.094516 10.141457)	Post-18	P18
POINT (77.093736 10.142938)	Tenmalay new divsn	12
POINT (77.103709 10.132039)	Tenmalay factory	13
POINT (77.118496 10.103795)	Node-13	N13
POINT (77.118727 10.104135)	Madupatty factory	14
POINT (77.119625 10.105471)	Node-14	N14
POINT (77.119727 10.105424)	Madupatty divsn	15
POINT (77.119959 10.105669)	Post-19	P19
POINT (77.122911 10.106223)	Node-15	N15
POINT (77.122994 10.106012)	Madupatty dam feedback	F2
POINT (77.123744 10.106114)	Madupatty hydel	16
POINT (77.119775 10.103184)	Node-16	N16
POINT (77.121702 10.101295)	Nettimadu divsn	17
POINT (77.135148 10.109863)	Node-17	N17
POINT (77.136917 10.108831)	High tech KLD board	18
POINT (77.137119 10.112248)	Node-18	N18
POINT (77.136946 10.112184)	Indo swiss project	19
POINT (77.140074 10.115097)	Node-19	N19
POINT (77.134158 10.121015)	Post-21	P21
POINT (77.141155 10.125622)	Post-22	P22
POINT (77.140727 10.129283)	Node-20	N20
POINT (77.140494 10.129655)	Gundumalay factory	20
POINT (77.141368 10.132498)	Node-21	N21
POINT (77.141144 10.132683)	Gundumalay factory divsn	21
POINT (77.139775 10.142939)	Node-22	N22
POINT (77.138977 10.142954)	Gundumalay benmore	22
POINT (77.135175 10.148753)	Node-23	N23
POINT (77.129367 10.14588)	Node-24	N24
POINT (77.129033 10.145766)	Gundumalay south para	23
POINT (77.122813 10.147048)	Node-25	N25
POINT (77.113937 10.146657)	Gundumalay new divsn	25
POINT (77.122285 10.153244)	Gundumalay BSNL	24
POINT (77.13488 10.157218)	Node-26	N26
POINT (77.134321 10.157574)	Gundumalay upper	26
POINT (77.134691 10.159033)	Node-27	N27
POINT (77.131647 10.166739)	Gundumalay lower	27
POINT (77.139203 10.172863)	Gundumalay kadugu	28
POINT (77.146325 10.120405)	Node-28	N28

POINT (77.152023 10.114764)	Node-29	N29
POINT (77.151674 10.114434)	New pump indo swiss	29
POINT (77.153771 10.119739)	Node-31	N31
POINT (77.15267 10.119847)	Ecopoint	32
POINT (77.160987 10.124289)	Node-32	N32
POINT (77.162862 10.122783)	East divsn pachakkad	33
POINT (77.178188 10.135131)	Node-33	N33
POINT (77.180058 10.136447)	Node-35	N35
POINT (77.180075 10.136509)	Pudukkadi	35
POINT (77.181477 10.137879)	Post-23	P23
POINT (77.197968 10.140834)	Node-36	N36
POINT (77.197778 10.142591)	Feedback dam LT	F4
POINT (77.19925 10.131266)	Post-24	P24
POINT (77.203567 10.127434)	Node-37	N37
POINT (77.205451 10.12642)	Yelapatty divsn	36
POINT (77.203996 10.126707)	Yelapatty factory	37
POINT (77.214974 10.141016)	Node-43	N43
POINT (77.192318 10.148214)	Node-38	N38
POINT (77.192296 10.148313)	Kundalay office	38
POINT (77.193041 10.149315)	Node-39	N39
POINT (77.195444 10.153409)	Post-26	P26
POINT (77.198377 10.157581)	Node 40	N40
POINT (77.185392 10.153868)	Post-25	P25
POINT (77.182475 10.155606)	Theerthamalay	39
POINT (77.175086 10.143934)	Node-34	N34
POINT (77.17489 10.14399)	Kundalay colony Feedback	F3
POINT (77.174439 10.148366)	Kundalay naturals	34
POINT (77.203009 10.161782)	Node-41	N41
POINT (77.203555 10.162698)	Old factory	41
POINT (77.202644 10.16289)	Post-28	P28
POINT (77.206898 10.166663)	Node-42	N42
POINT (77.212879 10.167805)	Top divsn	43
POINT (77.201384 10.183309)	PR divsn	42
POINT (77.209429 10.155737)	Post-27	P27
POINT (77.209517 10.15651)	Chunduvarrai factory	40
POINT (77.215445 10.145544)	Post-29	P29
POINT (77.214081 10.147689)	Post-30	P30
POINT (77.215362 10.148894)	Kundalay club	44
POINT (77.222619 10.136658)	Node-44	N44
POINT (77.227946 10.126857)	Chittivurrai pump (MC divsn)	45
POINT (77.228537 10.139095)	Node-45	N45
POINT (77.228909 10.139087)	Chittivurrai factory	46
POINT (77.228427 10.141405)	Node-46	N46
POINT (77.230727 10.13955)	Chittivurrai factory divsn	47
POINT (77.231851 10.144598)	Node-47	N47
POINT (77.231796 10.144278)	Chittivurrai new division	48

POINT (77.236835 10.149711)	Node-48	N48
POINT (77.236859 10.149709)	Chittivurrai OC divsn	49
POINT (77.236857 10.149737)	Vattavada feedback	F5
POINT (77.155662 10.109943)	Node-30	N30
POINT (77.155205 10.108718)	Aruvikkad divsn	30
POINT (77.156546 10.109604)	Aruvikkad factory	31
POINT (77.07427 10.08068)	Microwave	2

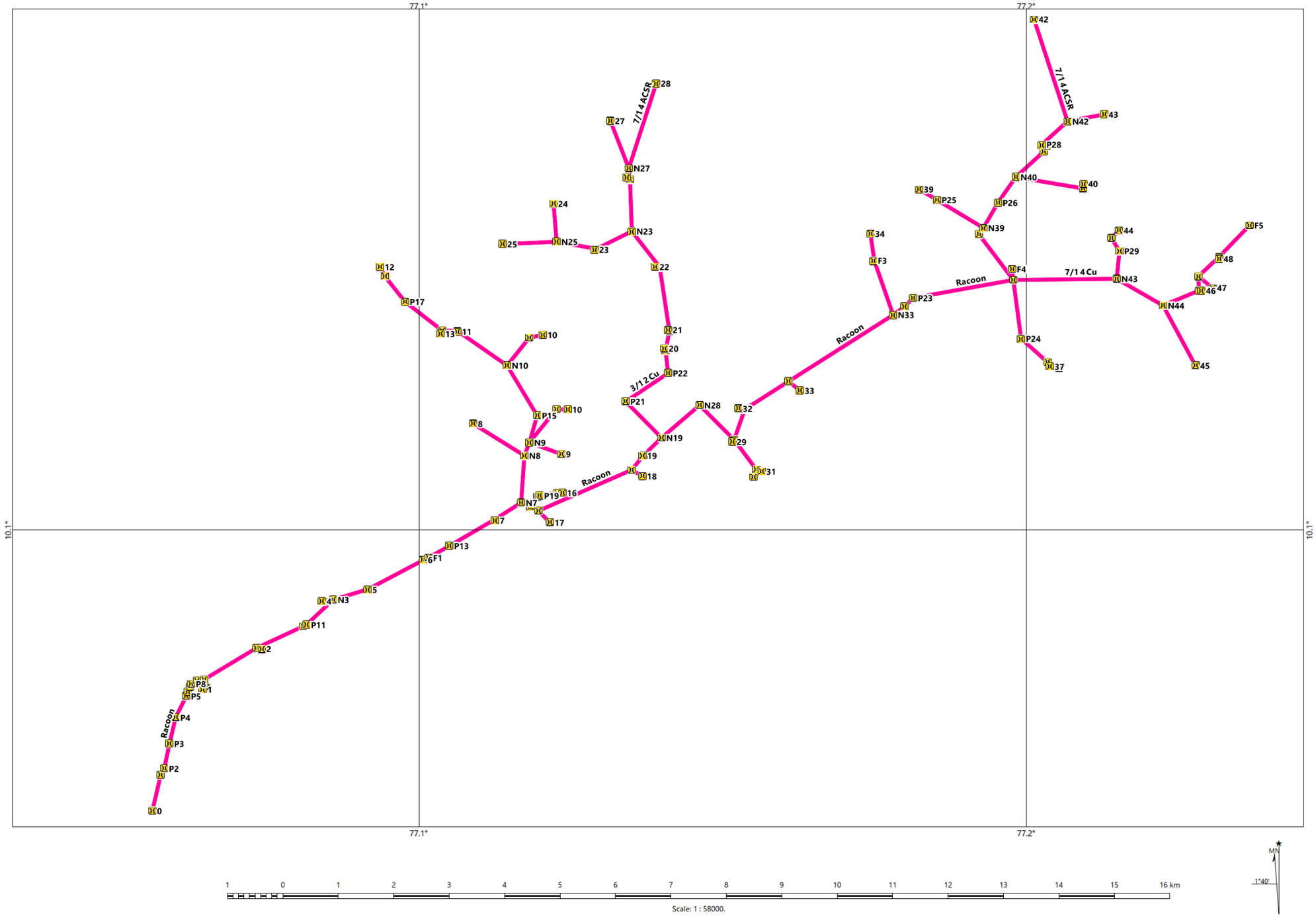


Figure 7: Madupatty feeder

5. ENERGY CONSERVATION MEASURES SUMMARY

LIST OF ENERGY CONSERVATION PROPOSED FOR FUTURE

The KDHP can consider several possible measures for energy conservation to reduce their distribution loss to their best value as summarised below.

- **Installation of energy efficient Transformer**

KDHP has initiated to install Energy efficient transformers from FY 2022-23 in different feeders which was mainly for the new consumers or divisions in the plant. The transformer details and locations are given in the table below:

TABLE 23: ENERGY EFFICIENT TRANSFORMER – INSTALLED IN LAST 3 YEARS

Location	KVA	Energy efficiency level
Grahamsland	63	02
ITD	100	02
Vagavurrai lakham	63	02
Casa mountana	163	02
Madupatty divsn	63	02

The further increase in the installation by purchasing new energy efficient ones, replacing the old ones (more than 40 years old, estimated 30 numbers) will reduce transformer loss along with the distribution loss.

- **Replacement of energy meters with prepaid meter**

KDHP has been following the conventional metering method during the period of FY 2022-23, however it changed to the instant billing method **– spot metering** - using the tablet and printing machine which interlinked with their TSoft – software for electricity department during March 2022.

During the conventional method, the overall time for completion of the bill cycle was high and reduces the billing efficiency. The present spot metering will also have implications on the collection efficiency while considering the monthly analysis.

The next stage that the KDHP can initiate is installing the prepaid meters, which will increase the customer satisfaction level, that will reduce the time for the whole billing process, and will also enable the consumer to monitor the consumption pattern & top-up the balance. The system once implemented would be unique in the industry and which will ultimately benefit the stakeholders.

➢ Reconductoring of HT overhead lines

KDHP conducted a detail reconductoring of main HT 11 kV line in 5 out of 7 feeders replacing Copper cables with Racoon or Mink in the year 2012-13. This has reduced the overall loss from the 21% to 12% range as per the records of KDHP. Furthermore, company installed either Racoon/mink for the HT lines in the later years.

Still 66% of the total HT overhead lines in KDHP are of either 7/14 ACSR or Copper which corresponds to 118.2 km out of the total HT line length of 180.23 km. This predominantly contributes to the HT overhead line losses. By replacing the same with DOG conductor throughout, the KDHP can have the following savings:

Particulars	Units	Values
Annual Energy savings	MU	0.734
Annual financial savings	Rs in lakhs	35.25
Estimated investment	Rs in lakhs	472.32
Simple payback period	Months	161

- ***Detailed analysis given in the Annexure-1***

➢ Reconductoring of LT overhead lines

Presently the whole LT overhead lines in KDHP are ACSR or Copper type conductors. total LT line length in the system is 193.8 km. The resistance per line length for these type conductors are comparatively high and hence the results in high LT overhead line losses. In KDHP, the LT overhead line losses share the major part of technical losses in almost all the feeders.

In order to reduce the LT overhead line losses, it is proposed to do reconductoring for the specified length of LT overhead lines with Rabbit conductor. The summary of the savings is given in the table below.

Particulars	Units	Values
Annual Energy savings	MU	1.28
Annual financial savings	Rs in lakhs	61.22
Estimated investment	Rs in lakhs	214.14
Simple payback period	Months	42

- ***Detailed analysis given in the Annexure-1***

➢ Summary of energy conservation measures

Table 24: Energy conservation measures - summary

ECM No	Energy Efficiency Measures	Annual Electricity Savings	Annual Financial Savings	Investment	Fixed interest rate	Cash inflow	Net present value	Internal rate of return
		MU	(Rs)	(Rs)	%	Years	Rs	%
1	Reconductoring of HT overhead lines	0.734	35,25,291	4,72,32,000	6	16	12,93,035	6.25%
2	Reconductoring of LT overhead lines	1.275	61,22,303	2,14,14,400	6	5	43,74,967	13.23%

➢ General observations and suggestions

Observation	Suggestions	Benefits
Some of the HT consumers are having metered at the secondary/LV side.	As per the CEA metering regulation, HT consumers shall meter at the HV side with CT/PT, 0.2s class TOD meter.	The actual transformer loss will get gauged in the bill which will reduce the KDHP overall T&D loss.
Estimated that Distribution transformers are more than 40 years old (Around 30 nos) and re-winded several times during its life time.	If any of failure of transformers in future, the no load loss of the same after rewinding is to be measured and ascertain the life cycle cost with new energy efficient transformers. No load loss of transformers after rewinding shall be logged and records shall be kept for future analysis.	By replacing the old re-winded transformers, with energy efficient ones, the overall T&D loss will reduce.
Registered maximum demand in past months was always above the contract demand (9 MVA) in KDHP. However, with the present 3nos of 11 kV feeders, 9 MVA is maximum allowed demand as per the regulations.	Increase the contract demand to 12 MVA by increasing the voltage level to 33 kV. For this, KDHP is in the process of installing 33 kV substation near to the town.	The HT line loss up to the town area will reduce (exactly 2.8 km) along with the reduction in the excess demand charges. This will also capable to cater the future consumer loads in the Munnar area.

LIST OF ENERGY CONSERVATION MEASURES ADOPTED/TAKEN

- **Power factor Improvement:** Power factor has been improved to 0.99 from 0.95 by improving the consumer side powerfactir. Also, an incentive of Rs 41.61 lakhs was received during the FY 2022-23 by maintaining a commendable power factor of 0.99, which significantly improved from the registered power factor of 0.95 in the preceding FY 2021-22.

ENERGY FLOW ANALYSIS

1. ENERGY FLOW

The basic energy flow in the DISCOM is given in the chart below.

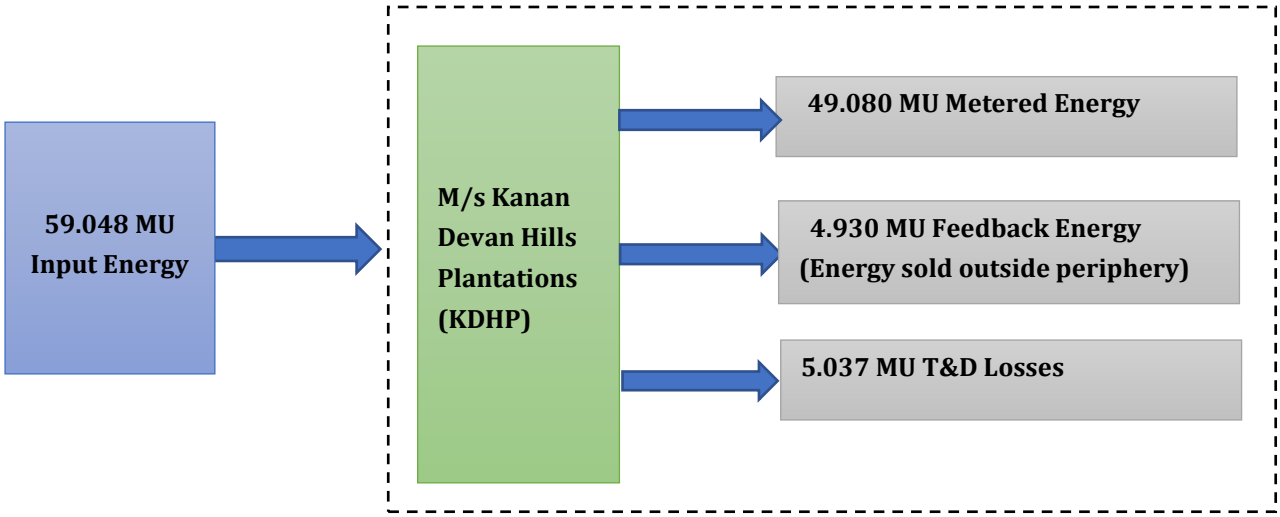


Figure 8: Energy flow diagram - KDHP

- *Input energy = the energy received at the KDHP for distribution including Feedback energy.*
- *Metered energy = energy metered at the consumer end*
- *Feedback energy = Energy sold outside the periphery*
- *T&D losses = Net losses*

2. VALIDATION OF METERED DATA

The validation of data includes the KSEB metering and feeder meters in the switching station of the KDHP. The following tables will provide the validation of the metering by comparing with the calibrated power analysers.

COMMERCIAL LOSSES

The estimated commercial losses/non-technical losses in the DISCOM during the FY 2022-23 was 2.98%. This can mainly attribute to the following things.

1. KDHP has been following the "spot metering" to raise bills on its electricity consumers and issue the same to them immediately thereof to the consumers at their doorsteps to facilitate timely receipt of bills by the consumers. The changes in the date of reading can result in the difference in the annual final reading of consumers.
2. Meter error is mainly accounting to the difference in the class of CT. All the consumer meters were 0.5s class however the incomer meters at the switching station and the Madupatty feeder was 0.2s class.
   Also, the meter damages in the consumers can lead to insufficient reading which leads to the unaccounted losses.
   Observed high consumption variation in the following consumers from the 2021-22 FY to 2022-23 FY in the ITD and Town feeder which could have led to the variation in the difference in sales and actual consumption.
   Will require detail measurement and verification for the following list of consumer meters to check for its functioning

Table 25: Consumption variation among the consumers

Consumer name	Type of consumer	FY 2022-23	FY 2021-22	Increase in consumption	
		kWh/annum	kWh/annum	Ratio	%
KTDC-KTDC HOTEL	HT	320088	229564	1.39	28.28
EEND-Eastend Hotel	HT	384330	146694	**2.62**	61.83
EVMH-EVM Hotels	HT	187758	99656	**1.88**	46.92
GRPL-Grand Plaza	HT	135543	86528	1.57	36.16
MSHT-MS HOTELS	HT	128862	45616	**2.82**	64.60
ECOL-ENGINEERING COLLEGE	HT	44634	36000	1.24	19.34
CASA-Casa Mountana Hotel	HT	51784	32490	1.59	37.26

3. Tree touching and its related interruption can lead to heavy current surge to the ground. This can be account as losses due to non-technical as it is unaccountable.

Metering deviation was done in sample basis in order to derive an energy balance between purchase and sale. The energy meters at incomer and few HT/LT consumer energy meters provided in the KDHP was cross checked using calibrated meters like Krykard ALM 35/ ALM 31.

DEVIATION OF METERING

- **Deviation of incomer meters**

The KSEBL incomer energy meters at the switching station were verified with the panel meters and the power quality analysers and given in the table below.

Table 26: KSEBL incomer meter – deviation with PQ analyser

Sl no	Meter	Hours of measurement	KSEBL meter	Panel reading	Power analyser reading	**KSEBL meter vs Power analyser**	**Panel meter vs Power analyser**
		Hours	kWh	kWh	kWh	**%**	**%**
1	Incomer-1 & 2	24	107370.0	110066.0	107150.1	**0.2**	**2.7**
2	Incomer-3	24	62320	64294.8	62545.7	**-0.4**	**2.8**

- **Deviation of feeder meters**

Table 27: Deviation of feeder meters

Sl no	Feeder name	Hours of measurement	Panel reading	Average PF	Power analyser reading	Difference in consumption	**% of error**
		Hours	kWh		kWh	kWh	
1	ITD	24	31062.0	0.98 lag	30701.5	360.512	1.2
2	Madupatty	24	15107.0	0.82 lead	14172.5	934.5	0.9
3	Nettigudi	24	36446.0	0.98 lag	35900.2	545.791	0.1
4	Neyamakad	24	57666.7	0.98 lead	57175.2	491.51	1.6
5	Pullivasal	24	15979.8	0.98 lag	16712.0	-732.16	-0.82
6	Town	24	25571	0.98 lag	25273.1	297.9	2.81

- *Error in the meters found in all the feeders except the Nettigudi.*
- *The commercial loss will reduce with the additions of this error to the input energy which is analysed in the following section.*

- **Commercial loss balance**

Here the reduction in commercial loss in each feeder considering the error in feeder input meter is analyzed and tabulated. The commercial loss reduced in the following listed feeders and total loss.

Table 28: Adjusted commercial loss

Feeder	% of error in Feeder input meter	Present commercial loss	Adjusted commercial loss	Present total loss	Corrected total loss
	%	%	%	%	%
ITD	1.17	-1.35	-2.52	5.03	7.55
Madupatty	0.9	7.38	6.48	13.9	7.42
Neymakad	1.57	5.95	4.38	10.17	5.79
Pullivasal	-0.82	0.2	1.02	5.17	4.15
Town	2.81	-3.6	-6.41	12.97	19.38

- ***Reduction in the commercial loss was from 2.984% to 0.59% with the error correction in the feeder input meters.***
- *The difference in the panel meter reading with the calibrated power analyser was mainly due to the difference in the CT class. Thus, the present meter can still continue to function, however, while calculating the T&D loss, the % of error in the above table shall include.*

3. VALIDATION OF ENERGY FLOW DATA

The section provides the details of energy purchased and sold in the DISCOM during the FY 2022-23.

INCOMER – AT SWITCHING STATION

KDHPCL procures electricity from KSEB Ltd for the supply to its consumers and for its own consumption. KDHP receives the power as 11 kV from the KSEBL (Kerala state electricity board limited) as **Part-C: BULK SUPPLY – EHT TARIFF APPLICABLE TO SMALL LICENSEES** category. The rates specified in this schedule (Part C) are exclusive of Electricity Duty and/or surcharge, other cess, taxes, minimum fees, duties and other impositions. Thus, only the demand and energy charges are applicable for the electricity cost.

- **BASELINE DATA**

The basic details of the bill and KDHP distribution are as follows:

Base Line Data – FY 2022-23		
1	Electricity provider	KSEBL
2	Supply Voltage	11 kV
3	Tariff	BULK SUPPLY – EHT TARIFF APPLICABLE TO SMALL LICENSEES
4	Consumer number	LCN 21/1014
5	Section office	Chithirapuram
6	Contract demand (kVA)	9000
7	Maximum demand registered (kVA)- (including feedback demand)	12,479
8	Billed demand - maximum (kVA)- (excluding feedback demand)	10644
9	Average monthly electricity consumption (MU) – KDHP	4.51
10	Annual unit consumption (MU) – KDHP	54.12
11	Average power factor	0.98
12	Tariff Rate of energy charges (Rs / kWh)	5.3
13	Demand charge (Rs / kVA)	380
14	Excess demand charge (Rs/kVA)	190
	Other details	
15	Number of incoming feeders – From KSEBL - 11 kV (Nos)	03 (Chithirapuram – 1no, Pullivasal-02 nos)
16	Number of KDHP Distribution Feeders – 11 kV (Nos)	07
17	Feedback points – To KSEBL (Nos)	15
18	Number of transformers under KDHP	133
19	Line length at 11 kV voltage level (km)	180.23
20	Line length at LT voltage level (km)	193.8
21	HT/LT ratio	1:1.075
22	Input energy source under KDHP distribution area – capacity – Type of station – Voltage level	Madupatty – 2 MW – Hydel – 11 kV
23	Number of consumers – March 2023	16583
24	Connected load (MW)	34.03
25	Number of HT consumers	36
26	Number of LT consumers	16547

➢ DEMAND ANALYSIS

DEMAND TARIFF STRUCTURE

As per the Kerala State Electricity regulatory comission (KSERC) tariff order dated 24/03/2022, Billing Demand (BD) shall be the Recorded Maximum Demand (RMD) for the month in kVA or 75% of Contract Demand (CD) whichever is higher in 30 minutes interval period. However the demand calculation for the KDHP is different due to the multiple feedback points (Selling outside the periphery) and one generating station. The demand calculation for the KDHP by the KSEBL is given below.

Recorded maximum demand (RMD)	•Pullivasal - at switching station (A) •Madupatty - Generating station (B)
HT feedback	•Vagavurrai HT feedback RMD (C) •Vagavurrai HT Feedback Energy (D)
LT feedback	•LT Feedback energy (E) •LT Feedback MD (F) = (C/D)*E
Net feedback RMD	•G = F + C
Billing demand - BD	•BD = A + B - G
Billing demand charge	•Demand charges = BD x 380 Rs/kVA

DEMAND REGISTERED - FY 2022-23

This section analyses the trend for the billing demand (BD), the Contract Demand (CD) & 75% of the contract demand over the FY 2022-23.

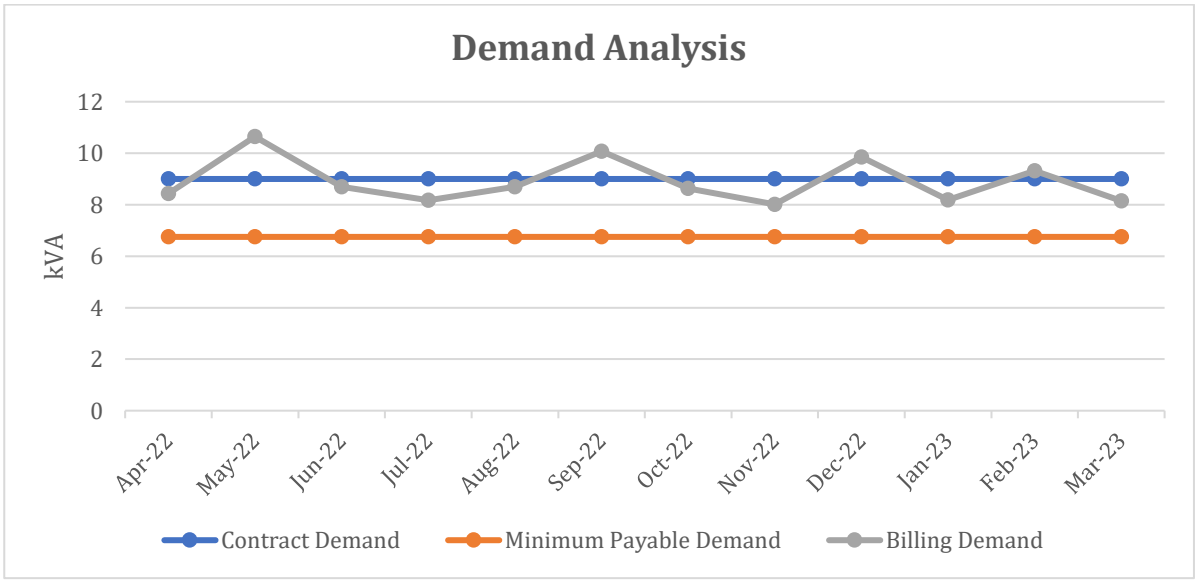


Figure 9: Demand variation – FY 2022-23

➢ ENERGY CONSUMPTION ANALYSIS

Energy Calculation Method

As per the Kerala State Electricity regulatory comission (KSERC) tariff order no: 0476/DD(T)/2020/KSERC dated 24/03/2022, TOD tariff is applicable to Bulk consumer - Small licensees. Though the KDHP has multiple feedback points (selling outside the periphery) and generating station in the distribution section, the calculation for billed energy is different.

The calculation method for the energy charges is mentioned below.

Energy consumption	•Pullivasal - at switching station (A) •Madupatty - Generating station (B)
HT feedback	•Vagavurrai HT Feedback Energy (C)
LT feedback	•LT Feedback energy (D)
Net feedback energy	•E = C + D
Net Feedback energy including Transmission loss	•F = E x 104% (4% transmission loss)
Chargeable energy	•G = A + B - F
Energy charges	•Energy charges = G x 5.3 Rs/kWh

Unit Consumed – Fy 2022-23

This section analyses the trend for the unit consumption by the KDHP and the feedback energy over the period FY 2022-23.

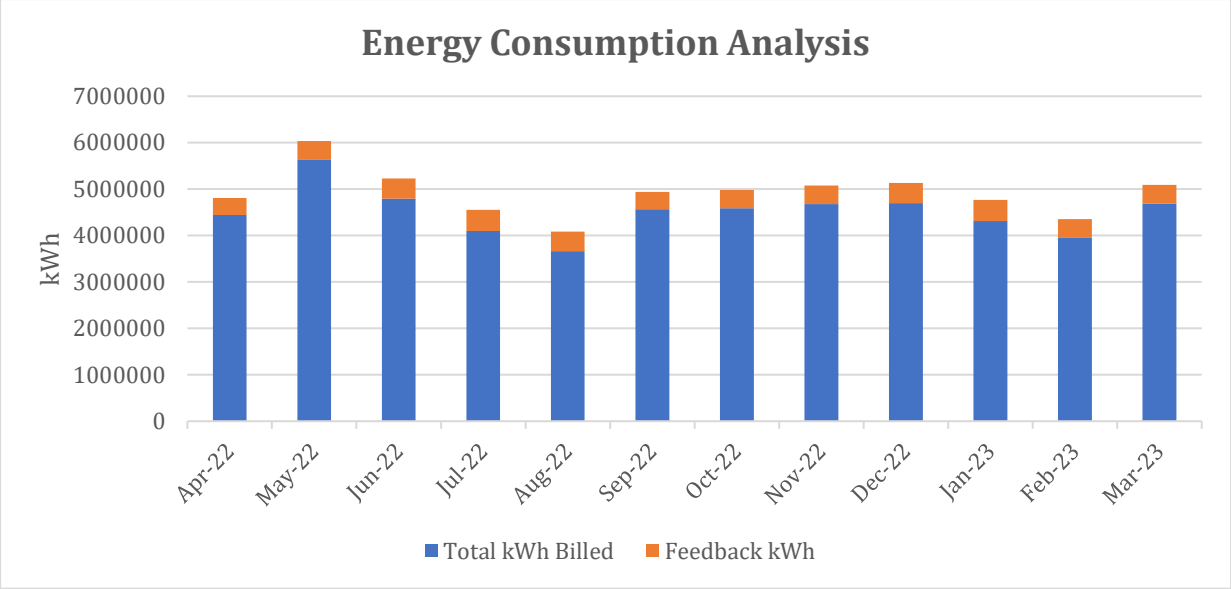


Figure 10: Energy consumption analysis

➢ POWER FACTOR ANALYSIS

Power factor calculation method

As per the Kerala State Electricity regulatory comission (KSERC) tariff order no: 0476/DD(T)/2020/KSERC dated 24/03/2022, power factor incentive/disincentives were applicable to Bulk consumer - Small licensees. The calculation method for the Power factor is mentioned below.

Active Energy consumption	•Denoted as (A)
Apparent Energy consumption	•Denoted as (B)
Power factor	•PF = A ÷ B
Power factor incentive	•For every increase of 0.01 from the 0.95 lagging, 0.5% of the energy charge will be provided as incentive.
PF disincentive	•For every decrease of 0.01 in the range of 0.95 to 0.90, 0.5% of the energy charge. •Less than 0.90 1% of energy charge.

Power factor registered in FY 2022-23

This section examines the Power factor trend and the corresponding power factor incentive acquired during the period FY 2022-23

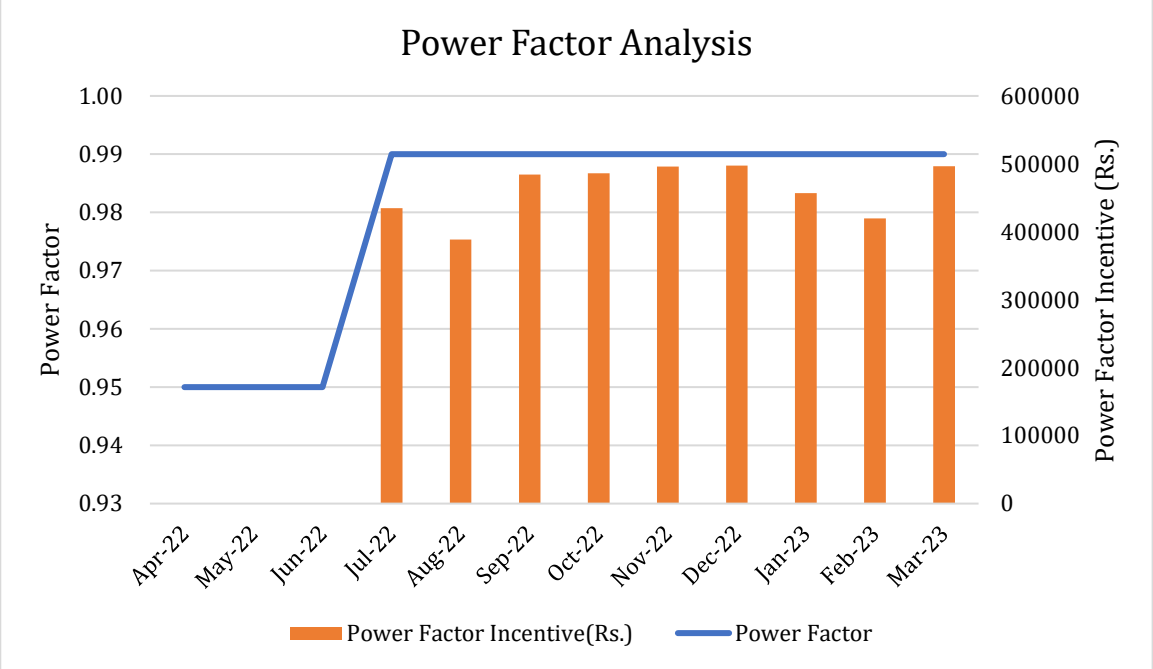


Figure 11: Power factor – FY 2022-23

➢ OBSERVATIONS AND RECOMMENDATION – ENERGY CONSUMPTION PROFILE

Table 29: Observations & Recommendation – Energy Consumption Profile

Observation	Recommendation	Benefit
Demand charges reduction by Power factor improvement		
Power factor was registered at 0.99 during the FY 2022-23. The PF was good considering the FY 2021-22 which was in the range of 0.95. An incentive of Rs 41.61 lakhs received in the FY 2022-23 for maintaining good PF in the DISCOM.	• Maintain the PF in this range for the incentive.	• Power factor incentive
Single metering system at the main incomer – at Pullivasal switching station		
The Pullivasal (at switching station) has two KSEBL incomers which has two independent TOD meters. Also, the Madupatty hydel input demand measures separately. The maximum demand is found by adding separately the registered value of demand in the independent TOD meters at the end of the month.	• 02 Pullivasal incoming energy meters and 01 Madupatty generating station energy meter is to be synchronised with respect to time. The net maximum demand in a month shall be the summation of three meters in 30 min time interval. • A continuous monitoring system shall provide for the measurement of demand in 30 min interval for the three meters.	• This will reduce the MD in the range of 500 to 1000 kVA per month, which will have an estimated annual savings of Rs 27.36 lakhs (Average 600 kVA/ month @ Rs 380/kVA)

ENERGY SOLD OUTSIDE THE PERIPHERY (FEEDBACK)

The table presented below outlines the energy distributed to locations outside the periphery. It also indicates the specific points at which this energy is fed back from each feeder.

Table 30: Energy sold outside the periphery

Feeder Name	ITD	Neymakad		Nettigudi				Town			Madupatty				
Name of Point	HARIGEN COLONY (LETCHMI)	VAGAVURRAI FEED BACK	Edamalakudy (Pettimudi)	RA HEAD WORKS	DEVIKULAM PUMP	DEVIKULAM TOWN	ALL INDIA RADIO (FM)	PHE COLONY	LT FEED BACK (QUARTERS)	HARIGEN COLONY (MUNNAR)	MADUPATTY DAM	KUNDALAY DAM	HARIGEN COLONY (KUNDALAY)	VATTAVADA	Kuttiyar Valley (Korandakad)
Unit	MU	MU	MU	MU	MU	MU	MU	MU	MU	MU	MU	MU	MU	MU	MU
Apr-22	0.05	0.01	0.002	0.012	0.01	0.06	0.00	0.01	0.00006	0.12	0.01	0.003	0.01	0.07	0.001
May-22	0.06	0.03	0.002		0.01	0.07	0.00	0.01	0.00008	0.13	0.01	0.003	0.01	0.08	0.001
Jun-22	0.05	0.08	0.002		0.01	0.06	0.00	0.01	0.00007	0.13	0.01	0.003	0.01	0.07	0.001
Jul-22	0.04	0.10	0.002	0.0003	0.01	0.07	0.00	0.01	0.00007	0.14	0.01	0.003	0.01	0.06	0.001
Aug-22	0.05	0.05	0.002		0.01	0.07	0.00	0.01	0.00007	0.13	0.01	0.003	0.01	0.07	0.001
Sep-22	0.05	0.02	0.002	0.0012	0.01	0.06	0.01	0.01	0.00006	0.13	0.01	0.003	0.01	0.07	0.004
Oct-22	0.05	0.005	0.002		0.01	0.07	0.01	0.01	0.00006	0.13	0.01	0.003	0.01	0.08	0.01
Nov-22	0.06	0.02	0.002		0.01	0.07	0.00	0.01	0.00007	0.13	0.01	0.002	0.01	0.08	0.01
Dec-22	0.06	0.01	0.002		0.01	0.08	0.00	0.01	0.00006	0.14	0.01	0.003	0.01	0.09	0.01
Jan-23	0.07	0.02	0.002		0.01	0.07	0.00	0.01	0.00006	0.14	0.01	0.003	0.01	0.09	0.01
Feb-23	0.06	0.02	0.002		0.01	0.06	0.00	0.01	0.00006	0.12	0.01	0.003	0.01	0.08	0.01
Mar-23	0.06	0.005	0.002		0.01	0.07	0.00	0.01	0.00006	0.14	0.01	0.003	0.01	0.08	0.01
Total	**0.66**	**0.37**	**0.02**	**0.01**	**0.14**	**0.81**	**0.05**	**0.07**	**0.0008**	**1.59**	**0.14**	**0.03**	**0.07**	**0.91**	**0.05**
Net Total	**4.930**														

FEEDER WISE SALES DATA

The following table presents the units sold by the DISCOM during the fiscal year 2022-23, depicting the energy consumption of consumers categorized by feeder.

Table 31: Feeder wise sales data FY 2022-23

Particulars	Unit	Pallivasal	ITD	Neymakad	Nettigudi	Madupatty	Town
Apr-22	kWh	2,96,860	8,46,714	8,36,450	7,05,441	8,96,165	5,27,162
May-22	kWh	3,70,221	8,04,388	11,35,966	9,20,955	11,86,051	5,92,221
Jun-22	kWh	2,95,091	8,30,836	7,74,574	7,99,417	10,61,621	6,13,966
Jul-22	kWh	2,56,331	7,29,732	7,02,758	7,56,239	8,31,338	5,77,338
Aug-22	kWh	1,84,669	6,70,252	5,83,504	6,22,778	6,73,374	5,54,477
Sep-22	kWh	2,70,930	7,63,851	7,95,548	7,56,511	10,99,039	5,14,532
Oct-22	kWh	2,51,880	7,31,760	7,32,235	7,20,051	10,90,792	5,99,865
Nov-22	kWh	2,14,702	8,41,970	8,04,201	7,89,953	9,83,689	6,22,618
Dec-22	kWh	2,43,313	7,28,034	7,32,334	7,39,765	10,77,828	6,21,688
Jan-23	kWh	2,43,788	5,89,166	7,65,714	6,01,821	9,94,766	6,68,135
Feb-23	kWh	1,98,791	5,35,787	8,32,497	6,73,170	8,39,236	6,40,481
Mar-23	kWh	2,17,230	7,49,356	9,03,636	7,42,231	9,60,488	5,59,733
Total	**kWh**	**30,43,806**	**88,21,846**	**95,99,417**	**88,28,332**	**1,16,94,387**	**70,92,216**
Net Total	**kWh**	**4,90,80,004**					

LOSS & SUBSIDY COMPUTATION

1. ENERGY ACCOUNTS ANALYSIS FOR PREVIOUS YEARS- FY 2021-22

The performance summary of KDHP as DISCOM as per the FY 2021-22 is given in the following table.

Table 32: Summary of DISCOM – FY 2021-22

Performance Summary of Electricity Distribution Companies			
1	Period of Information Year of (FY) information including Date and Month (Start & End)	1st Apr, 2021 - 31st March, 2022	
2	**Technical Details**		
(a)	**Energy Input Details**		
(i)	Input Energy Purchase (From Generation Source)	Million kWh	48.41
(ii)	Net input energy (at DISCOM Periphery including sale outside periphery)	Million kWh	53.07
(iii)	Total Energy billed (is the Net energy billed, adjusted for energy traded)	Million kWh	48.05
(b)	Transmission and Distribution (T&D) loss (Billing efficiency)	Million kWh	5.02
		%	9.45
	Collection Efficiency	%	97.62%
(c)	Aggregate Technical & Commercial Loss	%	11.61%

As the collection efficiency is 97.62% the AT&C loss of KDHP registered was 11.61% during the FY 2021-22.

Table 33: AT & C loss – FY 2021-22

S. No	**Name of circle**	**Period from April 2021 to March 2022**									
		Consumer profile	**Energy parameters**			**Losses**		**Commercial Parameter**			**AT & C loss (%)**
		Consumer category	**Input energy (MU)**	**Metered energy**	**% Of energy consumption**	**T&D loss (MU)**	**T&D loss (%)**	**Billed Amount in Rs. Crore**	**Collected Amount in Rs. Crore**	**Collection Efficiency**	
1	KDHP	Residential	53.07	7.70	16%	5.02	9.45%	3.60	3.51	97.50%	**11.61 %**
		Agricultural		0.013	0.03%			0.00	0.00	100%	
		Commercial/ Industrial-LT		2.60	5%			2.64	2.47	93.67%	
		Commercial/ Industrial-HT		30.48	63%			21.67	21.44	98.93%	
		Others		7.260	15%			2.07	1.84	89.12%	
Sub-total			**53.07**	**48.05**	**100%**	**5.02**	**9.45%**	**29.98**	**29.26**	**97.62%**	

2. ENERGY ACCOUNTS ANALYSIS FOR PRESENT YEAR- FY 2022-23

CATEGORY OF DIVISION WISE LOSSES – FY 2022-23

The consumer details, energy parameter and the overall circle wise T&D Losses are mentioned in the table below:

Table 34: Division wise losses

Division Wise Losses												
Name of circle	Period From 1st April 2022 to 31st March 2023											
	Consumer profile					Energy parameters					Losses	
	Consumer category	No of connection metered (Nos)	No of connection Un-metered (Nos)	Total Number of connections (Nos)	% of number of connections	Input energy (MU)	Billed energy (MU)			% of energy consumption	T&D loss (MU)	T&D loss (%)
							Metered energy	Unmetered/ assessment energy	Total energy			
KDHP	Residential	14010	0	14010	84.48%	59.048	7.80	0	7.80	14%	5.038	8.53%
	Agricultural	7	0	7	0.04%		0.016	0	0.016	0.03%		
	Commercial/ Industrial-LT	1317	0	1317	7.94%		3.99	0	3.99	7%		
	Commercial /Industrial-HT	31	0	31	0.19%		34.30	0	34.30	64%		
	Others + Feedback	1218	0	1218	7.34%		7.90	0	7.90	15%		
Sub-total		**16583**	**0**	**16583**	**100%**	**59.048**	**54.011**	**0.00**	**54.011**	**100%**	**5.038**	**8.53%**

Methodology for T&D loss computation:

- $T\&D\ Losses\ (MU) of\ a\ circle = Sum\ of\ Input\ Energy\ of\ the\ circle\ (MU) - Sum\ of\ Metered\ energy\ of\ all\ categories\ within\ the\ circle\ (MU) - Feedabck\ Energy\ (MU)$
- $T\&D\ Losses\ in\ \% = \frac{T\&D\ Losses\ (MU)}{Input\ Energy\ to\ the\ circle\ (MU)} * 100$
- $T\&D\ Losses\ (MU) of\ a\ DISCOM = \frac{Sum\ of\ circlewise\ T\&D\ Losses\ \ (MU)}{Cummulative\ Sum\ of\ \ Input\ Energy\ (MU)\ to\ all\ circle} * 100$

AGGREGATE TECHNICAL & COMMERCIAL (AT&C) LOSS:

Aggregate Technical & Commercial Loss (AT&C Loss) is defined as the summation of all technical as well as commercial power loss that occurs due to electrical power flow through sub-transmission and distribution network.

Technical Loss is defined as the summation of power loss through 33 kV, 11 kV line and LT line loss including transformer loss and others.

Commercial Loss is defined as the summation of power loss occurring due to theft/ pilferage, deficient meter, inefficiency in billing & unrealized revenue due to collection inefficiency.

Computation of AT& C Loss:

Aggregate Technical & Commercial Loss (AT&C) is computed from the actual meter readings of the meter installed at various locations in the system.

- **Overall Billing Efficiency (%)** = Total Sale in MU/ Total input in MU
- **Overall Collection Efficiency (%)** = Total Collection Received (Rs. in Crs.) / Total Billing to Consumers (Rs. in Crs.)

- **AT & C Loss (%)** = {(1- Collection Efficiency %)x T&D loss%)}

As the collection efficiency is 99.67% the AT&C loss of KDHP registered was 8.83% during the FY 2022-23.

Table 35: AT & C loss – FY 2022-23

S.No	Name of circle	Period From 1st April 2022 to 31st March 2023									
		Consumer profile	Energy parameters			Losses		Commercial Parameter			AT & C loss (%)
		Consumer category	Input energy (MU)	Metered energy	% Of energy consumption	T&D loss (MU)	T&D loss (%)	Billed Amount in Rs. Crore	Collected Amount in Rs. Crore	Collection Efficiency	
1	KDHP	Residential	59.048	7.80	14%	5.038	8.53%	3.7656	3.7841	100.49%	
		Agricultural		0.016	0.03%			0.0049	0.0049	100.00%	
		Commercial/ Industrial-LT		3.99	7%			3.9026	3.9073	100.12%	
		Commercial/ Industrial-HT		34.30	64%			25.3352	25.3174	99.93%	
		Others		7.90	15%			2.4389	2.3176	95.03%	
Sub-total			**59.048**	**54.011**	**100%**	**5.038**	**8.53%**	**35.45**	**35.33**	**99.67%**	**8.83 %**

3. TECHNICAL LOSSES

Technical losses are subdivided into three categories:

1. HT OH line & cable losses
2. Transformer loading & losses
3. LT OH line & cable losses

HT LINE LOSS CALCULATION

The HT overhead line length is measured with the help of GPS mapping. The details of mapping are given in the following section. The summarized HT OH line length in each feeder is given in the table below.

Table 36: HT OH line – feeder wise

Feeder Name	Type of overhead line									
	Dog	Raccoon	Mink	7/14 ACSR	7/12 ACSR	No:6 Cu	No:8 Cu	7/12 Cu	3/12 Cu	7/14 Cu
	Line Length in km									
Pullivasal				2.11						0.30
ITD		7.28	5.94	4.64			3.74	0.19	7.52	
Town		1.94		3.98	0.08		0.23	1.50	0.27	2.64
Nettigudi		10.23		2.87	0.94		1.15	0.36	12.55	4.39
Nyamakad	6.72	12.85		10.63		3.74	2.23		10.91	0.11
Madupatty		16.35	0.71	28.08	2.77		0.98	1.31	6.17	1.86
Total	**6.72**	**48.64**	**6.65**	**52.30**	**3.79**	**3.74**	**8.32**	**3.36**	**37.42**	**9.29**
% of total length	**3.7**	**27.0**	**3.7**	**29.0**	**2.1**	**2.1**	**4.6**	**1.9**	**20.8**	**5.2**
Total HT OH Line Length	**180.23**									

- **FEEDER WISE HT OH LINE LOSS**

Feeder wise HT OH Line loss calculation is given in the tables below. The calculations are based on month wise unit consumption and converted to yearly in the summary section.

3.1..1. Nyamakad Feeder

Table 37: HT OH line loss – Nyamakad feeder

Map no	Transformer/HT consumer name	Distance from switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh/Month		ohm	Amps	kWh	%
1	Srishti	6.017	5.124	11687.67	7/14 ACSR	0.5595	0.87	4.68	0.040
2	Nallathani factory	5.572	5.124	8464	DOG	0.2792	0.63	1.225	0.0145
			0.448	8464	Racoon	0.3712	0.63	0.142	0.0017
3	Tea museum	6.814	6.721	29871	DOG	0.2792	2.51	25.589	0.0857
			0.093	29871	3/12 Cu	5.41	2.51	6.861	0.0230
4	DYSP bunglow	7.682	6.721	141	DOG	0.2792	0.01	0.001	0.0004
			0.961	141	Racoon	0.3712	0.01	0.000	0.0001
5	Periyavurrai lower (Top)	9.378	6.721	13615	DOG	0.2792	1.15	5.316	0.0390
			1.666	13615	Racoon	0.3712	1.15	1.752	0.0129
			0.991	13615	7/14 ACSR	0.5595	1.15	1.571	0.0115
6	Sholamalai	9.975	6.721	8746	DOG	0.2792	0.74	2.194	0.0251
			2.053	8746	Racoon	0.3712	0.74	0.891	0.0102
			1.201	8746	7/14 ACSR	0.5595	0.74	0.785	0.0090
s	Periyavurrai factory (solamallai)	9.408	6.721	230863	DOG	0.2792	16.83	1148.1	0.4973
			2.554	230863	Racoon	0.3712	16.83	580.0	0.2512
			0.133	230863	3/12 Cu	5.41	16.83	440.2	0.1907
8	Anamudi	10.708	6.721	10671	DOG	0.2792	0.90	3.266	0.0306
			2.554	10671	Racoon	0.3712	0.90	1.650	0.0155

			0.119	10671	3/12 Cu	5.41	0.90	1.120	0.0105
Map no	Transformer/HT consumer name	Distance from switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh/Month		ohm	Amps	kWh	%
			1.3	10671	7/14 ACSR	0.5595	0.90	1.266	0.0119
9	Kanniar bunglow	10.253	6.721	651	DOG	0.2792	0.05	0.012	0.0019
			3.419	651	Racoon	0.3712	0.05	0.008	0.0013
			0.113	651	No.8 Cu	2.36	0.05	0.002	0.0003
10	Kannimalai top - KMFD	13.502	6.721	4226	DOG	0.2792	0.36	0.512	0.0121
			4.368	4226	Racoon	0.3712	0.36	0.443	0.0105
			2.413	4226	7/14 ACSR	0.5595	0.36	0.368	0.0087
11	Kannimalai lower	11.898	6.721	9654	DOG	0.2792	0.81	2.673	0.0277
			4.368	9654	Racoon	0.3712	0.81	2.309	0.0239
			0.809	9654	7/14 ACSR	0.5595	0.81	0.645	0.0067
12	Kannimalai factory (KMTD TOP)	11.261	6.721	188619	DOG	0.2792	13.75	766.4	0.4063
			4.435	188619	Racoon	0.3712	13.75	672.3	0.3564
			0.105	188619	7/14 Cu	8.79	13.75	376.9	0.1998
13	Nymakad bunglow	14.279	6.721	8195	DOG	0.2792	0.60	1.446	0.0177
			4.435	8195	Racoon	0.3712	0.60	1.269	0.0155
			1.739	8195	3/12 Cu	5.41	0.60	7.252	0.0885
			0.749	8195	Racoon	0.3712	0.60	0.214	0.0026
			0.635	8195	7/14 ACSR	0.5595	0.60	0.274	0.0033
14	Nymakad east (Office)	14.752	6.721	7664	DOG	0.2792	0.56	1.265	0.0165
			4.435	7664	Racoon	0.3712	0.56	1.110	0.0145
			1.739	7664	3/12 Cu	5.41	0.56	6.343	0.0828
			0.749	7664	Racoon	0.3712	0.56	0.187	0.0024
			1.108	7664	7/14 ACSR	0.5595	0.56	0.418	0.0055
15	Vagavurrai top	17.214	6.721	2246	DOG	0.2792	0.19	0.145	0.0064
			4.435	2246	Racoon	0.3712	0.19	0.127	0.0057

			1.739	2246	3/12 Cu	5.41	0.19	0.726	0.0323
Map no	Transformer/HT consumer name	Distance from switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh/Month		ohm	Amps	kWh	%
			4.215	2246	Racoon	0.3712	0.19	0.121	0.0054
			0.104	2246	7/14 ACSR	0.5595	0.19	0.004	0.0002
16	Vagavurrai lower	18.649	6.721	3234	DOG	0.2792	0.27	0.300	0.0093
			4.435	3234	Racoon	0.3712	0.27	0.263	0.0081
			1.739	3234	3/12 Cu	5.41	0.27	1.504	0.0465
			5.724	3234	Racoon	0.3712	0.27	0.340	0.0105
			0.03	3234	7/14 ACSR	0.5595	0.27	0.003	0.0001
17	Vagavurrai bazar	19.712	6.721	473	DOG	0.2792	0.04	0.006	0.0014
			4.435	449	Racoon	0.3712	0.04	0.005	0.0011
			1.739	449	3/12 Cu	5.41	0.04	0.029	0.0065
			6.567	449	Racoon	0.3712	0.04	0.007	0.0017
			0.132	449	3/12 Cu	5.41	0.04	0.002	0.0005
			0.118	449	Racoon	0.3712	0.04	0.000	0.0000
18	Thaliar bunglow	20.175	6.721	4008	DOG	0.2792	0.34	0.461	0.0115
			4.435	4008	Racoon	0.3712	0.34	0.404	0.0101
			1.739	4008	3/12 Cu	5.41	0.34	2.309	0.0576
			6.567	4008	Racoon	0.3712	0.34	0.598	0.0149
			0.713	4008	3/12 Cu	5.41	0.34	0.947	0.0236
19	Thaliar factory	21.055	6.721	85072	DOG	0.2792	7.16	207.6	0.2440
			4.435	85072	Racoon	0.3712	7.16	182.1	0.2140
			1.739	85072	3/12 Cu	5.41	7.16	1040.6	1.2232
			6.567	85072	Racoon	0.3712	7.16	269.6	0.3169
			1.593	85072	3/12 Cu	5.41	7.16	953.2	1.1205
20	Thaliar division	20.581	6.721	6731	DOG	0.2792	0.57	1.299	0.0193
			4.435	6731	Racoon	0.3712	0.57	1.140	0.0169
			1.739	6731	3/12 Cu	5.41	0.57	6.515	0.0968

			6.567	6731	Racoon	0.3712	0.57	1.688	0.0251
Map no	Transformer/HT consumer name	Distance from switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh/Month		ohm	Amps	kWh	%
			1.068	6731	3/12 Cu	5.41	0.57	4.001	0.0594
			0.051	6731	7/14 ACSR	0.5595	0.57	0.020	0.0003
21	Manager bunglow - vagavurrai	20.529	6.721	527	DOG	0.2792	0.04	0.154	0.0293
			4.435	527	Racoon	0.3712	0.04	0.007	0.0013
			1.739	527	3/12 Cu	5.41	0.04	0.002	0.0004
			7.578	527	Racoon	0.3712	0.04	0.012	0.0023
			0.056	527	3/12 Cu	5.41	0.04	0.001	0.0002
22	Vagavurrai factory	20.842	6.721	93755	DOG	0.2792	7.89	252.08	0.2689
			4.435	93755	Racoon	0.3712	7.89	221.15	0.2359
			1.739	93755	3/12 Cu	5.41	7.89	1263.82	1.3480
			7.845	93755	Racoon	0.3712	7.89	391.19	0.4173
			0.102	93755	7/14 ACSR	0.5595	7.89	7.666	0.0082
23	Vagavurrai factory division	21.061	6.721	20310	DOG	0.2792	1.71	11.83	0.0582
			4.435	20310	Racoon	0.3712	1.71	10.38	0.0511
			1.739	20310	3/12 Cu	5.41	1.71	59.31	0.2920
			7.845	20310	Racoon	0.3712	1.71	18.36	0.0904
			0.321	20310	7/14 ACSR	0.5595	1.71	1.132	0.0056
24	Vagavurrai naval	22.558	6.721	2736	DOG	0.2792	0.23	0.215	0.0078
			4.435	2736	Racoon	0.3712	0.23	0.188	0.0069
			1.739	2736	3/12 Cu	5.41	0.23	1.076	0.0393
			7.845	2736	Racoon	0.3712	0.23	0.333	0.0122
			1.818	2736	7/14 ACSR	0.5595	0.23	0.116	0.0043
25	Vagavurrai+ luckam - naval division new	23.291	6.721	4947	DOG	0.2792	0.42	0.702	0.0142
			4.435	4947	Racoon	0.3712	0.42	0.616	0.0124
			1.739	4947	3/12 Cu	5.41	0.42	3.519	0.0711

			7.845	4947	Racoon	0.3712	0.42	1.089	0.0220
Map no	Transformer/HT consumer name	Distance from switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh/Month		ohm	Amps	kWh	%
			2.449	4947	7/14 ACSR	0.5595	0.42	0.512	0.0104
26	Rajamalai west BSNL	12.4588	6.721	1274	DOG	0.2792	0.11	0.047	0.0037
			4.435	1274	Racoon	0.3712	0.11	0.041	0.0032
			1.239	1274	3/12 Cu	5.41	0.11	0.166	0.0131
			0.0638	1274	7/14 ACSR	0.5595	0.11	0.001	0.0001
27	Forest (NYFT)	13.589	6.721	1134	DOG	0.2792	0.10	0.037	0.0033
			4.435	1134	Racoon	0.3712	0.10	0.032	0.0029
			2.198	1134	3/12 Cu	5.41	0.10	0.234	0.0206
			0.235	1134	7/14 ACSR	0.5595	0.10	0.003	0.0002
28	Kadalaar bunglow (east)	14.604	6.721	3584	DOG	0.2792	0.30	0.368	0.0103
			4.435	3584	Racoon	0.3712	0.30	0.323	0.0090
			3.283	3584	3/12 Cu	5.41	0.30	3.486	0.0973
			0.165	3584	7/14 ACSR	0.5595	0.30	0.018	0.0005
29	Kadalaar hospital	16.576	6.721	979	DOG	0.2792	0.08	0.027	0.0028
			4.435	979	Racoon	0.3712	0.08	0.024	0.0025
			4.985	979	3/12 Cu	5.41	0.08	0.395	0.0403
			0.435	979	No-8 Cu	2.36	0.08	0.015	0.0015
30	Kadalaar factory division	17.914	6.721	5856	DOG	0.2792	0.49	0.984	0.0168
			4.435	5856	Racoon	0.3712	0.49	0.863	0.0147
			4.985	5856	3/12 Cu	5.41	0.49	14.136	0.2414
			0.435	5856	No-8 Cu	2.36	0.49	0.538	0.0092
			1.338	5856	3/12 Cu	5.41	0.49	3.794	0.0648
31	Kadalaar factory	17.942	6.721	31533	DOG	0.2792	2.76	30.843	0.0978
			4.435	31533	Racoon	0.3712	2.76	27.059	0.0858
			4.985	31533	3/12 Cu	5.41	2.76	443.27	1.4057
			0.435	31533	No-8 Cu	2.36	2.76	16.87	0.0535

			1.366	31533	3/12 Cu	5.41	2.76	121.47	0.3852
Map no	Transformer/HT consumer name	Distance from switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh/Month		ohm	Amps	kWh	%
32	Rajamalai park - NVPT	14.366	6.721	1167	DOG	0.2792	0.10	0.039	0.0033
			4.435	1167	Racoon	0.3712	0.10	0.034	0.0029
			3.21	1167	3/12 Cu	5.41	0.10	0.361	0.0310
33	REP (wireless) stn (Sanghumallai)	15.348	6.721	625	DOG	0.2792	0.05	0.011	0.0018
			4.435	625	Racoon	0.3712	0.05	0.010	0.0016
			4.192	625	3/12 Cu	5.41	0.05	0.135	0.0217
34	Rajamalai division	17.033	6.721	6298	DOG	0.2792	0.53	1.138	0.0181
			5.177	6298	Racoon	0.3712	0.53	1.165	0.0185
			11.156	6298	3/12 Cu	5.41	0.53	36.59	0.5809
			1.685	6298	No-8 Cu	2.36	0.53	2.411	0.0383
35	Pettimudi division	18.037	6.721	5366	DOG	0.2792	0.45	0.826	0.0154
			4.435	5366	Racoon	0.3712	0.45	0.725	0.0135
			4.192	5366	3/12 Cu	5.41	0.45	9.981	0.1860
			1.685	5366	No-8 Cu	2.36	0.45	1.750	0.0326
			1.004	5366	3/12 Cu	5.41	0.45	2.391	0.0445

3.1..2. Nettigudi feeder

Table 38: HT OH Line loss – Nettigudi feeder

Map no	Transformer/consumer name	Distance From Switching Station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh		ohm	A	kWh	%
1	Chokanad factory	2.694	2.651	254678	Racoon	0.3712	35.552	1791.04	0.7033
			0.043	254678	7/12 Cu	5.41	35.552	423.40	0.1663
2	Chokanad south (fac div)	3.07	2.994	20826	Racoon	0.3712	1.822	7.97	0.0383
			0.076	20826	7/12 Cu	5.41	1.822	2.95	0.0142
3	Chokanad east	5.14	4.095	5145	Racoon	0.3712	0.433	0.61	0.0120
			1.045	5145	No.8 Cu	2.36	0.433	1.00	0.0194
4	Chokanad north	5.202	4.095	8021	Racoon	0.3712	0.675	1.49	0.0186
			1.107	8021	7/14 ACSR	0.5595	0.675	0.61	0.0076
5	Chokanad K Kai	4.692	4.333	4167	Racoon	0.3712	0.304	0.32	0.0077
			0.359	4167	7/14 ACSR	0.5595	0.304	0.04	0.0010
6	Alisa craig	5.409	4.693	2503	Racoon	0.3712	0.211	0.17	0.0067
			0.716	2503	7/14 ACSR	0.5595	0.211	0.04	0.0015
7	Ladbrock	4.828	4.795	1857	Racoon	0.3712	0.135	0.07	0.0038
			0.033	1857	7/14 ACSR	0.5595	0.135	0.00	0.0000
8	Earlston	5.8	5.574	1579	Racoon	0.3712	0.115	0.06	0.0037
			0.226	1579	7/12 Cu	5.41	0.115	0.03	0.0022
9	Forest	5.703	5.574	981	Racoon	0.3712	0.072	0.02	0.0023
			0.129	981	3/12 Cu	5.41	0.072	0.01	0.0008
11	Lockhart colony	8.885	5.574	16823	Racoon	0.3712	1.226	6.72	0.0400
			2.554	16823	3/12 Cu	5.41	1.226	44.89	0.2668
			0.757	16823	7/12 ACSR	0.5595	1.226	1.38	0.0082
12	Lockhart factory	8.229	5.574	72932	Racoon	0.3712	7.975	284.25	0.3897
			2.554	72932	3/12 Cu	5.41	7.975	1898.21	2.6027
			0.101	72932	No.8 Cu	2.36	7.975	32.75	0.0449

Map no	Transformer/consumer name	Distance From Switching Station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh		ohm	A	kWh	%
13	Gunderle manager bunglow	13.228	8.87	669	Racoon	0.3712	0.049	0.02	0.0025
			4.358	669	3/12 Cu	5.41	0.049	0.12	0.0181
14	Gunderle factory divn	14.392	8.87	10683	Racoon	0.3712	0.779	4.31	0.0404
			5.514	10683	3/12 Cu	5.41	0.779	39.08	0.3658
			0.008	10683	7/14 ACSR	0.5595	0.779	0.01	0.0001
15	Gunderle factory	14.767	8.87	174808	Racoon	0.3712	20.335	1960.64	1.1216
			5.897	174808	3/12 Cu	5.41	20.335	18997.44	10.868
16	BSNL (silent valley)	16.135	8.87	1469	Racoon	0.3712	0.107	0.08	0.0056
			7.127	1469	3/12 Cu	5.41	0.107	0.95	0.0650
			0.138	1469	7/14 ACSR	0.5595	0.107	0.00	0.0001
17	Silent valley divn (North)	16.637	8.87	14295	Racoon	0.3712	1.042	7.72	0.0540
			7.528	14295	3/12 Cu	5.41	1.042	95.54	0.6683
			0.239	14295	7/14 ACSR	0.5595	1.042	0.31	0.0022
18	Silent valley office (South)	17.495	8.87	4557	Racoon	0.3712	0.332	0.78	0.0172
			8.625	4557	3/12 Cu	5.41	0.332	11.12	0.2441
19	Gunderle lower (Nettigudi)	9.059	8.993	4599	Racoon	0.3712	0.335	0.81	0.0176
			0.066	4599	7/14 ACSR	0.5595	0.335	0.01	0.0002
20	Gunderle center (middle)	9.571	9.512	6459	Racoon	0.3712	0.471	1.69	0.0262
			0.059	6459	7/14 ACSR	0.5595	0.471	0.02	0.0002
21	Gunderle top	10.364	10.222	5001	Racoon	0.3712	0.365	1.09	0.0218
			0.142	5001	7/14 Cu	8.79	0.365	0.36	0.0072
22	Devikulam middle	12.161	10.222	2931	Racoon	0.3712	0.214	0.37	0.0128
			1.087	2931	7/14 Cu	8.79	0.214	0.94	0.0322
			0.799	2931	3/12 Cu	5.41	0.214	0.43	0.0145
			0.053	2931	7/12 Cu	5.41	0.214	0.03	0.0010
23	Devikulam factory divsn	13.156	10.222	10058	Racoon	0.3712	0.733	4.41	0.0438
			1.087	10058	7/14 Cu	8.79	0.733	11.10	0.1103

Map no	Transformer/consumer name	Distance From Switching Station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			km	kWh		ohm	A	kWh	%
			1.788	10058	3/12 Cu	5.41	0.733	11.23	0.1117
			0.059	10058	7/14 ACSR	0.5595	0.733	0.04	0.0004
24	Devikulam factory	13.132	10.222	29249	Racoon	0.3712	3.198	83.84	0.2866
			1.087	29249	7/14 Cu	8.79	3.198	211.12	0.7218
			1.823	29249	3/12 Cu	5.41	3.198	217.91	0.7450
25	Devikulam ODK	13.27	10.222	3336	Racoon	0.3712	0.243	0.48	0.0145
			2.958	3336	7/14 Cu	8.79	0.243	3.32	0.0996
			0.09	3336	7/14 ACSR	0.5595	0.243	0.01	0.0002
26	Periyakanal PH divsn	15.1	10.222	3964	Racoon	0.3712	0.289	0.68	0.0173
			2.958	3964	7/14 Cu	8.79	0.289	4.69	0.1183
			1.92	3964	3/12 Cu	5.41	0.289	1.87	0.0473
27	Ayur county	15.911	10.222	23151	Racoon	0.3712	2.025	33.62	0.1452
			2.958	23151	7/14 Cu	8.79	2.025	230.35	0.9950
			2.548	23151	3/12 Cu	5.41	2.025	122.12	0.5275
			0.183	23151	7/12 ACSR	0.5595	2.025	0.91	0.0039
28	Periyakanal factory divsn	16.996	10.222	22180	Racoon	0.3712	1.940	30.86	0.1391
			2.958	22180	7/14 Cu	8.79	1.940	211.44	0.9533
			2.548	22180	3/12 Cu	5.41	1.940	112.10	0.5054
			1.191	22180	7/14 Cu	8.79	1.940	85.14	0.3838
			0.077	22180	3/12 Cu	5.41	1.940	3.39	0.0153
29	Periyakanal factory	17.014	10.222	50636	Racoon	0.3712	11.074	670.06	1.3233
			2.958	50636	7/14 Cu	8.79	11.074	4591.53	9.0678
			2.548	50636	3/12 Cu	5.41	11.074	2434.26	4.8074
			1.286	50636	7/14 Cu	8.79	11.074	1996.18	3.9423

3.1..3. Madupatty feeder

Table 39: HT OH Line loss – Madupatty feeder

Map no	Transformer/HT consumer name	Distance From switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
		km	km	kWh/Month		ohm	Amps	kWh/ month	%
1	Westwood	2.885	2.885	2722.40	Racoon	0.3712	0.229	0.12	0.0045
2	Microwave	3.855	3.855	2950.58	Racoon	0.3712	0.248	0.19	0.0065
3	Grahamsland office	4.6828		12057.13	Racoon	0.3712	1.014	3.86	0.0320
4	Grahamsland bazaar	5.612		209.56	Racoon	0.3712	0.018	0.001	0.0007
5	Grahamsland bunglows (Velmudi)	6.093		4667.44	7/12 ACSR	0.5595	0.393	0.75	0.0162
6	KKD church - korandikad	7.206		24077.97	7/14 ACSR	0.5595	2.025	23.71	0.0985
7	HR school	8.696		16107.32	7/14 ACSR	0.5595	1.355	0.04	0.0003
8	Madupatty top divsn	11.178		5553.55	7/14 ACSR	0.5595	0.467	0.29	0.0053
9	R&D complex	12.043		4190.49	7/14 ACSR	0.5595	0.367	0.33	0.0078
10	R&D lab	13.014	9.24	6965	Racoon	0.3712	0.609	2.38	0.0342
			2.192	6965	3/12 Cu	5.41	0.609	8.24	0.1183
			1.582	6965	7/14 ACSR	0.5595	0.609	0.62	0.0088
10	Thenmalay Asst manager bunglow (Hospital dn)	13.879		6417.64	7/14 ACSR	0.5595	0.540	0.320	0.0050
11	Tenmalay factory divsb	14.095		9974.88	7/14 ACSR	0.5595	0.839	0.018	0.0002
12	Tenmalay new divsn	15.977		2555.93	7/14 ACSR	0.5595	0.215	0.10	0.0040
13	Tenmalay factory	14.426	9.24	73398.42	Racoon	0.3712	6.486	270.09	0.3680
			2.192	73398.42	3/12 Cu	5.41	6.486	933.82	1.2723
			2.927	73398.42	No-6 Cu	1.44	6.486	331.90	0.4522
			0.067	73398.42	7/14 ACSR	0.5595	6.486	2.95	0.0040
14	Madupatty factory	9.472	9.24	296224.17	Racoon	0.3712	26.993	4678.44	1.5794
			0.232	296224.17	7/14 ACSR	0.5595	26.993	177.06	0.0598

Map no	Transformer/HT consumer name	Distance From switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
		km	km	kWh/Month		ohm	Amps	kWh/ month	%
15	Madupatty divsn	9.661		14500.63	7/14 ACSR	0.5595	1.257	3.62	0.0250
17	Nettimadu divsn	9.878		8749.17	7/14 ACSR	0.5595	0.736	3.75	0.0429
18	High tech KLD board - 2	11.645	9.24	4963.83	Racoon	0.3712	0.418	1.12	0.0226
			0.341	4963.8333	Racoon	0.3712	0.418	0.04	0.0008
			2.064	4963.8333	7/14 ACSR	0.5595	0.418	0.38	0.0076
19	Indo swiss project	11.781	11.781	23190.67	Racoon	0.3712	1.951	35.94	0.1550
20	Gundumalay factory	14.51	12.211	120579.17	Racoon	0.3712	11.103	1046.11	0.8676
			2.299	120579.17	3/12 Cu	5.41	11.103	2870.49	2.3806
21	Gundumalay factory divsn	14.87		5502.33	**7/14 ACSR**	**0.5595**	0.463	16.81	0.3055
22	Gundumalay benmore	16.093		3043.18	**7/14 ACSR**	**0.5595**	0.256	23.24	0.7636
23	Gundumalay south para (Top div)	17.572		4988.32	**7/12 ACSR**	**0.5595**	0.420	9.17	0.1838
24	Gundumalay BSNL	18.95		1041.58	7/14 ACSR	0.5595	0.088	0.41	0.0396
25	Gundumalay new divsn	19.235		2067.64	7/14 ACSR	0.5595	0.174	1.64	0.0791
26	Gundumalay upper	17.919		3896.57	7/14 ACSR	0.5595	0.328	5.64	0.1447
27	Gundumalay lower	18.963		2845.24	**3/12 Cu**	**5.41**	0.239	3.63	0.1275
28	Gundumalay kadugu	19.654		1142.32	7/14 ACSR	0.5595	0.096	0.44	0.0387
29	New pump indo swiss (irrigation)	14.048	14.048	3497.36	Racoon	0.3712	0.306	1.09	0.0311
30	Aruvikkad divsn	14.806		13000.96	7/12 ACSR	0.5595	1.094	15.02	0.1155
31	Aruvikkad factory	14.764	13.996	43770.75	Racoon	0.3712	3.989	154.72	0.3535
			0.768	43770.75	7/12 ACSR	0.5595	3.989	12.80	0.0292
32	Ecopoint	14.699		311.58	7/14 ACSR	0.5595	0.026	0.01	0.0023
33	East divsn pachakkad	15.78		3388.05	7/14 ACSR	0.5595	0.285	1.04	0.0306
34	Kundalay naturals (medicinal plant)	19.276		3005.47	7/14 ACSR	0.5595	0.263	6.72	0.2235
35	Pudukkadi	18.008		3419.51	7/14 ACSR	0.5595	0.288	6.68	0.1954

Map no	Transformer/HT consumer name	Distance From switching station	Adjusted distance as per cable type for HT consumers	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
		km	km	kWh/Month		ohm	Amps	kWh/ month	%
36	Yelapatty divsn	21.996		34582.02	7/12 ACSR	0.5595	2.909	155.90	0.4508
37	Yelapatty factory	21.854	20.059	34205.67	Racoon	0.3712	3.435	164.44	0.4807
			1.795	34205.67	7/14 ACSR	0.5595	3.435	22.18	0.0648
38	Kundalay office	21.094		6004.38	7/14 ACSR	0.5595	0.505	4.42	0.0736
39	Theerthamalay	22.579		2410.84	7/14 ACSR	0.5595	0.203	0.8	0.0326
40	Chunduvarrai factory	23.628	20.059	173786.67	Racoon	0.3712	15.356	3287.02	1.8914
			2.255	173786.67	7/14 ACSR	0.5595	15.356	556.97	0.3205
			1.314	173786.67	7/14 Cu	8.3	15.356	4814.58	2.7704
41	Old factory	23.119		9453.95	7/14 ACSR	0.5595	0.827	9.98	0.1055
42	PR divsn	25.694		2411.66	7/14 ACSR	0.5595	0.203	0.94	0.0391
43	Top divsn	24.423		4599.84	7/14 ACSR	0.5595	0.387	3.20	0.0695
44	Kundalay club	22.9		81.75	No 8 CU	2.36	0.007	0.003	0.0032
45	Chittivurrai pump (MC divsn)	24.119		2608.53	7/12 ACSR	0.5595	0.219	3.00	0.1149
46	Chittivurrai factory	23.631	20.059	9663.75	Racoon	0.3712	1.293	26.91	0.2784
47	Chittivurrai factory divsn	24.17		13677.49	7/12 ACSR	0.5595	1.150	84.26	0.6160
48	New Pump (Chittivurrai new div)	24.396		1406.81	7/14 ACSR	0.5595	0.118	0.90	0.0636
49	Chittivurrai OC divsn	25.148		5537.11	7/14 ACSR	0.5595	0.466	14.07	0.2540

3.1..4. ITD feeder

Table 40: HT OH line loss – ITD feeder

Map no	Transformer/HT consumer name	Distance from switching station	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
			kWh/Month		ohm	Amps	kWh/month	%
1	Tata BSS	5.767	6560.00	Racoon	0.3712	0.574	1.55	0.02
2	Nullathanni West Division	5.828	9191.02	Racoon	0.3712	0.804	3.05	0.03
3	ITD factory	5.777	387013.47	Mink 6 + 1/3.66 ACSR	0.4545	28.213	3912.44	1.01
4	Vermi compost	6.812	390.75	3/12 Cu	5.41	0.028	0.01	0.004
5	Kallar factory divsn	8.221	16306.20	No.8	2.36	1.189	41.92	0.26
6	JE Divsn (Null kallu pathu new)	11.491	1171.01	No.8	2.36	0.085	0.36	0.03
7	Hospital bunglow (Kallar West)	10.205	9329.36	No.8	2.36	0.680	19.99	0.21
8	Kallar factory	8.114	129917.00	3/12 Cu	5.41	9.471	2563.88	1.97
9	Seven mally godown (Nagermudi)	3.704	11675.18	3/12 Cu	5.41	0.851	7.17	0.06
10	Parvathi	4.615	5964.93	3/12 Cu	5.41	0.435	3.88	0.07
11	Nadiar	5.614	21234.96	3/12 Cu	5.41	1.548	77.88	0.37
12	Kurumalai	6.385	6410.00	3/12 Cu	5.41	0.467	9.00	0.14
13	ITD pump	7.105	8818.33	3/12 Cu	5.41	0.643	34.31	0.4
15	Upper seven malai	4.386	12213.68	7/14 ACSR	0.5595	0.890	2.84	0.02
16	Ottupara	5.483	11421.21	3/12 Cu	5.41	0.833	8.85	0.08
17	Letchmi east	6.485	4802.31	7/14 ACSR	0.5595	0.350	0.96	0.02
18	Letchmi factory	7.027	101860.75	7/14 ACSR	0.5595	7.501	265.39	0.26
19	Letchmi factory divs	7.187	27964.24	Mink	0.4545	2.039	24.12	0.09
20	Letchmi viriparrai	12.111	6466.08	7/14 ACSR	0.5595	0.471	2.62	0.04

3.1..5. Town feeder

Table 41: HT OH Line loss – Town feeder

Map no	Transformer/HT consumer name	Distance From switching station	Adjusted distance as per cable type for HT connections	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
		km	km	kWh/Month		ohm	Amps	kWh/ month	%
1	Old munnar tea tasting	1.791		19549	3/12 Cu	5.41	1.425	4.09	0.02
2	Casa montana	2.424	1.738	4315	Racoon	0.3712	0.315	0.14	0.003
			0.58	4315	7/14 Cu	8.79	0.315	1.09	0.03
			0.106	4315	7/14 ACSR	0.5595	0.315	0.01	0.0003
3	High range club	2.811		5694	7/12 Cu	5.41	0.415	3.25	0.06
4	Munnar palace (Grand Plaza)	2.599	1.738	11295	Racoon	0.3712	0.823	0.94	0.01
			0.674	11295	7/14 Cu	8.79	0.823	8.68	0.08
			0.187	11295	7/12 Cu	5.41	0.823	1.48	0.01
5	Poopada	2.703		32742	7/14 Cu	8.79	2.387	112.32	0.34
6	MS hotel	2.589	1.738	10739	Racoon	0.3712	0.783	0.85	0.01
			0.851	10739	7/14 Cu	8.79	0.783	9.90	0.09
7	Workshop club	2.93		24921	7/12 ACSR	0.5595	1.817	74.60	0.30
8	EVM	3.025	1.738	15647	Racoon	0.3712	1.141	26.42	0.17
			1.159	15647	7/14 Cu	8.79	1.141	28.63	0.18
			0.128	15647	3/12 Cu	5.41	1.141	1.95	0.01
9	Workshop	3.101		54903	3/12 Cu	5.41	4.002	413.02	0.75
10	Shikshak sadan	3.165		32682	7/12 ACSR	0.5595	2.383	145.84	0.45
11	RO	3.655		17135	3/12 Cu	5.41	1.249	58.81	0.34
12	Tea county-KTDC	4.155	1.738	26674	Racoon	0.3712	1.945	5.27	0.02
			1.917	26674	7/14 Cu	8.79	1.945	137.62	0.52
			0.5	26674	7/14 ACSR	0.5595	1.945	2.28	0.01
13	Grahamsland pump - petrol	5.615		2023	7/14 ACSR	0.5595	0.147	0.60	0.03

Map no	Transformer/HT consumer name	Distance From switching station	Adjusted distance as per cable type for HT connections	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
		km	km	kWh/Month		ohm	Amps	kWh/ month	%
14	Teacher's quarters	4.59		63257	7/14 ACSR	0.5595	4.611	558.33	0.88
15	KWA pump	4.795		14325	7/14 ACSR	0.5595	1.044	28.90	0.20
16	Botanical garden	4.964		2915	7/14 ACSR	0.5595	0.213	1.206	0.04
17	Eastend	3.949		38120	7/14 ACSR	0.5595	2.779	327.3	0.86
18	BSNL	4.263		28890	Racoon	0.3712	2.106	202.2	0.70
19	Town	4.118		33736	7/14 Cu	8.79	2.459	8.03	0.02
A1	Residency	4.206		28475	7/14 ACSR	0.5595	2.076	196.5	0.69
A2	Eastend hotel	4.206	1.738	32027	Racoon	0.3712	2.335	7.60	0.02
			2.319	32027	7/14 Cu	8.79	2.335	240.01	0.75
			0.149	32027	7/14 ACSR	0.5595	2.335	0.98	0.00
20	Nirmala society - NUSD	5.287		30122	7/12 Cu	5.41	2.196	280.8	0.93
21	GH	5.183	1.738	34613	Racoon	0.3712	2.523	8.87	0.03
			2.319	34613	7/14 Cu	8.79	2.523	280.33	0.81
			0.149	34613	7/14 ACSR	0.5595	2.523	1.15	0.003
			0.747	34613	7/12 Cu	5.41	2.523	55.58	0.16
			0.23	34613	No.8 Cu	2.36	2.523	7.46	0.02
22	KSEB	4.545		46604	7/14 ACSR	0.5595	3.397	531.105	1.14
24	OCR	5.051		3091	7/14 ACSR	0.5595	0.225	2.37	0.08
25	Munnar engineering college	5.173	1.738	3720	Racoon	0.3712	0.271	0.05	0.001
			2.319	3720	7/14 Cu	8.79	0.271	1.73	0.05
			0.149	3720	7/14 ACSR	0.5595	0.271	0.01	0.0002
			0.967	3720	7/14 ACSR	0.5595	0.271	0.05	0.001

3.1..6. Pullivasal feeder

Table 42: HT OH Line loss – Pullivasal feeder

Map no	Pole/transformer/metre	Distance from switching station	Energy transmitted through HT line	Cable type	R/km	Average current	HT OH line loss	HT OH loss
		km	kWh/Month		ohm	Amps	kWh/month	%
2	Attukad	0.999	30757.54	7/14 Cu	8.3	2.242	90.04	0.29
4	Devon Shire	0.605	20756.2	7/14 Cu	8.3	1.891	38.80	0.19
5	Pallivasal Packeting	0.698	37352.3	7/14 Cu	8.3	3.404	144.98	0.39
6	Pallivasal factory	0.748	131531.0	7/14 Cu	8.3	12.751	2180.26	1.66
7	Allakovil transformer	1.004	43125.99	7/14 Cu	8.3	3.144	177.91	0.41

Sample Calculations: **Attukad Transformer**

- Average monthly kWh = 30757.54 kWh
- Power factor = 1 (Measured from DT meter)
- System line voltage (V) = 11 kV
- Resistance Ω/km, for 7/14 Cu (R) = 8.3 Ω
- Line Length, (l) = 0.999 km
- $Average\ Current, I\ (A) = \frac{Average\ monthly\ kWh}{30*24*\sqrt{3}*system\ line\ voltage*Power\ factor}$

  $$Average\ Current, I\ (A) = \frac{30757.54}{30 * 24 * \sqrt{3} * 11 * 1} = 2.242A$$

- $HT\ line\ loss\ per\ month\ (kWh) = \frac{3*I^2*R*l*24*30}{1000}$

  $$HT\ line\ loss\ per\ month\ (kWh) = \frac{3 * 2.242^2 * 8.3 * 0.999 * 24 * 30}{1000} = 90.04\ kWh$$

TRANSFORMER & LT LINE LOSS CALCULATION

A. The Transformer loss & LT line length loss in feeder wise is summarized in this section.
B. The LT line length is measured with the help of GPS mapping and KDHP measured LT line length.
C. The transformer rated no load & load loss taken as per the IS 2026 standard.
D. LT cable length and details are measured physically from the site.

The LT OH line length as per the feeder wise is given in table below.

Table 43: LT OH line – feeder wise

Feeder	**Pullivasal**	**ITD**	**Town**	**Nettigudi**	**Nyamakad**	**Madupatty**	**Total**
LT Line Length (km)	6.9	37.5	18.5	34.3	31.4	65.2	**193.8**

Table 44: LT OH line Details – feeder wise

Feeder Name	**Type of LT overhead line**					
	ACSR	**7/14 ACSR**	**3/12 Cu**	**Cu 8**	**No 10 Cu**	**No 8 Cu**
	Line Length in km					
Pullivasal		5.274	1.476		0.15	
ITD	1.938	30.415	0.081	0.595	4.013	0.458
Town	3.036	6.552	4.931		3.981	
Nettigudi	3.998	25.288	2.534	0.258	2.212	
Nyamakad	3.998	21.322	2.86	1.535	1.391	0.294
Madupatty	8.176	44.165	4.585	0.929	7.345	
Total	21.15	133.02	16.47	3.32	19.09	0.75
Percentage of total length	**10.9**	**68.6**	**8.5**	**1.7**	**9.9**	**0.4**
Total LT Line Length	**193.8**					

3.1.1 FEEDER WISE TRANSFORMER AND LT LINE LOSS

Feeder wise Transformer and LT OH Line & UG cable loss calculation is given in the tables below. The calculations are based on month wise unit consumption and converted to yearly in the summary section.

4.1..1 Nyamakad feeder

Table 45: LT cable, LT OH line & Transformer loss – Neyamakad feeder

		LT OH line				LT UG cable							Transformer loss				
Map no	Pole/transformer/ metre	Energy transmitted through LT OH line	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/Month	Amps	kWh/month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	kW	kWh/month	%
3	Tea museum	24532	49.18	4854.18	19.8	240	1	3.5	0.16	58.9	24.0	0.08	150	29.9	0.64	460	1.6
4	DYSP bunglow	69	0.14	0.00	0.002	70	1	3.5	0.603	0.1	0.0004	0.001	5	1.9	0.10	72	104.3
5	Periyavurrai lower (Top)	11613	23.28	1631.63	14.0	70	1	3.5	0.603	26.6	13.8	0.10	63	29.5	0.49	356	2.7
6	Sholamalai	7634	15.30	789.61	10.3	70	1	3.5	0.603	16.9	11.1	0.13	63	18.8	0.43	311	3.7
s	Periyavurrai factory (solamallai)	7469	14.97	71.99	1.0	70	1	3.5	0.603	15.1	8.9	0.12	1000	32.2	1.91	1379	0.3
8	Anamudi	9406	18.86	927.61	9.9	70	1	3.5	0.603	20.7	11.2	0.11	63	23.0	0.45	327	3.2
9	Kanniar bunglow	510	1.02	0.42	0.1	70	1	3.5	0.603	1.0	0.020	0.004	15	4.8	0.20	141	27.6
10	Kannimalai top - KMFD	3681	7.38	256.16	7.0	70	1	3.5	0.603	7.9	1.2	0.03	63	8.8	0.40	287	7.3
11	Kannimalai lower	8017	16.07	1296.12	16.2	120	1	3.5	0.36	18.7	10.8	0.12	100	13.1	0.46	329	3.5
12	Kannimalai factory (KMTD TOP)	4053	8.12	25.97	0.6	70	1	3.5	0.603	8.2	2.6	0.06	750	35.0	1.82	1308	0.3
13	Nymakad bunglow	7267	14.57	610.88	8.4	70	1	3.5	0.603	15.8	9.7	0.12	63	17.6	0.43	307	3.9
14	Nymakad east (Office)	6499	13.03	851.75	13.1	70	1	3.5	0.603	14.7	8.5	0.12	63	16.4	0.42	304	4.1

		LT OH line				LT UG cable							Transformer loss				
Map no	Pole/transformer/ metre	Energy transmitted through LT OH line	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/Month	Amps	kWh/month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	kW	kWh/month	%
15	Vagavurrai top	1948	3.90	16.06	0.8	70	1	3.5	0.603	3.9	0.4	0.02	63	4.4	0.39	282	14.4
16	Vagavurrai lower	2857	5.73	90.85	3.2	70	1	3.5	0.603	5.9	1.4	0.05	63	6.6	0.40	285	9.6
17	Vagavurrai bazar	163	0.33	0.02	0.01	70	1	3.5	0.603	0.3	0.002	0.001	100	0.2	0.43	310	189.8
18	Thaliar bunglow	3694	7.41	24.87	0.7	70	1	3.5	0.603	7.5	2.2	0.06	63	8.3	0.40	287	7.7
20	Thaliar division	5793	11.61	617.22	10.7	95	1	3.5	0.456	12.9	2.4	0.04	100	9.0	0.44	319	5.0
21	Manager bunglow - vagavurrai	452	0.91	0.02	0.01	70	1	3.5	0.603	0.9	0.016	0.004	5	12.7	0.10	75	16.6
23	Vagavurrai factory division	16574	33.23	3324.29	20.1	120	1	3.5	0.36	39.9	12.4	0.06	100	27.9	0.55	399	2.0
24	Vagavurrai naval	2266	4.54	136.72	6.0	50	1	3.5	0.82	4.8	0.8	0.03	150	2.2	0.46	332	13.8
25	Vagavurrai+ luckam - naval division new	4547	9.12	105.06	2.3	50	1	3.5	0.82	9.3	4.6	0.10	63	10.4	0.40	290	6.2
26	Rajamalai west BSNL	1128	2.26	1.54	0.1	35	1	3.5	1.063	2.3	0.4	0.03	15	11.0	0.20	144	12.7
27	Forest (NYFT)	931	1.87	0.52	0.1	70	1	3.5	0.603	1.9	0.1	0.01	25	5.2	0.28	203	21.8
28	Kadalaar bunglow (east)	3226	6.47	71.34	2.2	50	1	3.5	0.82	6.6	1.2	0.04	63	7.3	0.40	285	8.7
29	Kadalaar hospital	666	1.34	2.81	0.4	50	1	3.5	0.82	1.3	0.048	0.01	100	0.9	0.43	310	46.3
30	Kadalaar factory division	5152	10.33	385.45	7.5	70	1	3.5	0.603	11.1	2.4	0.04	100	7.8	0.44	317	5.7
33	REP (wireless) stn (Sanghumallai)	483	0.97	0.86	0.2	70	1	3.5	0.603	1.0	0.0	0.00	15	4.7	0.20	141	29.1
34	Rajamalai division	5521	11.07	497.94	9.0	70	1	3.5	0.603	12.1	4.7	0.08	50	16.9	0.38	275	4.6
35	Pettimudi & Edamalakudi feedback	4708	9.44	362.16	7.7	70	1	3.5	0.603	10.2	4.0	0.08	63	11.3	0.41	292	5.8

4.1..2 ITD feeder

Table 46: LT cable, LT OH line & Transformer loss – ITD feeder

		LT OH line				**LT UG Cable line**							**Transformer loss**				
Map no	Transformer	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	Watts	kWh/ month	%
2	Nullathanni West Division	7186	14.41	1687	23.5	95	1	3.5	0.46	17.8	3.12	0.04	63	19.77	0.44	314.6	3.54
3	ITD factory	28448	57.03	2155	7.6	70	1	3.5	0.60	61.4	73.54	0.24	1000	54.03	2.67	1920.6	0.25
5	Kallar factory divsn	12899	25.86	3020	23.4	70	1	3.5	0.60	31.9	19.90	0.12	100	22.36	0.51	367.2	2.30
6	JE Divsn (Null kallu pathu new)	870	1.74	20	2.3	70	1	3.5	0.60	1.8	0.06	0.01	63	1.98	0.39	281.1	31.6
7	Hospital bunglow (Kallar West)	7071	14.17	1936	27.4	70	1	3.5	0.60	18.1	6.37	0.07	63	20.28	0.44	316.3	3.51
9	Seven mally godown (Nagermudi)	8628	17.30	2612	30.3	70	1	3.5	0.60	22.5	99.20	0.88	63	25.25	0.47	335.9	2.96
10	Parvathi	4722	9.47	945	20.0	70	1	3.5	0.60	11.4	3.36	0.06	63	12.63	0.41	294.6	5.20
11	Nadiar	15209	30.49	5598	36.8	120	1	3.5	0.36	41.7	20.29	0.10	100	29.22	0.57	407.9	1.96
12	Kurumalai	5111	10.25	1106	21.6	70	1	3.5	0.60	12.5	3.04	0.05	25	34.91	0.26	189.4	3.05
15	Upper seven malai	8674	17.39	3187	36.7	70	1	3.5	0.60	23.8	11.05	0.09	63	26.44	0.47	341.2	2.87
16	Ottupara	8367	16.77	2711	32.4	70	1	3.5	0.60	22.2	9.64	0.09	63	24.69	0.46	333.5	3.01
17	Letchmi east	3946	7.91	565	14.3	70	1	3.5	0.60	9.0	1.07	0.02	63	10.05	0.40	289.5	6.42
19	Letchmi factory divs	16983	34.05	10471	61.7	95	1	3.5	0.46	55.0	29.84	0.11	100	38.56	0.67	480.9	1.75
20	Letchmi viriparrai	5076	10.18	1091	21.5	70	1	3.5	0.60	12.4	1.99	0.03	63	13.60	0.41	296.8	4.81

4.1..3 Nettigudi feeder

Table 47: LT cable, LT OH line & Transformer loss – Nettigudi feeder

		LT OH line				LT UG cable							Transformer loss				
Map no	Transformer	Energy transmitted – LT OH line	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/month	%	kVA	%	kW	kWh	%
2	Chokanad south (fac div)	18653	43.1	1681.7	9.02	95	1	3.5	0.456	40.8	32.74	0.16	63	45.36	0.64	458.5	2.25
3	Chokanad east (Puthukad) + East	4372	10.1	480.3	10.99	70	1	3.5	0.603	9.7	2.46	0.05	63	10.81	0.40	290.9	5.99
4	Chokanad north (vattakad)	7482	17.3	225.5	3.01	70	1	3.5	0.603	15.5	7.77	0.10	63	17.18	0.43	306.3	3.97
5	Chokanad K Kai	3763	8.7	114.1	3.03	50	1	3.5	0.821	7.8	2.14	0.06	63	8.64	0.40	287.2	7.40
6	Alisa craig	2172	5.0	48.1	2.22	70	1	3.5	0.603	4.5	0.64	0.03	63	4.94	0.39	282.9	12.74
7	Ladbrock	1566	3.6	2.4	0.15	50	1	3.5	0.821	3.1	0.18	0.01	75	2.93	0.40	288.8	18.41
8	Earlston	1428	3.3	3.5	0.25	70	1	3.5	0.603	2.9	0.16	0.01	20	10.04	0.20	147.3	10.29
9	Forest	778	1.8	0.6	0.08	50	1	3.5	0.821	1.6	0.17	0.02	25	4.37	0.28	202.6	26.02
11	Lockhart colony	14269	35.1	1856.3	13.01	50	1	3.5	0.821	32.3	37.07	0.23	315	7.27	0.92	660.2	4.08
13	Gunderle manager bunglow	387	0.9	0.6	0.15	50	1	3.5	0.821	0.8	0.03	0.01	63	0.90	0.39	280.9	72.40
14	Gunderle factory divn	10042	23.2	308.7	3.07	70	1	3.5	0.603	20.8	5.61	0.05	63	23.06	0.45	326.8	3.16
16	BSNL (silent valley)	1319	3.1	2.8	0.21	25	1	3.5	1.405	2.7	0.43	0.03	15	14.24	0.20	146.2	11.06
17	Silent valley divn (North)	11143	27.1	2771.0	24.87	95	1	3.5	0.456	27.9	15.33	0.11	63	31.34	0.51	365.6	2.62
18	Silent valley office (South)	4028	9.3	214.3	5.32	95	1	3.5	0.456	8.5	1.07	0.03	100	5.95	0.44	313.7	7.39

		LT OH line				LT UG cable							Transformer loss				
Map no	Transformer	Energy transmitted – LT OH line	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/ km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/month	%	kVA	%	kW	kWh	%
19	Gunderle lower (Nettigudi)	4022	9.3	286.7	7.13	50	1	3.5	0.821	8.6	1.32	0.03	63	9.60	0.40	288.8	6.70
20	Gunderle center (middle)	5381	13.1	775.4	14.41	70	1	3.5	0.603	12.3	4.96	0.08	63	14.00	0.41	297.7	4.83
21	Gunderle top	4330	10.0	377.6	8.72	70	1	3.5	0.603	9.4	2.90	0.06	63	10.49	0.40	290.3	6.16
22	Devikulam middle	2628	6.1	18.5	0.71	70	1	3.5	0.603	5.3	0.73	0.03	63	5.90	0.39	283.8	10.72
23	Devikulam factory divsn	8723	20.2	999.1	11.45	70	1	3.5	0.603	19.5	4.95	0.05	100	13.65	0.46	331.1	3.40
25	Devikulam ODK	2935	6.8	114.5	3.90	70	1	3.5	0.603	6.1	0.97	0.03	63	6.79	0.40	284.8	9.33
26	Periyakanal PH divsn	3487	8.1	189.1	5.42	70	1	3.5	0.603	7.4	0.71	0.02	63	8.19	0.40	286.6	7.79
27	Ayur county	20514	49.9	1795.4	8.75	300	3	3.5	0.13	44.7	33.70	0.15	400	7.92	1.12	807.8	3.62
28	Periyakanal factory divsn	19969	48.6	1779.7	8.91	120	1	3.5	0.36	43.6	14.78	0.07	100	30.53	0.58	417.0	1.92

4.1..4 Madupatty feeder

Table 48: LT cable, LT OH line & Transformer loss – Madupatty feeder

		LT OH line				LT UG cable							Transformer				
Map no	Transformer	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% Of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	kW	kWh/ month	%
1	Westwood	2390				70	1	3.5	0.603	5.528	0.52	0.0217	160	2.18	0.46	332	13.9
2	Microwave												25	16.98	0.30	216	7.1
3	Grahamsland office	9214	21.3	2462	26.7	70	2	3.5	0.6	27.0	41.2	0.35	63	26.09	0.47	340	2.9
4	Grahamsland bazaar	191	0.4	1	0.5	70	1	3.5	0.6	0.4	0.0	0.01	5	5.60	0.03	18	9.4
5	Grahamsland bunglows (Velmudi)	3718	14.9	656	17.6	50	2	3.5	0.8	10.1	3.9	0.09	63	9.85	0.40	289	6.6
6	KKD church - korandikad	14733	34.1	8743	59.3	95	1	3.5	0.5	54.3	62.9	0.27	63	54.63	0.75	539	2.3
7	HR school	15090	45.4	620	4.1	150	2	3.5	0.3	36.3	32.8	0.21	150	15.34	0.51	365	2.3
8	Madupatty top divsn	4717	10.9	538	11.4	50	2	3.5	0.8	12.2	5.7	0.11	63	12.21	0.41	294	5.6
9	R&D complex	3577	10.8	324	9.1	120	2	3.5	0.4	9.0	2.2	0.06	63	9.06	0.40	288	7.4
10	Thenmalay Asst manager bunglow (Hospital dn)	5221	15.7	891	17.1	50	2	3.5	0.8	14.1	7.7	0.13	63	14.05	0.41	298	4.9
11	Tenmalay factory divsb	8101	18.7	1533	18.9	95	2	3.5	0.5	22.3	10.6	0.11	100	13.40	0.46	330	3.4
12	Tenmalay new divsn	2240	5.2	104	4.6	70	1	3.5	0.6	5.4	1.7	0.07	25	13.16	0.29	210	9.0
15	Madupatty divsn	11081	25.6	3023	27.3	95	1	3.5	0.8	32.6	24.5	0.17	63	32.45	0.52	372	2.6
17	Nettimadu divsn	7096	16.4	1338	18.9	240	2	3.5	0.2	19.5	1.7	0.02	63	19.37	0.44	313	3.7

		LT OH line				LT UG cable							Transformer				
Map no	Transformer	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% Of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	kW	kWh/ month	%
21	Gundumalay factory divsn	4498	10.4	685	15.2	95	2	3.5	0.5	12.0	3.7	0.07	100	7.20	0.44	316	6.1
22	Gundumalay benmore	2617	6.1	140	5.3	70	1	3.5	0.6	6.4	1.8	0.07	63	6.14	0.39	284	10.3
23	Gundumalay south para	4294	9.9	400	9.3	50	2	3.5	0.8	9.4	3.4	0.07	63	10.90	0.40	291	6.2
24	Gundumalay BSNL					95	1	3.5	0.5	2.0	0.1	0.01	15	8.55	0.20	143	16.2
25	Gundumalay new divsn	1739	4.0	122	7.0	70	1	3.5	0.6	4.3	0.3	0.02	25	10.44	0.29	207	11.1
26	Gundumalay upper	3324	7.7	285	8.6	70	1	3.5	0.6	8.3	1.2	0.03	63	8.38	0.40	287	7.9
27	Gundumalay lower	2441	5.6	119	4.9	70	1	3.5	0.6	5.9	1.0	0.04	63	5.94	0.39	284	11.1
28	Gundumalay kadugu	978	2.3	21	2.1	50	1	3.5	0.8	2.3	0.2	0.02	15	9.74	0.20	143	14.3
29	New pump indo swiss (irrigation)	915	7.3	48	1.5								163	2.84	0.46	332	10.5
30	Aruvikkad divsn	9831	22.7	2803	28.5	95	1	3.5	0.5	29.2	18.2	0.14	100	18.50	0.48	349	2.8
32	Ecopoint	31	0.1	0	0.1	50	2	3.5	0.8	0.1	0.0	0.00	63	0.07	0.39	281	912.4
33	East divsn pachakkad	2877	6.7	224	7.8	70	1	3.5	0.6	7.2	1.4	0.05	63	7.20	0.40	285	9.2
34	Kundalay naturals (medicinal plant)	2660	6.2	11	0.4	50	2	3.5	0.8	6.2	1.5	0.05	150	2.61	0.46	332	12.4
35	Pudukkadi	2917	6.7	217	7.4	70	1	3.5	0.6	7.2	1.5	0.05	63	6.98	0.40	285	9.1
36	Yelapatty divsn	18671	43.2	15165	81.2	185	2	3.5	0.3	78.3	151.9	0.45	100	49.69	0.83	594	1.7

		LT OH line				LT UG cable							Transformer				
Map no	Transformer	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% Of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	kW	kWh/ month	%
38	Kundalay office	5054	11.7	654	12.9	120	1	3.5	0.4	13.2	1.2	0.02	63	12.71	0.41	295	5.2
39	Theerthamalay	2088	4.8	39	1.9	50	2	3.5	0.8	4.9	0.9	0.04	75	3.98	0.39	282	13.3
41	Old factory	7490	17.3	1627	21.7	70	2	3.5	0.6	21.1	20.0	0.22	63	20.35	0.44	317	3.5
42	PR divsn	2069	4.8	59	2.9	70	1	3.5	0.6	4.9	1.1	0.05	63	4.74	0.39	283	13.3
43	Top divsn	3967	9.2	342	8.6	70	1	3.5	0.6	10.0	2.8	0.06	63	9.60	0.40	289	6.7
44	Kundalay club	10	0.0	0	0.0	35	1	3.5	1.1	0.0	0.0	0.00	5	0.30	0.10	72	738.4
45	Chittivurrai pump (MC divsn)	2316	5.4	9	0.4	50	2	3.5	0.8	5.4	1.1	0.05	63	5.18	0.39	283	12.2
47	Chittivurrai factory divsn	9866	22.8	3450	35.0	70	1	3.5	0.6	30.8	10.7	0.08	100	18.89	0.49	351	2.6
48	New Pump (Chittivurrai new)	1094	2.5	3	0.3	70	1	3.5	0.6	2.5	0.1	0.01	100	1.69	0.43	310	28.3
49	Chittivurrai OC divsn	4676	10.8	564	12.1	70	1	3.5	0.6	12.1	4.1	0.08	63	11.80	0.41	293	5.6

4.1..5 Town feeder

Table 49: LT UG cable, LT OH line & Transformer loss – Town feeder

		LT OH line				LT UG cable							Transformer				
Map no	Transformer name	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/Month	Amps	kWh/month	%	Sq mm	nos	nos	ohm	Amps	kWh/month	%	kVA	%	Watts	kWh/month	%
1	Old munnar tea tasting	15984	32.04	3091.70	19.34	185	2	3.5	0.21	44.12	92.3	0.48	150	18.68	0.53	381.5	1.99
3	High range club	5188	10.40	191.86	3.70	95	3	3.5	0.45	12.44	19.6	0.36	63	12.53	0.41	294.4	5.45
5	Poopada	24397	48.91	7058.57	28.93	95	3	3.5	0.46	72.76	813.5	2.59	150	31.45	0.66	473.6	1.47
7	Workshop club	19131	38.35	4340.25	22.69	70	3	3.5	0.60	54.29	993.2	4.23	100	35.77	0.63	457.0	1.87
9	Workshop	40651	81.49	8998.93	22.14	70	3	3.5	0.60	114.85	4444.6	8.95	300	26.36	1.12	808.1	1.49
10	Shikshak sadan	24484	49.08	7109.05	29.04	120	1	3.5	0.36	73.08	539.9	1.71	250	18.79	0.76	549.8	1.71
11	RO	14231	28.53	1911.51	13.43	95	3	3.5	0.46	37.34	623.4	3.86	150	16.34	0.51	369.7	2.20
13	Grahamsland pump - petrol					95	1	3.5	0.46	4.02	4.0	0.23	63	4.04	0.39	282.2	16.22
14	Teacher's quarters	44871	89.95	16568.11	36.92	185	2	3.5	0.21	142.12	1104.6	1.80	200	45.72	0.99	713.7	1.14
15	KWA pump					95	1	3.5	0.46	32.17	61.1	0.44	100	20.42	0.50	357.6	2.56
16	Botanical garden					95	1	3.5	0.46	6.09	0.4	0.01	63	6.11	0.39	284.0	10.79
17	Eastend	30714	61.57	6392.95	20.81	95	1	3.5	0.45	85.84	358.1	0.96	100	54.77	0.91	655.2	1.75
18	BSNL					120	1	3.5	0.36	64.92	393.2	1.40	200	20.80	0.60	433.2	1.52
19	Town	88366	177.15	32749.60	37.06	95	1	3.5	0.45	75.76	278.9	0.85	300	16.10	0.98	707.7	2.14
A1	Residency	21888	43.88	5681.82	25.96	70	1	3.5	0.60	63.77	263.6	0.96	63	64.59	0.89	641.3	2.30

		LT OH line				LT UG cable							Transformer				
Map no	Transformer name	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/ km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/Month	Amps	kWh/month	%	Sq mm	nos	nos	ohm	Amps	kWh/month	%	kVA	%	Watts	kWh/month	%
20	Nirmala society - NUSD	25035	50.19	3413.06	13.63	70	5	3.5	0.60	65.81	1222.0	4.30	150	28.92	0.63	451.6	1.52
21	GH	5933	11.90	110.77	1.87	70	5	3.5	0.60	13.98	55.2	0.91	250	19.92	0.78	558.1	1.64
22	KSEB	40568	81.33	5178.17	12.76	185	2	3.5	0.21	105.82	306.2	0.67	200	33.66	0.77	551.7	1.20

4.1..6 Pullivasal feeder

Table 50: LT UG cable, LT OH line & Transformer loss – Pullivasal feeder

		LT OH line				LT UG cable							Transformer				
Map no	Transformer	Energy transmitted	Average current	LT OH line loss	LT OH line loss	Size of cable	Run	Core	R/km	Average current	LT Cable line loss	LT Cable loss	Capacity of DT	% of loading - Avg	Transformer loss	Transformer loss	Transformer loss %
		kWh/ Month	Amps	kWh/ month	%	Sq mm	nos	nos	ohm	Amps	kWh/ month	%	kVA	%	Watts	kWh/ month	%
2	Attukad	26919	54	3069	11	70	2	3.50	0.60	60.12	235.37	0.78	100	44.19	0.74	535	1.77
7	Allakovil transformer	36853	74	5259	14	70	2	3.50	0.60	84.43	464.18	1.10	160	38.90	0.76	549	1.29

LOSSES DUE TO CIRCUIT INTERRUPTING DEVICES

Circuit-interrupting devices are switches, relays, circuit breakers, and fuses. Each of these devices is designed to carry and interrupt certain levels of current. Making and breaking the current carrying conductors in the transmission path with a minimum of arcing is one of the most important characteristics of this device. Relays can sense abnormal voltages, currents, and frequency and are designed to protect the system.

Generally, the losses due to the above account between 0.1% - 0.2% of the load. However, in the case of KDHP, this loss may be assumed as 0.2% (max value), considering the size and complexity of the network.

TECHNICAL LOSSES – SUMMARY

The technical losses comprising all the section above is estimated in feeder wise and given in the following tables.

- **Pullivasal feeder**

Table 51: T & D loss – Pullivasal feeder

Particulars	Calculation	Values		Remarks
Energy Transmitted	A	32,09,760 kWh		Measured at the Switching station – from KDHP Tsoft
HT Cable Losses	B	51 kWh	0.0016 %	Calculated with line length
HT Overhead line losses	C	31,584 kWh	0.98 %	Calculated with line length
Transformer Losses	D	13,004 kWh	0.41 %	Estimated with rated load loss values
LT Overhead line losses	E	99,942 kWh	3.11 %	Calculated with line length
LT Cable losses	F	8,395 kWh	0.26 %	Calculated with line length
Loss due to Fuses, Busway & switchgears	G	6,420 kWh	0.20 %	Estimated as per standard
Total T&D losses	**H = Sum (B:G)**	**159394 kWh**	**4.97 %**	
Available Power for sales	I = A - H	30,50,366 kWh		
Actual power sales	J	30,43,806 kWh		From KDHP Tsoft
Total Commercial and other losses	K = I - J	6560 kWh	0.20 %	
Estimated Total loss	**L = K + H**	**165954** kWh	**5.17** %	

- **ITD feeder***

Table 52: T & D loss – ITD feeder

Particulars	Calculation	Values		Remarks
Energy Transmitted	A	98,80,776 kWh		Measured at the Switching station – from KDHP Tsoft
HT Cable Losses	B	612 kWh	0.0062 %	Calculated with line length
HT Overhead line losses	C	83,763 kWh	0.85 %	Calculated with line length

Transformer Losses	D	77,404 kWh	0.78 %	Estimated with rated load loss values
LT Overhead line losses	E	4,45,261 kWh	4.51 %	Calculated with line length
LT Cable losses	F	3,389 kWh	0.03 %	Calculated with line length
Loss due to Fuses & switchgears	G	19,762 kWh	0.20 %	Estimated as per standard
Total T&D losses	**H = Sum (B:G)**	**630191 kWh**	6.38 %	
Available Power for sales	I = A - H	9250585 kWh		
Actual power sales	J	9383866 kWh		From KDHP Tsoft
Total Commercial and other losses	K = I - J	-133281 kWh	-1.35 %	
Estimated total loss	**L = K + H**	**496910 kWh**	**5.03 %**	

**Observed difference in available power for sales and actual power sales even though the losses are similar in the feeder. This could be due to error in the consumer meter which reads higher consumption than the actual.*

- **Town feeder***

Table 53: T & D loss – Town feeder

Particulars	Calculation	Values		Remarks
Energy Transmitted	A	9946400 kWh		Measured at the Switching station – from KDHP Tsoft
HT Cable Losses	B	384 kWh	0.0039 %	Calculated with line length
HT Overhead line losses	C	45,340 kWh	0.4558 %	Calculated with line length
Transformer Losses	D	1,11,057 kWh	1.1166 %	Estimated with rated load loss values
LT Overhead line losses	E	12,33,556 kWh	12.4020 %	Calculated with line length
LT Cable losses	F	1,38,943 kWh	1.3969 %	Calculated with line length
Loss due to Fuses & switchgears	G	19,893 kWh	0.20 %	Estimated as per standard
Total T&D losses	**H = Sum (B:G)**	**1549173** kWh	15.58 %	
Available Power for sales	I = A - H	8397227 kWh		
Actual power sales	J	8656207 kWh		From KDHP Tsoft
Total Commercial and other losses	K = I - J	-258980 kWh	-2.60 %	
Estimated total loss	**L = K + H**	**1290193** kWh	**12.97 %**	

**observed difference in available power for sales and actual power sales even though the losses are similar in the feeder. This could be due to error in the consumer meter which reads higher consumption than the actual.*

- **Nettigudi feeder**

Table 54: T & D loss – Nettigudi feeder

Particulars	Calculation	Values		Remarks
Energy Transmitted	A	1,05,78,900 kWh		Measured at the Switching station – from KDHP Tsoft
HT Cable Losses	B	695 kWh	0.01 %	Calculated with line length

HT Overhead line losses	C	440335 kWh	4.16 %	Calculated with line length
Transformer Losses	D	91749 kWh	0.87 %	Estimated with rated load loss values
LT Overhead line losses	E	168552 kWh	1.59 %	Calculated with line length
LT Cable losses	F	2050 kWh	0.02 %	Calculated with line length
Loss due to Fuses & switchgears	G	21158 kWh	0.20 %	Estimated as per standard
Total T&D losses	**H = Sum (B:G)**	**724538 kWh**	**6.85 %**	
Available Power for sales	I = A - H	98,54,362 kWh		
Actual power sales	J	98,45,691 kWh		From KDHP Tsoft
Total Commercial and other losses	**K = I - J**	8,671 kWh	**0.08%**	
Estimated total loss	**L = K + H**	**7,33,209 kWh**	**6.93%**	

- **Nyamakad feeder**

Table 55: T & D loss – Nyamakad feeder

Particulars	Calculation	Values		Remarks
Energy Transmitted	A	1,11,24,064 kWh		Measured at the Switching station – from KDHP Tsoft
HT Cable Losses	B	749 kWh	0.0067 %	Calculated with line length
HT Overhead line losses	C	1,16,501 kWh	1.0473 %	Calculated with line length
Transformer Losses	D	1,24,894 kWh	1.1227 %	Estimated with rated load loss values
LT Overhead line losses	E	2,03,449 kWh	1.8289 %	Calculated with line length
LT Cable losses	F	1,678 kWh	0.0151 %	Calculated with line length
Loss due to Fuses & switchgears	G	22,248 kWh	0.20 %	Estimated as per standard
Total T&D losses	**H = Sum (B:G)**	**4,69,518 kWh**	**4.22%**	
Available Power for sales	I = A - H	1,06,54,546 kWh		
Actual power sales	J	99,92,597 kWh		From KDHP Tsoft
Total Commercial and other losses	K = I - J	6,61,949 kWh	5.95 %	
Estimated total loss	**L = K + H**	**11,31,467 kWh**	**10.17%**	

- **Madupatty feeder**

Table 56: T & D loss – Madupatty feeder

Particulars	Calculation	Values		Remarks
Energy Transmitted	A	1,49,80,826 kWh		Combined value of Switching station & 2MW Madupatty generating station – from KDHP Tsoft
HT Cable Losses	B	1,227 kWh	0.0082 %	Calculated with line length

HT Overhead line losses	C	2,37,886 kWh	1.5879 %	Calculated with line length
Transformer Losses	D	1,36,680 kWh	0.9124 %	Estimated with rated load loss values
LT Overhead line losses	E	5,66,622 kWh	3.7823 %	Calculated with line length
LT Cable losses	F	5,082 kWh	0.0339 %	Calculated with line length
Loss due to Fuses & switchgears	G	29,962 kWh	0.20 %	Estimated as per standard
Total T&D losses	**H = Sum (B:G)**	**9,77,460 kWh**	**6.52** %	
Available Power for sales	I = A - H	1,40,03,366 kWh		
Actual power sales	J	1,28,98,457 kWh		From KDHP Tsoft
Total Commercial and other losses	K = I - J	11,04,909 kWh	7.38 %	
Estimated total loss	**L = K + H**	**20,82,369 kWh**	**13.90%**	

➢ **Summarisation of all feeders**

Table 57: T & D loss – Summarised – feeder wise

Feeder	Energy transmitted	T & D loss	Commercial and other losses	Energy sales	T&D loss	Total loss
	kWh	kWh	kWh	kWh	%	%
Pullivasal	32,09,760	1,59,394	6,560	30,43,806	4.97	5.17
ITD	98,80,776	659445.7	0	93,83,866	6.67	5.03
Town	99,46,400	1549173	0	86,56,207	15.58	12.97
Nettigudi	1,05,78,900	7,24,538	8,671	98,45,691	6.85	6.93
Nyamakad	1,11,24,064	4,69,518	6,61,949	99,92,597	4.22	10.17
Madupatty	1,49,80,826	9,77,460	11,04,909	1,28,98,457	6.52	13.90
Total	**5,97,20,726**	**45,39,529**	**17,82,089**	**5,38,20,624**	**7.60**	**9.88**

- ***All the above calculations are considering the transmitted feedback energy (Energy sold outside the periphery) through the KDHP distribution system.***
- *Total loss = T & D loss + Commercial loss*
- *Therefore, Commercial loss = 2.984% which can be accounted to the following ones:*
    1. ***Error in the meter reading***
    2. *Manual error in reading*
    3. *Interruption losses, and*
    4. ***Tree touching losses in the HT/LT overhead cables.***
- *During energy audit period, auditors attempted to verify the error in the meters by analysing the HT meter reading of few consumers and feeder meters at the switching station using the power quality analysers and hereby summarised in commercial losses section.*

4. HT/LT RATIO

The total length of the LT line from the transformer to the consumer end at the period of audit is 193.8 km. In that, the OH cable were 189.3 km and the UG cable were 4.5 km long.

The total 11kV HT line length from the switching station to the DT or HT consumers are 180.23 km, where the installed ones are ACSR and Copper cables of various sizes.

HT/LT ratio is the total distance of HT line to the LT lines in a system. The HT/LT ratio has calculated with respect to the total LT line where;

HT:LT = 1: 1.075, which approximately equal to the recommended level of 1:1.

Considering the terrain of KDHP the value is optimum. KDHP also were in continuous process replacing the LT lines with new HT lines and installation transformers at tail ends with the increase in population or divisions.

5. SUBSIDY COMPUTATION AND ANALYSIS

The DISCOM did not received subsidy from any government or government institutions on any category during the FY 2022-23.

6. TREND ANALYSIS

The historical energy accounts/loss of the KDHP DISCOM is tabulated below.

Table 58: Historical energy accounts/loss of the DISCOM

	1. T&D Losses analysis for 2020-21				2. T&D Losses analysis for 2021-22			
Particulars	Input energy (MU)	Total Billed energy (MU)	Total energy Loss (MU)	T&D losses %	Input energy (MU)	Total Billed energy (MU)	Total energy Loss (MU)	T&D losses %
DISCOM - KDHP	57.26	50.97	6.29	**10.98**	53.07	48.05	5.02	**9.45**

The graphical representation of the losses for the three years (including audit period FY 2022-23) is given in the figure below.

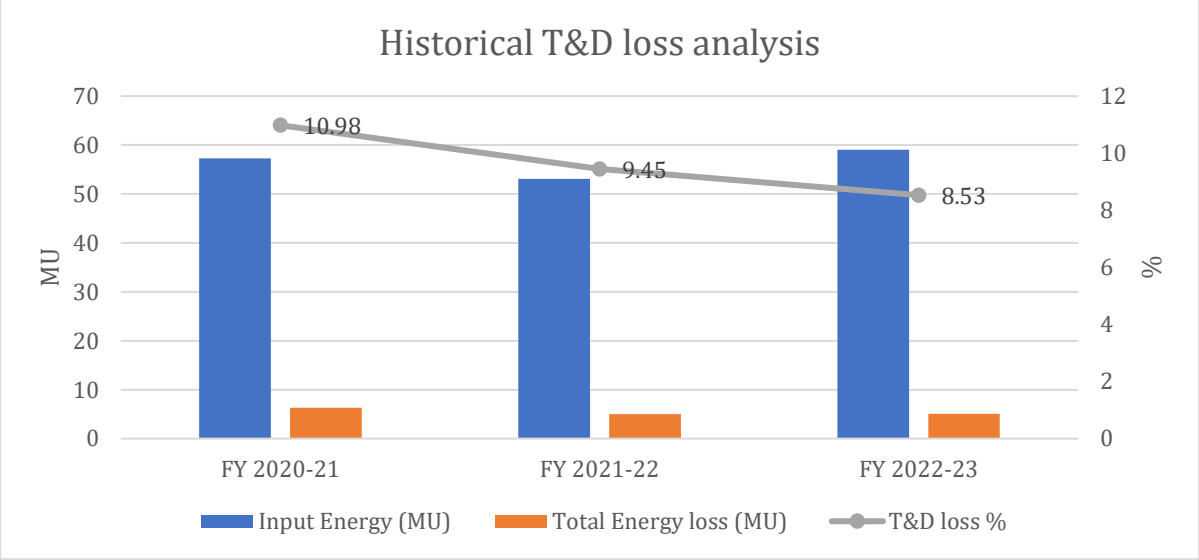


Figure 12: Historical T & D loss with audited data

- The T&D loss % shows a constant decrease from the FY 2020-21 to FY 2022-23 even though the input energy to the DISCOM is higher in the audited FY.
- While analyzing the consumption, transmission & sale pattern of energy, observed that the decrease in the loss mainly due to the reduction in the short circuits by proper tree prooning, by replacing the consumer meters if it's damaged in record time and by replacing the electromechanical/static meter with the electronic meter. The KSEB feedback at 11kV is observed to be directly proportional to the T&D loss % and the Madupatty generation units is inversely proportional to the T&D loss %.

ENERGY AUDIT FINDINGS

1 COMPLIANCE TO BEE REGULATIONS

The compliance status of DISCOM to various provisions of BEE Regulations 2021 is analysed and presented below.

Clause No	Clause Details	Subclause Details	Present Status	Action plan/ comments by DISCOM
3	Intervals of time for conduct of annual energy audit	a. Conducted an annual energy audit for every financial year and submitted the annual energy audit report to the Bureau and respective State Designated Agency and also made available on the website of the electricity distribution company within a period of four months from the expiry of the relevant financial year	a. Annual energy audit for all the FY including FY 2022-23 being conducted. Report will be submitted to BEE and SDA. Report will also be uploaded onto KDHP website.	Reports will be uploaded to the DISCOM site asap.
4	Intervals of time for conduct of periodic energy accounting	a. All feeder wise, circle wise and division wise periodic energy accounting is conducted by the energy manager of the electricity distribution company for each quarter of the financial year.	a. Periodic energy accounting for Q1 & Q2 FY 20-21 have been prepared by the DC.	
		b. Submitted the periodic energy accounting report to the Bureau and respective State Designated Agency and also made available on the website of electricity distribution company within forty-five days from the date of the periodic energy accounting.	b. Periodic energy accounting for Q1 & Q2 FY 20-21 have been prepared by the DC. DC has to upload the energy accounting reports onto the website of DC	
		c. Electricity distribution company conducted its first periodic energy accounting, for the last quarter of the financial year immediately preceding the date of such commencement (i.e. 6th October 2021).	c. DC has submitted its first periodic energy accounting for Q1 & Q2 FY20-21.	
		d. Electricity distribution company conducted its subsequent periodic energy accounting for each quarter of the financial year for a period of two	d. The DC used to submit the periodic energy auditing	

		financial years from the date of such commencement, and submit the periodic energy accounting report within sixty days from the date of periodic energy accounting	reports as per the Energy Audit regulations.	
Clause No	**Clause Details**	**Subclause Details**	**Present Status**	**Action plan/ comments by DISCOM**
5	Pre-requisites for annual energy audit and periodic energy accounting	a. Identification and mapping of all of the electrical network assets	a. Mapping of HT line and transformers conducted by the AEA and LT lines are mapped by the DISCOM.	
		b. Identification and mapping of high tension and low-tension consumers	b. All the HT and LT consumers have been mapped.	
		c. Development and implementation of information technology enabled energy accounting and audit system, including associated software.	c. DC has energy accounting and audit system however yet to implement into their software. DC uses T-Soft which is an internal software for the same.	The existing software will be modified to implement the same.
		d. Electricity distribution company ensures the installation of functional meters for all consumers, transformers and feeders. Meter installation is done in a phased manner within a period of three financial years from the date of the commencement of these regulations in accordance with the trajectory set out in the First Schedule	d. All 11kV feeders have been metered. All consumers have been metered under the DISCOM. As of audit period (31st July 2023) of the total 133 distribution transformers, 63 distribution transformers have been metered.	Rest of the DT meters will be installed in time bound manner.
		d1. 100% Communicable Feeder Metering integrated with AMI, by 31st December 2022 along with replacement of existing non- communicable feeder meters.	d.1. 100% of the feeders are having DLMS (Device Language Message Specification Communicable Meters).	
		d2. All Distribution Transformers (other than HVDS DT up to 25kVA and other DTs below 25 kVA) shall be metered with communicable meters.	d.2. DISCOM yet to start the work to install communicable meters for rest of the DT.	Plans to do the work in phased manner

		Communicable DT Metering for the following areas/ consumers to be completed by December 2023 and in balance areas by December 2025: 100% Communicable Feeder Metering integrated with AMI, by 31st December 2022 along with replacement of existing non-communicable feeder meters.	Feeder metering is integrated and results are available in their software.	
Clause No	**Clause Details**	**Subclause Details**	**Present Status**	**Action plan/ comments by DISCOM**
		d.2.1. All Electricity Divisions of 500 AMRUT cities, with AT&C Losses > 15%	d.2.1. Not Relevant for DC.	
		d.2.2. All Union Territories (for areas with technical difficulty, non-communicable meters may be installed)	d.2.2. Not Relevant for DC	
		d.2.3. All Industrial and Commercial consumers	d.2.3. DC has installed 36 communicable metering-AMI (HT consumers) and 16547 meters with non-communicable ones (LT, industrial and commercial).	Plans to do the remaining installations in phased manner
		d.2.4. All Government offices at Block level and above	D2.4. DC intends to install, communicable meters with AMI for Government offices.	Plans to do the work in phased manner
		d.2.5. Other high loss areas i.e. rural areas with losses more than 25% and urban areas with losses more than 15%	d.2.5. The whole DISCOM comes under the Rural area and thus not relevant for DC.	
		d.3. Prepaid Smart Consumer Metering to be completed for all directly connected meters and AMR in case of other meters, by December 2023 in the following areas:		
		d.3.1. All Electricity Divisions of 500 AMRUT cities, with AT&C Losses > 15%;	d.3.1. Not applicable as AT&C loss is less than 15%.	

<table>
<tr><th>Clause No</th><th>Clause Details</th><th>Subclause Details</th><th>Present Status</th><th>Action plan/ comments by DISCOM</th></tr>
<tr><td></td><td></td><td>d.3.2. All Union Territories (for areas with technical difficulty, prepaid meters to be installed);</td><td>d.3.2. Not Relevant for DC.</td><td></td></tr>
<tr><td></td><td></td><td>d.3.3. All Industrial and Commercial consumers;</td><td>d.3.3. DC intends to install consumer meters with AMI for commercial and industrial consumers.</td><td>Plans to do the work in phased manner</td></tr>
<tr><td></td><td></td><td>d.3.4. All Government offices at Block level and above;</td><td>d.3.4. yet to initiate the work</td><td>Plans to do the work in phased manner</td></tr>
<tr><td></td><td></td><td>d.3.5. Other high loss areas i.e. rural areas with losses more than 25% and urban areas with losses more than 15%.</td><td>d.3.5. Not applicable as T&D loss is less than 15%</td><td></td></tr>
<tr><td></td><td></td><td>d4. Consumer Metering: 98% by FY 2022-23 99% by FY 2023-24</td><td>d4. 100% of the consumers are metered.</td><td></td></tr>
<tr><td></td><td></td><td>d.5. Targets for functional meters.
<table><tr><td>Meter</td><td>FY 22-23</td><td>FY 23-24</td><td>FY24-25</td></tr><tr><td>Feeder metering</td><td>98.5%</td><td>99.5%</td><td>99.5%</td></tr><tr><td>DT metering</td><td>90%</td><td>95%</td><td>98%</td></tr></table></td><td>d5. 100% of the feeders are metered. 47% of the DT are metered. 100% of the consumers are metered.</td><td>DT metering will start in phased manner.</td></tr>
<tr><td></td><td></td><td>e. e1. All distribution transformers (other than high voltage distribution system up to 25kVA and other distribution system below 25 kVA) is metered with communicable meters.</td><td>e.1. DC yet to start the work</td><td>DT metering will start in phased manner.</td></tr>
<tr><td></td><td></td><td>e.2.And existing non-communicable distribution transformer meters is replaced with communicable meters and integrated with advanced metering infrastructure.</td><td>e.2. Yet to start the work</td><td>DT metering will start in phased manner.</td></tr>
<tr><td></td><td></td><td>e. Electricity distribution company has established an information technology enabled system to create energy accounting reports without any manual interference and such systems may be within a period of three years from the date of the</td><td>f. DC has energy accounting and audit system however yet to implement into their software. DC uses T-Soft which is an internal software for the same.</td><td>The existing software will be modified to implement the same.</td></tr>
</table>

		commencement of these regulations in case of urban and priority area consumers; and within five years from the date of the commencement of these regulations in case of rural consumers		
Clause No	**Clause Details**	**Subclause Details**	**Present Status**	**Action plan/ comments by DISCOM**
		g. Electricity distribution company has a centralized energy accounting and audit cell comprising of— (i) a nodal officer, an energy manager and an information technology manager, having professional experience of not less than five years; and (ii) a financial manager having professional experience of not less than five years	g. DISCOM has energy audit cell. List is mentioned in the audit report. Energy manager is designated one.	
6	Reporting requirements for annual energy audit and periodic energy accounting	a. Electricity distribution company has a nodal officer, who is a full time employee of the electricity distribution company in the rank of the Chief Engineer or above, for the purpose of reporting of the annual energy audit and periodic energy accounting and communicate the same to the Bureau.	a. The DC is complying with this requirement	
		b. Electricity distribution company ensures that the energy accounting data is generated from a metering system or till such time the metering system is not in place, by an agreed method of assumption as may be prescribed by the State Commission	b. DC has already had software system for keeping historical records.	
		c. Metering of distribution transformers at High Voltage Distribution System up to 25KVA is done on cluster meter installed by the electricity distribution company	c. Not yet done	Plans to do the work in phased manner

Clause No	Clause Details	Subclause Details	Present Status	Action plan/comments by DISCOM
		d. The energy accounting and audit system and software is developed to create monthly, quarterly and yearly energy accounting reports.	d. The DC has software's for energy accounting and audit and the software's are having the capability to create monthly, quarterly and yearly energy accounting reports.	
		e. Electricity distribution company has provided the details of the information technology system in place as specified in clause (f) of regulation 5 that ensures minimal manual intervention in creating the energy accounting reports and any manual intervention of any nature, in respect of the period specified therein, shall be clearly indicated in the periodic energy accounting report	e. The DC has software's for energy accounting and audit and the software's are having the capability to create monthly, quarterly and yearly energy accounting reports.	

2 NOTES OF THE EA/EM ALONG WITH QUERIES AND REPLIES TO DATA GAPS

There were no queries raised by the AEA to DISCOM during the period of MEA FY 2022-23

CONCLUSION AND ACTION PLANS

1 CRITICAL COMMENTS AND ANALYSIS BY ENERGY AUDITOR

ABOUT LOSS EVALUATION

The Distribution loss % calculation in KDHP is slightly different from other DISCOMs. The KSERC has accepted the formula which KDHP have adopted for the loss calculation due to the following reasons.

1. Multiple points where **feedback energy** fed back to KSEBL, who is the supplier of electricity to KDHP.
2. The distribution loss calculated by the KSEBL for the transmission of feedback energy is 4% instead of the actual value.

About Feedback energy:

Feedback is the energy wheeled though the system of KDHPCL for the consumers of KSEB Ltd (Energy sold outside the periphery). Since the feedback is wheeled through the distribution lines of KDHPCL, the same is considered for the computation of distribution loss for the submission to Kerala State Electricity Regulatory Commission (KSERC).

For KDHP, the distribution loss computed in the following way, considering the example of 2022-23 FY.

TABLE 59: Distribution loss – KDHP method approved by KSERC

No	Equation	Particulars	Units	2022-23
1		Gross energy flows in the system	MU	59.048
2		KSEBL feedback energy	MU	4.930
3	**1 – 2**	Energy purchased	MU	54.118
4		Energy sales to the consumers	MU	49.080
5	**3 – 4**	Distribution loss	MU	5.038
6	**5÷1**	Distribution loss	%	8.53

Where;

- *Gross energy > The energy metered at the 11 kV input lines (Pullivasal + Madupatty) at the KDHP incomer*
- *Feedback energy > The energy received by the KSEBL (Energy sold outside the periphery) after passing through the KDHP OH lines.*
- *Energy purchased > The actual energy of KDHPCL.*
- *Energy sales to the consumers > The energy that is sold to its consumers by KDHPCL.*

11KV FEEDER METERING AND ENERGY AUDIT

The DISCOM has 100% metering for all the 11 kV feeders and has provided energy input and consumption/ sale data of all the 11 KV feeders (11 kV feeders – 07 nos). The process of checking the functioning and calibration of the 11 KV feeder meters is an on-going process and is monitored by KDHP itself.

ANALYSIS ON T&D LOSSES AND AT&C LOSSES

% of losses – Aggregate: - The overall Technical Loss (T&D Loss) is 8.53% and overall AT&C Loss is 8.83% for FY 2022-23. This reflects an overall collection efficiency of 99.673%. The detailed HT, LT and Transformer losses with respect to the input energy is shown in table below.

Table 60: Analysis on T&D losses

Particulars	Units	Values
Total energy requirement	MU	59.048
Total energy sales	MU	54.011
Quantum of losses at HT level	**MU**	**1.227**
	%	**2.0781**
Quantum of LT level losses (LT and Transformer losses)	**MU**	**3.810**
	%	**6.4531**

- HT & LT level losses in the DISCOM is estimated through the line & transformer mapping.

2 ENERGY CONSERVATION MEASURES

RECONDUCTORING OF HT OVERHEAD LINES

Background

Presently 66% of the total HT overhead lines in KDHP are of either 7/14 ACSR or Copper which corresponds to 118.2 km out of the total HT line length of 180.23 km. This predominantly contributes to the HT overhead line losses. Previously, reconductoring has been done in the HT overhead lines with Racoon and Mink and this may be kept as such. The details of the HT overhead lines in KDHP are summarized in the table given below

TABLE 61 : HT OVERHEAD LINES DETAILS

OH Line type	Distance in km	Resistance of the line Ω/km
7/14 ACSR	52.3	0.5595
7/12 ACSR	3.79	0.5595
No:6 Cu	3.74	1.44

No:8 Cu	8.32	2.36
7/12 Cu	3.36	5.41
3/12 Cu	37.42	5.41
7/14 Cu	9.29	8.79
Racoon	48.64	0.3712
Mink	6.65	0.4545
DOG	6.72	0.2792

Proposal

1. In order to reduce the HT overhead line losses, it is proposed to do reconductoring for the HT overhead lines of ACSR and Copper type with DOG.
2. The resistance per line length for DOG type conductor is 0.2792 Ω/km which is considerably less than that of ACSR and Copper type conductors which will reduce the power loss through HT overhead line and thereby the net power losses in the system. Estimated reduction in energy loss is 70% of the present losses.
3. The detailed calculation for savings and financial viability is shown in the table given below.

Calculation

TABLE 62 : ECM 01

Particulars	**Units**	**ITD**	**Pullivasal**	**Town**	**Nyamakad**	**Nettigudi**	**Madupatty**
Present HT Line loss	kWh	88047	19965	32412	162909	568217	166578
Estimated HT line loss after reconductoring with DOG	kWh	45447	672	2507	87032	75784	92249
Annual Savings	kWh	42599	19294	29904	75876	492433	74329
HT line Distance to be reconducted with DOG	km	16.08	2.4	8.7	23.8	22.2	44.9
Energy charges	Rs/kWh	4.8	4.8	4.8	4.8	4.8	4.8
Reconductoring charges as per KDHP estimate	Rs/km	4,00,000	4,00,000	4,00,000	4,00,000	4,00,000	4,00,000
Annual Financial savings	Rs	2,04,476	92,609	1,43,541	3,64,206	23,63,679	3,56,780
Investment cost	Rs	64,32,000	9,60,000	34,80,000	95,20,000	88,80,000	1,79,60,000
Net Annual Financial Savings	Rs	**35,25,291**					
Net Investment	Rs	**4,72,32,000**					
Simple Pay Back Period	Months	**161**					

RECONDUCTORING OF LT OVERHEAD LINES

Background

Presently the whole LT overhead lines in KDHP are ACSR or Copper type conductors. total LT line length in the system is 193.8 km. The resistance per line length for these type conductors are comparatively high and hence the results in high LT overhead line losses. In KDHP, the LT overhead line losses share the major part of technical losses in almost all the feeders. The details of present LT overhead lines are summarized in the table given below.

TABLE 63 : LT OVERHEAD LINES DETAILS

OH Line type	Distance in km	Resistance of the line Ω/km
7/14 ACSR	133.02	0.5595
ACSR	21.15	0.5595
3/12 Cu	16.47	5.41
No:8 Cu	4.07	2.36
No:10 Cu	19.09	3.64

Proposal

1. In order to reduce the LT overhead line losses, it is proposed to do reconductoring for the specified length of LT overhead lines with Rabbit conductor.
2. The resistance per line length for Rabbit type conductor is 0.5524 Ω/km which is considerably less than the present overhead conductors which will reduce the power loss through LT overhead line and thereby the net power losses in the system. Estimated reduction in energy loss is 54% of the present losses.
3. The detailed calculation for savings and financial viability of the same, along with the distance of LT overhead line to be reconductored are mentioned in the table given below.

TABLE 64 : ECM 02

Particulars	**Units**	**ITD**	**Pullivasal**	**Town**	**Nyamakad**	**Nettigudi**	**Madupatty**
Present LT Overhead Line loss	kWh	411826	88091	804889	467561	134378	453593
Estimated LT line loss after reconductoring	kWh	181013	34908	369713	242506	53499	203219
Annual Savings	kWh	230813	53183	435176	225055	80879	250374
LT line Distance to be reconducted with Rabbit	km	37.5	0.922	9.25	21	14.2	24.2
Energy charges	Rs/kWh	4.8	4.8	4.8	4.8	4.8	4.8
Reconductoring charges as per KDHP estimate	Rs/km	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
Annual Financial savings	Rs	11,07,901	2,55,279	20,88,843	10,80,266	3,88,217	12,01,796
Investment cost	Rs	75,00,000	1,84,400	18,50,000	42,00,000	28,40,000	48,40,000
Net Annual Financial Savings	**Rs**	**61,22,303**					
Net Investment	**Rs**	**2,14,14,400**					
Simple Pay Back Period	**Months**	**42**					

ANNEXURE: COLLECTED DATA

1. ABOUT THE ACCREDITED ENERGY AUDIT FIRM

Centre for Energy Environment and Productivity (CEEP) is an Empanelled Accredited Energy Auditing Firm (EAEA) recognised by BEE. Consulting and training in the areas of energy audit, ISO 50001, cleaner production and environmental management,

Empaneled Accredited Energy Auditor with Bureau of Energy Efficiency (BEE) which have wide experience in the energy audit sector and have conducted the same in Chemical, Textile, Steel and DISCOM.

NAME AND DETAILS OF ENERGY MANAGER/AEA

M/s Kanan Devan Hills Plantations (KDHP) Company Private Limited, KDHP House, Munnar Idukki District-Kerala -685612 does not have a BEE Certified Energy Manager, however, Mr. R Jayaraman will be the signatory for all BEE activities.

On behalf of Centre for Energy Environment and Productivity (CEEP), Mr. Ashok K M P (CEA 34760/22) signed the quarterly Energy accounting report for the financial year 2022-23 and will be sign for the upcoming FY 2023-24.

The contact details of Accredited energy auditor and Energy manager from CEEP is given in the table below.

TABLE 65: CONTACT DETAILS OF AEA & CEA

Sr No	Name	Certification	EM/EA/AEA/ Registration No	Phone no	Email
1	Mr. J Nagesh Kumar	• Accredited Energy Auditor	AEA-0133	9444882553, 8668115663	ceepnagesh@gmail.com
2	Mr. Sunil kumar V K	• Sector Expert	EA – 3642	9497752463	vkoilothsunil@gmail.com
3	Mr. Ashok K M P	• Certified Energy Auditor	EA-34760/22	7356111991	ashokkmp@gmail.com
4	Ms. Della David	• Certified Energy Auditor	EA 34867/22	7356111992	delladavid19984@gmail.com

2. CHECKLIST PREPARED BY AUDITING FIRM

1. KSEB bill –FY 2022-23 – April to March
2. Truing up & ARR Document –FY
3. Bill collection data as per the performa for the FY
4. Annual financial statement – P&L – balance sheet
5. Electricity Transmission and consumption data: Both FY (year wise)
    1. Substation meter reading
    2. Feeder meter readings -
    3. DT meter reading – corresponding feeder wise
    4. HT consumer meter reading & PF - corresponding feeder wise
    5. LT consumer meter reading
    6. Solar export data – unit, location, size of the plant, voltage level, metering type (net or gross), feeder name, consumer no:
6. Transformer details
    1. Incomer transformer data
    2. Feeder wise transformer data (HT and DT separately)
    3. Name plate details of transformers
    4. No load and Copper loss of transformers
7. Energy Meter data
    1. Feeder meter & DT meter – serial no., type of meter
    2. Consumer meter – type & its number
8. HT network diagram (GRID Map)
9. Incomer substation single line diagram
10. Cable details
    1. HT cable – type, location, size, length
    2. LT cable – type, location, size, length
    3. HT & LT overhead line – type
11. Street light – number, location (estimate)
12. Quarterly Performa sheet submitted during the last FY to BEE

3. APPROACH, SCOPE & METHODOLOGY OF ENERGY AUDIT

PERIOD OF AUDIT

The energy audit field study was carried out during the period from 30th July 2023 to 01st Aug 2023 for the field study is given in the table below.

Table 66: Activity chart – Energy audit

ACTIVITIES	30th July	31st July	01st Aug
• Kick-off meeting with the concerned DISCOM officials • Data collection • site survey plan			
• Site survey • 11kV HT line mapping • DT mapping • Feeder wise measurement at switching station. • Metering deviations of major HT consumers.			
• Verification of T&D Losses, other Calculation • Finalization of form			

SCOPE OF AUDIT

1. Study and validation of the methodology adopted, data source and its accuracy of the energy audit works carried out for internal as well as external reporting in the following areas.
    a) 11 kV level for study of 11 kV distribution loss in 06 feeders.
        - Losses incurred in individual 11 kV feeders
        - Calculation of technical loss of 11 kV line
    b) Sample LT level study of Distribution transformer and LT distribution loss.
        - Losses incurred in LT line of different 11/0.433 kV distribution transformer in each feeder on 10% sample basis.
        - Calculation of technical loss of LT line with actual LT line data.
        - Selection of the distribution transformer shall be based on the differentiated consumer pattern, length of the distribution lines, old lines etc.
2. Collection and Review of the energy related data of last Financial Year (FY) in the Proforma by visiting the DISCOM physically.
3. Verification of existing pattern of energy distribution across periphery of electricity distribution company

4. Collection and verification of energy flow data of electricity distribution company at all applicable voltage level of distribution network.
5. Collection of data on energy received and distributed by DISCOM and verify the accuracy of data
6. Collection & analysis the data and prepare the same with report;
7. Input energy details:
    a) Collection of input energy from recorded system meter reading
    b) All the inputs points of transmission system
    c) Details provided by transmission unit
    d) System loading and Captures infrastructure details (i.e., no of circle, division, sub-division, feeders, DTs, & Consumers).
8. Parameters for computation of distribution losses:
    a) Details of open access, HT sale, LT sale and transmission losses
    b) Number of consumers category wise in each circle
    c) Consumers connected load category wise in each circle
    d) Details of billed and un-billed energy category wise of each circle
    e) Metered and un-metered details.
    f) Boundary meter details
    g) Energy Cost and Tariff data
    h) Source of energy Supply (e.g., electricity from grid or self-generation), including generation from renewables;
    i) Energy supplied to Open Access Consumers which is directly purchased by Open Access Consumers from any supplier other than electricity distribution company
9. Monitoring and verifications of input energy and consumption pattern at various voltage levels
10. Identify the areas of energy leakage, wastage or inefficient use;
11. Identify high loss-making areas/networks, for initiating target based corrective action;
12. Identify overloaded segments of the network for necessary capacity additions.
13. Computation of agriculture consumption (approved by SERC)
14. Methodology for loss computation various losses.
15. Computation of Average Billing Rate (ABR)
    a) Total revenue billed category wise.
    b) Category wise ABR with tariff subsidy.
    c) Category wise ABR without tariff subsidy.
    d) Collection Efficiency (Category wise) and computation of AT&C loss.

16. Observe and compile various Energy Conservation (ENCON) options implemented by the DISCOM and prepared report containing details of expenditure made by DC along with saving and payback period.
17. Recommendations to facilitate energy audit, energy accounting and improve energy efficiency
18. Study the details of loss/gain of DISCOM, analysis of Average Cost of Supply (ACS) and Average Revenue realized (ARR) gap, details of energy charges/Power purchase cost along with the financial analysis.
19. Current System Metering Status at various voltage level of DISCOM
    a) Status of Functional meters for all consumers, transformers and feeders.
    b) Status of default meters (non-functional meters) for all consumers, transformers and feeders
20. Current status of pre-requisites mentioned in regulations.
21. Copies of relevant authentic and certified documents should support the report. Each document should be sealed and signed by DISCOM authorized representative as well as by agency's AEA.
22. Prepare final report of DISCOM as per the scope of work and as per the regulation of Energy Audit, 2021, in a standard format duly indexed, covering profile of the unit and its details of energy related data w.r.t. DISCOMs Sector, analytical & Statistical details and any other relevant information.

METHODOLOGY

In order to meet requirements of the scope of Work, CEEP, adopted the following phase wise approach for completion of the assignment

Phase 1 – Pre-audit phase

a. Kick off meeting with DISCOM officials.

The following were the agenda during the kick off meeting.

- Introduction of the team
- Briefing of energy audit – Schedule of plan & execution
- Discussion about data collection format.
- Discussion on the scope of energy audit

After detailed deliberations following points were discussed.

- KDHP will provide the transportation facility for the field measurement.
- KDHP will provide a single person of contact for the energy audit assistance who has access to the T Soft (KDHP internal software).
- KDHP will provide an engineer in the field who has knowledge on the distribution lines

b. Assigning of team members.
c. Collection and Review of the energy related data

Phase 2 – Audit phase

Field survey:

a. The field survey had been conducted for HT lines and transformers of the designated area as representative data for compiling a comprehensive and diligent assessment.
b. A detail route plan of the distribution network had been also ascertained by way of segmenting data through walk down surveys along 11kV incoming feeder and corresponding 11kV feeders were also surveyed.
c. Hourly load analysis was done for all the six feeders and feeder energy meters were calibrated against the power analyzer.
d. HT lines & Transformers are mapped using the Global positioning system (GPS).
e. HT line length and partial LT line length were identified using the GPS.
f. The consumption data, type of cable, transformer details etc were collected from the DISCOM and verified with the field data.
g. Analysis of various types of losses in the system was done. Various losses in the system are as listed below.

   Technical Losses:

   - HT (11 kV) line losses
   - Distribution transformer losses (Iron & Copper losses).
   - L.T. Line losses
   - HT and LT cable losses

   Miscellaneous technical losses

   - Losses due to lose jump connections in the line
   - Losses due to short circuits & earth faults Losses in service mains of installations.
   - Losses incurred in CT'S of energy meters.
   - Losses incurred in old static energy meters.

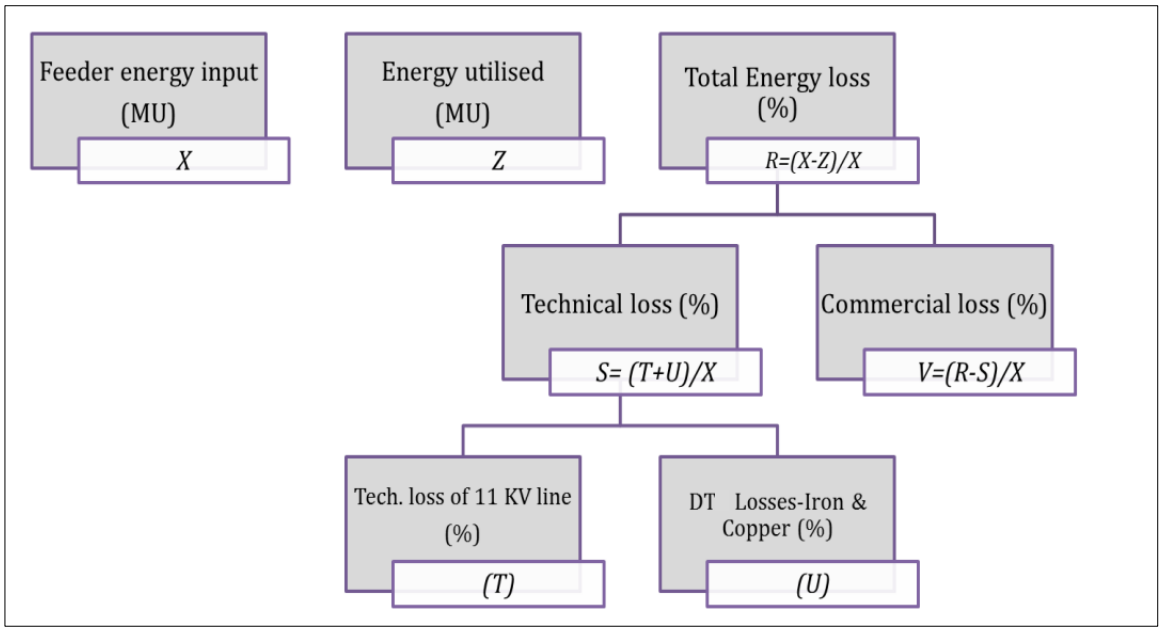


Figure 13: Schematic representation of technical losses

Commercial losses

- Mistakes in the billing.
- Meters not recording (MNR)
- Meters not recording correctly
- Meters bye passed due to defects/ intentionally.
- Meters not read & billed.
- Theft and pilferage.

Phase 3 – Post audit phase

After the identification of various loss reduction initiatives based on the HT & LT distribution detailed analysis was carried out in this phase of the study to prepare a strategy for loss reduction. Under this strategy, detailed steps are defined for loss measurement, energy audit and loss verification as well. A Final Report was prepared after discussion with KDHP officials. Submitted the report with complete database and techno economic analysis.

CALCULATIONS INVOLVED IN LOSS ANALYSIS

Technical losses occur in the system due to cables, overhead lines, transformers and other equipment in the substation. The losses in cables and overhead lines depends on the length, type of the cable/overhead line as well as the current passing through it.

The length of the overhead lines could be determined after mapping HT/LT lines and transformers using GPS and the type of overhead line was identified. The type of HT/LT cables, its length, were collected during the field visit. The energy consumption pattern during the previous 12 months for all HT consumers and LT consumers (under each distribution transformer) were analyzed and average monthly energy consumption was noted.

A. LT Losses

For LT side, the average monthly energy consumption is noted (at the transformer secondary side). The **LT overhead line losses** are calculated as per the formula given below

$$LT\ line\ losses\ per\ month\ \left(\frac{kWh}{month}\right) = 3I_L^2 * R_L * d * 24 * 30 \quad \text{..... (1)}$$

Where: I_L = average value of current passing through the LT overhead line (A)

R_L = Resistance/km of the LT overhead line (Ω/km)

d = mean length of the LT overhead line (km)

The value of I_L can be calculated from the total average monthly kWh consumption of all consumers under a single Distribution Transformer as per the following equation

$$I_L = \frac{Total\ Average\ monthly\ kWh\ consumption\ under\ each\ Distribution\ Transformer\ (\frac{kWh}{month})*1000}{\sqrt{3}*400*24*30} \quad \text{.....(2)}$$

Now, Energy transmitted from the pole of the distribution transformer (DT) is given by

$$Energy\ transmitted\ from\ the\ pole\ of\ DT\ \left(\frac{kWh}{month}\right) =$$
$$Total\ energy\ consumption\ under\ each\ DT\ (\frac{kWh}{month}) + LT\ line\ losses\ (\frac{kWh}{month}) \quad \text{.....(3)}$$

LT cable line losses are calculated as follows:

$$LT\ cable\ losses\ per\ month\ \left(\frac{kWh}{month}\right) = \frac{3I_c^2*R_c*d*24*30}{1000} \quad \text{.....(4)}$$

Where: I_c = average value of current passing through the LT cable (A)

R_c = Resistance/km of the LT cable (Ω/km)

d = length of the LT cable (km)

The value of $I_{c\ can}$ be calculated from the total average monthly energy transmitted from the pole of each Distribution Transformer as per the following equation

$$I_c = \frac{Total\ Average\ monthly\ energy\ transmitted\ from\ pole\ of\ each\ Distribution\ Transformer\ (kWh/month)*1000}{\sqrt{3}*400*24*30} \text{.....(5)}$$

Now, the energy at the secondary side of each distribution transformer is given by

$$Energy\ at\ the\ secondary\ side\ of\ each\ DT\ \left(\frac{kWh}{month}\right) =$$
$$Total\ energy\ transmitted\ from\ pole\ of\ each\ DT\ \left(\frac{kWh}{month}\right) + LT\ cable\ losses\ \left(\frac{kWh}{month}\right) \text{.....(6)}$$

B. Transformer losses

The major losses in a transformer are accounted as Core losses and Copper losses. Core losses are independent of the transformer loading whereas Copper losses depends on the loading factor. The transformer losses are given by the formula as

$$Transformer\ losses\ \left(\frac{kWh}{month}\right) = \frac{(P_{core}+x^2*P_{Cu})*24*30}{1000} \text{.....(7)}$$

Where: P_{core} = Transformer core losses (W)

P_{Cu} = Transformer Copper losses (W)

x, Transformer loading factor = Total average monthly Energy at the transformer secondary (kWh/month)/ (Average monthly Power Factor* Transformer capacity in kVA)

Thus, the total energy transmitted the HT side of each distribution transformer is given by the equation

$$Total\ average\ monthly\ energy\ transmitted\ from\ the\ transformer\ primary\ \left(\frac{kWh}{month}\right) =$$
$$Average\ monthly\ energy\ transmitted\ from\ the\ transformer\ secondary\ \left(\frac{kWh}{month}\right) +$$
$$Transformer\ losses\ \left(\frac{kWh}{month}\right) \text{.....(8)}$$

C. HT losses

For HT consumers the average monthly energy at the transformer HT side is available and the HT overhead line loss was calculated as per follows:

$$\text{HT line loss per month } \left(\frac{\text{kWh}}{\text{month}}\right) = 3I^2 * R * D * 24 * 30 \text{.....(9)}$$

Where: I = average value of current passing through the overhead line (A)

R = Resistance/km of the HT overhead line (Ω/km)

D = length of the overhead line (km)

The value of average current is found from the average monthly energy consumption recorded at the HT side as $I = \frac{average\ monthly\ kWh\ recorded\ at\ HT\ metering\ side}{24*30*11*\sqrt{3}}$ .....(10)

For LT consumers under distribution transformer the energy transmitted from the HT side of each distribution transformer is calculated as per equation (9)

$$Total\ \ monthly\ average\ energy\ transmitted\ from\ the\ pole\ at\ switching\ station\ \left(\frac{kWh}{month}\right) =$$
$$Total\ monthly\ average\ energy\ transmitted\ from\ the\ transformer\ primary\ \left(\frac{kWh}{month}\right) +$$
$$Total\ monthly\ average\ HT\ overhead\ line\ losses\ \left(\frac{kWh}{month}\right) \text{ .....(11)}$$

HT Cable losses is given by equation (12) as follows

$$HT\ cable\ losses\ \left(\frac{kWh}{month}\right) = 3\ I_T^2 * R_{HTcable} * D_c * 24 * 30 \text{ .....(12)}$$

Where: I_T = average current through the HT cable (A)

$R_{HTcable}$ = Resistance/km of HT cable (Ω/km)

D_c = length of HT Cable from incomer to Pole at switching station

The total monthly average energy transmitted from the feeder incomer =

$$The\ total\ monthly\ average\ energy\ transmitted\ from\ the\ feeder\ incomer\ (kWh/month)$$
$$= Total\ monthly\ average\ energy\ transmitted\ from\ the\ pole\ at\ switching\ station$$
$$+ HT\ cable\ losses$$

D. Feeder Meter Calibration

Continuous logging was done at each feeder for a period of 24 hours during a normal working day. The energy transmitted from each feeder was recorded using power analyzer and it is compared against the power analyzer readings. Percentage of error in the feeder side energy meter was found using the formula shown below.

$$\%\ of\ error = \frac{(Feeder\ energy\ meter\ reading - Power\ analyser\ reading\ ) * 100}{Power\ analyser\ reading}$$

LIST OF INSTRUMENTS

The instruments used for the measurements and analysis as a part of electrical distribution audit were as follows:

Table 67: Equipment list

Equipment/software name	**Make**	**Model**	**Purpose**
Portable load manager	Krykard	1. ALM 31 2. ALM 35	Load and distribution loss analysis, Meter deviation
Global positioning system meter	Garmin	Etrex 10	For mapping the HT lines and to have the coordinates of the transformers
Easy GPS software			For mapping the co-ordinates

4. INFRASTRUCTURE DETAILS

The infrastructure details of the KDHP DISCOM are given below as per the Performa filled out and verified by the accredited energy auditor.

Table 68: Infrastructure details

Form-Details of Input Infrastructure					
1	**Parameters**	**Total**	**Covered during in audit**	**Verified by Auditor in Sample Check**	**Remarks (Source of data)**
i	Number of circles	1	1	1	
ii	Number of divisions	1	1	1	
iii	Number of sub-divisions	1	1	1	
iv	Number of feeders	7	7	7	
v	Number of DTs	133	133	133	Including HT consumers
vi	Number of consumers	16583	16583	16583	
2	**Parameters**	**66kV and above**	**33kV**	**11/22kV**	**LT**
a. i.	Number of conventional metered consumers	-	-	-	6613
ii	Number of consumers with 'smart' meters	-	-	-	-
iii	Number of consumers with 'smart prepaid' meters	-	-	-	-
iv	Number of consumers with 'AMR' meters	-	-	-	-
v	Number of consumers with 'non-smart prepaid' meters	-	-	36	9934
vi	Number of unmetered consumers	-	-	-	
vii	**Number of total consumers**	-	-	36	16547
b.i.	Number of conventionally metered Distribution Transformers	-	-	-	63
ii	Number of DTs with communicable meters	-	-	-	-
iii	Number of unmetered DTs	-	-	-	70
iv	**Number of total Transformers**			-	133
c.i.	Number of metered feeders			-	
ii	Number of feeders with communicable meters			7	
iii	Number of unmetered feeders			-	
iv	**Number of total feeders**			7	
d.	Line length (ct km)			180.23	193.8
e.	Length of Aerial Bunched Cables			-	-
f.	Length of Underground Cables			0.405	4.525

3	Voltage level	Particulars	MU	Reference	Remarks (Source of data)
v	11 kV	Renewable Energy Procurement	0		
		Small capacity conventional/ biomass/ hydro plants Procurement	54.12	Purchase unit excluding feedback	
		Sales Migration Input	4.93		Feedback
vi	LT	Renewable Energy Procurement	0		
		Sales Migration Input	0		
vii		**Energy Embedded within DISCOM wires network**	59.048		
viii		**Total Energy Available/ Input**	59.048		
4	**Voltage level**	**Energy Sales Particulars**	**MU**	**Reference**	
i	LT Level	DISCOM' consumers	13.98	Include sales to consumers in franchisee areas, unmetered consumers (Total LT sales)	
		Demand from open access, captive	0.00	Non DISCOM's sales	
		Embedded generation used at LT level	0.0237	Demand from embedded generation at LT level	
		Sale at LT level	13.98		
		Quantum of LT level losses	3.81	Included the LT OH line length, LT cable, Switch gear, Commercial & Transformer losses	
		Energy Input at LT level	17.79		
ii	11 kV Level	DISCOM' consumers	35.10	Include sales to consumers in franchisee areas, unmetered consumers (HT sales)	
		Demand from open access, captive	4.93	Non DISCOM's sales	Feedback
		Embedded generation at 11 kV level used	0.001	Demand from embedded generation at 11 kV level	
		Sales at 11 kV level	40.03		
		Quantum of Losses at 11 kV	1.227		
		Energy input at 11 kV level	41.26		
		Total Energy Requirement	**59.048**		
		Total Energy Sales	**54.011**		
Energy Accounting Summary					
5	**DISCOM**	**Input (in MU)**	**Sale (in MU)**	**Loss (in MU)**	**Loss %**
i	LT				
ii	11 kV	59.048	54.011	5.038	8.53

Loss Estimation for DISCOM	
T&D loss (MU)	5.038
D loss	5.038
T&D loss (%)	8.53
D loss (%)	8.53

5. ELECTRICAL DISTRIBUTION SYSTEM

M/s Kanan Devan Hill Plantations Company Private Limited (hereinafter referred to as KDHPCL, the petitioner or the licensee) is the distribution licensee supplying electricity in its license area at Munnar. KDHPCL procures electricity from KSEB Ltd for the supply to its consumers and for its own consumption.

ELECTRICAL NETWORK CONFIGURATION

The Kanan Devan Hills Plantations Limited (KDHP) receives power at supply voltage of 11 kV from KSEBL through three incomers – two from Pullivasal feeder & One from Chithirapuram section.

The 11-kV supply from KSEBL is received at the 11-kV switching station located at the Pullivasal area, in KDHP Munnar. The received power is distributed to the consumers through seven numbers of 11 kV feeders. KDHP also receives power from the KSEBL owned and operated Maduppaty 2MW hydro generating station which is inputted into the Madupatty feeder.

The KSEBL metering is done at two locations:

1. At the 11kV incomer 1 & 2 common CT/PT and Incomer -3 CT/PT (Two TOD meters at switching station) and the value generated at two meters are summed up.
2. Madupatty Bidirectional meter.

The metered energy is transmitted to the switching station in Pullivasal using underground cables. The power then transmitted to consumers through 7 feeders through cables and overhead lines. The total number of DT under the KDHP is 133 nos', including the HT consumers.

1. Details of cables and overhead lines - summary

The details of 11 kV cable used at the switching station is given below. The data was taken from the Single line diagram of the switching station.

Table 69: Switching Station – 11 kV Cable Details

From	To	Cable size	Run	Core	Cable length (m)	R/km (ohm)
Incomer 1 &2	Switching station	300 sqmm XLPE	2	3	50	0.13
Incomer 3	Switching station	300 sqmm XLPE	1	3	60	0.13
Switching station	ITD feeder pole	240 sqmm XLPE	1	3	45	0.16
Switching station	Station transformer	240 sqmm XLPE	1	3	30	0.16
Switching station	Nyamakad feeder pole	240 sqmm XLPE	1	3	50	0.16
Switching station	Pullivasal feeder pole	240 sqmm XLPE	1	3	40	0.16
Switching station	Madupatty feeder pole	240 sqmm XLPE	1	3	50	0.16
Switching station	Town feeder pole	300 sqmm XLPE	1	3	40	0.13
Switching station	Nettigudi feeder pole	300 sqmm XLPE	1	3	40	0.13

The details of OH lines used in the KDHP distribution system is given in the table below. The HT line length was measured using the GPS mapping and LT line length was measured from the existing values of the KDHP data for the relatively new transformers.

Table 70: KDHP Distribution – OH line details

Name	Type	Voltage level (kV)	Overall, Dia (mm)	Measured length (km)	R/km (ohm)
Dog	ACSR	11	14.15	6.72	**0.2792**
Raccoon	ACSR	11	12.27	48.64	**0.3712**
Mink	ACSR	11	10.98	6.65	**0.4545**
7/14 ACSR	ACSR	11	13.7	52.30	**0.5595**
7/12 ACSR	ACSR	11	11.7	3.79	**0.5595**
No:6 Cu	Copper	11	4.11	3.74	**1.44**
No:8 Cu	Copper	11	3.26	8.32	**2.36**
7/12 Cu	Copper	11	2.05	3.36	**5.41**
3/12 Cu	Copper	11	2.05	37.42	**5.41**
7/14 Cu	Copper	11	1.63	9.29	**8.79**
Total HT OH line length				**180.23**	
Name	**Type**	**Voltage level (kV)**	**Overall, Dia (mm)**	**Estimated length (km)**	**R/km (ohm)**
Squirrel	ACSR	0.415	6.33	145	1.394
Weasel	ACSR	0.415	7.77	16.4	0.9291
3/12 Cu	Copper	0.415	2.05	12.2	5.41
No:8 Cu	Copper	0.415	3.26	4.1	2.36
No: 10 Cu	Copper	0.415	NA	16.1	2.36
Total LT OH line length				**193.8**	

The details of Transformers (HT consumers & DT) in feeder wise that has been audited under the DISCOM is listed below;

Table 71: Feeder wise transformer data

PULLIVASAL FEEDER			
HT Transformer	**Capacity in kVA**	**Distribution Transformer**	**Capacity in kVA**
Pullivasal Factory	750	Pullivasal Packeting	500
Devon Shrine	200	Allah Kovil (factory Div)	160
		Athakad	100
Total no of HT Consumers	**2**	**Total no of Distribution Transformers**	**3**
Total Capacity of HT Transformers	**950**	**Total Capacity of distribution Transformers**	**760**
ITD FEEDER			
HT Transformer	**Capacity in kVA**	**Distribution Transformer**	**Capacity in kVA**

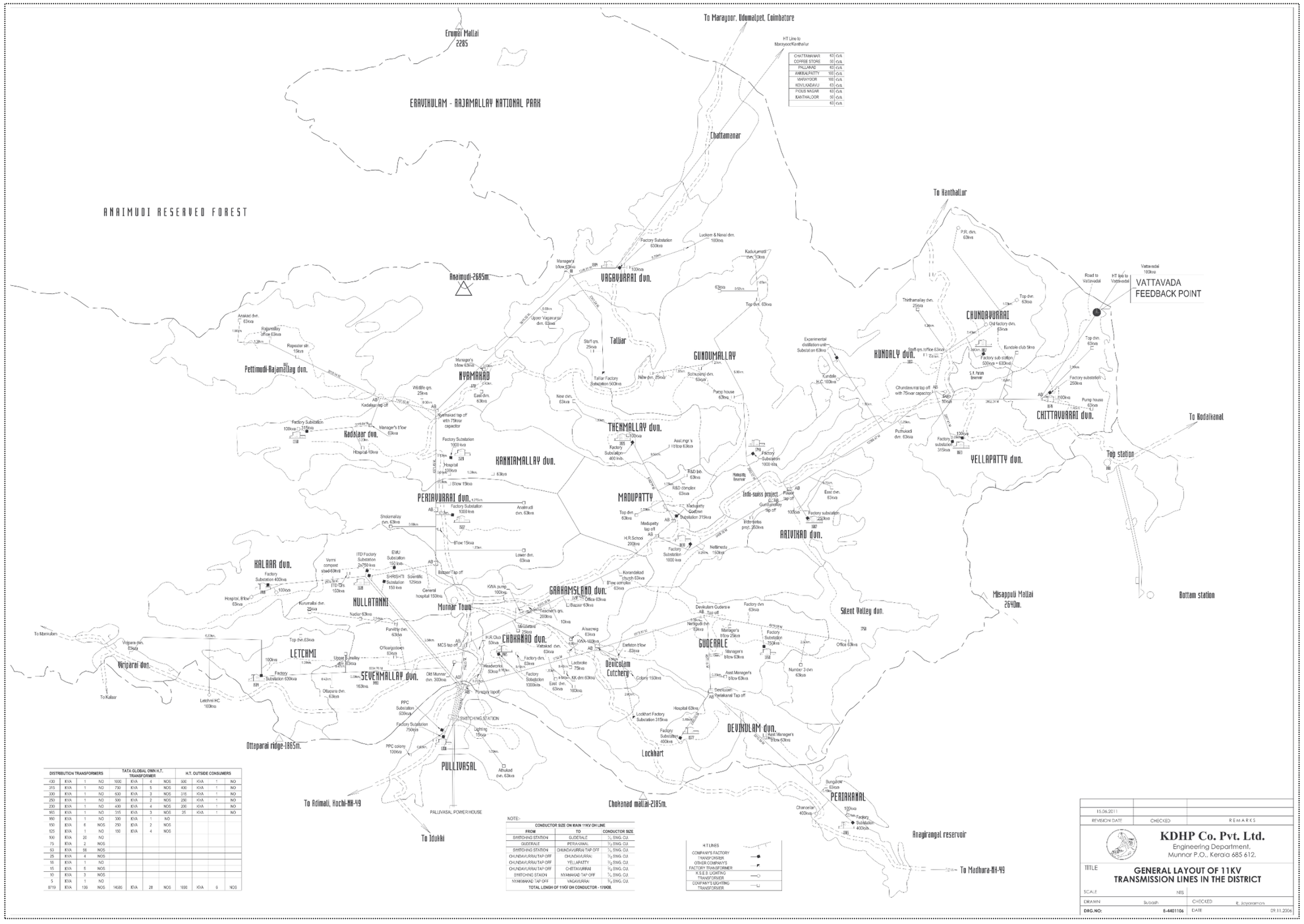
Kallar Factory	400	Kallar Factory Division	100
ITD Factory - 2 nos	1000	JE Division (new Div)	63
Letchmi Factory	630	Upper Seven Mallai Pump (sprinkler irrigation)	163
Tata BSS	200	Letchmi Viriparai	63
		Letchmi East	63
		Letchmi Factory Division	100
		Ottupara	63
		ITD Pump	63
		Upper Sevenmalay	63
		Sevenmalay Godown (Nagermudi)	63
		Paravathi	63
		Nadiar	100
		Kurumallay	25
		Hospital Bungalow (Kallar West)	63
		Nullathanni West Division	63
		Vermi Compost	63
Total no of HT Consumers	**4**	**Total no of Distribution Transformers**	**16**
Total Capacity of HT Transformers	**2230**	**Total Capacity of distribution Transformers**	**1118**
TOWN FEEDER			
HT Transformer	**Capacity in kVA**	**Distribution Transformer**	**Capacity in kVA**
Casa Montana	163	Old Munnar (tea tasting)	100
Munnar Palace (Grand Plaza)	160	Poopada	150
MS Hotels	160	Shikshak Sadan	250
EVM	200	Workshop Club	100
KTDC	400	RO	150
Engineering College	250	KSEB	250
Eastend Hotel	100	OCR	63
GH	250	Grahamsland Pump	63
		Teachers Quarters	100
		BSNL	200
		Botanical Garden	63
		Town	100
		Residency	63
		Nirmala Society	150
		Workshop Transformer	100
		High Range Club	100
		KWA Pump (water supply)	100
		Eastend	100
Total no of HT Consumers	**8**	**Total no of Distribution Transformers**	**18**
Total Capacity of HT Transformers	**1683**	**Total Capacity of distribution Transformers**	**2202**
NETTIGUDI FEEDER			
HT Transformer	**Capacity in kVA**	**Distribution Transformer**	**Capacity in kVA**
Chokanad Factory	1000	Chokanad South (fac div)	63
Periyakanal Factory	400	Chokanad East (puthukad)	63
Devikulam Factory	400	Ladbrock	75
Lockhart Factory	315	Chokanad North (vattakad)	63

Guderale Factory	750	Chokonad K K Division	63
		Periyakanal Division	100
		Ayur County	400
		Periyakanal PH(top) Division	63
		Devikulam ODK Division	63
		Devikulam Middle	63
		Devikulam Factory Division	100
		Lockhart Colony	63
		Ailsa Craig	63
		Earlston	20
		Forest (Central Nursery)	25
		Guderale Top	63
		Guderale Center (middle)	63
		Guderale Lower (Nettigudi)	63
		GuderaleManager	63
		Guderale Factory Division	63
		BSNL (Silent valley)	15
		Silent Valley Division (North)	63
		Silent Valley office (South)	100
Total no of HT Consumers	**5**	**Total no of Distribution Transformers**	**23**
Total Capacity of HT Transformers	**2865**	**Total Capacity of distribution Transformers**	**1780**
NYAMAKAD FEEDER			
HT Transformer	**Capacity in kVA**	**Distribution Transformer**	**Capacity in kVA**
Periavurrai Factory	1000	Tea Museum	150
Kadalar Factory	315	DYSP Bunglaw	5
Kannimalai Factory	750	Anamudi	63
Vagavurrai Factory	630	Periavurrai lower division (Top)	63
Thalayar Factory	500	Sollamalai	63
Nullathani Factory	315	Kanniar Bunglaw	15
Shrishti	150	Nyamakad Bunglaw	63
		Nyamakada East (Office)	63
		Forest (rajamalai)	25
		Rajamala Park	63
		Rajamala Division	50
		Pettimudi	63
		Rajamalai West BSNL	15
		Kadalar Factory Division	100
		Kadalar hospital	100
		Kadalar Bunglaw (East)	63
		Kannimalai Lower Division	100
		Kannimalai Top	63
		Vagavurrai Factory Division	100
		Vagavurrai Luckom	63
		Vagavurrai Naval	150
		Thalayar Factory Division	100
		Thalayar Bunglaw	63
		Vagavurrai Top	63
		REP station (sangumallai)	15
		Vagavurrai Bazar	100
		Manager Bunglaw	5
		Vagavurrai Lower	63

Total no of HT Consumers	**7**	**Total no of Distribution Transformers**	**28**
Total Capacity of HT Transformers	**3660**	**Total Capacity of distribution Transformers**	**1849**
MADUPATTY FEEDER			
HT Transformer	**Capacity in kVA**	**Distribution Transformer**	**Capacity in kVA**
Aruvikad Factory	250	Aruvikad Division	100
Chunduvarai Factory 1	630	Pachakad East	63
Chunduvarai Factory 2	500	Kundale Cattle shed	5
Chittivurrai factory	250	Eco Point	63
Yelapetty Factory	315	Kundale Club	5
Gundumalay Factory	1000	Chittivurrai O.C Division	63
Thenmalai Factory	500	Chittivurrai new pump (kundale pump)	100
R&D Lab	63	Chittivurrai Factory Division	100
Hi Tech KLD Board	200	Chittivurrai pump (new div)	63
Madupatty Factory	1000	Yelapetty Division	100
Indo Swiss		Chunduvarai old Factory	63
		Chunduvarai top division	63
		PR Division	63
		Kundale office	63
		Theerthamalai	75
		Puthukadi	63
		Netimadu Division	63
		KKD Church	63
		Grahamsland Office	63
		Gundumalay New Division	25
		Gundumalai BSNL (sothuara BSNL)	15
		Gundumalay Sothupara	63
		Gundumalay Benmore	63
		Gundumalay lower	63
		Gundumalay upper	63
		Gundumalay Kadugu	15
		Gundumalay Factory division	100
		Thenmalai Asst Manager Bunglaw (hospital div)	63
		Thenmalai Factory Division	100
		Thenmalai New Division	25
		R&D Complex	63
		Madupetty Godown (Fac Div/Packeting)	315
		Madupetty Top Division	63
		High Range School	150
		Grahamsland Bunglaw (Velmudi)	63
		Microwave	25
		Westwood Hotel	160
		Grahamsland Bazar	5
		Kundaly Naturals (medicinal Plant)	150
		New pump indo swiss	163
Total no of HT Consumers	**10**	**Total no of Distribution Transformers**	**40**
Total Capacity of HT Transformers	**4708**	**Total Capacity of distribution Transformers**	**2680**
Net HT Consumers	**36**		
Net Distribution Transformers	**128**		

Net Capacity of HT Transformers (kVA)	**16096**		
Net Capacity of Distribution Transformers (kVA)	**10389**		

GRID MAP



DISTRIBUTION TRANSFORMERS				TATA GLOBAL OWN H.T. TRANSFORMER				H.T. OUTSIDE CONSUMERS			
400	KVA	1	NO	1000	KVA	4	NOS	500	KVA	1	NO
315	KVA	1	NO	750	KVA	5	NOS	400	KVA	1	NO
300	KVA	1	NO	630	KVA	3	NOS	315	KVA	1	NO
250	KVA	1	NO	500	KVA	2	NOS	250	KVA	1	NO
200	KVA	1	NO	400	KVA	4	NOS	200	KVA	1	NO
160	KVA	1	NO	315	KVA	3	NOS	25	KVA	1	NO
160	KVA	1	NO	300	KVA	1	NO				
150	KVA	6	NOS	250	KVA	2	NOS				
125	KVA	1	NO	100	KVA	4	NOS				
100	KVA	20	NO								
75	KVA	2	NOS								
63	KVA	56	NOS								
25	KVA	4	NOS								
16	KVA	1	NO								
15	KVA	5	NOS								
10	KVA	3	NOS								
5	KVA	1	NO								
8719	KVA	159	NOS	14686	KVA	28	NOS	1690	KVA	9	NOS

NOTE:-

CONDUCTOR SIZE ON MAIN 11KV ON LINE		
FROM	TO	CONDUCTOR SIZE
SWITCHING STATION	GUDERALE	½ SWG. CU.
GUDERALE	PERIYAMALI	½ SWG. CU.
SWITCHING STATION	CHUNDAVURRAI TAP OFF	½ SWG. CU.
CHUNDAVURRAITAP OFF	CHUNDAVURRAI	½ SWG. CU.
CHUNDAVURRAITAP OFF	YELLAPATTY	½ SWG. CU.
CHUNDAVURRAITAP OFF	CHITTAVURRAI	½ SWG. CU.
SWITCHING STAION	NYAMAKAD TAP OFF	½ SWG. CU.
NYAKAMAD TAP OFF	VAGAVURRAI	½ SWG. CU.

TOTAL LENGH OF 11KV OH CONDUCTOR - 17.0KM.

H.T LINES
COMPANY'S FACTORY TRANSFORMER
OTHER COMPANY'S FACTORY TRANSFORMER
K.S.E.B. LIGHTING TRANSFORMER
COMPANY'S LIGHTING TRANSFORMER

15.06.2011		
REVISION DATE	CHECKED	REMARKS

KDHP Co. Pvt. Ltd.
Engineering Department,
Munnar P.O., Kerala 685 612.

TITLE: **GENERAL LAYOUT OF 11KV TRANSMISSION LINES IN THE DISTRICT**

SCALE	NTS		
DRAWN	Subash	CHECKED	R. Jayaraman
DRG. NO:	E-4401106	DATE	09.11.2006

Figure 14: Grid Map – 11 kV distribution line

6. POWER PURCHASE DETAILS

POWER ALLOCATION

The State Government of Kerala allocates the energy available from various sources among the state DISCOM's to ensure balanced financial viability and fairly uniform tariff for various categories of consumers in different parts of the state. The allocation is also to ensure payment of power purchase cost including transmission and other related expenses. The point of connection charges shall be paid by DISCOM proportionate to energy allocation of each source. The KDHP has only single source of power – KSEBL – which is owned and operated by the Kerala State Government. The power purchase capacity of the KDHP as per the Power purchase agreement is 09 MW.

AVERAGE BILLING RATE (ABR):

ABR for a consumer category is determined by dividing total expected revenue from the category by total expected sale to that category. Mathematically, it can be represented as:

$$ABR\ of\ a\ category\ of\ consumer = \frac{Total\ Expected\ revenue\ from\ a\ category}{Total\ Sale\ of\ power\ to\ that\ category}$$

The ABR (Average rate /kWh) of each category as per the audited sheet of KDHP is given below. The net average rate/unit is given as Rs 6.91/kWh.

Note:

- *There is no tariff subsidy for the DISCOM consumers as per the KSERC regulations*
- *ABR value received from the KDHP accounts based on the estimated purchase cost.*
- *Once the Truing up and the annual accounts completed actual value will be different from the present reported one.*

AVERAGE POWER PURCHASE COST PER UNIT:

Average per unit cost power purchase for a consumer category is determined by dividing total unit purchase cost from the category by total input purchase in units. Mathematically, it can be represented as:

$$APC\ of\ a\ category\ of\ consumer = \frac{Total\ Purchase\ cost\ from\ a\ category}{Total\ input\ purchase\ units}$$

The net average power purchase cost per unit of the DISCOM is available from the Trueing up document and summarised in the table below.

Table 72: Average purchase cost – DISCOM

FY	Total input energy purchased (MU)**	Total purchase cost (Rs lakhs)	APC (Rs/unit)
2020-21	48.14	2689.53	5.59
2021-22	48.4	2695.88	5.57
2022-23	NA	NA	NA

***Total input energy purchased (MU) = Input energy (MU) at the KDHP – feedback energy (MU)*

- ***Source**: Audited balance sheet and financial year statement 2020-21 & 2021-22*
- ***Audited balance sheet of FY 2022**-23 not yet finished while submitting the energy audit report.*

ACS – ARR GAP ANALYSIS

The Average cost of supply (ACS) and the average revenue realised (ARR) is conducted in the DISCOM during the energy audit and summarized in the below table and chart.

Table 73: ACS- ARR gap

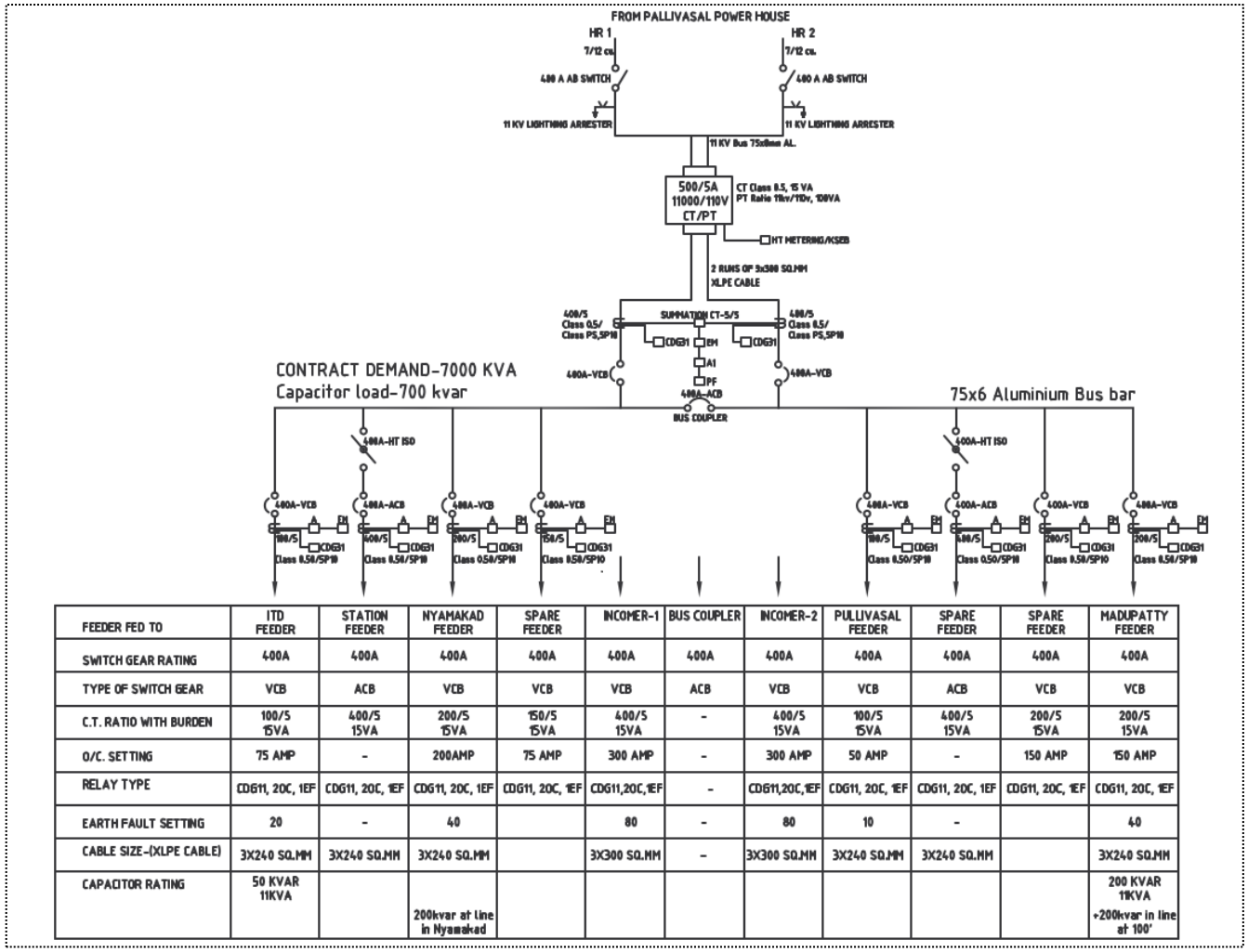
	Input energy (MU)**	Total expenditure (Rs in lakhs)	Total revenue (Rs)	ACS (Rs/kWh)	ARR (Rs/kWh)	ACS - ARR gap (Rs/kWh)
2020-21	48.14	2967.88	2884.83	6.17	5.99	-0.17
2021-22	48.4	2,992.30	2,955.48	6.18	6.11	-0.08
2022-23	NA	NA	NA	NA	NA	NA

***Total input energy purchased (MU) = Input energy (MU) at the KDHP – feedback energy (MU)*

- ***Source**: Audited balance sheet and financial year statement 2020-21 & 2021-22*
- ***Audited balance sheet of FY 2022**-23 not yet finished while submitting the energy audit report.*

7. SINGLE LINE DIAGRAM

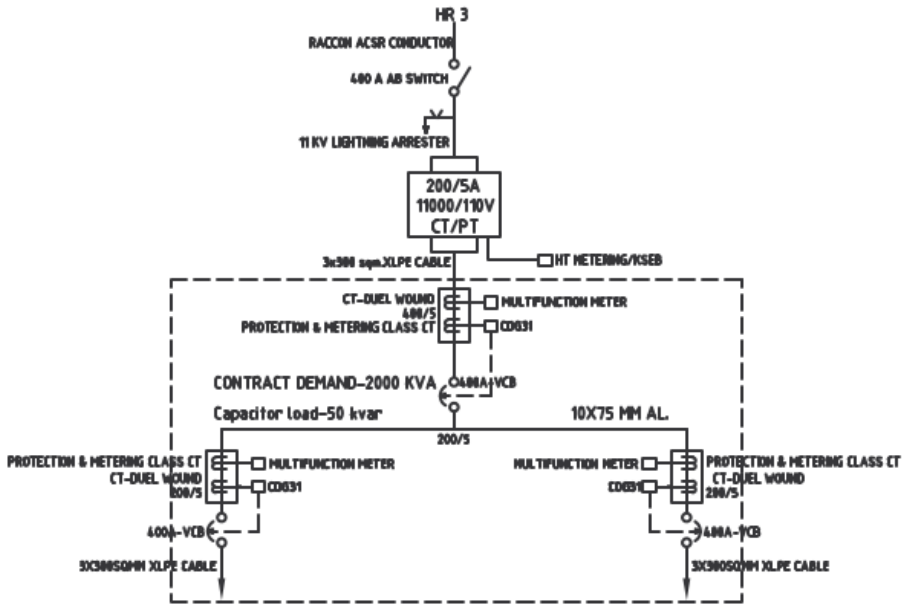
FROM PULLIVASAL POWER HOUSE – INCOMER 1&2



FEEDER FED TO	ITD FEEDER	STATION FEEDER	NYAMAKAD FEEDER	SPARE FEEDER	INCOMER-1	BUS COUPLER	INCOMER-2	PULLIVASAL FEEDER	SPARE FEEDER	SPARE FEEDER	MADUPATTY FEEDER
SWITCH GEAR RATING	400A	400A	400A	400A	400A	400A	400A	400A	400A	400A	400A
TYPE OF SWITCH GEAR	VCB	ACB	VCB	VCB	VCB	ACB	VCB	VCB	ACB	VCB	VCB
C.T. RATIO WITH BURDEN	100/5 15VA	400/5 15VA	200/5 15VA	150/5 15VA	400/5 15VA	-	400/5 15VA	100/5 15VA	400/5 15VA	200/5 15VA	200/5 15VA
O/C. SETTING	75 AMP	-	200AMP	75 AMP	300 AMP	-	300 AMP	50 AMP	-	150 AMP	150 AMP
RELAY TYPE	CDG11, 20C, 1EF	CDG11, 20C, 1EF	CDG11, 20C, 1EF	CDG11, 20C, 1EF	CDG11,20C,1EF	-	CDG11,20C,1EF	CDG11, 20C, 1EF	CDG11, 20C, 1EF	CDG11, 20C, 1EF	CDG11, 20C, 1EF
EARTH FAULT SETTING	20	-	40		80	-	80	10	-		40
CABLE SIZE-(XLPE CABLE)	3X240 SQ.MM	3X240 SQ.MM	3X240 SQ.MM		3X300 SQ.MM	-	3X300 SQ.MM	3X240 SQ.MM	3X240 SQ.MM		3X240 SQ.MM
CAPACITOR RATING	50 KVAR 11KVA		200kvar at line in Nyamakad								200 KVAR 11KVA +200kvar in line at 100'

Figure 15: SLD – From Pullivasal power house- at switching station

FROM CHITHIRAPURAM SECTION – INCOMER 3



FEEDER FED TO	NETTIGUDI FEEDER		TOWN FEEDER
SWITCH GEAR RATING	400A		400A
TYPE OF SWITCH GEAR	VCB		ACB
C.T. RATIO WITH BURDEN	200/5 15VA		200/5 15VA
O/C. SETTING	150 AMP		100 AMP
RELAY TYPE	CDG11, 2 OC, 1EF		CDG11, 2 OC, 1EF
EARTH FAULT SETTING	20		10
CABLE SIZE-(XLPE CABLE)	3X300 SQ.MM		3X300 SQ.MM
CAPACITOR RATING	50 KVAR 11KVA		-
EARTHING	25X6 CU.		25X6 CU.

Figure 16: From Chithirapuram – at switching station – Incomer 3

8. CATEGORY OF SERVICE DETAILS

DETAILS OF CONSUMERS AND CONSUMPTION

The details of consumers and consumption is given in the table below:

Table 74: Details of consumers and consumption

Summary of Energy						
Period from 1st April 2022 to 31st March 2023						
S. No	**Type of Consumers**	**Category of Consumers (EHT/HT/LT /Others)**	**Voltage Level (In Voltage)**	**No of Consumers**	**Total Consumption (In MU)**	**Remarks (Source of data)**
1	Domestic	LT	0.415	14010	7.80	T-soft - KDHP s/w
2	Commercial	LT	0.415	1224	3.40	T-soft - KDHP s/w
3	IP Sets					
4	Hor. & Nur. & Coffee/Tea & Rubber (Metered)					
5	Hor. & Nur. & Coffee/Tea & Rubber (Flat)					
6	Heating and Motive Power					
7	Water Supply					
8	Public Lighting	LT	0.415	265	0.39	T-soft - KDHP s/w
9	HT Water Supply					
10	HT Industrial	HT	11	22	32.26	T-soft - KDHP s/w
11	Industrial (Small)	LT	0.415	93	0.59	T-soft - KDHP s/w
12	Industrial (Medium)					
13	HT Commercial	HT	11	9	2.05	
14	Applicable to Government Hospitals & Hospitals	HT	11	1	0.045	T-soft - KDHP s/w
15	Lift Irrigation Schemes/Lift Irrigation Societies	HT Others	11	4	0.75	T-soft - KDHP s/w
16	HT Res. Apartments Applicable to all areas					
17	Mixed Load					
18	Government offices and department					
19	Feedback energy – Energy sold outside the periphery	HT/LT	11/0.415		4.93	T-soft - KDHP s/w
20	Agriculture	LT	0.415	7	0.016	T-soft - KDHP s/w
21	LT General	LT	0.415	948	1.78	T-soft - KDHP s/w
	Total			**16583**	**54.011**	

DIVISION WISE STATUS OF DT LEVEL METERING

The division wise status of DT level metering is given in the table below.

Table 75: Division wise status of DT level metering

a. Division wise status of DT level metering										
Zone name	Circle name	Division name	Feeder name	Total no of DT on feeder	No of unmetered DTs	No of metered DTs			No. of DTs with functional meters	
						AMR metered (communicable)	AMI metered (communicable)	Non-AMR / AMI metered (non-communicable)	Communicating (Total No out of 7 and 8)	Non-communicating (Total No. out of 7,8 and 9)
1	2	3	4	5=(6+7+8+9)	6	7	8	9	10	11
KDHP	KDHP	KDHP	Nayamakad	31	16			15		15
KDHP	KDHP	KDHP	Madupatty	41	25			16		16
KDHP	KDHP	KDHP	Nettigudi	24	12			12		12
KDHP	KDHP	KDHP	Town	18	9			9		9
KDHP	KDHP	KDHP	ITD	16	8			8		8
KDHP	KDHP	KDHP	Pullivasal	3	0			3		3

DETAILS OF DT WISE LOSSES

The details of DT wise losses as per the Performa is given in the table below.

Table 76: DT wise losses

b. Details of DT-wise losses													
Sub-station ID	**Feeder ID**	**Feeder Name**	**DT Id no**	**DT Capacity (kVA)**	**Predominant consumer type of DT (Domestic/Industrial/Agriculture/Mixed)**	**Type of metering (Unmetered/AMI/AMR/Other)**	**Status of meter (functional/non-functional)**	**% of data received automatically (if AMI/AMR)**	**No. of connected consumers**	**Input Energy (MU)**	**Billed Energy (MU)**	**Loss of Energy (MU)**	**% Loss**
		1	**2**						**3**	**4**	**5**	**6 = 4-5**	**(7)= [(6)/(4)]*100**
		Pullivasal	Pullivasal Estate	750	Industrial								
		Pullivasal	Pullivasal Packeting Centre (PPC)	500	Industrial								
		Pullivasal	DEVONSHIRE GREENS	200	Mixed								
		Pullivasal	Athukadu dn.	100	Domestic								
		Pullivasal	Allakovil transformer	160	Domestic	Metered							
		ITD	Tata BSS	200	Mixed								
		ITD	Instant Tea Division (ITD)	1000	Industrial								
		ITD	KALAAR	400	Industrial								
		ITD	LETCHMI	630	Industrial								
		ITD	Vermi compost	63	Domestic								
		ITD	Nullatanni West Division	63	Domestic								
		ITD	Kallar Factory Divi	100	Domestic	Metered							
		ITD	JE Divsn	63	Domestic								
		ITD	Hospital Bungalow(Kallar West)	63	Domestic								
		ITD	Sevenmalay Godown (Nagermudi)	63	Domestic								

		ITD	Paravathi	63	Domestic								
		ITD	Nadiar	100	Domestic								
		ITD	Kurumallai	25	Domestic								
		ITD	UpperSevenmallaiPump(Sprinkler)	163	Domestic								
		ITD	Upper Sevenmallay	63	Domestic								
		ITD	Ottaparai	63	Domestic								
		ITD	Letchmi East	63	Domestic								
		ITD	Letchmi Factory Div	100	Domestic								
		ITD	Letchmi viriparai	63	Domestic	Metered							
		Nyamakad	Shristi Complex	150	Mixed								
		Nyamakad	Nullatanni Withering Factory	315	Industrial								
		Nyamakad	PERIAVURRAI	1000	Industrial								
		Nyamakad	KANNIAMALLAY	750	Industrial								
		Nyamakad	Talliar	500	Industrial								
		Nyamakad	VAGAVURRAI	630	Industrial								
		Nyamakad	KADALAAR	315	Industrial								
		Nyamakad	Tea Museum	150	Mixed								
		Nyamakad	DYSP bunglaw	5	Domestic								
		Nyamakad	Periavurrai lower(top)	63	Domestic								
		Nyamakad	Sholamalai	63	Domestic	Metered							
		Nyamakad	Anamudi	63	Domestic	Metered							
		Nyamakad	Kanniar Bunglaw	15	Domestic								
		Nyamakad	Kannimalai top	63	Domestic	Metered							
		Nyamakad	Kannimalai lower	100	Domestic	Metered							
		Nyamakad	Nyamakad blow	63	Domestic	Metered							
		Nyamakad	Nyamakad east (office)	63	Domestic	Metered							
		Nyamakad	Vagavurrai top	63	Domestic								
		Nyamakad	Vagavurrai lower	63	Domestic								
		Nyamakad	Vagavurrai bazar	100	Domestic								
		Nyamakad	Thalayar blow	63	Domestic								

		Nyamakad	thalayar division	100	Domestic								
		Nyamakad	manager blow	5	Domestic								
		Nyamakad	vag fac div	100	Domestic								
		Nyamakad	vag naval	150	Domestic								
		Nyamakad	vag luckom	63	Domestic								
		Nyamakad	Rajamalai west bsnl	15	Domestic								
		Nyamakad	forest (rajamalai)	25	Domestic								
		Nyamakad	kadalar blow (east)	63	Domestic								
		Nyamakad	kadalar hospital	100	Domestic								
		Nyamakad	kadalar fac div	100	Domestic								
		Nyamakad	Rajamalai park	63	Mixed	Metered							
		Nyamakad	wireless station (sangumalai)	15	Domestic								
		Nyamakad	Rajamalai div	50	Domestic	Metered							
		Nyamakad	Pettimudi	63	Domestic	Metered							
		Nettigudi	Chokanad Factory	1000	Industrial								
		Nettigudi	Lockhart Factory	315	Industrial								
		Nettigudi	Guderale Factory	750	Industrial								
		Nettigudi	Devikulam Factory	400	Industrial								
		Nettigudi	Periyakanal Factory	400	Industrial								
		Nettigudi	Chokanad South (fac div)	63	Domestic	Metered							
		Nettigudi	Chokanad East (puthukad)	63	Domestic	Metered							
		Nettigudi	Chokanad North (vattakad)	63	Domestic	Metered							
		Nettigudi	Chokonad K K Division	63	Domestic	Metered							
		Nettigudi	Ailsa Craig	63	Domestic	Metered							
		Nettigudi	Ladbrock	75	Domestic								
		Nettigudi	Earlston	20	Domestic								
		Nettigudi	Forest (Central Nursery)	25	Domestic								
		Nettigudi	Lockhart Colony	63	Domestic								
		Nettigudi	GuderaleManager	63	Domestic	Metered							
		Nettigudi	Guderale Factory Division	63	Domestic	Metered							
		Nettigudi	BSNL (Silent valley)	15	Domestic								

		Nettigudi	Silent Valley Division (North)	63	Domestic								
		Nettigudi	Silent Valley office (South)	100	Domestic								
		Nettigudi	Guderale Lower (Nettigudi)	63	Domestic	Metered							
		Nettigudi	Guderale Center (middle)	63	Domestic	Metered							
		Nettigudi	Guderale Top	63	Domestic	Metered							
		Nettigudi	Devikulam Middle	63	Domestic	Metered							
		Nettigudi	Devikulam Factory Division	100	Domestic	Metered							
		Nettigudi	Devikulam ODK Division	63	Domestic	Metered							
		Nettigudi	Periyakanal PH(top) Division	63	Domestic	Metered							
		Nettigudi	Ayur County	400	Mixed								
		Nettigudi	Periyakanal Division	100	Domestic								
		Town	CASA-Casa Mountana Hotel	163	Mixed								
		Town	GRAND PLAZA MUNNAR	160	Mixed								
		Town	M.S.HOTELS	160	Mixed								
		Town	EVM Hotels	200	Mixed								
		Town	KTDC Tea county	400	Mixed								
		Town	Eastend Hotel	100	Mixed								
		Town	General Hospital	250	Mixed								
		Town	ECOL-ENGINEERING COLLEGE	250	Domestic								
		Town	Old Munnar (tea tasting)	100	Domestic								
		Town	High Range Club	100	Domestic								
		Town	Poopada	150	Domestic								
		Town	Workshop Club	100	Domestic								
		Town	Workshop Transformer'	100	Domestic								
		Town	Shikshak Sadan	250	Domestic								
		Town	RO	150	Domestic								
		Town	Grahamsland Pump	63	Domestic								
		Town	Teachers Quarters	100	Domestic								
		Town	KWA Pump	100	Domestic								
		Town	Botanical Garden	63	Domestic								
		Town	Eastend	100	Domestic								

		Town	BSNL	200	Domestic	Metered							
		Town	Town	100	Domestic	Metered							
		Town	Residency	63	Domestic								
		Town	Nirmala Society(scientific Div)	150	Domestic								
		Town	General Hospital		Domestic	Metered							
		Town	KSEB	250	Domestic								
		Town	OCR	63	Domestic								
		Madupatty	R&D lab	63	Mixed								
		Madupatty	Tenmalay factory	500	Industrial								
		Madupatty	Madupatty factory	1000	Industrial								
		Madupatty	Madupatty hydel			Metered							
		Madupatty	High tech KLD board	200	Industrial								
		Madupatty	Indo swiss project		Industrial								
		Madupatty	Gundumalay factory	1000	Industrial								
		Madupatty	Aruvikkad factory	250	Industrial								
		Madupatty	Yelapatty factory	315	Industrial								
		Madupatty	Chunduvarrai factory	630	Industrial								
		Madupatty	Chittivurrai factory	250	Industrial								
		Madupatty	WestWood Hotel	160	Mixed								
		Madupatty	Microwave	25	Domestic								
		Madupatty	Grahamsland Office	63	Domestic	Metered							
		Madupatty	Grahamsland Bazar	5	Domestic								
		Madupatty	Grahamsland Bunglaw (Velmudi)	63	Domestic	Metered							
		Madupatty	KKD Church (Korandikad dn)	63	Domestic	Metered							
		Madupatty	High Range School	150	Mixed								
		Madupatty	Madupatty Top Dn.	63	Domestic								
		Madupatty	R & D Complex	63	Domestic								
		Madupatty	Thenmalai AsstManager Bunglaw(Hospital Division)	63	Domestic	Metered							
		Madupatty	Thenmalai Factory Dn	100	Domestic	Metered							
		Madupatty	Thenmalai New Division	25	Domestic	Metered							

		Madupatty	Madupetty Godown	315	Domestic								
		Madupatty	Netimadu Division	63	Domestic								
		Madupatty	Gundumallay Factory dvn	100	Domestic	Metered							
		Madupatty	GUNDUMALLAY Benmure	63	Domestic	Metered							
		Madupatty	Gundumalay Sothupara (Top Dn)	63	Domestic	Metered							
		Madupatty	Gundumalay BSNL(Sothuparai BSNL tower)	15	Domestic								
		Madupatty	Gundumalay New Dn	25	Domestic	Metered							
		Madupatty	Gundumalay Upper Dn	63	Domestic								
		Madupatty	Gundumalay Lower Dn	63	Domestic	Metered							
		Madupatty	Gundumalay Kadugu	15	Domestic								
		Madupatty	New pump indo swiss (irrigation)	163	Domestic								
		Madupatty	Aruvikad Division	100	Domestic	Metered							
		Madupatty	Eco Point	63	Domestic								
		Madupatty	East divsn pachakkad	63	Domestic	Metered							
		Madupatty	Kundaly Naturals (medicinalPlant)	150	Domestic								
		Madupatty	Puthukadi	63	Domestic	Metered							
		Madupatty	Yelapetty	100	Domestic	Metered							
		Madupatty	Kundale office	63	Domestic								
		Madupatty	Theerthamalai	75	Domestic	Metered							
		Madupatty	Chunduvarai Old factory	63	Domestic	Metered							
		Madupatty	PR Division`	63	Domestic	Metered							
		Madupatty	Top DN(CHUNDAVURRAI)	63	Domestic	Metered							
		Madupatty	Kundale Club	5	Domestic								
		Madupatty	Chittivurrai Factory Div	100	Domestic	Metered							
		Madupatty	Chittivurri pump (new Div)	100	Domestic	Metered							
		Madupatty	Chittivurrai OC Division	63	Domestic	Metered							
		Madupatty	KUNDALAY Cattle shed	5	Domestic								

Note: The DT level input energy is not recorded by the DISCOM that results in non-evaluation of DT level losses.

9. FIELD VERIFICATION DATA

ENERGY & POWER QUALITY ANALYSIS) – AT SWITCHING STATION

The objective of this section is to establish how the facility is performing in terms of energy consumption and the quality of power at the switching station.

- **Incomer 1 & 2, 3 – Measurement Evaluation**

The continuous power measurement of incomer feeders (Pullivasal feeder 1&2, chithirapuram feeder no-3) conducted using the Krykard ALM 35 and ALM 31 series power quality analysers. The incomer side was logged for 24 hours and measured data is summarized in the following table. The measurement-averaging period was 02 minutes. The measurement was done on 30th & 31st July 2023.

The summary of measured parameters of the transformer is given in the table below.

Table 77: Incomer Measurement Data

Incomer Name		**Incomer 1&2**	**Incomer 3**	
Date of measurement		30th & 31st July 2023	30th & 31st July 2023	
Basic Parameters				**Remarks**
Parameters	**Units**	**Incomer 1&2**	**Incomer 3**	
Voltage line (kV)	Min	9.89	0	Power failure in Incomer-3 for a period of 05 minutes
	Avg	10.49	10.49	
	Max	11.06	11.1	
Current (A)	Min	99.52	0	Power failure in Incomer-3 for a period of 05 minutes
	Avg	237.4	141.7	
	Max	632.88	193.6	
Frequency (Hz)	Min	49.8	49.29	
	Avg	50	50	
	Max	50.18	50.18	
Energy Parameters				
Parameters	**Units**	**Incomer 1&2**	**Incomer 3**	
Energy consumed (kWh)	Total	104969.46	62545.77	
Energy received (kVAh)	Total	106341.27	63701.76	
Power factor		0.986	0.98	
Active power (kW)	Min	1896.6	0	Power failure in Incomer-3 for a period of 05 minutes
	Avg	4232.6	2522	
	Max	6165.8	3330.8	
Apparent power (kVA)	Min	1914.3	0	
	Avg	4287.9	2568.6	
	Max	6257.1	3363.4	
Reactive power (kVAr)	Min	-604.4	0	Power failure in Incomer-3 for a period of 05 minutes
	Avg	129.4	612.8	

	Max	596.3	847.3	
Power quality parameters				
Parameters	**Units**	**Incomer 1&2**	**Incomer 3**	**Remarks**
Voltage imbalance %	Min	0.5	0.1	
	Avg	0.59	0.29	
	Max	0.7	0.5	
Current imbalance %	Min	0.5	1	
	Avg	1.26	2.19	
	Max	2.2	4.5	
THDv %	Min	0.3	1.3	
	Avg	0.62	1.66	
	Max	1.1	2.1	
THDa %	Min	1.1	0.7	
	Avg	2.4	1.7	
	Max	6.4	5.9	

- **Electrical Parameters – Profile**

10.1..1 Power Variations – Incomer

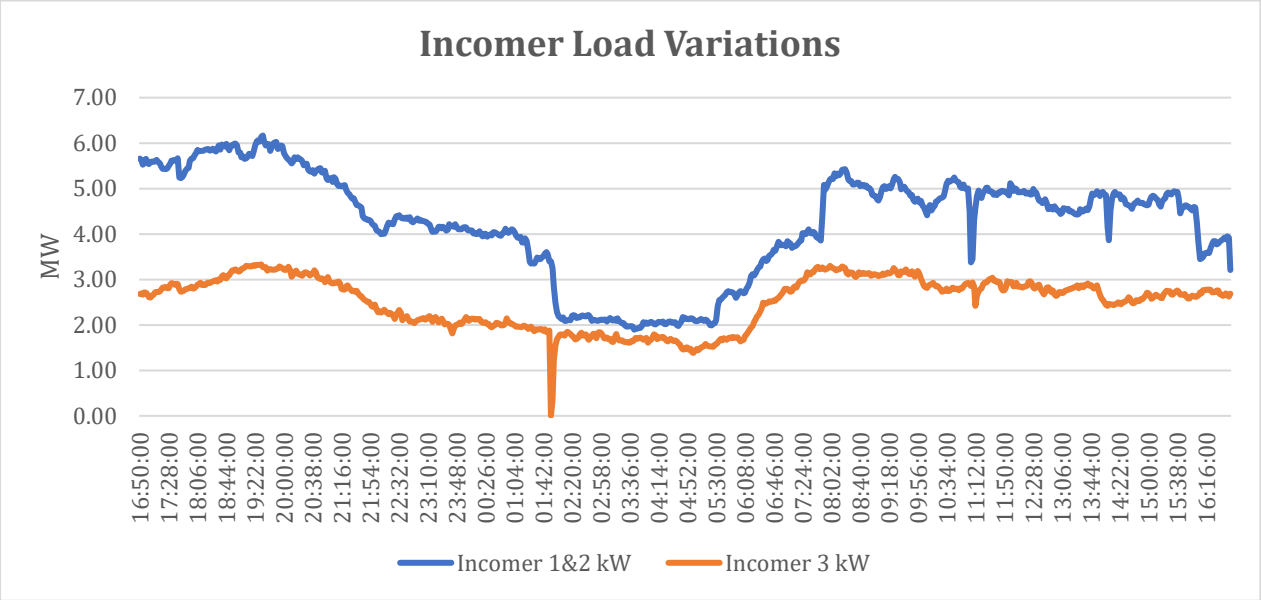


Figure 17: Power variations – continuous logged data

10.1..2 Demand Variations – Incomer

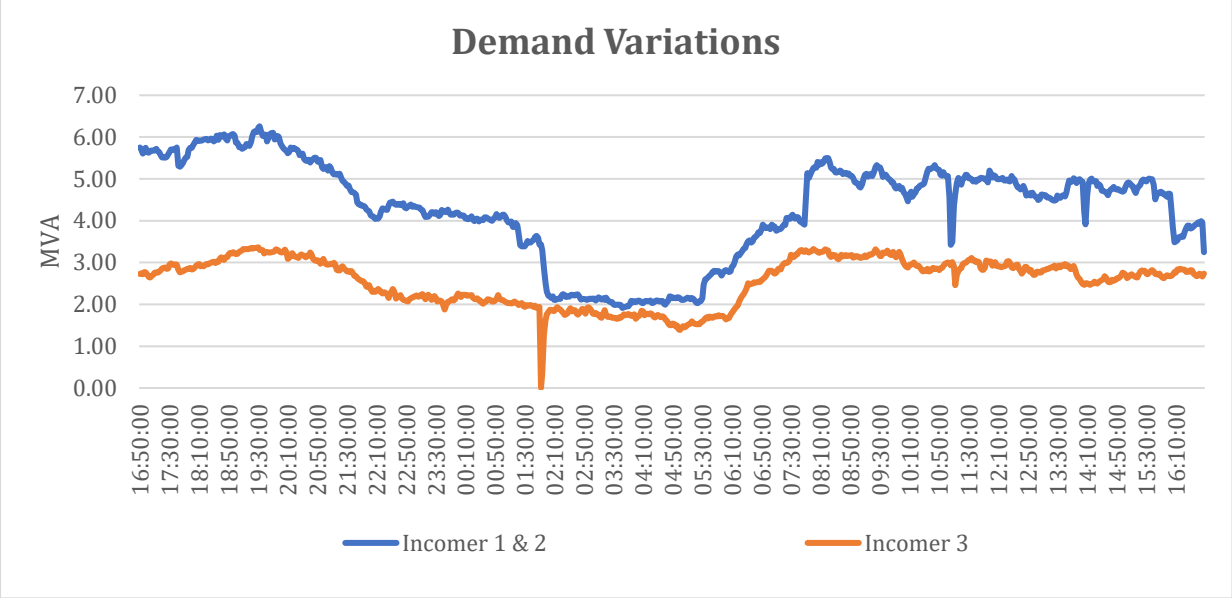


Figure 18: Demand variations – continuous logged data

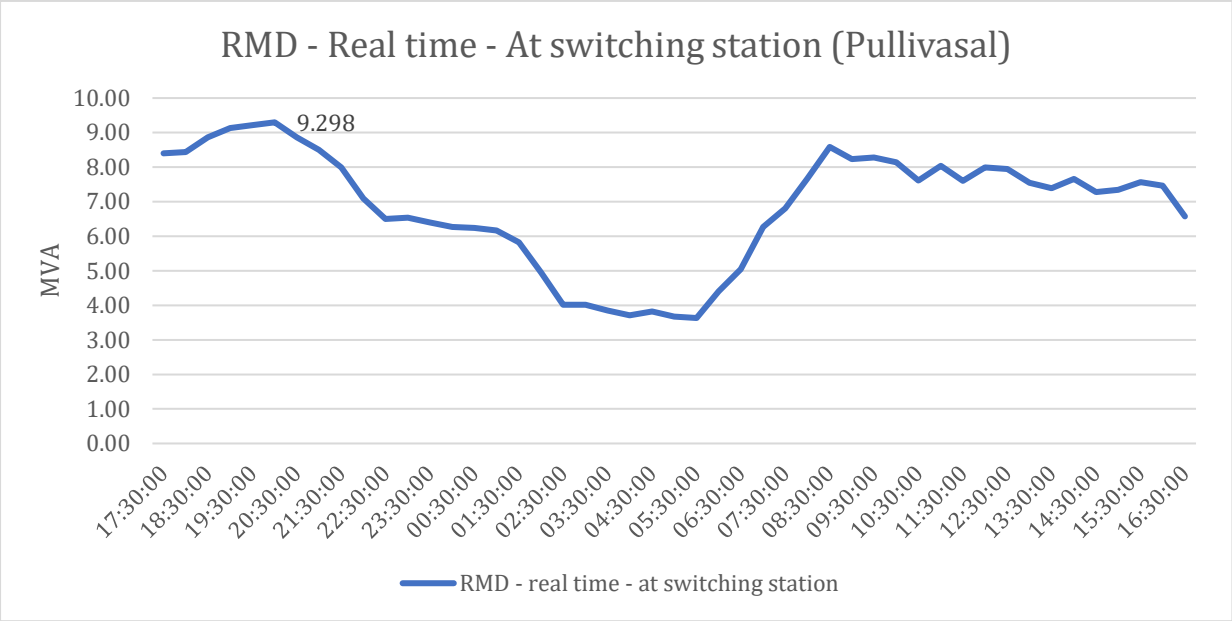


Figure 19: RMD – Real time

- The maximum demand registered in 30-minute cycle in the continuous logging of 24-hour measurement at Pullivasal switching station after summing up the two incomer metering points was 9298 kVA (9.29 MVA) at 20:00 hours.

10.1..3 Power Factor Variations - Incomer

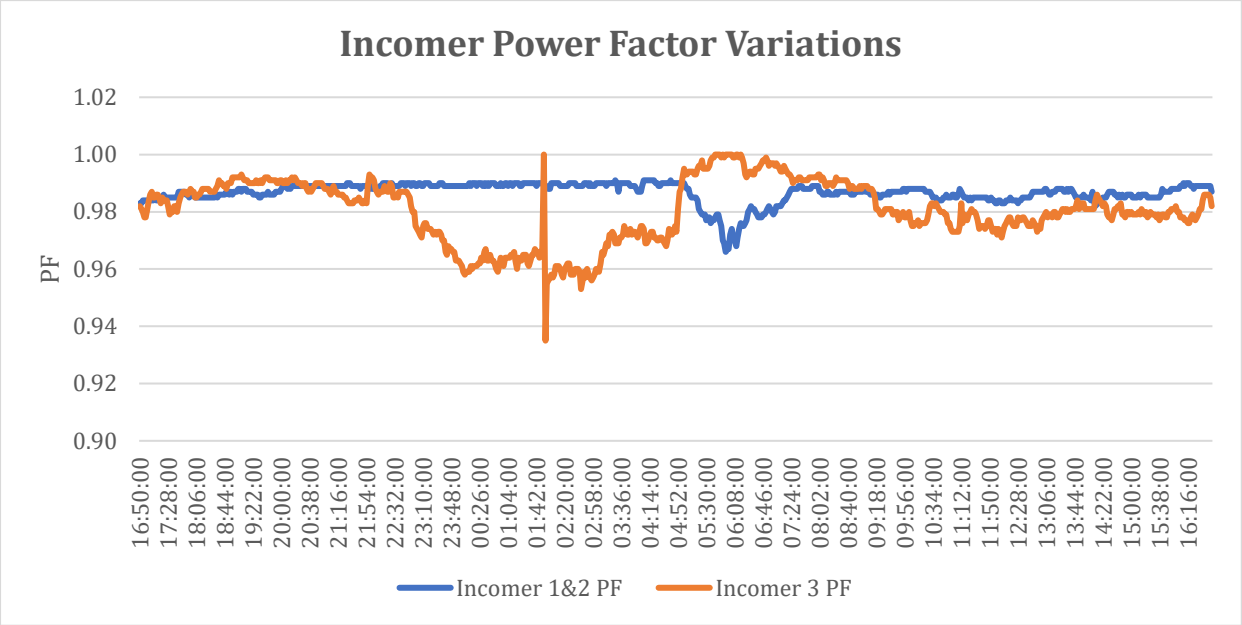


Figure 20: Power factor – variations

- **Power Quality**

Harmonics study revolves around the use of non-linear loads that are connected to electric power systems including static power converters, arc discharge devices, saturated magnetic devices and to a lesser degree, rotating machines. Static power converters of electric power are the largest non-linear loads and are used in industry for a variety of purposes such as electro- chemical power supplies, adjustable speed drives, and uninterruptible power supplies.

Table 78: CURRENT HARMONICS LIMIT (IEEE 519-2014)

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)[a, b]						
I_{SC}/I_L	$3 \le h < 11$	$11 \le h < 17$	$17 \le h < 23$	$23 \le h < 35$	$35 \le h \le 50$	TDD
< 20[c]	4.0	2.0	1.5	0.6	0.3	5.0
$20 < 50$	7.0	3.5	2.5	1.0	0.5	8.0
$50 < 100$	10.0	4.5	4.0	1.5	0.7	12.0
$100 < 1000$	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

[a]Even harmonics are limited to 25% of the odd harmonic limits above.

[b]Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.

[c]All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

where

I_{sc} = maximum short-circuit current at PCC

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions

Table 79: VOLTAGE HARMONICS LIMIT (IEEE 519-2014)

Voltage distortion limits		
Bus voltage at PCC	**Individual voltage distortion %**	**Total voltage harmonics distortion %**
V ≤ 01 kV	5.0	8.0
01 kV < V ≤ 69 kV	3.0	5.0
69.001 kV < V ≤ 161 kV	1.5	2.5
161.001 kV and above	1.0	1.5

Harmonic limits at the KDHP incomer is given in the table below:

Table 80: Standard limits as per the IEEE 519-2014 – at KDHP incomer

2. Normal range of Isc/I_L at KDHP incomer	-	**<20**
3. Maximum standard Total demand distortion – current	-	5%
4. Maximum standard Total harmonic distortion – voltage	-	5%

Harmonic values at the KDHP incomer are given in the table below:

Table 81: Harmonics values – KDHP incomer

Particulars	THDv max	THDa max	Remarks
	%	%	
Incomer 1 & 2	1.1	6.4	Higher current harmonics
Incomer 3	2.1	5.9	Higher current harmonics

10.1..1 Harmonic spectrum

- **Voltage harmonic spectrum:**

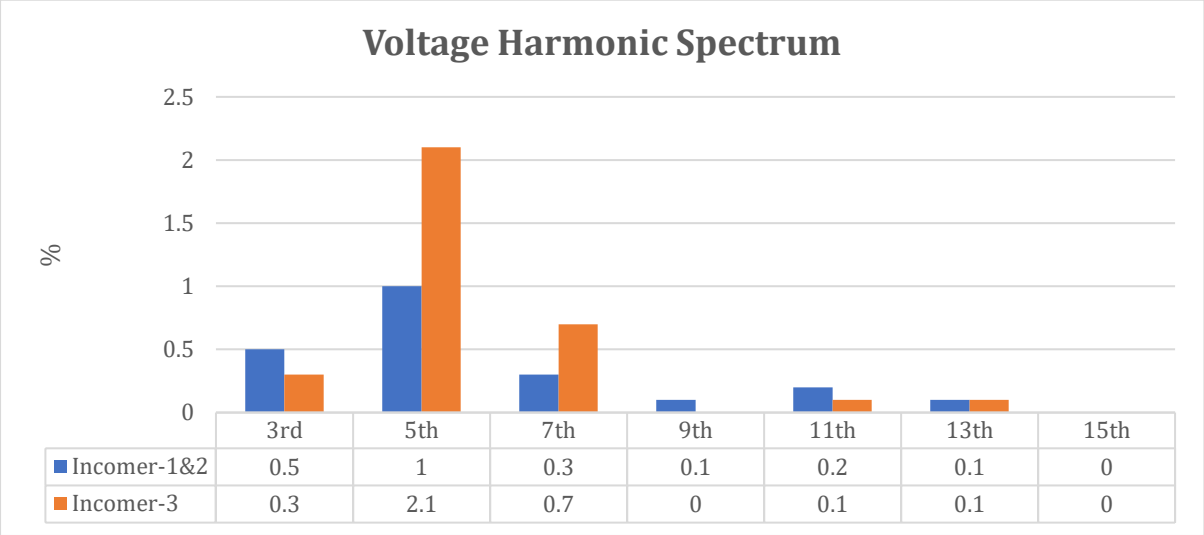


Figure 21: Voltage harmonic spectrum

- **Current harmonic spectrum:**

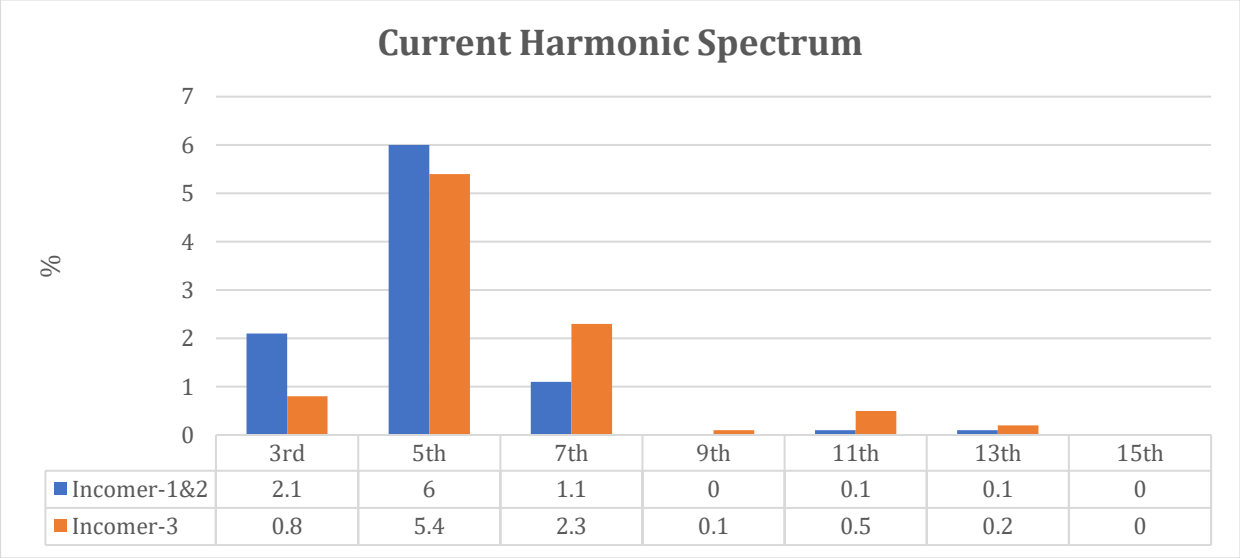


Figure 22: Current harmonic spectrum

OBSERVATIONS AND RECOMMENDATION – ELECTRICAL NETWORK CONFIGURATION

Table 82: Observations & recommendation – electrical network configuration

Observation	Recommendation	Benefit
Overhead lines (OH) and cables		
• 31.1 % in the total 11 kV cable is of ACSR type which corresponds to 56.09 km out of 180.23 km. • Also 34.6% of the total 11 kV is Cu which corresponds to 62.13 out of 180.23 km.	• Replace these OH 11 kV lines with DOG which has a resistance of 0.2792 ohms/km.	• This will reduce the distribution loss as well as energy consumption.
Incomer measurement evaluation		
• **Real time Demand** variation shows that the maximum demand registered at Peak period (6pm – 10pm) was 9.29 MVA which is an excess of the contract demand 9 MVA. • The real time data does not consider the Madupatty generation input which is 2 MW.	• This shows that the contract demand needs to increase. However, the present switching station does not cater as it is 11 kV and require to substitute with 33 kV new substation in order to increase the demand. • The construction of a new 33 kV substation is in progress during the period of audit. The proposed site was near to town to reduce the line length of 2.5 kms.	• This will avoid the excess demand charges and more importantly will able to cater the future loads in the Munnar area.
Energy & power quality analysis		
• Average total current harmonic distortion at the incomer is in the range of 1 to 3%. • Average total voltage harmonic distortion at the incomer is in the range of 0.3 to 1.11%.	• The current THD values are within the IEEE 519 standard limit (<5%). • The voltage THD values are within the IEEE 519 standard limit (<3%)	• NIL

PICTURES

- **Different types of energy meters used in KDHP**

Static TOD meter mostly used for HT consumers (Industries) under the KDHP

TOD meter mostly used for HT consumers under the KDHP

TOD meter mostly used for HT consumers under the KDHP

- **General photos**

Distribution Transformer sample

Switching station yard

SAMPLES OF TSOFT DATA

These are the data collection format that received from the T soft (KDHP software) for the energy audit data preparation.

Table 83: Sample feeder wise consumer list – for reference only

Feeder wise Consumer list: for the month 202301												
Feeder	Transformer Type	Transformer Name	Estate Name	Division Name	Category	Sub Category	Consumer No	Consumer Name	Connected Load	Jan	Feb	Mar
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	A-Null - ON East	Low Tension	LT-I (Domestic)	10519	MAHABIR SINGH	1			18
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	High Tension	HT - IA (Industrial)	15728	KALAAR		1E+05	####	###
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	Low Tension	LT-I (Domestic)	10443	NATARAJAN	1	20	40	39
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	Low Tension	LT-I (Domestic)	10473	MRAJ	1	100	40	60
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	Low Tension	LT-I (Domestic)	10500	RAJAN	1	35	44	25
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	Low Tension	LT-I (Domestic)	10549	KUMAR	1	39	42	32
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	Low Tension	LT-I (Domestic)	10554	PAULOSE - (2458) 2458	1	25	18	7
FDR7-ITD Feeder	Step Down	KLFD-Factory dn.	E06-NULLATANNI	F-Kala - Factory House	Low Tension	LT-I (Domestic)	10559	PREMALATHA	1	50	64	40

10. LIST OF DOCUMENTS VERIFIED WITH EACH PARAMETER

The following are the documents verified during Annual Energy Audit:

Table 84: List of Doucuments verified

FY 2022-23 Data Verification		
Sl No	**Name**	**Name Supporting Document**
Input Energy		
1	Input Energy (MU)	Electricty bill of FY April 2022-March 2023 from KSEBL
Feederwise Losses		
2	Feederwise Energy Accounting	T-soft - KDHP s/w
3	No of connection metered (Nos)	T-soft - KDHP s/w
4	No of connection Unmetered (Nos)	T-soft - KDHP s/w
5	Connected Load Metered (MW)	T-soft - KDHP s/w
6	Connected Load Unmetered (MW)	T-soft - KDHP s/w
7	Input Energy (MU)	T-soft - KDHP s/w
8	Metered energy (MU)	T-soft - KDHP s/w
9	Unmetered energy/Assessment Energy (MU)	T-soft - KDHP s/w
10	T&D Losses (MU)	T-soft - KDHP s/w
11	Collected Amount	T-soft - KDHP s/w
12	AT&C Loss	T-soft - KDHP s/w
Details of Input Energy Sources		
13	Generation at Transmission Periphery (Details)	T-soft - KDHP s/w
14	Embedded Generation in DISCOM Area	T-soft - KDHP s/w

11. DETAILED FORMATS TO BE ANNEXED

BALANCE SHEET – FY 2021-22

Form D BS

Balance Sheet at the end of the year

Name of Distribution Business/Licensee: Kanan Devan Hills Plantations Company Private Limited
Licensed Area of Supply: Munnar

Rs. In lakh

S.No.	Particulars	Ref	Previous Year Actual 2020/21	Current Year Actual 2021/22	Remarks
1	2	3	4	5	6
	Sources of Funds:				
	(A) Capital Funds:				
	Share Capital (Govt. equity)		-	-	
	Reserves & Surplus		(1,000.31)	(1,031.80)	
	Total (A)		(1,000.31)	(1,031.80)	
	(B) Loans:				
	Loan from State Government				
	Loan from others:				
	- Secured		-	-	
	- Unsecured		-	-	
	Total (B)		-	-	
	(C) Contribution, grants & subsidies towards cost of capital assets	D 3.5	7.89	7.89	
	Grand total of sources of funds (A+B+C)		(992.42)	(1,023.91)	
	Application of Funds:				
	A) Fixed assets				
	a) Gross fixed assets	D 3.5	427.85	431.76	
	b) Less accumulated depreciation	D 3.5	218.57	241.53	
	c) Net Fixed assets ((a)-(b))		209.28	190.23	
	d) Capital works in progress	D 4.1	9.55	16.34	
	e) Assets not in use		-	-	
	f) Deferred costs		-	-	
	g) Intangible assets		-	-	
	h) Investments		-	-	
	Total (c)+(d)+(e)+(f)+(g)+(h)		218.83	206.57	
	B) Subsidy receivable from Government				
	Contribution receivable from State Government towards pension liability		-	-	
	C) Net Current Assets				
	(1) Current assets, loans and advances				
	a) Deposit with KSEB		247.28	247.28	
	b) Receivables against Sale of Power		112.71	51.25	
	c) Cash & bank balances		-	-	
	d) Loans and advances		-	-	
	e) Interest receivable		116.28	116.28	
	f) Prepaid expenses		0.52	-	
	Total (C) (1)		476.79	414.81	
	(2) Current liabilities & provisions				
	a) Security Deposits from Consumers		230.25	196.29	
	b) Borrowings for working capital		-	-	
	c) Payments due on capital liabilities		-	-	
	d) Current Account Balances with other operations		1,197.07	1,189.67	
	e) Other current liabilities		260.72	259.33	
	Total (C) (2)		1,688.04	1,645.28	
	Net Current Assets (C(1) - C(2))		(1,211.25)	(1,230.48)	
	Grand Total of Application of funds (A)+(B)+(C)		(992.42)	(1,023.91)	

In terms of our Report attached

For Deloitte Haskins & Sells LLP
Chartered Accountants

Krishna Prakash E
Partner
Coimbatore, November 2, 2022.

DELOITTE HASKINS & SELLS LLP * CHARTERED ACCOUNTANTS * KOCHI

For Kanan Devan Hills Plantations Company Private Limited

P M Srikrishnan
Executive Director & CFO
Munnar, November 2, 2022.

KANAN DEVAN HILLS PLANTATIONS COMPANY PRIVATE LIMITED * KDHP House Munnar P. O Kerala- 685612

FIGURE 23: BALANCE SHEET FY 2021-22

PROFIT & LOSS STATEMENT – FY 2021-22

Form D P&L

Profit & Loss Account

Name of Distribution Business/Licensee: Kanan Devan Hills Plantations Company Private Limited
Licensed Area of Supply: Munnar

Rs. In lakh

S. No.	Particulars	Ref	Previous Year Actual 2020/21	Current Year Actual 2021/22	Remarks
1	2	3	4	5	6
	I. INCOME				
	a. Revenue from Sale of Power	D 2.1	2,884.83	2,955.48	
	b. Revenue Subsidies and Grants		-	-	
	c. Other Income	D 2.4	11.66	5.33	
	Total (a+b+c)		2,896.49	2,960.81	
	II. EXPENDITURE				
	a. Repairs and Maintenance	D 3.4(c)	48.55	52.84	
	b. Employee Cost	D 3.4(a)	166.07	172.12	
	c. Administration and General Expenses	D 3.4(b)	10.34	17.33	
	d. Depreciation	D 3.5	22.71	22.96	
	e. Interest and Finance charges	D 3.7	17.73	18.78	
	f. Subtotal (a+b+c+d+e)		265.40	284.03	
	g. Less Capitalised Expenses:				
	- Interest & Finance Charges		-	-	
	- Other Expenses		-	-	
	h. Other Debits	D 4.3	12.95	14.08	
	i. Extra Ordinary Items		-	-	
	j. Purchase of power	D 3.1	2,689.53	2,694.19	
	k. Generation of Power		-	-	
	Total Expenditure (f-g+h+i+j+k)		2,967.88	2,992.30	
	Return on Net Fixed Assets	D 3.8	-	-	
	III. Profit/(Loss) before Tax (I-II)		(71.39)	(31.49)	
	IV. Provision for Income Tax		-	-	
	V. Net Prior period credits / (Charges)		-	-	
	VI. Surplus/(Deficit)		(71.39)	(31.49)	
	VII. Net Assets at the beginning of the year (Less consumer's Contribution)		219.38	201.39	
	VIII. Rate of Return (VI/VII)		-33%	-16%	

In terms of our Report attached

For Deloitte Haskins & Sells LLP
Chartered Accountants

Krishna Prakash E
Partner

Coimbatore, November 2, 2022.

DELOITTE HASKINS & SELLS * CHARTERED ACCOUNTANTS * KOCHI

For Kanan Devan Hills Plantations Company Private Limited

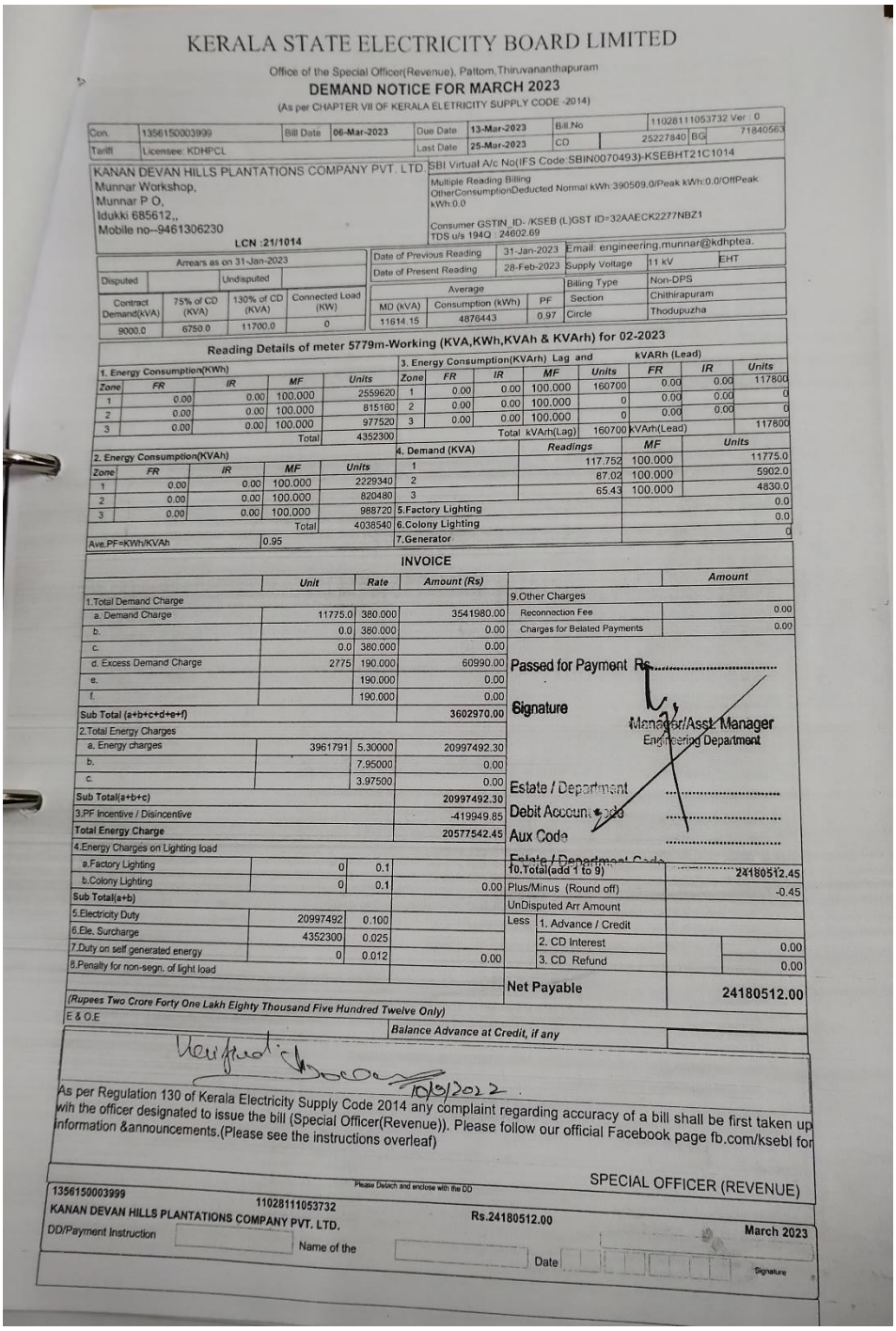
P M Sriprisonan
Executive Director & CFO

Munnar, November 2, 2022.

KANAN DEVAN HILLS PLANTATIONS COMPANY PRIVATE LIMITED * KDHP House Munnar P. O Kerala-685612

FIGURE 24: P&L SHEET FY 2021-22

ELECTRICITY BILL - KSEBL



KERALA STATE ELECTRICITY BOARD LIMITED

Office of the Special Officer(Revenue), Pattom,Thiruvananthapuram

DEMAND NOTICE FOR MARCH 2023

(As per CHAPTER VII OF KERALA ELETRICITY SUPPLY CODE -2014)

Con.	1356150003999	Bill Date	06-Mar-2023	Due Date	13-Mar-2023	Bill.No	11028111053732 Ver 0
Tariff	Licensee: KDHPCL			Last Date	25-Mar-2023	CD	25227840 BG 71840563

KANAN DEVAN HILLS PLANTATIONS COMPANY PVT. LTD.
Munnar Workshop,
Munnar P O,
Idukki 685612,,
Mobile no–9461306230

LCN :21/1014

SBI Virtual A/c No(IFS Code:SBIN0070493)-KSEBHT21C1014

Multiple Reading Billing
OtherConsumptionDeducted Normal kWh:390509.0/Peak kWh:0.0/OffPeak kWh:0.0

Consumer GSTIN_ID- /KSEB (L)GST ID=32AAECK2277NBZ1
TDS u/s 194Q 24602.69

Arrears as on 31-Jan-2023	
Disputed	Undisputed

Contract Demand(kVA)	75% of CD (KVA)	130% of CD (KVA)	Connected Load (KW)
9000.0	6750.0	11700.0	0

Date of Previous Reading	31-Jan-2023	Email: engineering.munnar@kdhptea.	
Date of Present Reading	28-Feb-2023	Supply Voltage	11 kV EHT
Average		Billing Type	Non-DPS
MD (kVA)	Consumption (kWh) PF	Section	Chithirapuram
11614.15	4876443 0.97	Circle	Thodupuzha

Reading Details of meter 5779m-Working (KVA,KWh,KVAh & KVArh) for 02-2023

1. Energy Consumption(KWh)

Zone	FR	IR	MF	Units
1	0.00	0.00	100.000	2559620
2	0.00	0.00	100.000	815160
3	0.00	0.00	100.000	977520
			Total	4352300

2. Energy Consumption(KVAh)

Zone	FR	IR	MF	Units
1	0.00	0.00	100.000	2229340
2	0.00	0.00	100.000	820480
3	0.00	0.00	100.000	988720
			Total	4038540

Ave.PF=KWh/KVAh 0.95

3. Energy Consumption(KVArh) Lag and kVARh (Lead)

Zone	FR	IR	MF	Units	FR	IR	Units
1	0.00	0.00	100.000	160700	0.00	0.00	117800
2	0.00	0.00	100.000	0	0.00	0.00	0
3	0.00	0.00	100.000	0	0.00	0.00	0
			Total kVArh(Lag)	160700	kVArh(Lead)		117800

4. Demand (KVA)

	Readings	MF	Units
1	117.752	100.000	11775.0
2	87.02	100.000	5902.0
3	65.43	100.000	4830.0
5.Factory Lighting			0.0
6.Colony Lighting			0.0
7.Generator			0

INVOICE

	Unit	Rate	Amount (Rs)
1.Total Demand Charge			
a. Demand Charge	11775.0	380.000	3541980.00
b.	0.0	380.000	0.00
c.	0.0	380.000	0.00
d. Excess Demand Charge	2775	190.000	60990.00
e.		190.000	0.00
f.		190.000	0.00
Sub Total (a+b+c+d+e+f)			**3602970.00**
2.Total Energy Charges			
a. Energy charges	3961791	5.30000	20997492.30
b.		7.95000	0.00
c.		3.97500	0.00
Sub Total(a+b+c)			**20997492.30**
3.PF Incentive / Disincentive			-419949.85
Total Energy Charge			**20577542.45**
4.Energy Charges on Lighting load			
a.Factory Lighting	0	0.1	
b.Colony Lighting	0	0.1	0.00
Sub Total(a+b)			
5.Electricity Duty	20997492	0.100	
6.Ele. Surcharge	4352300	0.025	
7.Duty on self generated energy	0	0.012	0.00
8.Penalty for non-segn. of light load			

	Amount
9.Other Charges	
Reconnection Fee	0.00
Charges for Belated Payments	0.00
10.Total(add 1 to 9)	24180512.45
Plus/Minus (Round off)	-0.45
UnDisputed Arr Amount	
Less 1. Advance / Credit	
2. CD Interest	0.00
3. CD Refund	0.00
Net Payable	**24180512.00**

Passed for Payment Rs.....

Signature

Manager/Asst. Manager
Engineering Department

Estate / Department .....

Debit Account Code .....

Aux Code .....

Estate / Department Code .....

(Rupees Two Crore Forty One Lakh Eighty Thousand Five Hundred Twelve Only)

E & O.E

Balance Advance at Credit, if any

Verified 10/3/2023

As per Regulation 130 of Kerala Electricity Supply Code 2014 any complaint regarding accuracy of a bill shall be first taken up with the officer designated to issue the bill (Special Officer(Revenue)). Please follow our official Facebook page fb.com/ksebl for information &announcements.(Please see the instructions overleaf)

SPECIAL OFFICER (REVENUE)

Please Detach and enclose with the CD

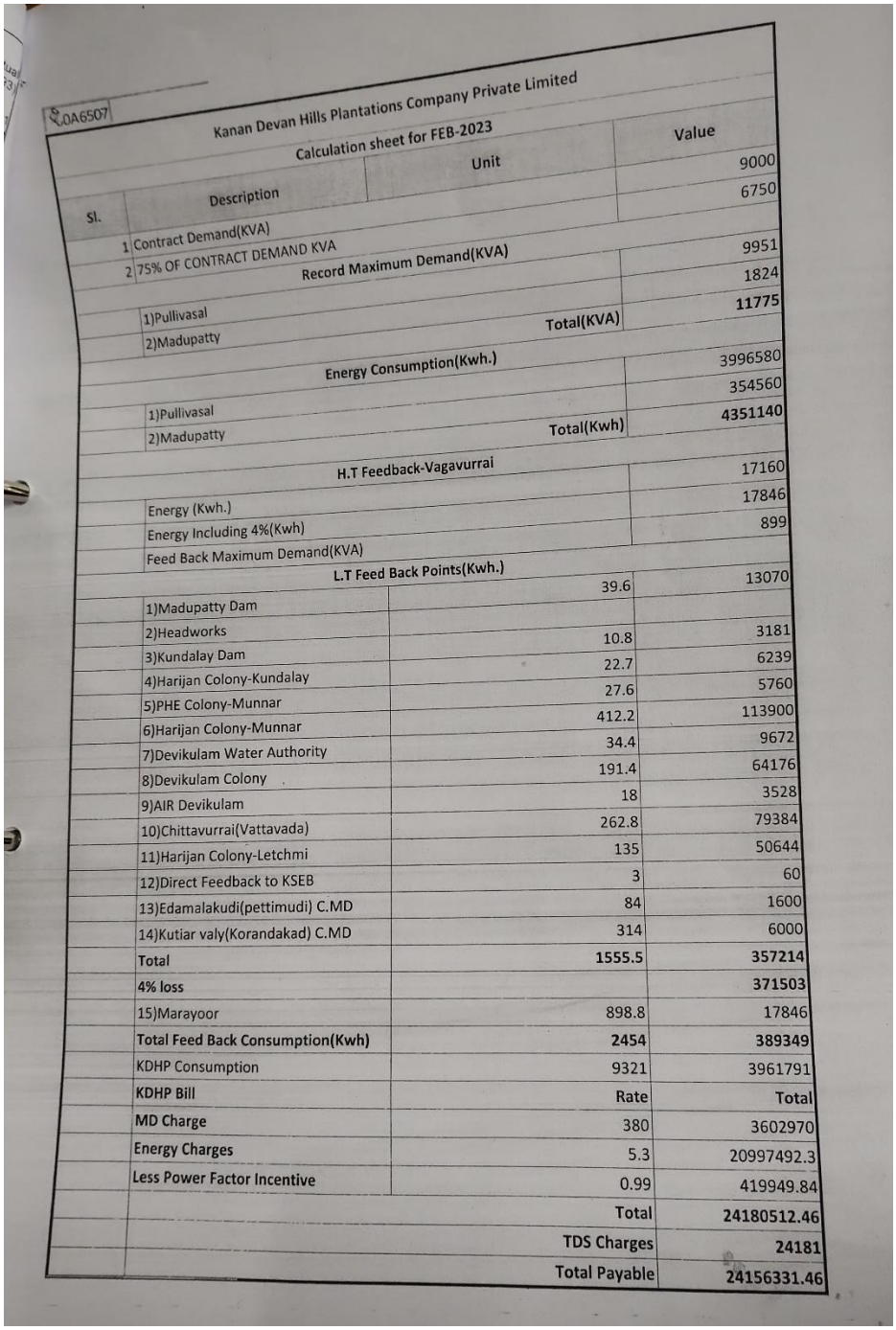
1356150003999 11028111053732 Rs.24180512.00 March 2023

KANAN DEVAN HILLS PLANTATIONS COMPANY PVT. LTD.

DD/Payment Instruction Name of the Date Signature

FIGURE 25: KSEB BILL – MARCH 2023 – SAMPLE COPY

ELECTRICITY BILL – CALCULATION SHEET



Kanan Devan Hills Plantations Company Private Limited

Calculation sheet for FEB-2023

Sl.	Description	Unit	Value
1	Contract Demand(KVA)		9000
2	75% OF CONTRACT DEMAND KVA		6750
	Record Maximum Demand(KVA)		
	1)Pullivasal		9951
	2)Madupatty		1824
		Total(KVA)	**11775**
	Energy Consumption(Kwh.)		
	1)Pullivasal		3996580
	2)Madupatty		354560
		Total(Kwh)	**4351140**
	H.T Feedback-Vagavurrai		
	Energy (Kwh.)		17160
	Energy Including 4%(Kwh)		17846
	Feed Back Maximum Demand(KVA)		899
	L.T Feed Back Points(Kwh.)		
	1)Madupatty Dam	39.6	13070
	2)Headworks	10.8	3181
	3)Kundalay Dam	22.7	6239
	4)Harijan Colony-Kundalay	27.6	5760
	5)PHE Colony-Munnar	412.2	113900
	6)Harijan Colony-Munnar	34.4	9672
	7)Devikulam Water Authority	191.4	64176
	8)Devikulam Colony	18	3528
	9)AIR Devikulam	262.8	79384
	10)Chittavurrai(Vattavada)	135	50644
	11)Harijan Colony-Letchmi	3	60
	12)Direct Feedback to KSEB	84	1600
	13)Edamalakudi(pettimudi) C.MD	314	6000
	14)Kutiar valy(Korandakad) C.MD	**1555.5**	**357214**
	Total		**371503**
	4% loss	898.8	17846
	15)Marayoor	**2454**	**389349**
	Total Feed Back Consumption(Kwh)	9321	3961791
	KDHP Consumption	**Rate**	**Total**
	KDHP Bill	380	3602970
	MD Charge	5.3	20997492.3
	Energy Charges	0.99	419949.84
	Less Power Factor Incentive		**24180512.46**
		TDS Charges	**24181**
		Total Payable	**24156331.46**

MONTHLY ENERGY BILL DETAILS – FY 2022-23

Table 85: Energy bill summary – FY 2022-23

KANAN DEVAN HILLS PLANTATIONS COMPANY PVT LTD	**CONTRACT DEMAND = 9000 KVA**					**LICENSEE: KDHPCL**			**Consumer No: LCN: 21/014**				**Total (MU)**
Particulars	**Apr-22**	**May-22**	**Jun-22**	**Jul-22**	**Aug-22**	**Sep-22**	**Oct-22**	**Nov-22**	**Dec-22**	**Jan-23**	**Feb-23**	**Mar-23**	
75% OF CONTRACT DEMAND	6,750	6,750	6,750	6,750	6,750	6,750	6,750	6,750	6,750	6,750	6,750	6,750	
kVA Normal	11,150	12,479	11,674	10,516	11,036	12,175	11,813	10,711	12,309	10,902	11,775	11,083	
kVA Peak	6,274	6,972	7,056	6,728	5,618	6,520	6,934	7,160	6,758	6,474	5,902	6,292	
kVA Off Peak	4,874	6,938	5,566	5,022	4,112	4,694	5,282	5,876	5,542	4,950	4,830	4,472	
RMD (Pullivasal + Madupatty)	11,150	12,479	11,674	10,516	11,036	12,175	11,813	10,711	12,309	10,902	11,775	11,083	
Net feedback RMD	2,715	1,835	2,981	2,348	2,342	2,105	3,179	2,698	2,461	2,716	2,454	2,939	
Billing Demand	8,435	10,644	8,693	8,168	8,694	10,070	8,634	8,013	9,848	8,186	9,321	8,144	
Demand Charges	28,67,900	36,18,960	33,03,360	31,03,840	33,03,720	38,26,600	32,80,920	30,44,940	37,42,240	31,10,680	35,41,980	30,94,720	
Excess Demand	-	1,644	-	-	-	1,070	-	-	848	-	321	-	
Excess Demand Charge		2,79,480				2,03,300			1,61,120		60,990		
Total Demand Charges	28,67,900	38,98,440	33,03,360	31,03,840	33,03,720	40,29,900	32,80,920	30,44,940	39,03,360	31,10,680	36,02,970	30,94,720	
Total kWh - Billed energy	48,08,620	60,34,520	52,26,960	45,55,820	40,80,760	49,40,540	49,82,640	50,78,780	51,31,720	47,64,240	43,51,140	50,92,440	**54.118**
Feedback kWh	3,64,937	4,07,317	4,35,887	4,55,962	4,15,115	3,73,775	3,94,009	4,00,278	4,36,368	4,51,174	3,89,349	4,06,054	**4.93**
Total kWh – metered energy	44,43,683	56,27,203	47,91,073	40,99,858	36,65,645	45,66,765	45,88,631	46,78,502	46,95,352	43,13,066	39,61,791	46,86,386	**59.048**
Total kWh Charges	2,13,29,678	2,70,10,574	2,34,69,631.40	2,17,29,247	1,94,27,919	2,42,03,855	2,43,19,744	2,47,96,061	2,48,85,366	2,28,59,250	2,09,97,492	2,48,37,846	
PF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.99	0.95	0.95	0.95	0.95	
PF incentive/Penalty				-4,34,585	-3,88,558	-4,84,077	-4,86,395	-4,95,921	-4,97,707	-4,57,185	-4,19,950	-4,96,756	
GRAND TOTAL	2,41,97,578	3,09,09,014	2,67,72,991	2,43,98,502	2,23,43,080	2,77,49,677	2,71,14,269	2,73,45,079	2,82,91,019	2,55,12,745	2,41,80,512	2,74,35,810	

SIGNED PERFORMA

12.6.1 General information

General Information					
1	**Name of the DISCOM**	KANAN DEVAN HILLS PLANTATIONS COMPANY PRIVATE LIMITED			
2	**i) Year of Establishment**	2007			
	ii) Government/Public/Private	PRIVATE			
3	**DISCOM's Contact details & Address**				
i	City/Town/Village	MUNNAR			
ii	District	IDUKKI			
iii	State	KERALA		Pin	685612
iv	Telephone	04868 255000		Fax	
4	**Registered Office**				
i	Company's Chief Executive Name	**K.MATHEW ABRAHAM**			
ii	Designation	MANAGING DIRECTOR			
iii	Address	K.D.H.P HOUSE,			
iv	City/Town/Village	MUNNAR TOWN		P.O.	MUNNAR
v	District	IDUKKI			
vi	State	KERALA		Pin	685612
vii	Telephone	04868 255000		Fax	
5	**Nodal Officer Details***				
i	Nodal Officer Name (Designated at DISCOM's)	**RAJU U. WARRIER**			
ii	Designation	HEAD - ENGINEERING DEPARTMENT			
iii	Address	KDHP HOUSE			
iv	City/Town/Village	MUNNAR		P.O.	MUNNAR
v	District	IDUKKI			
vi	State	KERALA		Pin	685612
vii	Telephone	04868 255101		Fax	
6	**Energy Manager Details***				
i	Name	Mr. R. JAYARAMAN			
ii	Designation	EXECUTIVE		Whether EA or EM	EM
iii	EA/EM Registration No.				
iv	Telephone	04868 255107		Fax	
v	Mobile	9446130623	E-mail ID	jayaraman.r@kdhptea.co.in	
7	**Period of Information**				
	Year of (FY) information including Date and Month (Start & End)	01st April 2022 - 31st March 2023			

J Nagesh Kumar
Director/AEA 0133
Centre for Energy Environment & Productivity

Centre for Energy, Environment and Productivity
Plot No. 1039, 26th Street, H-Block,
Ponni Colony, Anna Nagar, Chennai - 600 040.
PH : 044 2616 3483, 9444882553

12.6.2 Performance Summary of DISCOM – Form-1

Performance Summary of Electricity Distribution Companies			
1	Period of Information Year of (FY) information including Date and Month (Start & End)	01st April 2022 - 31st March 2023	
2	**Technical Details**		
(a)	**Energy Input Details**		
(i)	Input Energy Purchase (From Generation Source)	Million kwh	54.118
(ii)	Net input energy (at DISCOM Periphery after adjusting the transmission losses and energy traded)	Million kwh	59.048
(iii)	Total Energy billed (is the Net energy billed, adjusted for energy traded))	Million kwh	54.011
(b)	Transmission and Distribution (T&D) loss Details	Million kwh	5.038
		%	8.53
	Collection Efficiency	%	99.673%
(c)	Aggregate Technical & Commercial Loss	%	8.83%

I/We undertake that the information supplied in this Document and Pro-forma is accurate to the best of my knowledge and if any of the information supplied is found to be incorrect and such information result into loss to the Central Government or State Government or any of the authority under them or any other person affected, I/we undertake to indemnify such loss.

Authorised Signatory and Seal

Signature:-

Name of energy manager: **J Nagesh Kumar**

Director/AEA 0133

Registration Numbe Centre for Energy Environment & Productivity

Name of Authorised Signatory

Name of the DISCOM:

Full Address:-

Centre for Energy, Environment and Productivity
Plot No. 1039, 26th Street, H-Block,
Ponni Colony, Anna Nagar, Chennai - 600 040.
PH : 044 2616 3483, 9444882553

Seal

12.6.3 Details of Division wise losses

Details of Division Wise Losses (See note below)**

Division Wise Losses

Period From 1st April 2022 to 31st March 2023

S.No	Name of circle	Circle code	Name of Division	Consumer profile: Consumer category	No of connection metered (Nos)	No of connection Un-metered (Nos)	Total Number of connections (Nos)	% of number of connections	Connected Load metered (MW)	Connected Load Un-metered (MW)	Total Connected Load (MW)	% of connected load	Energy parameters: Input energy (MU)	Billed energy (MU): Metered energy	Billed energy (MU): Unmetered/assessment energy	Billed energy (MU): Total energy	% of energy consumption	Losses: T&D loss (MU)	Losses: T&D loss (%)	Commercial Parameter: Billed Amount in Rs. Crore	Collected Amount in Rs. Crore	Collection Efficiency	AT & C loss (%)
1	KDHP	KDHP	KDHP	Residential	14010	0	14010	84.48%	16.45	0	16.45	48.33%		7.80	0	7.80	14%			3.7656	3.7841	100.49%	
				Agricultural	7	0	7	0.04%	0.04	0	0.04	0.13%		0.016	0	0.016	0.03%			0.0049	0.0049	100.00%	
				Commercial/Industrial-LT	1317	0	1317	7.94%	4.94	0	4.94	14.51%	59.048	3.99	0	3.99	7%	5.038	8.53%	3.9026	3.9073	100.12%	
				Commercial/Industrial-HT	31	0	31	0.19%	9.69	0	9.69	28.46%		34.30	0	34.30	64%			25.3352	25.3174	99.93%	
				Others + feedback	1218	0	1218	7.34%	2.92	0	2.92	8.57%		7.90	0	7.90	15%			2.4389	2.3176	95.03%	
Sub-total					**16583**	**0**	**16583**	**100%**	**34.03**	**0**	**34.03**	**100%**	**59.048**	**54.011**	**0.00**	**54.011**	**100%**	**5.038**	**8.53%**	**35.4473**	**35.3314**	**99.673%**	**8.83%**
2				Residential	0	0	0	0%	0	0	0	0%		0	0	0	0%			0	0	0.00%	
				Agricultural	0	0	0	0%	0	0	0	0%		0	0	0	0%			0	0	0.00%	
				Commercial/Industrial-LT	0	0	0	0%	0	0	0	0%	0	0	0	0	0%	0	0%	0	0	0.00%	
				Commercial/Industrial-HT	0	0	0	0%	0	0	0	0%		0	0	0	0%			0	0	0.00%	
				Others	0	0	0	0%	0	0	0	0%		0	0	0	0%			0	0	0.00%	
Sub-total					**0**	**0**	**0**	**100%**	**0**	**0**	**0**	**100%**	**0**	**0**	**0**	**0**	**100%**	**0**	**0%**	**0**	**0**	**0.00%**	**100%**
76	Total			Residential	14010	0	14010	84.48%	16.45	0	16.45	48.33%		7.80	0	7.80	14%			3.7656	3.7841	100.49%	
				Agricultural	7	0	7	0.04%	0.04	0	0.04	0.13%		0.016	0	0.016	0.03%			0.0049	0.0049	100.00%	
				Commercial/Industrial-LT	1317	0	1317	7.94%	4.94	0	4.94	14.51%	59.048	3.99	0	3.99	7%	5.038	8.53%	3.9026	3.9073	100.12%	
				Commercial/Industrial-HT	31	0	31	0.19%	9.69	0	9.69	28.46%		34.30	0	34.30	64%			25.3352	25.3174	99.93%	
				Others	1218	0	1218	7.34%	2.92	0	2.92	8.57%		7.90	0	7.90	15%			2.4389	2.3176	95.03%	
77	At company level				**16583**	**0**	**16583**	**100%**	**34.03**	**0**	**34.03**	**100%**	**59.048**	**54.011**	**0**	**54.011**	**100%**	**5.038**	**8.53%**	**35.4473**	**35.3314**	**99.673%**	**8.83%**

** Note - It shall be mandatory to record the energy supplied separately for each category of consumers which is being provided a separate rate of subsidy in the tariff, by the state government, so that the subsidy due for the electricity distribution company is quarterly calculated by multiplying the energy supplied to each of such category of consumers by the applicable rate of subsidy notified by the state government.

I/We undertake that the information supplied in this Document and Pro-forma is accurate to the best of my knowledge and if any of the information supplied is found to be incorrect and such information result into loss to the Central Government or State Government or any of the authority under them or any other person affected, I/we undertake to indemnify such loss.

Authorised Signatory and Seal

Name of Authorised Signatory:

Name of the DISCOM:

Full Address:-

Seal

Signature:-

Name of Energy Manager:

Registration Number:

J Nagesh Kumar

Director/AEA 0133

Centre for Energy Environment & Productivity

Centre for Energy, Environment and Productivity
Plot No. 1039, 26th Street, H-Block,
Ponni Colony, Anna Nagar, Chennai - 600 040.
PH : 044 2616 3483, 9444882553

12.6.4 Details of infrastructure

Form-Details of Input Infrastructure					
1	**Parameters**	**Total**	**Covered during in audit**	**Verified by Auditor in Sample Check**	**Remarks (Source of data)**
i	Number of circles	1	1	1	
ii	Number of divisions	1	1	1	
iii	Number of sub-divisions	1	1	1	
iv	Number of feeders	7	7	7	
v	Number of DTs	133	133	133	Including HT consumers
vi	Number of consumers	16583	16583	16583	
2	**Parameters**	**66kV and above**	**33kV**	**11/22kV**	**LT**
a. i.	Number of conventional metered consumers	-	-	-	6613
ii	Number of consumers with 'smart' meters	-	-	-	-
iii	Number of consumers with 'smart prepaid' meters	-	-	-	-
iv	Number of consumers with 'AMR' meters	-	-	-	-
v	Number of consumers with 'non-smart prepaid' meters	-	-	36	9934
vi	Number of unmetered consumers	-	-	-	
vii	**Number of total consumers**	-	-	36	16547
b.i.	Number of conventionally metered Distribution Transformers	-	-	-	63
ii	Number of DTs with communicable meters	-	-	-	-
iii	Number of unmetered DTs	-	-	-	70
iv	**Number of total Transformers**			-	133
c.i.	Number of metered feeders			-	
ii	Number of feeders with communicable meters			7	
iii	Number of unmetered feeders			-	
iv	**Number of total feeders**			7	
d.	Line length (ct km)			180.23	193.8
e.	Length of Aerial Bunched Cables (km)			-	-
f.	Length of Underground Cables (km)			0.405	4.525
3	**Voltage level**	**Particulars**	**MU**	**Reference**	**Remarks (Source of data)**
v	11 kV	Renewable Energy Procurement	0		
		Small capacity conventional/ biomass/ hydro plants Procurement	54.12		Purchase unit excluding feedback
		Sales Migration Input	4.93		Feedback
vi	LT	Renewable Energy Procurement	0		
		Sales Migration Input	0		
vii		**Energy Embedded within DISCOM wires network**	59.048		
viii		**Total Energy Available/ Input**	59.048		
4	**Voltage level**	**Energy Sales Particulars**	**MU**	**Reference**	
i	LT Level	DISCOM' consumers	13.98	Include sales to consumers in franchisee areas, unmetered consumers	Total LT sales
		Demand from open access, captive	0.00	Non DISCOM's sales	
		Embedded generation used at LT level	0.0237	Demand from embedded generation at LT level	
		Sale at LT level	13.98		
		Quantum of LT level losses	3.81	Included the LT OH line length, LT cable, Switch gear, Commercial & Transformer losses	6.4531% of total energy requirement
		Energy Input at LT level	17.79		
		DISCOM' consumers	35.10	Include sales to consumers in franchisee areas, unmetered consumers	HT sales
ii	11 kV Level	Demand from open access, captive	4.93	Non DISCOM's sales	Feedback
		Embedded generation at 11 kV level used	0.001	Demand from embedded generation at 11kV level	PPC solar export
		Sales at 11 kV level	40.03		
		Quantum of Losses at 11 kV	1.227		2.0781% of total energy requirement
		Energy input at 11 kV level	41.26		
		Total Energy Requirement	**59.048**		
		Total Energy Sales	**54.011**		

Energy Accounting Summary

5	DISCOM	Input (in MU)	Sale (in MU)	Loss (in MU)	Loss %
i	LT				
ii	11 Kv	59.048	54.011	5.038	8.53
iii	33 kv				
iv	> 33 kv				

Loss Estimation for DISCOM	
T&D loss (MU)	5.038
D loss (MU)	5.038
T&D loss (%)	8.53
D loss (%)	8.53

J Nagesh Kumar
Director/AEA 0133
Centre for Energy Environment & Productivity

Centre for Energy, Environment and Productivity
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12.6.5 Details of input energy sources

Form-Input energy(Details of Input energy & Infrastructure)

A. Summary of energy input & Infrastructure

S.No	Parameters	Period From April 2022 to March 2023	Remarks (Source of data)
A.1	Input Energy purchased (MU)	54.118	Electricity bill
A.2	Transmission loss (%)	0%	
A.3	Transmission loss (MU)	0	
A.4	Energy sold outside the periphery(MU)	4.93	Feedback energy
A.5	Open access sale (MU)	0	
A.6	EHT sale	0	
A.7	Net input energy (received at DISCOM periphery or at distribution point)-(MU)	59.048	Total feeder input
A.8	Is 100% metering available at 66/33 kV (Select yes or no from list)	No	
A.9	Is 100% metering available at 11 kV (Select yes or no from list)	Yes	
A.10	% of metering available at DT	47%	63 out of 133 DT
A.11	% of metering available at consumer end	100%	
A.12	No of feeders at 66kV voltage level	0	
A.13	No of feeders at 33kV voltage level	0	
A.14	No of feeders at 11kV voltage level	7	
A.15	No of LT feeders level	0	Not available
A.16	Line length (ckt. km) at 66kV voltage level	0	
A.17	Line length (ckt. km) at 33kV voltage level	0	
A.18	Line length (ckt. km) at 11kV voltage level	180.23	Measured through HT line mapping
A.19	Line length (km) at LT level	193.8	Measured through LT line mapping
A.20	Length of Aerial Bunched Cables	0	
A.21	Length of Underground Cables	4.525	Site measurement
A.22	HT/LT ratio	1:1.075	

B. Meter reading of Input energy at injection points

S.No	Zone	Circle	Voltge Level (KV)	Division (KVA)	Sub-Division (KVA)	Feeder ID	Feeder Name	Feeder Metering Status (Metered/ unmetered/ AMI/AMR)	Status of Meter (Functional/Non-functional)	Metering Date	Feeder Type (Agri/ Industrial/Mixed)	Status of Communication			Period From 1st April 2022 to 31st March 2023				Sales	Remarks (Source of data)
										Date of last actual meter reading/ communication		% data received through automatically if feeder AMR	Number of hours when meter was unable to communicate in period	Total Number of hours in the period	Meter S.No	CT/PT ratio	Import (MU)	Export (MU)		
B.1	KDHP	KDHP	11	NIL	NIL	NIL	HR 1 & 2	Metered	Functioning	31-03-2023	Mixed	0	0	NA	KSE98355	500/5	46.089	-		Switching station
B.2		KDHP	11	NIL	NIL	NIL	Pipeline (HR-3)	Metered	Functioning	31-03-2023	Mixed	0	0	NA	16116905	200/5	8.700	-		Switching station
B.3		KDHP	11	NIL	NIL	NIL	Madupatty	Metered	Functioning	31-03-2023	Mixed	0	0	NA	16088095	200/5	4.259	-		Switching station
B.8																				
B.1001	Total (MU)																59.048	0.00		
B.1002	Net input energy at DISCOM periphery (MU)																	59.048		

I/We undertake that the information supplied in this Document and Pro-forma is accurate to the best of my knowledge and if any of the information supplied is found to be incorrect and such information result into loss to the Central Government or State Government or any of the authority under them or any other person affected, I/we undertake to indemnify such loss.

Authorised Signatory and Seal	
Name of Authorised Signatory	Signature:-
Name of the DISCOM:	Name of Energy Manager:
Full Address:-	Registration Number:
Seal	

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12.6.6 Details of consumers and consumption

(Details of Consumers)						
Summary of Energy						
Period From 1st April 2022 to 31st March 2023						
S.No	Type of Consumers	Category of Consumers (EHT/HT/LT/Others)	Voltage Level (kV)	No of Consumers	Total Consumption (In MU)	Remarks (Source of data)
1	Domestic	LT	0.415	14010	7.80	T-soft - KDHP s/w
2	Commercial	LT	0.415	1224	3.40	T-soft - KDHP s/w
3	IP Sets					
4	Hor. & Nur. & Coffee/Tea & Rubber (Metered)					
5	Hor. & Nur. & Coffee/Tea & Rubber (Flat)					
6	Heating and Motive Power					
7	Water Supply					
8	Public Lighting	LT	0.415	265	0.39	T-soft - KDHP s/w
9	HT Water Supply					
10	HT Industrial	HT	11	22	32.26	T-soft - KDHP s/w
11	Industrial (Small)	LT	0.415	93	0.59	
12	Industrial (Medium)					
13	HT Commercial	HT	11	9	2.05	
14	Applicable to Government Hospitals & Hospitals	HT	11	1	0.045	T-soft - KDHP s/w
15	Lift Irrigation Schemes/Lift Irrigation Societies	HT Others	11	4	0.75	T-soft - KDHP s/w
16	HT Res. Apartments Applicable to all areas					
17	Mixed Load					
18	Government offices and department					
19	Feedback energy	HT/LT	11/0.415		4.93	T-soft - KDHP s/w
20	Agriculture	LT	0.415	7	0.016	T-soft - KDHP s/w
21	LT General	LT	0.415	948	1.78	T-soft - KDHP s/w
22	Others-5 (if any , specify in remarks)					
23	Others-5 (if any , specify in remarks)					
24						
25						
			Total	16583	54.011	

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12.6.7 Details of Feeder wise losses

(Details of Feeder-wise losses) Period From 1st April 2022 to 31st March 2023																
Sl No.	Zone	Received at Circle (In MU)	Received at Division (In MU)	Received at Sub-division (In MU)	Name of the Station	Feeder Code/ID	Feeder Name	Type of Feeder (Urban/Mixed/Industrial/Agricultural/Rural)	Type of feeder meter (AMI/AMR/ Other)	Received at Feeder (Final in MU)	Feeder Consumption (In MU)	Final Net Export at Feeder Level (In MU)	T&D losses	AT&C losses	% Data Received through Automatically (if feeder AMR/AMI)	Remarks
1	KDHP						Nayamakad	Mixed	Others	11.12	9.99	0	10.17	12.24	nil	
2	KDHP						Madupatty	Mixed	Others	14.98	12.90	0	13.90	15.88	nil	Madupatty 2 MW gets exported
3	KDHP						Nettigudi	Mixed	Others	10.58	9.85	0	6.93	9.07	nil	
4	KDHP						Town	Mixed	Others	9.95	8.66	0	12.97	14.97	nil	
5	KDHP						ITD	Auxiliary	Others	9.88	9.38	0	5.03	7.21	nil	
6	KDHP						Pullivasal	Mixed	Others	3.21	3.04	0	5.17	7.35	nil	
7	KDHP						Station	Mixed	Others	0.01	0.01	0	0.00	0.00	nil	

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12.6.8 Details of Subsidy

Consumer category (Separate for each subsidized consumer category)	Billed energy			Subsidized billed energy			Applicable rate of subsidy as notified by state govt		Subsidy due from state govt			Subsidy actually billed/claimed from state govt (as against col 12)	Subsidy received from state govt (As against col 13)
	(in kWh)			(in kWh)			(in Rs/kWh)		(in Rs Cr)			(in Rs Cr)	(in Rs Cr)
	Metered	Unmetered	Total	Metered (out of col 2)	Unmetered* (out of col 3)	Total	Metered energy**	Unmetered energy	Metered energy	Unmetered energy	Total		
1	2	3	4= 2 + 3	5	6	7 = 5+6	8	9	10 = 5 x 8	11 = 6 x 9	12 = 10 + 11	13	14
Residential	7802628	0	7802628	0	0	0	0	0	0	0	0	0	0
Agricultural	15942	0	15942	0	0	0	0	0	0	0	0	0	0
Commercial/Industrial-LT	3991682	0	3991682	0	0	0	0	0	0	0	0	0	0
Commercial/Industrial-HT	34303573	0	34303573	0	0	0	0	0	0	0	0	0	0
Others + feedback	7896825	0	7896825	0	0	0	0	0	0	0	0	0	0
Total	**5,40,10,650**		**5,40,10,650**										
*Basis of assessment of energy to be provided in the notes along with relevant Government Orders													
** Provide copy of relevant work orders													

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12.6.9 Details of DT level losses

a. Division wise status of DT level metering													
Zone name	Circle name	Division name	Feeder name	Total no of DT on feeder	No of unmetered DTs	No of metered DTs			No. of DTs with functional meters				
						AMR metered (communicable)	AMI metered (communicable)	Non-AMR / AMI metered (non-communicable)	Communicating (Total No out of 7 and 8)	Non-communicating (Total No. out of 7,8 and 9)			
1	2	3	4	5=(6+7+8+9)	6	7	8	9	10	11			
KDHP	KDHP	KDHP	Nayamakad	31	16			15		15			
KDHP	KDHP	KDHP	Madupatty	41	25			16		16			
KDHP	KDHP	KDHP	Nettigudi	24	12			12		12			
KDHP	KDHP	KDHP	Town	18	9			9		9			
KDHP	KDHP	KDHP	ITD	16	8			8		8			
KDHP	KDHP	KDHP	Pullivasal	3	0			3		3			

b. Details of DT-wise losses													
Sub-station ID	Feeder ID	Feeder Name	DT Id no	DT Capacity (kVA)	Predominant consumer type of DT (Domestic/Industrial/Agriculture/Mixed)	Type of metering (Unmetered/AMI/AMR/Other)	Status of meter (functional/non-functional)	% of data received automatically (if AMI/AMR)	No. of connected consumers	Input Energy (MU)	Billed Energy (MU)	Loss of Energy (MU)	% Loss
		1	2						3	4	5	6 = 4-5	(7)= [(6)/(4)]*100
Not available as 100% DT metering not done also the DT measurement not yet commenced													

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12. ABBREVIATIONS

ABR	:	Average billing rate
ACSR	:	Aluminium core steel reinforced
APFC	:	Automatic Power Factor controller
AVG	:	Average
BD	:	Billing demand
BDV	:	Breakdown voltage
BEE	:	Bureau of energy efficiency
CEA	:	Central electrical authority
CFL	:	Compact fluorescent lamp
CFM	:	Feet cube per minute
CT	:	Current transformer
DB	:	Distribution Board
DC	:	Designated consumer
DT	:	Distribution transformer
EC	:	Energy Conservation
FD	:	Forced draft
HPSV	:	High pressure sodium vapour
HT	:	High Tension
IEC	:	International electro technical commission
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
KG	:	Kilo gram
KSEB	:	Kerala state electricity board
KVA	:	Kilo Volt Ampere
KVAH	:	Kilo volt Ampere Hour
KVAR	:	Kilo volt ampere
KW	:	Kilo Watts
KWH	:	Kilo watt hour
LED	:	Light emitting diode
LT	:	Low tension
MAX	:	Maximum
MH	:	Metal halide
MU	:	Million units
MVA	:	Mega volt ampere
MW	:	Mega watt
NEMA	:	National Electrical Manufacturers Association
ONAN	:	Oil natural air natural
PCC	:	Point of common coupling
PF	:	Power factor
PSI	:	Pound square inch
PT	:	Protentional transformer
R/km	:	Resistance per kilometre
RMD	:	Registered Maximum demand
SDA	:	State designated agency
SEC	:	Specific electricity consumption
SFU	:	Switch Fuse Unit
SLD	:	Single Line Diagram
TDD	:	Total demand distortion
THD	:	Total harmonics distortion
TOD	:	Time of day
TOE	:	Tonne of oil equivalent
TPEA	:	Third party energy auditor
UG	:	Underground
UPS	:	Uninterruptible power supply
VFD	:	Variable frequency drive