Identification of Technical Loss Reduction and Rationalization of Secondary Distribution System at selected typical three Distribution Transformers of Kerala State Electricity Board

Bureau of Energy Efficiency
Government of India, Ministry of Power 4th Floor,
SEWA Bhawan R. K.Puram, New Delhi - 110 066

Energy Management Centre-Kerala
Sreekrishna Nagar, Chavadimukku
Sreekariyam P.O.
Thiruvananthapuram - 695 017

Consultant:
Dynaspede Integrated Systems Pvt. Ltd.
#302 & 303, Money Chambers 6, K.H. Road,
Bangalore - 560 027, Karnataka, India.
Tel: 91-80-22109117/8, Telefax: 91-80-22273608

ABOUT THE STUDY

The major share of distribution loss results from the LT distribution network, centered at distribution transformers. Also majority of power interruptions and power quality issues are attributable to problems associated with LT distribution system. Hence Energy Management Centre-Kerala (EMC), as a part of its SDA activity (State Designated Agency *to implement Energy Conservation Act, 2001 in the State*) submitted a proposal, for a study titled, "Identification of Technical Loss Reduction and Rationalization of Secondary Distribution System at selected typical three distribution transformers (as a model) in the Kerala Power System", to the Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India. The objective of the project was Rationalization of Secondary Distribution System through a Micro Level Approach and to generate replicable model for studying the Energy Efficiency Improvement in Distribution System.

On receipt of the approval and assistance from Bureau of Energy Efficiency, EMC floated tenders for the project. Four consulting firms participated in the tendering process and after detailed evaluation the tender was awarded to M/s Dynaspede Integrated Systems. Pvt. Ltd, Chennai. Kerala State Electricity Board (KSEB) was contacted for identifying three Distribution Transformers on the basis of one location each from Urban, Rural and Semi-Urban areas. KSEB suggested the following distribution transformers and the secondary distribution network associated with them.

i. Housing Board- 250kVA transformer in Electrical Section, Puthenchantha, Electrical Division, Thiruvananthapuram
ii. Thirumoolapuram, 250 kVA transformer in Electrical Section, Thiruvalla, Electrical Division, Kottayam
iii. Kalpaka, 160kVA transformer in Electrical Section, Sulthanpet, Electrical Division, Palakkad.

The field study started in January 2009. Each location was studied in detail in order to capture the representative energy end use pattern, demand profile vis-a-vis transformer loading, power flow etc.

The details of the study including a model for replicating the study are given in this report

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Sl. No.	Abbreviation	Expansion
1	V	volt
2	A	ampere
3	kW	kilo watt
4	kWh	kilo watt hour
5	P F	Power Factor
6	kVA	kilo volt ampere
7	kVAr	kilo volt ampere reactive
8	THD	Total Harmonic Distortion
9	DB	Distribution Board
10	MCB	Miniature Circuit Breaker
11	ACB	Air Circuit Breaker
12	BEE	Bureau of Energy Efficiency
13	EMC	Energy Management Centre - Kerala
14	KSEB	Kerala State Electricity Board
15	KSHB	Kerala State Housing Board
16	SS	Substation
17	OH	Over Head
18	UG	Under Ground
19	HT	High Tension
20	LT	Low Tension
21	OLTC	On Load Tap Changer
22	APDRP	Accelerated Power Development and Reform Programme
23	DSM	Demand Side Management
24	CFL	Compact Fluorescent Lamp
25	CDM	Clean Development Mechanism
26	CER	Certified Emission Reductions
27	GOI	Government of India
28	T&D	Transmission and Distribution
29	REC	Rural Electrification Corporation
30	PFC	Power Finance Corporation
31	PGCIL	Power Grid Corporation of India Limited
32	CGS	Central Generating Station
33	AT&C	Aggregate Technical & Commercial
34	EOI	Expression of Interest
35	RGGVY	Rajiv Gandhi Grameena Vidyutikaran Yojana

Section 1

INTRODUCTION

1.1.0 INTRODUCTION

The distribution loss study was conducted at three 11/0.433kV, 3ø transformers of KSEB in Kerala State. The supply to all the three transformers is from Kerala State Electricity Board. Electricity is used for the following applications:

a. Lighting System (Incandescent Lamp, Fluorescent Lamp, CFL)
b. Street Lighting System (Incandescent Lamp, Fluorescent Lamp, C F L, HPSV)
c. Electrical Equipments such as Air conditioners, UPS, Computers, Fans, Water Coolers, Copier Machines, Domestic Appliances.

1.2.0 IMPORTANCE OF ENERGY CONSERVATION

1.2.1 Electrical Energy is part of our minute-to-minute existence today. Everyday witnesses the entry of new homes, industries, offices and several infrastructure projects being implemented for the welfare of the common man by respective governments.

1.2.2 Electrical Energy usage has increased to gigantic proportions all over the world. Several methods of generation have been successfully implemented. However it is important to note that the generation of electrical energy has been part of the continuous degradation of our environment since each unit of energy generated from fossil fuel based thermal power plant releases about 0.8 to 1.2 gram of Carbon Dioxide into the atmosphere. This fact has been recognized by world leaders and is in the process of implementing the KYOTO Protocol, which will reduce Carbon emissions into the environment.

1.2.3 The generation as well as purchase of power from distant locations and transmitting it to all over the habitat regions and distributing to customer specific locations is a challenging activity to all power utilities.

1.2.4 During the last few years the state has witnessed an increase in industrial, commercial and residential complexes which in turn has put a lot of pressure on the state electricity board to meet the extra demand for electrical energy by industrial, commercial, and residential sectors. However, the domestic consumer growth is comparatively higher which makes the Demand Side Management (DSM) strategies more relevant.

1.3.0 EQUIPMENTS USED

Following equipments were used to carry out the studies

Fluke Harmonic Analyser -433/434 with its associated Software

1. Fluke Harmonic Analyser -41 B with its associated Software
2. Power Monitor with Data Logger with Sequence Software.
3. Non Contact Infrared Thermo meter

1.4.0 METHODOLOGY OF MEASUREMENT

As per Power Quality Manual IEEE 1159, & IEEE 519 , the measurements were carried out both in continuous mode using the Data Logger and in instantaneous mode with the Fluke 41 Harmonic Analyzer. The complete log were captured into the laptop computer and sequenced, formatted and analyzed to arrive at the various status of load and supply conditions including the Harmonic distortions, active and reactive power variations, power quality conditions etc.

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Section 2

EXECUTIVE SUMMARY

2.1.0 EXECUTIVE SUMMARY

2.1.1 The study encompassed the examination of the existing distribution and loading pattern of the Distribution Transformers and secondary distribution system and identification of techno-economic feasible measures to find the Distribution loss and arrive at appropriate measures to rationalize the same.

2.1.2 The report gives the details of observation along with appropriate recommendations and supporting facts.

2.1.3 The findings in the report is expected to supplement the efforts of KSEB in optimizing distribution and loading pattern of the Transformers to the maximum possible extent.

2.1.4 This report is based on the present loading pattern of the Transformers and the operating status of the loads connected to the Transformers. The recommendations are based on the various operational parameters examined by the team and the data and information supplied to the team by the Executive Engineers/ Asst Exe. Engineers, Asst. Engineers / Sub-Engineers of the respective divisions of KSEB in addition to field measurements carried out

2.1.5 The details of observation and recommendations are discussed in detail in the report.

2.1.6 The general observation is that the distribution fuse boards in the secondary side of transformer are of very old type, the fuses are bypassed with shorting links, the loads are unbalanced, neutral current is high, neutral connections are joined outside the distribution board and the Cables are not dressed.

2.1.7 Suggestion for improvement consists of action plan to reduce the unbalance current in certain phases and neutral current, improvement of voltage level at the far end, replacement of transformer with optimum capacity transformer and replacement of defective meters

2.2.0 *SUMMARY OF SUGGESTIONS*

Table 2.1

No	Distribution Transformer	Suggestion	Remarks
1.	Thiruvananthapuram	Load to be balanced at the secondary side.	This will reduce the un-balance current and the neutral current
2.	Thiruvananthapuram	Service wires to the consumer to be provided in a standard manner	This will improve the voltage level at the fag end
3.	Thiruvalla	Load to be balanced at the secondary side.	This will reduce the un-balance current and the neutral current
4.	Thiruvalla	Service wires to the consumer to be provided in a standard manner	This will improve the voltage level at the fag end
5.	Thiruvalla	The defective meters are to be replaced(33 Nos)	This will collect the exact revenue from the consumer and enable proper energy accounting. Presently, consumers having faulty meters are billed according to average consumption.
6.	Thiruvalla	Separate line can be run for the street light connections. Energy meter can be fitted at the feeding point and the exact consumption can be measured and billed for street lighting. A 10kVA Energy Saver with Real Time Clock timer (RTC) for Switching it ON and OFF at specified timing, such as Almanac based developed by EMC.	This will improve the power factor nearer to unity. Savings in energy consumption in street lighting can be achieved
7.	Palakkad	Load to be balanced at the secondary side Some of the Y Phase loads can be shifted to other two phases.	This will reduce the Y Phase Current which is now around 90% of full load current of the Transformer and the unbalance will be reduced.

2.3.0 SUGGESTIONS FOR SAFETY

2.3.1 Suggestions for safety consists of replacement of secondary distribution panel with ACBs/MCBs/MCCBs, providing dummy carriers where connections are not taken, Dressing of cables, earthing of distribution panels, re-shackling of lines, replacement of wooden poles with RCC poles, periodical clearing of tree touchings and possible falling trees and providing safe working clearance before the distribution panel.

2.3.2 Based on the methods followed and the experience gained, a replicable model is developed and suggested for periodical study of distribution system as an attempt of rationalization and standardization. The model gives the methodology, meters/instruments required, forms/format required to collect the data, reference standards/norms for various practices, a method for analysis of data, observations and findings and recommendations on energy efficiency improvement and energy conservation.

2.3.3 It is expected that the model will be useful for conducting Distribution Loss Evaluation for other areas of the utility/ other licensees. It is presumed that the model can be further refined for future applications.

2.3.4 It may be worthwhile to imparting periodic training and refresher programmes on energy efficiency in distribution system to the team of technical personal of KSEB engaged in the Distribution System

2.3.4 Programmes and policy to accelerate penetration of energy efficient equipments and appliances such as Star rated distribution transformers and other appliances may be initiated

2.3.5 Awareness programmes with demonstration may be conducted periodically for consumers in efficient use of energy and tips for energy saving to different sectors of consumers in regular manner

2.3.5 Power quality audit, as well as review of Licensees Stands of Performance may also be initiated quarterly focusing secondary distribution system improvement

Section 3

INITIATION OF PROJECT

3.1.0 ENERGY MANAGEMENT CENTRE- KERALA (EMC)

Kerala Government has become the first State Government in India to establish an Energy Management Centre (EMC) at State level, aiming to mould and instrumentalise energy sector as a catalyst in promoting a development process which is economically and ecologically sustainable. With a view to making energy sector achieve such a lead and catalytic role, EMC has evolved a novel and comprehensive energy management approach and institutional philosophy encompassing energy management, energy technology systems - both conventional and non-conventional, energy conservation in all sectors of the economy, energy resource management, rural and urban energy systems, energy education, campaigning and training, energy generation and conservation employment and poverty alleviation programs through Energy Efficiency and Energy Conservation.

3.1.0 ABOUT EMC

Energy Management Centre-Kerala was established in Thiruvananthapuram, Kerala, India in February 1996 as an autonomous organization under the Department of Power, Government of Kerala. As such, EMC has got a functional framework devoted to comprehensive and multi-disciplinary institutional objectives and orientation encompassing all aspects of energy, with a focus on energy-environment-development interactions. The guiding philosophy and school of thought of the Centre is "achieving sustainable development by enhancing total energy efficiency and application of renewable energy and environment friendly energy systems in all sectors of the economy". To realise the above goals, the Centre is adopting a multi-faceted institutional and functional strategy focusing on the following programs:

- Initiating and strengthening integrated sustainable development in different sectors of economy through comprehensive energy management programs encompassing research, education and training, and consultancy related to all aspects of Energy-Environment-Development interactions.

- Promoting energy conservation in all sectors of the economy through scientific and technological research and professional consultancy and advice
- Evolving comprehensive strategy, framework, platform and programs for people's participation with target focus on women, students and youth in energy conservation.
- Identifying energy intensity and energy efficiency status and evolving energy efficiency standardization in different sectors of the economy.
- Initiating and promoting awareness programs on energy-environment-development interface, aiming at evolving an integrated energy policy framework which will help achieve econo-ecologically sustainable development.
- Developing a state-of the-art data bank encompassing all aspects and dimensions of energy as a basic infrastructure facility.
- Establishing an international research, training and academic facility for studies on comprehensive energy management for the benefit of SARC countries.
- Upgrading the skills and capabilities of energy professionals through training on energy and environment management programs.
- Facilitating exchange of energy experts between different regions within India and abroad.
- Collaborating with national and international organizations, universities, research centres, regulatory bodies, funding agencies etc. involved in promotion of energy conservation and sustainable development, with a view to identifying, adopting and transferring of energy technologies relevant to the State.
- Instrumentalising energy systems, especially renewable energy package systems to improve the quality of life (increasing income and employment generation opportunities, health and emotional welfare) of the people, particularly the poor segment of the society who are deprived of electricity and other energy opportunities.
- Promoting comprehensive energy planning and management through co-operative movement and institution development, providing grass root level opportunity to the people for shaping an energy system

which help achieve all round quality of life and sustainable development.

- Performing such other functions as directed by the Government or relevant to the objectives of EMC.

Government of the Kerala has constituted a Small Hydro Promotion Cell, attached to EMC. United Nations Industrial Development Organization (UNIDO) opened its first Regional Centre for small Hydro Power in EMC during April 2003.It may be noted that EMC - Kerala has been bestowed with the Best State Designated Agency Award for the Year, 2008 by Government of India.

3.2.0 ABOUT THE STUDY

Identification of Technical Loss Reduction and Rationalization of Secondary Distribution System at selected typical three Distribution Transformers (as a model) in the Kerala Power System

3.2.1 Project Summary

The major share of distribution loss results from the LT distribution network centered at distribution transformers. The major cause for power interruptions and power quality issues are also attributed to problems associated with LT distributions. This project aims at identification of technical loss reduction and rationalization of secondary distribution system at selected typical three distribution transformers as a model case in the Kerala Power System

3.2.2 Background

Kerala is one of the southern states in India with several unique features in its economy and electricity consumption pattern. Kerala's economy has a strong base on service sector rather than on industrial sector. The industrial sector including High Tension & Extra High Tension (HT & EHT) electrical consumers has been in the field of energy efficiency improvement for some time. Proposal for study on Identification of Technical Loss Reduction and Rationalization of Secondary Distribution System at selected typical three distribution transformers (as a model) in the Kerala Power System was submitted by EMC to BEE and BEE has approved and extended its support.

3.2.3 Project objective

Rationalization of Secondary Distribution System through a Micro Level Approach

3.2.4 Immediate Objective

Evaluate the distribution side losses in the identified areas and propose Energy efficiency measures with techno economic calculations and implementation strategies.

3.2.5 Project Strategy and Project Description

The project envisages identifying three locations in the state covering the rural, urban and semi urban network, centered on distribution transformers. The identification of the three locations was based on various parameters, which make the adaptability of the cases to similar locations. Emphasis was given to the sampling process to ensure further extension of the project. The project was done in a micro level keeping in view of the macro level necessities of the distribution system and state grid. The study attempt to involve all the major stakeholders in the distribution network like the distribution company and the consumers. Secondary data collection like consumption details of any major consumers in the line who has already identified/ implemented energy efficiency measures, metering and automation, barriers in improvement etc. The scope of having a stakeholders meeting as part of the secondary data collection was assessed. The technical analysis was done using power analyzers, data loggers and load flow analyses. Kerala State Electricity Board identified the three distribution transformers for this study.

3.2.6 Implementation strategies

- Identify three locations in rural, urban and semi urban areas in the state.
- Collect and collate the secondary data available
- Ensure key stakeholders involvement
- Develop a work plan to conduct the technical study
- Technical Study of the identified network

- Determine the Energy Efficiency Measures
- Prepare a draft report and present for review
- Publish the final report

3.2.7 Target beneficiaries

- The domestic and commercial end users ie; the LT consumers in the state
- Distribution Licensees

3.2.8 Project Duration

Sampling Process took two months. The stakeholder consultation and secondary data collection was completed in a period of two months. The technical study was completed in a month and the draft report was prepared within in three months. The complete project duration was about eight months.

3.2.9 Justification

The compounded annual growth rate of electricity consumption of LT Consumers is about 11%. The Kerala power system is dominated by 99.97% of Low Tension (LT) consumers, who accounts for about 70% of total electricity consumption. The Low Tension (LT) distribution network consists of about 2,26,000 circuit kilometers of LT lines and 39,850 distribution transformers. Distribution is the weakest link in the chain of power supply. The load density, HT: LT ratio and the growth in LT consumers justify the need for such studies involving a dedicated micro-level approach in the LT distribution network. The LT distribution system accounts for more than 70% of the total aggregate technical and commercial (AT & C) loss.

3.2.10 HT-LT Ratio

The report obtained from Kerala State Electricity Board (KSEB) shows that the ratio of HT-LT line in the State is 1:6, and transition in HT-LT ratio from the present level of 1:6 to 1:1, which is an ideal case, is not possible due to variety of reasons ranging from availability of required capital to other constraints in the physical implementation, such as population density and land use issues.

Section 4

BACKGROUND INFORMATION

4.1.0 KERALA POWER SECTOR- AN OVERVIEW

Electricity Sector in the country is now in a transition phase. The Electricity Act, 2003 was enacted to replace, The Indian Electricity Act, 1910 and The Electricity Supply Act, 1948 with the primary goal to improve the efficiency and quality of the power sector. KSEB has been taking several initiatives to improve its physical and the financial performance during the past several years and even well before the enactment of The Electricity Act, 2003. It is to be specifically noted that the performance of KSEB has been well appreciated at national level as well. KSEB has been selected as the best performing SEB for the year 2006 in the country by the INDIA TECH FOUNDATION

Table 4.1

Growth of Kerala Power System

Year	Inst. Cap. MW within the State				Annual Sales MU	No of Consumers (Lakhs)	Per Capita Conspn. kWh	EHT lines Ckt Kms	EHT S/s (Nos)	HT lines Ckt Kms	LT lines Ckt Kms	Dist Trfrs (Nos)
	Hydel	Thermal (Incl. IPPs)	Wind	Total								
57-58	109.0	0	0	109.0	363	1.06	19	1600	15	3851	4980	1862
60-61	133.0	0	0	133.0	518	1.75	30	1900	22	5449	8899	2898
73-74	622.0	0	0	622.0	2121	7.77	79	3378	59	9645	25968	8285
80-81	1012.0	0	0	1012.0	4499	15.72	109	4638	92	14189	55963	11656
85-86	1272.0	0	0	1272.0	4172	23.96	136	5317	109	16917	76141	13314
90-91	1477.0	0	0	1477.0	5331	34.50	185	5885	140	20221	101834	17838
97-98	1676.5	85.3	2	1763.8	7716	52.11	239	7074	168	27083	138732	26826
98-99	1692.5	336.2	2	2030.7	9182	56.39	285	7381	177	28090	174196	28058
99-00	1742.5	594.2	2	2338.7	9812	60.30	300	7599	179	28672	180499	29551
00-01	1792.5	614.6	2	2409.1	10319	64.46	311	9085	194	30035	187169	31329
01-02	1795.0	771.6	2	2568.6	8667	66.62	395	9274	204	30971	191931	32585
03-04	1807.0	591.6	2	2400.6	8910	73.00	391	9718	225	33323	201638	34758
04-05	1843.6	591.6	2	2437.2	9384	77.99	400	9924	251	33998	207711	36442
05-06	1849.6	591.6	2	2443.2	10906	82.98	427	10178	269	35060	215152	38193
06-07	1849.6	591.6	2	2443.2	11331	87.14	465	10593	276	37891	223370	39872
07-08	1851.6	591.6	2	2445.2	12050	90.3	470	10650	281	38227	234252	42401
08-09	1886.5	591.6	23.9	2502.0	12414	93.6	470	10855	299	41245	241888	46510

4.2.0 KERALA STATE ELETRICITY BOARD

4.2.1 The Kerala State Electricity Board is a statutory body constituted under section (5) of The Electricity Supply Act 1948. In consistence with the state power policy, KSEB has been functionally organized in to three profit centers, namely Generation, Transmission and Distribution with a Corporate Office for co-ordination. The distribution profit center has been further divided in to 3 regional centers –South, Central and North under each distribution Chief engineer. After the enactment of The Electricity Act 2003, KSEB has been functioning as the State Transmission Utility and Distribution Licensee with effect from 10.12.2004 under Section 172(a) of The Electricity Act, 2003.

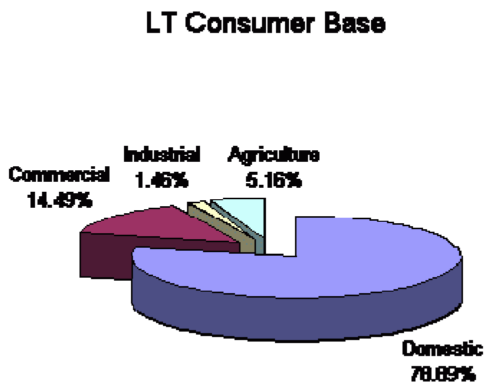
4.2.2 Distribution Profit Centre (DPC) has the overall control of distribution of electrical energy in the state, except a minority area by other licensees in the state. DPC monitors energy transactions, revenue realization, voltage improvement /system improvement works and Master Plan works. DPC implements and monitors APDRP and RGGVY Schemes under central assistance. Works under MP LAD Schemes, MLA LAD Schemes and Kerala Development Scheme are also under taken by the DPC

4.2.3 During the past 40 years, Board has made tremendous growth and development. The consumer strength has increased from 1.06 Lakh in 1977 to 87.13 Lakh in 2007 and presently about 93 Lakh. The installed capacity in the state has increased from 106 MW to 2657 MW in 2007. Till 1980 the energy requirements of the state were met from the Hydel projects developed by KSEB. However after the promulgamation of the Forest Conservation Act in 1980, implementation of new projects to meet the increasing demands has been blocked and hence costlier thermal energy had to be generated and purchased to meet the increased demand .It was reported that in Fy 2009-10 the hydro-thermal mix was 36:64 and has resulted into 63% of the annual expenses for purchasing costly energy from thermal sources (KSEB ARR&ERC 2010-11)

Board has provided different categories of tariff to the consumers based on usage. The category wise consumer list is furnished below.

LT Consumers as on 31.08.2008

Category	No of Consumers
Domestic	70,25,259
Commercial	16,46,389
Industrial	1,28,358
Agriculture	4,35,400
Total	**92,35,406**



4.2.4 The KSEB's mission is to supply electricity at affordable cost and supply on demand to the electricity consumers of the state. Its endeavor is to supply quality and uninterrupted power, improve consumer satisfaction and to act as a catalyst for development of the state. The KSEB has to perform its social obligations to the public in the midst of economic reform process underway in the country.

4.3.0 PHYSICAL PERFORMANCE

4.3.1 A gist of physical performance for the last 5 years in Generation, Transmission and Distribution Sector in the state is furnished below.

Table 4.2

	Particulars	2003-04	2004-05	2005-06	2006-07	2007-08
a	Generation					
	Capacity Addition (MW)	12.60	3.00	14.00	13.00	5.000
	Allocation from CGS (MW)	72.00	90.00	225.00	0.00	0.141
b	Transmission					
	EHT S/S (no.)	13.00	26.00	19.00	15.00	16.000
	EHT Lines, (ckt.km)	296.00	206.00	256.00	107.00	108.000
	HT Lines (ckt.km)	1269.00	675.00	1062.00	1819.00	1807.000
c	Distribution					
	No of consumers (lakhs) added	3.52	5.48	5.48.00	4.79	4.820
	LT Lines added in ckt.km	4429.00	4725.00	6439.00	8229.00	8128.000
	Distribution Transformers added	1066.00	1894.00	1778.00	2148.00	2553.000

4.4.0 ENERGY AUDIT

In order to estimate Profit Centre wise Energy Transfer, T&D losses and to identify high loss areas, Profit Centre wise accounting system was initiated in KSEB.

4.5.0 DEMAND SIDE MANAGEMENT (DSM) CELL IN KSEB

4.5.1 Demand Side Management Cell was constituted in KSEB in July 2002 as per the direction of Ministry of Power, Govt. of India. The cell aims at organizing extensive awareness programs with the aim of flattening the system load curve. Assistance of Governmental and Non- Governmental Organizations (NGOs) was sought for conducting the awareness programs.

Energy conservation day is observed on December 14th of every year with wide publicity.

4.6.0 ACCELERATED POWER DEVELOPMENT AND REFORM PROGRAMME (APDRP)

4.6.1 APDRP, a major initiative to bring about reforms in power distribution has been introduced by the Ministry of Power, Govt. of India for improving the commercial viability of the distribution sector. The funds provided under the program are utilized for upgradation and modernization of the sub transmission and distribution networks. The program which was initiated in February 2000 is being implemented in Kerala since 2003.The scheme has two components: the investment component and the incentive component. Under the investment component, Govt. of India provides 25 % of the project cost as financial assistance by way of grant. The remaining 75 % be arranged from REC/PFC or other financial institutions as counter part funding.

4.6.2 Under the incentive component, incentive is given to the power utilities at 50 % of the actual net cash loss reduction for the 10th plan period with base year as 2000-01. For the reduction of revenue deficit in 2002-03 as compared to the base year 2001-02, KSEB received an incentive of Rs 64.94 Crores, from the Govt. of India in 2005-06

4.6.3 Against the claim for incentive amount of Rs. 295.40 Crores and Rs.311.13 Crores for the year 2003-04 and 2004-05 respectively, Ministry of Power, Govt. of India recommended release for an amount of Rs.79.97 Crores during the year 2006-07. Out of this, Ministry of Finance, released an amount of Rs.44.33 Crores to the state and the same has been received by the Board and the remaining amount of Rs. 35.64 Crores is expected to be released soon.

4.7.0 CIRCLE SCHEMES

In the first phase, the scheme has been sanctioned for the three Electrical Circles: Pathanamthitta, Manjeri and Kasargod with a total outlay of Rs.148.32 Crores out of which work for an amount of Rs.143.11 Crores has been completed and the scheme has been closed on 31.3.2006

4.8.0 TOWN SCHEMES

1. As second phase, Town schemes were sanctioned during 2002, covering the towns of Thiruvananthapuram, Alapuzha, Cochin, Kozhikode, Thalassery, and Kannur with a total revised outlay of Rs.160.72 Crores. So far, financial achievement to the extent of Rs.139.17 Crores has been secured as on 31.03-2008.

2. In the third phase, 26 new Town schemes have been sanctioned with a total outlay of Rs.123.91 Crores, for implementation during 2004-05. Works amounting to Rs.105.21 Crores have been completed as on 31-03-2008

3. As the fourth phase, Town schemes covering 13 towns with a total outlay of Rs.57.18 Crores was sanctioned during 2005. Works amounting to Rs.40.724 Crores have been completed as on 31-03-2008.

4.9.0 CITY SCHEMES

4.9.1 Three special schemes for the cities of Thiruvananthapuram (Rs.122.39 Crores), Kochi (Rs 115.13 Crores) and Kozhikode (Rs. 66.48 Crores) with a total revised outlay of Rs.304 Crores have been sanctioned on 04-04-2005. The major work include construction of 11 KV lines, (UG Cables), Installation of Distribution Transformers, Construction of Substations, Distribution Automation, SCADA, TCMS, GIS Mapping, etc which are proposed to be completed by 2009.

4.9.2 The work related to SCADA, GIS Mapping and other IT related aspects shall be arranged on turnkey basis after obtaining approval for the DPRs. So far Transmission works amounting to 2.12 Crores have been completed on 31-3-2007.

4.9.3 As on 31-03-2008, a total of 1629246 energy meters have been replaced. 3078 KM of 11 kV lines were newly constructed, and 3021 numbers of 100 kVA Transformers were installed. Re-conductoring of 883 KMs of 11 kV lines and computerization of billing and revenue collection in 231 electrical sections covering the scheme area have been completed.

4.10.0 AT & C LOSS REDUCTION

4.10.1 Since the year 2001-02 KSEB has been able to achieve significant reduction of losses in the system by replacement of faulty meters and electromechanical meters by electronic meters, antitheft activities, system improvement schemes, energy audit etc. The details of the year wise reduction in T&D losses since 2001-02 are given in the following table.

4.11.0 REDUCTION OF T&D LOSS

Table 4.3

YEAR	GROSS LOSS IN KSEB			INTERNAL LOSS IN KSEB		
	Total Loss in MU	Total Loss in %	Extent of Reduction In %	Total Loss in MU	Total Loss in %	Extent of Reduction In %
2001-02	4106.05	32.15	-	3850.99	30.76	-
2002-03	3897.84	30.41	1.73	3639.03	29.08	1.65
2003-04	3544.53	28.46	1.95	3370.03	27.44	1.64
2004-05	3335.32	26.22	2.24	3120.39	24.95	2.49
2005-06	3349.16	24.59	1.63	3061.42	22.96	1.99
2006-07	3467.07	23.43	1.16	3096.97	21.47	1.49

4.11.1 The achievement of KSEB in reducing the T&D loss is appreciated by the Ministry of Power, Government of India and KSEB is rated as the first among power utilities as far as reduction of T&D Loss is concerned. It is seen that KSEB is taking sincere and dedicated efforts to further reduce the T&D Losses.

4.11.2 T & D loss

The T&D Loss of a system can be classified in to two components. 1. Technical Loss and 2.Commercial Loss. The Technical loss includes the inherent loss in the Transmission and Distribution system up to the point of supply at the premises of the consumer. Commercial Loss includes loss such as theft of power, errors in billing and collection etc., other than technical factors. In addition to the T&D Loss in the KSEB system, KSEB has to bear the proportionate loss in PGCIL lines through which allocation to KSEB from Ex-Bus of CGS is transmitted to KSEB periphery and this loss component is treated as the external loss to the KSEB system. The energy loss in KSEB system (excluding the external PGCIL loss) is accounted as internal loss. The internal loss is the difference between the Net Ex Bus - (including the energy generated and purchased from IPPs & CGS) and the total energy sold.

Although KSEB has no control over the external loss, the energy from the CGS is to be scheduled at the CGS Bus and KSEB has to pay for the same. KSEB has to bear the proportionate loss in the PGCIL lines in the southern grid, in proportion to the allocation from the CGS.

4.11.3 Technical loss reduction

Technical loss is the energy loss in the substation and lines in the transmission and distribution networks. It is estimated that the loss in the transmission system of voltage level below 220 kV is about 5% of the total energy input. The remaining technical loss is contributed by the distribution system. So KSEB has been taking efforts to strengthen the primary and secondary distribution system within the State by:-

(a) Constructing more high voltage distribution lines which will improve the HT: LT ratio as well as reduce distribution loss. Accordingly, KSEB has taken steps to construct 1km/month of HT lines in each section.

(b) Strengthening of sub transmission network by upgrading voltage levels of distribution feeders from 11kV to 33kV.

(c) Re-conductoring of old LT lines.

(d) Using higher size conductors at the substation end of 11kV feeders.

(e) Power factor compensation using shunt and series capacitors.

(f) Introducing automatic voltage boosters in selected areas of low voltage.

(g) Rearrangement of LT feeders to avoid overloading as well as under loading of distribution transformers.

(h) Reducing length of LT lines by suitable relocation of distribution transformers.

(i) Introducing amorphous core transformers for reducing core loss.

(j) Introducing the concept of 'less LT' system in selected areas.

(k) Balancing of the load on distribution feeders through regular monitoring.

(l) Measures for Energy audit at transformer level.

As part of the reduction of technical loss in transmission sector, KSEB is adding more substations and lines every year as detailed below.

4.12.0 TRANSMISSION LINES AND SUBSTATIONS CONSTRUCTED

Table 4.4

Year	**Substation in Nos.**				**Lines in kilometers**			
	220kV	**110kV**	**66kV**	**33kV**	**220kV**	**110kV**	**66kV**	**33kV**
2003-04	1	6	3	7	4.3	154.6	8.4	95.4
2004-05	1	8	2	15	15	30	5	157
2005-06	1	4	4	10	56	55	13	131
2006-07	Nil	2	3	10		30	15	95

Similarly, the works executed to strengthen distribution sector in reducing the technical loss is given below.

4.13.0 ACHIEVEMENT IN DISTRIBUTION WORKS

Table 4.5

Year	Distribution Transformer in Nos.	11kV lines in (km)	LT lines in (km)
2003-04	1063	1269	4429
2004-05	1882	955	6074
2005-06	1751	1062	7441
2006-07	2124	1820	8229

4.13.1 Even though the ideal ratio of HT-LT line for a power system is 1:1, in the State of Kerala, the ratio is about 1:6. This is mainly due to the topography especially in the hilly areas and dispersed pattern of housing in rural areas in the State. A sudden transition in HT-LT ratio from the present level of 1:6 to 1:1 is not possible due to variety of reasons ranging from availability of required capital to other constraints in the physical implementation.

4.13.2 Further, it may be noted that the construction of HT lines requires way leave clearance at least to a width of 4 meters for 11 kV lines. It is more in the case of higher voltage lines. Construction of 11 kV lines to the tune of 1,75,000 km would involve a way leave clearance of over 68,000 hectares of land. In a State like Kerala where density of population is highest in the country and is covered by thick vegetation, it is extremely difficult to achieve the ideal situation in a short span of time. Therefore, being a highly capital intensive work involving innumerable collective and individual resistance at local level, the reduction in Technical loss thereon should be realistically worked out.

However, during the 11th Plan, Board is targeting to improve the HT-LT ratio from the present level of 1: 6 to 1:4.

4.14.0 COMMERCIAL LOSS REDUCTION

KSEB has been giving equal thrust on commercial loss reduction through the following efforts.

- Replacement of faulty and sluggish electromechanical meters by Electronic meters.
- Intensification of theft detection by the Anti Power-Theft Squad (APTS).
- Computerization of billing and revenue collection.
- Enlarging energy audit.
- Development of transmission and distribution systems.
- Conducting loss analysis at circle level.
- Installing transformer, feeder and border meters to determine the loss.
- Giving incentives for load factor and power factor improvements.
- Refining the method of estimation of the loss.

4.15.0 FAULTY METER REPLACED

The number of faulty meters replaced during the last few years is given below:

Table 4.6

Year	Meters in Lakhs
2002-03	4.21
2003-04	8.67
2004-05	4.35
2005-06	6.38
2006-07	2.69

4.16.0 In addition to the inspection conducted by APTS under Inspector General of Police (IGP), the Regional Audit Offices as well as Division and Section squads are conducting inspection in the premises of consumers with a view to checking power theft and misuse of power.

4.17.0 TARGET OF LOSS REDUCTION IN 2007-08 AND 2008-09

The Board will continue to intensify the measures for reduction of T&D loss during 2007-08 and 2008-09 so as to bring down the losses further by the following measures:

(i) Faulty meter replacements

- During the year 2007-08, the Board has target to replace 6 lakh of faulty meters and so far (up to August 2007) 2.52 lakh faulty meters have been replaced.
- In 2008-09, Board has target to replace 6 lakh faulty meters.

(ii) Intensification of theft detection

4.17.1 During the year 2007-08, up to October 2007, APTS has detected 10986 cases of theft involving a penal assessment of Rs.8.29 Crores out of which Rs.5.60 Crores has already been realized. The KSEB continues the efforts of theft detection. In addition to the APTS, the Division/ Section squads has detected 11588 theft cases and assessed Rs 5.68 Crores, out of which Rs 3.30 Crores was realised.

KSEB intensify the theft detection activities of APTS and Division and Section squads.

4.18.0 DISTRIBUTION WORKS PROPOSED

Particulars	2007-08	2008-09 (Revised)
11 kV line (km)	2000	3000
LT line (km)	6000	6000
Dist. Transformers (Nos.)	2000	2000

4.19.0 T& D LOSS REDUCTION MEASURES (2007-08)

KSEB achieved T&D loss reduction from 23.43 % to 21.63 % in 2007-08. To facilitate the loss reduction, 10 nos. of 33 kV substations and connected lines, 1807 KM of 11 kV lines and 2553 Nos. of distribution transformers were installed in 2007-08. 580484 nos. of faulty, sluggish and old meters were replaced with electronic meters during 2007-08 to reduce commercial loss. Anti Power Theft Squad has been strengthened and its activities were intensified to detect cases of malpractices and pilferage of energy.1144 cases of irregularity in the use of electricity were detected during 2007-08.Rs.16.93 Crores was assessed and Rs.10.49 Crores was realized. All the above measures helped in bringing down the T&D loss to 21.63 % in the year 2007-08.

It can be seen that the T & D loss has been reduced by 8.78 % during the period from 2002-03 to 2007-08. Thus the increase in the demand for energy could be partially met by the T&D loss reduction, instead of resorting to the purchase of costly energy. It is seen that the equivalent amount of saving in 2002-03 was Rs 61.90 Crores where as that for the year 2007-08 is Rs 89.67 Crores.

Section 5

SCOPE OF WORK

5.1.0 PROJECT NAME:

Identification of Technical Loss Reduction and Rationalization of Secondary Distribution System at selected typical three Distribution Transformers (as a model) in the Kerala Power System.

5.1.1 Project Objective: Rationalization of Secondary Distribution System through a Micro Level Approach.

5.1.2 Scope of Work

- Coordinate with the distribution utility.
- Map the distribution transformer and the connected primary and secondary distribution points.
- Make arrangement for adequate instrumentation to conduct the study
- Measure the load, power factor, harmonics and other parameters at the transformer secondary as well as the end-user point at any particular time as is found convenient.
- Study of harmonics, phase imbalances, loss profile, network data, load flow and other aspects in distribution lines etc.
- Provide detailed performance data of the transformer (Actual Load Variations)
- Peak load evaluation/load curve
- Conduct a detailed load survey of the locality, which exactly determines the total transmission losses of the transformer.
- Evaluate the magnitude of technical losses
- Prepare a replicable model for loss study
- Make a thorough study of the power quality issues such as harmonics in the pretext of the loads used by the end user
- Evaluate the non-technical loss analysis in a socio-economic preview and make suggestions and road map of implementation

5.2.0 IDENTIFICATION OF SITES

5.2.1 Site 1- Thiruvananthapuram

Originally a Transformer of rating 250 kVA, 11/0.433kV located at Aristo Junction under KSEB Electrical Section Puthenchantha under Electrical Division, Thiruvananthapuram was scheduled for the study. This Division comes under the Urban circle, Thiruvananthapuram of the Southern Region. Actually at site a 500KVA Transformer was feeding the total load inclusive of another 2 failed transformers. Since it was not feasible to carry out the study, an alternate Transformer (rating 250 kVA) was selected after getting concurrence from KSEB. This is located near Kerala State Housing Board (KSHB) Complex at Housing Board Junction. This transformer comes under the same Electrical Section.

5.2.2 Site 2-Thiruvalla

Originally a transformer of rating 160kVA, 11/0.433kV, located near Thirumoolapuram Junction, Thiruvalla was scheduled for the study. This comes under the Electrical Division Thiruvalla of KSEB. Thiruvalla Division comes under Electrical Circle of Allappuzha in Central Region. But the actual capacity of the transformer was found to be 250kVA. After getting concurrence from KSEB, the same transformer was selected for study.

5.2.3 Site 3-Palakkad

As per the order the Transformer is of rating 160kVA, 11/0.433kV, located near Kalpaka Tourist Home, Sulthanpet, Palakkad. The same was taken for study. This transformer comes under the Electrical Section of KSEB, Sulthanpet and Electrical Division, Palakkad. This Division is under Electrical Circle, Palakkad.

5.3.0 METHODOLOGY TO IDENTIFY TECHNICAL LOSS REDUCTION AND RATIONALIZATION OF SECONDARY DISTRIBUTION SYSTEM.

5.3.1 Transformer Loss study

1. Loggers were fitted on the secondary side of the Transformer and all the electrical parameters were recorded every 10 minutes continuously for 15 to 20 days.
2. The total energy recorded for 20 days was compared with the available HT Energy meter reading for the same period.
3. The Logger was recording load, Power factor and other Electrical parameters at the Transformer secondary.
4. The detailed performance data of the transformer in the dynamic mode like Peak Load evaluation /Load curve/Load factor were arrived at from the above recorded parameters.

All the analysis and the backup calculations are given in the report

5.3.2 Secondary Distribution System analysis

1. Detailed load survey of the locality was done to determine total transmission losses.
2. Mapping was done for the distribution Transformer and the connected distribution point.
3. The mapping was done after physical measurement of the distance between poles and the distance between poles and the Load point.
4. GPS survey was not used for this project, as the total Distribution is well under 5Km. The distribution is clear plain area. In practice GPS is normally adopted only for the distribution at a dense, vastly spread elevated/un approachable area.
5. The Cable joints and terminations were checked for proper contact. The heat generated at the junction was measured by a non-contact type infrared thermometer.

6. Observation and Analysis of measures taken by KSEB in loss reduction at different voltage levels/feeders.
7. Power factor and other Electrical Parameters at the load point/consumer end were measured at convenient time. The load details and the approximate operating time of the loads from the individual consumers were collected. The Electricity Bills were used as a reference.
8. Collection of energy consumption data from each and every consumer for last six months, according to KSEB bill. Verified instantaneous readings with meter readings and checked for accuracy of meters.

Section

6

THIRUVANANTHAPURAM SITE

6.1.0 SITE DESCRIPTION

6.1.1 There is a 250 kVA Transformer located near Kerala State Housing Board, Thiruvananthapuram. Specifications of conductor are given in Table 6.1 and Name Plate Details in Table 6.2. There are three feeders out going from the transformer. One of the feeders, Feeder-1 is fed to the domestic consumers and commercial consumers through the overhead line towards Gandhariamman Kovil Street, Street lights and Shanthi Nagar Area. Other two feeders feed through UG Cable to Housing Board Complex. Most of the loads are connected in this feeder. Feeder- 2 is feeding the upper block of the Housing Board Complex. Feeder-3 is feeding the lower block of the Housing Board Complex. Pole to pole and pole to consumer distance are measured and drawn in the pole mapping, which is shown in the figures 6.13 to 6.15. The exact energy consumption is arrived from the Signature Analysis and given in Tables 6.6 to 6.12. The data logger was put for 15 days and the data were analysed and the load trend is given in the figures 6.1 to 6.10 for a week day and a Sunday and logged for weekday and Sunday is given in table 6.3 and 6.4.

6.1.2 The HT supply is fed from 66/11kV Power House Substation which is hardly 1km away. The supply is fed through 300sq.mm Al. 3 ½ core UG cable from SS. Standby feeder is from PWD no.2 SS, fed from 110/11kV SS Thirumala. Under normal condition the stand by supply is kept off and during emergency will be charged after receiving SMS from the Field Staff/Engineers of the Section Office located in Shanthi Nagar.

6.1.3 Specifications of the ACSR Conductor used

Table 6.1

Used for	Code Name	No. of Strands and Dia.				Diameter of complete conductor mm	Gross area of Al. Sq.mm	Resistance at 20^{0}C Ohms/Km	Current rating for Tem. Raise 40^{0}C above ambient
		Aluminum		Steel					
		No.	Dia. mm	No.	Dia. mm				
LT 433V	Rabbit	6	3.35	1	3.35	10.05	52.95	0.54	148

6.1.4 Location of the Transformer: - Housing Board Compound

KSEB Office under which purview the Transformer Comes: - Puthenchantha

Place / Locality / Village fed by the Transformer: - Housing Board, Shanthi Nagar, Gandari Amman koil street

6.1.5 Transformer Name Plate details

Table 6.2

MAKE	**KERALA ELECTRICAL & ALLIED ENGINEERING .CO.LTD**				
TYPE	DYN11				
SERIAL NO	24305	**Manufacturing Date**			1998
RATING	250	kVA	**PHASE**	3	
HIGH VOLTAGE	11000	VOLTS	**FREQUENCY**	50	HZ
LOW VOLTAGE	433	VOLTS	**% IMPEDENCE @ 75**	4.58	OHMS
CURRENT AT HV	13.12	A	**TEMPERATURE RISE LIMIT**	45	DEGREE CELCIUS
CURRENT AT LV	333.3	A	**COOLING TYPE**	ONAN	
CONNECTIVITY			**OIL IN LITRES**	285 LITRES	
WEIGHT OF OIL IN KG	256	KG	**WEIGHT OF CORE IN KG**	530 KG	
TOTAL WEIGHT IN KG	1091	KG			

Short circuit current level = {(100/4.58) x 250000} / 433 X 1.732
= 7278A

6.1.6 HT side Measurement

There was no metering arrangement on HT side The HT voltage level was verified at the feeding substation. As per their records Voltage is maintained always at 11KV by adjusting On Load Tap Changer (OLTC), which is operated manually.

6.1.7 HT / LT Ratio

H.T /L.T ratio is the total distance of HT line to the total distance of L.T lines in an Electrical utility. Unless the network connected to the whole major substation (220KV & below) is carried out, HT/LT ratio cannot be arrived at, as the HT line is feeding many other transformers. Whatever can be calculated based on single Distribution Transformer might be erroneous.

6.2.0

Data loggers were provided at the out going of the transformer and the parameters were downloaded from 20/1/ 09 to 6/2/09.

From the data the load curve is plotted and given in fig 6.1 to 6.10

6.2.1 Logged data on a week day

Table 6.3

Record Time	Vr	Vy	Vb	Ir	Iy	Ib	kWr	kWy	kWb	kVAr	kVAy	kVAb	kWt	kVAt	PF
12:31 AM	236	238	239	75	102	67	17	22	15	17	24	16	54	57	0.95
1:01 AM	235	237	237	89	102	65	20	22	15	21	24	15	57	60	0.95
1:30 AM	235	237	236	94	107	63	21	23	14	22	25	14	58	61	0.95
2:02 AM	238	240	241	79	98	62	18	21	14	18	23	15	53	56	0.95
2:31 AM	238	240	239	79	98	63	18	21	14	19	23	15	53	56	0.95
3:00 AM	238	238	239	63	98	65	14	21	15	15	23	15	50	52	0.96
3:30 AM	238	238	239	67	105	64	15	23	14	16	25	15	52	54	0.96
4:01 AM	238	237	239	63	106	66	14	23	15	15	25	15	52	55	0.94
4:30 AM	237	238	239	86	110	67	19	24	15	20	26	16	58	60	0.97
5:00 AM	235	237	236	69	97	71	15	21	16	16	23	16	52	55	0.94
5:31 AM	234	234	234	76	108	79	17	23	18	17	25	18	58	60	0.97
6:01 AM	234	234	236	82	100	82	18	21	19	19	23	19	58	60	0.97
6:30 AM	231	232	232	97	110	85	22	23	19	22	25	19	64	66	0.97
6:32 AM	231	230	232	99	112	82	22	24	18	23	25	19	64	66	0.97
7:02 AM	238	240	241	87	106	77	19	23	17	20	25	18	59	63	0.94
7:31 AM	237	237	239	116	166	83	26	37	18	27	39	19	81	84	0.96
8:00 AM	237	237	239	120	94	63	27	20	14	28	22	15	61	64	0.95
8:30 AM	236	237	238	94	121	59	21	27	13	22	28	14	61	64	0.95
9:01 AM	233	234	234	122	124	78	27	27	17	28	29	18	71	74	0.96
9:30 AM	232	233	234	107	170	98	23	36	21	25	39	23	80	85	0.94
9:33 AM	231	232	233	115	154	107	24	31	23	26	35	25	78	85	0.92
10:03 AM	231	233	233	171	218	170	36	46	35	39	50	39	117	128	0.91
10:32 AM	235	234	234	209	256	224	45	54	47	49	60	52	146	161	0.91
11:01 AM	231	230	232	212	279	242	45	57	51	49	64	56	153	167	0.92
11:31 AM	231	230	232	228	303	264	49	63	56	52	69	61	168	181	0.93
12:00 PM	235	235	236	251	297	279	56	63	60	59	69	65	179	193	0.93
12:31 PM	232	233	234	239	297	281	52	62	61	55	68	65	175	188	0.93
1:01 PM	234	234	236	239	265	241	52	56	52	56	62	56	160	173	0.93
1:30 PM	236	236	236	245	270	242	55	57	52	58	63	57	164	176	0.93
2:02 PM	235	236	237	240	272	251	53	58	55	56	64	59	166	178	0.93
2:31 PM	235	233	234	232	297	264	50	62	57	54	68	61	169	183	0.92
2:33 PM	235	233	234	248	320	278	54	68	60	58	74	65	182	196	0.93
3:00 PM	235	233	234	238	301	252	53	64	54	56	69	58	171	183	0.93
3:30 PM	233	233	234	236	333	257	51	71	55	55	77	60	177	191	0.93
4:01 PM	235	235	237	241	280	246	54	60	54	57	65	58	168	179	0.94
4:31 PM	235	234	234	246	322	276	54	69	59	58	75	64	182	197	0.92
5:00 PM	235	234	235	187	272	219	40	58	46	44	63	51	144	158	0.91
5:32 PM	240	240	241	160	195	168	35	41	36	38	46	40	112	123	0.91
6:01 PM	247	244	246	142	167	140	32	35	31	35	40	34	98	109	0.90
6:30 PM	233	232	234	134	159	125	29	32	27	31	36	29	88	96	0.92
7:30 PM	229	228	231	137	175	112	29	35	23	31	39	26	87	96	0.91
8:01 PM	231	228	229	127	190	148	27	40	31	29	43	33	98	104	0.94
8:30 PM	231	230	232	121	170	106	26	35	22	28	39	24	83	88	0.94
9:00 PM	235	234	236	100	160	98	23	33	21	23	37	23	77	82	0.94
9:31 PM	231	230	234	135	192	96	29	39	20	31	44	22	88	95	0.93
10:01 PM	233	233	236	129	167	94	29	35	20	30	38	22	84	90	0.93
10:30 PM	235	235	237	125	152	100	28	32	22	29	35	23	82	87	0.94
11:01 PM	240	239	241	113	140	79	25	30	18	27	33	19	73	79	0.92
11:31 PM	238	238	240	110	151	84	24	32	19	26	35	20	75	81	0.93
12:00 AM	235	235	237	112	120	66	25	25	14	26	28	15	64	69	0.93

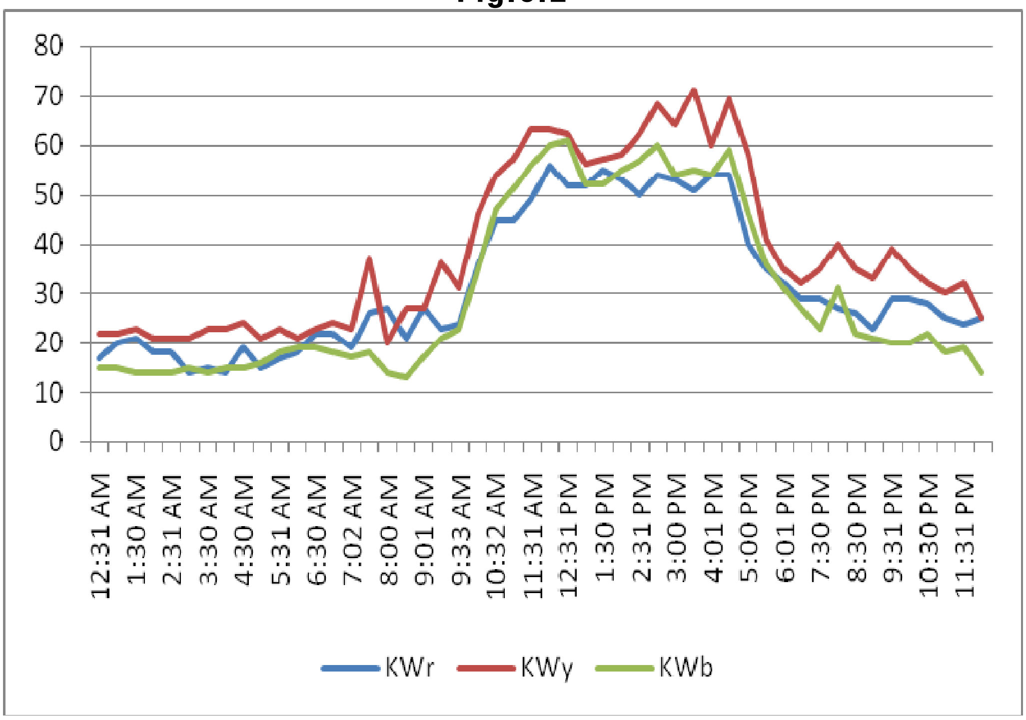
6.2.2 Load Curve for the above logging (weekday)

0.1 Fig. 6.1 shows the Current Trend in each phase on a week day

Fig. 6.1

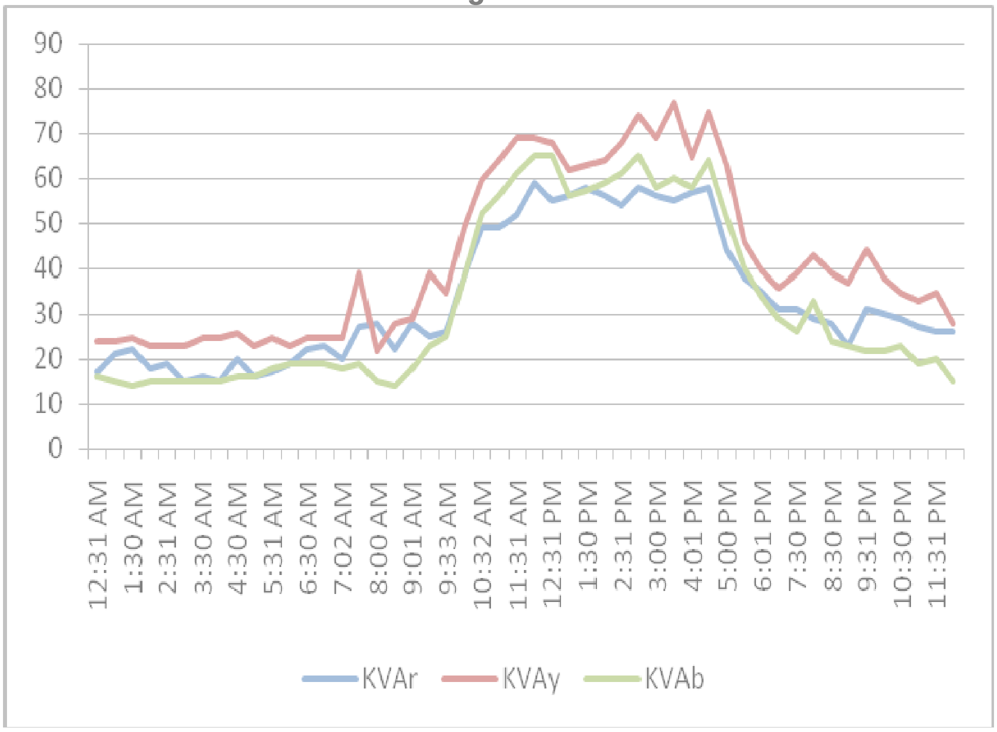
0.2 Fig. 6.2 shows the Power Trend in each phase on a week day

Fig.6.2



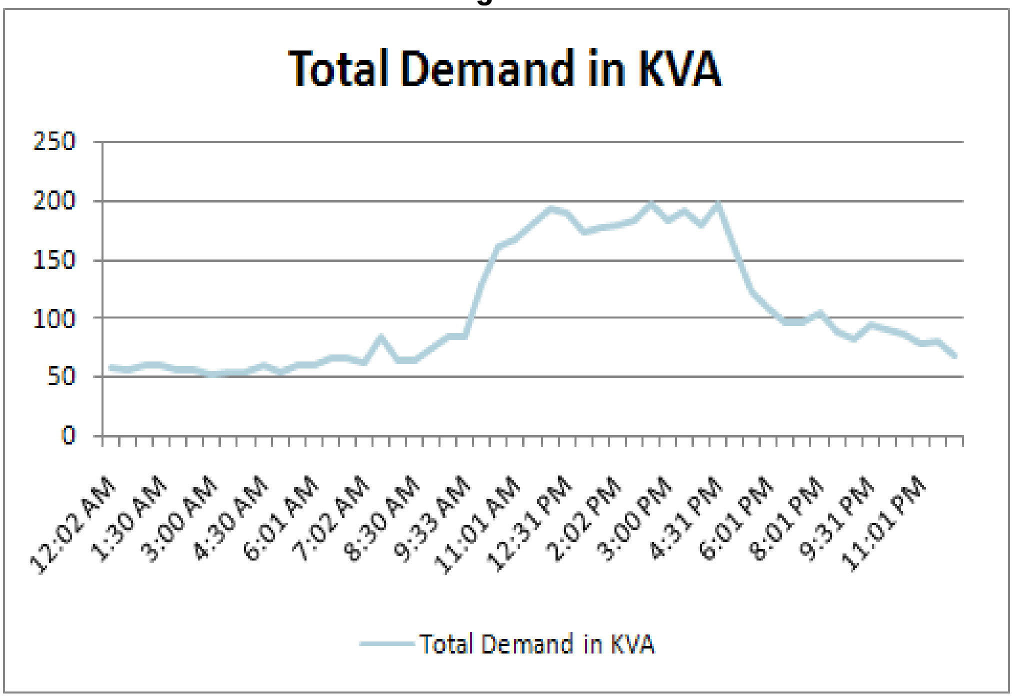
0.3 Fig. 6.3 shows the Demand Trend in each phase on a week day

Fig. 6.3



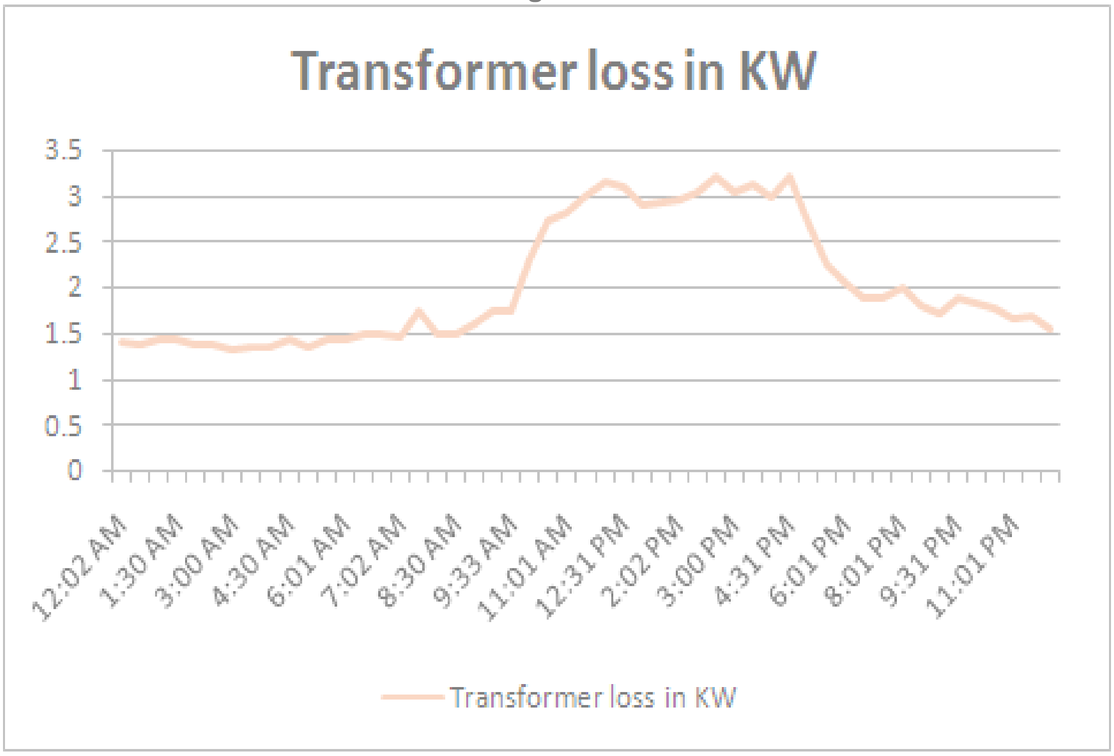
0.4 Fig. 6.4 shows the total Demand Trend on a week day

Fig. 6.4



0.5 Fig. 6.5 shows the Transformer loss Trend on a week day

Fig. 6.5



Demand varies from 20% to 79%
Power factor varies from 0.9 lag to Unity

6.2.3 Logged data on a Sunday

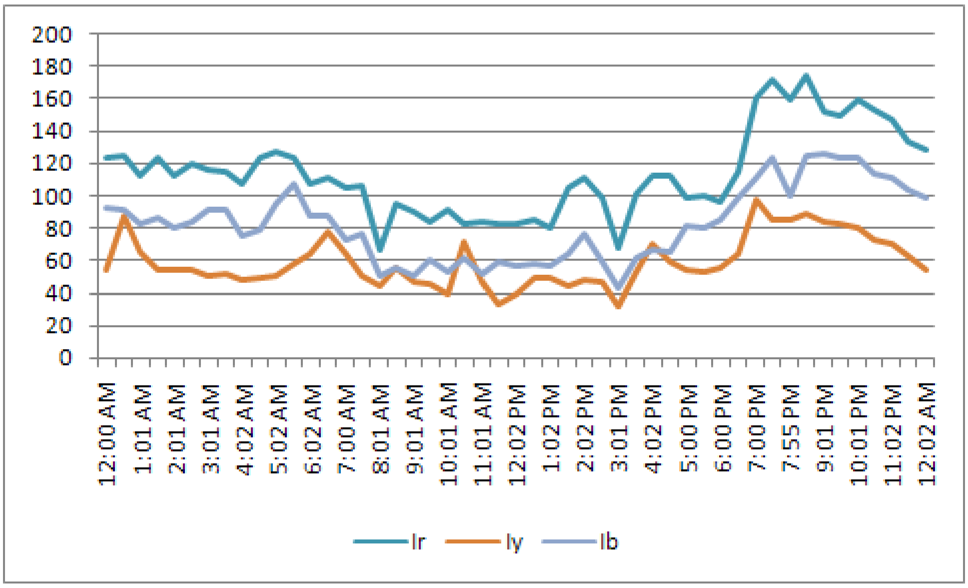
Table 6.4

Record Time	Vr	Vy	Vb	Ir	Iy	Ib	kWr	kWy	kWb	kVAr	kVAy	kVAb	kWt	kVAt	PF
12:31 AM	235	235	237	79	93	84	17	20	19	18	22	20	56	59	0.95
1:01 AM	235	235	236	82	97	72	18	21	16	19	23	17	55	59	0.93
1:30 AM	238	237	238	76	89	69	17	19	16	18	21	16	52	55	0.94
2:02 AM	236	237	239	88	111	79	19	23	17	21	26	19	59	65	0.91
2:31 AM	241	242	242	74	96	74	17	21	16	18	23	18	54	58	0.93
3:00 AM	238	240	239	62	94	68	14	20	16	15	23	16	50	53	0.94
3:30 AM	238	240	242	74	110	77	17	24	17	18	27	18	58	62	0.94
4:01 AM	238	240	240	71	88	78	16	19	18	17	21	19	53	56	0.95
4:30 AM	238	239	239	95	130	98	21	29	22	23	31	24	72	78	0.92
5:00 AM	238	239	239	76	110	75	17	24	17	18	26	18	58	62	0.94
5:31 AM	237	237	238	69	107	86	15	23	19	16	25	20	57	61	0.93
6:01 AM	235	235	236	85	95	78	19	20	18	20	22	18	57	60	0.95
6:30 AM	233	234	234	90	95	75	21	20	17	21	23	18	58	61	0.95
6:32 AM	231	231	232	83	82	82	19	18	18	19	19	19	55	57	0.96
7:02 AM	231	231	232	59	95	64	13	21	15	14	22	15	49	50	0.98
7:31 AM	235	235	236	53	58	49	12	13	11	12	14	11	36	37	0.97
8:00 AM	236	237	238	78	109	59	17	24	13	18	26	14	54	57	0.95
8:30 AM	234	235	236	71	101	84	16	22	19	16	24	20	57	60	0.95
9:01 AM	233	233	234	71	72	84	16	15	19	16	17	20	50	53	0.94
9:30 AM	236	238	239	56	80	57	12	17	13	13	19	13	42	44	0.95
9:33 AM	232	234	234	82	89	68	18	20	15	19	21	16	53	55	0.96
10:03 AM	223	224	227	72	94	81	15	20	18	17	22	19	53	56	0.95
10:32 AM	221	221	224	79	89	85	17	19	18	18	21	20	54	58	0.93
11:01 AM	220	219	222	82	103	82	18	22	17	19	24	19	57	61	0.93
11:31 AM	226	226	230	75	106	95	16	23	21	17	25	22	60	64	0.94
12:00 PM	221	221	224	70	112	119	15	24	26	16	26	28	65	69	0.94
12:31 PM	224	224	227	73	85	88	16	18	19	17	20	20	53	56	0.95
1:01 PM	226	224	229	79	100	79	17	21	17	18	23	18	55	59	0.93
1:30 PM	226	224	229	73	87	79	16	18	17	17	20	18	51	55	0.93
2:02 PM	220	220	224	83	99	91	18	21	20	19	23	21	59	63	0.94
2:31 PM	238	238	240	71	100	109	15	21	24	16	23	25	60	64	0.94
2:33 PM	238	237	239	87	96	94	19	20	21	20	22	22	60	64	0.94
3:00 PM	238	240	241	66	106	98	14	23	22	15	24	23	59	62	0.95
3:30 PM	240	240	241	76	114	97	16	24	21	17	26	22	61	66	0.92
4:01 PM	241	240	242	69	121	103	15	26	22	16	28	24	63	67	0.94
4:31 PM	247	247	248	78	102	102	17	22	22	18	23	24	61	65	0.94
5:00 PM	247	244	246	79	103	74	18	23	17	19	25	18	58	60	0.97
5:32 PM	226	228	229	62	109	78	14	23	17	14	25	18	54	57	0.95
6:01 PM	221	221	224	83	153	84	18	32	18	19	35	19	68	71	0.96
6:30 PM	223	224	227	88	134	84	20	28	18	20	31	19	66	70	0.94
7:30 PM	224	224	226	85	162	87	19	33	18	19	36	20	70	74	0.95
8:01 PM	233	233	234	87	144	92	19	30	19	20	33	21	68	72	0.94
8:30 PM	235	237	237	96	154	98	21	32	21	22	35	22	74	78	0.95
9:00 PM	235	235	237	103	149	106	23	31	23	23	34	24	77	81	0.95
9:31 PM	238	238	240	100	158	93	22	33	20	23	36	22	75	80	0.94
10:01 PM	238	239	241	91	149	99	19	31	21	21	34	23	71	76	0.93
10:30 PM	235	235	237	73	132	95	16	28	20	17	31	22	64	69	0.93
11:01 PM	233	233	234	69	121	94	15	26	21	16	29	22	62	67	0.93
11:31 PM	237	238	239	65	98	77	14	21	17	15	23	18	52	57	0.91
12:00 AM	235	235	237	79	93	84	17	20	19	18	22	20	56	59	0.95

6.2.4 Load Curve for the above logging (Sunday)

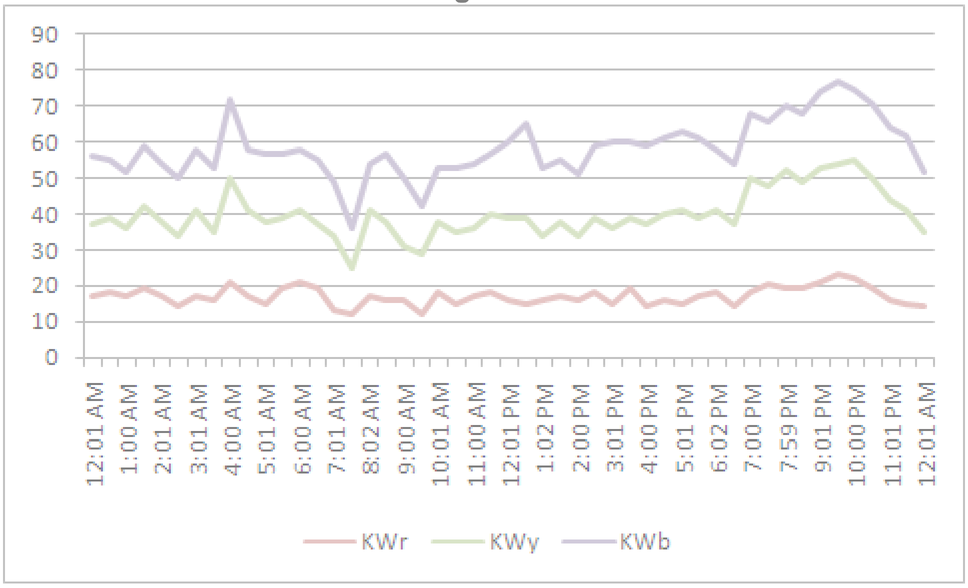
0.1 Fig. 6.6 shows the Current Trend in each phase on a Sunday

Fig. 6.6



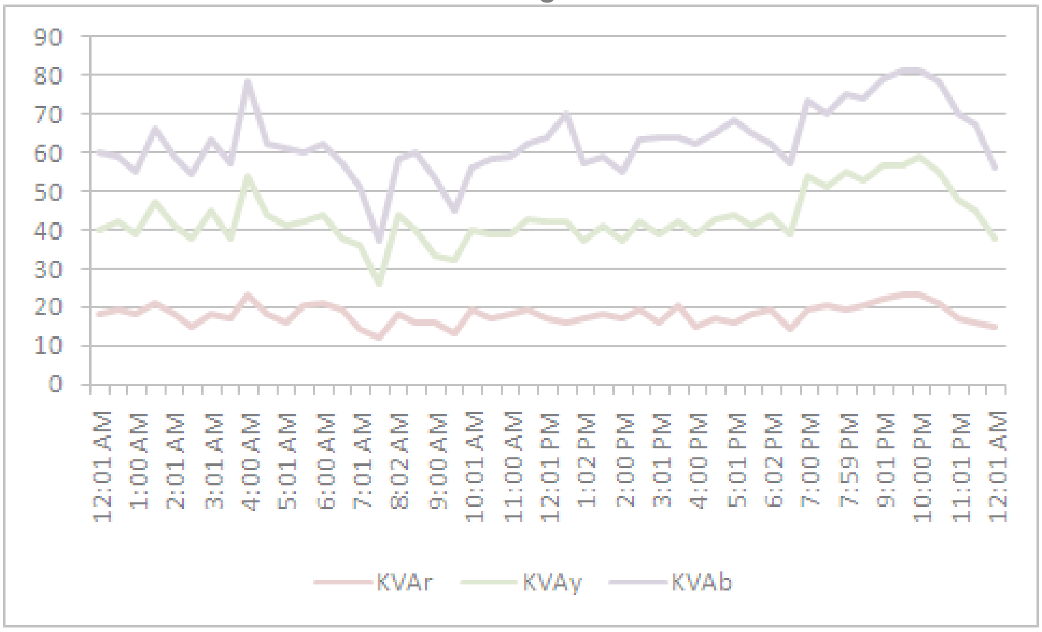
0.2 Fig. 6.7 shows the Power Trend in each phase on a Sunday

Fig. 6.7



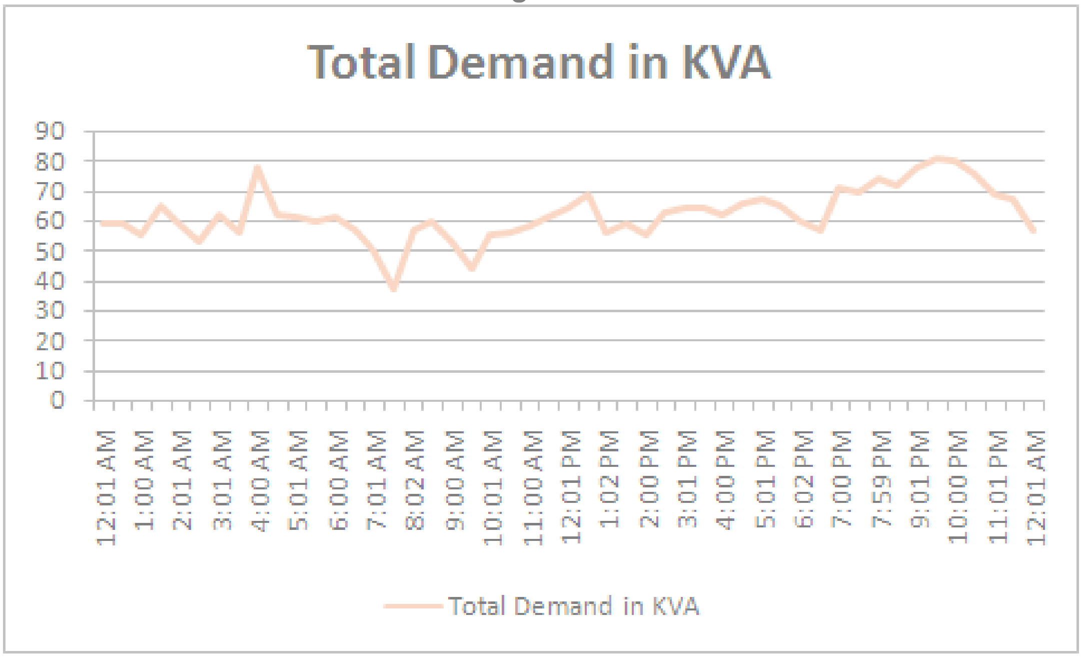
0.3 Fig. 6.8 shows the Demand Trend in each phase on a Sunday

Fig. 6.8



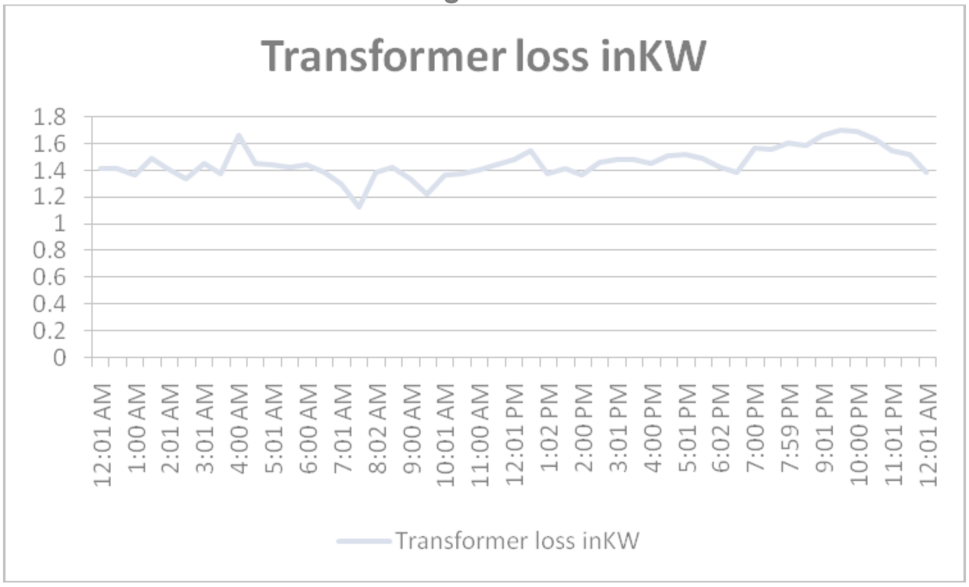
0.4 Fig. 6.9 shows the total Demand Trend on a Sunday

Fig. 6.9



0.5 Fig. 6.10 shows the Transformer loss Trend on a Sunday

Fig. 6.10



Demand varies from 15% to 32%
Power factor varies from 0.9 lag to Unity

6.2.5 Load Ratio of the Transformer /Load Factor

=Transformer Loading x 24Hrs /Capacity of the Transformer x 24Hrs
= (58 x 7) + (76 x 2.5) + (160 x 10.5) + (86 x 4)/250 x 24
= 2620/6000 = 0.436 = 44%

Transformer Losses
As per the Specification No load loss is 650W and Load loss is 3250W

For the above load Ratio the total Transformer loss per day=
$[650+3250(44/180)^2]$ (24/1000) =30.7kWh/day

6.2.6 SUGGESTION

It is suggested to fix an energy meter at the HT side of the Transformer to ascertain the exact transformer losses.

6.2.7 OBSERVATION

- Maximum load on the transformer is 32% on Sundays and 79% on weekdays.
- During peak hour’s maximum loading is 44% and minimum load is 33% on week days. This is because most of the commercial loads are off during peak hours. On Sundays maximum load is 32% and minimum load is 28%

- During off peak hrs/night Max loading is 35% and minimum load is 22% on week days. On Sundays maximum load is 31% and minimum load is 21%
- During normal hrs. Max loading is 79% and minimum load is 52% on week days. This is because the commercial loads are on along with the domestic load. On Sundays maximum load is 27% and minimum load is 15%. This is because most of the commercial loads (Offices and shops) are off on Sunday.
- Un-balanced load between phases. Y Phase Load is higher when compared to other two phases.
- During day time Y Phase current is more than the full load current of the transformer and comes down to almost 90% of the full load current
- Neutral current is 70A
- R Phase load is around 64 to 75% of Y Phase load
- B Phase load is around 62 to 84% of Y Phase load
- It is observed that though the power factor is relatively good, considering the load variation, the influence of harmonic content cannot be ignored. Presently the transformer is severely under loaded and therefore the present harmonic distortions are not much harmful. But as and when the transformers get loaded above 50%, the harmonic amplification will be pronounced and will need to be attended to, using tuned harmonic filters.
- The electricity distribution company may plan for a typical harmonic audit of the substations and the transformers.

6.2.8 Analysis for unbalance load

From the data it is clear that throughout the day unbalance load is there. While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase of consumers and load might have created the unbalance.

6.2.9 Effects of unbalanced load

It reduces the overall efficiency of System by forcing the voltage and current to be out of phase (reduced Power Factor). There will be Neutral current also.

6.2.10 SUGGESTION

It is suggested to fix an Ammeter at the LT Distribution fuse panel to monitor the LT current of the transformer.

This will also give an opportunity for the supervisory staff to monitor the peak loads and off peak loads and to take corrective action.

6.2.11 SUGGESTION

Load to be balanced at the secondary side.

Some of the R Phase load can be shifted to Y Phase

This will reduce the un- balance current and the neutral current.

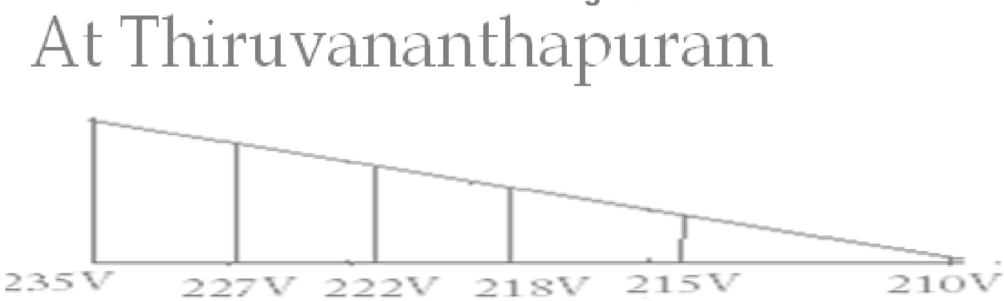
6.3.0 TEMPERATURE MEASUREMENT

Taken at full load
Atmosphere temperature is 38^0C
At Transformer Termination is 40^0C
At Distribution end is 42^0C
At OH line termination is 41^0C

The above temperature reveals that that the Joints/Binding at the junction is properly done.

6.4.0 VOLTAGE TREE DIAGRAM

Fig. 6.11



6.4.1 OBSERVATION

The voltage was measured at the consumer end.

The voltage Drop is around 10.6%. This is very high. LT side voltage as per Supply Code shall be +/-6%. Actual voltage regulation is ((235-210)/210) x100=11.9%.

The size of the conductor used is adequate and the distance between pole and the consumer meter is not exceeding 100metres.

6.4.2 SUGGESTION

The voltage drop is due to the contact resistance at the junction of the conductor connected to consumer near the pole.

The joints/termination can be redone to make the contact proper and to avoid voltage drop and bring it within limits.

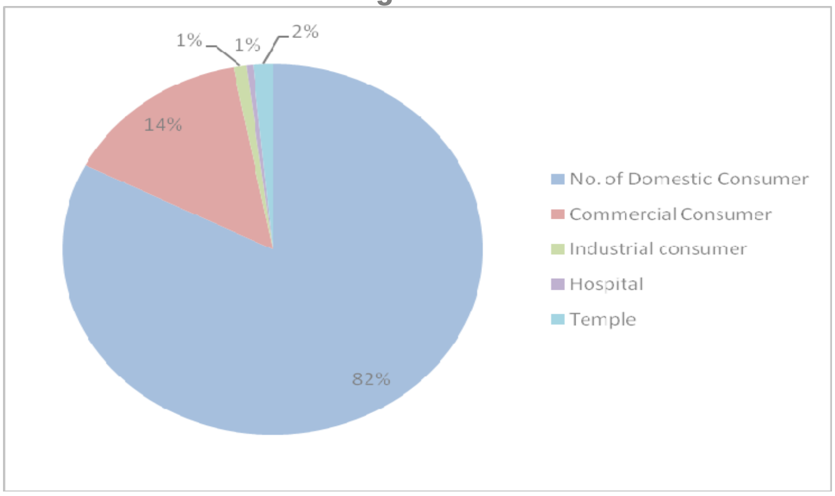
6.5.0 COMBINATION OF CONSUMER MIX OF THE TRANSFORMER IS AS UNDER

Table 6.5

No. of Domestic Consumer	165
No. of BPL Consumer	Nil
Commercial Consumer	29
Industrial consumer	2
Hospital	1
Temple	3

Total No. of Consumers = 200

Fig. 6.12



6.5.1 The consumer mix of this transformer may not have any impact on the distribution. There is only two small industrial loads and the significant loads are residential and partially commercial loads .The mix is in line with the total consumer mix of the entire Kerala State but the agriculture load is not there.

6.5.2 Consumer Density

No. of Consumers x 100/Transformer capacity
= 200 x 100/250 = 80 consumers per 100 kVA of transformer

The above no. is slightly high, and considering the modern homes, the consumer density of 50 to 60 per 100 kVA is more reasonable. However the loading density being low, this situation can be ignored, as losses will not be substantial.

6.5.3 Load Density

Connected load/Transformer capacity in kVA= 226/250 = 0.904

6.6.0 CONSUMPTION DETAILS OF CONSUMER FOR SIX CONSECUTIVE MONTHS

0.1 POST (from PT TDR 3A to KAR 10G/1/1A) in Table. 6.6

Table 6.6

Sl. No	Pole/ Post No	Consumer No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	PT TDR 3A	4571	355	371	350
2	PT TDR 3B	4019	413	173	132
3	PT TDR 3B	7598	87	53	62
4	PT TDR 3B	2390	426	409	495
5	PT TDR 3B	8116	161	Bills not available	Bills not available
6	PT TDR 3D	TEMPLE	Bills not available		
7	PT TDR 3D	7925	32	31	40
8	KAR 10G/2	7817	327	283	318
9	KAR 10G/2	7818	244	260	176
10	KAR 10G/2	7819	136	92	34
11	KAR 10G/2	8104	122	211	205
12	KAR 10G/2	7748	381	500	537
13	KAR 10G/1A	4581	394	419	343
14	KAR 10G/1B	7017	372	392	446
15	KAR 10G/1B	7018	362	309	411
16	KAR 10G/1	7861	691	651	668
17	KAR 10G/1	7862	730	650	518
18	KAR 10G/1	7863	192	141	200
19	KAR 10G/1	4279	Bills not available		
20	KAR 10G/1	6075	324	386	399
21	KAR 10G/1	7242	200	184	204
22	KAR 10G/1	7080	380	315	409
23	KAR 10G/1/1A	4579	Bills not available		
24	KAR 10G/1/1A	4346	53	70	68
25	KAR 10G/1/1A	8636	71	75	80
26	KAR 10G/1/1A	4306	233	398	230

0.2 POST (from PT KAR10H to KAR 10J) in Table. 6.7

Table 6.7

Sl. No	Pole/ Post No	Consumer No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	KAR10H	2200	468	487	576
2	KAR10H	712	606	672	502
4	KAR10I	3920	263	263	294
5	KAR10J	7772	448	488	452
6	KAR10J	7718	240	218	214
7	KAR10J	2208	182	153	169
8	KAR10J/1	4075	123	106	84
9	KAR10J/1	2204	100	200	200
10	KAR10J/1	3591	201	211	197
11	KAR10J/2	4470	468	499	358
12	KAR10J/2	2205	198	200	167
13	KAR10J/2	7369	391	397	492
14	KAR10J/2	2206	88	89	100
15	KAR10J/2	4364	263	270	184
16	KAR10J/2	7731	200	200	DL
17	KAR10H	7222	74	78	72
18	KAR10H	8933	390	360	350
19	KAR10H	9942	1022	1034	799
20	KAR10H	9941	114	109	99
21	KAR10J	7672	570	514	345
22	KAR10J	2203	393	390	400
23	KAR10H	4304	2059, 1534	2040,1649	1141,1785

0.3 POST (from PT KAR10C to KAR 10E/1) in Table. 6.8

Table 6.8

Sl. No	Pole/ Post No	Consumer No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	PT KAR 10C	10894	Bill not available		
2	PT KAR 10C	2193	345	407	386
3	PT KAR 10C	2194	245	231	222
4	PT KAR 10C	5249	162	187	38
5	PT KAR 10C	7350	221	173	203
6	PT KAR 10C	4111	145	160	120
7	PT KAR 10C	4064	461	421	425
8	PT KAR 10C	1640	DL	DL	DL
9	PT KAR 10C	9770	62, 74	75,79	63, 72
10	PT KAR 10C	8657	360	381	376
11	PT KAR 10C	9558	288	268	319
12	PT KAR 10C	7078	330	322	382
13	PT KAR 10C	7779	272	368	228
14	PT KAR 10D	2195	303	316	319
15	PT KAR 10D	2195A	303	316	319
16	PT KAR 10D	2195B	Bill not available		
17	PT KAR 10D	4487	144	145	180
18	PT KAR 10D	2213	457	210	158
19	PT KAR 10D	4375	126	132	150
20	PT KAR 10E	7098	19	93	DL
21	PT KAR 10E	7345	199	158	66
22	PT KAR 10E	3933	211	111	121
23	PT KAR 10E1	2196	375	327	313
24	PT KAR 10E1	4342	190	130	127
25	PT KAR 10E1	2176A	322	413	316
26	PT KAR 10E1	8622	97	62	60
27	PT KAR 10E1	7576	339	288	338

0.4 POST (from PT KAR10F to KAR 10D) in Table. 6.9

Table 6.9

Sl. No	Pole/ Post No	Consumer's No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	PT KAR 10F	7103	4038	3147	2117
2	PT KAR 10F	4869	222	171	235
3	PT KAR 10F	9868	5195	3352	3362
4	PT KAR 10F	2198	78	89	102
5	PT KAR 10F	8439	388	318	435
6	PT KAR 10F	2211	327	292	18
7	PT KAR 10F	8316	212	148	47
8	PT KAR 10F	2212	367	355	241
9	PT KAR 10F	4680	330	372	268
10	PT KAR 10F	9428	176	71	15
11	PT KAR 10F	9584	679	859	905
12	PT KAR 10F	9587	3285	2233	2452
13	PT KAR 10F	9427	664	601	535
14	PT KAR 10F	9598A	290	342	267
15	PT KAR	7605	538	460	582
16	PT KAR	4333	329	307	307
17	PT KAR 10B	4413	Bill not available		
18	PT KAR 10B	4439	359	313	359
19	PT KAR 10B	2192	1	1	1
20	PT KAR 10B	4015	407	500	368
21	PT KAR 10B	2216	50	12	127
24	PT KAR 10A	2188	200	200	188
26	PT KAR 10A	2186	255	487	0
27	PT KAR 10A	2185	160	150	152
28	PT KAR 10A	TEMPLE	Bill not available		
29	PT KAR 10D	TEMPLE	Bill not available		
30	PT KAR 10A	10302	53	684	765
31	PT KAR 10A	10302A	37	202	341

0.5 **POST (from PTSN1 to SN7) in Table. 6.10**

Table 6.10

Sl. No	Pole/ Post No	Consumer's No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	PT SN1	4355	239	242	239
2	PT SN2	4410	DL	150	287
3	PT SN2	4409	100	100	250
4	PT SN3	4469	4141,3207	3384,3026	2841,2845
5	PT SN3	4193	391	367	371
6	PT SN3	133			
7	PT SN4	4229	126	150	113
8	PT SN4				
9	PT SN4	4231	122	125	117
10	PT SN4				
11	PT SN5	4194	641	387	356
12	PT SN5	4329	489	492	512
13	PT SN5	4195	257	163	144
14	PT SN5	4339	474	498	506
15	PT SN5	No connection			
16	PT SN6	4359	399	413	405
17	PT SN6	4209	355	352	354
18	PT SN5A	4196	287	300	275
19	PT SN5A	4349	341	336	338
20	PT SN5B	8204	DL	200	0
21	PT SN7	4173A			
22	PT SN7	4173	300	Bills not available	
23	PT SN7	4168	572	490	491
24	PT SN7	4178	407	403	396
25	PTSN 3	4177	13	DL	127
26	PTSN1	10301	Disconnected		
27		4254	122	132	121
28		4255	13	52	30
29		4256	238	200	236
30	PTSN5	9310	291	273	168

0.6 POST (from PT SN8 to SN1) in Table. 6.11

Table 6.11

Sl. No	Pole/ Post No	Consumer's No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	PT SN8	4198	476	469	427
2	PT SN8	4175	0	184	174
3	PT SN8	4551	Disconnected		
4	PT SN9	4228	750	238	300
5	PT SN9	4226	200	214	440
6	PT SN10	4205	1200	1107	1299
7	PT SN10A	4180	343	304	323
8	PT SN10A	7624	1395	1483	1259
9	PT SN10A	4179	200	200	250
10	PT SN10A	4201	1897	1657	1551
11	PT SN11	8836	403	313	253
13	PT SN1/3	4199	270	266	235
14	PT SN1/3	4323	208	173	178
15	PT SN1/3A	4200	294	274	207
16	PT SN1/3B	7843	200	200	200
17	PT SN1/2	4218	418	410	386
18	PT SN1/2	4556	453	656	624
19	PT SN1/2	4172	596	498	430
20	PT SN1/1	4187	308	280	277
22	PT SN1/1	4184	790	705	696
24	PT SN1/1	6304	DL	DL	DL
25	PT SN1/1	6305	DL	DL	DL
26	PT SN1/1	4185	587	454	400
27	PT SN1	4181	326	367	335
28		8484	790	705	696
29		4351	441	399	413
30		4227	Bills not available		
31		7876	780	741	681
32		9659	81	879	539
33		9660	597	242	156
34		10065	300	479	359

0.7 Feeder (from HB LOWER to HB UPPER) in Table. 6.12

Table 6.12

Sl. No	Pole/ Post No	Consumer's No	Consumption details for the month of July & August 2008 (kWh)	Consumption details for the month of September & October 2008 (kWh)	Consumption details for the month of November & December 2008 (kWh)
1	HB LOWER	8588	Bill not available		
2	HB LOWER	8589	118	113	112
3	HB LOWER	4617	80	0	0
4	HB LOWER	4616	8944	3591	2936
5	HB LOWER	4614	233	409	538
6	HB LOWER	4615	3740	2531	1271
7	HB LOWER	4613	3005	2625	2638
8	HB LOWER	4618	3983	3831	3886
9	HB LOWER	4474	2544	2402	2284
10	HB LOWER	4475	69	80	67
11	HB LOWER	4476	116	86	75
12	HB LOWER	4477	484	482	387
13	HB LOWER	4478	17	17	16
14	HB LOWER	4479	69	80	67
15	HB LOWER	4480	Bill not available		
16	HB UPPER	4624	7945,7168	6606,7945	6440,6365
17	HB UPPER	4623	6640	3798	5635
18	HB UPPER	4658	1462	1259	1184
19	HB UPPER	4622	138	200	202
20	HB UPPER	4660	568	555	502
21	HB UPPER	4621	909	853	770
22	HB UPPER	4619	1500	1500	1500
23	HB UPPER	4519	1679	1369	1365
24	HB UPPER	4659	1275	967	902
25	HB UPPER	4859	645	646	618
24	HB UPPER	4620	494	320	268
25	HB UPPER	4669	854	1062	1013
26	HB UPPER	4661	102	119	97
27	HB UPPER	4625	1337	1267	1429

The above data is analyzed and compared with the actual measurement taken during signature analysis and found to be matching

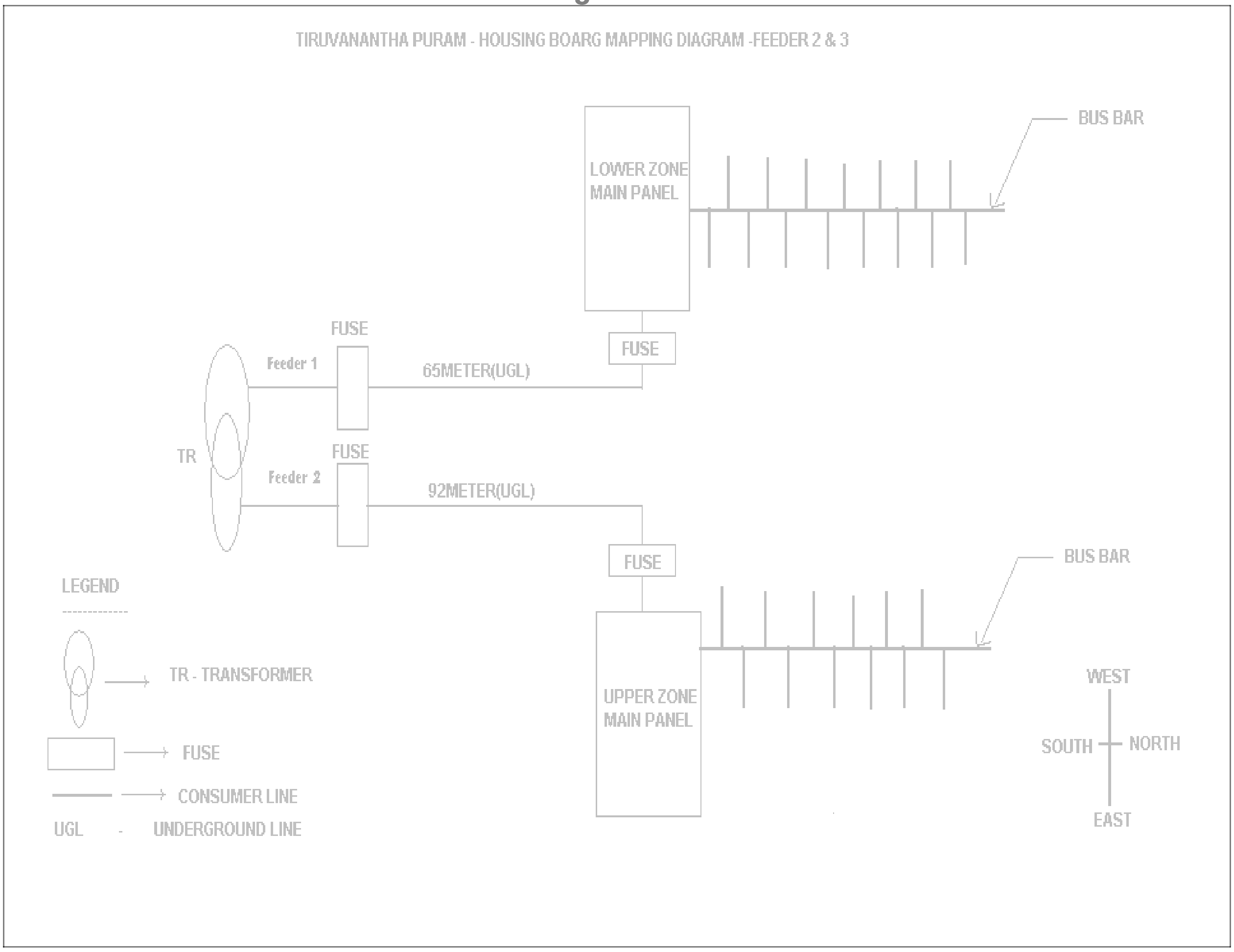
All the consumers connected from this transformer are metered in working condition at the time of the study.

No Street light is connected in this transformer.

6.6.1 Mapping

0.1 Distributor network diagram & Routing

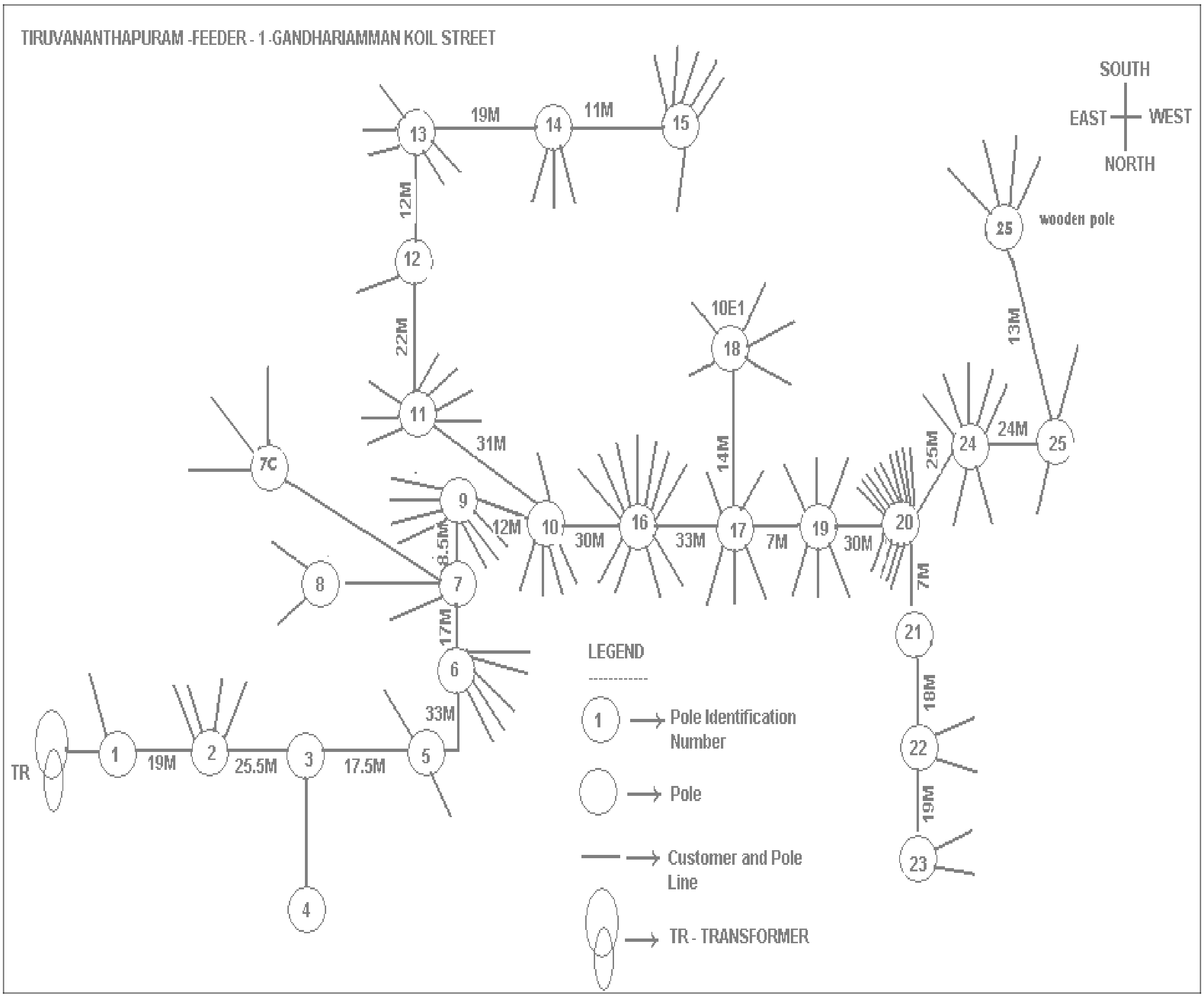
Fig.6.13



Total length of the LT Cable of the above feeder is 157 meters

0.2 Distributor network diagram & Routing

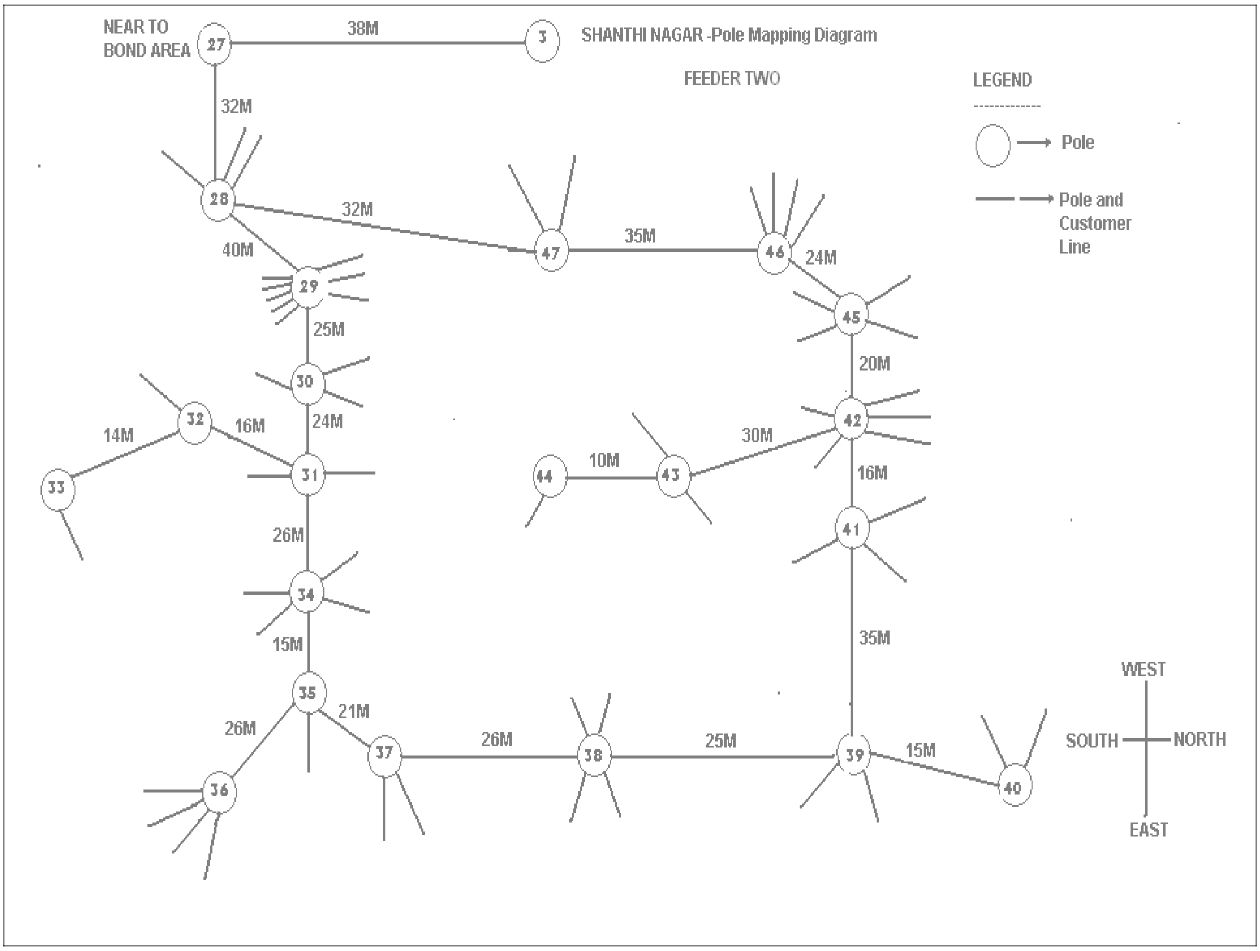
Fig. 6.14



Total length of the LT line of the above routing is 447.5 meters

0.3 Distributor network diagram & Routing

Fig. 6.15



Total length of the LT line of the above routing is 505 meters
Length of the LT line in total is 952.5 meters

0.4 OBSERVATION

There are 13 and 11 connections from pole no. 20 and 16 respectively. A cluster of houses and commercial establishments are connected from these posts. But the distance between the pole and the consumer meter is short and below 100 metres.

6.6.2 Consumer particulars

Post wise consumers connected are shown in table 6.13 to 6.19

0.1 Table 6.13 shows the Pole Nos. 01 to 10 in the map

Table 6.13

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
01	PT TDR 3A	4571	One consumer	3 phase
02	PT TDR 3B	4019		1 Phase
02	PT TDR 3B	7598	4 consumers	1 Phase
02	PT TDR 3B	2390		1 Phase
02	PT TDR 3B	8116		1 Phase
03	No Connection			
04	No Connection			
05	PT TDR 3D	TEMPLE	2 connections	1 Phase
05	PT TDR 3D	7925		3 Phase
06	KAR 10G/2	7817	5 connections	1 Phase
06	KAR 10G/2	7818		3 phase
06	KAR 10G/2	7819		1 Phase
06	KAR 10G/2	8104		1 Phase
06	KAR 10G/2	7748		1 Phase
07	KAR 10G/1A	4581		
07C	KAR 10G/1/1A	4579	4 connections	
07C	KAR 10G/1/1A	4346		1 Phase
07C	KAR 10G/1/1A	8636		1 Phase
08	KAR 10G/1B	7017	2 connections	1 Phase
08	KAR 10G/1B	7018		1 Phase
09	KAR 10G/1	7861	7 connections	3 phase
09	KAR 10G/1	7862		3 Phase
09	KAR 10G/1	7863		3 Phase
09	KAR 10G/1	4279		3 phase
09	KAR 10G/1	6075		1 Phase
09	KAR 10G/1	7242		1 Phase
09	KAR 10G/1	7080		1 Phase
10	No connection			

0.2 Table 6.14 shows the Pole Nos. 11 to 16 in the map

Table 6.14

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
11	KAR10H	2200		1 Phase
11	KAR10H	712	7 connections	DL
11	KAR10H	4304		3 Phase
11	KAR10H	7222		1 Phase
11	KAR10H	8933		1 Phase
11	KAR10H	9942		1 Phase
11	KAR10H	9941		1 PhaSE
12	KAR10I	3920	1 connection	1 Phase
13	KAR10J	7672		
13	KAR10J	2203	5 connections	DL
13	KAR10J	7772		DL
13	KAR10J	7718		1 Phase
13	KAR10J	2208		1 Phase
14	KAR10J/1	4075	3 connections	1 Phase
14	KAR10J/1	2204		1 Phase
14	KAR10J/1	3591		1 Phase
15	KAR10J/2	4470		1 Phase
15	KAR10J/2	2205	6 connections	1 Phase
15	KAR10J/2	7369		1 Phase
15	KAR10J/2	2206		1 Phase
15	KAR10J/2	4364		1 Phase
15	KAR10J/2	7731		1 Phase
16	PT KAR 10F	7103		3 phase
16	PT KAR 10F	4869	14 connections	3 Phase
16	PT KAR 10F	9868		3 phase
16	PT KAR 10F	2198		1 Phase
16	PT KAR 10F	8439		3 Phase
16	PT KAR 10F	2211		1 Phase
16	PT KAR 10F	8316		
16	PT KAR 10F	2212		1 Phase
16	PT KAR 10F	4680		1 Phase
16	PT KAR 10F	9428		1 Phase
16	PT KAR 10F	9584		3 Phase
16	PT KAR 10F	9587		1 Phase
16	PT KAR 10F	9427		3 Phase
16	PT KAR 10F	9598A		

0.3 Table 6.15 shows the Pole Nos. 17 to 24 in the map

Table 6.15

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
17	PT KAR 10E	7098	5 connections	
17	PT KAR 10E	7345		3 Phase
17	PT KAR 10E	3933		
17	PT KAR	7605		3 Phase
17	PT KAR	4333		
18	PT KAR 10E1	2196		1 Phase
18	PT KAR 10E1	4342		1 Phase
18	PT KAR 10E1	2176A		1 Phase
18	PT KAR 10E1	8622		1 Phase
18	PT KAR 10E1	7576	5 connections	1 Phase
19	PT KAR 10D	2195		1 Phase
19	PT KAR 10D	2195A		1 Phase
19	PT KAR 10D	2195B	6 connections	1Phase
19	PT KAR 10D	4487		
19	PT KAR 10D	2213		1 Phase
19	PT KAR 10D	4375		
20	PT KAR 10C	10894		
20	PT KAR 10C	2193		1 Phase
20	PT KAR 10C	2194		1 Phase
20	PT KAR 10C	5249	13 connections	
20	PT KAR 10C	7350		1 Phase
20	PT KAR 10C	4111		1 Phase
20	PT KAR 10C	4064		1 Phase
20	PT KAR 10C	1640		
20	PT KAR 10C	9770		1 Phase
20	PT KAR 10C	8657		1 Phase
20	PT KAR 10C	9558		1 Phase
20	PT KAR 10C	7078		1 Phase
20	PT KAR 10C	7779		3 Phase
21	Supporting poles			
22	Supporting poles			
23	Supporting Poles			
23				
24	PT KAR 10B	4413	5 connections	1 Phase
24	PT KAR 10B	4439		1 Phase
24	PT KAR 10B	2192		1 Phase
24	PT KAR 10B	4015		1 Phase
24	PT KAR 10B	2216		1 Phase

0.4 Table 6.16 shows the Pole Nos. 25 to 27 in the map

Table 6.16

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
25	PT KAR 10A	2188		1 Phase
25	PT KAR 10A	2186	7 connections	1 Phase
25	PT KAR 10A	2185		1 Phase
25	PT KAR 10A	TEMPLE		3 Phase
25	PT KAR 10A	10302		3 Phase
25	PT KAR 10A	10302A		1 Phase
25	PT KAR 10A	TEMPLE		3 Phase
26	NC			
27	NC			

0.5 Table 6.17 shows the Pole Nos. 28 to 36 in the map

Table 6.17

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
28	PT SN1	4355		3 Phase
28	PTSN1	10301	3 connections	1 Phase
28	PT SN1	4181		1 Phase
29	PT SN1/1	4187		1 Phase
29	PT SN1/1	4254		1 Phase
29	PT SN1/1	4184		1 Phase
29	PT SN1/1	4255	8 connections	1 Phase
29	PTSN 1/1	4256		1 Phase
29	PT SN1/1	6304		1 Phase
29	PT SN1/1	6305		1 Phase
29	PT SN1/1	4185		1 Phase
30	PT SN1/2	4218		1 Phase
30	PT SN1/2	4556	3 connections	EB Office
30	PT SN1/2	4172		3 Phase
31	PT SN1/3	4199	2 connections	1 Phase
31	PT SN1/3	4323		1 Phase
32	PT SN1/3A	4200	1 connection	1 Phase
33	PT SN1/3B	7843	1 connection	3 Phase
34	PT SN11	8836		3 Phase
34	PT SN11	Construction is going on 4 connections		
34	PTSN 11	4227		
34	PT SN 11	7876		
35	PT SN10	4205		3 Phase
36	PT SN10A	4180		1 Phase
36	PT SN10A	7624	4 connections	1 Phase
36	PT SN10A	4179		1 Phase
36	PT SN10A	4201		1 Phase

0.6 Table 6.18 shows the Pole Nos. 37 to 47 in the map

Table 6.18

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
37	PT SN9	4228	2 connections	1 Phase
37	PT SN9	4226		1 Phase
38	PT SN8	4198	4 connections	3 Phase
38	PT SN8	4175		1 Phase
38	PT SN8	4551		
38	PT SN8	8484		
39	PT SN7	4173A		
39	PT SN7	4173	2 connections	
40	PTSN7A	4168		
40	PTSN7A	4178	2 connections	
41	PT SN6	4359		1 Phase
41	PT SN6	4359	3 connections	1 Phase
41	PT SN6	4209		
42	PT SN5	4194		DL
42	PT SN5	4329	5 connections	DL
42	PT SN5	4195		1 Phase
42	PT SN5	4339		1 Phase
42	PTSN5	9310		1 Phase
43	PT SN5A	4196		1 Phase
43	PT SN5A	4349	2 connections	1 Phase
44	PT SN5B	8204		
45	PT SN4	4229		3 Phase
45	PT SN4	D/L	4 conections	3 Phase
45	PT SN4	4231		3 Phase
45	PT SN4	D/L		DL
46	PT SN3	4469		3 Phase
46	PT SN3	4193	4 connections	3 Phase
46	PT SN3	133		DL
46	PTSN 3	4177		3 Phase
47	PT SN2	4409	2 connections	1 Phase
47	PT SN2	4410		1 Phase

0.7 Table 6.19 shows the KSHB Commercial complex connection

Table 6.19

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
Feeder One	HB LOWER	8588		1 Phase
Feeder One	HB LOWER	8589		1 Phase
Feeder One	HB LOWER	4617		3 Phase
Feeder One	HB LOWER	4616		3 Phase
Feeder One	HB LOWER	4614		3 Phase
Feeder One	HB LOWER	4615		3 Phase
Feeder One	HB LOWER	4613		3 Phase
Feeder One	HB LOWER	4618	15 Connection	3 Phase
Feeder One	HB LOWER	4474		3 Phase
Feeder One	HB LOWER	4475		1 Phase
Feeder One	HB LOWER	4476		1 Phase
Feeder One	HB LOWER	4477		1 Phase
Feeder One	HB LOWER	4478		1 Phase
Feeder One	HB LOWER	4479		1 Phase
Feeder One	HB LOWER	4480		1 Phase
Feeder Two	HB UPPER	4624		3 Phase
Feeder Two	HB UPPER	4623		3 Phase
Feeder Two	HB UPPER	4658		3 Phase
Feeder Two	HB UPPER	4622		3 Phase
Feeder Two	HB UPPER	4660		3 Phase
Feeder Two	HB UPPER	4621		3 Phase
Feeder Two	HB UPPER	4619	14 Connection	3 Phase
Feeder Two	HB UPPER	4519		3 Phase
Feeder Two	HB UPPER	4659		3 Phase
Feeder Two	HB UPPER	4859		3 Phase
Feeder Two	HB UPPER	4620		3 Phase
Feeder Two	HB UPPER	4669		3 Phase
Feeder Two	HB UPPER	4661		3 Phase
Feeder Two	HB UPPER	4625		3 Phase

6.7.0 DISTRIBUTION LOSS STUDY

Signature analysis was carried out to find out the losses

Signature analysis is one of the most adaptable and reasonably accurate type of mechanism for real time energy studies in a Distribution Network. Though the readings are taken manually (in the absence or wireless remote metering), the probability of errors have been minimized by ensuring the bandwidth of timing in data collection to be as small and stable as required

6.7.1 Procedure adopted for Signature Analysis:

The transformer was switched off for half an hour. The energy meter reading at the L.T. side is noted down before switching off the transformer. Within half an hour time, the meter readings of the all consumers connected to the transformer are taken/measured. Again the transformer is switched on. This process is repeated for three days. From this figure, the consumption of the consumers is arrived at for two days. This gives the average consumption pattern of the consumer. From these data, the distribution loss is calculated and arrived at.

As the loss is the function of output energy vs. input energy and the loss percentage will remain within acceptable variation, the loss does not depend on the duration of study.

6.7.2 Table 6.20 to 6.26 shows the Unit Consumption from Signature analysis

0.1 POST (from PT TDR 3A to KAR 10G/1) in Table 6.20

Table 6.20

Sl. No	Pole/ Post No	Consumer's No	First Day Consumption (kWh)	Second Day Consumption (kWh)
1	PT TDR 3A	4571	5	10.7
2	PT TDR 3B	4019	3.7	2.1
3	PT TDR 3B	7598	4	3.6
4	PT TDR 3B	2390	9	8.4
5	PT TDR 3B	8116	0.5	0
6	PT TDR 3D	TEMPLE	DL	DL
7	PT TDR 3D	7925	0.7	0.5
8	KAR 10G/2	7817	2.4	3
9	KAR 10G/2	7818	8.2	8.4
10	KAR 10G/2	7819	6.7	1.9
11	KAR 10G/2	8104	1.5	1.5
12	KAR 10G/2	7748	8.4	8.1
13	KAR 10G/1A	4581	4	5.2
14	KAR 10G/1B	7017	6.9	6.1
15	KAR 10G/1B	7018	6.7	6.6
16	KAR 10G/1	7861	11.6	11.4
17	KAR 10G/1	7862	13.4	12.1
18	KAR 10G/1	7863	5.9	7
19	KAR 10G/1	4279	34	30.7
20	KAR 10G/1	6075	Disconnected	
21	KAR 10G/1	7242	3.7	3.2
22	KAR 10G/1	7080	0.3	0
23	KAR 10G/1/1A	4579	2.8	2.6
24	KAR 10G/1/1A	4346	4.7	2.2
25	KAR 10G/1/1A	8636	1.6	0.3
26	KAR 10G/1/1A	4306	2	12.6
		Total	**147.7**	**148.2**

0.2 POST (from PT KAR10H to KAR 10J/2) in Table 6.21

Table 6.21

Sl. No	Pole/ Post No	Consumer's No	First Day Consumption (kWh)	Second Day Consumption (kWh)
1	KAR10H	2200	7.5	7.4
2	KAR10H	712	DL	DL
3	KAR10H	No connection		
4	KAR10I	3920	4.3	5.4
5	KAR10J	7772	DL	DL
6	KAR10J	7718	3.7	3.8
7	KAR10J	2208	2.8	2.9
8	KAR10J/1	4075	0.1	0.3
9	KAR10J/1	2204	0	0
10	KAR10J/1	3591	3.9	4.5
11	KAR10J/2	4470	DL	DL
12	KAR10J/2	2205	2.3	2.8
13	KAR10J/2	7369	0	0
14	KAR10J/2	2206	0	0
15	KAR10J/2	4364	1.4	0.2
16	KAR10J/2	7731	DL	DL
17	KAR10H	7222	1.2	1.3
18	KAR10H	8933	DL	DL
19	KAR10H	9942	4	4
20	KAR10H	9941	1	1
21	KAR10J	7672	6.9	8.1
22	KAR10J	2203	DL	DL
23	KAR10H	4304	64.6	61.8
Total			**103.7**	**103.5**

0.3 POST (from PT KAR10C to KAR 10G/1) in Table 6.22

Table 6.22

Sl. No	Pole/ Post No	Consumer's No	First Day Difference (kWh)	Second Day Difference (kWh)
1	PT KAR 10C	10894	8	9
2	PT KAR 10C	2193	4	6.3
3	PT KAR 10C	2194	3	4
4	PT KAR 10C	5249	1	2.9
5	PT KAR 10C	7350	1	2.9
6	PT KAR 10C	4111	2	3.2
7	PT KAR 10C	4064	3.4	12
8	PT KAR 10C	1640	Disconnected	
9	PT KAR 10C	9770	9	7.2
10	PT KAR 10C	8657	2	3
11	PT KAR 10C	9558	5	6
12	PT KAR 10C	7078	6	5.5
13	PT KAR 10C	7779	6	7
14	PT KAR 10D	2195	5	7.1
15	PT KAR 10D	2195A	2	2.1
16	PT KAR 10D	2195B	3	5.2
17	PT KAR 10D	4487	0	0
18	PT KAR 10D	2213	2	3
19	PT KAR 10D	4375	1	1.7
20	PT KAR 10E	7098	DL	DL
21	PT KAR 10E	7345	0	1.1
22	PT KAR 10E	3933	7	7.2
23	PT KAR 10E1	2196	3	6.7
24	PT KAR 10E1	4342	3	3.5
25	PT KAR 10E1	2176A	1	1
26	PT KAR 10E1	8622	1	0.9
27	PT KAR 10E1	7576	1	5.4
	Total		**79.4**	**113.9**

0.4 POST (from PT KAR10F to KAR 10D) in Table 6.23

Table 6.23

Sl. No	Pole/ Post No	Consumer's No	First Day Difference (kWh)	Second Day Difference (kWh)
1	PT KAR 10F	7103	DL	DL
2	PT KAR 10F	4869	DL	DL
3	PT KAR 10F	9868	DL	DL
4	PT KAR 10F	2198	0.3	0.2
5	PT KAR 10F	8439	9	8.7
6	PT KAR 10F	2211	DL	DL
7	PT KAR 10F	8316	3	2.9
8	PT KAR 10F	2212	0	0
9	PT KAR 10F	4680	5	5.7
10	PT KAR 10F	9428	5.2	5.3
11	PT KAR 10F	9584	17.7	19
12	PT KAR 10F	9587	30.1	30.3
13	PT KAR 10F	9427	8	7.7
14	PT KAR 10F	9598A	DL	DL
15	PT KAR	7605	4.6	8.6
16	PT KAR	4333	4.8	5.2
17	PT KAR 10B	4413	2	1.9
18	PT KAR 10B	4439	4.5	4.3
19	PT KAR 10B	2192	0.5	0.4
20	PT KAR 10B	4015	7	6.8
21	PT KAR 10B	2216	2.5	2.3
22	PT KAR 10B		DL	DL
23	PT KAR 10A		5	4.8
24	PT KAR 10A	2188	DL	DL
25	PT KAR 10A	No connection		
26	PT KAR 10A	2186	9.1	10.9
27	PT KAR 10A	2185	3.2	DL
28	PT KAR 10A	TEMPLE	DL	0
29	PT KAR 10D	TEMPLE	DL	0
30	PT KAR 10A	10302	34.2	43.2
31	PT KAR 10A	10302A	7.3	8.4
	Total		**163**	**176.6**

0.5 POST (from PTSN1 to SN7) in Table 6.24

Table 6.24

Sl. No	Pole/ Post No	Consumer's No	First Day Difference (kWh)	Second Day Difference (kWh)
1	PT SN1	4355	5	7
2	PT SN2	4410	DL	DL
3	PT SN2	4409	DL	DL
4	PT SN3	4469	3.3	5.1
5	PT SN3	4193	6.3	7.4
7	PT SN4	4229	2.2	1.8
8	PT SN4	133	1.3	1.8
9	PT SN4	4231	3.4	4.3
11	PT SN5	4194	4.7	5.2
12	PT SN5	4329	10.3	8.7
13	PT SN5	4195	2.2	1.9
14	PT SN5	4339	9	8.8
15	PT SN5	9310	3	2.4
16	PT SN6	4359	6	4.7
17	PT SN6	4209	6.2	4.9
18	PT SN5A	4196	5.1	6
19	PT SN5A	4349	7.2	7.2
20	PT SN5B	8204	75	84
21	PT SN7	4173A	7.3	5.9
22	PT SN7	4173	0.7	0
23	PT SN7	4168	9.7	9.3
24	PT SN7	4178	8.7	6.9
25	PTSN 3	4177	1	1
26	PTSN1	10301	0.6	0.7
27		4254	2.1	2.1
28		4255	DL	DL
29		4256	7.5	6.8
	Total		**188**	**193.9**

0.6 POST (from PT SN8 to SN1) in Table 6.25

Table 6.25

Sl. No	Pole/ Post No	Consumer's No	First Day Difference (kWh)	Second Day Difference (kWh)
1	PT SN8	4198	0.6	1
2	PT SN8	4175	6.2	6.5
3	PT SN8	9409	4.7	5
4	PT SN9	4228	DL	DL
5	PT SN9	4226	9.3	10
6	PT SN10	4205	15.7	16.7
7	PT SN10A	4180	5.8	5.9
8	PT SN10A	7624	6.7	6.8
9	PT SN10A	4179	0.8	0.8
10	PT SN10A	4201	30.5	29.8
11	PT SN11	8836	6.6	5.7
13	PT SN1/3	4199	3.6	4
14	PT SN1/3	4323	2.8	2.9
15	PT SN1/3A	4200	3.3	3.8
16	PT SN1/3B	7843	2.4	2.1
17	PT SN1/2	4218	11.2	11.3
18	PT SN1/2	4556	1.4	1.5
19	PT SN1/2	4172	10.5	10.3
20	PT SN1/1	4187	4.4	5
21	PT SN1/1	6304	13.6	13.3
22	PT SN1/1	4184	11.5	12.3
23	PT SN1/1	6305	6.5	6.7
24	PT SN1/1	4185	10.7	10.2
25	PT SN1	4181	5	5
26		8484	0.9	1
27		4351	6	6
28		4227	0.8	0.8
29		7876	DL	DL
30		9659	7.5	7.8
31		9660	6.2	5.9
32		10065	11.6	11.3
	Total		**206.8**	**209.4**

0.7 POST (from HBLOWER to HBUPPER) in Table 6.26

Table 6.26

Sl. No	Pole/ Post No	Consumer's No	First Day Difference (kWh)	Second Day Difference (kWh)
1	HB LOWER	8588	1.1	1.1
2	HB LOWER	8589	2.1	1.5
3	HB LOWER	4617	0	0
4	HB LOWER	4616	55	65.7
5	HB LOWER	4614	10	11
6	HB LOWER	4615	16	15
7	HB LOWER	4613	61	66.7
8	HB LOWER	4618	125	135
9	HB LOWER	4474	44.5	46.3
10	HB LOWER	4475	1	0.9
11	HB LOWER	4476	0.9	1.4
12	HB LOWER	4477	8.3	9.4
13	HB LOWER	4478	0.2	0.3
14	HB LOWER	4479	3.7	4.7
15	HB LOWER	4480	0.2	0
16	HB UPPER	4624	317	325
17	HB UPPER	4623	119.9	117.2
18	HB UPPER	4658	25.1	25.5
19	HB UPPER	4622	2.1	2.4
20	HB UPPER	4660	5.2	7.2
21	HB UPPER	4621	13.7	16.7
22	HB UPPER	4619	0	0
23	HB UPPER	4519	29.9	37.5
24	HB UPPER	4659	17.5	19.3
25	HB UPPER	4859	9.9	7.8
24	HB UPPER	4620	1.9	5.5
25	HB UPPER	4669	16	17
26	HB UPPER	4661	0.1	0.1
27	HB UPPER	4625	31.9	30.3
	Total		**919.2**	**970.5**

6.7.3 Table 6.27 gives the total consumption obtained from the LT side of transformer as well as that taken by signature analysis

Table 6.27

ENERGYMETER	First Day Consumption (kWh)	Second Day Consumption (kWh)
Transformer energy meter	1888	2008
Consumer Meter	1807	1916

6.7.4 Secondary Distribution Loss is shown in fig 6.28

Table 6.28

Description	Energy Consumption for two days in kWh
From Consumer's Energy Meter	3723
From Energy Meter at Transformer LT side	3896
Difference in Units / Energy Loss	173
% Energy Loss in distribution line	4.4%
% energy loss of the feeding transformer	1.9%
Total secondary distribution loss	6.3%

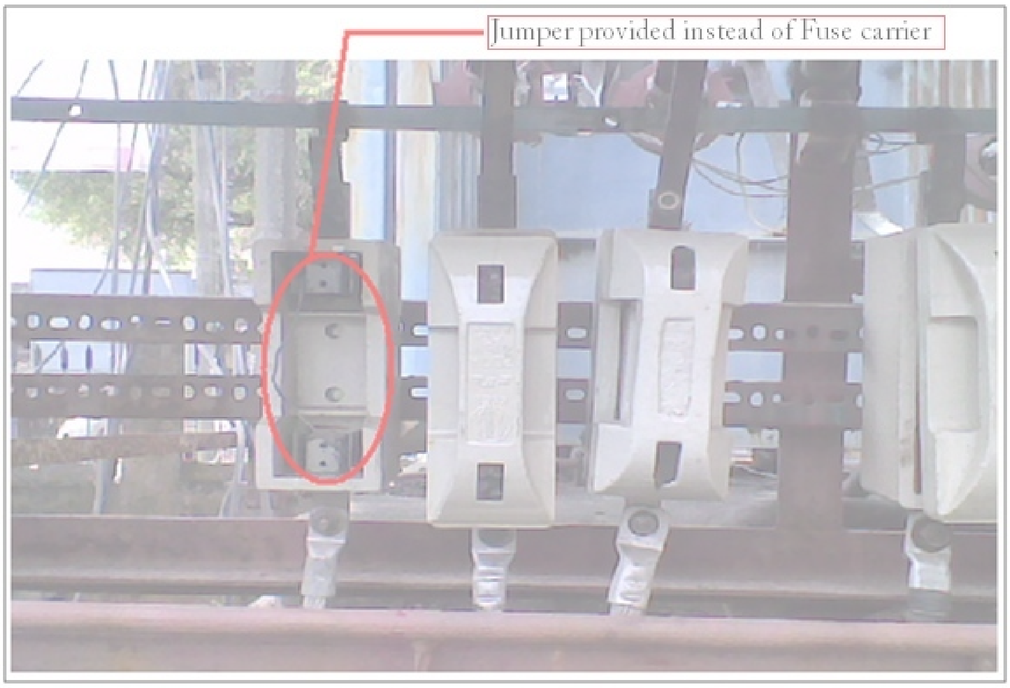
6.8.0 PICTURES OF THIRUVANANTHAPURAM SITE SECONDARY DISTRIBUTION FUSE PANEL AND CABLE TERMINATION

6.8.1 Fig 6.16 shows the front view of the distribution fuse panel

Fig. 6.16

6.8.2 Fig. 6.17 shows the jumper provided instead of fuse carrier

Fig.6.17



6.8.3 Fig 6.18 shows the LT outgoing terminal at transformer terminal

Fig. 6.18

6.8.4 Fig 6.19 shows the neutral connection taken outside the DB with joint by bolt & nut

Fig. 6.19

6.8.5 Fig.6.20 shows the fuse carrier not fitted properly

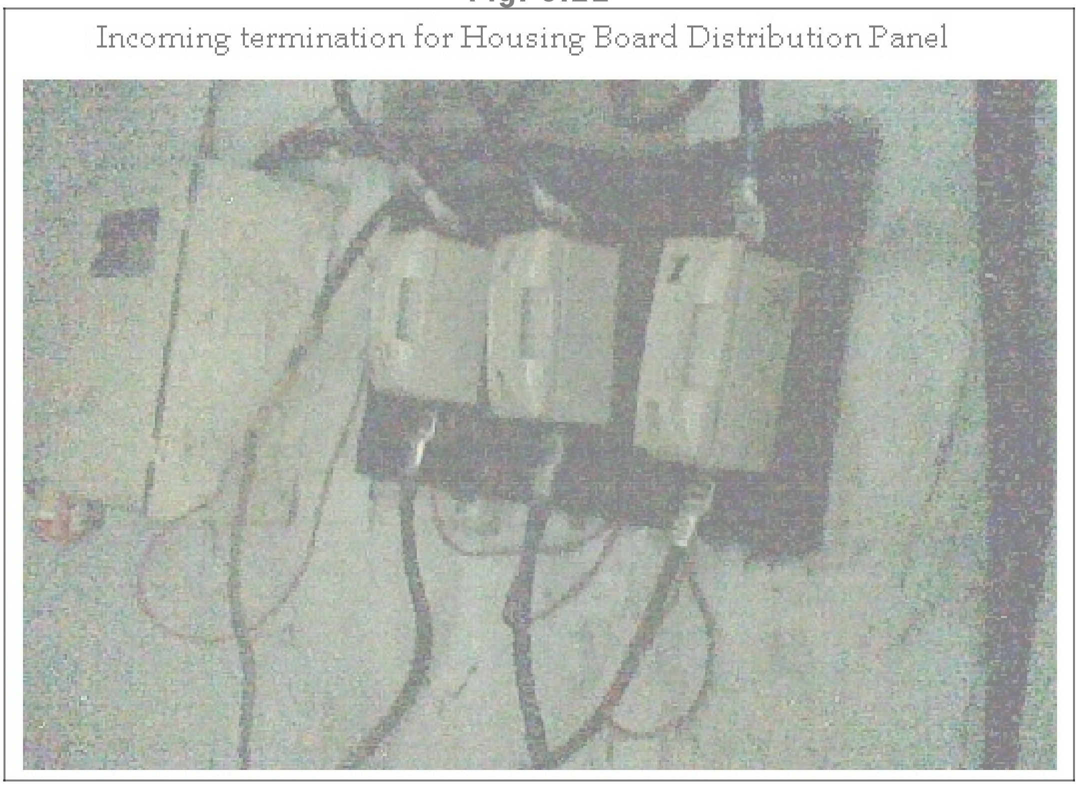
Fig. 6.20

6.8.6 Fig.6.21 shows the termination with overhead lines

Fig. 6.21

6.8.7 Fig.6.22 shows the incoming termination for Housing Board distribution panel.

Fig. 6.22



6.8.8 OBSERVATION

From the above pictures it may be noted that

- The Distribution Panel is not closed.
- The Fuse carriers found to be removed and jumpers provided in place of fuse wires
- The cables are not dressed properly

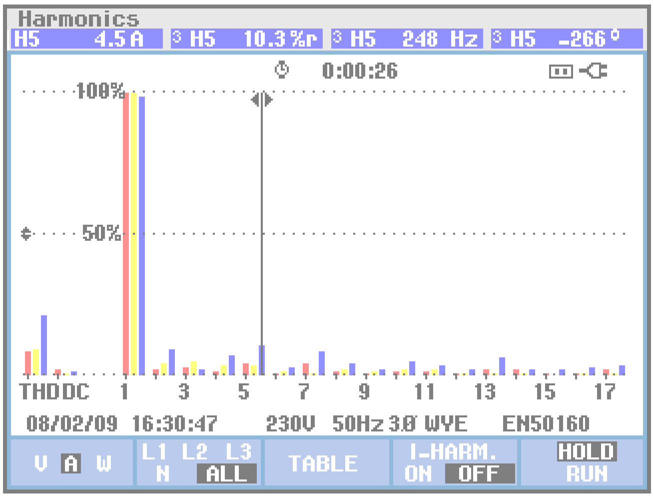
6.8.9 SUGGESTION

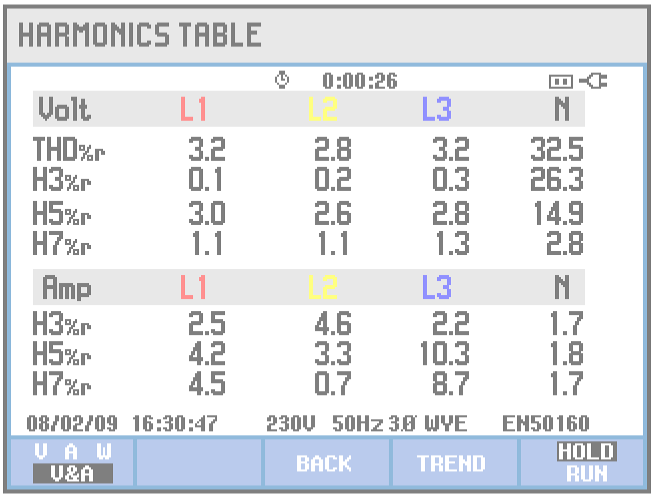
- Secondary Distribution Fuse Panel can be replaced with panel with MCB as followed by other Electricity Boards. Till such time Doors can be fitted.
- Dummy Carriers to be provided where connections are not taken
- The cables are to be dressed.
- Distribution panel is to be earthed.

6.9.0 HARMONICS MEASUREMENT

6.9.1 Fig. 6.23 shows the % value and the intensity of 5th Harmonics current

Fig. 6.23




HARMONICS TABLE

0:00:26

Volt	L1	L2	L3	N
THD%r	3.2	2.8	3.2	32.5
H3%r	0.1	0.2	0.3	26.3
H5%r	3.0	2.6	2.8	14.9
H7%r	1.1	1.1	1.3	2.8

Amp	L1	L2	L3	N
H3%r	2.5	4.6	2.2	1.7
H5%r	4.2	3.3	10.3	1.8
H7%r	4.5	0.7	8.7	1.7

08/02/09 16:30:47 230V 50Hz 3Ø WYE EN50160

V A W V&A | BACK | TREND | HOLD RUN

Fig. 6.24

9.2 Fig. 6.24 shows the % value of voltage and current harmonics

As per IEEE-519 – 1996 The THD for voltage at the connection point shall not exceed 5% with no individual Harmonics higher than 3%.
The THD for current drawn from the transmission system at the connection point shall not exceed 8%.

6.9.3 OBSERVATION

The THD (Total Harmonic Distortion) level is within limit.

Only in Blue Phase current the 5th harmonic is around 10% but the intensity is very low. Hence this will not pose any power quality problem, as such.

Section 7

THIRUVALLA SITE

7.1.0 SITE DESCRIPTION

7.1.1 There is a 250 kVA Transformer located near Thirumoolapuram Junction, Thiruvalla. There are four outgoing secondary feeders from the transformer. One of the feeders is fed to the domestic consumers toward the Mag Fast Road through the overhead line. The second feeder is fed to Iruvillipuram Road through over head line. Remaining two feeders are fed towards the Chenganur Road side and Thiruvalla road side respectively. The street lights are also connected to all the feeders. Details of the street lights are given in the appropriate Pole maps. Pole to pole and pole to consumer distance are measured and drawn in the pole mapping, which is shown in Figure 7.14 to 7.22. The exact energy consumption is arrived from the Signature Analysis and given in Table 7.15 to 7.32. The data logger was put for 15 days and the data were analysed and the load trend is given for a week day and a Sunday in Figure 7.1 to 7.10

7.1.2. HT supply fed from 66/11KV SS, Pathanamthitta Road, Manjadi, which is around 4KM away from the Transformer. Standby feeder is Thiruvalla Feeder.

7.1.3 Specifications of the ACSR conductor used

Table 7.1

Used for	Code Name	No. of Strands and Dia				Diameter of complete conductor mm	Gross area of Al. Sq.mm	Resistance at 20^0C Ohms/Km	Current rating for Tem. Raise 40^0C above ambient
		Aluminium		Steel					
		No.	Dia mm	No.	Dia mm				
HT1 1KV	Racoon	6	4.09	1	4.09	12.27	77.83	0.3656	197A
LT 433V	Rabbit	6	3.35	1	3.35	10.05	52.95	0.54	148

To connect the LT bushing and the distribution fuse panel, 2 runs of 50sqmm single core copper cable is used for each phase and neutral.

7.1.4 Location of the Transformer: - Thirumoolapuram. Opposite to SNVS High School

KSEB Office under which purview the Transformer Comes: - Thiruvalla

Place / Locality / Village fed by the Transformer: - Thirumoolapuram Area

7.1.5 Transformer Name Plate details

Table 7.2

MAKE	**ELTRA, BANGALORE**				
TYPE	DY 11				
SERIAL NO	ET 3968	**Manufacturing Date**		1979	
RATING	250	kVA	**PHASE**	3	
HIGH VOLTAGE	11000	VOLTS	**FREQUENCY**	50	HZ
LOW VOLTAGE	433	VOLTS	**% IMPEDENCE @ 75**	4.32	OHMS
CURRENT AT HV	13.12	A	**TEMPERATURE RISE LIMIT**	45	DEGREE CELCIUS
CURRENT AT LV	333.3	A	**COOLING TYPE**	ONAN	
CONNECTIVITY			**OIL IN LITRES**	280	
WEIGHT OF OIL IN KG	250	KG	**WEIGHT OF CORE IN KG**	500 KG	
TOTAL WEIGHT IN KG	1030	KG			

Short circuit current level of the transformer
= {(100/4.32) x 250000} / 433 X 1.732
= 7716 A

7.1.6 HT side Measurement

As there was no metering arrangement on HT side, the HT voltage level was verified at the feeding substation. As per the records maintained by KSEB Voltage is maintained always at 11kV by adjusting OLTC (On Load Tap Changer) at 66kV Side Manually.

7.1.7 HT/LT Ratio

H.T /L.T ratio is the total distance of HT line to the total Distance of L.T lines in an Electrical utility. Unless study of the network connected to the whole major substation (220kv& below) is carried out, HT/LT ratio cannot be arrived at, as the HT line is feeding many other transformers.

7.2.0

Data loggers were provided at the secondary side of the transformer and the parameters were down loaded from 7/2/09 to 22/2/09.

7.2.1 Logged Data for a weekday

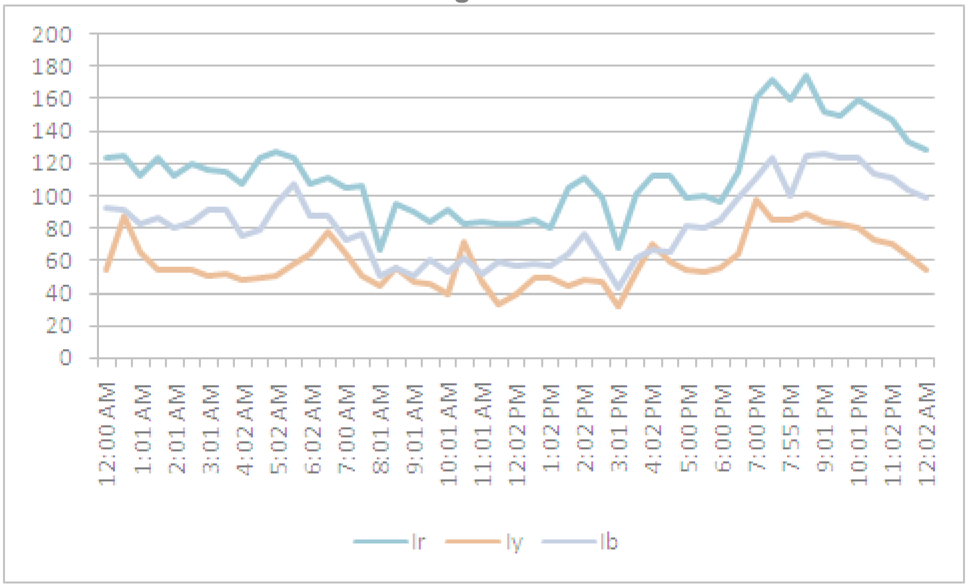
Table 7.3

Record Time	Vr	Vy	Vb	Ir	Iy	Ib	kWr	kWy	kWb	kVAr	kVAy	kVAb	kWt	kVAt	PFt
12:00 AM	234	238	235	120	51	86	24	11	18	26	11	19	53	56	0.95
12:29 AM	234	239	236	119	49	84	23	10	17	26	11	19	50	54	0.93
1:00 AM	235	241	237	115	48	81	23	10	17	26	11	18	50	54	0.93
1:29 AM	236	241	239	109	52	74	22	11	15	24	12	17	48	52	0.92
2:01 AM	238	243	241	108	47	74	22	10	16	24	11	17	48	52	0.92
2:29 AM	239	243	241	107	46	76	22	10	16	24	10	17	48	52	0.92
3:01 AM	239	243	241	116	50	81	24	10	17	26	11	18	51	55	0.93
3:30 AM	239	243	241	113	47	85	23	10	18	25	11	19	51	56	0.91
4:01 AM	239	243	241	111	48	84	22	10	17	25	11	19	49	54	0.91
4:30 AM	237	243	241	111	54	78	22	11	16	25	12	18	49	54	0.91
5:02 AM	237	241	238	113	50	96	23	11	20	25	11	21	54	58	0.93
5:30 AM	236	240	238	121	54	95	25	11	19	27	12	21	55	60	0.92
6:02 AM	236	239	236	104	59	107	21	12	22	23	13	24	55	60	0.92
6:31 AM	233	238	236	113	55	86	23	12	18	25	12	19	53	57	0.93
7:02 AM	234	236	235	84	54	68	17	11	14	18	12	15	42	45	0.93
7:31 AM	236	239	238	71	49	58	14	10	11	16	11	13	35	39	0.9
8:00 AM	236	239	238	81	38	65	16	7	14	18	9	15	37	40	0.93
8:31 AM	235	236	236	83	50	74	17	9	15	18	11	16	41	45	0.91
9:00 AM	235	236	236	83	65	66	16	13	14	18	14	15	43	48	0.9
9:29 AM	227	230	229	80	54	60	14	10	11	17	12	13	35	40	0.88
10:00 AM	230	231	231	82	67	74	15	12	14	18	14	16	41	47	0.87
10:29 AM	230	231	231	34	31	15	6	6	3	7	7	3	15	17	0.88
11:01 AM	232	234	232	46	18	29	8	3	6	10	4	6	17	19	0.89
11:32 AM	226	228	227	42	21	24	7	4	4	9	4	5	15	17	0.88
12:01 PM	227	231	226	87	65	130	16	11	25	18	14	28	52	60	0.87
12:30 PM	226	228	226	94	63	110	17	11	21	20	13	24	49	56	0.88
1:01 PM	227	231	228	101	62	95	19	12	19	21	13	20	50	55	0.91
1:30 PM	229	233	229	111	62	123	21	11	25	24	13	27	57	63	0.9
2:02 PM	230	233	231	112	64	93	22	12	18	24	14	20	52	58	0.9
2:30 PM	224	229	226	114	51	87	22	9	17	24	11	19	48	53	0.91
3:02 PM	224	228	226	110	60	103	21	11	20	23	13	22	52	58	0.9
3:31 PM	224	225	223	107	67	97	20	13	18	22	14	20	51	57	0.89
4:02 PM	222	225	223	124	63	102	24	11	19	26	13	22	54	60	0.9
4:31 PM	222	225	224	118	63	87	22	12	16	25	13	18	50	56	0.89
5:00 PM	224	228	227	120	62	81	22	12	15	25	13	17	49	55	0.89
5:31 PM	232	236	232	110	58	104	22	12	21	24	13	23	55	60	0.92
6:00 PM	232	234	232	105	63	93	20	13	19	23	14	20	52	56	0.93
6:32 PM	233	236	233	120	105	103	24	22	21	26	23	23	67	71	0.94
7:00 PM	222	226	224	163	92	122	33	19	24	34	19	26	76	79	0.96
7:32 PM	222	225	224	155	91	117	31	19	24	32	19	25	74	77	0.96
8:01 PM	225	228	226	152	85	121	31	17	25	32	18	26	73	76	0.96
8:24 PM	227	231	229	158	77	108	32	16	22	34	17	23	70	73	0.96
9:02 PM	224	228	226	167	87	142	33	18	28	35	19	31	79	83	0.95
9:30 PM	220	223	219	163	84	132	32	17	26	34	17	27	75	78	0.96
10:02 PM	219	223	222	150	81	120	29	16	24	31	17	25	69	73	0.94
10:31 PM	222	228	226	145	71	110	28	14	22	30	15	24	64	68	0.94
11:00 PM	227	234	231	157	65	108	31	13	22	34	14	24	66	71	0.93
11:31 PM	232	239	233	137	54	102	27	11	21	30	12	23	59	63	0.94
12:00 AM	230	236	231	116	51	106	23	10	22	25	11	23	55	59	0.93

7.2.2 Load Curve for a week day

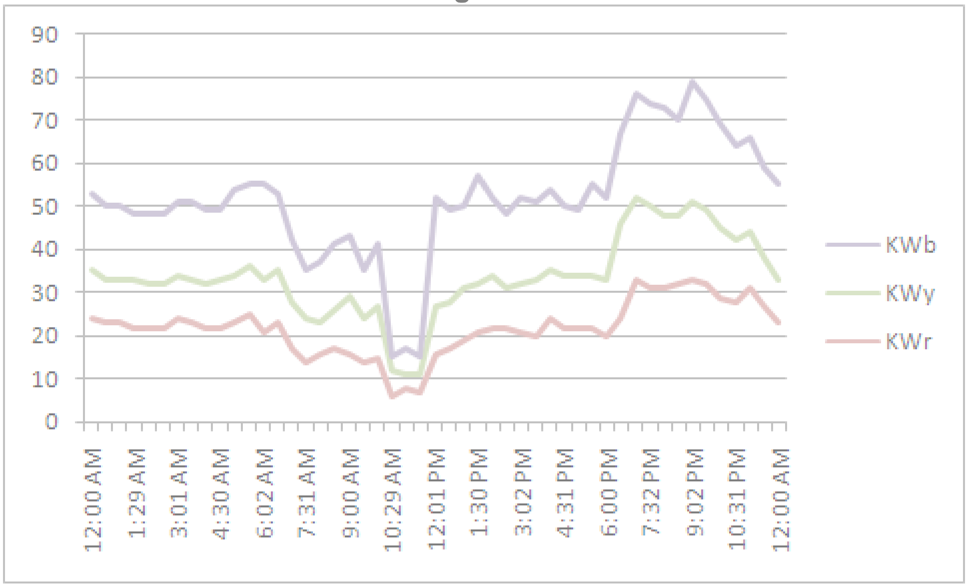
0.1 Fig. 7.1 Shows the Current Trend in each phase on a week day

Fig. 7.1



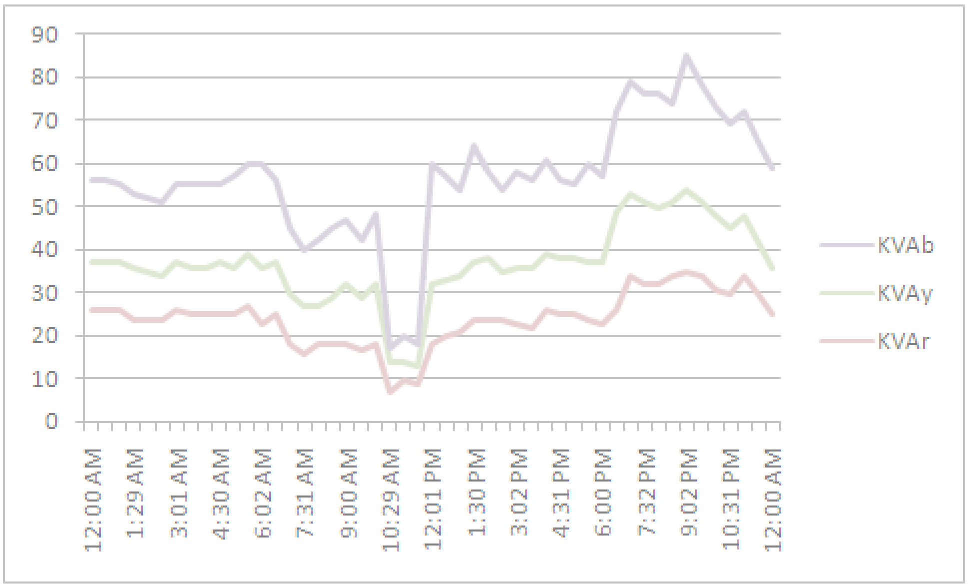
0.2 Fig. 7.2 shows the Power Trend in each phase on a week day

Fig. 7.2



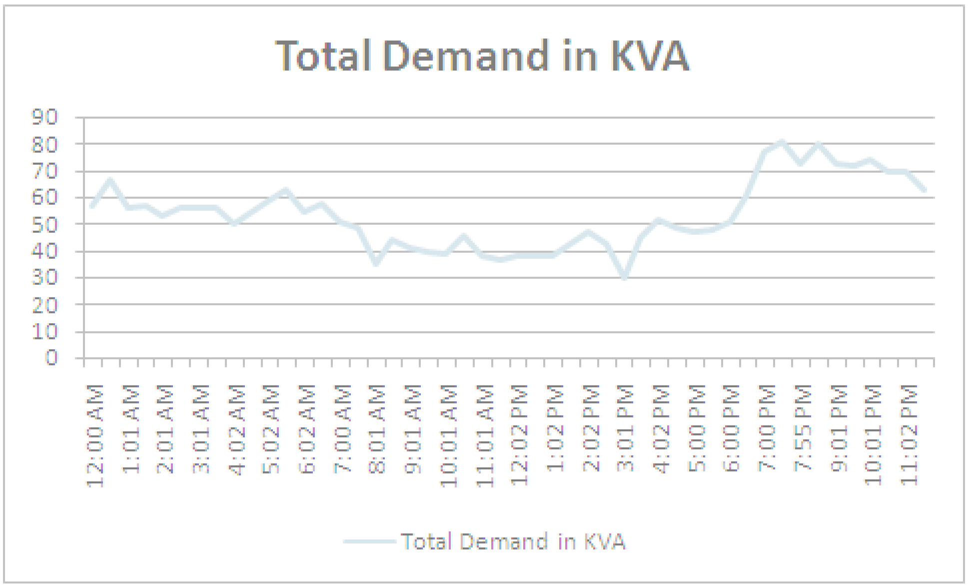
0.3 Fig. 7.3 shows the Demand Trend in each phase on a week day

Fib. 7.3



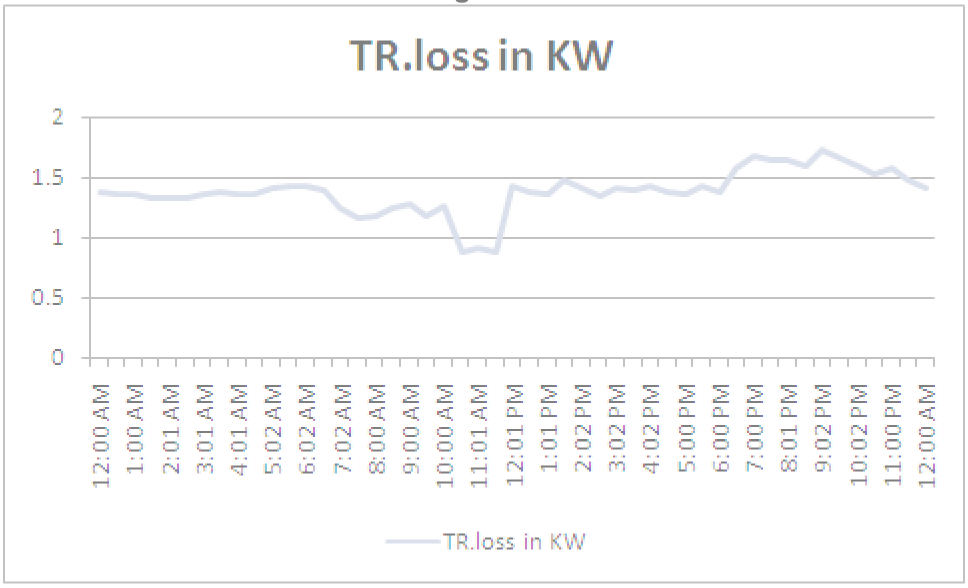
0.4 Fig. 7.4 shows the total Demand Trend on a week day

Fig. 7.4



0.5 Fig. 7.5 shows the Transformer loss Trend on a week day

Fig. 7.5



Power factor varies from 0.9 lag to Unity

Demand varies from 7% to 33%

7.2.3 Logged data on a Sunday

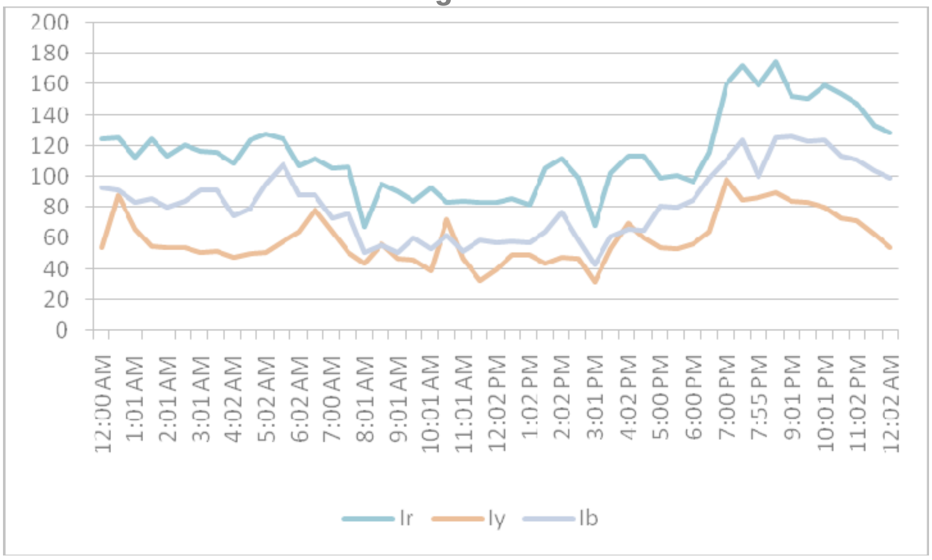
Table 7.4

Record Time	Vr	Vy	Vb	Ir	Iy	Ib	kWr	kWy	kWb	kVAr	kVAy	kVAb	kWt	kVAt	PFt
12:00 AM	229	233	231	124	54	93	24	11	18	27	12	20	53	57	0.93
12:29 AM	230	234	232	125	88	91	25	17	18	27	19	20	60	67	0.90
1:01 AM	227	233	231	112	66	83	22	13	17	24	14	18	52	56	0.93
1:32 AM	229	234	231	124	55	86	24	11	17	27	12	19	52	57	0.91
2:01 AM	232	236	233	113	54	80	22	11	16	25	12	18	49	53	0.93
2:30 AM	230	236	233	120	54	84	23	11	17	26	12	19	51	56	0.91
3:01 AM	232	236	233	116	51	91	23	10	19	25	11	20	52	56	0.93
3:30 AM	232	236	233	115	52	91	23	10	18	25	11	20	51	56	0.91
4:02 AM	232	238	235	108	48	75	21	10	15	23	11	17	46	50	0.92
4:30 AM	231	238	233	123	50	79	24	10	16	27	11	17	50	55	0.91
5:02 AM	230	236	232	127	51	95	25	10	19	27	11	21	54	59	0.92
5:31 AM	229	234	229	124	58	108	24	12	22	27	13	24	58	63	0.92
6:02 AM	224	228	226	107	64	88	21	13	17	23	14	19	51	55	0.93
6:31 AM	224	228	226	111	78	88	22	15	17	23	17	19	54	58	0.93
7:00 AM	224	228	229	105	64	73	21	12	14	22	14	16	47	51	0.92
7:31 AM	224	231	229	106	51	76	20	10	16	22	11	16	46	49	0.94
8:01 AM	229	233	232	67	44	51	14	8	11	14	9	11	33	35	0.94
8:32 AM	226	231	230	95	56	56	18	10	10	20	12	12	38	44	0.86
9:01 AM	227	233	231	90	47	51	18	9	10	19	10	11	37	41	0.90
9:32 AM	226	230	229	84	46	60	16	8	12	18	10	13	36	40	0.90
10:01 AM	227	232	231	92	39	53	18	7	10	20	8	11	35	39	0.90
10:30 AM	228	231	231	83	72	62	15	14	12	18	16	13	41	46	0.89
11:01 AM	227	231	231	84	47	52	15	8	10	18	10	11	33	38	0.87
11:30 AM	227	233	229	83	33	59	15	7	11	18	7	13	33	37	0.89
12:02 PM	222	226	223	83	40	57	15	8	10	17	9	12	33	38	0.87
12:30 PM	217	219	216	85	49	58	15	9	10	17	10	12	34	38	0.89
1:02 PM	217	221	220	81	49	57	15	9	11	16	10	12	35	38	0.92
1:31 PM	215	221	219	105	44	64	20	8	12	21	9	13	40	43	0.93
2:02 PM	214	221	217	111	48	77	21	9	14	22	10	16	44	47	0.94
2:37 PM	225	231	229	99	47	59	20	9	12	21	10	13	41	43	0.95
3:01 PM	227	231	229	68	32	43	14	7	9	14	7	9	30	30	1.00
3:31 PM	222	228	226	102	53	61	19	10	12	21	11	13	41	45	0.91
4:02 PM	222	226	224	113	70	66	22	14	12	24	15	14	48	52	0.92
4:31 PM	220	225	224	113	60	65	21	12	12	23	13	14	45	49	0.92
5:00 PM	222	226	224	99	54	81	18	10	15	20	11	17	43	47	0.92
5:31 PM	222	228	224	100	53	80	18	10	16	21	11	17	44	48	0.92
6:00 PM	227	231	228	96	56	85	18	12	17	21	12	18	47	51	0.92
6:32 PM	229	234	232	115	64	99	23	14	20	25	14	22	57	61	0.93
7:00 PM	219	223	222	160	98	111	31	20	22	33	21	23	73	77	0.95
7:32 PM	224	231	226	172	85	124	34	18	25	37	18	26	77	81	0.95
7:55 PM	223	228	229	159	86	100	31	18	21	33	18	22	70	73	0.96
8:32 PM	217	223	222	173	94	136	33	19	27	35	20	29	79	84	0.94
9:01 PM	216	221	216	152	84	126	29	17	24	31	17	26	70	73	0.96
9:30 PM	213	217	214	150	83	123	29	16	24	30	17	25	69	72	0.96
10:01 PM	214	219	216	159	80	124	30	16	24	32	17	25	70	74	0.95
10:30 PM	217	223	222	153	73	113	30	14	22	31	15	24	66	70	0.94
11:02 PM	222	228	226	147	71	111	29	14	22	31	15	24	65	70	0.93
11:30 PM	224	231	227	133	63	104	26	13	20	28	13	22	59	63	0.94

7.2.4 Load Curve on a Sunday

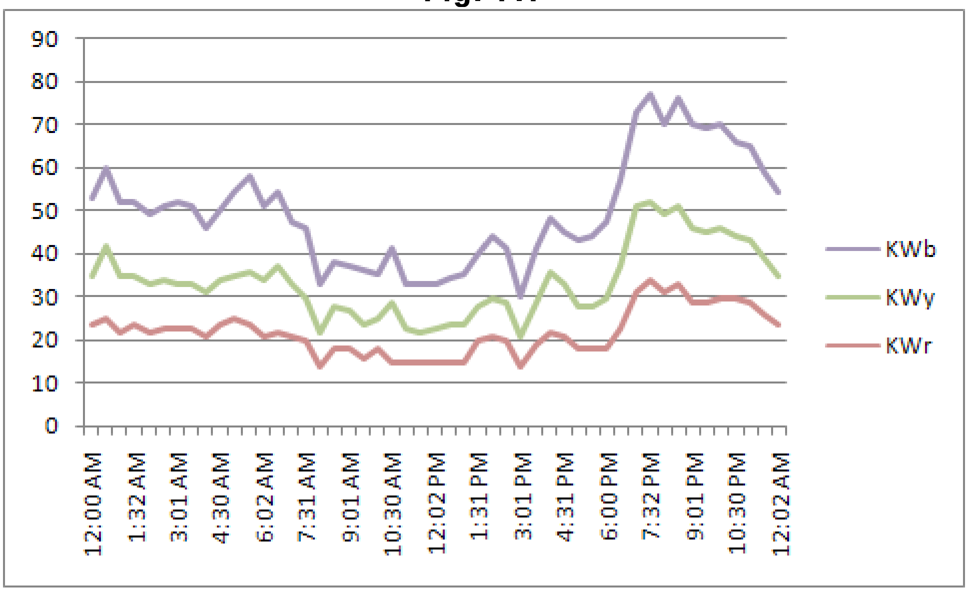
0.1 Fig. 7.6 shows the Current Trend in each phase on a Sunday

Fig. 7.6



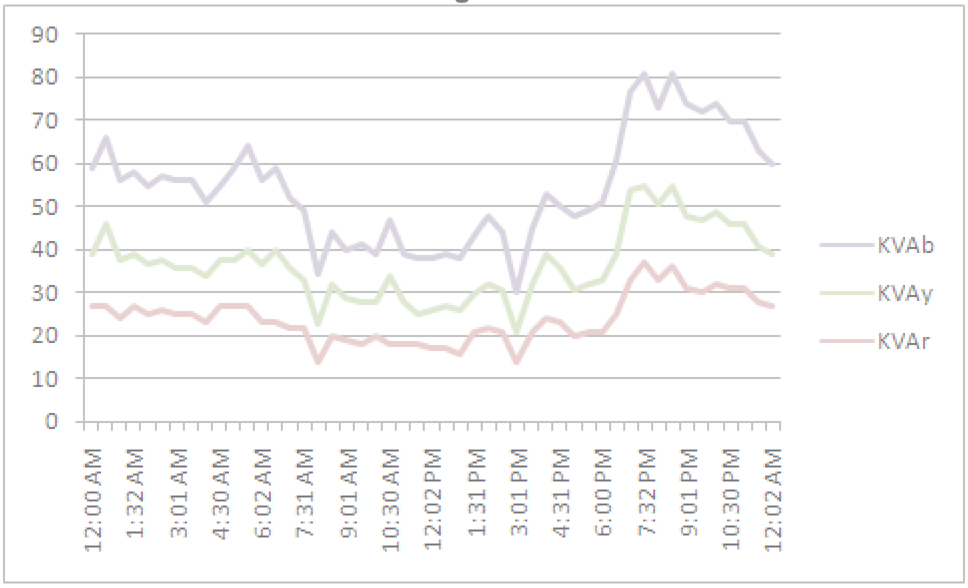
0.2 Fig. 7.7 shows the Power Trend in each phase on a Sunday

Fig. 7.7



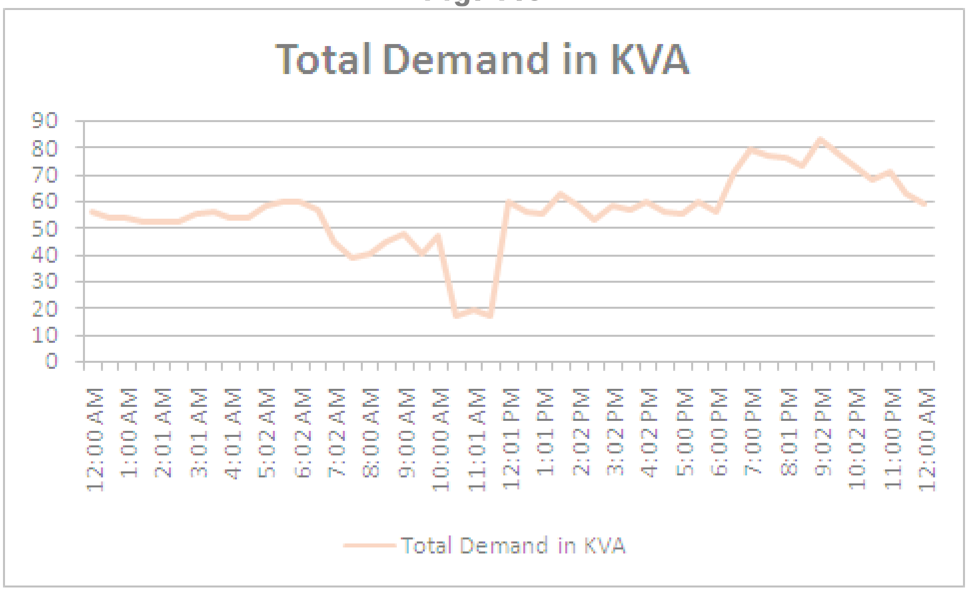
0.3 Fig. 7.8 shows the Demand Trend in each phase on a Sunday

Fig. 7.8



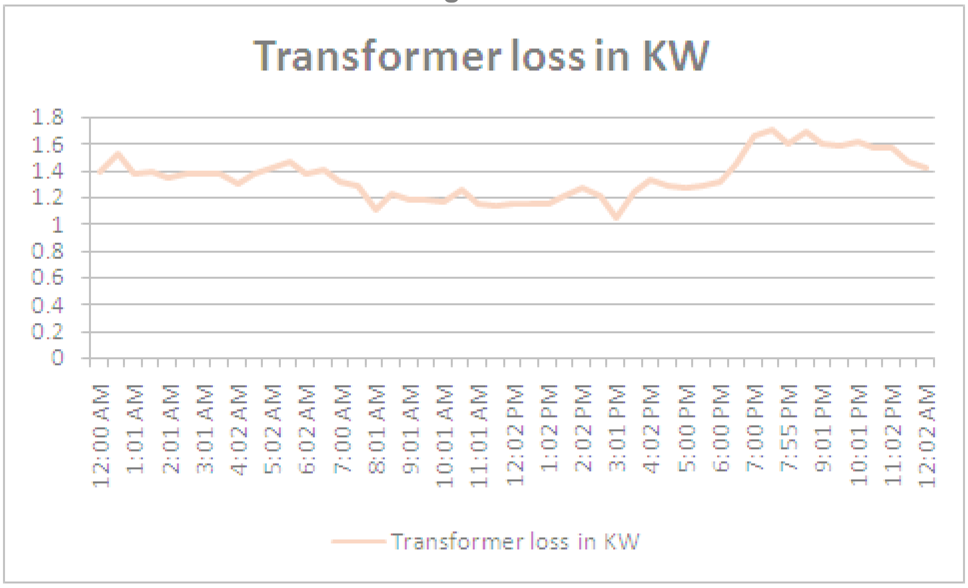
0.4 Fig. 7.9 shows the total Demand Trend on a Sunday

Fig. 7.9



0.5 Fig. 7.10 shows the Transformer loss Trend on a Sunday

Fig. 7.10



Demand varies from 12% to 32%
Power factor varies from 0.86 lag to Unity

7.2.5 Load Ratio of the Transformer

=Transformer Loading x 24Hrs /Capacity of the Transformer x 24Hrs
= (55 x 6.5) + (43 x 3.5) + (18 x 1.5) + (57 x 6.5) + (74 x 6)/250 x 24
= 1349.5/6000 = 0.22 = 22%

7.2.6 Transformer Loss

As per the Specification No load loss is 650W and Load loss is 3250W
Transformer loss = 19.38kWh/day

7.2.7 Suggestion

It is suggested to fix an energy meter at the HT side of the Transformer to ascertain the exact transformer losses.

7.2.8 Observation

- Maximum load on the transformer is not more than 33% on Sundays as well as week days.
- Minimum load on transformer is 20% on Sundays and 28% on week days.
- During peak hours max load on Sunday is 33% and 33% on week days and minimum load is 20% on Sunday and 28% on week days.

- During normal hours max load on Sunday is 23% and 25% on week days and minimum load is 12% on Sunday and 7%on week days
- During off peak hours/night max load on Sunday is 28% and 25% on week days and minimum load is 20% on Sunday and 21% on week days
- The Transformer is around 30 years old (Manufactured in 1979)
- Un- balance load between Phases, R Phase Load is higher when compared to other two phases.
- Y Phase load is around 52% of R Phase load.
- B Phase load is around 70% of R Phase load.
- Y Phase having very less load only during Peak Hrs (i.e.) half of the R Ph. Load.
- Neutral current is around 45A.
- Voltage un-balance 3 to 4% between phases.
- Voltage at Y Phase is around 238V. During peak hours in evening it is around 222V.
- This is due to low load on that phase during normal hours.

7.2.9 Suggestion

The Transformer can be replaced with 160kVA star labeled transformer with High Energy Efficiency.

Saving due to implementation =

No load loss of 160KVA Transformer as per specification is 460W

= {(650 – 460) x 24 x 365}/1000 =

= 1644kWh/annum

7.2.10 Analysis for un-balance load

From the data it is clear that throughout the day unbalance load is there. While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase in number of consumers and the increase of load of the existing consumers might have created the unbalance.

7.2.11 Suggestion

It is suggested to fix an Ammeter at the LT Distribution fuse panel to monitor the LT current of the transformer.

7.2.12 Suggestion

Load to be balanced at the pole side

Some of the R Phase loads can be shifted to Y Phase.

This will reduce the un- balance current and the neutral current.

7.3.0 TEMPERATURE MEASUREMENT

Taken at full load

Atmosphere temperature is 35^0C

At Transformer Termination is 38^0C

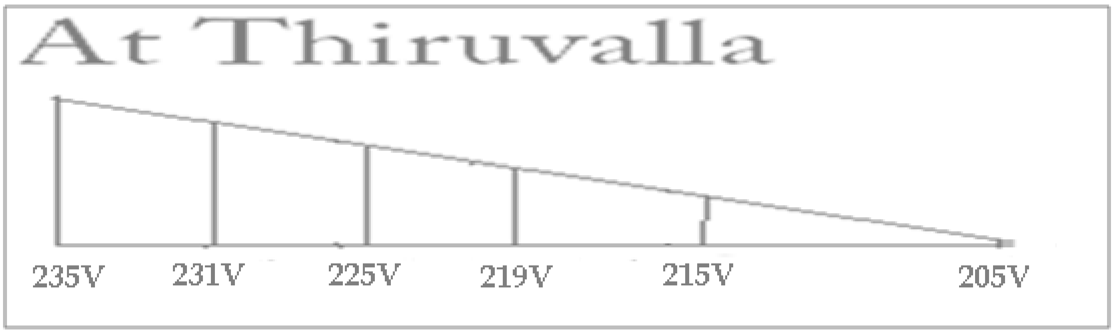
At Distribution end is 40^0C

At OH line termination is 38^0C

The above temperature reveals that that the Joints/Binding at the junction is properly done.

7.4.0 VOLTAGE TREE DIAGRAM

Fig. 7.11



7.4.1 OBSERVATION

The voltage Drop is around 12.7% to 14.6%, which are on the higher area
The size of the conductor used is adequate and the distance between pole and the consumer meter is not exceeding 100meters.

7.4.2 SUGGESTION

The voltage drop is due to the contact resistance at the junction of the conductor connected to consumer near the pole.
The joints/termination can be redone to make the contact proper and to avoid voltage drop and bring it within limits.

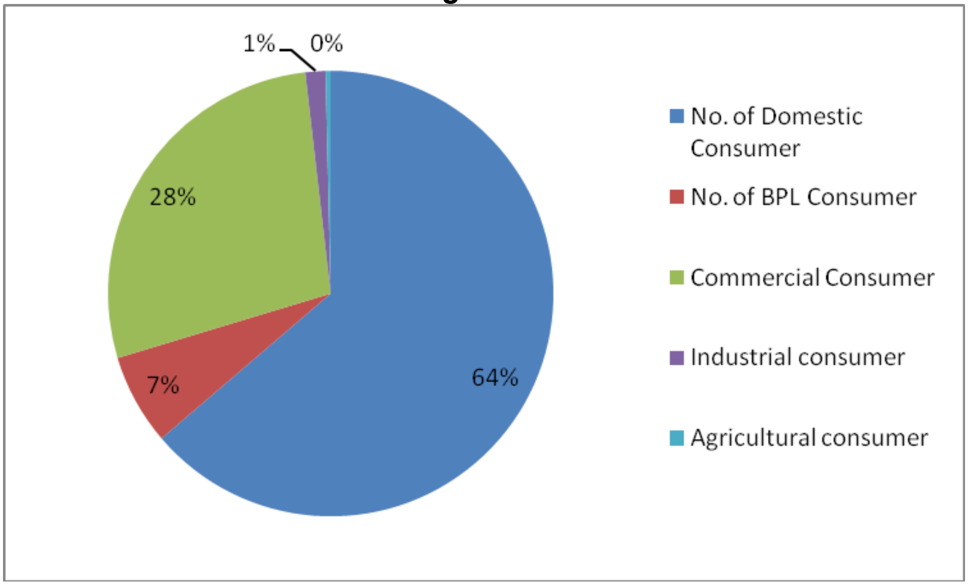
7.5.0 COMBINATION OF CONSUMER MIX AT THIRUVALLA SITE IS AS UNDER

Table 7.5

No. of Domestic Consumer	174
No. of BPL Consumer	18
Commercial Consumer	76
Industrial consumer	4
Agricultural consumer	1

Total No. of Consumers = 273

Fig. 7.12



7.5.1 The consumer mix of this transformer may not have any impact on the distribution. There are only four small industrial loads and mostly residential and partially commercial loads. In this, there are 18 nos. of BPL loads

The % mix of commercial consumer is higher and the Domestic consumer low when compared with the total consumer mix data of the entire Kerala State. The agriculture load is not there.

7.5.2 Consumer Density

No. of Consumer x 100/Transformer Capacity
= 273 x 100/250 = 109.29 consumers per 100 kVA of transformer

7.5.3 The above no. is fairly high, and considering the modern homes, the consumer density of 50 to 60 per 100 kVA is more reasonable. However the loading density being low, this situation can be ignored, as losses will not be substantial.

7.5.4 Load Density

Connected load/Transformer capacity in kVA
= 123/250 = 0.492 = 49%

7.6.0 CONSUMPTION DETAILS OF CONSUMERS FOR SIX CONSECUTIVE MONTHS

0.1 Pole No TT34/1 to TT34/12.1 is given in Table 7.6

Table 7.6

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
0	TT34/1	96491			
1	TT34/1	712	38	38	38
3	TT34/2	18009	613	624	608
4	TT34/2	6951	0	0	0
5	TT34/2	715	299	306	433
6	TT34/3	6128	8	4	0
7	TT34/3	8798	200	199	251
8	TT34/3	18980	26	34	28
9	TT34/3 A	9483	416	430	446
10	TT34/3 A	714	248	229	201
11	TT34/3 A	6439	369	204	146
12	TT34/4	3619	39	36	36
13	TT34/5	9515	481	453	258
14	TT34/5	8178	367	301	325
15	TT34/8	812	17	47	69
16	TT34/8	811	85	93	143
17	TT34/9	8343	286	247	280
18	TT34/10	11133	339	308	303
19	TT34/10	15806	357	308	297
20	TT34/10 A	3936	164	167	177
21	TT34/11	810	226	205	255
22	TT34/11	3370	243	252	259
23	TT34/12	11653	363	291	260
24	TT34/12	9149	226	204	227
25	TT34/13	11669	166	198	180
26	TT34/13	10894	52	52	52
27	TT34/12/1	17209	104	81	75
28	TT34/12/1	11591	67	71	73
29	TT34/12/1	11296	42	65	84
30	TT34/12/1	7603	91	56	81
31	TT34/12/2	9514	202	183	180
32	TT34/12/3	11661	177	191	210
33	TT34/12/3	5406	292	178	176
34	TT34/12/4	5539	112	111	139
35	TT34/12/4	11295	52	55	62
36	TT34/12/5	10950	143	133	131
37	TT34/12/5	11226	130	114	121
38	TT34/12/5	7121	110	101	113
39	TT34/12/6	9253	100	100	100

0.2 Thiruvalla Road (TT32 to TT36 and TV4) is giving in table 7.7

Table 7.7

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	TT32	716	254	143	70
2	TT32	6590	300	298	280
3	TT32/1	15711	314	275	270
4	TT32/1	3059	53	54	55
5	TT33	675	187	195	197
6	TT33	11303	203	208	187
7	TT33	4738	2534	2717	2850
8	TT33/1	17465	8	16	33
9	TT33/1A	Dummy			77
10	TT33/2	8140	66	62	77
11	TT33/2	674	592	548	487
12	TT33/2	7562	842	693	963
13	TT33/3	673	348,293	214,246	272,243
14	TT33/3	10220	1424	1382	1436
15	TT34	676	565	354	293
16	TT34	10579	410	414	388
17	TT35	4696	31	39	50
18	TT35	679	0	0	0
19	TT35	7940	59	55	56
20	TT35/1	10982	534	499	581
21	TT35/1	6536	120	121	50
22	TT35/1	710	102	109	103
23	TT35/1	8177	234	244	247
24	TT35/1	709	19	22	221
25	TT36	8046	100	100	100
26	TT36	8424	167	154	140
27	TT36	8226	60	58	52
28	TT36	17469	308	293	303
29	TT36	700	347	320	302
30	TV1	No connection			
31	TV3	10369	94	81	78
32	TV3	11918	214	168	144
33	TV3	6544	207	264	231
34	TV4	Interlink			
35	TT34	8082	309	279	280
36	TT34	2987	13	16	16
37	TT32/A	8378	Bills not available	0	0

0.3 Towards Thirumoolapuram Junction and Chenganur Side (Pole NO: TE 1 to TT33 and TT29 to TT27/B) is given in table 7.8

Table 7.8

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	TE1	5559	143	161	98
2	TE1	18890			
3	TE1	16011	72	40	57
4	TE1	15799	140	127	140
5	TE1	16213	61	80	51
6	TT30/1	8320	25	28	24
7	TT30/1	765	86	63	69
8	TT30/1/A	17519	61	49	48
9	TT30/1/C	7258	170	168	103
10	TT30/1/B	5929	200	200	200
11	TT30/1/C	18543	63	61	50
12	TT30/1/C	7003	323	287	287
13	TT30/1/D	18044	31	56	62
14	TT30/1/E	8259	154	154	154
15	TT/28/1	16386	18	20	28
16	TT/28/1	DL			
17	TT/28/1	19149			
18	TT/28/1	16857	81	82	73
19	TT/28/1	15656			
20	TT/28/1	18851	600	556	546
21	TT/27/B	672	1865	1661	1961
22	TT/27/2	18664	35	63	48
23	TT/27/2	16422	33	61	91
24	TT/27/2	8775	233	230	234
25	TE/2	718	755	930	1086
26	TE33	16501	34	33	29

0.4 Adaikkakulam Left side (Pole NO: TE 13 / 10 to TE / 13 / 21) is given in table 7.9

Table 7.9

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	TE/13/10	7965	155	144	137
2	TE/13/10	7959	119	122	110
3	TE/13/12/1	18273	69	81	76
4	TE/13/15	15955 (Agri)	Not in use	0	0
5	TE/13/17/1/A	17482	81	70	77
6	TE/13/19	17475	27	28	25
7	TE/13/19	17476	155	189	159
8	TE/13/20	17454	45	82	75
9	TE/13/22	17468	62	60	53
10	TE/13/10/1	4459	99	109	95
11	TE/13/10/2	4460	175	194	115
12	TE/13/10/2	11511	70	64	65
13	TE/13/10/3	9059	78	82	79
14	TE/13/10/3	6197	78	101	80
15	TE/13/10/3	10562	178	204	155
16	TE/13/10/3	6497	161	121	115
17	TE/13/10/3	DL			

0.5 Adaikkakulam Right side (Pole No: TE 13 / 9 / 1 to TE / 13 / 9 / 7) is given in table 7.10

Table 7.10

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	TE/13/9/1	8538	156	139	88
2	TE/13/9/1	7332	82,59	57,134	97, 80
3	TE/13/9/1	6425	196	189	180
4	TE/13/9/1/B	16337	595	217	299
5	TE/13/9/1/A1	757	150	129	129
6	TE/13/9/1/A1	7933	52	52	4
7	TE/13/9/1/A3	8096	138	101	48
8	TE/13/9/1/A3	16634	98	94	119
9	TE/13/9/2	7316	173	189	186
10	TE/13/9/2	4051	244	113	89
11	TE/13/9/3	9420	211	158	175
12	TE/13/9/3	755	248	249	220
13	TE/13/9/3	756	428	262	287
14	TE/13/9/4	6954	118	120	108
15	TE/13/9/5	8537	195	207	169
16	TE/13/9/5	8846	28	17	15
17	TE/13/9/6	5806	217	210	191
18	TE/13/9/6	7820	202	196	180
19	TE/13/9/6	10028	119	91	98
20	TE/13/9/6/B	5074	45	41	36
21	TE/13/9/6/B	5073	122	129	105
22	TE/13/9/7	11397	286	281	263
23	TE/13/9	754	181	188	120

0.6 Adaikkakulam Road (Pole No: TE 13 to TE/13/9) is given in Table 7.11

Table 7.11

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	TE 13	7581	7	6	7
2	TE 13	723	295	264	237
3	TE 13	7506	52	219	1
4	TE 13/1	16938	119	117	113
5	TE 13/1	3865	275	271	278
6	TE 13/2/B	15319	0	0	30
7	TE 13/2/B	4988	263	275	213
8	TE 13/2/C	11236	332	294	317
9	TE 13/2/C/1	11451	77	89	77
10	TE 13/2/C/2	11775	141	130	134
11	TE 13/2/D	18957	106	94	134
12	TE 13/2/E	11186	224	217	207
13	TE 13/2/E	12136	158	184	184
14	TE 13/2/E	11519	128	131	124
15	TE 13/3	750	483,407	425,293	335,567
16	TE 13/3	761	722	723	344
17	TE 13/3	19095			312
18	TE 13/4	7153	210	175	156
19	TE 13/4	11514	327	295	305
20	TE 13/4/1	12095	186	186	200
21	TE 13/4/1	4211	74	156	120
22	TE 13/4/2	18460	Bills not Available	0	0
23	TE 13/4/2	8635	86	49	169
24	TE 13/4/2	18659	330	245	247
25	TE 13/5/1	4983	Bills not Available	0	0
26	TE/13/6	9677	342	340	337
27	TE 13/6	11480	115	143	153
28	TE 13/6	8672	167	175	159
29	TE 13/6	6223	204	239	209
30	TE 13/6	752	273	272	248
31	TE 13/7	10512	254	153	132
32	TE 13/7	15389	320	249	257
33	TE 13/7	759	126	81	87
34	TE 13/8	3828	192	194	167
35	TE 13/8	753	164	171	171
36	TE 13/8	6912	173	119	190
37	TE 13/8	7096	215	256	269
38	TE 13/9	9218	93	93	93
39	TE13/4	760	273	210	148
40	TE13/4	6144	Bills not Available	0	0

0.7 MAG FAST College (Pole No: TE 2 / 3 to TE / 2 / 13)is given in Table 7.12

Table 7.12

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for month of November and December 2008 (kWh)
1	TE/2/3	3968	256	251	287
2	TE/2/4	3819	155	137	121
3	TE/2/4	4576			
4	TE/2/5	5767	309	261	262
5	TE/2/5/1	3708	397	396	363
6	TE/2/5/2	7584	270	250	238
7	TE/2/5/4	3711	171	156	141
8	TE/2/6	717	673	537	506
9	TE/2/7	18352	484	476	489
10	TE/2/7	4337	50	46	62
11	TE/2/8	6906	197	146	128
12	TE/2/8/1	9594	379	95	206
13	TE/2/8/1	10517	285	255	275
14	TE/2/8/1	10853	152	145	97
15	TE/2/8/1	9552	267	252	249
16	TE/2/8/2	16681	134	112	144
17	TE/2/8/B	8416	365	252	238
18	TE/2/8/B	17868	162	128	129
19	TE/2/8/B	16527	83	83	44
20	TE/2/8/C	5740	162	164	201
21	TE/2/8/C	16293	86	79	81
22	TE/2/8/C	16339	128	116	124
23	TE/2/8/C/1	18458	213	184	165
24	TE/2/8/D	18203	142	142	181
25	TE/2/8/E	9039	164	188	179
26	TE/2/8/E	5855	60	63	86
27	TE/2/8/E	3712	40	Bills not Available	Bills not Available
28	TE/2/8/E	11481	132	173	226
29	TE/2/8/E	9273	158	157	143
30	TE/2/8/F	8037	72	57	24
31	TE/2/8/F	8202	Bills not Available	0	46
32	TE/2/9	3710	206	181	182
33	TE/2/10	6560	517	507	464
34	TE/2/10/1	5644	Bills not Available	0	28
35	TE/2/10/1	DL			
36	TE/2/11	8418	13	36	34
37	TE/2/12	8123	114	109	104
38	TE/2/12	8002	85	120	120
39	TE/2/13	6419	349	259	239
40		4936	52	52	52
41		4498	243	139	135

0.8 Eruvallipura Road (Pole No: TE 6 to TE/12/1) is given in Table 7.13

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	TE6	7606	106	54	47
2	TE6/2	2110	163	163	170
3	TE6/2	11005	118	99	101
4	TE6/3	10304	162	99	91
5	TE6/3	11006	183	170	169
6	TE6/3	15517	182	151	154
7	TE6/3	11475	113	108	24
8	TE6/3	16544	42	36	39
9	TE6/4	10829	128	110	118
10	TE6/5	17990	110	29	123
11	TE7	5255	345	385	369
12	TE7	3820	131	127	121
13	TE7	8807	160	210	174
14	TE/8/2	763	52	52,	52
15	TE/8/3	17555	24,21	72,36	30,28
16	TE/8/3	12097	402	404	352
17	TE/9	4852	30	43	20
18	TE/9	762	427	351	291
19	TE/9/2	8937	248	277	221
20	TE/9/2	9105	122	170	150
21	TE/9/2/B	17816	80	79	79
22	TE/9/3	9164	229	236	137
23	TE/9/4	7531	285	270	171
24	TE/9/4	9305	228	135	271
25	TE/9/4	6098	207	192	83
26	TE/9/4	7470	72	80	42
27	TE/10	721	168	162	148
28	TE/10	8162	230	224	220
29	TE/10	4623	39	36	40
30	TE/10/2	10686	0	0	1442
31	TE/11	9365	291	211	232
32	TE/11	9681	Bills not Available	0	0
33	TE/11/1	17448	53	45	44
34	TE/11/1	8038	99	101	117
35	TE/11/1	12014	276	168	53
36	TE/11/3	8571	274	287	258
37	TE/11/3	6778	201	165	194
38	TE/11/3	12102	326	274	266
39	TE/11/4	9065	262	302	233
40	TE/11/4	9108	201	134	87
41	TE/11/5	9109	68	73	69
42	TE/11/5	19080		14	90
43	TE/11/5	17962	295	293	231
44	TE/12	16692	512	438	391
45	TE/12/1	15408	332	287	243
46	TE/12/1	3981	70	83	82
47	TE/11/3	4485	170	182	190
48	TE/10	721	168	162	148
49	TE/9/2	11520	61	30	23

0.9 Eruvallipura Road (Pole No: TT 37/B to TT 41) is given in Table 7.14

Table 7.14

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1					
2	TT37/B	9517	295	347	335
3	TT37/1	4866	0	0	0
4	TT37/1	6320	407	374	339
5	TT37/1	5371	250	232	234
6	TT37/1	5957	131,64	89,86	80, 121
7	TT37/1	11460	253	290	196
8	TT37/1	3753	29	32	47
9	TT37/1	15768	3	2	2
10	No NO	18848	63	58	46
11	TT38	11780	583	547	514
12	TT38	10149	6	5	3
13	TT38	7783	194	205	178
14	TT38	17979	316	373	275
15	TT39	9947	13	17	23
16	TT39	8444	204	196	198
17	TT39	3227	300	300	300
18	TT39	703	456	420	340
19	TT39	16744	120	76	85
20	TT39	11936	616, 8	12, 183	1249, 1268
21	TT39	18761	10	11	23
22	TT39	4408	536	460	358
23	TT40	4896	24	16	13
24	TT41	707	162	197	156
25	TT41	11068	58	57	93
26	TT37	9045	99	111	118
27	TT41	16106	1380	1358	1369
28	TT37/1	6635	287	262	295

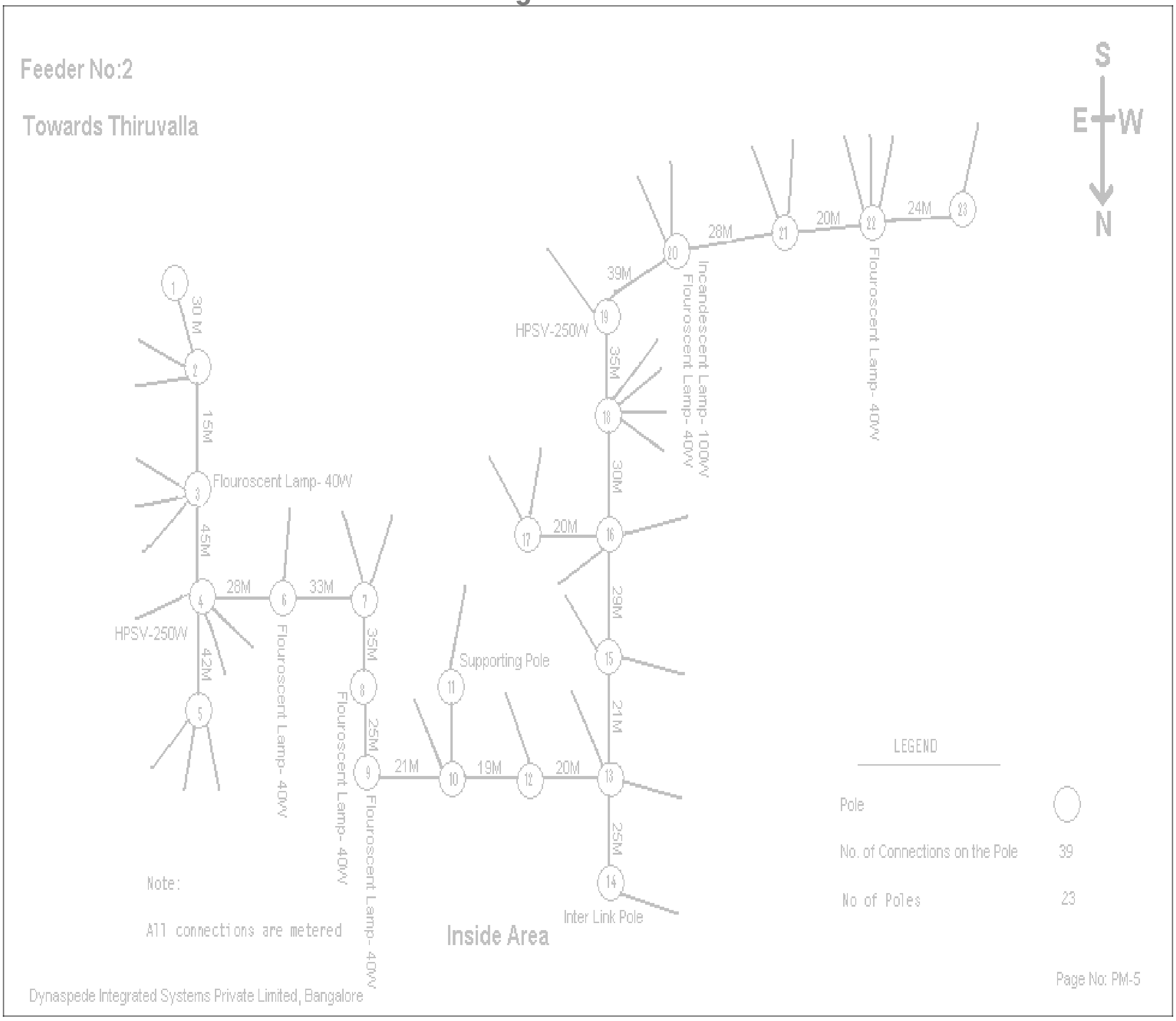
The above data is analysed and compared with the actual measurement taken during signature analysis and found to be matching

All the consumers connected from this transformer is metered. In that around 12% of meters are faulty.
Street lights connected are not metered

7.7.0 DISTRIBUTOR NETWORK DIAGRAM & ROUTING

0.1 Distribution Routing in fig. 7.13

Fig. 7.13



6 x 40w tube lights, 1 x 100w incandescent lamp and 1 x 250w HPSV lamp are connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 584 meters

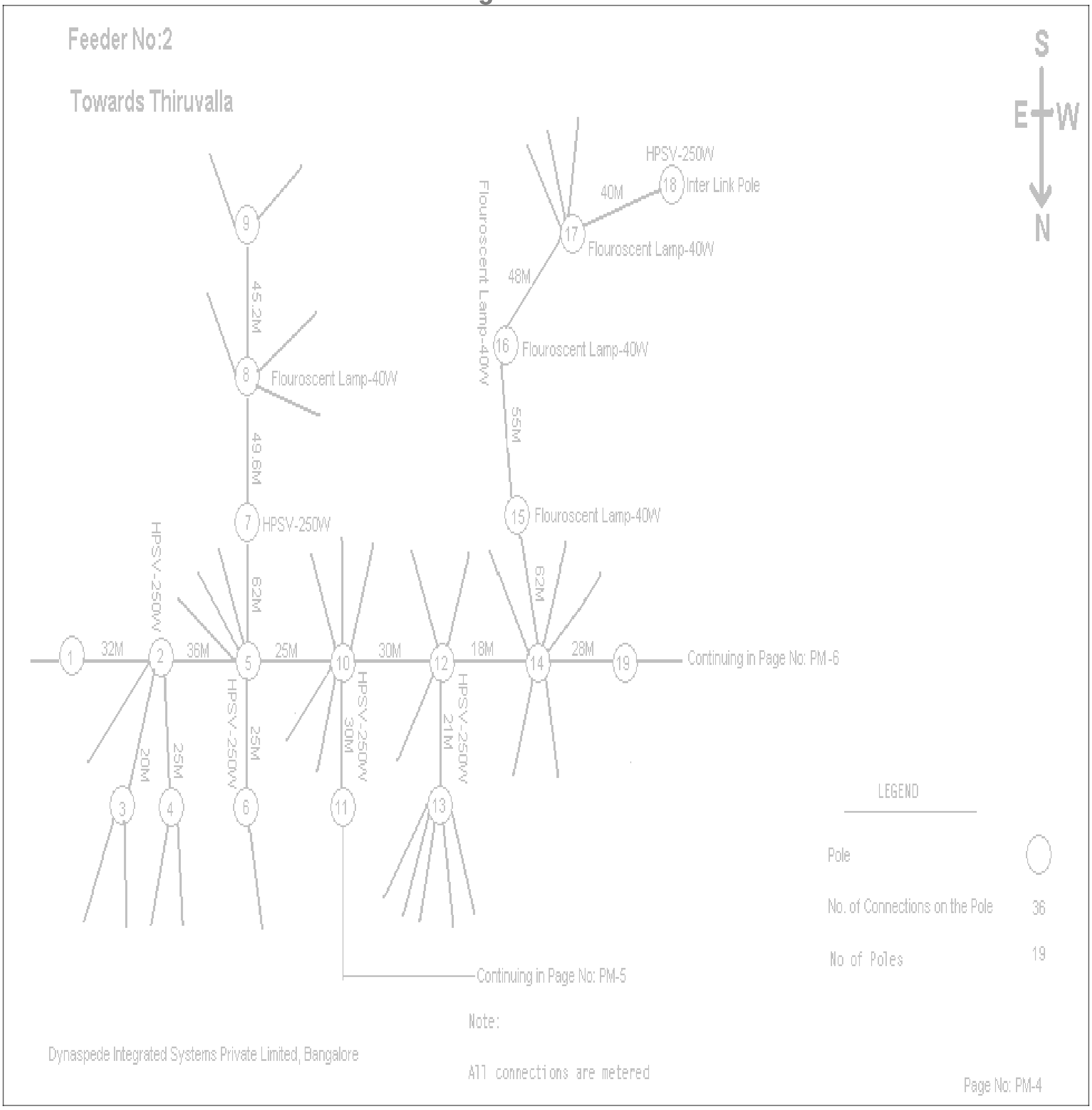
0.2 Consumer Particulars in Table 7.15

Table 7.15

Pole No in the Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TT34			
2	TT34/1	96491	2 Connection	
2	TT34/1	712		
3	TT34/2	18009		
3	TT34/2	6951	3 Connection	1 Phase
3	TT34/2	715		3 Phase
4	TT34/3	6128		
4	TT34/3	8798	3 Connection	
4	TT34/3	18980		3 Phase
5	TT34/3 A	9483		
5	TT34/3 A	714	3 Connection	
5	TT34/3 A	6439		
6	TT34/4	3619	1 Connection	
7	TT34/5	9515	2 Connection	1 Phase
7	TT34/5	8178		1 Phase
8	TT34/6	Dummy	1 Connection	1 Phase
9	TT34/7	Dummy	1 Connection	1 Phase
10	TT34/8	812	1 Connection	1 Phase
11	TT34/8	811	1 Connection	1 Phase
12	TT34/9	8343	1 Connection	1 Phase
13	TT34/10	11133	2 Connection	1 Phase
13	TT34/10	15806		1 Phase
14	TT34/10 A	3936	1 Connection	1 Phase
15	TT34/11	810	2 Connection	1 Phase
15	TT34/11	3370		1 Phase
16	TT34/12	11653	2 Connection	1 Phase
16	TT34/12	9149		1 Phase
17	TT34/13	11669	2 Connection	1 Phase
17	TT34/13	10894		1 Phase
18	TT34/12/1	17209		1 Phase
18	TT34/12/1	11591	4 Connection	1 Phase
18	TT34/12/1	11296		1 Phase
18	TT34/12/1	7603		1 Phase
19	TT34/12/2	9514	1 Connection	1 Phase1
20	TT34/12/3	11661	2 Connection	1 Phase
20	TT34/12/3	5406		1 Phase
21	TT34/12/4	5539	2 Connection	1 Phase
21	TT34/12/4	11295		1 Phase
22	TT34/12/5	10950		1 Phase
22	TT34/12/5	11226	3 Connection	1 Phase
22	TT34/12/5	7121		1 Phase
23	TT34/12/6	9253	1 Connection	1 Phase

0.3 Distribution Routing in fig. 7.14

Fig. 7.14



4 x 40w Tube lights and 6 x 250w HPSV lamps connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 651.8 meters

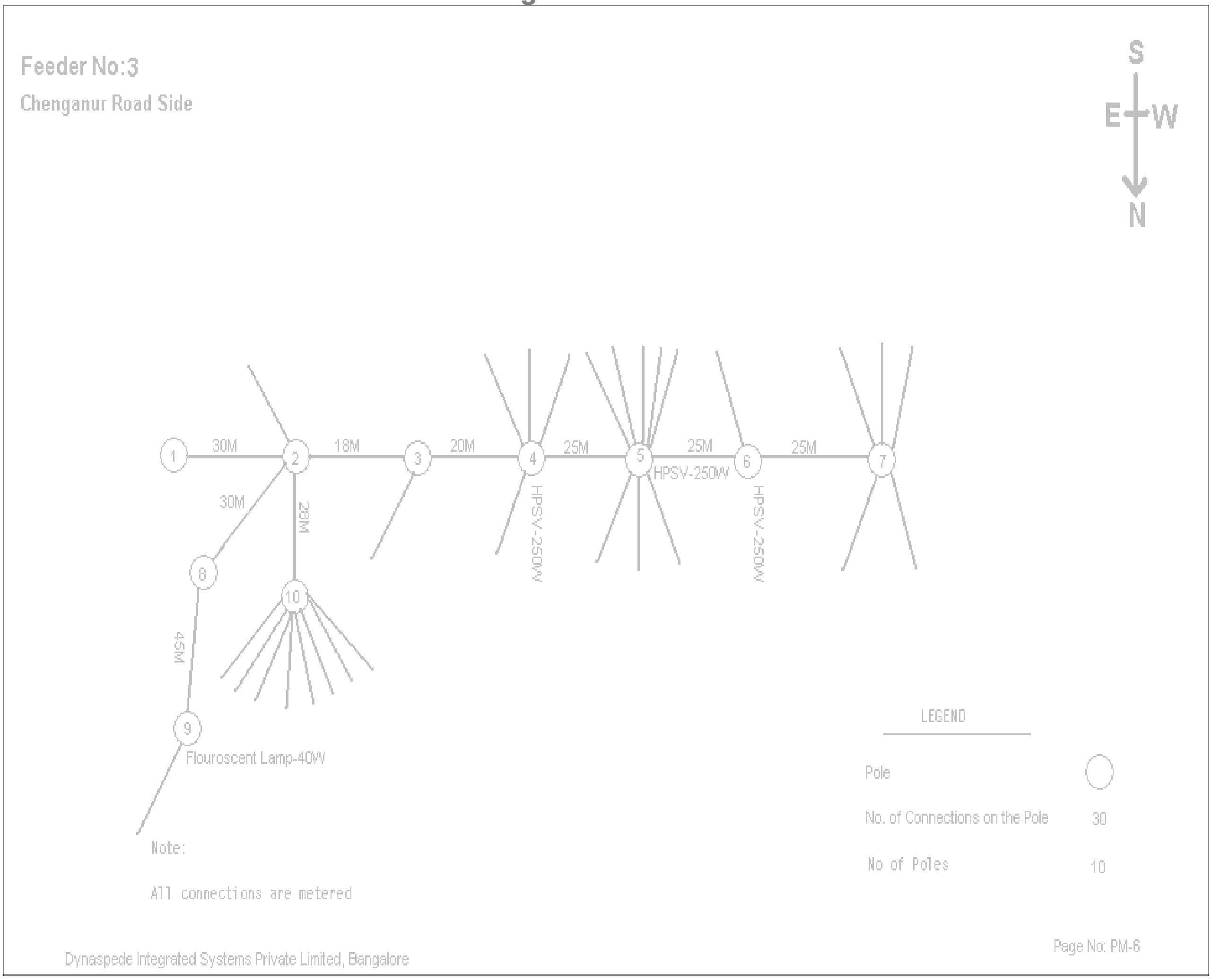
0.4 Consumer Particulars in Table 7.16

Table 7.16

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TT31			
2	TT32	716		1 Phase
2	TT32	6590		1 Phase
3	TT32/A	8378		1 Phase
4	TT32/1	15711		
4	TT32/1	3059		
5	TT33	675		1 Phase
5	TT33	11303		1 Phase
5	TT33	4738		3 Phase
6	TT33/1	17465		1 Phase
7	TT33/1A	Dummy		
8	TT33/2	8140		1 Phase
8	TT33/2	674		3 Phase
8	TT33/2	7562		1 Phase
9	TT33/3	673		3 Phase
9	TT33/3	10220		1 Phase
10	TT34	676		1 Phase
10	TT34	10579		
10	TT34	8082		
10	TT34	2987		
11	TT 34/1	Dummy		
12	TT35	4696		
12	TT35	679		
12	TT35	7940		
13	TT35/1	10982		1 Phase
13	TT35/1	6536		1 Phase
13	TT35/1	710		1 Phase
13	TT35/1	8177		1 Phase
13	TT35/1	709		1 Phase
14	TT36	8046		
14	TT36	8424		
14	TT36	8226		
14	TT36	17469		
14	TT36	700		
15	TV1	No connection		
16	TV2	No connection		1 Phase
17	TV3	10369		1 Phase
17	TV3	11918		1 Phase
17	TV3	6544		1 Phase
18	TV4	Interlink		
19	TT37			

0.5 Distribution Routing in Fig. 7.15

Fig. 7.15



1 x 40w Tube light and 3 x 250w HPSV lamps are connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 242 meters

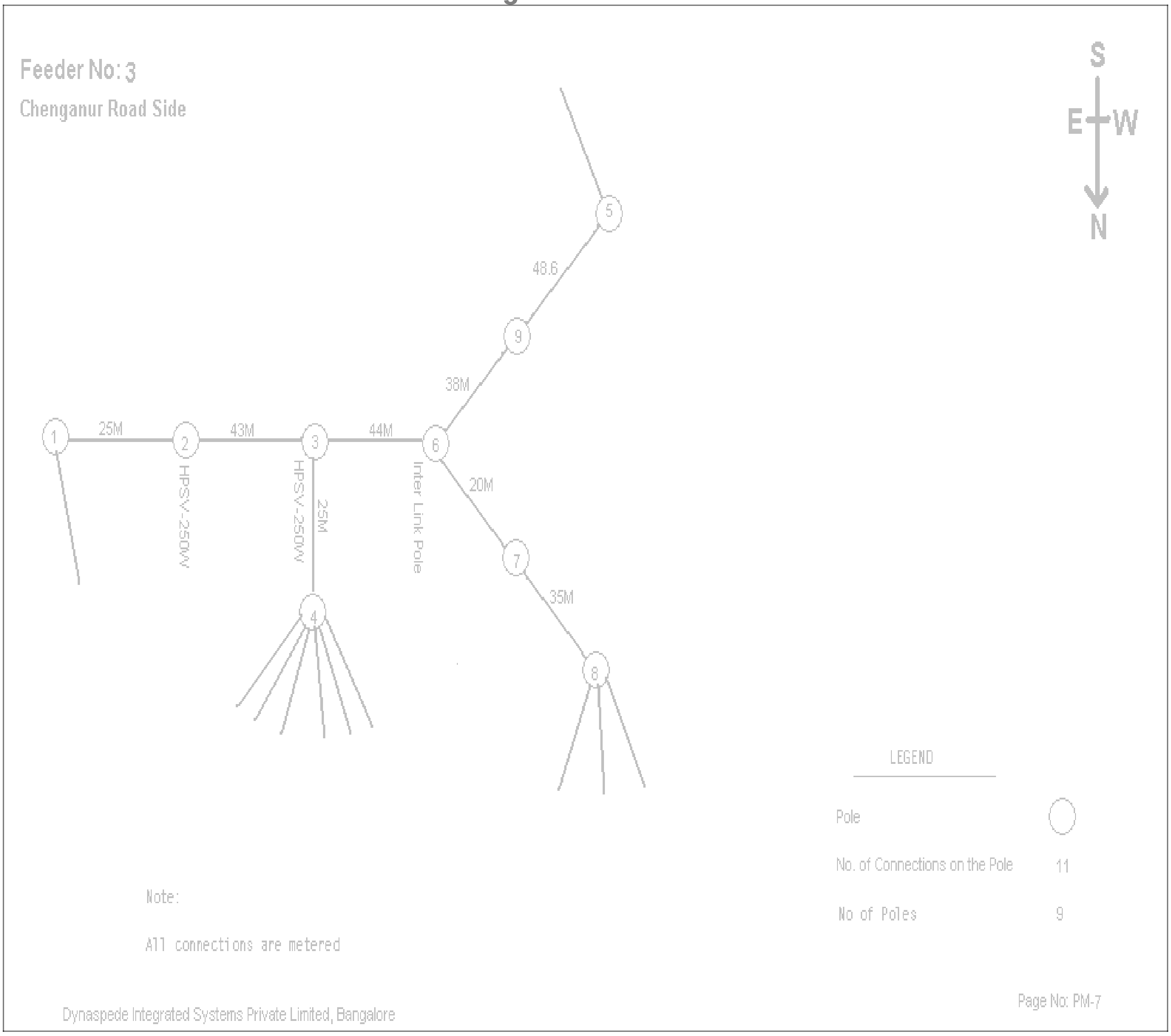
0.6 Consumer Particulars in Table 7.17

Table 7.17

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/ 3 Phase
1	TT36			
2	TT37	9045		1 Phase
3	No Number	18848	Pole no is not available	1 Phase
4	TT38	11780		1Phase
4	TT38	10149		1Phase
4	TT38	7783		1Phase
4	TT38	17979		1Phase
5	TT39	9947		1Phase
5	TT39	8444		1Phase
5	TT39	3227		1Phase
5	TT39	703		1Phase
5	TT39	16744		1Phase
5	TT39	11936		1Phase
5	TT39	18761		1Phase
5	TT39	4408		1Phase
6	TT40	4896		1Phase
7	TT41	707		1Phase
7	TT41	11068		1Phase
7	TT41	16106		1Phase
7	TT41	705		1Phase
7	TT41	DL	Door Locked	
8	TT37/A	Dummy	Dummy Post	
9	TT37/B	9517		1Phase
10	TT37/1	6635		1Phase
10	TT37/1	4866		1Phase
10	TT37/1	6320		1Phase
10	TT37/1	5371		1Phase
10	TT37/1	5957		1Phase
10	TT37/1	11460		1Phase
10	TT37/1	3753		1Phase
10	TT37/1	15768		1Phase

0.7 Distribution Routing in Fig.7.16

Fig. 7.16



2 x 250w HPSV lamps are connected in this Feeder (as Street lights).

Total length of the LT line of the above feeder is 253.6 meters

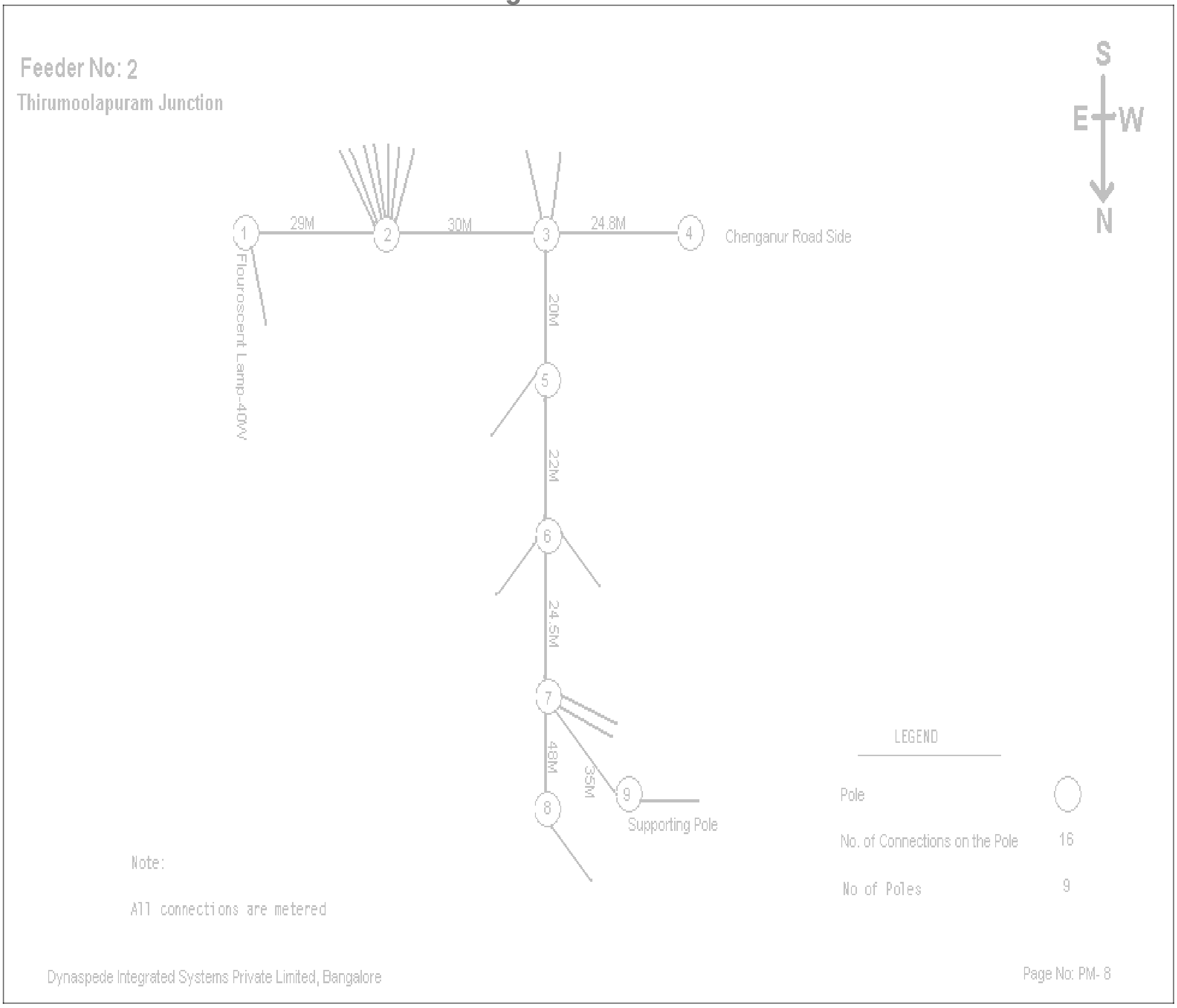
0.8 Consumer Particulars in Table 7.18

Table 7.18

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
4	TT/28/1	16386	1 Connection	1 Phase
4	TT/28/1		Door Locked	
4	TT/28/1	19149		1 Phase
4	TT/28/1	16857	4 Connection	1 Phase
4	TT/28/1	15656		1 Phase
4	TT/28/1	18851		1 Phase
9	TT/27/A		Dummy Pole	
5	TT/27/B	672		1 Phase
7	TT27/1		Dummy Pole	
7	TT/27/2	18664		1 phase
7	TT/27/2	16422		1 Phase
7	TT/27/2	8775		1 Phase
1	TT31	16501		1 Phase
2	TT32		Dummy Pole	
3	TT28		Dummy Pole	
6	TT27		Interlink Pole	

0.9 Distribution Routing in Fig 7.17

Fig. 7.17



1 x 40w tube light is connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 233.3 meters

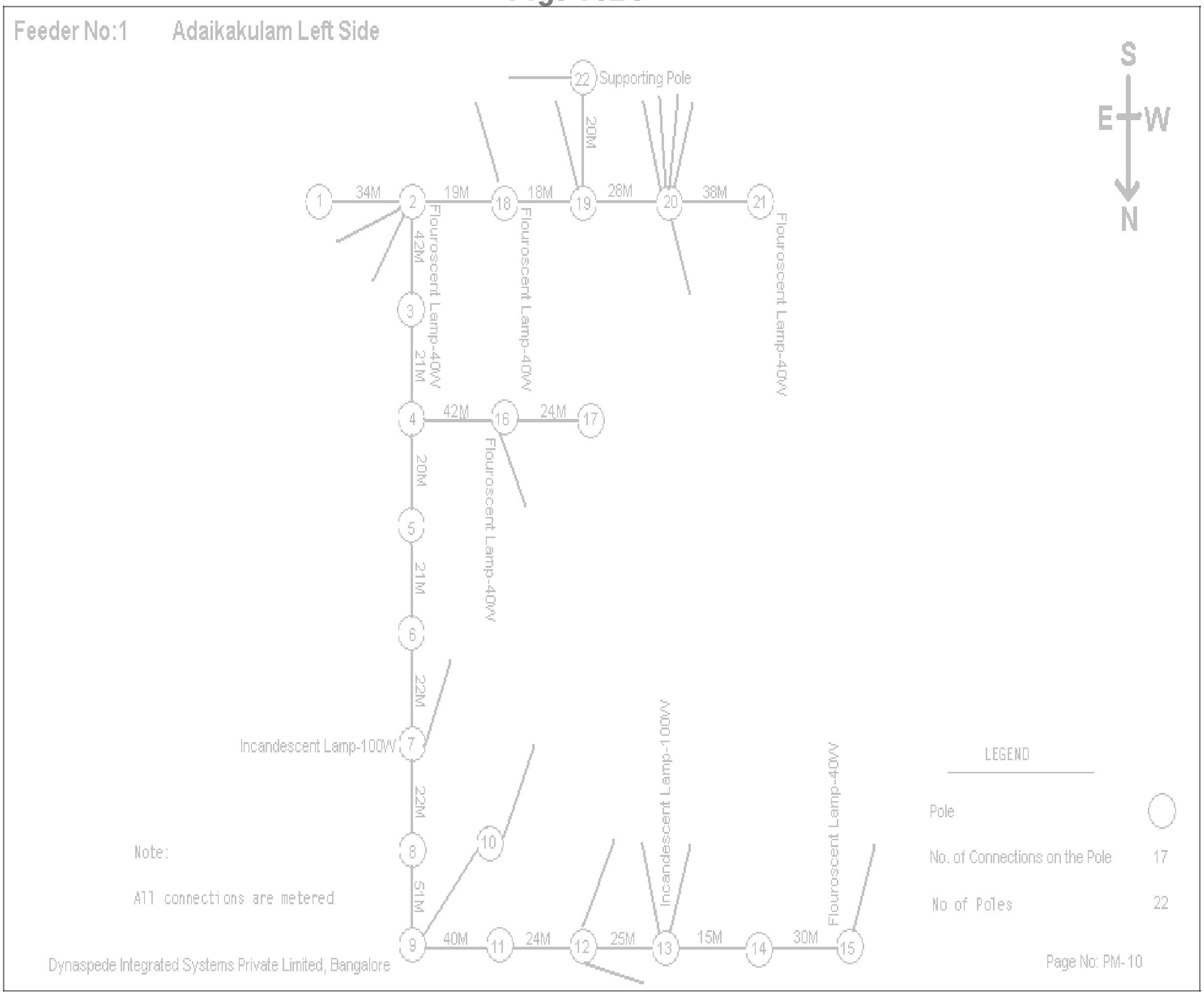
0.10 Consumer Particulars in Table 7.19

Table 7.19

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TE/2	718	1 Connection	1 Phase
2	TE1	5559		1 Phase
2	TE1	18890	7 Connection	1 Phase
2	TE1	Dismantled		
2	TE1	Door Closed		
2	TE1	16011		1 Phase
2	TE1	15799	3 Connection	1 Phase
2	TE1	16213		1 Phase
3	TT30/1	8320	2 Connection	1 Phase
3	TT30/1	765		1 Phase
4	TT33		1 Connection	
5	TT30/1/A	17519	1 Connection	1 Phase
6	TT30/1/B	7258	2 Connection	3 Phase
6	TT30/1/B	5929		3 Phase
7	TT30/1/C	18543	2 Connection	1 Phase
7	TT30/1/C	7003		1 Phase
8	TT30/1/D	18044	1 Connection	1 phase
9	TT30/1/E	8259	1 Connection	1 phase

0.11 Distribution Routing in Fig.7.18

Fig. 7.18



5 x 40w Fluorescent and2 x 100w Incandescent lamp are connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 556 meters

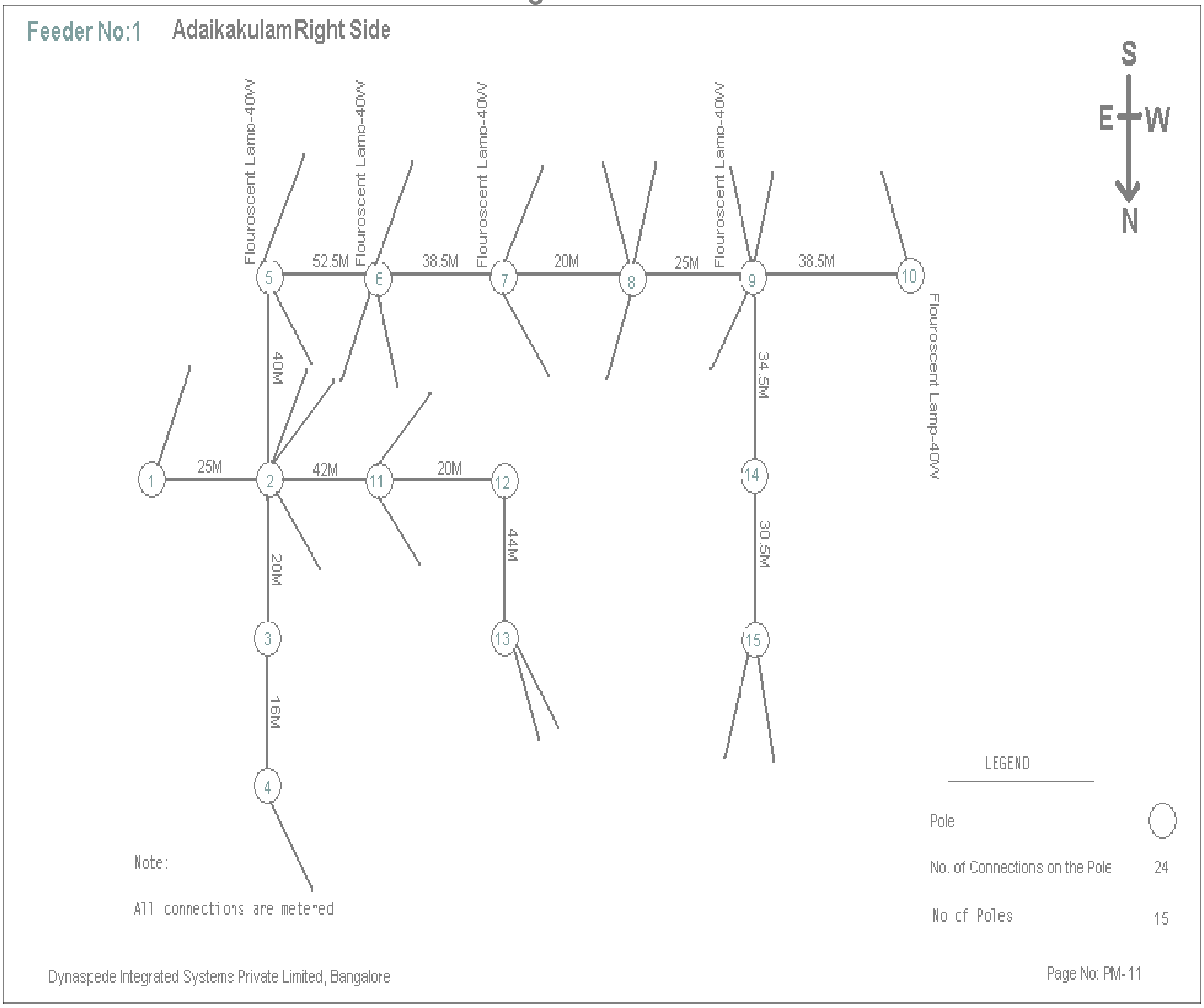
0.12 Consumer Particulars in Table 7.20

Table 7.20

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TE/13/9			
2	TE/13/10	7965	1 Connection	1 Phase
2	TE/13/10	7959		1 Phase
3	TE/13/11	No Connection	1 Connection	
4	TE/13/12	No Connection	1 Connection	
5	TE/13/13	No Connection	1 Connection	
6	TE/13/14	No Connection	1 Connection	
7	TE/13/15	15955	1 Connection	Agriculture Connection
10	TE/13/17/1/A	17482	1 Connection	1 Phase
11	TE/13/18		No Connection	
12	TE/13/19	17475	2 Connection	1 Phase
12	TE/13/19	17476		1 Phase
13	TE/13/20	17454	1 Connection	1 Phase
14	TE/13/21		No Connection	
15	TE/13/22	17468	1 Connection	1 Phase
16	TE/13/12/1	18273	1 Connection	1 Phase
18	TE/13/10/1	4459	1 Connection	1 Phase
19	TE/13/10/2	4460	1 Connection	1 Phase
22	TE/13/10/2	11511	1 Connection	1 Phase
20	TE/13/10/3	9059		1 Phase
20	TE/13/10/3	6197	5 Connection	1 Phase
20	TE/13/10/3	10562		1 Phase
20	TE/13/10/3	6497		Phase
20	TE/13/10/3	DL	Door Closed	
21	TE/13/10/4		1 Connection	

0.13 Distribution Routing shown in Fig 7.19

Fig. 7.19



5 x 40w florescent lamps are connected in this feeder (as street lights)

Total length of the LT line of the above feeder is 446.5 meters

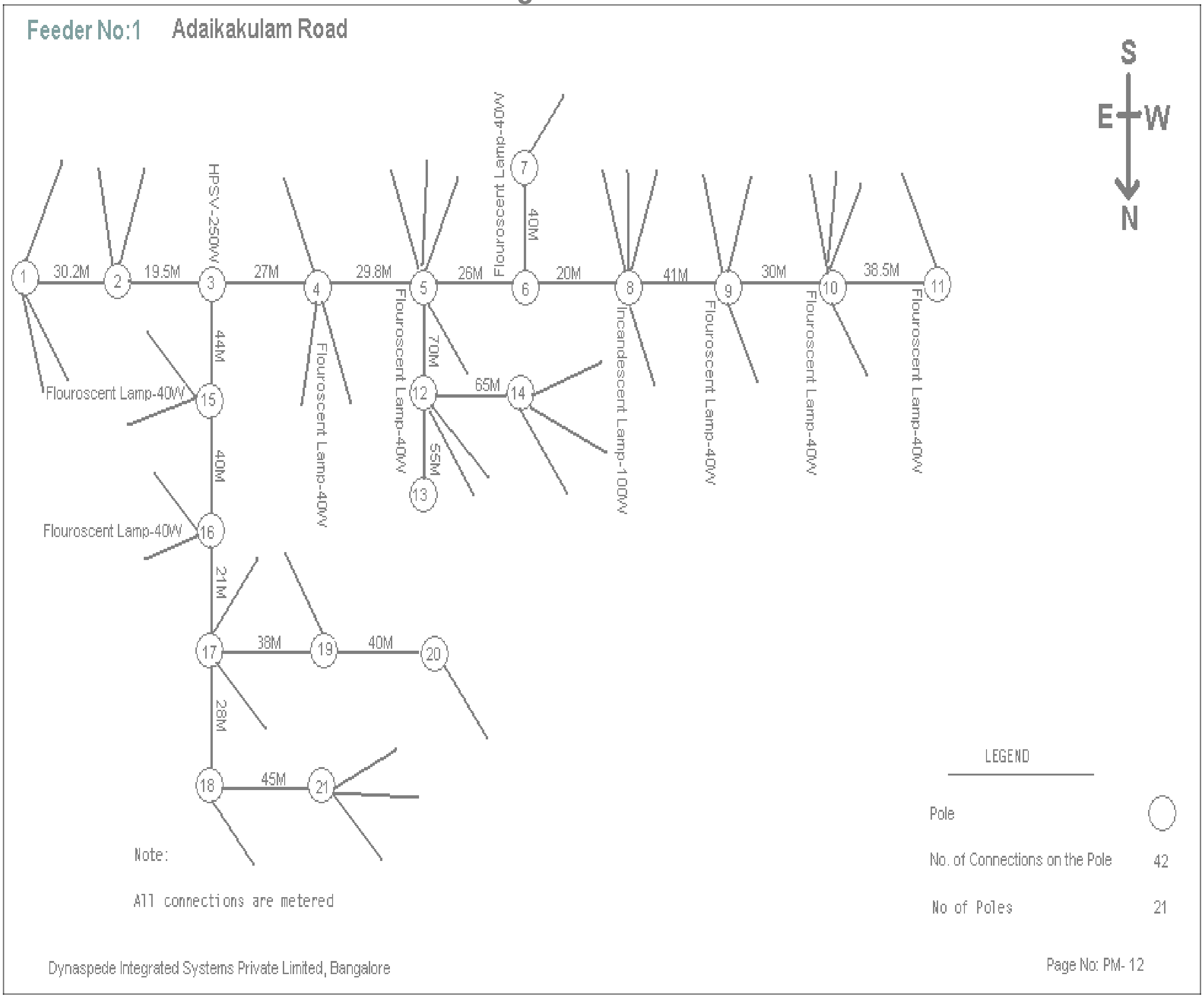
0.14 Consumer Particulars in Table 7.21

Table 7.21

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TE/13/9	754	1 Connection	1 Phase
2	TE/13/9/1	8538		3 phase
2	TE/13/9/1	7332	3 Connection	1 Phase
2	TE/13/9/1	6425		1 Phase
4	TE/13/9/1/B	16337	1 Connection	1 Phase
3	TE/13/9/1/A		No Connection	
11	TE/13/9/1/A1	757		1 Phase
11	TE/13/9/1/A1	7933	2 Connection	1 Phase
12	TE/13/9/1/A2		No Connection	
13	TE/13/9/1/A3	8096	2 Connection	1 Phase
13	TE/13/9/1/A3	16634		1 Phase
5	TE/13/9/2	7316	2 Connection	1 Phase
5	TE/13/9/2	4051		1 Phase
6	TE/13/9/3	9420		1 Phase
6	TE/13/9/3	755	3 Connection	1 Phase
6	TE/13/9/3	756		1 Phase
7	TE/13/9/4	6954	1 Connection	1 Phase
8	TE/13/9/5	8537		1 Phase
8	TE/13/9/5	8846	2 Connection	1 Phase
9	TE/13/9/6	5806		1 Phase
9	TE/13/9/6	7820	3 Connection	1 Phase
9	TE/13/9/6	10028		1 Phase
14	TE/13/9/6/A		No Connection	1 Phase
15	TE/13/9/6/B	5074	2 Connection	1 Phase
15	TE/13/9/6/B	5073		1 Phase
	TE/13/9/7	11397	1 Connection	1 Phase

0.15 Distribution Routing shown in Fig. 7.20

Fig. 7.20



8 x 40w florescent lamps and 1 x 100w incandescent lamp are connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 708 meters

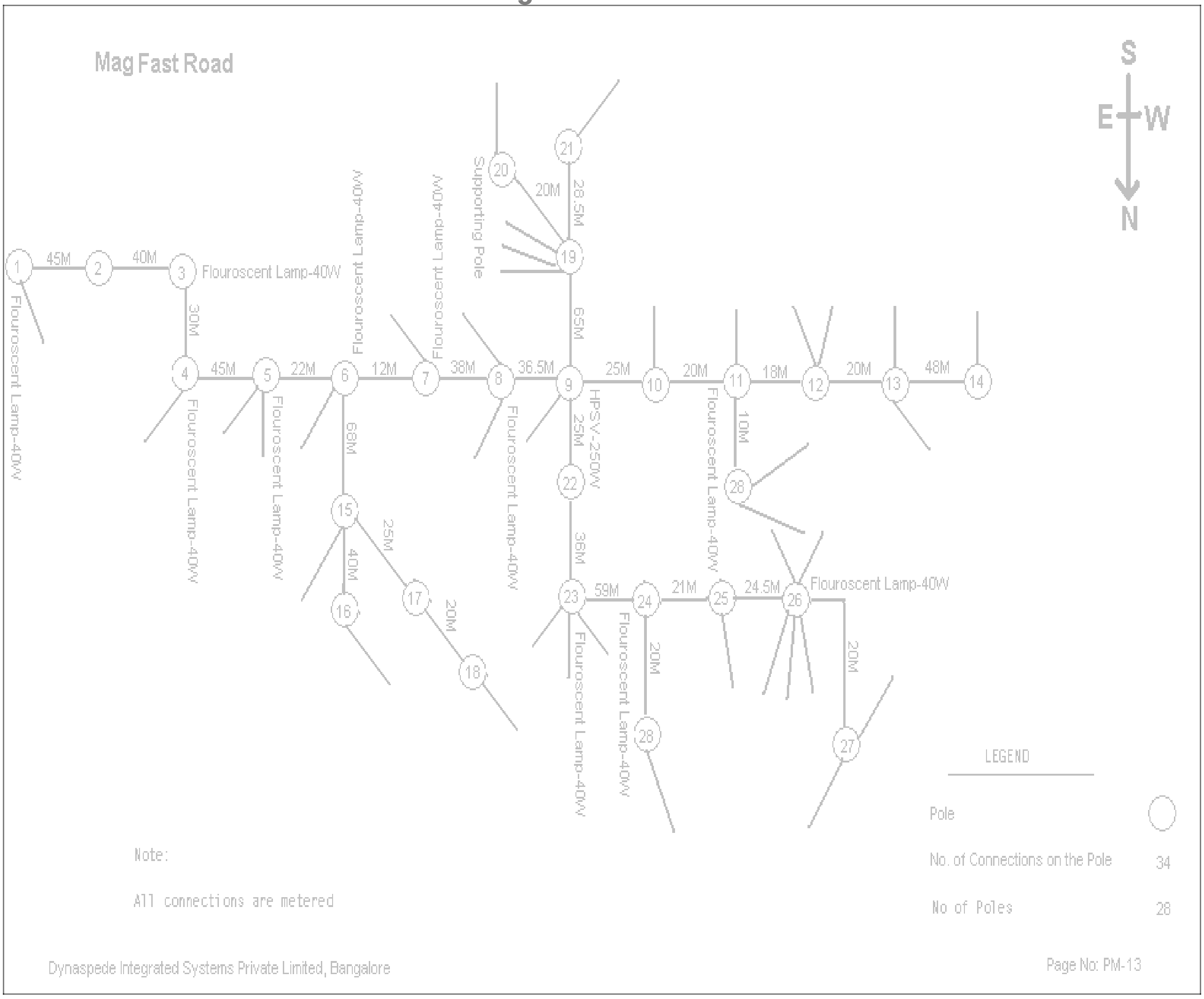
0.16 Consumer Particulars in Table 7.22

Table 7.22

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TE 13	7581		1 Phase
1	TE 13	723	3 Connection	1 Phase
1	TE 13	7506		1 Phase
2	TE 13/1	16938	2 Connection	1 Phase
2	TE 13/1	3865		1 Phase
3	TE 13/2		1 Connection	1 Phase
15	TE 13/2/B	15319		3 Phase
15	TE 13/2/B	4988	2 Connection	1 Phase
17	TE 13/2/C	11236	1 Connection	1 Phase
19	TE 13/2/C/1	11451	1 Connection	1 Phase
20	TE 13/2/C/2	11775	1 Connection	1 Phase
18	TE 13/2/D	18957	1 Connection	1 Phase
21	TE 13/2/E	11186		1 Phase
21	TE 13/2/E	12136	3 Connection	1 Phase
21	TE 13/2/E	11519		1 Phase
4	TE 13/3	750		3 Phase
4	TE 13/3	761	3 Connection	3 Phase
4	TE 13/3	19095		1 Phase
5	TE 13/4	7153	2 Connection	1 Phase
5	TE 13/4	11514		1 Phase
6	TE 13/5		No Connection	
12	TE 13/4/1	12095	2 Connection	1 Phase
12	TE 13/4/1	4211		1 Phase
14	TE 13/4/2	18460		1 Phase
14	TE 13/4/2	8635	3 Connection	1 Phase
14	TE 13/4/2	18659		1 Phase
7	TE 13/5/1	4983	1 Connection	1 Phase
8	TE/13/6	9677		1
8	TE 13/6	11480	5 Connection	1 Phase
8	TE 13/6	8672		1 Phase
8	TE 13/6	6223		1 Phase
8	TE 13/6	752		1 Phase
9	TE 13/7	10512		1 Phase
9	TE 13/7	15389	3 Connection	3 Phase
9	TE 13/7	759		1 Phase
10	TE 13/8	3828		1 Phase
10	TE 13/8	753	4 Connection	1 Phase
10	TE 13/8	6912		1 Phase
10	TE 13/8	7096		1 Phase
11	TE 13/9	9218	1Connection	1 Phase
5	TE13/4	760		1 Phase
5	TE13/4	6144	2 Connection	1 Phase

0.17 Distribution Routing shown in Fig. 7.21

Fig. 7.21



11 x 40w florescent lamp and 1 x 250w HPSV lamps are connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 843 meters

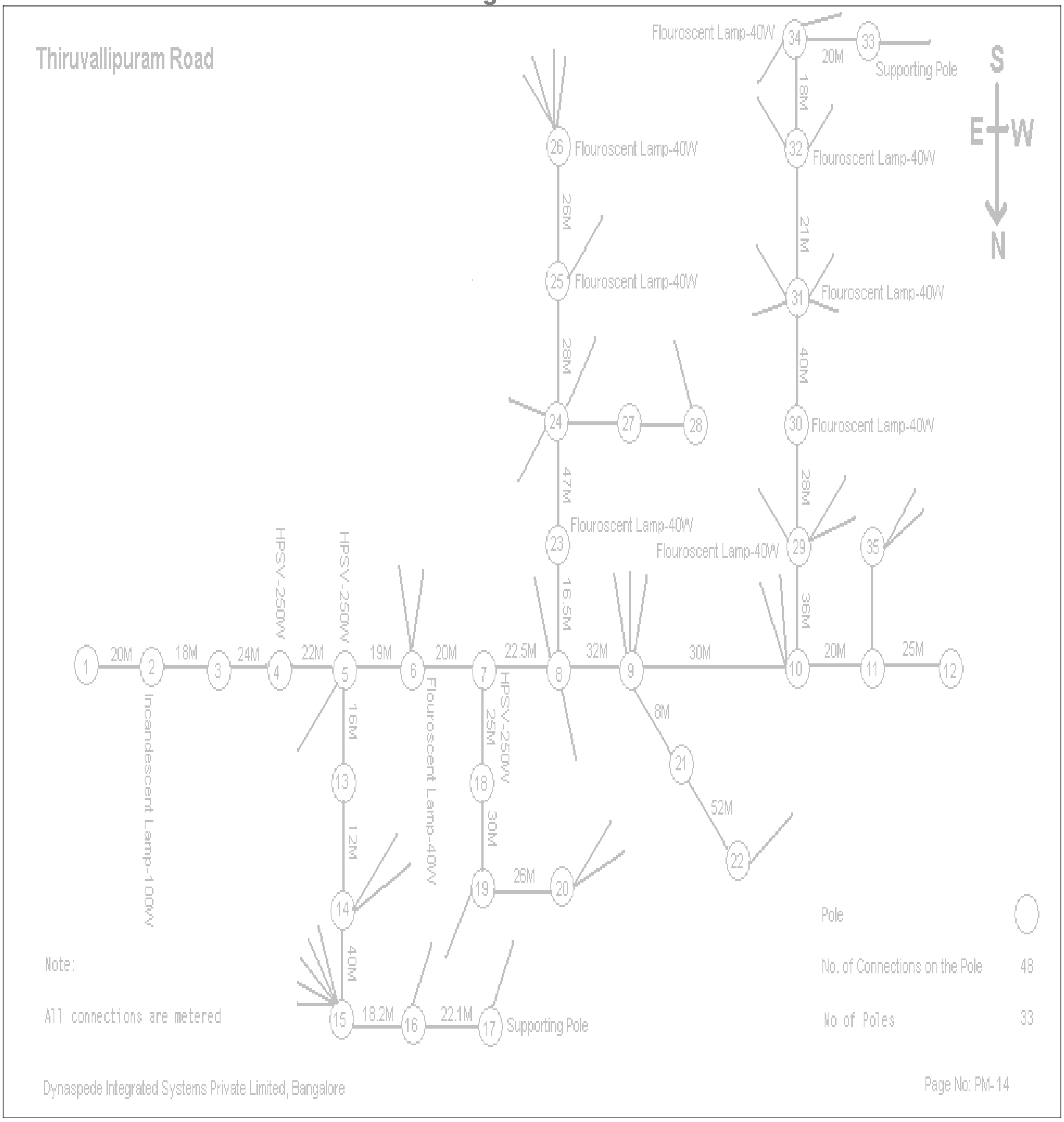
0.18 Consumer Particulars in Table 7.23

Table 7.23

Pole No in Map	Post Identification No in the Area	Consumers connected	Remarks	1 Phase/3 Phase
1	TE/2		No Connection	
2	TE2/1		No Connection	
3	TE2/2		No Connection	
4	TE/2/3	3968	1 Connection	1 Phase
5	TE/2/4	3819	2 Connection	1 Phase
5	TE/2/4	4576		1 Phase
6	TE/2/5	5767	1 Connection	1 Phase
7	TE/2/6	717	1 Connection	1 phase
8	TE/2/7	18352	2 Connection	1 Phase
8	TE/2/7	4337		1 Phase
9	TE/2/8	6906	1 Connection	1 Phase
10	TE/2/9	3710	1 Connection	1 Phase
11	TE/2/10	6560	1 Connection	1 Phase
12	TE/2/11	8418	1 Connection	1 Phase
13	TE/2/12	8123		
13	TE/2/12	8002	2 Connection	1 Phase
14	TE/2/13	6419	1 Connection	1 Phase
15	TE/2/5/1	3708	1 Connection	1 Phase
16	TE/2/5/2	7584	1 Connection	1 Phase
17	TE/2/5/3			1 Phase
17	TE/2/5/A	3709	2 Connection	1 Phase
18	TE/2/5/4	3711	1 Connection	1 Phase
19	TE/2/8/1	9594		1 Phase
19	TE/2/8/1	10517	3 Connection	1 Phase
19	TE/2/8/1	10853	Through Supporting	1 Phase
19	TE/2/10/1	4936		1 Phase
19	TE/2/8/1	9552	2 Connection	1 Phase
20	Supporting Pole			
21	TE/2/8/2	16681	1 Connection	1 Phase
22	TE/2/8/A		1 Connection	1 Phase
22	TE2/8/A	4498	1 Connection	1 Phase
23	TE/2/8/B	8416	3 Connection	1 Phase
23	TE/2/8/B	17868		1 Phase1
23	TE/2/8/B	16527		1 Phase
24	TE/2/8/C	5740		1 Phase
24	TE/2/8/C	16293	3 Connection	1 Phase
24	TE/2/8/C	16339		1 Phase
25	TE/2/8/D	18203	1 Connection	1 Phase
26	TE/2/8/E	9039		1 Phase
26	TE/2/8/E	5855		1 Phase
26	TE/2/8/E	3712	5 Connection	1 Phase
26	TE/2/8/E	11481		1 Phase
26	TE/2/8/E	9273		1 Phase
27	TE/2/8/F	8037		1 Phase
27	TE/2/8/F	8202	2 Connection	1 Phase
28	TE/2/8/C/1	18458	3 Connection	1 Phase
28	TE/2/10/1	5644		1 Phase
28	TE/2/10/1	DL	Door Locked	1 Phase

0.19 Distribution Routing shown in Fig. 7.22

Fig. 7.22



9 x 40w florescent lamps, 1 x 100w incandescent lamp and 3 x 250W HPSV lamps are connected in this feeder (as Street lights).

Total length of the LT line of the above feeder is 823.3 meters

Summary of Street light

Total Street lights connected with the transformer

40w florescent lamps	= 50Nos.	= (40 + 10) x 50	=2500W
100W incandescent lamp	= 5Nos.	= 100 x 5	= 500W
250w HPSV lamp	= 13 Nos.	= (250 + 20) x 13	= 3510W
		Total	= 6.51kW

Total length of the LT line from the transformer is 5337.5 meters/5.3km

7.8.0 THE DISTRIBUTION LOSS STUDY

Signature analysis was carried out to find out the losses

7.8.1 Procedure of Signature Analysis:

The transformer was switched off for half an hour. The energy meter reading at the L.T. side is noted down before switching off the transformer. Within half an hour time, the meter readings of all the consumers connected to the transformer are taken / measured. Again the transformer is switched on. This process is repeated for three days. From this figure, the consumption of the consumers is arrived at for two days. This gives the average consumption pattern of the consumer. From these data, the distribution loss is calculated and arrived at.

As the loss is the function of output energy vs. input energy and the loss percentage will remain within acceptable variation, the loss does not depend on the duration of study.

7.8.2 Table 7.24 to 7.32 shows the Unit Consumption from Signature analysis

0.1 POST (from TT34 to TT34/11) in Table 7.24

Table 7.24

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TT34	96491	1.4	1.8
1	TT34/1	712	0.5	1
3	TT34/2	18009	9.4	9.3
4	TT34/2	6951	Meter not working	
5	TT34/2	715	5.5	6.2
6	TT34/3	6128	Meter not working	
7	TT34/3	8798	4.4	3.3
8	TT34/3	18980	Meter not working	
9	TT34/3 A	9483	12.7	10.6
10	TT34/3 A	714	3.7	3.9
11	TT34/3 A	6439	1.6	1.9
12	TT34/4	3619	0.4	0.7
13	TT34/5	9515	Meter not working	
14	TT34/5	8178	4	4.3
15	TT34/8	812	0	5.2
16	TT34/8	811	1.7	1.5
17	TT34/9	8343	4.3	5.5
18	TT34/10	11133	4.6	4.9
19	TT34/10	15806	4	4
20	TT34/10A	3936	1.6	1.6
21	TT34/11	810	5.4	5.9
22	TT34/11	3370	3.9	3.8
23	TT34/12	11653	3.7	0
24	TT34/12	9149	2.8	3.2
25	TT34/13	11669	2.3	1.6
26	TT34/13	10894	DL	DL
27	TT34/12/1	17209	1.5	1.5
28	TT34/12/1	11591	1.1	1.1
29	TT34/12/1	11296	1.2	1.2
30	TT34/12/1	7603	1.6	1.7
31	TT34/12/2	9514	2.8	2.6
32	TT34/12/3	11661	2.5	2.7
33	TT34/12/3	5406	4.3	5.2
34	TT34/12/4	5539	3	2.6
35	TT34/12/4	11295	0.3	0.7
36	TT34/12/5	10950	1.2	2
37	TT34/12/5	11226	2.3	2.2
38	TT34/12/5	7121	1.5	1.4
39	TT34/12/6	9253	1	1.2
		Total	**102.2**	**106.3**

0.2 POST (from TT32 to TT32/A) in Table 7.25

Table 7.25

Sl. No	Pole / Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TT32	716	1.2	1.1
2	TT32	6590	3.8	5.1
3	TT32/1	15711	4.9	4.8
4	TT32/1	3059	1.2	1.4
5	TT33	675	3.3	3.4
6	TT33	11303	2.4	3.1
7	TT33	4738	43.5	47
8	TT33/1	17465	Meter not working	
9	TT33/1A	Dummy		
10	TT33/2	8140	1.2	1.1
11	TT33/2	674	8.8	8.3
12	TT33/2	7562	26.1	24.2
13	TT33/3	673	6.5	8.9
14	TT33/3	10220	18.1	24.1
15	TT34	676	5	5.1
16	TT34	10579	5.4	6.1
17	TT35	4696	1.2	1.2
18	TT35	679	DL	DL
19	TT35	7940	1.1	1.3
20	TT35/1	10982	11.9	8.8
21	TT35/1	6536	0	1.9
22	TT35/1	710	1.2	1.8
23	TT35/1	8177	3.9	4
24	TT35/1	709	0.3	0.4
25	TT36	8046	1.9	3.6
26	TT36	8424	Meter not working	
27	TT36	8226	2.8	0.9
28	TT36	17469	6.6	8.2
29	TT36	700	3.3	5.7
30	TV1	No connection		
31	TV3	10369	1.3	0.2
32	TV3	11918	3.7	3.9
33	TV3	6544	4.6	4.6
34	TV4	Interlink		
35	TT34	8082	5.6	6.5
36	TT34	2987	0.2	0.2
37	TT32/A	8378	Meter not working	
		Total	**181**	**196.9**

0.3 POST (from TE1 to TT31) in Table 7.26

Table 7.26

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TE1	5559	2.1	1.7
2	TE1	18890	Meter not working	
3	TE/2	718	15.5	14.4
4	TE1	16011	3.6	4
5	TE1	15799		DL
6	TE1	16213	1.2	2
7	TT30/1	8320	0.4	0.3
8	TT30/1	765	1.2	1.3
9	TT30/1/A	17519	0.8	1.3
10	TT30/1/C	7258	0.9	0.9
11	TT30/1/B	5929	12.2	9.6
12	TT30/1/C	18543	1.4	1.4
13	TT30/1/C	7003	4.9	5.1
14	TT30/1/D	18044		0
15	TT30/1/E	8259	0.1	0.1
16	TT/28/1	16386	0.5	0.2
17	TT/28/1	DL		0
18	TT/28/1	19149	0.6	1.5
19	TT/28/1	16857	0.1	1.6
20	TT/28/1	15656	0.3	0
21	TT/28/1	18851	8.6	5.9
22	TT/27/B	672	37.3	34.1
23	TT/27/2	18664	Meter not working	
24	TT/27/2	16422	1.3	1.5
25	TT/27/2	8775	3.7	4
26	TT31	16501	0.4	0.6
		Total	**97.1**	**91.5**

0.4 POST (from TE/13/10 to TE/13/10/3) in Table 7.27

Table 7.27

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TE/13/10	7965	3.4	3.1
2	TE/13/10	7959	1.9	2.1
3	TE/13/12/1	18273	1.1	1.1
4	TE/13/15	15955	Meter not working (Agri)	
5	TE/13/17/1/A	17482	2.5	0.7
6	TE/13/19	17475	0.5	0.4
7	TE/13/19	17476	1.5	1.4
8	TE/13/20	17454	1.2	1
9	TE/13/22	17468	0.8	0.7
10	TE/13/10/1	4459	2.9	2.8
11	TE/13/10/2	4460	2.1	2.4
12	TE/13/10/2	11511	1	0.3
13	TE/13/10/3	9059	1	1
14	TE/13/10/3	6197	1.4	1.1
15	TE/13/10/3	10562	2.4	3.1
16	TE/13/10/3	6497	1.4	1.8
17	TE/13/10/3	DL		DL
		Total	**25.1**	**23**

0.5 POST (from TE/13/9/1 to TE/13/9/7) in Table 7.28

Table 7.28

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TE/13/9/1	8538	2.5	2.7
2	TE/13/9/1	7332	P-11.7, L-0.1	P-7.7, L-0
3	TE/13/9/1	6425	2.7	3.2
4	TE/13/9/1/B	16337	3.2	3
5	TE/13/9/1/A1	757	3.1	2.6
6	TE/13/9/1/A1	7933	1.7	2.2
7	TE/13/9/1/A3	8096	Meter not working	
8	TE/13/9/1/A3	16634	1.7	1.8
9	TE/13/9/2	7316	2.4	3.6
10	TE/13/9/2	4051	1.8	1.8
11	TE/13/9/3	9420	2.9	4
12	TE/13/9/3	755	3.3	3.5
13	TE/13/9/3	756	8.8	9.5
14	TE/13/9/4	6954	1.5	1.9
15	TE/13/9/5	8537	2.8	2.6
16	TE/13/9/5	8846	Meter not working	
17	TE/13/9/6	5806	3.6	3.7
18	TE/13/9/6	7820	2.2	2.8
19	TE/13/9/6	10028	0.8	0.8
20	TE/13/9/6/B	5074	1	0.7
21	TE/13/9/6/B	5073	2.2	2.7
22	TE/13/9/7	11397	4.1	5.5
23	TE/13/9	754	2.7	2
		Total	**66.7**	**68.3**

0.6 POST (from TE13 to TE13 / 9) in Table 7.29

Table 7.29

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TE 13	7581	0	0.1
1	TE 13	723	4.4	4.9
3	TE 13	7506	Meter not working	
4	TE 13/1	16938	2	2.1
5	TE 13/1	3865	4	4.3
6	TE 13/2/B	15319	Meter not working	
7	TE 13/2/B	4988	3.2	4
8	TE 13/2/C	11236	6.2	6
9	TE 13/2/C/1	11451	1	1.3
10	TE 13/2/C/2	11775	2.2	2.2
11	TE 13/2/D	18957	1.1	1.1
12	TE 13/2/E	11186	2.3	2.3
13	TE 13/2/E	12136	3.2	3.1
14	TE 13/2/E	11519	2	1.9
15	TE 13/3	750	15.6	9.3
16	TE 13/3	761	4.2	3.2
17	TE 13/3	19095	1.5	22.7
18	TE 13/4	7153	2.1	1.9
19	TE 13/4	11514	3.5	3.3
20	TE 13/4/1	12095	2.9	4
21	TE 13/4/1	4211	Meter not working	
22	TE 13/4/2	18460	0.6	0.7
23	TE 13/4/2	8635	2.6	2.5
24	TE 13/4/2	18659	4.3	4
25	TE 13/5/1	4983	Meter not working	
26	TE/13/6	9677	5.4	4.5
27	TE 13/6	11480	3	1.9
28	TE 13/6	8672	2	2.9
29	TE 13/6	6223	3.1	4.3
30	TE 13/6	752	4.1	4.7
31	TE 13/7	10512	1.4	1.6
32	TE 13/7	15389	5.5	5.9
33	TE 13/7	759	1.1	1.3
34	TE 13/8	3828	3.1	3.1
35	TE 13/8	753	2.8	3.3
36	TE 13/8	6912	2.7	4.3
37	TE 13/8	7096	4.4	4.6
38	TE 13/9	9218	1	1.8
39	TE13/4	760	Meter not working	
40	TE13/4	6144	Meter not working	
		Total	**107.96**	**129.1**

0.7 POST (from TE/2/3 to TE /2/10/1) in Table 7.30

Table 7.30

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TE/2/3	3968	5.4	6
2	TE/2/4	3819	1.7	2
3	TE/2/4	4576	2.8	3.2
4	TE/2/5	5767	3.9	3.9
5	TE/2/5/1	3708	5	5.1
6	TE/2/5/2	7584	3.4	4.1
7	TE/2/5/4	3711	2.2	2.7
8	TE/2/6	717	8.6	8
9	TE/2/7	18352	4.6	5.3
10	TE/2/7	4337	0.7	0.8
11	TE/2/8	6906	3.7	5.1
12	TE/2/8/1	9594	2	3
13	TE/2/8/1	10517	4.9	3.8
14	TE/2/8/1	10853	2	2
15	TE/2/8/1	9552	1.4	1.1
16	TE/2/8/2	16681	2.2	2.3
17	TE/2/8/B	8416	3.9	4.5
18	TE/2/8/B	17868	2.3	2
19	TE/2/8/B	16527	0.9	2
20	TE/2/8/C	5740	2.3	2.5
21	TE/2/8/C	16293	1.3	1.5
22	TE/2/8/C	16339	2.6	3.4
23	TE/2/8/C/1	18458	3	3
24	TE/2/8/D	18203	3	3
25	TE/2/8/E	9039	2.8	2.7
26	TE/2/8/E	5855	2.4	1.7
27	TE/2/8/E	3712	Meter not working	
28	TE/2/8/E	11481	3.8	4
29	TE/2/8/E	9273	2.5	2.9
30	TE/2/8/F	8037	0.3	0.8
31	TE/2/8/F	8202	1.3	1.2
32	TE/2/9	3710	2.4	3.1
33	TE/2/10	6560	6.7	7.3
34	TE/2/10/1	5644	1.9	1.8
35	TE/2/10/1	DL		DL
36	TE/2/11	8418	6.2	0.5
37	TE/2/12	8123	1.7	1.7
38	TE/2/12	8002	2.1	2
39	TE/2/13	6419	3.9	4.4
40	TE/2/10/1	4936	0	0
41	TE2/8/A	4498	1.9	2.1
42	TE/2/5/A	3709	Meter not working	
		Total	**113.7**	**116.5**

0.8 POST (from TE6 to TE12/1) in Table 7.31

Table 7.31

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TE6	7606	1.1	1.2
2	TE6/2	2110	1.7	1.4
3	TE6/2	11005	1.3	1.3
4	TE6/3	10304	1.3	1.3
5	TE6/3	11006	3.5	3.2
6	TE6/3	15517	1.7	2
7	TE6/3	11475	1	1.3
8	TE6/3	16544	0.4	0.3
9	TE6/4	10829	1.9	2.2
10	TE6/5	17990	2.1	4.3
11	TE7	5255	6	7
12	TE7	3820	6.8	1.9
13	TE7	8807	1.9	2.1
14	TE/8/2	763		DL
15	TE/8/3	17555	P-2.2,L-0.5	P-0.2, L-0.1
16	TE/8/3	12097	7.3	6.6
17	TE/9	4852	0.7	1
18	TE/9	762	2.6	3.5
19	TE/9/2	8937	3.7	3.6
20	TE/9/2	9105	2.6	2.5
21	TE/9/2/B	17816	1.6	2.1
22	TE/9/3	9164	Meter not working	
23	TE/9/4	7531	Meter not working	
24	TE/9/4	9305	2.9	2.8
25	TE/9/4	6098		DL
26	TE/9/4	7470	Meter not working	
27	TE/10	721	2.1	2.5
28	TE/10	8162	3.7	4.1
29	TE/10	4623	Meter not working	
30	TE/10/2	10686	Meter not working	
31	TE/11	9365	3.2	3.2
32	TE/11	9681	Meter not working	
33	TE/11/1	17448	Meter not working	
34	TE/11/1	8038	1.2	0.8
35	TE/11/1	12014	0.3	0.4
36	TE/11/3	8571	4.8	5.7
37	TE/11/3	6778	2.9	1.9
38	TE/11/3	12102	4.5	4.7
39	TE/11/4	9065	5	5.6
40	TE/11/4	9108	2.3	2
41	TE/11/5	9109	0.9	0.9
42	TE/11/5	19080	1.5	1.9
43	TE/11/5	17962	4.6	5.1
44	TE/12	16692	3	4
45	TE/12/1	15408	4.1	4.9
46	TE/12/1	3981	8.3	21.2
47	TE/11/3	4485	1.3	0.6
48	TE/10	721	2.1	2.5
49	TE/9/2	11520	0.3	0.3
		Total	**110.9**	**124.2**

0.9 POST (from TT37 to TT41) in Table 7.32

Table 7.32

Sl. No	Pole/ Post No	Consumer's No	Consumption of 11.02.2009 in kWh	Consumption of 12.02.2009 in kWh
1	TT37		2.2	
2	TT37/B	9517	6.5	6.6
3	TT37/1	4866	DL	DL
4	TT37/1	6320	5.9	6
5	TT37/1	5371	6.6	6.7
6	TT37/1	5957	P-0.5	P-0.7, L-0
7	TT37/1	11460	Meter not working	0
8	TT37/1	3753	0.3	0.8
9	TT37/1	15768	Meter not working	0
10	No NO	18848	0.4	1.4
11	TT38	11780	9.8	9.5
12	TT38	10149	Meter not working	0
13	TT38	7783	2.4	2.5
14	TT38	17979	4.2	4.3
15	TT39	9947	0.5	0.7
16	TT39	8444	3.1	3.9
17	TT39	3227	DL	DL
18	TT39	703	5.1	3.8
19	TT39	16744	1.6	1.1
20	TT39	11936	P-34, 0.1	P-27.5, L-0.1
21	TT39	18761	5.4	5.6
22	TT39	4408	3	5.2
23	TT41	707	1.8	2.6
24	TT41	11068	1	3.2
25	TT41	16106	Meter not working	
26	TT41	705	Meter not working	
27	TT37/1	6635	Meter not working	
		Total	**94.4**	**92.2**

7.8.3 Secondary Distribution Loss

Table 7.33

Description	Energy Consumption for two days in kWh
From Consumer's Energy Meter	1824
Form Energy Meter at Transformer	2280
Difference in Units / Energy Loss	456
% Energy Loss for the LT distribution line	20%
Commercial loss (due to defective meters and Street lighting)	11.9%
Technical loss	8.1%
Transformer loss	2.8%
Total secondary distribution loss	10.9%

7.8.4 OBSERVATION

During Signature analysis we found

Streetlights are also connected in the transformer

33 Consumer meters were found to be not working. (12% of total)

To segregate the Technical losses we followed the below procedure

Interacting with the consumer not revealed the exact load.

The past bills were analysed and the average is arrived out.

The average consumption of the above consumer is 116kWh for the analysis period.

Total loss	= 456kWh
Street light consumption	= 156kWh
Due to defective meter	= 116kWh
Actual technical loss	= 184kWh

% of technical loss on total consumption = (184/2280) x 100 = **8.1**

7.8.5 SUGGESTION

The defective meters are to be replaced to get the exact revenue from the consumer. Presently, consumers having faulty meters are billed according to average consumption.

7.8.6 SUGGESTION

Separate line can be run and the street light connections can be taken from the same.

Energy meter can be fitted at the feeding point and the exact consumption can be measured and billed

One no 10kVA Energy Saver with RTC timer for Switching it ON and OFF at specified timing.

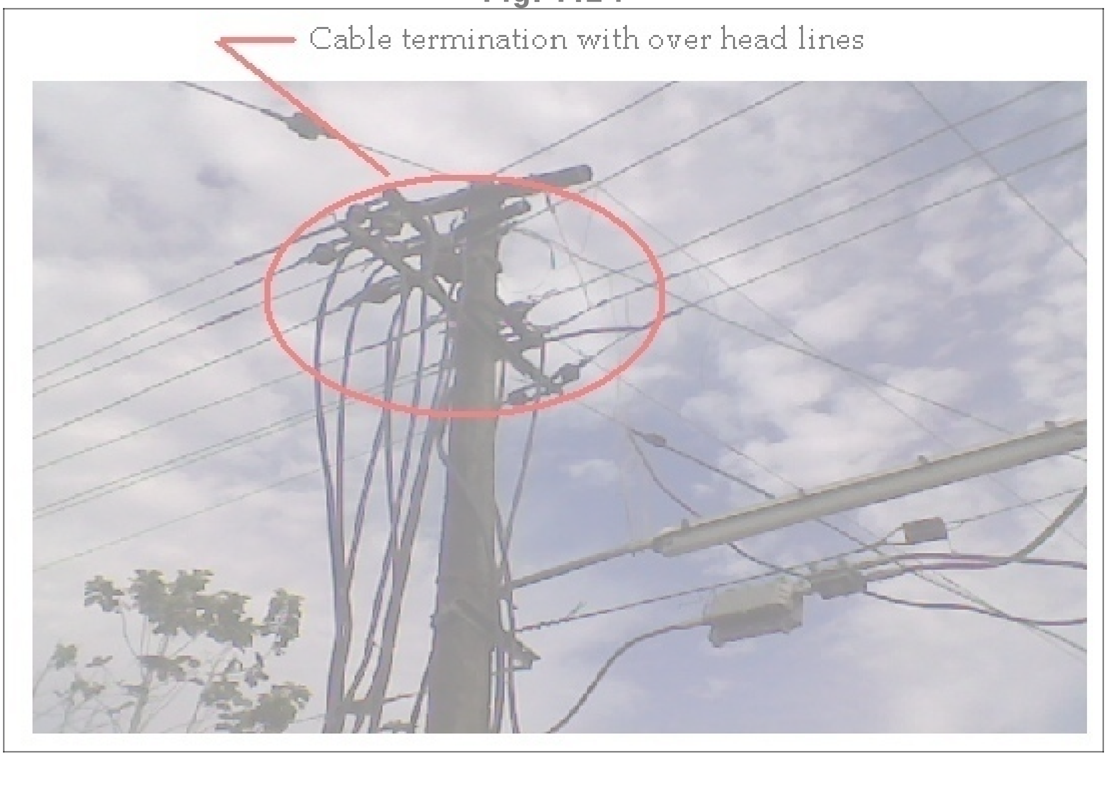
7.9.0 PICTURES OF THIRUVALLA SITE SECONDARY DISTRIBUTION FUSE PANEL AND CABLE TERMINATION

0.1 Fig 7.23 shows the front view of the distribution fuse panel

Fig. 7.23

0.2 Fig. 7.24 shows the termination with overhead lines

Fig. 7.24



0.3 Fig 7.25 shows the LT outgoing terminal at transformer terminal

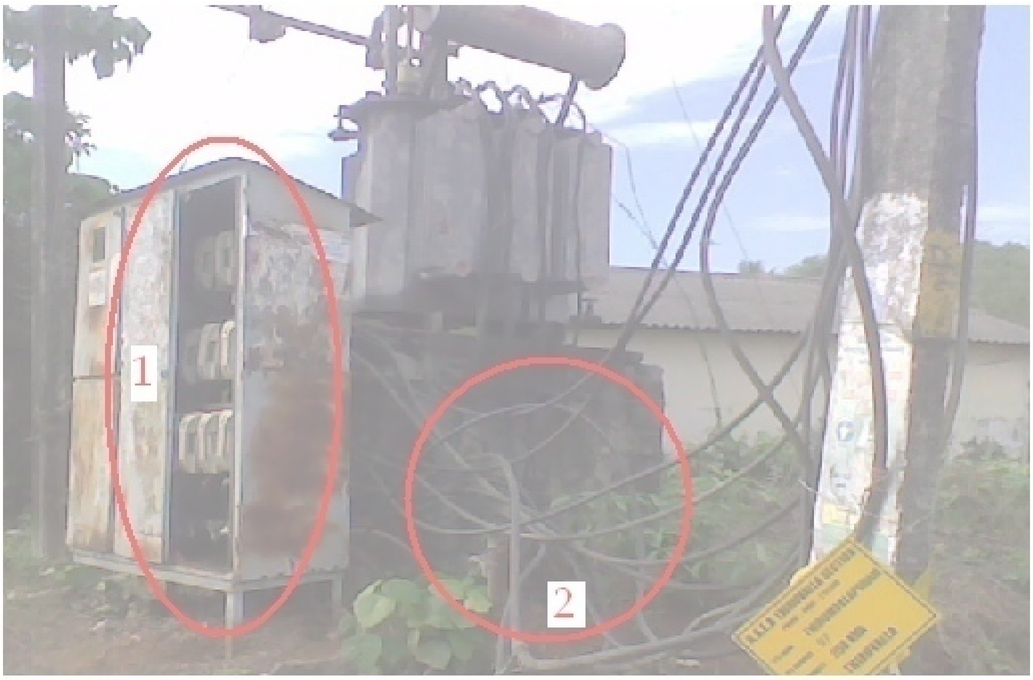
Fig. 7.25

LT cable Tremination at Transformer

0.4 Fig 7.26 shows the improper dressing of cables and the missing front cover of the panel

Fig. 7.26

1. Panel door missing. 2. Cables are not properly terminated



7.9.1 OBSERVATION

From the above pictures it is clear that

- The Distribution Panel is not closed.
- The cables are not dressed properly
- Distribution Board not earthed.
- LT line Sagging found on the interior area.
- Wooden poles were used in some places, which are very old

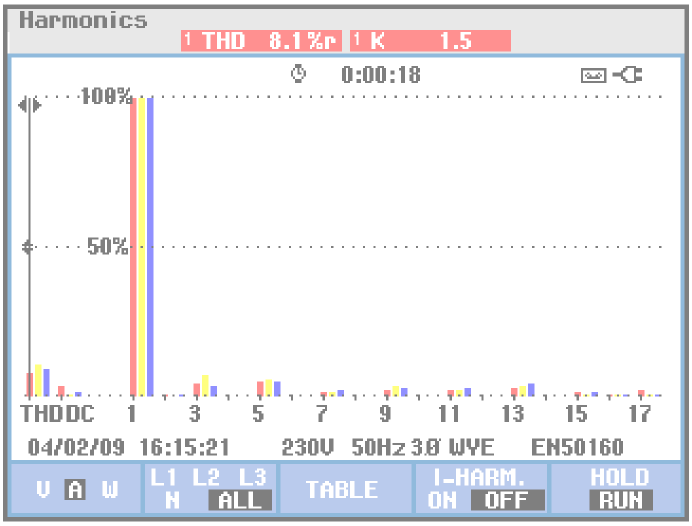
7.9.2 SUGGESTION

- Secondary Distribution Fuse Panel can be replaced with panel with MCB as followed by other Electricity Boards.
- Till such time Doors can be fitted.
- Dummy Carriers to be provided where connections are not taken
- The cables are to be dressed.
- Distribution panel is to be earthed.
- Lines are to be re- shackled.
- Wooden poles are to be replaced with RCC poles.
- Trees touching the OH lines are to be cut/trimmed periodically.
- Energy efficiency of street lights has to be improved.

7.10.0 HARMONICS MEASUREMENT

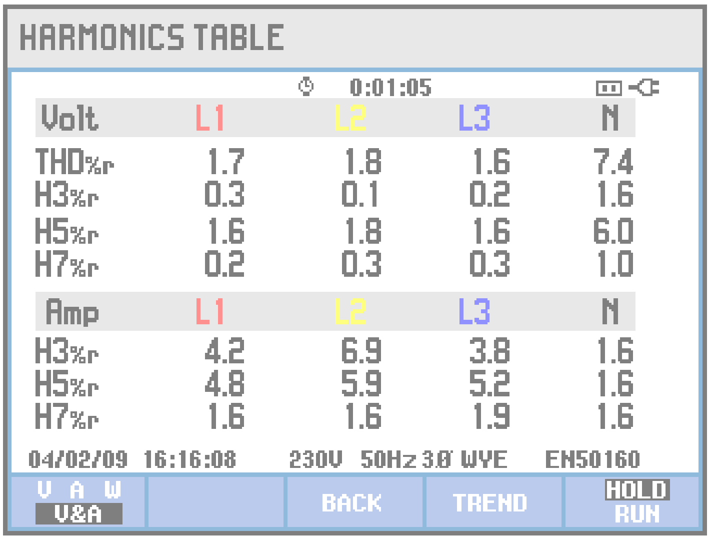
7.10.1 Fig. 7.27 shows the TDH value of the current

Fig. 7.27



7.10.2 Fig. 7.28 shows the % value of voltage and current harmonics

Fig. 7.28



HARMONICS TABLE

0:01:05

Volt	L1	L2	L3	N
THD%r	1.7	1.8	1.6	7.4
H3%r	0.3	0.1	0.2	1.6
H5%r	1.6	1.8	1.6	6.0
H7%r	0.2	0.3	0.3	1.0

Amp	L1	L2	L3	N
H3%r	4.2	6.9	3.8	1.6
H5%r	4.8	5.9	5.2	1.6
H7%r	1.6	1.6	1.9	1.6

04/02/09 16:16:08 230V 50Hz 3Ø WYE EN50160

V A W V&A | BACK | TREND | HOLD RUN

As per IEEE-519 – 1996 The THD for voltage at the connection point shall not exceed 5% with no individual Harmonics higher than 3%.

The THD for current drawn from the transmission system at the connection point shall not exceed 10%.

OBSERVATION

The THD (Total Harmonic Distortion) level is within limit.

Section 8

PALAKKAD SITE

8.1.0 SITE DESCRIPTION

The Transformer is of 160 kVA capacity located near Kalpaka Tourist Home, Sulthanpet, and Palakkad. There are three feeders going from the transformer. One of the feeders is fed to the domestic consumers through the overhead line. Other two feeders are fed to Commercial consumers in the G.B.Road Area. There is no street light feeder from this transformer. Pole to pole and pole to consumer distance are measured and drawn in the pole mapping, which is shown in Figures 8.13 to 8.15. The exact unit consumption is arrived from the Signature Analysis and given in the tables. The Electrical measurements of the transformer at different time were measured and tabulated in detail .The data logger was put for 15 days and the data was analyzed and the load trend is given for a week day and a Sunday in Figure 8.1 to 8.10.

HT supply is fed from 110/11kV Vennakkara Substation 5Km away from the transformer. Standby feeder is from Kalmandapam substation.

8.1.1 Specifications of the ACSR conductor used

Table 8.1

Used for	Code Name	No. of Strands and Dia				Diameter of complete conductor mm	Gross area of Al. Sq.mm	Resistance at 20^0C Ohms/Km	Current rating for Tem. Raise 40^0C above ambient
		Aluminium		Steel					
		No.	Dia mm	No.	Dia mm				
HT 1KV	Racoon	6	4.09	1	4.09	12.27	77.83	0.3656	197A
LT 433V	Rabbit	6	3.35	1	3.35	10.05	52.95	0.54	148

To connect the LT bushing and the distribution fuse panel single run of 70sqmm single core copper cable is used for each phase and neutral.

8.1.2 Location of the Transformer: - Kalpaka Tourist home
KSEB Office under which purview the Transformer Comes- Sultanpet
Place/ Locality / Village fed by the Transformer: - Sultanpet Area

8.1.3 Transformer Name Plate details

Table 8.2

MAKE	**VEE YES JOY, PALAKKAD**				
TYPE					
SERIAL NO	V53198/ 1984	**Manufacturing Date**		1998	
RATING	160	kVA	**PHASE**	3	
HIGH VOLTAGE	11000	VOLTS	**FREQUENCY**	50	HZ
LOW VOLTAGE	415	VOLTS	**% IMPEDENCE @ 75**	4.66	OHMS
CURRENT AT HV	8.40	A	**TEMPERATURE RISE LIMIT**	44/5 5	DEGREE CELCIUS
CURRENT AT LV	213.35	A	**COOLING TYPE**	ONAN	
CONNECTIVITY			**OIL IN LITRES**	270 LITRES	
WEIGHT OF OIL IN KG	235	KG	**WEIGHT OF CORE IN KG**	360 KG	
TOTAL WEIGHT IN KG	895	KG			
TAPPING Selected	7				

Short circuit current level {(100/4.66) x 160000} / 415 X 1.732 = 4578A

8.1.4 HT side Measurement

As there was no metering arrangement on HT side The HT voltage level verified at the feeding substation. As per their records Voltage is maintained always at 11KV by adjusting OLTC.

8.1.5 HT/LT Ratio

H.T /L.T ratio is the total distance of HT line to the total Distance of L.T lines in an Electrical utility. Unless the study of the network connected to the whole major substation (220kV& below) is carried out, HT/LT ratio cannot be arrived at, as the HT line is feeding many other transformers; whatever can be calculated based on single Distribution Transformer might be erroneous.

8.2.0

Data loggers were provided at the outgoing of the transformer and the parameters were down loaded from15/1/09 to 5/2/09.

From the data the load curve is plotted and given below

8.2.1 Logged Data for a weekday shown in Table 8.3

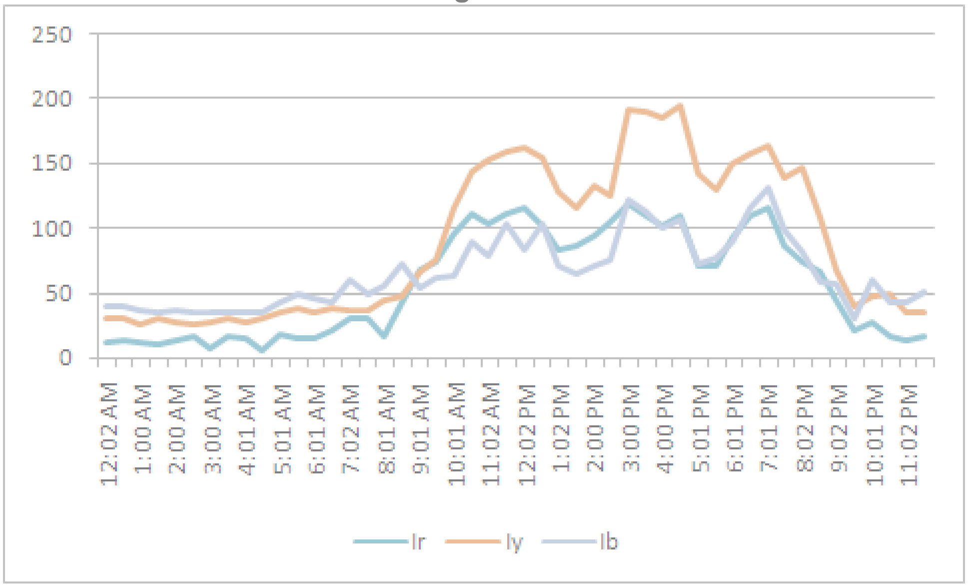
Table 8.3

Record Time	Vr	Vy	Vb	Ir	Iy	Ib	kWr	kWy	kWb	kVAr	kVAy	kVAb	kWt	kVAt	PFt
12:02 AM	251	246	243	11	31	40	2	6	9	2	7	9	17	19	0.89
12:31 AM	249	245	243	12	31	41	2	6	9	3	7	9	17	19	0.89
1:00 AM	250	243	241	11	26	37	2	5	8	2	6	8	15	16	0.94
1:31 AM	251	246	245	10	30	36	1	6	8	2	7	8	15	16	0.94
2:00 AM	254	250	247	12	27	37	2	5	8	3	6	8	15	17	0.88
2:31 AM	251	248	245	16	26	36	2	5	8	4	6	8	15	17	0.88
3:00 AM	254	248	245	7	27	35	1	5	8	1	6	8	14	15	0.93
3:32 AM	251	248	245	16	30	36	2	6	8	4	7	8	16	17	0.94
4:01 AM	254	248	245	14	27	35	2	5	8	3	6	8	15	17	0.88
4:32 AM	251	248	245	5	31	36	1	6	8	1	7	8	15	16	0.94
5:01 AM	250	244	242	17	35	44	4	6	9	4	8	10	19	21	0.90
5:30 AM	245	239	236	15	38	50	2	7	10	3	8	11	19	22	0.86
6:01 AM	241	236	233	15	35	47	2	6	9	3	8	10	17	20	0.85
6:30 AM	236	230	226	20	38	43	3	7	8	4	8	9	18	20	0.90
7:02 AM	239	232	229	30	37	60	5	7	12	7	8	13	24	27	0.89
7:32 AM	239	236	233	30	37	50	5	7	9	7	8	11	21	24	0.88
8:01 AM	236	233	231	16	44	56	2	8	11	3	9	12	21	24	0.88
8:32 AM	236	233	229	42	47	72	8	9	15	9	10	16	32	35	0.91
9:01 AM	236	231	231	67	66	54	13	13	11	15	14	12	37	41	0.90
9:30 AM	232	228	227	73	75	62	14	14	12	16	16	13	40	45	0.89
10:01 AM	229	223	226	95	115	64	18	20	12	20	24	14	50	58	0.86
10:30 AM	227	223	224	111	143	90	20	26	17	24	30	19	63	73	0.86
11:02 AM	230	223	226	103	152	79	19	28	15	22	32	17	62	69	0.90
11:30 AM	227	223	224	110	158	103	21	29	20	23	33	22	70	78	0.90
12:02 PM	229	225	228	115	162	83	21	30	16	25	35	18	67	77	0.87
12:31 PM	232	228	229	101	154	103	19	29	21	22	33	22	69	76	0.91
1:02 PM	236	231	232	83	128	71	15	24	14	18	28	15	53	60	0.88
1:31 PM	235	231	233	86	116	65	14	22	13	19	25	14	49	58	0.85
2:00 PM	235	231	232	94	133	71	17	26	14	21	29	16	57	65	0.88
2:31 PM	232	228	229	104	124	76	20	23	15	23	27	16	58	66	0.88
3:00 PM	230	223	226	118	191	122	22	36	24	25	40	26	82	90	0.91
3:29 PM	229	223	226	108	189	113	21	36	23	23	40	24	80	88	0.91
4:00 PM	231	224	226	101	184	101	19	35	20	22	39	22	74	81	0.91
4:32 PM	230	223	226	109	194	106	21	36	21	24	41	23	78	87	0.90
5:01 PM	234	228	229	70	142	72	12	26	13	15	31	15	51	61	0.84
5:32 PM	236	231	231	70	130	77	13	23	15	15	28	17	51	60	0.85
6:01 PM	241	238	239	91	149	89	17	27	18	21	34	20	62	74	0.84
6:30 PM	229	223	226	109	157	115	19	27	22	23	33	25	68	80	0.85
7:01 PM	229	223	224	115	163	131	21	29	26	25	35	28	76	87	0.87
7:30 PM	227	223	223	86	139	98	15	24	18	18	29	21	57	67	0.85
8:02 PM	232	225	228	73	146	82	13	25	16	16	31	18	54	64	0.84
8:30 PM	238	233	233	65	107	58	12	18	11	14	23	13	41	50	0.82
9:02 PM	239	236	233	43	68	57	8	13	12	9	15	13	33	37	0.89
9:25 PM	246	241	239	21	40	31	3	8	6	5	9	7	17	20	0.85
10:01 PM	244	239	238	26	48	60	4	9	12	6	11	13	25	29	0.86
10:30 PM	246	241	239	16	49	44	3	10	9	4	11	10	22	23	0.96
11:02 PM	250	245	243	12	35	43	2	7	9	3	8	10	18	20	0.90
11:30 PM	247	243	241	16	36	51	2	7	11	4	8	11	20	22	0.91
12:02 AM	244	241	238	9	35	48	1	7	10	2	8	11	18	19	0.95

8.2.2 Load Curve for a week day

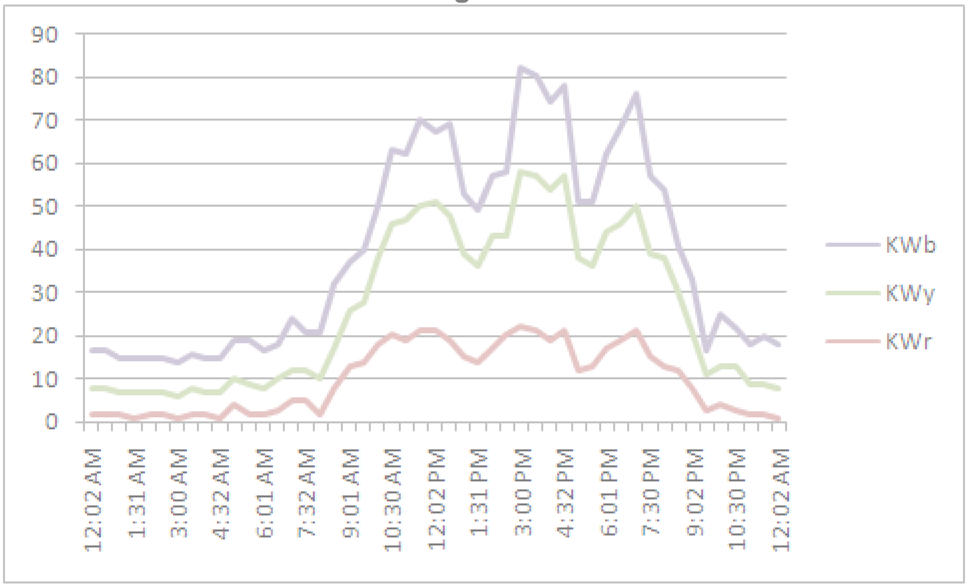
0.1 Fig. 8.1 Shows the Current Trend in each phase on a week day

Fig. 8.1



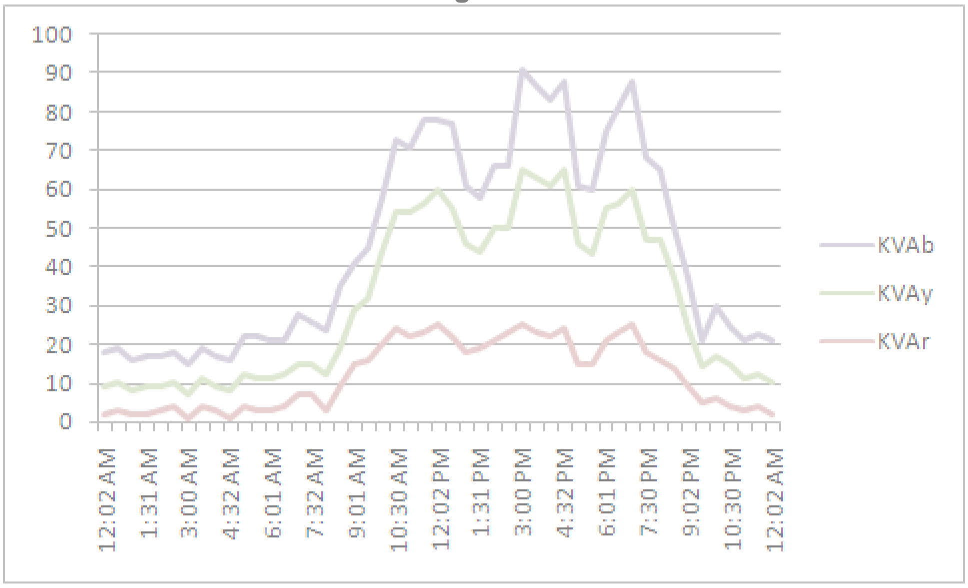
0.2 Fig. 8.2 Shows the Power Trend in each phase on a week day

Fig. 8.2



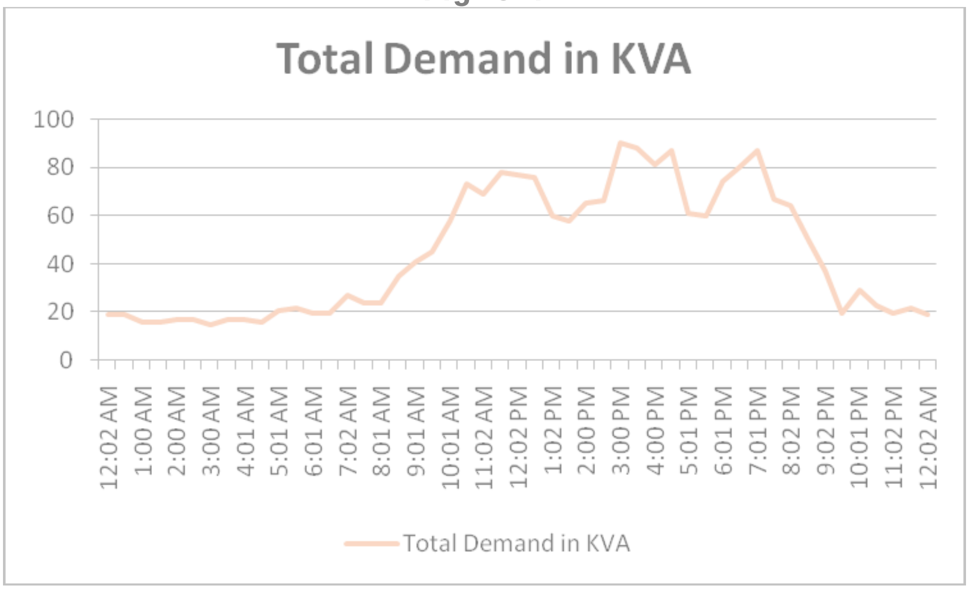
0.3 Fig. 8.3 Shows the Demand Trend in each phase on a week day

Fig. 8.3



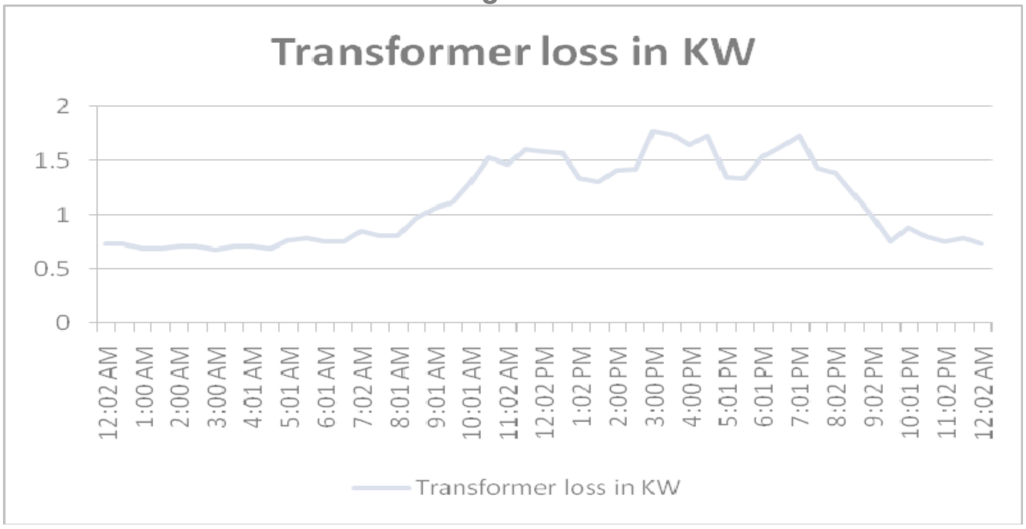
0.4 Fig. 8.4 shows the total Demand Trend on a week day

Fig. 8.4



0.5 Fig. 8.5 shows the transformer loss Trend on a week day

Fig. 8.5



On week days transformer load factor varies from 10% to 56.2%
Power factor varies from 0.82 to 0.96 lag.

8.2.3 Logged Data on a Sunday shown in Table 8.4

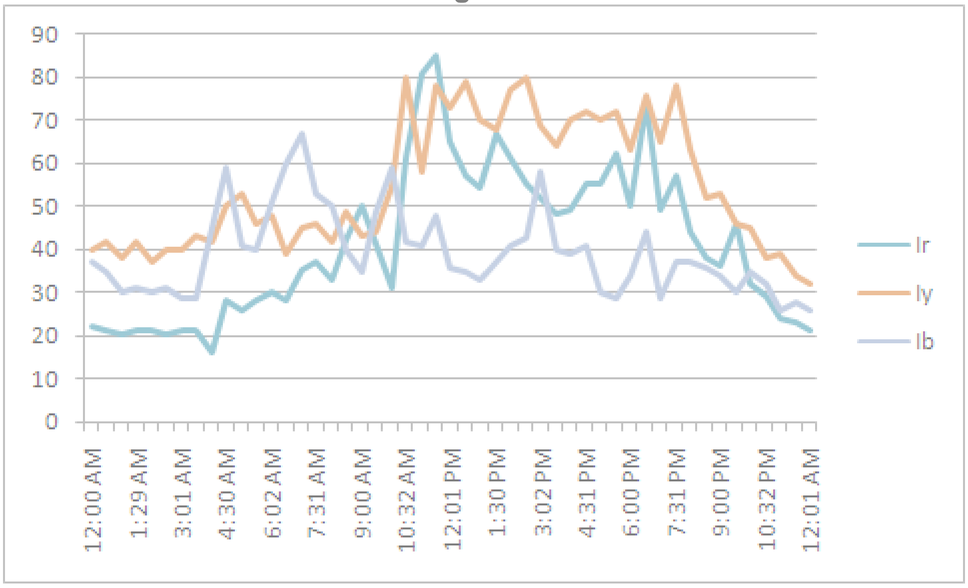
Table 8.4

Record Time	Vr	Vy	Vb	Ir	Iy	Ib	kWr	kWy	kWb	kVAr	kVAy	kVAb	kWt	kVAt	PFt
12:00 AM	242	238	236	22	40	37	4	8	8	5	9	8	20	22	0.91
12:29 AM	244	239	236	21	42	35	3	8	8	5	9	8	19	21	0.90
1:00 AM	244	239	236	20	38	30	3	8	6	4	8	6	17	18	0.94
1:29 AM	244	241	238	21	42	31	4	9	7	4	9	7	20	21	0.95
2:01 AM	249	245	243	21	37	30	4	8	6	5	8	7	18	19	0.95
2:32 AM	247	242	241	20	40	31	4	9	6	4	9	7	19	20	0.95
3:01 AM	249	243	243	21	40	29	4	9	6	5	9	7	19	20	0.95
3:30 AM	249	245	243	21	43	29	4	9	6	5	10	7	19	20	0.95
4:01 AM	250	243	242	16	42	45	3	9	10	4	9	10	22	23	0.96
4:30 AM	247	243	241	28	50	59	5	10	12	6	11	13	27	30	0.90
5:02 AM	244	241	239	26	53	41	4	11	8	6	12	9	23	26	0.88
5:30 AM	241	238	236	28	46	40	4	9	8	6	10	9	21	25	0.84
6:02 AM	241	236	233	30	48	51	5	9	10	7	11	11	24	28	0.86
6:31 AM	237	233	231	28	39	60	4	7	12	6	8	13	23	26	0.88
7:02 AM	236	231	229	35	45	67	6	8	13	8	9	15	27	30	0.90
7:31 AM	239	236	233	37	46	53	6	8	10	8	10	11	24	29	0.83
8:00 AM	239	237	233	33	42	50	6	7	9	7	9	11	22	26	0.85
8:31 AM	238	234	233	42	49	40	8	9	7	9	11	9	24	28	0.86
9:00 AM	239	236	233	50	43	35	10	8	6	11	9	8	24	28	0.86
9:31 AM	237	234	232	41	44	49	7	8	10	9	9	11	25	28	0.89
10:07 AM	239	236	233	31	55	59	6	11	12	7	12	13	29	32	0.91
10:32 AM	236	234	233	61	80	42	10	16	7	13	18	9	33	39	0.85
11:01 AM	235	232	231	81	58	41	15	11	7	18	13	9	33	38	0.87
11:30 AM	235	231	231	85	78	48	16	14	8	19	17	10	38	45	0.84
12:01 PM	238	236	236	65	73	36	11	14	6	14	16	8	31	37	0.84
12:30 PM	235	230	229	57	79	35	10	15	6	13	17	7	31	36	0.86
1:01 PM	236	233	232	54	70	33	9	13	6	12	15	7	28	33	0.85
1:30 PM	236	234	233	67	68	37	12	13	6	15	15	8	31	37	0.84
2:02 PM	239	233	231	61	77	41	10	15	7	14	17	9	32	39	0.82
2:30 PM	237	233	231	55	80	43	10	15	7	12	18	9	32	38	0.84
3:02 PM	237	234	232	52	69	58	9	13	11	11	15	13	33	39	0.85
3:31 PM	238	236	233	48	64	40	8	12	6	11	14	9	26	33	0.79
4:00 PM	239	236	233	49	70	39	8	13	7	11	15	8	28	34	0.82
4:31 PM	236	231	231	55	72	41	8	13	7	12	16	9	28	36	0.78
5:00 PM	237	234	233	55	70	30	9	13	5	12	15	6	27	34	0.79
5:31 PM	236	234	233	62	72	29	10	14	5	14	16	6	29	36	0.81
6:00 PM	250	245	245	50	63	34	9	12	7	12	14	8	28	33	0.85
6:29 PM	241	239	239	74	76	44	13	14	9	17	17	10	36	43	0.84
6:55 PM	237	234	233	49	65	29	8	12	5	11	14	6	25	31	0.81
7:31 PM	236	234	233	57	78	37	11	14	7	13	17	8	32	37	0.87
8:00 PM	238	233	232	44	63	37	8	12	7	10	14	8	27	30	0.90
8:29 PM	241	236	236	38	52	36	7	10	7	9	11	8	24	27	0.89
9:00 PM	241	237	236	36	53	34	7	11	7	8	12	7	25	27	0.93
9:32 PM	241	239	238	46	46	30	9	10	6	10	10	7	25	27	0.93
10:01 PM	245	241	238	32	45	35	6	9	7	7	10	8	22	23	0.96
10:32 PM	240	236	233	29	38	32	5	7	6	6	8	7	18	20	0.90
11:01 PM	244	241	240	24	39	26	4	8	5	5	9	6	17	18	0.94
11:30 PM	250	244	242	23	34	28	4	7	6	5	8	6	17	18	0.94
12:01 AM	249	243	241	21	32	26	4	6	5	4	7	6	15	16	0.94

8.2.4 Load Curve on a Sunday

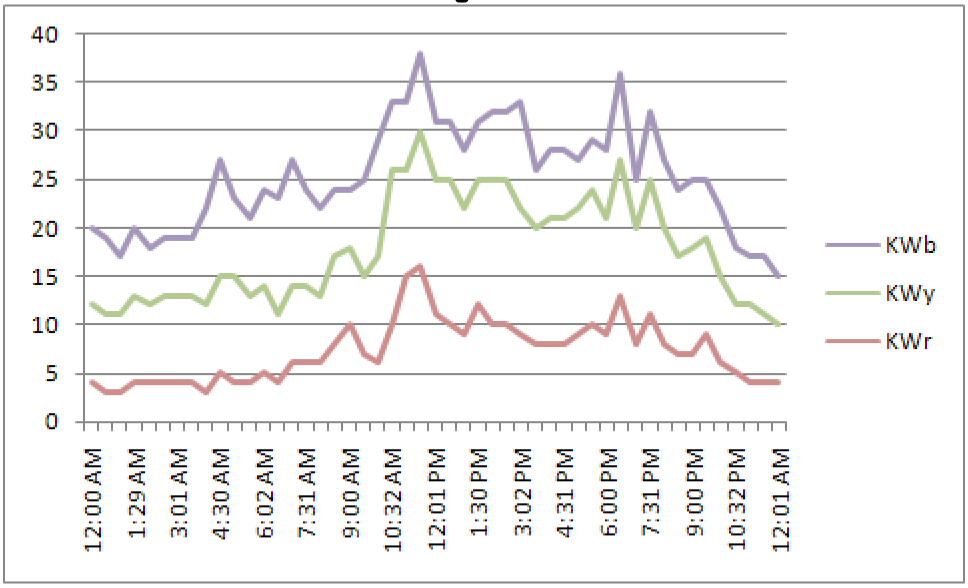
0.1 Fig. 8.6 Shows the Current Trend in each phase on a Sunday

Fig. 8.6



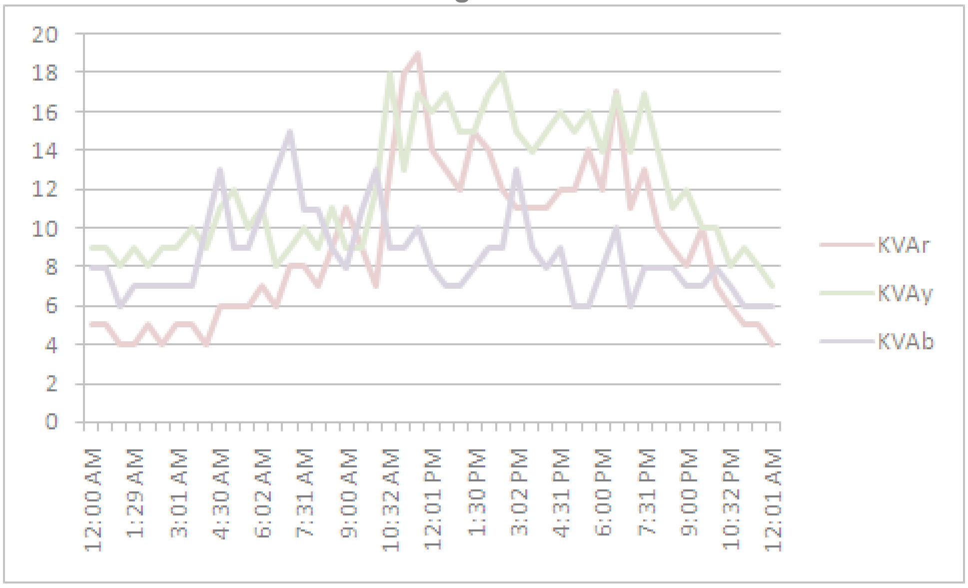
0.2 Fig. 8.7 Shows the Power Trend in each phase on a Sunday

Fig. 8.7



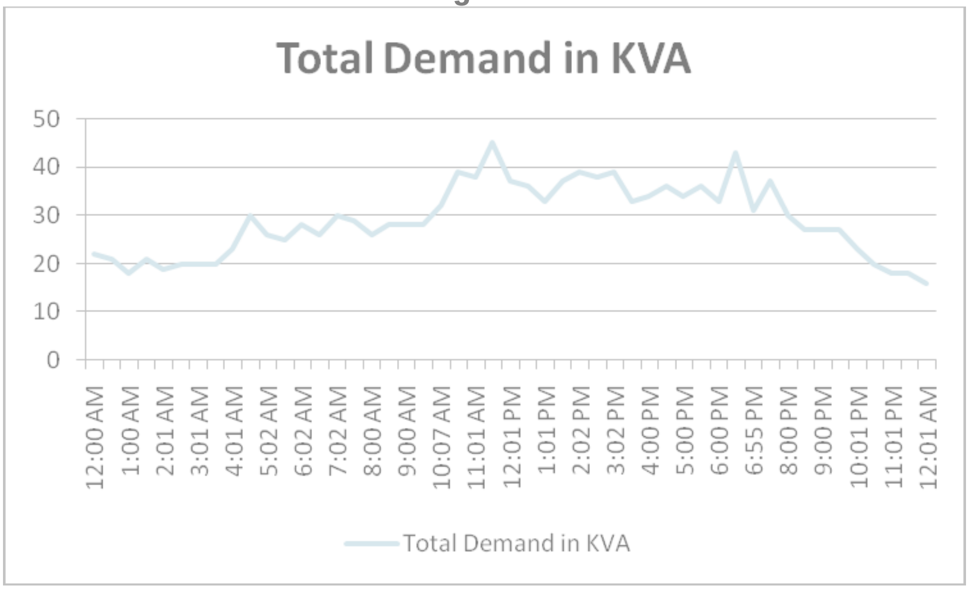
0.3 Fig. 8.8 shows the demand Trend in each phase on a Sunday

Fig. 8.8



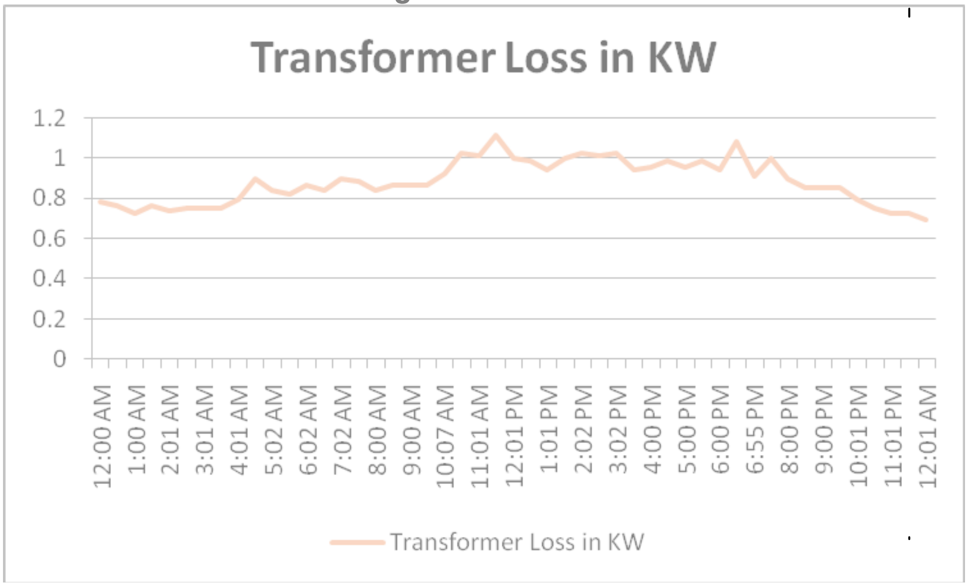
0.4 Fig. 8.9 shows the total Demand Trend on a Sunday

Fig. 8.9



0.5 Fig. 8.10 shows the transformer loss Trend on a Sunday

Fig. 8.10



The load factor of Transformer varies from 10% to 28.1%
The Power factor varies from 0.78 to 0.96 Lag

8.2.5 Load Ratio of the Transformer

Transformer Loading x 24Hrs /Capacity of the Transformer x24Hrs
={ (16.9x4.5)+(22.5 x 3.5)+(44.75 x 2)+(74.6 x 3)+(62.5 x 2)
+(86.5 x 2)+(60.5 x 1)+(74.4 x 2.5)+(27.5 x 3.5)}/160 x 24
= 1109.3/3840 = 0.29
= 29%

8.2.6 Transformer Loss

As per the Specification No load loss is 460W and Load loss is 2350W
For the above, total Transformer loss = 15.78 kWh/day

8.2.7 Suggestion

It is suggested to fix an energy meter at the HT side of the Transformer to ascertain the exact transformer losses.

Minimum Maximum actual loading

Load	Weekday	Sunday	Peak Time Weekday	Sunday	Offday Weekday	Sunday	Normal Weekday	Sunday
Maximum	56	28	54	27	15.6	14	12.5	28
Minimum	12.5	14	14	12.5	10	9	15.6	12.5

8.2.8 Observation

- Maximum load on the transformer is not more than 28% on Sunday and 56% on week days.
- During peak hours maximum load on Sunday is 27% and 54% on week days. The minimum load is 12.5% on Sunday and 14% on week days
- During normal hrs. max load on Sunday is 28% and 56% on week days and minimum load is 12.5% on Sunday and 15.6% on week days
- There is no much of difference on normal and peak hrs on loading pattern. This is because the commercial loads are along with the domestic load.
- During off peak hours/night max load is 14%on Sunday and 15.6% on week days and minimum load is 9% on Sunday and 10% on week days
- Un-balance load between Phases. Y Phase Load is higher when compare to other two phases.
- Y Phase reaches around 90% of name plate current.
- R Phase load is around 60% of Y Phase load
- B Phase load is around 67% of Y Phase load
- Neutral current is around 73A
- Voltage is having high Un-balance, between Phases
- Voltage at Y Phase is around 250V. During peak hours in evening it is around 240V
- This is due to low load on that phase during off peak hrs.
- The H.T voltage being maintained near rated voltage by OLTC in substation at the feeding end.
- It is observed that though the power factor is relatively good, considering the load variation, the influence of harmonic content cannot be ignored. Presently the transformer is severely under loaded and therefore the present harmonic distortions are not much harmful. But as and when the transformers get loaded above 50%, the harmonic amplification will be pronounced and will need to be attended to, using tuned harmonic filters.

8.2.9 Analysis for un- balance load

From the data it is clear that throughout the day unbalance load is there. While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase in number of consumer and the increase of load of the existing consumer might have created the unbalance.

8.2.10 Suggestion

It is suggested to fix an Ammeter at the LT Distribution fuse panel to monitor the LT current of the transformer.

8.2.11 Suggestion

Load to be balanced at the pole side

Some of the Y Phase loads can be shifted to other two phases.

This will reduce the Y Phase Current. This is now around 90% of full load current of the Transformer.

The neutral current will be reduced.

8.3.0 TEMPERATURE MEASUREMENT

Taken at full load

Atmosphere temperature is 35^0C

At Transformer Termination is 38^0C

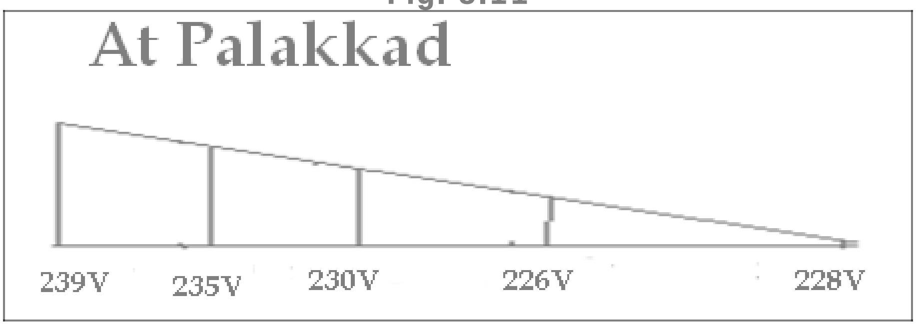
At Distribution end is 40^0C

At OH line termination is 38^0C

The above temperature reveals that that the Joints/Binding at the junctions is properly done.

8.4.0 VOLTAGE TREE DIAGRAM

Fig. 8.11



The voltage Drop is around 4.6%. This is within limit.

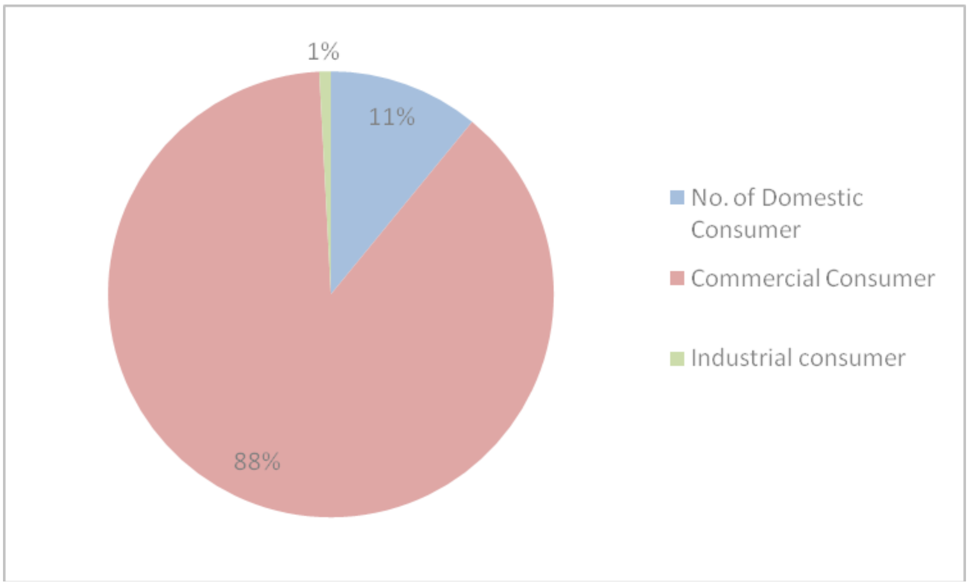
8.5.0 COMBINATION OF THE CONSUMER TYPE IS AS BELOW

Table 8.5

No. of Domestic Consumer	13
No. of BPL Consumer	Nil
Commercial Consumer	105
Industrial consumer	01

Total number of Customer: 119

Fig. 8.12



8.5.1 The consumer mix of this transformer may not have any impact on the distribution. There is only one small industrial load and most of the consumers are commercial and few Domestic consumers

The % mix of commercial load is very much high and the Domestic consumer is very low comparing with the total consumer mix of the entire Kerala State but the agriculture load is not there. The Commercial load

8.5.2 Consumer Density

No. of Consumer x 100/Transformer capacity

= 119 x 100/160 = 74.375 consumers per 100 kVA of transformer

8.5.3 The above no. is slightly high, and considering the modern homes, the consumer density of 50 to 60 per 100 kVA is more reasonable. However the loading density being low, this situation can be ignored, as losses will not be substantial.

8.5.4 Load Density

Connected load/Transformer capacity in kVA = 112.5/160 = 0.703 = 70%

8.6.0 CONSUMPTION DETAILS OF CONSUMER FOR SIX CONSECUTIVE MONTHS

0.1 POST (KLS-7 & KLS-11) in Table 8.6

Table 8.6

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	KLS-11	316	60	51	41
2	KLS-11	317	157	129	148
3	KLS-11	318	140	91	124
4	KLS-11	96	261	165	212
5	KLS-11	94	132	91	161
6	KLS-11	93	76	58	2
7	KLS-11	3217	26	88	90
8	KLS-11	4270	26	88	90
9	KLS-7	319	2798,2791	2841, 2928	2907, 3076
10	KLS-7	322	Bill not available		
11	KLS-7	323	260	173	214
12	KLS-7	324	148	142	141
13	KLS-7	10389	1060	887	957
14	KLS-7	321	0	0	18
15	KLS-11	95	206	190	69
16	KLS-7	91	656	535	630

0.2 POST (KLS-7, 8, 9 & 10) in Table 8.7

Table 8.7

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	KLS-7	16462	55	60	70
2	KLS-8	13334	0	76	97
3	KLS-8	91	656	535	630
4	KLS-8	15913	15	60	70
5	KLS-9	8083	25	54	52
6	KLS-9	8084	4	48	56
7	KLS-9	625	76	286	324
8	KLS-9	19089	Not available		
9	KLS-9	19088	Not available		
10	KLS-9	626	Not available		
11	KLS-9	No connection			
12	KLS-9	No connection			
13	KLS-9	No connection			
14	KLS-10	18465	1547	1272	1599
15	KLS-10	628	5	5	7
16	KLS-10	3657	186	158	172
17	KLS-10	110	2344,2458	2649,3173	2498,2583
18	KLS-10	14010	534	455	547

0.3 POST (KLS-7, 7(1) & KLS-4) in Table 8.8

Table 8.8

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	KLS-7	12562	114	231	143
2	KLS-7	4194	95	50	60
3	KLS-7	4631	196	394	370
4	KLS-7 (1)	16112	Bill not available		
5	KLS-7 (1)	4194	95	50	60
6	KLS-7 (1)	16169	136	113	162
7	KLS-7 (1)	16170	136	113	162
8	KLS-4	87	123	95	77
9	KLS-4	12756	Bill not available		
10	KLS-4	12755	1273	1144	1325
11	KLS-4	2898	14040,1312	1274,1177	1245,1252
12	KLS-4	15394	228	215	235
13	KLS-4	16743	122	99	143
14	KLS-4	81	385	247	274

0.4 POST (KLS-4 & KLS-6) in Table 8.9

Table 8.9

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	KLS-4	329	176	94	144
2	KLS-4	331			
3	KLS-4	332	70	64	77
4	KLS-4	333	70	68	84
5	KLS-4	6482	Bill not available		
6	KLS-4	4368	8	7	6
7	KLS-4	334	Not available		
8	KLS-4	335	Not available		
9	KLS-4	336	86	72	82
10	KLS-4	338	68	59	59
11	KLS-4	10047	No consumption		
12	KLS-4	2723	146	101	128
13	KLS-6	6513	No consumption		
14	KLS-6	7330	145	67	150
15	KLS-6	14414	No consumption		
16	KLS-6	6449	260	184	235
17	KLS-6	8262	Not available		
18	KLS-4	2831	314	311	276
19	KLS-2	2782	Not available		
20	KLS-4	6713	252	219	298
21	KLS-4	6714	112	77	89
22	KLS-2	339	15	15	15

0.5 POST (KLS-3, KLS-4 & KLS-12) in Table 8.10

Table 8.10

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	KLS-4	80	121	95	81
2	KLS-4	18452	612	529	497
3	KLS-3	9307	16	9	17
4	KLS-3	2752	821	725	891
5	KLS-3	5828	45	81	80
6	KLS-3	4283	No consumption		
7	KLS-3	76	120	120	141
8	KLS-3	3602	184	25	54
9	KLS-3	74	72	83	90
10	KLS-3	3845	1385	1000	1789
11	KLS-3	4374	874,944	1282,836	853,
12	KLS-12	4373	107	96	117
13	KLS-12	69	200	140	169
14	KLS-12	3930	1889	1482	1752
15	KLS-12	68	498	342	53
16	KLS-12	3399	dismantled		
17	KLS-12	66	171	158	161

0.6 POST (KLS-3, KLS-12 & KLS-13) in Table 8.11

Table 8.11

Sl. No	Pole/ Post No	Consumer's No	Consumption Units for the month of July and August 2008 (kWh)	Consumption Units for the month of September and October 2008 (kWh)	Consumption Units for the month of November and December 2008 (kWh)
1	KLS-3	3526	3990,5448	4267,5377	4323,4959
2	KLS-3	648	391,35	435, 636	457,379
3	KLS-3	340	1320	830	441
4	KLS-3	2831	314	311	276
5	KLS-3	343	100	8	Dl
6	KLS-2	344	458	361	462
7	KLS-2	2782	86	48	58
8	KLS-12	355	1985	1325	1496
9	KLS-12	354	34	18	18
10	KLS-13	349	196	194	200
11	KLS-13	350	61	47	47
12	KLS-13	351	139	113	143
13	KLS-13	352	205	118	176
14	KLS-13	353	79	65	62
15	KLS-13	2720	167	137	155
16	KLS-13	278	127	165	212
17	KLS-13	2708	120	161	149
18	KLS-13	5949	49	32	34
19	KLS-13	2781	180	157	149

The above data is analyzed and compared with the actual measurement taken during signature analysis and found to be matching

All the consumers connected from this transformer are metered in working condition at the time of the study.

No Street light is connected in this transformer.

8.7.0 CONSUMER PARTICULAR AND DISTRIBUTOR NETWORK DIAGRAM & ROUTING

0.1 Consumer Particulars in Table 8.12

Table 8.12

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
1		No connection		
2	KLS-11	DL		
2	KLS-11	DL		
2	KLS-11	316		Single phase
2	KLS-11	317		Single phase
2	KLS-11	318	10 Connection	Single Phase
2	KLS-11	96		Single phase
2	KLS-11	94		Single phase
2	KLS-11	95		Single phase
2	KLS-11	3217		Single phase
2	KLS-11	4270		Single phase
3	KLS-7	319		Single phase
3	KLS-7	322		Single phase
3	KLS-7	323		Single phase
3	KLS-7	324		Single phase
3	KLS-7	10389	12Connection	Three Phase
3	KLS-7	12234		Single phase
3	KLS-7	321		Single phase
3	KLS-7	91		Single phase
3	KLS-7	12562		Single phase
3	KLS-7	4194		Single phase
3	KLS-7	4631		Single phase
3	KLS-7	16462		Single phase
4	KLS-7 (1)	16112		
4	KLS-7 (1)	4194	4 Connection	Single Phase
4	KLS-7 (1)	16169		
4	KLS-7 (1)	16170		

0.2 Consumer Particulars in Table 8.13

Table 8.13

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
5	KLS-4	87		Single phase
5	KLS-4	12756		Three Phase
5	KLS-4	12755		Three Phase
5	KLS-4	2898		Three phase
5	KLS-4	15394		Single phase
5	KLS-4	16743		Single phase
5	KLS-4	81		Single phase
5	KLS-4	80		Single phase

0.3 Consumer Particulars in Table 8.14

Table 8.14

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
5	KLS-4	18452		
5	KLS-4	329		
5	KLS-4	331	22 Connection	
5	KLS-4	332		
5	KLS-4			Single phase
5	KLS-4			
5	KLS-4	4368		
5	KLS-4	334		
5	KLS-4	335		
5	KLS-4	336		Single phase
5	KLS-4	338		Single phase
5	KLS-4	10047		
5	KLS-4	2723		Single phase
5	KLS-4	2831		Single phase
6	KLS-5	NO Connection		
7	KLS-6	6513		
7	KLS-6	7330		Single phase
7	KLS-6	14414	5 connection	
7	KLS-6	6449		Single phase
7	KLS-6	8262		

0.4 Consumer Particulars in Table 8.15

Table 8.15

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
9	KLS-3	2752		Single phase
9	KLS-3	5828		Single phase
9	KLS-3	4283		Single phase
9	KLS-3	76		Single phase
9	KLS-3	3602		Single phase
9	KLS-3	74		Single phase
9	KLS-3	3845		Three Phase
9	KLS-3	4374	14 Connection	Three Phase
9	KLS-3	9307		Single phase
9	KLS-3	3526		Three Phase
9	KLS-3	648		Three Phase
9	KLS-3	340		Single phase
9	KLS-3	2831		Single phase
9	KLS-3	343		Single phase
10	KLS-2	344		Single phase
10	KLS-2	2782	3 Connection	Single phase
10	KLS-2	339		Single phase
11	NC			
12	KLS-12	4373		Single phase
12	KLS-12	69		Single phase
12	KLS-12	3930		Single phase
12	KLS-12	68		Single phase
12	KLS-12	3399	8 Connection	Single phase
12	KLS-12	66		Single phase
12	KLS-12	355		Single phase
12	KLS-12	354		Single phase
13	KLS-13	349		Single phase
13	KLS-13	350		Single phase
13	KLS-13	351		Single phase
13	KLS-13	352	10 Connection	Single phase
13	KLS-13	353		Single phase
13	KLS-13	2720		Single phase
13	KLS-13	278		Single phase
13	KLS-13	2708		Single phase
13	KLS-13	5949		Single phase
13	KLS13	2781		Single phase

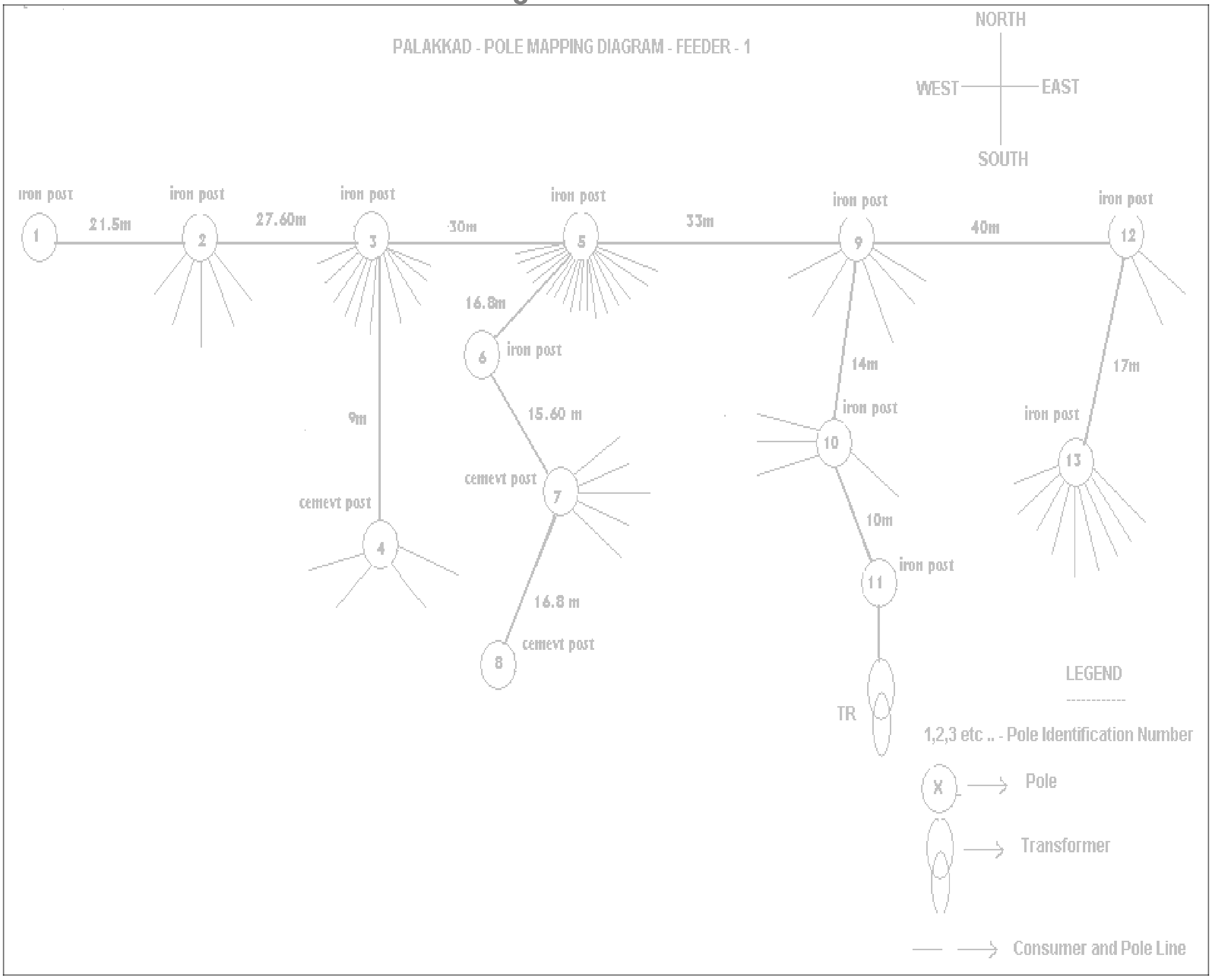
0.5 Consumer Particulars in Table 8.16

Table 8.16

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
14	KLS-8	13334		Single phase
14	KLS-8	91	3 Connection	Single phase
14	KLS-8	15913		Three Phase
15	KLS-9	8083		Single phase
15	KLS-9	8084		Single phase
15	KLS-9	625		Single Phase
15	KLS-9	19089		Single phase
15	KLS-9	19088	9 Connection	Single Phase
15	KLS-9	626		Single phase
15	KLS-9	DL		
15	KLS-9	DL		
15	KLS-9	DL		
16	KLS-10	18465		Three Phase
16	KLS-10	628		Single Phase
16	KLS-10	3657		Single phase
16	KLS-10	1110	6 Connection	Three Phase
16	KLS-10	14010		Single Phase
16	KLS-10	113		Single phase
17	KLN-1	12900		Single phase
17	KLN-1	2688	3 Connection	Single phase
17	KLN-1	DL		
18	KLN-2	1509		Three Phase
18	KLN-2	5101	3 Connection	Three Phase
18	KLN-2	9504		Three Phase
19	KLN-3	6762		Three Phase
19	KLN-3	14256		Three Phase
19	KLN-3	15214	5 Connection	Three Phase
19	KLN-3	4636		Single phase
19	KLN-3	347		Single phase
20	KLN-4	7419	1Connection	Three Phase
21	KLN-5	12442	1 Connection	Three Phase

0.6 Distributor network diagram & Routing shown in Fig. 8.13

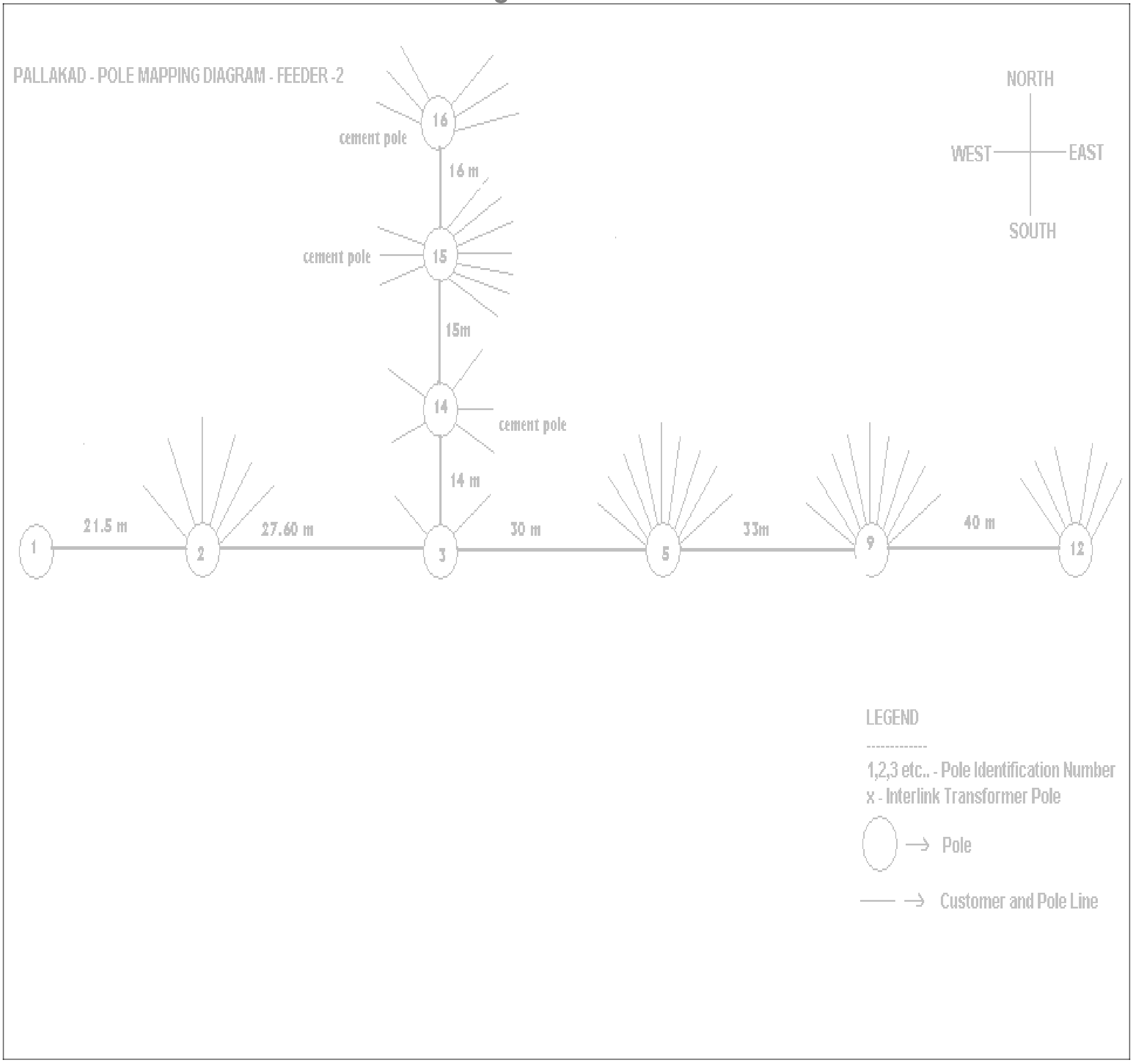
Fig. 8.13



Total length of the LT line of the above feeder is 251.3 meters

0.7 Distributor network diagram & Routing shown in Fig. 8.14

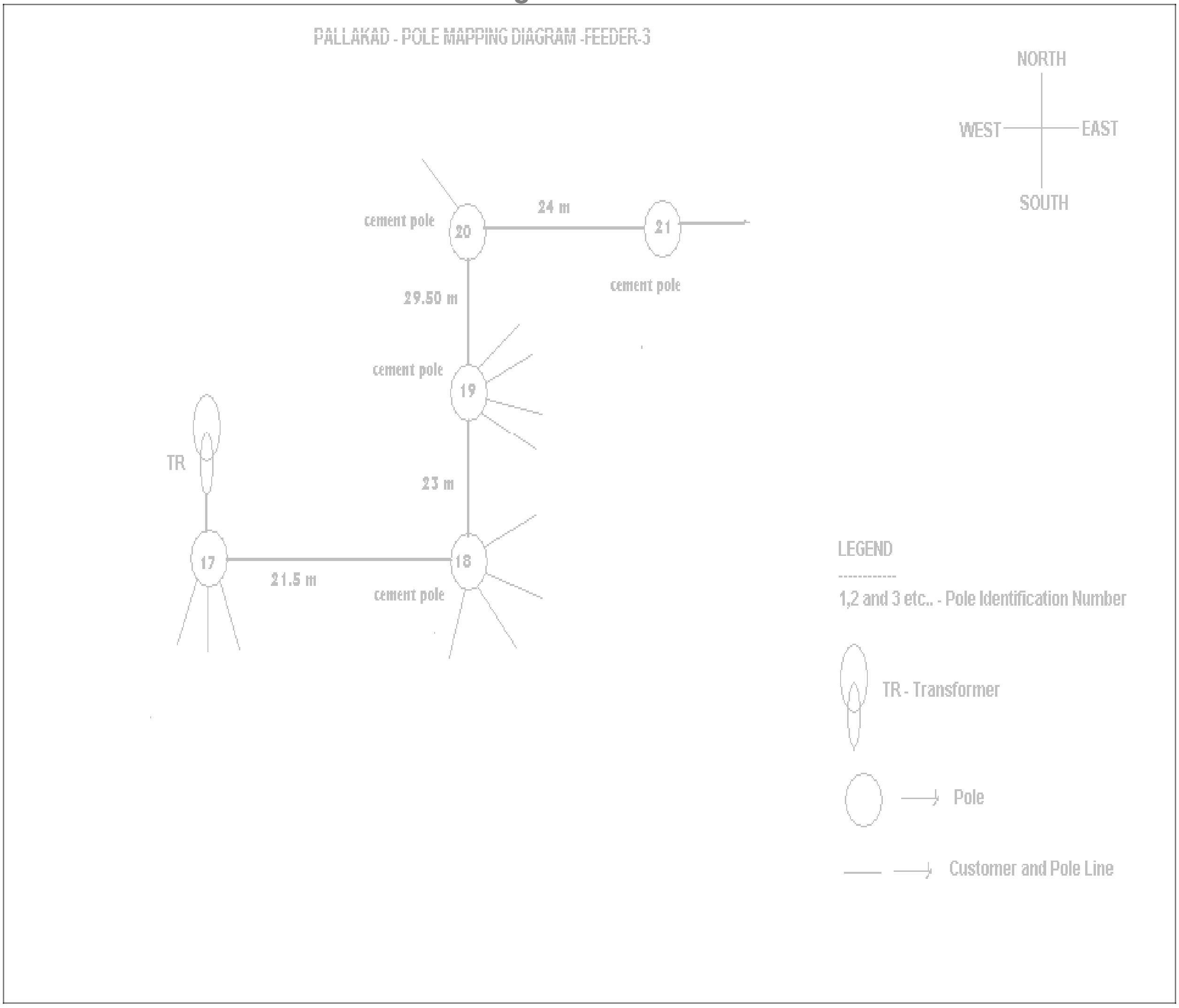
Fig 8.14



Total length of the LT line of the above feeder is 197.1 meters

0.8 Distributor network diagram & Routing shown in fig. 8.15

Fig 8.15



Total length of the LT line of the above feeder is 98 meters

Total length of the LT line from the transformer is 546.4 meters

0.9 Consumer Particulars in Table 8.17

Table 8.17

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
1		No connection		
2	KLS-11	DL		
2	KLS-11	DL		
2	KLS-11	316		Single phase
2	KLS-11	317		Single phase
2	KLS-11	318	10 Connection	Single Phase
2	KLS-11	96		Single phase
2	KLS-11	94		Single phase
2	KLS-11	95		Single phase
2	KLS-11	3217		Single phase
2	KLS-11	4270		Single phase
3	KLS-7	319		Single phase
3	KLS-7	322		Single phase
3	KLS-7	323		Single phase
3	KLS-7	324		Single phase
3	KLS-7	10389	12Connection	Three Phase
3	KLS-7	12234		Single phase
3	KLS-7	321		Single phase
3	KLS-7	91		Single phase
3	KLS-7	12562		Single phase
3	KLS-7	4194		Single phase
3	KLS-7	4631		Single phase
3	KLS-7	16462		Single phase
4	KLS-7 (1)	16112		
4	KLS-7 (1)	4194	4 Connection	Single Phase
4	KLS-7 (1)	16169		
4	KLS-7 (1)	16170		

0.10 Consumer Particulars in Table 8.18

Table 8.18

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
5	KLS-4	87		Single phase
5	KLS-4	12756		Three Phase
5	KLS-4	12755		Three Phase
5	KLS-4	2898		Three phase
5	KLS-4	15394		Single phase
5	KLS-4	16743		Single phase
5	KLS-4	81		Single phase
5	KLS-4	80		Single phase

0.11 Consumer Particulars in Table 8.19

Table 8.19

9	KLS-3	2752		Single phase
9	KLS-3	5828		Single phase
9	KLS-3	4283		Single phase
9	KLS-3	76		Single phase
9	KLS-3	3602		Single phase
9	KLS-3	74		Single phase
9	KLS-3	3845		Three Phase
9	KLS-3	4374	14 Connection	Three Phase
9	KLS-3	9307		Single phase
9	KLS-3	3526		Three Phase
9	KLS-3	648		Three Phase
9	KLS-3	340		Single phase
9	KLS-3	2831		Single phase
9	KLS-3	343		Single phase
10	KLS-2	344		Single phase
10	KLS-2	2782	3 Connection	Single phase
10	KLS-2	339		Single phase
11	NC			
12	KLS-12	4373		Single phase
12	KLS-12	69		Single phase
12	KLS-12	3930		Single phase
12	KLS-12	68		Single phase
12	KLS-12	3399	8 Connection	Single phase
12	KLS-12	66		Single phase
12	KLS-12	355		Single phase
12	KLS-12	354		Single phase
13	KLS-13	349		Single phase
13	KLS-13	350		Single phase
13	KLS-13	351		Single phase
13	KLS-13	352	10 Connection	Single phase
13	KLS-13	353		Single phase
13	KLS-13	2720		Single phase
13	KLS-13	278		Single phase
13	KLS-13	2708		Single phase
13	KLS-13	5949		Single phase
13	KLS13	2781		Single phase
14	KLS-8	13334		Single phase
14	KLS-8	91	3 Connection	Single phase
14	KLS-8	15913		Three Phase
15	KLS-9	8083		Single phase
15	KLS-9	8084		Single phase
15	KLS-9	625		Single Phase
15	KLS-9	19089		Single phase
15	KLS-9	19088	9 Connection	Single Phase
15	KLS-9	626		Single phase
15	KLS-9	DL		
15	KLS-9	DL		
15	KLS-9	DL		
16	KLS-10	18465		Three Phase
16	KLS-10	628		Single Phase
16	KLS-10	3657		Single phase
16	KLS-10	1110	6 Connection	Three Phase
16	KLS-10	14010		Single Phase
16	KLS-10	113		Single phase
17	KLN-1	12900		Single phase
17	KLN-1	2688	3 Connection	Single phase
17	KLN-1	DL		
18	KLN-2	1509		Three Phase
18	KLN-2	5101	3 Connection	Three Phase
18	KLN-2	9504		Three Phase
19	KLN-3	6762		Three Phase
19	KLN-3	14256		Three Phase
19	KLN-3	15214	5 Connection	Three Phase
19	KLN-3	4636		Single phase
19	KLN-3	347		Single phase
20	KLN-4	7419	1Connection	Three Phase
21	KLN-5	12442	1 Connection	Three Phase

0.12 Consumer Particulars in Table 8.20

Table 8.20

Pole No in Map	Pole/ Post No	Consumer's No		1Phase/3 Phase
5	KLS-4	18452		Three Phase
5	KLS-4	329		Single phase
5	KLS-4	331	22 Connection	
5	KLS-4	332		Single phase
5	KLS-4	333		Single phase
5	KLS-4	6482		
5	KLS-4	4368		
5	KLS-4	334		
5	KLS-4	335		
5	KLS-4	336		Single phase
5	KLS-4	338		Single phase
5	KLS-4	10047		
5	KLS-4	2723		Single phase
5	KLS-4	2831		Single phase
7	KLS-6	6513		
7	KLS-6	7330		Single phase
7	KLS-6	14414	5 connection	
7	KLS-6	6449		Single phase
7	KLS-6	8262		

8.8.0 THE DISTRIBUTION LOSS STUDY

Signature analysis was carried out to find out the losses

8.8.1 Procedure of Signature Analysis:

The transformer was switched off for half an hour. The energy meter reading at the L.T. side is noted down before switching off the transformer. Within half an hour time, the meter readings of all the consumers connected to the transformer are taken / measured. Again the transformer is switched on. This process is repeated for three days. From this figure, the consumption of the consumers is arrived at for two days. This gives the average consumption pattern of the consumer. From these data, the distribution loss is calculated and arrived at.

As the loss is the function of output energy vs. input energy and the loss percentage will remain within acceptable variation, the loss does not depend on the duration of study.

8.8.2 To assess the variation in percentage of losses for long duration the consumption of 15 days were taken at this site and found the variation was with in acceptable limit.

8.8.3 Table 8.21 to 8.27 shows the Unit Consumption from Signature analysis

0.1 POST (from KLN-1 to KLN-5) in Table 8.21

Table 8.21

Sl. No	Pole/ Post No	Consumer's No	1st day Consumption in kWh	2nd day Consumption in kWh	15 days consumption in kWh
1	KLN-1	12900	3.5	3.9	49.7
2	KLN-1	2688	DL	DL	DL
3	KLN-2	1509	DL	DL	DL
4	KLN-2	5101	17	18	253
5	KLN-2	9504	9	8	18
6	KLN-3	6762 (3PH-P)	8.8	7.4	161.5
		6762 (1PH-L)	0.9	0.3	11
7	KLN-3	14256	3	3	50
8	KLN-3	15214	8.2	8	123.3
9	KLN-3	4636	2.4	2.6	41.4
10	KLN-3	347	9.7	9.7	150
11	KLN-4	7419	DL	DL	DL
12	KLN-5	12442	7	8	126
13	KLN-3	5949	0.4	0.4	5.7
		Total	**69.9**	**69.3**	**989.6**

0.2 POST (from KLS-11 & KLS-7) in Table 8.22

Table 8.22

Sl. No	Pole/ Post No	Consumer's No	1st Day Consumption in kWh	2nd Day Consumption in kWh	15 days consumption in kWh
1	KLS-11	316	1	2.3	29.8
2	KLS-11	317	3	3.1	38.2
3	KLS-11	318	2.2	2.9	33.4
4	KLS-11	96	2.3	3	37
5	KLS-11	94	1.7	1.7	24
6	KLS-11	93	0.4	0.5	DL
7	KLS-11	3217 (3PH-P)	0.8	0.5	7.2
		3217 (1PH-L)	1.4	1.1	12.9
8	KLS-11	4270	1.5	1.8	22.9
9	KLS-7	319	87	83	1372
10	KLS-7	322	DL	DL	DL
11	KLS-7	323	2.6	4.2	54.7
12	KLS-7	324	0.1	0.5	4
13	KLS-7	10389	27.5	25.5	392.9
14	KLS-7	321	6.1	5.4	159.1
15	KLS-7	95	1.8	1.7	25.6
16	KLS-11	91	8.6	11.4	128.9
Total			**148**	**148.6**	**2342.6**

0.3 POST (from KLS-4, 3 & KLS-12) in Table 8.23

Table 8.23

Sl. No	Pole/ Post No	Consumer's No	1st Day Consumption in kWh	2nd Day Consumption in kWh	15 days consumption in kWh
1	KLS-4	18452	8.6	8.9	105.9
2	KLS-3	9307	0.2	0.3	2.3
3	KLS-3	2752	23.6	23.8	331.8
4	KLS-3	5828	2.8	0.8	28
5	KLS-3	4283	0	0	0
6	KLS-3	76	0.9	2.5	29.6
7	KLS-3	3602	0.7	1.9	6
8	KLS-3	74	1.9	1.5	21.2
9	KLS-3	3845	15	19	214
10	KLS-3	4374	29.3	29.8	406.7
11	KLS-12	4373	1.7	1.8	24.9
12	KLS-12	69	2.7	3.8	42
13	KLS-12	3930	35.1	35.2	509.8
14	KLS-12	68	3.6	3.7	58
15	KLS-12	3399	4.2	4.9	74.1
16	KLS-12	66	2.6	3.4	37.2
		Total	**132.9**	**141.3**	**1891.5**

0.4 POST (from KLS-7, 8, 9 & 10) in Table 8.24

Table 8.24

Sl. No	Pole/ Post No	Consumer's No	1st Day Consumption in kWh	2nd Day Consumption in kWh	15 days consumption in kWh
1	KLS-7	16462	1	DL	15.7
2	KLS-8	13334	DL	DL	DL
3	KLS-8	91	DL	DL	DL
4	KLS-8	15913	8.3	20.25	139.6
5	KLS-9	8083	0.8	0.6	7
6	KLS-9	8084	0.75	0.65	9.2
7	KLS-9	625	6	5	57.1
8	KLS-9	19089	2.9	3.3	49.7
9	KLS-9	19088	0	0	2.5
10	KLS-9	626	DL	DL	DL
11	KLS-9	14180	DL	DL	DL
12	KLS-10	18465	23.6	22.6	353
13	KLS-10	628	0	0.2	3.3
14	KLS-10	3657	3.95	3.8	45.65
15	KLS-10	110	79	91	1149
16	KLS-10	14010	9.2	8.5	138.6
17	KLS-10	113	25.75	28.1	408.15
18	KLS-10	3799	4.8	4.9	69.1
		Total	**166.05**	**188.9**	**2447.6**

0.5 POST (from KLS-4 & KLS-4) in Table 8.25

Table 8.25

Sl. No	Pole/ Post No	Consumer's No	1st Day Consumption in kWh	2nd Day Consumption in kWh	15 days consumption in kWh
1	KLS-4	329	2	2	27
2	KLS-4	331	DL	DL	DL
3	KLS-4	332	4.3	0.9	17.8
4	KLS-4	333	0.5	0.1	10.7
5	KLS-4	6482	0	0	0
6	KLS-4	4368	0.1	0.1	1.4
7	KLS-4	334	No	0	No
8	KLS-4	335	No	0	No
9	KLS-4	336	2.3	0.7	21.4
10	KLS-4	338	0.7	0.9	11.9
11	KLS-4	10047	0	0	-5.5
12	KLS-4	2723	2.5	2.5	33.2
13	KLS-6	6513	DL	DL	DL
14	KLS-6	7330	3.3	2.4	44.5
15	KLS-6	14414 (3PH-P)	0	0	0
		14414 (1PH-L)	0	0	0
16	KLS-6	6449	3.4	3.4	61
17	KLS-6	8262	DL	0	DL
18	KLS-6	2831	0.1	4.3	76
19	KLS-6	2782	1.1	1.2	20.2
20	KLS-6	6713	3.1	4.6	73.4
21	KLS-6	6714	1.7	1.7	20.4
22	KLS-4	339	DL	DL	0.4
		Total	**25.1**	**24.8**	**413.8**

0.6 POST (from KLS-2, 3 & KLS-13) in Table 8.26

Table 8.26

Sl. No	Pole/ Post No	Consumer's No	1st Day Consumption in kWh	2nd Day Consumption in kWh	15 days consumption in kWh
1	KLS-3	3526	229.3	200	2930.4
2	KLS-3	648	11.4	11.8	146.2
3	KLS-3	340	No connection	No connection	No connection
4	KLS-3	2831	12.5	4.7	84.1
5	KLS-3	343	No connection	No connection	No connection
6	KLS-2	344	9.5	9.3	141
7	KLS-2	2782	1.1	0.2	20.2
8	KLS-12	355	3.7	3.8	502.1
9	KLS-12	354	0.5	0.5	8.7
10	KLS-13	349	2.5	2.6	37.1
11	KLS-13	350	0.8	0.8	10.9
12	KLS-13	351	1.4	1.6	21.4
13	KLS-13	352	0.5	0.5	30.4
14	KLS-13	353	0.3	0.2	6.9
15	KLS-13	2720	3.3	2.5	50.1
16	KLS-13	278	DL	DL	DL
17	KLS-13	2708	0.8	1.2	23.2
18	KLS-13	2781	2.3	2.8	37.1
		Total	**279.9**	**242.5**	**4049.8**

0.7 POST (from KLN-1 to KLN-5/11) in Table 8.27

Table 8.27

No	Pole/ Post No	Consumer's No	1st Day Consumption in kWh	2nd Day Consumption in kWh	15 days consumption in kWh
1	KLS-7	12562	1.2	3.2	33.6
2	KLS-7	4194	0.2	0.7	9.4
3	KLS-7	463	5.4	6	86.9
4	KLS-7 (1)	16112	0	0.1	0.1
5	KLS-7 (1)	16169	0	0	0.3
6	KLS-7 (1)	16170	2.5	3.9	37.2
7	KLS-4	87	0.3	0.6	10.3
8	KLS-4	12756	20	21	58
9	KLS-4	12755	22	22	322
10	KLS-4	2898	40.2	40	639.4
11	KLS-4	15394	5.8	2	88.6
12	KLS-4	16743	3.45	4.09	53.6
13	KLS-4	81	7.7	7	83.9
14	KLS-4	80	0.8	1.5	26
		Total	**109.55**	**112.09**	**1449.3**

0.8 Table 8.28 shows the Total consumption of the consumer

Table 8.28

	First Day Consumption	Second day consumption	Fifteen days consumption
Energy Meter Reading	1032	1048	14948

8.8.4 Secondary Distribution Loss

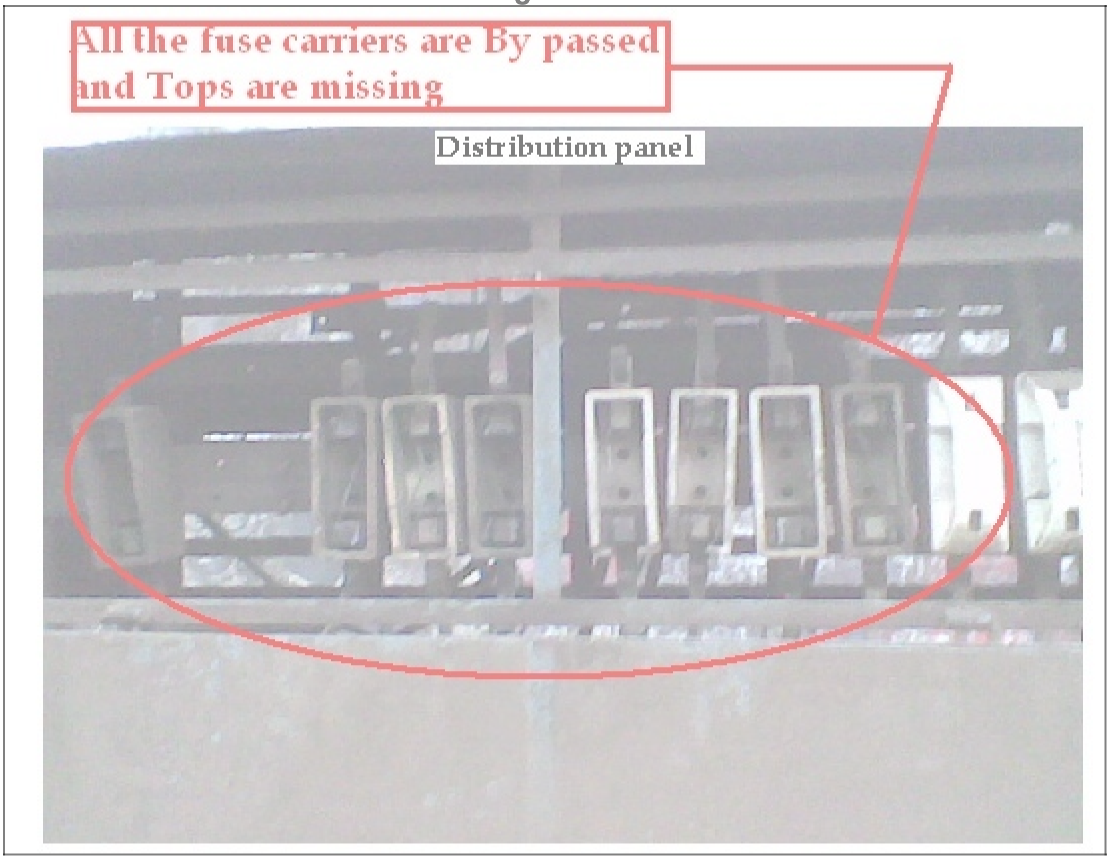
Table 8.29

Description	Energy Consumption for 15 days in kWh
From Consumer's Energy Meter	13577
Form Energy Meter at Transformer	14948
Difference in Units / Energy Loss	1371
% Energy Loss on the distribution line	9.1%
% Energy loss of the transformer	2.6%
Total secondary distribution loss	11.7%

8.9.0 PALAKKAD SITE SECONDARY DISTRIBUTION FUSE PANEL AND CABLE TERMINATION

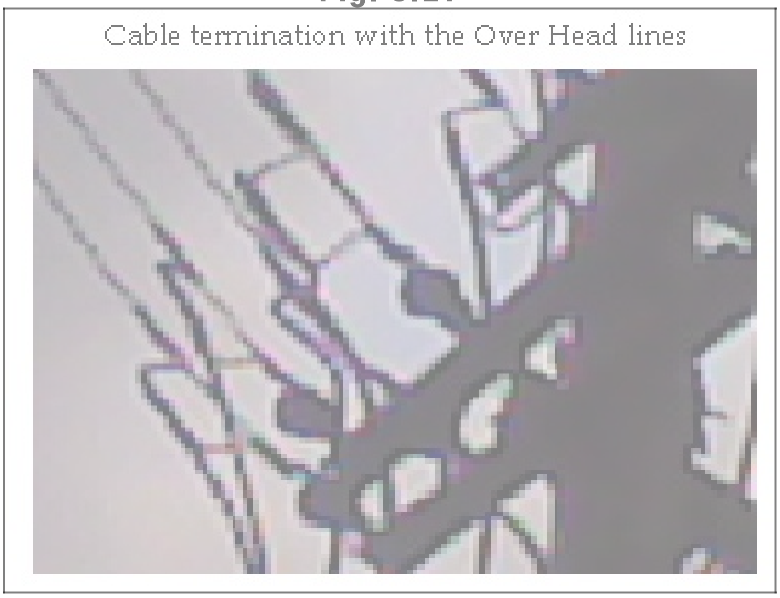
0.1 Fig 8.16 shows the front view of the distribution fuse panel

Fig. 8.16



0.2 Fig. 8.17 shows the termination with overhead lines

Fig. 8.17



0.3 Fig. 8.18 shows the location of the distribution fuse panel

Fig.8.18

8.9.1 Observation

Distribution panel is fabricated by angles and channels and kept open.

No bus bars for neutral and all the neutrals for the feeders are joined together with incoming with bolt and nut.
The cables are not dressed properly.
The distribution panel’s opening is kept facing the wall behind the Structure.
Adequate clearance is not provided for safe working.
Most of the fuse units provided with wire link in place of fuse wire with fuse carriers.

8.9.2 Suggestion

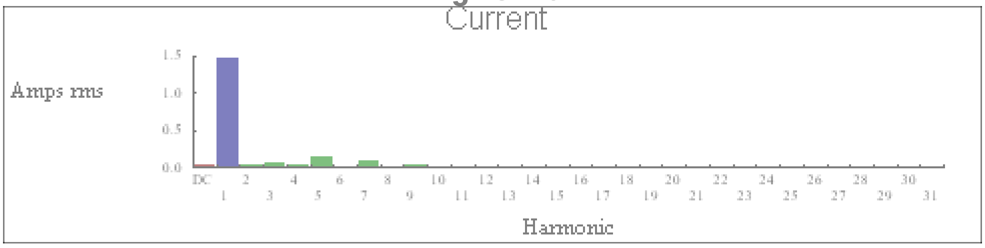
- Secondary Distribution Fuse Panel can be replaced with panel with MCB as followed by other Electricity Boards.
- Till such time Proper enclosure to be made and provided
- All the fuse units to be provided with Fuse Carriers.
- The cables are to be dressed.

- Distribution panel is to be earthed.
- The Panel can be relocated at the opposite side of the structure for safe working clearance.

8.10.0 HARMONICS MEASUREMENT

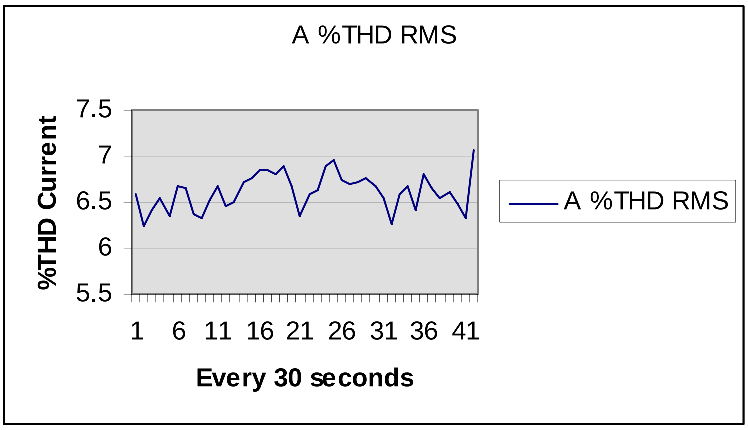
0.1 Fig. 8.19 shows the intensity of the THD current

Fig. 8.19



0.2Fig. 8.20 shows the % value of the THD current

Fig. 8.20



As per IEEE-519 – 1996 The THD for voltage at the connection point shall not exceed 5% with no individual Harmonics higher than 3%.

The THD for current drawn from the transmission system at the connection point shall not exceed 10%.

8.10.1 OBSERVATION

The THD (Total Harmonic Distortion) level is within limit around 7.1%.

Section 9

CONSOLIDATION

9.0.0 INTRODUCTION

The project envisaged identifying 3 locations in the state covering the rural, urban and semi urban network, centered on distribution transformers. The identification of the three locations had to be based on various parameters, to make the adaptability of the cases to similar locations. Emphasis was given to the sampling process to ensure further extension of the project. The project was done in micro level keeping in view of the macro level necessities of the distribution system and state grid. The study was conducted to involve all the major stakeholders in the distribution network like the distribution company and the consumers. Secondary data collection like consumption details of all consumers in the line already identified/ implemented energy efficiency measures, metering and automation, barriers in improvement etc. were carried out. The technical analysis was done using power analyzers, data loggers. Meeting was conducted with respective stakeholders as part of the secondary data collection.

Consolidated analysis

This section gives the findings, suggestions and the comparison of all the three sites on various parameters

9.1.0 THIRUVANANTHAPURAM SITE

9.1.1 Observation

- Maximum load on the transformer is 32% on Sundays and 79% on week days.
- Un-balanced load between phases. Y Phase Load is higher when compared to other two phases.
- **During day time Y Phase current goes more than the full load current of the transformer and coming down but almost nearer to 90% of the full load current**
- Neutral current is 70A
- R Phase load is around 64 to 75% of Y Phase load

- B Phase load is around 62 to 84% of Y Phase load
- The voltage Drop is around 12.5% at the fag end of distribution, this is very high, Permissible regulation as per the Supply Code is 6%.
- The THD (Total Harmonics Distortion) level is with in limit.
- The Distribution Panel is not closed.
- The Fuse carriers found to be removed and jumpers provided in place of fuse wires
- The cables are not dressed properly

9.1.2 Analysis for unbalance load

From the data it is clear that throughout the day unbalance load is there. While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase in no. of consumers and the increase of load of the existing consumers might have created the unbalance.

9.1.3 Suggestion 1

It is suggested to fix an energy meter at the HT side of the Transformer to ascertain the exact transformer losses.

9.1.4 Suggestion 2

Load to be balanced at the pole side.

Some of the Y Phase load can be shifted to R Phase.

This will reduce the un- balance current and the Y Phase Current will not exceed the full load current of the Transformer. It will be maintained well under the operation limit.

Neutral current will be reduced.

9.1.5 Suggestion 3

It is suggested to fix an Ammeter at the LT Distribution fuse panel.

The LT current of the transformer can be monitored regularly for unbalance.

9.1.6 Suggestion 4

The voltage drop is due to the contact resistance at the junction of the conductor connected to consumer near the pole.

The joints/termination can be redone to make the contact proper and to avoid voltage drop and bring it within limits.

9.1.7 Suggestion 5

- Secondary Distribution Fuse Panel can be replaced with MCCB/MCB as followed by Electricity Board of other states like Uttrakand
- Till such time Doors can be fitted to the existing distribution fuse panel.
- Dummy Carriers to be provided where connections are not taken
- The cables are to be dressed properly.
- Distribution panel is to be earthed with two distinguished earth of adequate capacity.

9.1.8 Load Ratio of the Transformer /Load Factor

= Transformer Loading x 24Hrs /Capacity of the Transformer x 24Hrs
= (58 x 7) + (76 x 2.5) + (160 x 10.5) + (86 x 4)/250 x 24
= 2620/6000 = 0.436 = 44%

9.1.9 Transformer Loss

As per the Specification No load loss is 650W and Load loss is 3250W

Transformer loss = 30.7 kWh/day

The above loss is calculated theoretically. As the HT metering was not available at the site, it was not possible to compare the same with actual.

9.1.10 Consumer Density

= No. of Consumer x 100/Transformer capacity
= 200 x 100/250 = 80 consumers per 100kVA

The consumer density of 50 to 60 per 100kVA is more reasonable. The above value is slightly high, considering the modern homes. However, since the loading density being low, this situation can be ignored, as losses will not be substantial.

9.1.11 Load Density

Connected load/Transformer capacity in kVA = 226/250 = 0.904

Because of diversification, the load density is acceptable.

9.1.12 Secondary Distribution Loss

Table9.1

Description	Energy Consumption for two days in kWh
From Consumer's Energy Meter	3723
From Energy Meter at Transformer LT side	3896
Difference in Units / Energy Loss	173
% Energy Loss in distribution line	4.4%
% energy loss of the feeding transformer	1.9%
Total secondary distribution loss	6.3%

9.2.0 THIRUVALLA SITE

9.2.1 Observation

- Maximum load on the transformer is not more than 33% on Sundays as well as week days.
- Minimum load on transformer is 20% on Sundays and 28% on week days.
- The Transformer is around 30 years old (Manufactured in 1979)
- Un-balance load between Phases. R Phase Load is higher when compared to other two phases
- Y Phase load is around 52% of R Phase load
- B Phase load is around 70% of R Phase load
- Y Phase having very less load only during Peak Hours (i.e.) high but half of the R Phase Load.
- Neutral current is 45A
- Input voltage is Un-balance 3 to 4% between phases.
- Input voltage at Y Phase is high around 240V. During peak hours in evening it is around 230V
- The voltage Drop is around 12.5%. This is very high
- The Joints/Binding at the junction is properly done.

- The THD (Total Harmonics Distortion) level is only 8%. This is with in limit.
- The Distribution fuse Panel is not closed which is very unsafe.
- The cables are not dressed properly
- Distribution fuse panel not earthed.
- LT line sagging found on the interior area.
- Very old wooden poles were used in some places.
- Around 33 consumer's meters were not working at the time of signature analysis. Concerned officers of the utility were informed about the same.
- Now they are in the process of replacement.

9.2.2 Suggestion 6

It is suggested to fix an energy meter at the HT side of the Transformer to ascertain the exact transformer losses.

9.2.3 Suggestion 7

The existing 250kva Transformer can be replaced with 160KVA amorphous core transformer with High Efficiency, which will only 30% of no load of the normal transformer of the same capacity.

9.2.4 Analysis for unbalance load

From the data it is clear that throughout the day unbalance load is there. While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase in number of consumers and the increase of load of the existing consumers might have created the unbalance.

9.2.5 Suggestion 8

It is suggested to fix an Ammeter at the LT Distribution fuse panel.
The LT current of the transformer can be regularly monitored and corrective action be taken.

9.2.6 Suggestion 9

Load to be balanced at the pole side

Some of the R Phase Loads can be shifted to Y Phase

This will reduce the un- balance current and the neutral current

9.2.7 Suggestion 10

The voltage drop (12.7%) is due to the contact resistance at the junction of the conductor connected to consumer near the pole.

The joints/termination can be redone to make the contact proper and to avoid voltage drop and bring it within limits.

9.2.8 Load Ratio of the Transformer /Load factor

= Transformer Loading x 24Hrs /Capacity of the Transformer x 24Hrs

= (55 x 6.5) + (43 x 3.5) + (18 x 1.5) + (57 x 6.5) + (74 x 6)/250 x 24

= 1349.5/6000 = 0.22 = 22%

The load ratio of the transformer is very low. And hence recommended for replacement

9.2.9 Transformer Loss

As per the Specification No load loss is 650W and Load loss is 3250W

Transformer loss = 19.38kWh/day

9.2.10 Consumer Density

= No. of Consumer x 100/Transformer capacity = 273 x 100/250 = 109.29 consumers per 100 kVA

The consumer density of 50 to 60 per 100 kVA is more reasonable The above value is fairly high, considering the modern homes. However the loading density being low, this situation can be ignored, as losses will not be substantial.

9.2.11 Load Density

= Connected load/Transformer capacity in kVA= 123/250 = 0.492 = 49%

9.2.12 Secondary Distribution Loss

Table 9.2

Description	Energy Consumption for two days in kWh
From Consumer's Energy Meter	1824
Form Energy Meter at Transformer	2280
Difference in Units / Energy Loss	456
% Energy Loss for the LT distribution line	20%
Commercial loss (due to defective meters and Street lighting)	11.9%
Technical loss	8.1%
Transformer loss	2.8%
Total secondary distribution loss	10.9%

9.2.13 During Signature analysis we found

- Street lights are also connected in the transformer
- 33 Consumer meters were found to be not working.
- To segregate the Technical losses we followed the below procedure
- Interacting with the consumer not revealed the exact load.
- The past bills were analysed and the average is arrived out.

The average consumption of the above consumers is 116kWh for the analysis period.

Total loss = 456kWh

Street light consumption = 156kWh

Due to defective meter = 116kWh

Actual technical loss = 184kWh

% loss on total consumption = (184/2280) x 100 = **8.1**

<u>9.2.14 Suggestion 11</u>

The defective meters are to be replaced to get the exact revenue from the consumer. Presently, consumers having faulty meters are billed according to average of past consumption.

9.2.15 Suggestion 12

Separate line can be run and the street light connections can be taken from the same.

Energy meter can be fitted at the feeding point and the exact consumption can be measured and billed

One no.10 kVA energy saver with RTC timer for Switching it ON and OFF at specified timing.

9.2.16 Suggestion 13

- Secondary Distribution Fuse Panel can be replaced with MCB as followed by Electricity Boards of other states like Uttrakand.
- Till such time Distribution panel Doors can be fitted.
- Dummy Carriers to be provided where connections are not taken
- The cables are to be dressed.
- Distribution fuse panel is to be earthed.
- Lines are to be re- shackled.
- Wooden poles may be replaced with RCC poles.
- Trees touching the OH lines are to be cut/trimmed periodically

9.3.0 PALAKKAD SITE

9.3.1 Observation

- Maximum load on the transformer is not more than 28% on Sunday’s and 56% on week days.
- Un-balance load between Phases Y Phase Load is higher when compared to other two phases.
- Y Phase reaches around 90% of name plate current.
- R Phase load is around 60% of Y Phase load
- B Phase load is around 67% of Y Phase load
- Neutral current is 73A
- Input voltage is having high Un-balance, between Phases
- In put voltage at Y Phase is high around 240V. During peak hrs. in evening it is around 230V
- Distribution panel is fabricated by angles and channels and kept open.
- No bus bars for neutral and all the neutrals for the feeders are joined together with incoming with bolt and nut.
- The cables are not dressed properly.
- The distribution panel’s opening is kept facing the wall behind the Structure.
- Adequate clearance is not provided for safe working.
- Most of the fuse carriers provided with wire link in place of fuse wire with top
- The voltage Drop is around 4.1%. This is within limit.
- The Joints/Binding at the junction is properly done.

9.3.2 Analysis for unbalance load

From the data it is clear that throughout the day unbalance load is there. While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase in no. of consumers and the increase of load of the existing consumer might have created the unbalance.

9.3.3 Suggestion- 14

It is suggested to fix an Ammeter at the LT Distribution fuse panel.
The LT current of the transformer can be regularly monitored.

9.3.4 Suggestion 15

Load to be balanced at the pole side
Some of the R Phase Loads can be shifted to B phases.
This will reduce the R Phase Current. The neutral current will be reduced.

9.3.5 Suggestion 16

- Secondary Distribution Fuse Panel can be replaced with MCB as followed by Electricity Boards of other states like Uttrakand
- Till such time proper enclosure to be made and provided
- All the fuse units to be provided with fuse carriers.
- The cables are to be dressed.
- Distribution panel is to be earthed.
- The Panel can be relocated at the opposite side of the structure for safe working clearance.

9.3.6 Load Ratio of the Transformer

Transformer Loading x 24Hrs /Capacity of the Transformer x 24Hrs
={ (16.9x4.5)+(22.5 x 3.5)+(44.75 x 2)+(74.6 x 3)+(62.5 x 2)
+(86.5 x 2)+(60.5 x 1)+(74.4 x 2.5)+(27.5 x 3.5)}/160 x 24
= 1109.3/3840 = 0.29 = 29%

9.3.7 Transformer Loss

As per the Specification No load loss is 460W and Load loss is 2350W.
Transformer loss= 15.78kWh/day

9.3.8 Suggestion 17

It is suggested to fix an energy meter at the HT side of the Transformer to ascertain the exact transformer losses

Consumer Density

No. of Consumer x 100/Transformer capacity= 119 x 100/160 = 74.375

9.3.9 The above no. is slightly high, and considering the modern homes, the consumer density of 50 to 60 per 100 kVA is more reasonable. However the loading density being low, this situation can be ignored, as losses will not be substantial.

9.3.10 Load Density

Connected load/Transformer capacity in KVA = 112.5/160 = 0.703 = 70%

9.3.11 Secondary Distribution Loss

Table 9.3

Description	Energy Consumption for 15 days in kWh
From Consumer's Energy Meter	13577
Form Energy Meter at Transformer	14948
Difference in Units / Energy Loss	1371
% Energy Loss on the distribution line	9.1%
% Energy loss of the transformer	2.6%
Total secondary distribution loss	11.7%

9.4.0 TOTAL PARAMETERS IN BRIEF OF THE ENTIRE THREE SITES

Comparative statement for various parameters in brief for the three sites is furnished in Table 9.4

Table 9.4

Particular	**Thiruvananthapuram**	**Thiruvalla**	**Palakkad**
Transformer Capacity in KVA	250	250	160
Full load current	333.3	333.3	213.5
Max. loading of transformer on week days	79%	33.6%	56.2%
Max. loading of transformer on Sundays	33.6	33.6%	28.1%
Transformer loss in kWh/day	30.7	19.38	15.78
Load Density	90%	49%	70%
Load ratio /Load factor	0.436	0.22	0.29
Voltage drop at the far end of distribution	10.6%	12.7%	4.6%
No. of consumers	200	273	119
Consumer density, consumers per 100kVA	80	109.22	74.37
Distribution loss	4.4%	20%	9.1%
Termination at the joints	Good	Good	Good
Power factor	0.9 to unity	0.86	0.88
Neutral Current (Peak hr.)	71A	79A	48A
Neutral current (Normal hr.)	51A	45A	43.7A
Neutral potential	0.8V	1.2V	1V
Phase unbalance% on total current (R-Y-B)	27-42-31	44-25-31	37-34-29
THD (Total Harmonics Distortion)	10%	8.1%	8.4%
Street light connection	Not connected	connected	Not connected
Street light consumption (metered/ unmetered)	Not connected	unmetered	Not connected
Faulty meters	Nil	33	Nil
No of LT feeders	3	4	3
Length of LT feeder (longest)	294 meters	770.5 meters	136.1 meters

Table 9.4 Cont'd

Particular	Thiruvananthapuram	Thiruvalla	Palakkad
Total length of LT lines	952.5 meters	5.3km	546.4 meters
LT Conductor/cable size dia in mm/capacity in A	Rabbit 10.05 / 148A	Rabbit 10.05 / 148A	Rabbit 10.05 / 148A
Particular	Thiruvananthapuram	Thiruvalla	Palakkad
Pole numbering	Available	Available	Available
Transformer meter at LT side	Provided	Provided	Provided at
Transformer meter at HT side	Not provided	Not provided	Not provided
Measurement of temperature	Done	Done	Done
Consumer mapping	Done	Done	Done
Adoption of GPS	Not required	Not required	Not required
Segregation of commercial loss	No commercial loss	Done	No commercial loss

Loading of the transformer

Thiruvananthapuram site

Maximum load on the transformer is 32% on Sundays and 79% on week days. During peak hrs, Max loading is 44% and minimum load is 33% on week days. This is because most of the commercial loads are closed during peak hrs. On Sundays maximum load is 32% and minimum load is 28%. During off peak hrs/night Max loading is 35% and minimum load is 22% on week days. On Sundays maximum load is 31% and minimum load is 21%. During normal hrs, Max loading is 79% and minimum load is 52% on week days. This is because the commercial loads are on along with the domestic load. On Sundays maximum load is 27% and minimum load is 15%. This is because most of the commercial loads (Offices and shops) are closed on Sunday.

Thiruvalla Site

Maximum load on the transformer is not more than 33% on Sundays as well as week days. Minimum load on transformer is 20% on Sundays and 28% on week days. During peak hrs, max load on Sunday is 33% and 33% on week days and minimum load is 20% on Sunday and 28% on week days. During normal hrs, max load on Sunday is 23% and 25% on week days and minimum load is 12% on Sunday and 7%on week days

During off peak hrs, /night max load on Sunday is 28% and 25% on week days and minimum load is 20% on Sunday and 21% on week days

Palakkad Site

Maximum load on the transformer is not more than 28% on Sunday and 56% on weekdays. During peak hrs, max load on Sunday is 27% and 54% on weekdays. The minimum load is 12.5% on Sunday and 14% on weekdays. During normal hrs, max load on Sunday is 28% and 56% on weekdays and minimum load is 12.5% on Sunday and 15.6% on weekdays

There is no much difference on normal and peak hrs on loading pattern. This is because the commercial loads are on along with the domestic load.

During off peak hrs, /night max load is 14%on Sunday and 15.6% on week days and minimum load is 9% on Sunday and 10% on week days

Load Density

Load density = Connected load/Transformer capacity in KVA

Load density is 90%, 49% and 70% in Thiruvananthapuram, Thiruvalla and Palakkad site respectively. This is depending upon the diversification of the load connected. Only in Thiruvalla it is on the lower side as the transformer is of higher capacity for the total load of the consumer connected.

Load ratio / Load factor

Transformer Loading x 24Hrs /Capacity of the Transformer x 24Hrs

The Load factor is 0.49, 0.22 and 0.29 in Thiruvananthapuram, Thiruvalla and Palakkad site respectively.

Voltage drop at the far end

Ratio of the voltage level at the far end with respected to voltage at the feeding end

The voltage drop is 10.6%, 12.7% and 4.6% in Thiruvananthapuram, Thiruvalla and Palakkad site respectively. This is higher at Thiruvananthapuram and Thiruvalla site.

The voltage drop is due to the contact resistance at the junction of the conductor connected to consumer near the pole. The joints/termination can be redone to make the contact proper and to avoid voltage drop and bring it within limits. In Thiruvalla the lines feeding interior location are through single phase lines. This can be converted to three phase line to reduce the drop.

Consumer Density

No. of Consumer x 100/Transformer capacity

Consumer density is 80%, 109.2% and 74.4% in Thiruvananthapuram,Thiruvalla and Palakkad site respectively.

In Thiruvananthapuram and Thiruvalla the above no. is high, and in Palakkad it is slightly high. Considering the modern homes, the consumer density of 50 to 60 per 100 kVA is more reasonable. However the loading density being low, this situation can be ignored, as losses will not be substantial

Secondary Distribution losses

Distribution losses are 4.4%, 20% and 9.1% in Thiruvananthapuram,Thiruvalla and Palakkad site respectively. In this loss at Thiruvalla site found to be very high. It is further analysed and several consumer meters were found to be not working. And streetlights of various types were connected and not metered. After taking that consumption in to account the exact loss (technical loss) found to be 8.1% which is fair.

It suggested connecting all the street lights with a separate line and that point can be metered. The defective meters can be replaced to get the exact revenue from the consumer.

Power Factor

The power factor is 0.9, 0.86 and 0.88 in Thiruvananthapuram,Thiruvalla and Palakkad site respectively. By providing reactive compensation at the transformer end it can be improved nearer to unity. Now they have 9kVAr capacitor bank at all the sites but found to be disconnected. The same can be connected back along with the additional requirement.

Unbalance load

In Thiruvananthapuram site Y phase draws around 42% of the total current and R & B phases draw around 27% and 31% respectively. In Thiruvalla site R phase draws around 44% of the total current and Y & B phases draw around 25% and 31% respectively. In Palakkad site R phase draws around 37% of the total current and Y & B phases draw around 34% and 27% respectively.

It is alarming in Thiruvananthapuram site during day time Y Phase current goes more than the full load current of the transformer and coming down but almost nearer to 90% of the full load current. In Thiruvalla site the R phase current goes to 45% of the full load current of the transformer.

In Palakkad site the unbalance is not much.

While commissioning of the transformer the utility might have distributed the loads balanced. But subsequent increase in no. of consumers and the increase of load of the existing consumer might have created the unbalance. This can be corrected only through regular monitoring.

It is suggested for the utility to have a schedule monitoring practice for checking the unbalance and to do the corrective measure, by providing ammeter at the LT side of the transformer.

Neutral Current

Neutral current is found to be 51A, 45A and 43.7A during normal hrs in Thiruvananthapuram, Thiruvalla and Palakkad site respectively. The maximum neutral current (i.e. 71A, 79A and 48A in Thiruvananthapuram, Thiruvalla and Palakad respectively during peak hours) is around 20% of the full load current in all the 3 sites. In Thiruvananthapuram and Thiruvalla it is around 50% current rating of the conductor used. By balancing the loads among three phases this will be reduced. Abnormal neutral current is very dangerous for the persons working on line.

A well planned approach to distribution network losses at micro level was carried out at selected typical three distribution transformers (as a model) in the Kerala Power System. The work included Identification of Technical Loss Reduction and Rationalization of Secondary Distribution System. Efforts were taken to identify the key barriers.

- The major barrier was unavailability of HT side metering of the individual transformer. Others includes defective consumers' meters, non metering of street lights
- The key issues faced by the domestic customers due to poor power quality are low voltage at the fag end. The voltage drop is due to the contact resistance at the junction of the conductor connected to consumer near the pole.
- The data on number of failure of transformer for the selected location or the no of interruption was not collected. Improvement in O & M practices including housekeeping can improve the performance of the transformer. The consumer awareness on the “star rated, energy efficient” equipment will also reduce loss.

Formulation of internal team for energy monitoring will improve energy efficiency and continuous improvement of performance.

The most important criteria for adopting a distribution transformer for load study are to ensure metering at both HT and LT sides of the transformer.

For Best O & M practices and reduction in distribution transformer failures and for improvements in compliance of Standard of Performance of Distribution Licensee the concept of zero failure of transformer can be adopted. The employee's skill and knowledge can be improved by giving training. The consumer can also be made aware of energy efficiency and energy conservation. Energy monitoring and targeting is an essential management technique for improvement, which has to be done at managerial level.

For overall improvement in the power quality and reduction in AT & C losses, it is recommended to carry out power quality and Energy Audit for a section of transmission and distribution net work from sub station to the consumer end.

Section 10

MODEL FOR REPLICABILITY OF THIS STUDY

10.0.0 INTRODUCTION

Objective of the Project is Rationalization of Secondary Distribution System through a Micro Level Approach.

This Section gives the methodology, Meters and Instrument required, forms and formats required to collect the data, Reference standards and norms for various facts and practices and the method for the analyses of various data.

The scope of the work included:

- Coordinating with the distribution utility.
- Map the distribution transformer and the connected primary and secondary distribution points till the consumer end.
- Make arrangement for the adequate instrumentation to conduct the study
- Measure the load, power factor, harmonics and other parameters at the transformer secondary as well as the end-user point at any particular time as is found convenient.
- Study of harmonics, phase imbalances, loss profile, network data, load flow and other aspects in distribution lines etc.
- Provide detailed performance data of the transformer in the dynamic mode.
- Peak load evaluation and preparation of load curve with detailed explanation.
- Conduct detailed load survey of the locality, which exactly determine the total distribution losses of the transformer.
- Evaluate the magnitude of technical losses as well as the non technical losses
- Make a thorough study of the power quality issues such as harmonics in the pretext of the loads used by the end user
- Evaluate the non technical loss analysis and make suggestions and road map of implementation
- Submit report with complete database and techno economic analysis

10.1.0 METHODOLOGY

10.1.1 Transformer Loss study

1. Loggers fitted on the secondary side of the Transformer and all the electrical parameters recorded every 10 minutes continuously for 15 to 20 days.
2. The total energy recorded for 15 to 20 days are compared with the available HT Energy meter reading for the same period. Ensure the metering availability of HT and LT side of the particular transformer.
3. The Logger record load, Power factor and other Electrical Parameters at the Transformer secondary.
4. The detailed performance data of the transformer in the dynamic mode like Peak Load evaluation, Load curve and Load factor are arrived at from the above recorded parameters.
5. All the analysis and the backup calculations should be given in the report

10.1.2 Secondary Distribution System analysis

1. Detailed load survey of the locality to determine total distribution losses.
2. Mapping of the distribution Transformer and the connected distribution point till the end user/consumer.
3. The mapping done after physical measurement of the distance between poles and the distance between poles and the Load point. GPS mapping adopted for the distribution at a dense/elevated/un approachable area.
4. The Cable joints and terminations checked for proper contact. The heat generated at the junction measured by a non contact type (infra red) thermometer.
5. Observation & Analysis of measures taken by KSEB in loss reduction at different voltage levels/feeders, energy conservation and Energy efficiency improvement. This includes:

a) A checklist for transformer including Fencing, Laying of granite jelly, clearing vegetation, status of earthing, Transformer metering, Distribution panel board, and the existing maintenance schedule including outage/failure.
b) A checklist of LT Lines including no of LT Feeders, poles & numbering, earthing, conductor and joints, clearing of touching, alternate feeding and the existing maintenance schedule under adherence and outage/ failure.
c) A checklist for streetlight metering, street main, number of lights light level, Type & Layout of light, etc.

6. Power factor and other Electrical Parameters at the load point/consumer end to be measured at convenient time. The load details and the approximate operating time of the loads from the individual consumer should be collected. The Electricity bill can be used as reference.
7. Methodology of MBC (Metering/Billing & Collection) of KSEB has to be studied and the suggestion for improvement can be given based on the analysis.
8. Collection of energy consumption data from each and every consumer for last 6 months, according to KSEB bill. Verify instantaneous readings with meter readings and check for accuracy of meters. By this way non technical loss can also be segregated. All distances, Peak and off peak loading of all consumers required.
9. Suggestion for improvements in Energy efficiency and Energy conservation measures may be listed for future guidelines, including reaching for implementation with investment if any and responsibility matrix.
10. Check list of employee’s and their status on awareness and skill level on energy conservation and energy efficiency improvement.
11. Check list of consumers’ awareness on energy conservation and energy efficiency measures.

10.2.0 INSTRUMENTS REQUIRED

1.0 Fluke Harmonic Analyzer -433/434 with its associated Software
2.0 Fluke Harmonic Analyzer -41 B with its associated Software
3.0 Power Monitor cum Data logger with Sequence Software.
4.0 Non Contact Infra red Thermo meter.

10.3. 0 STANDARDS TO BE REFFERED

1	IEE -519 (1992) with latest revisions	: Harmonics effects and Controls
2	IEE-1159 (1996) and its latest revisions	: Power Quality practices for Offices, Buildings and Industries (Emerald Book)
3	IEE-738 – 1 with latest revisions	: Best Energy Practices for Industrial use and High Rise Buildings (Bronze Book)
4	For Distribution reference	: Hand book on distribution by H.S. Pabla

5 The Electricity Act, 2003.
6 Annual Report /System statistics of the concerned utility/licensee
7 CEA Standards and Regulations.
8 EMC & REC guidelines and notifications.
9 The Indian Electricity Rules, 1956.
10 Supply Code
11 Electrical Inspectorate Standards
12 CEA Technical Standards
13 Other relevant technical standards/literatures

14 Kerala State Electricity Licensing Board Rules.

15 Directives of State Electricity Regulatory Commission.

16 CERC websites.

10.4.0 DATA TO BE COLLECTED FOR THE STUDY

0.1 Format 1

Location of the Transformer:
Identification no:

KSEB office under which purview the Transformer comes:

Place /Locality / Village fed by the Transformer:

Transformer Name Plate details

MAKE					
Type					
Serial No		Manufacturing Date			
RATING		KVA	PHASE		
HIGH VOLTAGE		VOLTS	FREQUENCY	50	HZ
LOW VOLTAGE	415	VOLTS	% IMPEDANCE @ 75◦		Ohms
CURRENT AT HV		A	Temperature Rise Limit		◦ C
CURRENT AT LV		A	COOLING TYPE		
CONNECTIVITY		Oil in litres			
Weight of oil in Kg		Weight of core in Kg			
Total Weight in Kg					
Tapping Selected					

0.2 Format 2

Type of LT Distribution

Type of distribution	Distance / Nos.	Size /capacity	Remarks
Over Head Distribution			
Distribution through Cable			
Distribution Pillars			
Poles	**Between Poles in meter**		

The addresses of each consumer and the bill copy for 12 consecutive months.

0.3 Format 3

Details to be collected about the Loads connected with the Transformer

Type of consumer *	No. of connections	Monthly Units	Tariff	
Metered Domestic				
Unmetered Domestic				
Metered Commercial				
Street Lights				
Private Institution				
Metered Agricultural Connection				
Unmetered Agricultural Connection				
Public Govt. Bodies (Schools, College & Govt. Office				
Public Water Supply				
Temporary Supply				
Small Industries				

*modify list as required to suit the location/area

0.4 Format 4 Load particulars of domestic consumer

Distribution transformer no:

Area Name : 		**Consumer Name :**
Meter Number: 		**Consumer Number :**
Date:

Domestic Appliances*				
Sl.No	Apparatus	Number of Apparatus	Specific Operating Time	Remarks
1	Fluorescent Tube-40W			
2	Fluorescent Tube-20W			
3	Incandescent Lamp-40W			
4	Incandescent Lamp-60W			
5	CFL (Watt-)			
6	Night Lamp(Watt-)			
7	Fan			
8	Refrigerator			
9	Electric Iron Box			
10	Television			
11	A/C(Ton-)			
12	Washing Machine(Cap-)			
13	Computer			
14	Water Pump			
15	Oven(Heater -)			
16	Mixer			
17	Grinder			
18	Others			

*modify suitably as required

Consumer Signature:

Representative Name:

0.5 Format 5 Load particular for commercial consumer

Area Name : **Consumer Name :**
Meter Number: **Consumer Number:**
Date:

Office Appliances

Sl.No	Apparatus*	Number of Apparatus	Specific Operating Time	Remarks
1	Fluorescent Tube-40W			
2	Fluorescent Tube-15W			
3	Incandescent Lamp-40W			
4	Incandescent Lamp-60W			
5	Incandescent Lamp-100W			
6	CFL(Watt -)			
7	Fan			
8	Refrigerator(Ton-)			
9	Computer			
10	A/C (Tonnage -)			
11	Xerox machine(Cap-)			
12	Printer			
13	Vacuum cleaner(KW-)			
14	Tea/Coffee machine			
15	Room Heater(KW-)			
16	Television			
17	Cooler(Capacity-)			
18	Exhaust Fan(KW-)			
19	Garden Light(Watt-)			
20	Night Lamp(Watt-)			
21	Others			

*modify suitably as required

Consumer Signature:

Representative Name:

0.6 Format 6 (Consumer Particulars)

Pole No in Map	Post Identification No in the Area	Connected Consumers No.	Remarks	1 Phase/3 Phase

0.7 Format 7 (For Signature analysis)

Sl. No	Pole/ Post No	Consumer's No	Consumption of I day in kWh	Consumption of II day in kWh	Consumption of 14th day in kWh	Consumption of 15th day in kWh
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
		Total				

0.8 Maintenance practice checklist for Transformer to be studied for the last three years.

0.9 Maintenance practice checklist for the LT line and poles to be studied for the last three years.

10.5.0 PROCEDURE OF SIGNATURE ANALYSIS:

The energy meter reading at the L.T. side and the meter readings of the all consumers connected to the transformer are to be noted down. This process is to be repeated for three to five days. From this figure, the consumption of the consumers is arrived. This gives the average consumption pattern of the consumer. From these data, the distribution loss of the transformer can be calculated. For confirmation of such consumption pattern one more set of reading can be taken at the 14th and 15thth day, so that the averages arrived can be compared for more reliability.

Format 8

10.6.0 TABLE FOR NOTING DOWN THE ENERGY METER READING

ENERGYMETER	First Day Consumption	Second Day Consumption	14th day consumption	15th day consumption
Energy meter at LT side of transformer				
Total Consumer Meters				

Format 9

10.6.1 Table for Energy loss calculation

Description	Energy Consumption for three days in kWh
From Consumer's Energy Meter	
Form Energy Meter at Transformer	
Difference in Units / Energy Loss	
% Energy Loss for the LT distribution line	
Non technical loss (due to defective meters, power theft and Street lighting)	
Technical loss	
Transformer loss	
Total secondary distribution loss	

10.7.0 THE CONTENT OF THE REPORT

10.7.1 Add pictures/photos taken on the installation/line/transformer/consumer etc and comments

10.7.2 Harmonic measurement and comments

10.7.3 Temperature measurement and comments

10.7.4 Analysis of results, observations, optimization

10.7.5 Conclusions and Recommendations for Energy Efficiency and Energy Conservation at Transformer, at LT line and Consumer points

Format 10 (Transformer failure particular)

Site description:

S.NO	Transformer	Capacity of transformer	Commissioned on	Failed on

Format 11 (Power interruption record)

Site description:

S.NO	Date	Time duration	Reason for interruption	Action taken	Remarks

Format 12 for employee status on awareness of energy conservation and energy efficiency
Format 13 for consumer awareness awareness of energy conservation and energy efficiency

The model can be used and further refined for identical study in the same utility as well as for other licensees.

Section 11

CONCLUSION

11.0.0 CONCLUSION

11.1.0 The Project, Rationalization of Secondary Distribution System through a Micro Level Approach was conducted at KSEB Transformers and Distribution lines with the following expectations.

- A well planned approach to distribution network losses at a micro level
- Identifying the key barriers
- Addressing the key issues faced by the domestic customers due to poor power quality
- Adaptability assessment of such identified locations
- Best O& M practices and reduction in distribution transformer failures
- Improvements in compliance of Standard of Performance of Distribution Licensee
- Overall improvement in the power quality and reduction in AT & C losses in the state

11.2.0 OBSERVATIONS ON THE STUDY

Kerala State Electricity Board has taken many energy conservation and energy efficiency initiatives. Yet there are opportunities available for further improvement. KSEB may go for the Zero Transformer Failure (ZTF), the Zero Meter Failure (ZMF) and Zero Consumer Complaint (ZCC) status monitoring. Improving the awareness of the employees and the consumer on energy conservation and energy efficiency measure will lead to better results.

Out of the three sites where the study was carried out two sites are having status of zero meter failure. At one location the transformer is underutilized and recommended for replacement with lower rating. In all the sites, the neutral current is more due to unbalanced load which calls for regular balancing of load. In all the sites the harmonics level is within limit. The audit will be more effective if the metering facility was available at the HT side of the transformer in addition to LT metering for getting the accurate transformer loss.

11.2.1 Even though the scope of work and the methodology is sufficient enough to achieve the expected results, it is suggested to adopt the following points for future study to get a better result.

a. It is suggested to ensure/provide Metering at the HT and LT side of the transformer before starting the study in future to ascertain the exact Transformer losses of the particular distribution transformer.
b. The study can be carried out for a section of transmission and distribution net work from sub station to the consumer for getting the exact HT/LT ratio and ascertain the T & D losses of that section and to compare and arrive at a standard for the distribution losses of different transformers and the corresponding distribution lines.
c. The data collection can be further extended for a standard Transformer station and its requirements/specification at other locations.
d. It is recommended to carry out thorough Power quality audit at the substation end.

11.2.2 If the consumer data on type of loads and lights used are also surveyed at the micro level, the optimum no of different lights, optimization for improvements, energy efficiency equipments can be recommended.

11.2.3 The study can be extended to other utility/licensee based on the model developed and further refined.

11.2.4 Signature analysis can be carried out within 15 days twice so that the data will be more realistic and findings will be more reliable.

11.2.5 The selection of the transformer can be done segment wise (Industrial / Domestic / Commercial dominant) to do improvement at the load side. With that the distribution losses and the load factor of the transformer can be reduced and the effect can be measured and verified,

11.2.6 Monitoring, Standardization and process improvement are the key factors for sustainable energy efficiency practice.

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