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A Case Study: Ways And Means to Measure and Reduce ATC Losses in Distribution Systems

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***Abstract:** Electricity system consists of generation, transmission & distribution networks. The transmission & distribution loss and commercial losses play an important role in determining the cost of energy utilized by the user. The generation capacity, transmission, and distribution capacity depends on the losses & demand. When the loss is more, the generation capacity, transmission, and distribution capacity are to be increased.*

The main aim of SEBs is to give the electricity at cheaper cost, so it is necessary to minimize the Aggregate Technical and Commercial (ATC) Losses. But so far, no attempt is made to accurately calculate the losses by the SEBs. A test feeder is taken to analyses the ATC losses. In the analysis, distribution transformers (DT) loading, Power factor, Regulation and energy meter working conditions are studied.

The aim of the analysis is to assess the present ATC losses in secondary distribution system on a selected feeder. This work suggests improvement measures reduce the ATC losses within the permissible value and implement some of our suggestions and then determine the new ATC losses. After corrective measures are taken, the ATC losses are found reduced.

sKeywords: ATC Losses, Distribution Feeders, Efficiency.

1. INTRODUCTION

Indian Electricity has frequent power cuts, less reliability, and poor quality supply. Problems of Indian power sector are low plant load factors, lack of optimization of generation, frequent load shedding, burnouts, high losses (tech & commercial losses), Poor quality of power supply, poor revenue collection efficiency. For the development of a country electric power is the key component. The National goal is to provide reliable, affordable and quality power to all by 2012. This work deals with reduction of ATC losses.

1.1 Aggregate Technical and Commercial (ATC) Losses

Our natural resources are getting depleted fast and so the available energy has to be handled carefully without unnecessary wastage. Energy conservation is the need of the hour.

Further, each second of electricity supplied earns revenue for the Board. Hence, the spotlight is now turned on the ways and means of reduction of ATC losses.

While transmitting power, losses occur in the transmission, sub-transmission and distribution lines as well as in power transformers and distribution transformers.

The technical loss in the power system is an inherent characteristic which is due to the resistive, capacitive and inductive circuits. As such, the technical loss cannot be totally eliminated but can be reduced to an optimum level by carrying out improvement works. This involves a considerable investment. However, a well-planned transmission and distribution network can certainly reduce the transmission and distribution loss and supply stable and quality power to the consumers.

The T & D loss in State Electricity Board (Tamil Nadu) is estimated as 18% for the year 2005-06. This arrives from units generated and units sold.

Sl.No.	Description	2005-06
A	Gross generation + power purchase	55802MU
B	Auxiliary consumption	1802 MU
C	Kadamparai pumping	592 MU
D	Net energy available for sale A-(B+C)	53408MU
E	Total sales	43795 U
F	T & D loss (D-E)	9613 MU
G	% ATC loss (F/D x 100)	18.0%

Although the units billed was 43795 MU, the units realized was 43215 MU due to the collection efficiency of 98.68%. The ATC loss considering the collection efficiency works out to 19.09%. The ATC loss is a grave area of concern in this whole cycle of generation of energy to its utilization by end users.

1.2 Categorization of ATC losses

The ATC losses may be categorized as under a. Technical losses b. Commercial losses

1.2.1Technical losses

The technical losses are due to energy dissipation in the conductor and equipment used in the system of transmission and distribution of power. This is an inherent characteristic.

1.2.2 Commercial losses

The commercial loss is caused by theft of energy, defective meters, wrong billing, collection inefficiency and errors in the estimation of unmetered supply. The agricultural and hut services in SEB are unmetered and the consumption is computed.

1.2.3 Reasons for high technical loss

The main reasons for high transmission and distribution loss are as follows:

- Length of LV distribution
- Size of conductor
- Primary distribution voltage level
- Too many levels of transformation of voltage
- Low power factor.
- Overloading and under loading of transformer
- Poor quality equipment
- Low System load factor
- The absence of optimizing distribution and transmission losses.

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.1.2.4 Measures for reducing technical losses

- Use of adequate size of conductor.
- Appropriate length.
- Maintain proper voltage at consumer point
- Proper location and loading of DT.
- Improvement of power factor by application of shunt capacitor.
- Quality equipment
- By providing a clamp instead of binding of the conductor.

1.2.5 Reasons for high commercial losses

- Meters not read / inaccurate / defective
- Inaccurate billing/bill not prepared
- Theft of energy

1.2.6 Measures for reducing commercial losses

1. Quality meter can be provided
2. Defective meter is replaced by new
3. Bill is properly prepared
4. Theft should be avoided

2 PRESENT STATUS

Now, Energy meters have been provided at the generation end in all the transmission feeders and HT feeders for computing the energy flow both import and export flow. Installation of energy meters in the Distribution Transformers (DTs) located in urban areas is completed. The computerization of LT Billing and the process of consumer indexing are under process in SEB, Hence it is the appropriate time to access the actual ATC losses.

3 REASON FOR SELECTION OF TEST FEEDER

The reason for selection of 11KV test feeder for the study is that the feeder has 100% metering arrangements. Also, this feeder is categorized as urban feeder by SEB, which has all categories of consumers like industries, commercial & domestic services.

Analysis of T&D loss, implementation of improvement measures reduces T&D loss in this feeder would be very much useful to SEB in saving revenue.

4 CALCULATION OF ATC LOSSES

ATC Losses = Sending end energy – Receiving end energy
Technical Losses = Line Losses + Transformer Losses
Transformer Losses = Constant Losses + Copper Losses
Commercial Losses = ATC Losses – Technical Losses

5 SINGLE LINE DIAGRAM FOR TEST FEEDER

Fig. No.1 shows the single line diagram of test Feeder. The supply is fed from nearest SS and distributed to various points. This feeder is an 11KV Feeder. It has 11 Distribution Transformer. Energy meter and the capacitor have been provided in each distribution transformer. Capacitors are provided in this feeder to improve the power factor. These capacitors are connected in LV side of Distribution Transformers.

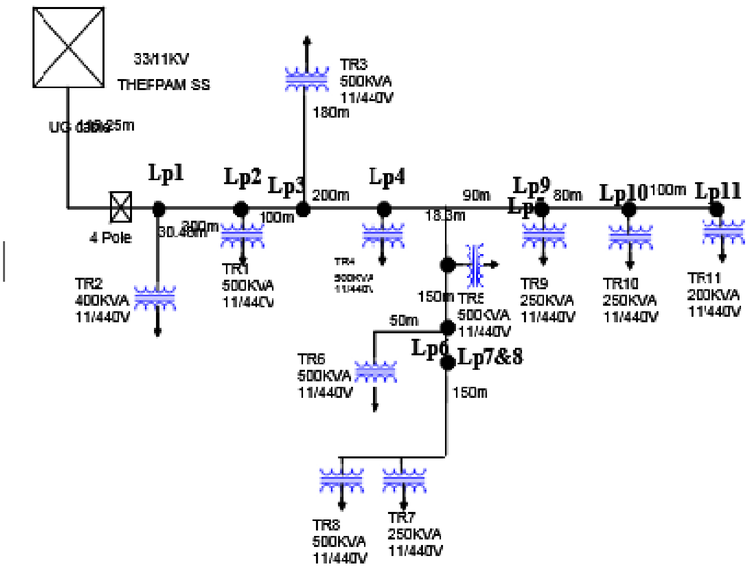

Fig. No.1 Single line diagram of test feeder

5.1 Details for Sending End

- 11KV FEEDER
- Meter make –ABB
- Meter constant-1000
- CT ratio-400/1
- PT ratio-11KV/110V
- MF - 4000
- Feeder length -2.533Km
- UG cable from SS to 4pole -3X300sqmm
- From 4pole to TR4 -7/0.074 cu
- From TR4 to TR11- 7/0.161 ACSR
- From TR4 to TR8 -7/0.132 ACSR.

5.2 Details for Receiving End

The Table No.3 shows the capacity of transformers. Energy meters are L&T, the capacity of Capacitor 9+9 KVAr and Capacitor current rating is 25.23 Amps.

5.3 Verification of CT Connection

The CT connections are verified through the instantaneous reading of CMRI (common meter reading instrument). The reading is shown in the Fig. No.2. From this reading the collection of data indicates normal, so the CT connection was proper. If it indicates abnormal, the CT connections were reversed. From these set of readings, all CT Connection were found correct.


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                     Larsen & Toubro Limited, Mysore

Work File              : PS002                Record No.     : 10
Data Dump Time(PC)     : 12-01-2007 10:23     Unit Code      : 04257177
Data Read Time(MRI)    : 08-01-200721:12      Unit Type      : 3ph-4 Wire
Data Read Time(Meter)  : 08-01-07 21:02       Unit Location  : ---------
CT Ratio               : 1.00                 CT Tapping     : 5
PT Ratio               : 1.00                 Collection     : Normal
Meter Version          : verJBHY.01 pc54      PC S/W "LUCID" Version : C 54.02

INSTANTANEOUS VALUES
    RV : 243.538      YV : 244.931      BV : 242.264
    RI : 2.684        YI : 2.741        BI : 2.926
    Seq:  V : RYB I : RYB
    R Phase    kW :    0.523   kVAr :    0.394   Pf :    0.798
    Y Phase    kW :    0.536   kVAr :    0.395   Pf :    0.804
    B Phase    kW :    0.590   kVAr :    0.405   Pf :    0.824
      Total     kW :    1.650   kVAr :    1.196
      Total    kVA :    2.038     Pf :    0.809
      Frequency    :   49.250
```

Fig. No.2 instantaneous reading of TR1

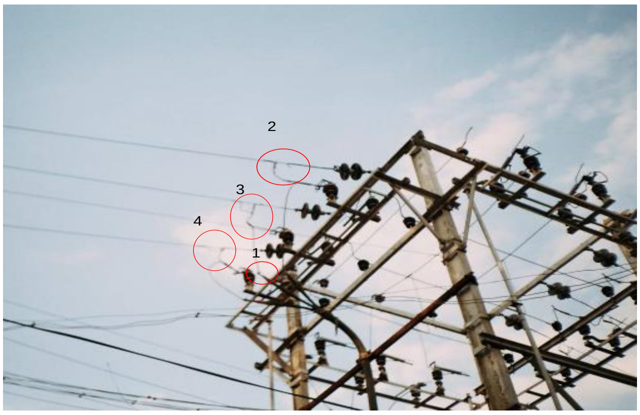
6 IDENTIFIED PROBLEMS

Some of the faults are identified are:

- Loose connection & improper of joints of Conductor
- Burnout jumpers of Conductor
- Conductor burnout
- Burnout DP flex wire

Totally 10 fault locations are identified. The following sample photos are showing the above faults.

Location: DP switch
Problem: damage of binding



Location: 4pole structure
Problem: 1. connection bolt damaged, 2. jumper totally burnout,
3 & 4. Improper jumpering

Location: DP switch
Problem: flex wire damage

Location: incoming pole 3(Anthony moopanar ss)
Problem: Imper binding& loose connection

Location: Incoming to Ganthi Pottal ss
Problem: improper binding location:

7. CORRECTIVE MEASURES

The Corrective measures are:

- Bimetal joints are replaced by clamp
- Improper binding is replaced by proper.

Fig. No.3

Fig. No.4 s

The Fig. No. 3 shows the joining of two conductors by proper binding and the Fig.No.4 shows the bimetallic joining of two conductors by a bimetallic clamp. Permissions got from the SS authorities for the line clear of test feeder for the purpose of corrective measures to be carried out. The corrective measures are taken on 20/2/2007.

8. LOSS ANALYSIS BEFORE & AFTER IMPLEMENTATION OF CORRECTIVE MEASURES

Before Implementation of corrective measures, More than 50 thousand readings are taken through CMRI (common meter reading instrument) for this analysis. The 1st set of reading is taken from 1st December to 31st December at the interval of 30 minutes.
After corrective measures, the second sets of readings are taken from 21st February to 2nd march during the interval of 30 minutes. From this reading, the following are obtained:

I. ATC losses
II. Transformer losses
III. Line losses
IV. Technical losses & Commercial losses
V. Power factor
VI. Loading of transformers
VII. %Regulation
VIII. %Efficiency of transformers
IX. Cost analysis

8.1 Calculation of ATC Losses

Before corrective measures, Table No. 1 shows the Calculation of ATC losses. The ATC loss is **11.02%.** Table No.4 shows the calculation of ATC losses, after Corrective measures the ATC loss is **10.6%.**The ATC loss is reduced by **0.96%**

8.2 Calculation of Transformer Losses

Table No.2 shows the calculation of transformer losses. Before corrective measures are taken. No-load losses are not depending upon the loading of the transformer, at the same time the copper loss are depending upon the loading of the transformer. Data sheet available for the no load & full load copper loss. From these, the no-load loss & copper loss were calculated. The total loss of each transformer is tabulated. The transformer losses are calculated by

Total Transformer Losses = (No Load Loss + Actual Load Loss)

Actual load loss= load^2 x full load copper loss

Before corrective measures Total Transformer Losses/month= **21874741 Watts**

Table No.5 shows the Calculation of Transformer losses after Corrective measures Total Transformer Losses/month= **20145268.9 Watts**

8.3 Calculation of Line Losses

Before corrective measures Table No.1 shows the Line loss of total feeder.

Line loss = I^2x conductor resistance.

Total Line Losses/Month are **5286125.203 Watts.**

Table No.3 shows the calculation of Line losses after corrective measures the Total Line Losses/month are **3354285.3 Watts**

8.4 Calculation of Technical Losses & Commercial Losses

Table No.2 shows the calculation Technical and Commercial Losses. Before corrective measures, Total Technical losses = **27160866.349 Watts.** & Total Commercial Loss/ month **= 59015022.6 Watts**.

Table No.5 shows the calculation of commercial of that feeder. After corrective measures Total Technical losses **= 23499554.2 Watts** & Total Commercial Loss/ month **= 47485237.8watts**

8.5 Calculation of Power Factor (Pf)

Before corrective measures, Table No.3shows the calculation of power factor of that feeder.

The Power Factor Is calculated by KWh reading / KVAh reading.

From this calculation the TR9, TR10, TR11 are the poor pf, others are the acceptable limits. The acceptable limits are above 0.8

After corrective measures, Table No.6 shows the calculation of power factor of the feeder. From this calculation the TR8, TR9, TR10, TR11 are having poor pf, others are within the acceptable limits.

8.6 Calculation for Loading of Transformers

Before corrective measures, Table No.3 shows the calculation for Loading of each distribution transformer of that feeder. The Efficient Loading of a distribution transformer is 70% to 80 %.

Loading of Transformer = (actual loading / capacity) x 100.

The TR4 &TR11 are only loaded optimally, others are under loaded, it causes more constant loss & capital cost

After corrective measures, Table No.6 shows the calculation of loading of each distribution transformer in the feeder. All are found under loaded because the feeder was recently reconstructed, the higher capacity of distribution transformers are provided for feature development. Before corrective measures the major part of the loading of transformers TR4, TR11 are due to losses, after corrective measures the TR4, TR11 are under loaded.

8.7 Calculation of Regulation

Before corrective measures, Table No.3 shows the calculation of regulation. The acceptable limits for voltage regulation are ±6%. The regulation is calculated by the formula given in reference [6]. The feeder has 11 load points as shown in Fig. No.4

Formula for Regulation

%Regulation = Momentum x regulation constant

Momentum = cumulative load in KVA x distance in Km

From this, the HT regulation of the feeder is **1.118%** before corrective measures.

After corrective measures, Table No.6 shows the calculation of regulation. From this, the HT regulation of this feeder is **0.871%**

8.8 Calculation of % Efficiency of Transformers

Before corrective measures, Table No.3 shows the Calculation of %efficiency. From this, all transformers are found working in better efficiency.

After corrective measures, Table.No.6 shows the Calculation of %efficiency. From this, TR8 only has poor efficiency. The remaining all are working in better efficiency.

8.9 Cost Analysis

Before corrective measures,

- Technical loss / month = Rs 84,470.71
- Revenue losses / month
  (Commercial loss alone) = Rs 1,83,536.65
- Total ATC loss / month = Rs 2,68,0076

After corrective measures,

- Technical loss/month = Rs 71980.95
- Revenue losses / month
  (Commercial loss alone) =Rs 1,47,678.35
- Total ATC loss/ month = Rs 2,19,659.30

9 .CALCULATION OF LOSS REDUCTION & SAVINGS

Table No.7 shows the loss reduction.The average ATC loss/month reduced by 0.96%

Details	1st Analysis (before remedial measures taken)	2nd Analysis (after remedial measures taken)	Difference in Losses
AVG ATC LOSS/month	11.02%	10.06%	0.96%
LINE LOSS/ Month in MWh	5.286	3.354	1.932
Total Trf Losses / Month in MWh	21.875	20.145	1.73
Total Tech Losses / Month in MWh	27.161	23.499	3.662

Commercial Losses / Month in MWh	59.015	47.485	11.53
Atc Losses / Month in MWh	86.176	70.984	15.192

The Table No.8 shows the savings. From ATC loss/month, the amount of saving is Rs 8,348.06. The amount of saving from ATC loss/year is Rs 5, 80,176.72

Table No.8

Details	Cost Analysis		Savings in Rs
	Before Remedial Measures Taken	After Remedial Measures Taken	
Total Tech Losses / Month in Rs	84,470.71	71980.95	12489.76
Commercial Losses / Month in Rs	183536.65	147678.35	35858.3
ATC Losses / Month in Rs	268007.36	219659.3	48348.06

CONCLUSION

During the study, efforts have been taken to find the length of HV distribution, type, and size of conductors in the HV feeder.

Loading of distribution transformers in the 11KV test feeder, the level of reactive power compensation made at each distribution transformers end were also studied.

The result of the energy meter readings taken at two different periods enabled to analyze the condition of meters, its connection, and the condition of shunt capacitors provided in the DT end. Energy meters condition and meter connections were checked, The Energy meter readings are taken from 1-12-2006 to 31-12-2006 and 21-2-2007 to 02-03-2007 at the sending end of the DT end. This is the conventional method to analyze the T&D losses.

The already existing system was studied and following corrective measures are taken:

- Improper bindings are replaced by proper binding.
- Bi-metallic clamps replace bi-metal joints.

The ATC losses obtained after the corrective measures are found less compared to the old system.

- ATCLOSSES(Before emedial measure) / month -11.02%
- ATC LOSSES (after remedial measure) / month - 10.06%
- Amount of Savings / month - Rs 48,348.06

Retrieving the data for weekly, monthly would enable us to arrive average consumption during the said period.Therefore computation of average T & D loss and commercial losses would be made more accurately from the above study.

Table No.1 Calculation of ATC, Transformer, Line, Technical & Commercial Losses.

Date	Reading		AVERAGE TOTAL LINE LOSS in Watts	Daily average ATC losses in KWh	Daily average %ATC losses
	average sending end energy in kWh	average receiving end energy in kWh			
1-Dec-06	524167	456757	4019.631	67409	12.405
2-Dec-06	415833	433720	3593.94	-17887	-3.319
3-Dec-06	460167	413265	3178.5717	46902	9.793
4-Dec-06	498667	436740	3719.6867	61926	11.555
5-Dec-06	500167	454140	4051.3027	46027	8.785
6-Dec-06	503333	439591	3756.7444	63743	11.746
7-Dec-06	496750	441350	3825.6075	55400	10.53
8-Dec-06	501750	434216	3667.3543	67535	12.932
9-Dec-06	430667	441908	3805.2347	-11241	-1.645
10-Dec-06	520500	384053	2728.1443	136447	23.413
11-Dec-06	517333	457612	4068.638	59721	10.891
12-Dec-06	500083	454614	4003.9166	45470	-1.791
13-Dec-06	502417	437080	3698.9885	65336	11.982
14-Dec-06	507917	438910	3732.9912	69007	12.17
15-Dec-06	489667	445077	3830.8302	44590	8.868

16-Dec-06	412750	428777	3585.3552	-16027	-3.377
17-Dec-06	486417	368261	2529.9622	118156	21.813
18-Dec-06	512167	426491	3544.1208	85676	16.068
19-Dec-06	501750	448657	3965.7378	53093	9.301
20-Dec-06	504000	438901	3766.1588	65099	12.313
21-Dec-06	498417	442269	3829.5538	56147	10.519
22-Dec-06	508083	435345	3694.1299	72739	13.705
23-Dec-06	416167	443718	3864.3574	-27551	-5.426
24-Dec-06	482667	371457	2598.7698	111210	20.173
25-Dec-06	424498	535708	3548.9332	111210	20.173
26-Dec-06	504417	311693	1863.4498	192723	37.854
27-Dec-06	491000	442106	3782.9432	48894	9.462
28-Dec-06	513667	430642	3574.1453	83025	15.314
29-Dec-06	490667	449328	3951.7888	41339	8.08
30-Dec-06	426417	431163	3616.5355	-4746	-0.798
31-Dec-06	475250	380254	2730.0849	94996	18.184
		Total	5286125.2	**Average**	**11.022**

Table No.2 Calculation of Technical & Commercial Losses

TOTAL TRF LOSS IN KWH/MONTH	TOTAL LINE LOSS IN KWH/MONTH	TOTAL TECHNICAL LOSS IN KWH/MONTH	ATC LOSSES IN KWH/MONTH	COMMERCIAL LOSS IN KWH/MONTH
20145.2689	3354.285251	23499.5542	70984.7920	47485.2378

Table No.3 Calculation of Pf, Loading of Transformer & Regulation

load point	size of the conductor	Actual PF	Regu.constant at 0.8 pf / KVA/Km	distance in km	name of the DT	capacity of DT IN KVA	maxloading in KVA	%Efficiency	Cummulative load in KVA	momentum(cum load*distance)
1	7/0.074 cu	0.891	0.000882	0.030	TR1	500	270.072	99.297	1956.894	59.646
"	3X300Sqmm	0.883	0.000121	1.015	TR2	400	57.276	98.369	1686.822	1712.529
2	7/0.074 cu	0.948	0.000882	0.300	TR2	-	-	-	1629.546	-
3	7/0.074 cu	"	0.000884	0.180	TR3	250	108.270	99.193	1629.546	293.318
4	7/0.074 cu	0.875	0.000869	0.300	TR4	500	416.880	99.340	1521.276	456.383
5	7/.132 ACSR	0.800	0.000572	0.018	TR5	500	150.342	98.939	1104.396	20.210
6	7/.132 ACSR	0.822	0.000572	0.200	TR6	500	251.580	99.210	954.054	190.811
7	7/.132 ACSR	0.824	0.000572	-	TR7	250	159.720	98.781	702.474	-
8	7/.132 ACSR	0.846	0.000574	0.150	TR8	500	261.168	99.534	542.754	81.413
9	7/.161 ACSR	0.768	0.000450	0.160	TR9	500	65.772	97.820	281.586	44.913
10	7/.161 ACSR	0.722	0.000450	0.080	TR10	250	63.000	98.605	215.814	17.265
11	7/.161 ACSR	0.789	0.000450	0.100	TR11	200	152.814	99.171	152.814	15.281
										%Regu

Table No.4 Calculation of ATC & Line Losses.

DATE	OBSERVED READING		TOTAL LINE LOSS/day in watthour	Daily average ATC losses in KWh	%ATC/day
	sending end energy in a watthour	receiving end energy in a watthour			
21-Feb-07	22141520.000	19113090.00	109118.965	3028.43	13.68
22-Feb-07	21493520.000	18591348.00	101625.653	2902.172	13.50
23-Feb-07	21809520.000	18783858.00	99529.850	3025.662	13.87
24-Feb-07	20535200.000	18948036.00	103451.931	1587.164	7.73
25-Feb-07	19621520.000	17157840.00	84827.630	2463.68	12.56
26-Feb-07	22645520.000	19398318.00	108426.299	3247.202	14.34
27-Feb-07	22495200.000	19934250.00	114500.590	2560.95	11.38

28-Feb-07	22935200.000	20024868.00	115544.512	2910.332	12.69
1-Mar-07	22237520.000	20242668.00	118071.465	1994.852	8.97
2-Mar-07	20175200.000	20988396.00	126930.605	-813.196	-4.03
		TOTAL	3354.2853	Average	10.60

Table No.5 Calculation of Technical & Commercial losses

Total TRF loss in kWh/month	Total line loss in kWh/month	Total Technical loss in kWh/month	ATC losses in kWh/month	Commercial Loss in kWh/month
20145.2689	3354.285251	23499.5542	70984.7920	47485.2378

Table No.6 Calculation of PF, Loading of Transformer, Transformer Loss & Regulation

Load point	Size of theConductor	Actual PF	Regu.constant / KVA/Km	Distance in km	Name of the DT	Capacity of DT IN KVA	max. loading of Transformer in KVA	%efficiency	Cummulative load in KVA	Momentum(cum load*distance)	VR (momentum * constant)
1	7/0.074 cu	0.880	0.000882	0.030	TR1	500	259.176	98.757	1858.578	56.649	0.050
"	3X300Sqmm	0.895	0.000121	1.015	TR2	400	90.192	98.215	1599.402	1623.777	0.196
2	7/0.074 cu	0.955	0.000882	0.300	TR2	-	-	-	1509.210	-	-
3	7/0.074 cu	"	0.000884	0.180	TR3	250	118.716	98.684	1390.494	250.289	0.221
4	7/0.074 cu	0.873	0.000869	0.300	TR4	500	428.808	98.787	961.686	288.506	0.251
5	7/.132 ACSR	0.808	0.000572	0.018	TR5	500	142.974	98.096	818.712	14.982	0.009
6	7/.132 ACSR	0.820	0.000572	0.200	TR6	500	260.028	98.648	558.684	111.737	0.064
7	7/.132 ACSR	0.833	0.000572	-	TR7	250	135.444	98.187	423.240	-	-
8	7/.132 ACSR	0.252	0.000574	0.150	TR8	500	1.578	25.811	421.662	63.249	0.036
9	7/.161 ACSR	0.767	0.000450	0.160	TR9	500	58.848	95.291	362.814	57.869	0.026
10	7/.161 ACSR	0.710	0.000450	0.080	TR10	250	55.266	96.537	307.548	24.604	0.011
11	7/.161 ACSR	0.774	0.000450	0.100	TR11	200	153.774	98.197	153.774	15.377	0.007
										%Regu	0.871

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BIOGRAPHIES

SR. SHANKAR obtained B.E. degree in Electrical and Electronics Engineering in 2003 from Madurai Kamaraj University. Presently doing M.E (Power System Engineering) in Thiagarajar College of Engineering, Madurai. He has 3 ½ yeas industrial experience, after that he worked as a Lecturer at Thanapandian polytechnic and as an Electrical maintenance engineer at PTR College of engineering and Thanapandian polytechnic.

Dr. N.KAMARAJ obtained Ph.D. Degree in the Power System Security Assessment. He is involved in many consultancies works in the industries across Madurai. His research areas include Security Assessment and Voltage stability of power systems using Neural Network, Fuzzy logic, and Genetic Algorithm. He has published many papers in the National & International journals, International & National conferences. He is the recipient of Merit award from IEEE – Computer Society for CSIDC 2003 as best advisor for the team contested in CSIDC. Also, he has received a Gold medal and Corps subject award from Institution of Engineers (India) for the year 2003.