ENERGY AUDIT REPORT

Of

Damodar Valley Corporation

2021-22

PPS Energy Solutions

THE POWER OF ENERGY

Energy Audit Report

Damodar Valley Corporation

Submitted By

PPS Energy Solutions
THE POWER OF ENERGY

JUNE 2022

Document Submission

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Designation	Name	Signature
Accredited Energy Auditor	Ravi Deshmukh (AEA – 0243)	

Acknowledgement

We express our sincere gratitude to the authorities of Damodar Valley Corporation Limited for entrusting and offering the opportunity of energy performance assignment.

We are thankful to Damodar Valley Corporation Limited officials for timely guidance and for their positive support in undertaking the task of system mapping and energy efficiency assessment of sampled electrical distribution system. The field studies would not have been completed on time without their interaction and guidance. We admire their cooperation during field studies and providing necessary data for the study.

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Abbreviations

Abbreviations	Explanations
DVC	Damodar Valley Corporation
PPSES	PPS Energy Solutions
BEE	Bureau of Energy Efficiency

Electrical Terms

- V (Volt) - Unit of voltage.
- kV (kilovolt) - 1,000 volts.
- W (Watt) - Unit of active power.
- kW (kilowatt) - 1,000 watts.
- MW (Megawatt) - 1,000 kW.
- Wh (watt-hour) - Unit of Energy.
- kWh (kilowatt-hour) - 1,000 Wh.
- MWh (Megawatt-hour) - 1,000 kWh.
- MUs (Million Units)-1kWh x 10^6.
- VA (Volt-ampere) - Unit of apparent power.
- kVA (kilovolt-ampere) - 1,000 VA.
- MVA (Megavolt-ampere) - 1,000 kVA.
- VAr (volt-ampere reactive) - Unit of reactive power.
- Load Factor - Ratio of average power demand to maximum power demand
  Electrical Losses - Difference between energy delivered and energy sent out.
- PF – Power Factor

1 Executive Summary

1.1 DVC Introduction

Damodar Valley Corporation (DVC) has been generating, transmitting and distributing power since 1953 in the eastern region of India. DVC over the last 74 years has developed a big and robust transmission grid network and expanded its grid from 132KV to 220KV & 400KV to serve its consumers across the valley area and to export power to other power deficit regions.

DVC grids operates in unison with the eastern regional grid through 132 KV, 220KV and 400 KV Tie lines. All the Power stations and Sub stations of DVC are connected through DVC grids. DVC power consumers are provided supply at 33KV, 132KV and 230KV voltage level. Considering 12th plan projected load & evacuation of generation corresponding to 2016-17 Power scenarios, DVC has taken transmission system augmentation work under 12th Master plan.

1) DVC has their own Coal based & Hydel Power stations. In addition to their own generation, it procures power from Grid. Other major source are bilateral arrangements and energy from private traders for renewable energy.
2) DVC has only HT & EHT consumers. DVC power consumers are provided supply at 33KV, 132KV and 220KV voltage level..

Table 1 DVC Network Snapshot

DVC Network Snapshot	
Number of divisions	7
Number of sub-station	38
Number of feeders	184
Number of DTs	81
Number of consumers	295
33kV DVC Transmission CKT Length	1519
132kV DVC Transmission CKT Length	3639
220kV DVC Transmission CKT Length	2310
400kV DVC Transmission ckt	478

1.2 About Assignment

Bureau of Energy Efficiency (BEE) through Ministry of Power, Government of India issued regulations namely Bureau of Energy Efficiency (Manner and Intervals for Conduct of Energy Audit in electricity distribution companies) Regulations, 2021 (hereinafter referred

as 'BEE EA Regulation 2021'), for Conduct of Annual Energy Audit and Periodic Energy Accounting in DISCOMs.

As per the notification, the work of Energy Audit of DVC was awarded to PPS Energy Solutions Pvt. ltd.

Auditors have critically examined the various systems, schemes, devices employed as well as the associated documents at DVC for above 11kV, at 11kV and below 11kV as to ascertain its adequacy and efficacy as per the directives of the BEE and guidelines as per regulation.

1.3 Study Team

As per the directives of team given by regulation, the teams were formed by DVC and PPSES to conduct the energy accounting and energy audit.

1.3.1 DVC TEAM

DVC has a Centralized Audit Cell as per BEE notification which is shown below.

Table 2 Team of DVC

Sr. Nos	Name	Designation	Contact number
1	Shri. Debashis Dey	Chief Engineer	033-66072141
2	Shri. Anil Kumar Jain	Deputy Chief Engineer	7003171374
3	Shri. Vinoy Sil Ashok	Superitending Engineer(Elec.)	
4	Shri. Joydip Saha	Senior Divisional Engineer(Elec.)	
5	Shri. Kumar Nitish	Executive Engineer(IT)	
6	Shri. Debasish Roy	Dy. Manager (Finance)	
7	Shri. Pritam Ghosh	Executive Engineer (Mech.)	

1.3.2 PPS Energy Solutions PVT Ltd (PPSES)

Table 3 PPSES Team

Sr. No.	Name	Designation
1	Dr. Ravi Deshmukh	Team Leader. Accredited Energy Auditor (AEA-0243)
2	Mr. Dinesh Baharate	Team member - Electrical Engg. (EA 24237) (Certified Energy Auditor)
3	Mr. Shashikant Puranic	Sector Expert - Electrical Engg.
4	Mr. Prasad Bhosale	Team member- Electrical Engg 1
5	Mr. Hemant Kadu	Team Member – Electrical Engg 2

1.4 Methodology

The methodology adopted,

1. Kick of meeting with DVC team to finalize the sample size
2. Survey of the Distribution network
3. Collection of the Primary Data and finalization of the sample size check
4. Site visit and Energy Meter data collection
5. Collection of the Metered Energy Data for the respective voltage level as per the sample size
6. Scrutiny of collected data and Data gaps of the submitted data
7. Loss calculation for the network segment then if required normalization
8. Compilation of the Draft report
9. Presentation on Draft report
10. Final report with incorporation of comments

As per the methodology, after collection of the data, site visit for different substations were conducted in month of July 2022, along with DVC Team and consultant team.

1.5 Injection Energy

The total energy purchased by DVC from different Generation plants is 41258.41 MU. The transmission loss of 2.13 %, which is the difference between the energy purchased at generating point and input at the interface point. To arrive at the input energy, the transmission loss is subtracted from purchased energy. The net input energy is 18483.76 MU. The input energy is at various voltage levels. There are 5 Nos of 220 kV EHT Consumers, 35 Nos of 132 kV EHT Consumer and 253 no of 33kV EHT consumer and 11kV level input point through which energy flows into the systems.

Table 4 Input MU

DC	Type	Assessment Net Input Energy Consumption (MU)	Remarks
DVC	DISCOM	18483.76	The net energy at periphery of DVC Network is summation of the division wise input energy. The details are enclosed in Table no 14 - Net Energy at DVC Periphery.

1.6 Energy Consumption for 2020-21

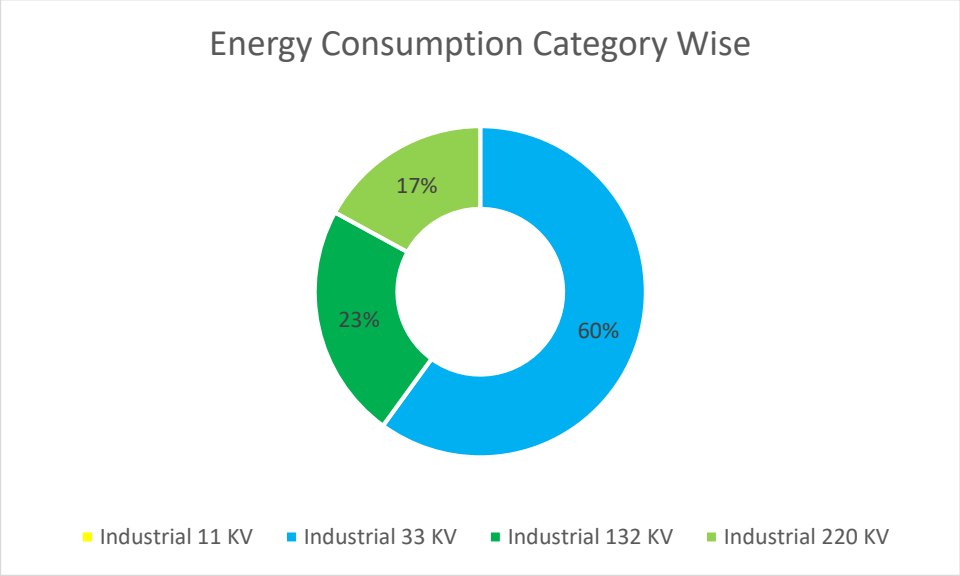


Figure 1 Energy consumption Category Wise of DVC

The major energy consumption of 33 KV Industrial Consumers which is 60% followed by 132 KV consumers of 23%. Review of the current consumption practices in order to identify the energy loss in the system was carried out.

1.7 Energy Balance at Different Voltage level.

The energy balance of at different voltage level is not possible as the ring man of 132kV and above is formed and the net meters are not available. Hence total system energy balance is carried out.

Table 5 DVC loss

Loss Estimation for DISCOM	
T&D loss (MU)	394
D loss (MU)	394
T&D loss (%)	2.04%
D loss (%)	2.04%

The formula used for the AT&C loss calculation

AT & C Loss: [1- Billing Efficiency X Collection Efficiency] X 100%

Since the 33 kV and above consumers are billed monthly, The loss Technical loss is only present in the system and A&TC loss is technical loss of the system.

The overall loss of the DVC For 2021-22 year are tabulated below

Table 6 Overall Loss

1	Period of Information Year of (FY) information including Date and Month (Start & End)	1st April, 2021 - 31st March, 2022	
2	**Technical Details**		
(a)	**Energy Input Details**		
(i)	Input Energy Purchase (From Generation Source)	Million kwh	41258.41
(ii)	Net input energy (at DISCOM Periphery after adjusting the transmission losses and energy traded)	Million kwh	18483.76
(iii)	Total Energy billed (is the Net energy billed, adjusted for energy traded))	Million kwh	18089.64
(b)	Transmission and Distribution (T&D) loss Details	Million kwh	394.12
		%	2.04%
	Collection Efficiency	%	100%
(c)	Aggregate Technical & Commercial Loss	%	2.04%

Table 7 : T&D Loss % in r/o DVC System (Provisioanl) (as per format prescribed by WBERC)

Ref.	Particulars	Unit	Derivation	FY 21-22
1	Generation (Gross)	MU	A	41264.37
2	Unit Auxiliary Consumption	MU	B1	2927.886
3	Transformation Loss	MU	B2	
4	**Units delivered to system from generation (including infirm power, if any)**	MU	C=A-B1-B2	38336.48
5	Quantunm of Infirm power included in 1	MU		0
6	Energy Purchased	MU	D=D1+D2+D3+D4+D5	2042.657
	*i) Thru' Central Sector Allocation	MU	D1	701.2097
	*ii) Thru' Maithon Power Ltd.	MU	D2	994.3035
	iii) thru' Solar Power	MU	D3	50.17669
	iv) thru' exchange	MU	D4	267.3681
	v) URS power	MU	D5	0
	v) GTAM (solar)	MU		17.12082
	vi) GTAM (non-solar)	MU		12.47848
7	Energy Received for Wheeling	MU	E=E1+E2+E3+E4	870.3815
	a) On account of Tata Steel	MU	E1	142.4307
	b) On account of Indian Railways	MU	E2	722.2508
	c) On account of India Power Corporation (IPCL)	MU	E3	0
	d) On account of Jindal Steel	MU	E4	5.7
8	e) Incidental energy injected by TISCO without commercial implication			8.889929
9	**Overall Gross Energy in System**	MU	F=C+D+E	41258.41
10	Units Sold to persons other than licensees or any consumers	MU	G_1	0

Ref.	Particulars	Unit	Derivation	FY 21-22
11	Additional Units allowed by Commission for Sales to persons other than licensees or any consumers	MU	G_2	
12	Units sold/ used for pumping energy of Pumped Storage Project at Bus bar	MU	G_3	0
13	Additional Units allowed by Commission against Pumping Energy for pumping loss	MU	G_4	0
14	i) Units sold to JBVNL (metered)	MU	G_5	3246.733
	ii) Units sold to other licensees	MU	G_7	15783.46
	iii) Short term sale to other licensees	MU	G_8	0
	iv) sale to Bangladesh	MU	G9	2530.588
15	Units sold thru' IEX/PXIL	MU	G10	196.9544
16	i) Net UI [Actual drawal]	MU	G11	14.55301
	ii) UI power to RAIL	MU	G13	193.2032
17	Standby Power supplied to Indian Railways	MU	G14	0
18	**Total Energy goes out of System**	MU	(G=G1 to G12)	21965.49
19	**Net Energy in System**	MU	H=F-G	19292.92
20	Units sold to consumers	MU	I	17979.17
21	Units wheeled	MU	J=J1+J2+J3	809.1628
	a) On account of Tata Steel	MU	J1	103.3127
	b) On account of Schd. of Power by Indian Railways	MU	J2	705.85
	c) On account of India Power Corporation (IPCL)	MU	J3	0
22	Additional Units allowed for wheeling	MU	K	0
23	Units utilised in own premises including construction power	MU	L= C1+ C2	110.4678
	a) Quantunm of construction power, if any	MU	C1	0.0399

Ref.	Particulars	Unit	Derivation	FY 21-22
	b) Colony in P/H and S/Stn. fed from DVC source	MU	C2	110.4279
24	**Overall Utilisation**	MU	M=sum(I:L)	18898.8
25	Unutilised Units	MU	N=H-M	394.1188
26	**System Loss**	%	O=N*100/H	2.042815

1.7.1 System Analysis :

Thier is difference between actual units sold to the consumer and the units showed for calculation of total loss because, the 110 units are consumed by the client it self for construction work.

1.8 Recommendations

1.8.1 Transformer Optimization During Off Peak Season

During off-peak periods, DVC can minimize the no load losses by maintaining optimal loading of transformers by configuring its network in such a manner that reliability of supply is also not compromised.

1.9 Energy saving Schemes

Development of comprehensive System Energy Measurement accounting & Audit (SEMA) at 33,132, 220 & 400 kV level is required to be developed as per CEA regulation which will enable us to quantify losses in every component/segment of the DVC power systems. The exercise involves accounting of tie flow from generating station down to consumers up to 33kV level & accounting Tie flow exchanges. Corporation had taken it into two phases. In SEMA Phase-II project focus has been laid on energy metering at all components/segments (equipment/lines) at 132 & 220kV level however SEMA Phase-I was for a 33kV system as per CEA regulation.

It was decided by the corporation for implementation of SEMA scheme for aforementioned voltage level of DVC Power system: Vis-a-vis segregation of T&D losses. DVC's target was to come down to 3.0% from 4.03 % that time.

This project includes procurement of 0.2 accuracy class metering equipment along with 0.2 accuracy class CT's & PT's for every component of 132 & 220kV System thereafter dismantling of existing 0.5 class 132& 220kV CT's & PT's, erection of new 0.2 accuracy class CT's & PT's with modification of support structure, Installation, testing and commissioning to achieve metering scheme with comprehensive networking system for remote access of energy data for computation of T&D losses of all grid substation and to identify the loss prone areas for remedial measures thereof for each substation and MIS report generation.

SEMA Phase-I was completed long back however updated progress of SEMA Phase-II is furnished hereunder;

Installation of 220 & 132kV PT's	100% completed
Installation of 220 & 132kV CT's	90% completed & balance under progress and likely to be completed by september'22
Installation of Meters & Networking	95% completed & balance under progress and likely to be completed by september'22

2 Introduction

2.1 Energy Accounting

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. 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.

Bureau of Energy Efficiency (BEE) through Ministry of Power, Government of India issued regulations namely Bureau of Energy Efficiency (Manner and Intervals for Conduct of Energy Audit in electricity distribution companies) Regulations, 2021 (hereinafter referred as 'BEE EA Regulation 2021'), for Conduct of Mandatory Annual Energy Audit and Periodic Energy Accounting in DISCOMs. As per the said regulation, all Electricity Distribution Companies are mandated to conduct annual energy audit and periodic energy accounting on quarterly basis. These Regulations for Energy audit in Electricity Distribution Companies provides broad framework for conduct of Annual Energy Audit though and Quarterly Periodic Energy Accounting with necessary Pre-requisites and reporting requirements to be met.

The major stake holders of this assignment are DVC and PPS Energy Solutions (PPSES).

2.2 Accredited Firm

M/s PPS Energy Solutions Private Limited as have been appointed by DVC to carry out the *Energy Audit of Power Distribution Network of DVC for year 2021-22.*

2.3 Objective

DVC has engaged PPSES to carry out the Energy Audit in DVC license area FY 2021-22. The objective of this assignment is to carry out the Annual Energy Audit as per the prescribed formats of BEE EA Regulation 2021 to conduct Energy Audit in DVC issued by Bureau of Energy Efficiency, Ministry of Power Government of India.

2.4 Scope of work

1 To carry out Energy Audit in line with the BEE EA Regulation 2021 to Conduct Energy Audit in DVC.

- Preparation of checklist/action plan for Energy Audit.
- Pro-forma of Energy Audit will be shared with selected agency after the issuance of Work Award.
- DISCOM visit should be carried out by all team members of the agency as per the team declaration in technical proposal. BEE EA Regulation 2021, proforma (formats) will be used for this audit. The regulations along with proforma (formats) are enclosed at Annexure-1.
- Collection and Review of the energy related data of last Financial Year (FY 2021-22) in the Pro-forma by visiting the DISCOM physically.
- Verification of existing pattern of energy distribution across periphery of electricity distribution Company
- Collection and verification of energy flow data of electricity distribution company at all applicable voltage level of distribution network (please refer energy audit regulation) Collection of data on energy received and distributed by DISCOM and verify the accuracy of data

2 Collection & analysis the data and prepare the same with report;

I. 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. Recorded meter reading at all export points (where energy sent outside the State (interstate as well as intrastate) is from the distribution system);

e

II. Parameters for computation of distribution losses:

a) Details of open access, EHT sale, HT sale, LT sale and transmission losses

b) Number of consumer's category wise in each circle

c) Consumers connected load category wise in each circle and division

f) Division and Circle wise losses of all circles under DISCOM periphery

g) Boundary meter details

h) Energy Cost and Tariff data

i) Source of energy Supply (e.g. electricity from grid or self-generation), including generation from renewables;

j) Energy supplied to Open Access Consumers, which is directly purchased by Open Access Consumers from any supplier other than electricity Distribution Company

III. Monitoring and verifications of input energy and consumption pattern at various voltage levels

IV. Identify the areas of energy leakage, wastage or inefficient use;

V. Identify high loss-making areas/networks, for initiating target based corrective action.

VI. Identify overloaded segments of the network for necessary capacity additions.

VII. Computation of agriculture consumption

VIII. Methodology for loss computation various losses.

IX. 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.

X. Collection Efficiency (Category wise) and computation of AT&C loss.

3 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.

Recommendations to facilitate energy audit, energy accounting and improve energy efficiency.

4 Study the details of loss/gain of DVC, 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.

- Current System Metering Status at various voltage level of DISCOM
- Status of Functional meters for all consumers, transformers and feeders.
- Status of default meters (non-functional meters) for all consumers, transformers and feeders
- Current status of pre-requisites mentioned in regulations (Please refer energy accounting regulation).
- 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.

5 Prepare final report of DVC as per the scope of work and as per the BEE Energy Audit Regulation, 2021, in a standard format duly indexed, covering profile of the unit and its details of energy related data w.r.t DVC analytical & Statistical details and any other

relevant information. The indicative report structure is provided in second schedule of BEE EA Regulation 2021.

2.4.1 Deliverables

- Preparation of report as per BEE EA Regulation 2021
- Verify & submit the duly signed annual energy audit report

2.5 Approach

Approach for the assignment, which was scheduled for 1 month, is guided by following points

- **Kick of Meeting:** Offline meeting with DVC personnel's and Energy Audit team will be conducted
  1. Communication to the selected the data points like input energy, out energy, renewable open access etc. were pointed out.
  2. Different measures included to account the energy were discussed

- **Site Visit:**

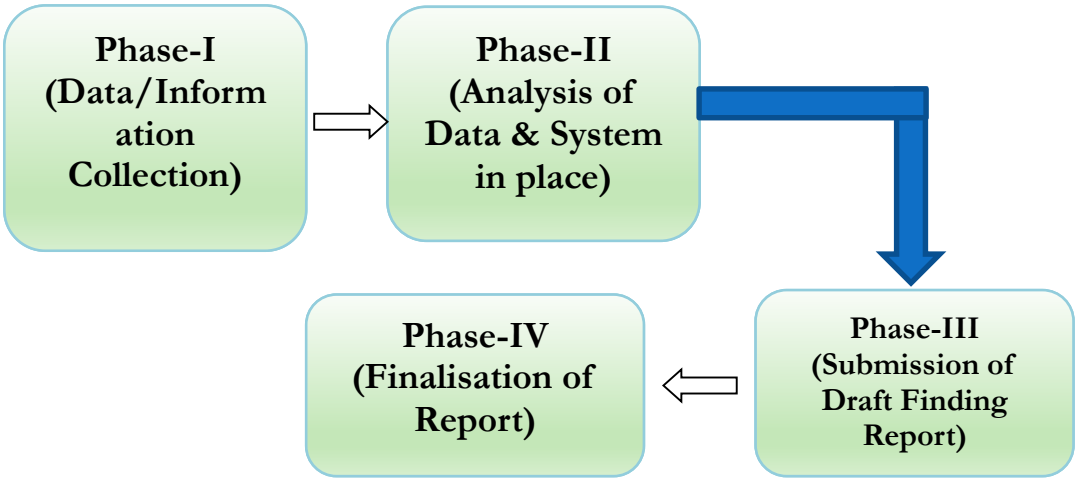
  Site visits were carried out in order to ascertain the meter numbers, boundary location meters,

- **Data analysis and Data Gaps:**

  Data Scrutiny was carried out and the data gaps were raised. The data validation was performed.

- **Deliverable submission**: The Report submission to the BEE will be executed as specified by BEE regulations.

2.6 Methodology



Phase I: Data Collection and Analysis & Approach and methodology document 1 week from work order

(a) Deal with identification of information and data requirement to carry out the Work/Job

(b) Meeting and Discussion with DVC to propose a detailed work plan.

Phase II: Data Analysis

(a) Data mining and procedural analysis of system in place for record of sales data.

(b) Meter reading data collection

The team members of Field Team did meter reading and data collection of field.

(c) Analysis of the Meter reading

Our team member with input from the respective experts analyzed the collected data.

(d) Based on the outcomes of the data analysis, a preliminary fact-finding report was submitted highlighting various issues at various sub-division levels.

Phase III: Detailed Analysis and Submission of Draft Report 1 month from work order

(a) Detailed analysis and preparation a draft report highlighting the validity, basis, consistency and objectivity of the approach adopted.

(b) Analysis of Specific Issues such as:

- Analysis of assessed sales in terms of load factor and specific consumption and its comparison with the sales based on actual meter reading.

- Reasons for exceptional high or low-metered sales as reported.
- Consistency in approach for assessed consumption.
- Methodology of assessing consumption and comparison of assessed sales with actual meter reading wherever meter readings are available.
- Comparison of Actual Category-wise Average Billing Rate (ABR) with ABR approved in Order

(b) Assessment of AT&C losses for HT, LT and Total Sales and comparison vis-à-vis as reported in the MIS of DVC and Recommendations for reducing AT&C Losses by DVC.

Phase IV: Detailed Analysis and Submission of Draft Report within 1 month from work order

(a) Incorporation of the suggestions received and carry out any further analysis as required and incorporate the same in the Final Report with Recommendations to reduce the AT&C losses of DVC.

Report Submissions

The report submitted as per the deliverables of this assignment.

3 DVC Distribution Network

3.1 General information of DVC Distribution Network

Damodar Valley Corporation (DVC) has been generating, transmitting and distributing power since 1953 in the eastern region of India. DVC over the last 74 years has developed a big and robust transmission grid network and expanded its grid from 132KV to 220KV & 400KV to serve its consumers across the valley area and to export power to other power deficit regions.

DVC grids operates in unison with the eastern regional grid through 132 KV, 220KV and 400KV Tie lines. All the Power stations and Sub stations of DVC are connected through DVC grids. DVC power consumers are provided supply at 33KV, 132KV and 230KV voltage level. Considering 12th plan projected load & evacuation of generation corresponding to 2016-17 Power scenarios, DVC has taken transmission system augmentation work under 12th Master plan.

1) DVC has their own Coal based & Hydel Power stations. In addition to their own generation, it procures power from Grid. Other major source are bilateral arrangements and energy from private traders for renewable energy.

2) DVC has only HT & EHT consumers. DVC power consumers are provided supply at 33KV, 132KV and 220KV voltage level..

	DVC TRANSMISSION LINE LENGTH(CKM)			
STATE	33 KV	132KV	220 KV	400 KV
JHARKHAND	889	2332	1323	251
WEST BENGAL	630	1307	952	227
ORISSA			35	
TOTAL	1519	3639	2310	478

The tie line network of the DVC is enclosed below for the various voltage level.

INTER/INTRA STATE TIE LINES	
VOLTAGE LEVEL	TIE LINES
400 KV	D/C RTPS-RANCHI PGCIL
400 KV	S/C RTPS-RANCHI PGCIL
400 KV	S/C RTPS-MAITHON A PGCIL
400 KV	D/C DSTPS- JAMSHEDPUR PGCIL
400 KV	S/C MTPS B- JAMSHEDPUR PGCIL
400 KV	D/C MTPS B- MAITHON B
400 KV	S/C MTPS B-MAITHON B

INTER/INTRA STATE TIE LINES	
400 KV	D/C KTPS-BIHAR SARIFF
400 KV	D/C KTPS-GAYA PG
220 KV	D/C PARULIA-PARULIA PGCIL
220 KV	D/C DTPS-BIDHANNAGAR PGCIL
220 KV	D/C KALYANESWARI-MAITHON PGCIL
220 KV	D/C DHANBAD-MAITHON PGCIL
220 KV	S/C JAMSHEDPUR-JINDAL
220 KV	S/C RAMGARH-RANCHI PGCIL
132 KV	S/C BARHI- BIHARSARIFF
132 KV	S/C BARHI-RAJGIR
132 KV	D/C PATRATU-PTPS
132 KV	D/C MAITHON HYDEL- JUVNL S.GANJ
132 KV	S/C KOLAGHAT-WBSETCL KOLAGHAT
132 KV	S/C CHANDIL-MANIQUI

SUBSTATION

DVC NO. OF SUBSTATION AT A GLANCE					
STATE	33KV	132 KV	220 KV	400 KV	TOTAL
JHARKHAND	1	15	5	0	21
WEST BENGAL		10	5	0	15
TOTAL	1	25	10	0	36
DVC NO. OF POWER HOUSE SWITCHYARD AT A GLANCE					
STATE	33KV	132 KV	220 KV	400 KV	TOTAL
JHARKHAND	0	2	3	2	7
WEST BENGAL		0	2	3	5
TOTAL	0	2	5	5	12

General Information of the DVC is enclosed below.

General Information				
1	**Name of the DISCOM**	Damodar Valley Corporation		
2	**i) Year of Establishment**	1948		
	ii) Government/Public/Private	Government		
3	**DISCOM's Contact details & Address**			
i	City/Town/Village	Kolkata		
ii	District	Kolkata		
iii	State	West Bengal	Pin	700054
iv	Telephone	033-66072141	Fax	
4	**Registered Office**			
i	Company's Chief Executive Name	Shri Ram Naresh Singh		
ii	Designation	Chairman		
iii	Address	DVC Tower, VIP Road, Kolkata, West Bengal - 700054		
iv	City/Town/Village	Kolkata	P.O.	Maniktala
v	District	Kolkata		
vi	State	West Bengal	Pin	700054
vii	Telephone		Fax	
5	**Nodal Officer Details***			
i	Nodal Officer Name (Designated at DISCOM's)	Debashis Dey		
ii	Designation	Chief Engineer		
iii	Address	1st Floor, Commercial Department, DVC Tower, VIP Road		
iv	City/Town/Village	Kolkata	P.O.	Maniktala
v	District	Kolkata		
vi	State	Kolkata	Pin	700054

vii	Telephone	033-66072141	Fax	
6	**Energy Manager Details***			
i	Name	Anil Kumar Jain		
ii	Designation	Deputy Chief Engineer	Whether EA or EM	EA
iii	EA/EM Registration No.	EA-5614		
iv	Telephone		Fax	
v	Mobile	7003171374	E-mail ID	anil.jain@dvc.gov.in
7	**Period of Information**			
	Year of (FY) information including Date and Month (Start & End)	1st April, 2021 - 31st March, 2022		

Table 8 General Information

3.2 Schedule of the work

Initial kick of meeting was arranged between the DVC official and the PPSES Team on 16 July 2022. In the kick of meeting the various data, PPSES team raised gaps.

DVC officials responded to the data gaps and the plan for the site visit with Accredited Energy Auditor was prepared.

3.3 Check list Prepared by EmAEA

List of Documents

Sr. No	Description
1	Energy Purchase Documents- Power Purchase report from all sources
2	Consumers Category wise details
3	Billed energy for different category of the consumer
4	Annual Calculation of transmission Loss
5	Annual EHT Sales Report-

6	Sample 33kV input and billed energy
7	DTR and consumer mapping for the LT loss calculation
8	Average Billing Rate for consumer category
9	Feeder wise injected energy into the network
10	Open access consumers and their consumption details
11	Infrastructure details

4 Document verification

The submitted data by the DVC has been reviewed as per the guide lines of BEE regulation and comments / remarks are mentioned at respective places

4.1 Energy Distribution Verification

Verification of existing pattern of energy distribution across periphery of electricity Distribution Company.
For the Energy Accounting year 2021-22, The Energy Distribution of DVC consumption is tabulated as follows

Table 9 Voltage level and Feeder wise consumption

Voltage Level	Feeder Name	Import MU	Consumed MU
220	Par-Parulia	441.42	32.49
132	B/N	972.96	0.00
400	J/J	86.53	84.16
220	KLY Pithakary	1129.54	0.00
132	B/Sarif	1.53	0.10
220	Ram/Patr	7.30	0.00
132	C/M	0.00	0.78
132	Kola/DVC	4.68	0.21
220	(Dhanbad)-Pithakary	1692.82	0.00
132	STPS/Puru.	0.00	0.00
400	MTPS- Jam PG	65.37	596.08
400	MTPS-Maithon PG	0.00	5532.63
400	DSTPS- Jam PG	0.00	3609.90
400	400 kV TSL BPRS at J'pur	1007.71	0.00
400	400 kV Kod-BBs (KTPS)-I	0.00	1100.65
400	400 kV Kod-BBs (KTPS)-II	0.00	1110.45
400	RTPS-MTN-II	0.00	1477.11
400	RTPS-Ranchi I	0.00	1223.29
400	KOD_Gaya-I	0.00	1041.63
400	KOD_Gaya-II	0.00	1064.35
400	RTPS-RAN-II	0.00	1684.14
400	RTPS-RAN_III	0.00	1683.65
220	RAMG-RAN	403.14	0.00
400	MTPS-RAN	0.65	0.00

4.2 Verification of periodic Reports

4.2.1 Yearly energy consumption data of consumers

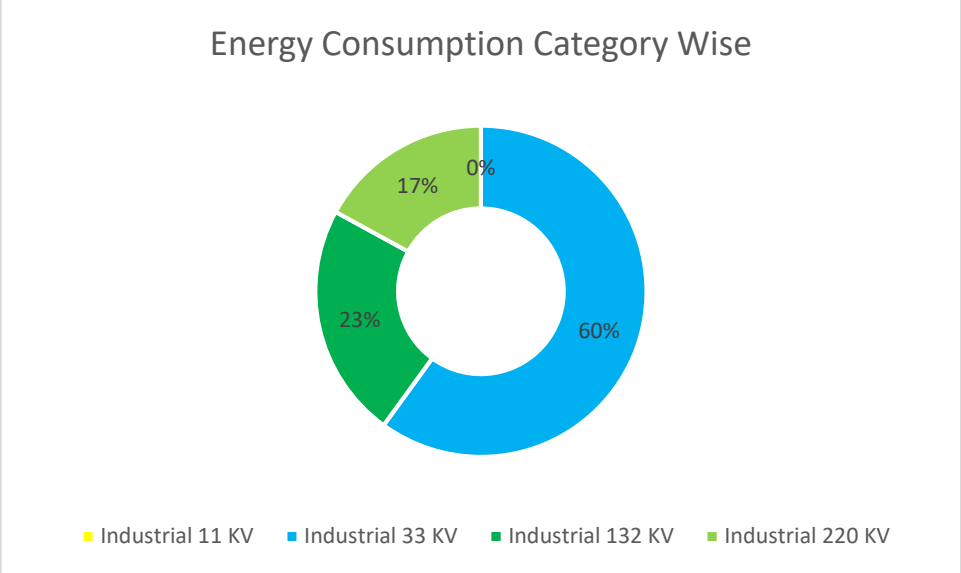


Figure 2 Energy Consumption Consumer Category wise

4.2.2 Source of energy supply (e.g. electricity from grid or self-generation), including generation from renewables

The source of energy supply for year 2020-21 is tabulated below

S. No.	Name of Generation Station	Generation Capacity (In MW)	Type of Station Generation (Based- Solid (Coal ,Lignite)/Liquid/Gas/Renewable (biomass-bagasse)/Others)	Type of Contract (in years/months/days)	Type of Grid (Intra-state/Inter-state)	Point of Connection (POC) Loss MU	Voltage Level (At input)	Remarks (Source of data)
1	NTPC TSTPS - I	1.859	Thermal	25 Years	Inter State	0.42867486 3	400 KV	Tariff Order for DISCOM
2	NTPC KBUNL	9.2274	Thermal	25 Years	Inter State	2.86172811 8	400 KV	Tariff Order for DISCOM

S. No.	Name of Generation Station	Generation Capacity (In MW)	Type of Station Generation (Based- Solid (Coal ,Lignite)/Liquid/Gas/Renewable (biomass-bagasse)/Others)	Type of Contract (in years/months/days)	Type of Grid (Intra-state/Inter-state)	Point of Connection (POC) Loss MU	Voltage Level (At input)	Remarks (Source of data)
3	NHPC Rangit	5.94	Hydel Power Station	25 Years	Inter State	1.094154169	400 KV	Tariff Order for DISCOM
4	NHPC Teesta	43.5456	Hydel Power Station	25 Years	Inter State	7.42644706	400 KV	Tariff Order for DISCOM
5	PTC Chukha	28	Hydel Power Station	25 Years	Inter State	6.1474436844	400 KV	Tariff Order for DISCOM
6	PTC Tala	55.95	Hydel Power Station	25 Years	Inter State	4.93826178	400 KV	Tariff Order for DISCOM
7	PTC Kurichu	29.7	Hydel Power Station	25 Years	Inter State	0.77259676	400 KV	Tariff Order for DISCOM
8	MPL	140.5	Thermal	25 Years	Inter State	35.209683069	400 KV	Tariff Order for DISCOM

4.2.3 T<>D Boundary meter details:

Table 10 Voltage wise audited feeders

Voltage Level	Number of Feeders	Imports (MU)
132	5	979.17
220	5	3674.22
400	14	1160.26
Grand Total	24	5813.65

4.2.4 Verification of Sales energy

4.2.4.1 Energy Accounting Verification at HT level

Consumers Category	Consumer	CONSUMPTION Metered Units (in MU)
Industrial 11 KV	2	0.20
Industrial 33 KV	253	10786.66
Industrial 132 KV	35	4128.19
Industrial 220 KV	5	3064.12
HT-TOTAL	295	17979.17

5 Critical Network Analysis

The DVC network is above 33kV Voltage level. The tie Lines and ring main is constraint for calculation of the loss voltage level wise. SEMA scheme is being implemented as per the direction of CEA . The scheme involved placement of the energy meters at the tie line inorder to facilitate the energy accounting.

DVC has it own generation station and it also purchased the energy from the grid.

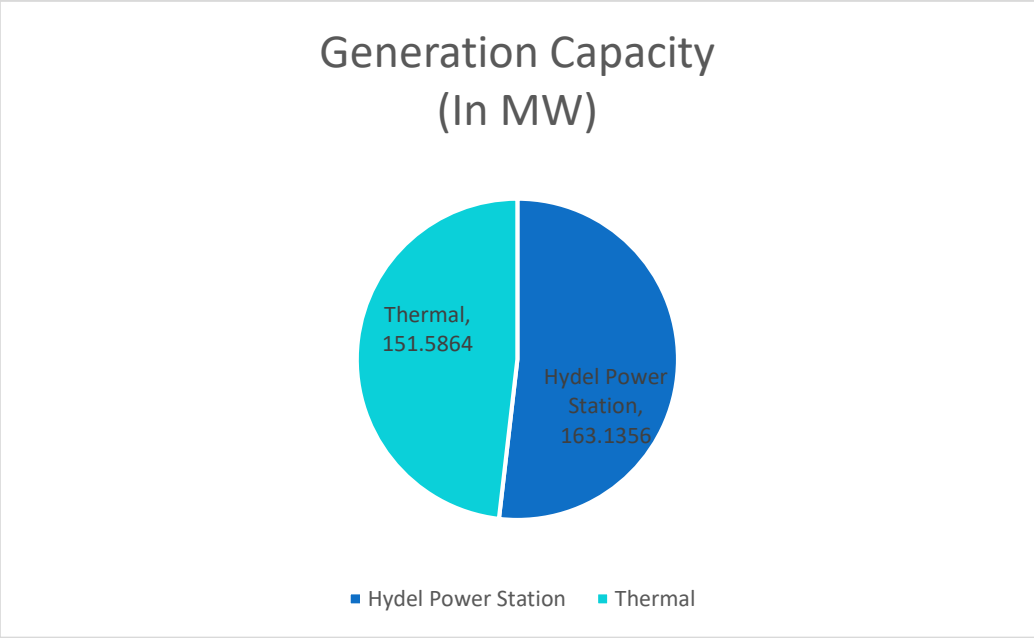
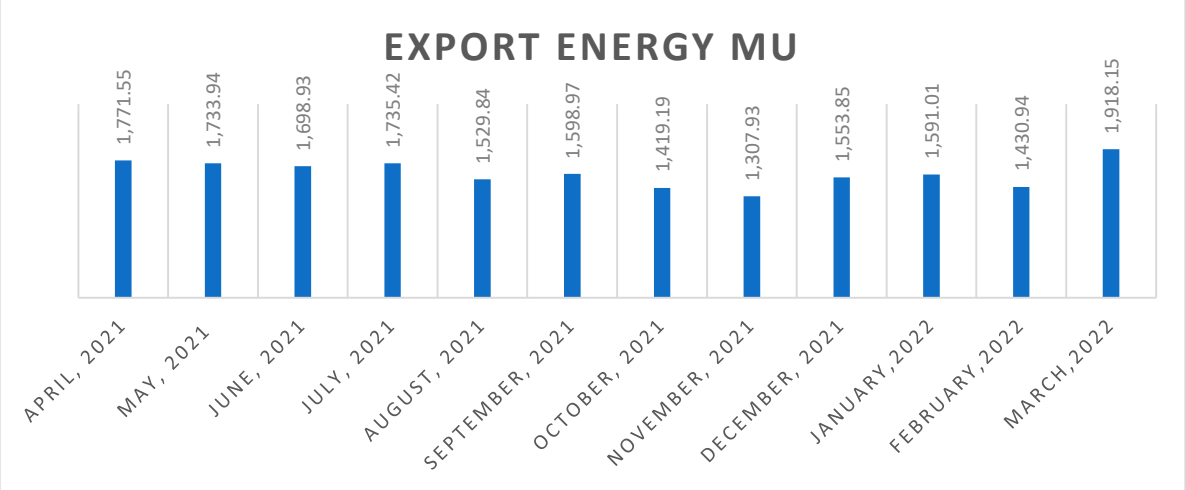


Figure 3 MW Installed

The consumption month wise which is exported and billed in the next month is shown below.



The months are next months of the consumption the billing is carried out.

5.1.1 Purchased Energy for 2021-22

The total purchased energy by DVC is 41258.41 MU and the exported energy by DVC over it transmission network to other discoms.

Table 11 Purchased Energy

DC	Type	Assessment Net Input Energy Consumption (MU)	Remarks
DVC	DISCOM	41258.41	Total Energy purchased by DVC.

5.1.2 Input Energy

The energy recorded at the Interface point of transmission and DVC Distribution is 41258.41 MU.

5.1.3 Billed energy 2021-22

All the 33kV and above conusmer are billed.

Table 12 Billed energy

Sr. No	Billed Energy (MU)	Data Source
1	18089.64	As per the submitted data by the DVC team

5.1.4 System Analysis :

Thier is difference between actual units sold to the consumer and the units showed for calculation of total loss because, the 110 units are consumed by the client it self for construction work.

5.2 Distribution Loss calculation

The feeder level energy audit is not performed by DVC. The energy billed by consumer and the net energy accessed at the periphery is used for the calculation of the technical loss.

Table 13 Input Mus voltage by bifurcation

3	Voltage level	Particulars	MU
i	66kV and above	Long-Term Conventional	1,695.51
		Medium Conventional	0
		Short Term Conventional	267.37
		Banking	0
		Long-Term Renewable energy	50.18
		Medium and Short-Term RE	29.60
		Captive, open access input	879.27
		UI Drawal	
		Sale of surplus power	
		Quantum of inter-state transmission loss	
		Power procured from inter-state sources	2,921.93
		Power at state transmission boundary	2,921.93
		Gross Generation	41,264.37
		Unit Auxiliary Consumption	2,927.89
		Units delivered to system from generation	38,336.48
ii	33kV	Long-Term Conventional	0
		Medium Conventional	0
		Short Term Conventional	0
		Banking	0
		Long-Term Renewable energy	0
		Medium and Short-Term RE	0
		Captive, open access input	0
		Sale of surplus power	0
		Quantum of intra-state transmission loss	0
		Power procured from intra-state sources	0
iii		**Input in DISCOM wires network**	41,258.41
iv	33 kV	Renewable Energy Procurement	
		Small capacity conventional/ biomass/ hydro plants Procurement	
		Captive, open access input	

3	Voltage level	Particulars	MU
v	11 kV	Renewable Energy Procurement	
		Small capacity conventional/ biomass/ hydro plants Procurement	
		Sales Migration Input	
vi	LT	Renewable Energy Procurement	
		Sales Migration Input	
vii		**Energy Embedded within DISCOM wires network**	0
viii		**Total Energy Available/ Input**	41,258.41
4	**Voltage level**	**Energy Sales Particulars**	**MU**
i	LT Level	DISCOM' consumers	
		Demand from open access, captive	
		Embedded generation used at LT level	
		Sale at LT level	0
		Quantum of LT level losses	0
		Energy Input at LT level	
ii	11 kV Level	DISCOM' consumers	0.202
		Demand from open access, captive	
		Embedded generation at 11 kV level used	
		Sales at 11 kV level	0.202
		Quantum of Losses at 11 kV	-0.202
		Energy input at 11 kV level	
iii	33 kV Level	DISCOM' consumers	10,897.12
		Demand from open access, captive	
		Embedded generation at 33 kV or below level	
		Sales at 33 kV level	10,897.12
		Quantum of Losses at 33 kV	-10,897.12
		Energy input at 33kV Level	
iv	> 33 kV	DISCOM' consumers	7192.31
		Demand from open access, captive	1,002.37
		Cross border sale of energy	2,530.59
		Sale to other DISCOMs	19,227.15

3	Voltage level	Particulars	MU
		Banking	
		Energy input at > 33kV Level	14.55
		Sales at 66kV and above (EHV)	29,966.96
			Total Energy Requirement **41,258.41**
			Total Energy Sales **40,864**

Table 14 Transmission and Distribution loss

Loss Estimation for DISCOM	
T&D loss (MU)	394
D loss (MU)	394
T&D loss (%)	2.04%
D loss (%)	2.04%

Total Distribution Loss of the DVC is 2.04% and T & D loss is 2.04%

Table 15 Collection Efficiency Division wise

Name of Division	Billed Amount in Rs. Crore	Collected Amount in Rs. Crore	Collection Efficiency
GOMD-I	480.0653	485.5381	101.14%
GOMD-V	503.668	502.2168	99.71%
GOMD-VI	195.2802	190.8609	97.74%
GOMD-I	314.792	317.0648	100.72%
GOMD-IV	450.549	453.6235	100.68%
GOMD-IV	174.9039	175.3159	100.24%
GOMD-I	347.3946	341.8425	98.40%
GOMD-II	166.6811	158.9633	95.37%
GOMD-III	194.4164	182.1887	93.71%
GOMD-IV	243.0032	217.9972	89.71%
GOMD-IV	153.7687	150.4952	97.87%
GOMD-I	60.90924	58.33159	95.77%
GOMD-I	298.6842	276.1965	92.47%
GOMD-IV			

Name of Division	Billed Amount in Rs. Crore	Collected Amount in Rs. Crore	Collection Efficiency
GOMD-VII			
GOMD-I	**164.2991**	**164.2991**	**100.00%**
GOMD-III	**49.05868**	**49.05868**	**100.00%**
GOMD-I	**1009.024**	**1009.024**	**100.00%**
GOMD-I	**30.81986**	**30.81986**	**100.00%**
GOMD-II	**279.1082**	**279.1082**	**100.00%**
GOMD-V	**128.4666**	**128.4666**	**100.00%**
GOMD-I	**304.0816**	**304.0816**	**100.00%**
GOMD-V	**441.8209**	**441.8209**	**100.00%**
GOMD-II	**189.7065**	**189.7065**	**100.00%**
GOMD-II	**733.7523**	**733.7523**	**100.00%**
GOMD-III	**202.8946**	**202.8946**	**100.00%**
GOMD-VI	**22.43448**	**22.43448**	**100.00%**
GOMD-IV	**645.6972**	**645.6972**	**100.00%**
GOMD-VII	**417.3145**	**417.3145**	**100.00%**
GOMD-II	**58.22425**	**58.22425**	**100.00%**
GOMD-VI	**77.25471**	**77.25471**	**100.00%**
GOMD-IV	**221.16**	**221.16**	**100.00%**
GOMD-VII	**379.8012**	**379.8012**	**100.00%**
GOMD-III	**137.5173**	**137.5173**	**100.00%**
GOMD-IV	**544.2784**	**544.2784**	**100.00%**
GOMD-VII	**102.6441**	**102.6441**	**100.00%**
GOMD-II	**14.64382**	**14.64382**	**100.00%**
GOMD-IV	**56.64515**	**56.64515**	**100.00%**

Table 16 Division wise T & D Loss

Name of Division	Input energy (MU)	Metered energy	Total energy	% of energy consumption	T&D loss (MU)	T&D loss (%)
GOMD-I	**0**	**352.45**	**352.45**	**100%**	**-352.45**	**0%**
GOMD-V	**0**	**112.30**	**112.30**	**100%**	**-112.30**	**0%**
GOMD-VI	**0**	**2164.19**	**2164.19**	**100%**	**-2164.19**	**0%**
GOMD-I	**0**	**59.22**	**59.22**	**100%**	**-59.22**	**0%**
GOMD-IV	**0**	**642.45**	**642.45**	**100%**	**-642.45**	**0%**
GOMD-IV	**0**	**233.71**	**233.71**	**100%**	**-233.71**	**0%**
GOMD-I	0	628.58	628.58	100%	-628.58	0%
GOMD-II	0	907.77	907.77	100%	-907.77	0%
GOMD-III	0	484.68	484.68	100%	-484.68	0%
GOMD-IV	0	1615.57	1615.57	100%	-1615.57	0%
GOMD-IV	0	402.88	402.88	100%	-402.88	0%
GOMD-I	0	40.61	40.61	100%	-40.61	0%
GOMD-I	0	1307.94	1307.94	100%	-1307.94	0%
GOMD-IV	0	969.19	969.19	100%	-969.19	0%
GOMD-VII	0	130.95	130.95	100%	-130.95	0%
GOMD-I	0	167.05	167.05	100%	-167.05	0%
GOMD-III	0	466.66	466.66	100%	-466.66	0%
GOMD-I	0	806.62	806.62	100%	-806.62	0%
GOMD-I	0	225.26	225.26	100%	-225.26	0%
GOMD-II	0	1186.96	1186.96	100%	-1186.96	0%
GOMD-V	0	240.07	240.07	100%	-240.07	0%
GOMD-I	0	26.35	26.35	100%	-26.35	0%
GOMD-V	0	132.47	132.47	100%	-132.47	0%
GOMD-II	0	154.53	154.53	100%	-154.53	0%
GOMD-II	0	314.89	314.89	100%	-314.89	0%
GOMD-III	0	75.98	75.98	100%	-75.98	0%
GOMD-VI	0	2.68	2.68	100%	-2.68	0%
GOMD-IV	0	7.98	7.98	100%	-7.98	0%
GOMD-VII	0	153.72	153.72	100%	-153.72	0%
GOMD-II	0	129.88	129.88	100%	-129.88	0%
GOMD-VI	0	1159.46	1159.46	100%	-1159.46	0%
GOMD-IV	0	458.39	458.39	100%	-458.39	0%
GOMD-VII	0	216.37	216.37	100%	-216.37	0%
GOMD-III	0	117.01	117.01	100%	-117.01	0%
GOMD-IV	0	446.90	446.90	100%	-446.90	0%

Name of Division	Input energy (MU)	Metered energy	Total energy	% of energy consumption	T&D loss (MU)	T&D loss (%)
GOMD-VII	0	1006.29	1006.29	100%	-1006.29	0%
GOMD-II	0	419.49	419.49	100%	-419.49	0%
GOMD-IV	0	11.69	11.69	100%	-11.69	0%
Total	**0**	**17979.17**	**17979.17**	**100%**	**-17979.17**	**0%**

5.2.1 Total A T&C Loss.

Table 17 Total AT&C Loss

1	Period of Information Year of (FY) information including Date and Month (Start & End)	1st April, 2021 - 31st March, 2022	
2	**Technical Details**		
(a)	**Energy Input Details**		
(i)	Input Energy Purchase (From Generation Source)	Million kwh	41258.41
(ii)	Net input energy (at DISCOM Periphery after adjusting the transmission losses and energy traded)	Million kwh	18483.76
(iii)	Total Energy billed (is the Net energy billed, adjusted for energy traded))	Million kwh	18089.64
(b)	Transmission and Distribution (T&D) loss Details	Million kwh	394.12
		%	2.04%
	Collection Efficiency	%	100%
(c)	Aggregate Technical & Commercial Loss	%	2.04%

The Total AT&C loss of the DVC is 2.04% for the year 2021-22

5.3 Energy Balance :

Ref.	Particulars	Unit	Derivation	FY 21-22
1	Generation (Gross)	MU	A	41264.37
2	Unit Auxiliary Consumption	MU	B1	2927.886
3	Transformation Loss	MU	B2	
4	**Units delivered to system from generation (including infirm power, if any)**	MU	C=A-B1-B2	38336.48
5	Quantunm of Infirm power included in 1	MU		0
6	Energy Purchased	MU	D=D1+D2+D3+D4+D5	2042.657
	*i) Thru' Central Sector Allocation	MU	D1	701.2097
	*ii) Thru' Maithon Power Ltd.	MU	D2	994.3035

Ref.	Particulars	Unit	Derivation	FY 21-22
	iii) thru' Solar Power	MU	D3	50.17669
	iv) thru' exchange	MU	D4	267.3681
	v) URS power	MU	D5	0
	v) GTAM (solar)	MU		17.12082
	vi) GTAM (non-solar)	MU		12.47848
7	Energy Received for Wheeling	MU	E=E1+E2+E3+E4	870.3815
	a) On account of Tata Steel	MU	E1	142.4307
	b) On account of Indian Railways	MU	E2	722.2508
	c) On account of India Power Corporation (IPCL)	MU	E3	0
	d) On account of Jindal Steel	MU	E4	5.7
8	e) Incidental energy injected by TISCO without commercial implication			8.889929
9	**Overall Gross Energy in System**	MU	F=C+D+E	41258.41
10	Units Sold to persons other than licensees or any consumers	MU	G_1	0
11	Additional Units allowed by Commission for Sales to persons other than licensees or any consumers	MU	G_2	
12	Units sold/ used for pumping energy of Pumped Storage Project at Bus bar	MU	G_3	0
13	Additional Units allowed by Commission against Pumping Energy for pumping loss	MU	G_4	0
14	i) Units sold to JBVNL (metered)	MU	G_5	3246.733
	ii) Units sold to other licensees	MU	G_7	15783.46
	iii) Short term sale to other licensees	MU	G_8	0
	iv) sale to Bangladesh	MU	G9	2530.588
15	Units sold thru' IEX/PXIL	MU	G10	196.9544

Ref.	Particulars	Unit	Derivation	FY 21-22
16	i) Net UI [Actual drawal]	MU	G11	14.55301
	ii) UI power to RAIL	MU	G13	193.2032
17	Standby Power supplied to Indian Railways	MU	G14	0
18	**Total Energy goes out of System**	MU	(G=G1 to G12)	21965.49
19	**Net Energy in System**	MU	H=F-G	19292.92
20	Units sold to consumers	MU	I	17979.17
21	Units wheeled	MU	J=J1+J2+J3	809.1628
	a) On account of Tata Steel	MU	J1	103.3127
	b) On account of Schd. of Power by Indian Railways	MU	J2	705.85
	c) On account of India Power Corporation (IPCL)	MU	J3	0
22	Additional Units allowed for wheeling	MU	K	0
23	Units utilised in own premises including construction power	MU	L= C1+ C2	110.4678
	a) Quantunm of construction power, if any	MU	C1	0.0399
	b) Colony in P/H and S/Stn. fed from DVC source	MU	C2	110.4279
24	**Overall Utilisation**	MU	M=sum(I:L)	18898.8
25	Unutilised Units	MU	N=H-M	394.1188
26	**System Loss**	%	O=N*100/H	2.042815

5.5 Recommendations

5.5.1 System automation for loss calculation

The division wise excel sheet shall be automated via some software and the respective changes in the field in order to maintain the supply and meter faults, etc. shall be updated in the software on timely basis.

5.5.2 Transformer Optimization During Off Peak Season

During off-peak periods, DVC can minimize the no load losses by maintaining optimal loading of transformers by configuring its network in such a manner that reliability of supply is also not compromised

6 Energy Conservation Schemes

Under the system Energy Measurement accounting & audit at 33kV & above voltage level, the meter installation is under process

6.1 SEMA SCHEME:

Development of comprehensive System Energy Measurement accounting & Audit (SEMA) at 33,132, 220 & 400 kV level is required to be developed as per CEA regulation which will enable us to quantify losses in every component/segment of the DVC power systems. The exercise involves accounting of tie flow from generating station down to consumers up to 33kV level & accounting Tie flow exchanges. Corporation had taken it into two phases. In SEMA Phase-II project focus has been laid on energy metering at all components/segments (equipment/lines) at 132 & 220kV level however SEMA Phase-I was for a 33kV system as per CEA regulation.

It was decided by the corporation for implementation of SEMA scheme for aforementioned voltage level of DVC Power system: Vis-a-vis segregation of T&D losses. DVC's target was to come down to 3.0% from 4.03 % that time.

This project includes procurement of 0.2 accuracy class metering equipment along with 0.2 accuracy class CT's & PT's for every component of 132 & 220kV System thereafter dismantling of existing 0.5 class 132& 220kV CT's & PT's, erection of new 0.2 accuracy class CT's & PT's with modification of support structure, Installation, testing and commissioning to achieve metering scheme with comprehensive networking system for remote access of energy data for computation of T&D losses of all grid substation and to identify the loss prone areas for remedial measures thereof for each substation and MIS report generation.

SEMA Phase-I was completed long back however updated progress of SEMA Phase-II is furnished hereunder;

7 Data Gaps & List of Annexures

7.1 Data Gaps raised by AEA

Table 18 Data Gaps

Sr. No	Data Gaps in the Data provided by MESCOM for Annual Energy Audit as per BEE regulation 6th Oct 2021	Remarks
1	Kindly provide the identification and mapping of high tension and low-tension consumers	SLD is provide for 132 kV Level.
2	Kindly provide the details of the energy accounting data - 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	Metering is provided and home grown software is used as per tariff category
3	Whether the Metering of distribution transformers at High Voltage Distribution System up to 25KVA is done on cluster metering? If not what is the action plan	No HVDS installation
4	Energy (Electrical) Purchase report for the year 2021-22	Data provided by DVC
5	Open access consumer and their details	Data provided by DVC
6	High loss Network segments	The segment identification is not possible due to ring main.

7.2 List of Annexure

1. General Information
2. Minutes of Meeting with the DISCOM team
3. Check List prepared by auditing Firm.
4. Form-Input energy (Details of Input energy & Infrastructure)
5. Infrastructure Details
6. Power Purchase Details
7. Details of Input Energy Sources
8. Details of Consumers & Category of service details
9. Details of Division Wise Losses
10. Detailed Site visit annexed -Site photos