Cost Effective Electrical Reticulation of the Rural Areas in Transkei at the District of Lady Frere (NKOLONGA).

A RESEARCH REPORT SUBMITTED IN PARTIAL COMPLIANCE WITH THE REQUIREMENTS FOR THE NATIONAL MASTER'S DIPLOMA IN TECHNOLOGY IN THE DEPARTMENT OF POWER ENGINEERING

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DECLARATION

I, Bongani, M. Booi sincerely and solemnly declare that the copy of this research report submitted by me in MAY 1995 is original. It is no way the work of anyone else.

The research is the product of my efforts through the professional guidance of my supervisor whose name appears below.

Candidate's Signature: Date: 01.05.95

Supervisor's Signature: Date:

ACKNOWLEDGEMENTS

For any piece of research work, there are people one need to consult: forintance experts in the field of research for professional advice: people for whom the research is to be conducted, so as to reach the aims and objectives of the study. In the name of my Saviour Christ Jesus, I thank God for the following persons, whose sacrifices and skills made it possible for me to succeed in my study.

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ABSTRACT

The purpose of this study is to investigate the most cost effective way of electrifying rural areas in the Transkei concentrating in the district of LADY FRERE. One Administrative Area (A.A) was used for research. Questionnaires were send to people of this area where a likerat format was followed. For the purpose of this study, 20 families were randomly selected for investigation.

The data was captured by taking the responses of the respondents to questionnaires and tabling them. Rating of responses was according to the needs and desires of each family. Tape recordings of verbal exchange and production of transcripts was also made. Rating of questionnaires was a point form, where the highest family with high points and others with less points. From each of these families of different classes, a list or a table is drawn up.

The Local Authority or Eskom is used as an extra sample where possible. Once the data from all questionnaires was been captured and interpreted the assistance of Eskom engineers was called to analyse and highlight the problem.

The involved community voiced out problems like: (1) low source of income per household. (2) remote areas they are staying at.

The research finding: that people are interested in getting their area electrified, people see electricity as the way of uplifting their standard of living, the involvement of these people from inception stage through to the operation stage. It was suggested that the government must empower the communities to small scale rural development programmes focusing mainly on homesteads.

To devise some kind of solution to the problem, much research has been conducted in recent years. A lot of these projects were aimed at long term effectiveness of various measures to establish electricity in rural areas. Two types of approach were discussed which, however the 1000 volts approach is cost effective for customers of less than 5000 square metres. Secondly, the fact that the load can be easily added at cost effective amount is an advantage for Nkolonga administrative area.

In conclusion, it was recommended that this area should be electrified for the participation of rural community in the stimulation of economic growth.

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This research report is specially dedicated to my four months baby boy

KHANYISO.

CHAPTER ONE

COST EFFECTIVE ELECTRICAL RETICULATION IN RURAL AREAS OF TRANSKEI AT THE DISTRICT OF LADY FRERE (NKOLONGA).

THE PROBLEM AND ITS SETTING

1.1 STATEMENT OF THE PROBLEM

This research proposes to investigate and identify the key factors to be taken into consideration for the provision of electrical reticulation in the informal, semi-formal, and low cost formal residential areas, situated in rural districts so that the needy people may have access to electricity. In order to achieve this objective the project will focus in an informal residential area called Nkolonga in the district of Lady Frere. This area is difficult to develop because of the imbalances which exist between rural and urban areas.

1.2 THE SUB-PROBLEMS

1.2.1 First Sub-problem

The first sub-problem is to evaluate the community's perception of, and need for, electricity in their area.

1.2.2 **Second sub-problem**

The second sub-problem is to establish the community's ability to pay for electrical installation per household.

1.2.3 **Third sub-problem**

The third sub-problem is to establish the affluence of the communities and their ability to pay for major energy intensive appliances and to the energy required.

1.2.4 **Fourth sub-problem**

The fourth sub-problem is to establish the preferred methods, materials and equipment to be used to provide an economical system which, however, is safe, reliable and requires minimal maintenance.

1.3 THE HYPOTHESIS

1.3.1 **Hypothesis One**

It is hypothesised that the rural people's perception of electricity is positive and their electricity's needs are not met.

1.3.2 **Hypothesis Two**

It is hypothesised that the rural people can afford the installation of electricity in their homes.(Appendix One B.) The community can empower themselves to mall scale rural development programmes focusing mainly on homesteads.

1.3.3 Hypothesis Three

It is hypothesised that the rural residents are affluent enough to purchase the major energy intensive appliances and pay for the energy required.

1.3.4 Hypothesis Four

It is hypothesised that suitable methods, materials and equipment exist to provide an economical system which is safe, reliable and requires minimal maintenance.

1.4 THE DELIMITATIONS

The study will not attempt to involve areas that are within the Municipality boundary of Lady Frere. The study will be limited to Nkolonga Administrative Area. The recommendation of this study will not be applicable to other rural areas. However, the illustration of how a particular rural are can be electrified, could be informative for other similar areas.

1.5 THE DEFINITIONS OF TERMS

1.5.1 Electrical Reticulation

Electrical reticulation is a complex assemblage of equipment and circuits for transforming and distributing electrical energy.

1.5.2 **ADMD**

After Diversity Maximum Demand is the simultaneous maximum demand of a group of customers divided by the number of customers normally expanded in Kva

1.5.3 **Rural Areas**

Rural areas are areas that are geographically outside the municipal areas.

1.5.4 **Infrastructure**

An infrastructure is a substructure or underlying foundation, especially the basic economic, social, and installation of a community, state.

1.5.5 **Distribution**

Distribution is that part of electric system that takes power from a bulk power station to consumer's switches.

1.5.6 **Development**

Development is a process whereby people are awakened to opportunities within their reach.

1.5.7 **Lightning Arrestor**

A device designed to protect electrical appliances from high transit voltage and to limit the duration and amplitude of the flow current

1.5.8 **Administrative Area (A.A.)**

Administrative area is one whereby plus minus five rural areas are under one chieftainship.

1.5.9 **Marketing**

Marketing is the stimulating movement of goods and service from producer to consumer or user.

1.5.10 **Feeder**

A feeder is an untapped, overhead or underground three-phase cable, or set of conductors connecting distribution substations

1.6 ASSUMPTIONS

1.6.1 **First Assumption**

It is assumed that the rural resident's electricity need will continue till their area is electrified.

1.6.2 **Second Assumption**

It is assumed that the major electrical suppliers will be willing to take electricity to rural areas.

1.6.3 **Third Assumption**

It is assumed that the principles and problems associated with reticulation in under developed areas will be applicable in this area.

1.7 IMPORTANCE OF THE STUDY

South Africa is at a stage where the country desperately needs economic growth.

An important contribution to achieve such growth is through the electrification of the rural areas which are mostly without domestic electricity. Approximately 15 percent of Transkeians living in rural areas have access to electricity. See as illustrated in figure 1.1 below.

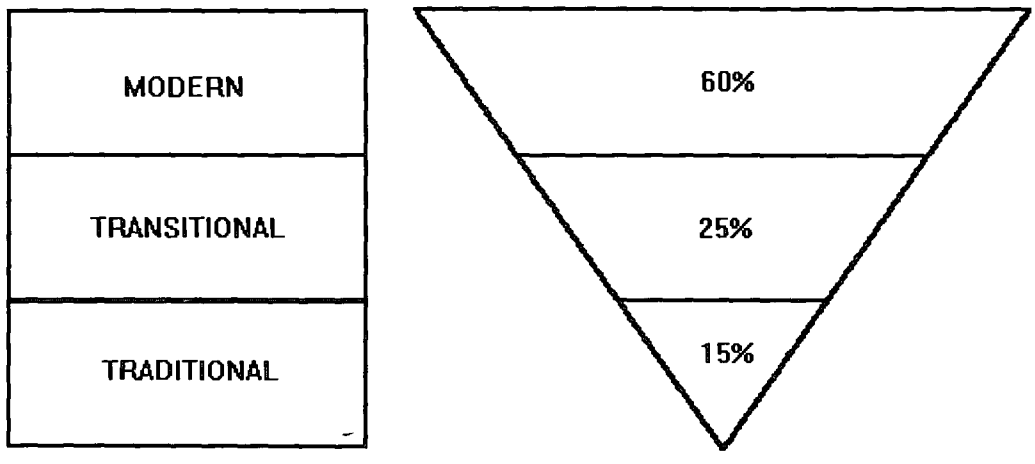


FIGURE 1.1 RELATIONSHIP OF CONSUMERS TO NETT ENERGY CONSUMED.

The nett energy consumption in the transitional sector is small in relation to those in the modern sector.

This is indeed because of the following reasons:

(a) the political scenario in the past.

(b) peoples' dependence on natural resources such as wood, coal and cow-dung.

(c) the peoples' perception about electricity e.g. that electricity is a dangerous monster.

(d) The exposure of others people to urban life, thus making them able to pay for electricity in their areas.

The electrification of rural areas will make a valuable contribution towards the economy of the country. This is done through the establishment of home industries, extra business for the repair of appliances and construction in industry. In tandem with this state of affairs, Eskom's objective is to supply electricity to every South African both in the urban, rural and farming sectors. It needs to be mentioned that already a considerable number of rural residents have the desire to use electricity in their homes. This is so precisely because people are acquiring freedom in business and taking up well paid positions in the TBVC states, hence improving their earning power. It is hoped that, in future rural development will also receive its fair share so that peoples' traditions, beliefs can be entrenched hence encouraged to stay in their traditional homes.

Most of the electricity in Transkei is generated from the Mbashe river, supplying an area from Flagstaff in the East to the Kei river in the South and Cofimvaba in the West.

The absence of electricity also discourages investors from coming into the country and developing rural areas. Consequently people from rural areas flock into cities to look for employment, thus destabilising their families. Bembo[1] clearly explains the nature and extent of the problem in South Africa, I quote:

"As the economic structure in South Africa moved from a purely agricultural to an agricultural-mining and then to the agricultural-mining-industrial phase, Blacks flocked to an increasing extent from their traditional homes in South Africa and from the neighbouring states to the White areas, and especially to the White urban areas of South Africa. From this it is evident that the free market mechanism is indifferent to an even distribution of economic activity". The purpose of this project therefore is to investigate and establish as economically as possible means of getting electricity to the needy, not only in the urban areas or those areas in the proximity of power lines, but also in remote locations.

Eskom has already undertaken a pilot study in areas such as Sterkspruit in the Transkei and Orange Farm in the Eastern Transvaal. For this reason, this project will critically examine some of the technology used by Eskom with a view to applying it in the area under consideration. In the light of the foregoing facts, it can be shown that the importance of this service cannot be overemphasised.

1.8 ARRANGEMENT OF RESEARCH CHAPTERS

Chapter One: The problem and its Setting

Chapter one introduces the origin of the researched problem, and provides the background necessary for understanding the problem. The hypotheses are introduced and the delimitation's, assumptions, and definitions of terms, are mentioned.

Chapter Two: Review of the related literature

Chapter two deals with a brief historical overview of Transkei related to the problem of search, geographical location, housing structure, and education levels of the area under investigation. The economic potential is also briefly described.

Chapter Three: General Procedure

In chapter three, attention is given to two different approaches for rural electrification, cost analysis of materials, pole structures, transformer sizes, calculation of losses, and cables sizes are described respectively.

Chapter Four: General Discussion Of Results

Chapter four will provide the general discussion of the results. Personal suggestions of the researcher will also be discussed as part of the investigation.

Chapter Five: Conclusion And Recommendations

In chapter five, the researcher will attempt to draw conclusion, by examining the merits and demerits of development in the rural area of Nkolonga. Suggestions and recommendations will be offered regarding possible future directions which could be followed in electrifying rural areas in Transkei.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.1 Historical overview of Transkei

Transkei is the first self governing African National Homeland which came into existence as a result of the passing of the Transkei Constitution Act, 1963 by the South African government[2]. It is known as the Republic of Transkei after having attained its independence on the 26 October 1976. Nkolonga which is the area under consideration, is situated in the district of Lady Frere about 40 kilometres out of town. It is a piece of land which is under the jurisdiction of local Chiefs. This area is composed of different types of people, that is some are educated and others are illiterate. About 40 percent of these people have been exposed to "MODERN" urban styles of living, where electricity is used.

A prerequisite for any growth of a country is a developed infrastructure so that the people can maintain and enjoy the "GOOD LIFE". The main problem with the rural areas of Transkei with regard to development has been with inadequate infrastructure in the country.

For this reason, this study will analyse the gathered data that contributes to rural development. To determine the causes of the problem mentioned above, a case study approach has been chosen as a means of research. In the collection of data, the methods utilized are :

(a) descriptive interviews, and

(b) a study of literature and records. The report is accompanied by diagrams where appropriate.

During the period of development the community is awakened to opportunities within their reach. Kotze[3] gives us a useful definition for under developed areas, as :

"These are areas that are inhabited with population with low income who have no access to basic services, who have fertility and mortality rates higher than the national average and who are relatively unmodernized".

A developed infrastructure would mean an abundant and well maintained communication network facility and housing, for the people to use as basic services in the economic development of the country. According to Makandula[4] , "Development should always be a step of the actual supply of basic needs such as shelter, food and electricity".

As one may observe from above it appears, therefore, that the main problem with rural areas have been the under developed areas. Development has been defined as a change plus growth. Cloete[5], states that development implies wide ranging changes as well as growth. Development can be considered either as a process of improvements with respect to a set of values or, when comparing the relative levels of development being with respect to such values[6].

There are different methods of metering which need to be considered in electrification. In areas where there is no infrastructure for billing customers, or where it is preferable not to use credit metering, electricity dispensers should be used. There are basic factors which need to be taken into consideration when evaluating the community's perception of, and need for electricity in their area, which are:

(a) Geographical location,

(b) Housing structures,

(c) Education level.

2.2 GEOGRAPHICAL LOCATION

Rural areas are areas that are geographically outside the municipal areas. Kotze[7], defines these areas as those that are furthest from the metropolis, and are characterized by a high degree of migrants, particularly of male population.

The rural communities of Nkolonga do lack knowledge and need of electricity since they are located far from urban areas. Therefore a need to awaken them about social and environmental benefits this service will bring has to be emphasised.

Geographical location has got to do with development where major infrastructure should produce a basic planning layout, showing infrastructure positioning, stand numbers, roads, shops and schools where possible[8]. Factors such as household income, modernisation access to basic services (electricity) and allow differentiation between rural and urban areas.

Certain key factors have to be taken into consideration when power distribution is to be implemented. The map in figure 2.1 shows the metropolitan cores and the periphery of South Africa. It is expedient to distinguish between urban and rural areas. Urban areas include all the peripheral settlements that are functionally part of the metropoles. The rural areas are furthest from the metropoles, generally most underdeveloped and are characterized by a high degree of migrancy.

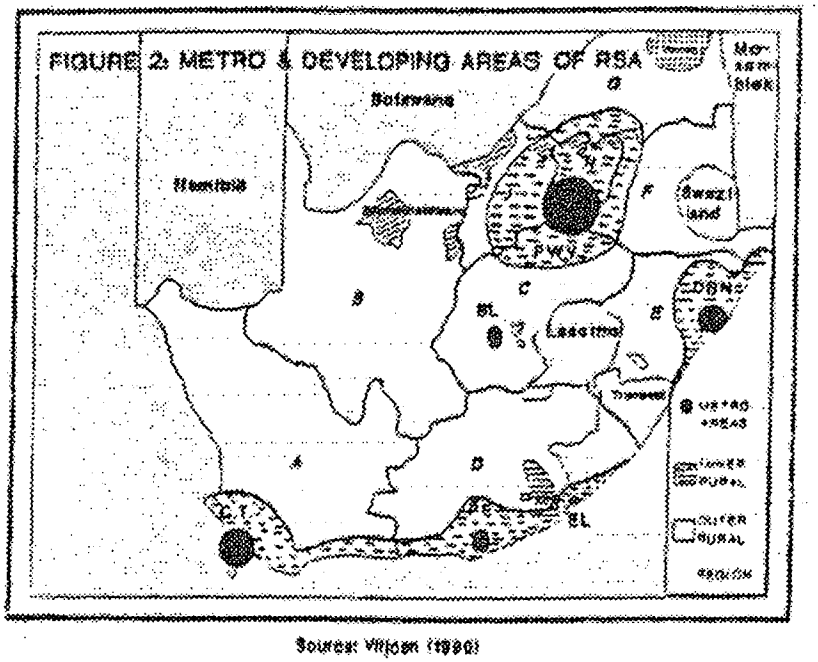


FIGURE 2.1 METROPOLITAN DEVELOPING AREAS IN SOUTH AFRICA.

Description of how schemes have to be built and the design parameters used describe aspects of importance in electricity supply[9].

In rural areas the situation is more complex, in that the role of traditional fuel (figure 2.2 and 2.3) is greatly influenced by population density and limited access to electricity, while the proximity to urban areas translate into higher average household income and access to better distribution networks[10]. The spatial imbalance of the South African economy is illustrated in Table 2.1 and 2.2.

SPATIAL IMBALANCE OF S.A. ECONOMY.			
	Proportion of population	Economic activity	Electricity consumed
Metropoles	30%	60%	87%
Platteland	28%	36%	10%
Homelands	42%	5%	3%

TABLE 2.1 IMBALANCE OF THE SOUTH AFRICA'S ECONOMY.

It is evident from Table 2.1 that community in homelands have a small quality of electricity consumed. This is so because the choice of fuels is often determined by the cost of appliances rather the cost of fuels themselves. The constraint of entry cost on the use of electricity is born out by the observed low uptake rate of electricity in rural areas including Nkolonga in Transkei. This is further proved by different fuels used at different areas as seen in Table 2.2.

PERCENTAGE OF HOUSEHOLD IN DEVELOPING AREAS USING DEFERENT FUELS.				
FUEL TYPE	OUTER RURAL	RURAL FARMS	INNER RURAL AND INFO.RURAL	FORMAL URBAN
Electricity	<1	14	3	29
Wood	99	97	68	38
Paraffin	96	19	84	71
Candles	73	86	79	77
Coal	12	5	53	47
LPG	5	9	7	14
Batteries	55	7	60	2

TABLE 2.2 PERCENTAGE OF HOUSEHOLDS IN DEVELOPING AREAS USING DIFFERENT FUELS.

From table 2.2 it appears that in urban areas there is no overwhelming dominance of single fuel is observed. It shows therefore that large regional differences in fuel consumption exist. It would further appear that in informal and formal areas there is a large difference between fuels used by households. In terms of electricity expenditure in urban areas access is dominant whereas wood or other fuels are dominant in rural areas.

Figure 2.2 and 2.3 are showing the high percentages of fuels like wood and paraffin that are dominant at Nkolonga administrative area. This further proves that rural areas have a great need of fuels like electricity to perform their duties much quicker. This service can also improve their economic activities. Looking at how these areas uses fuels over a period of an annum, one might predict a constant growth in electricity consumption over a short time.

FIGURE 2.2 : NETT DOMESTIC ENERGY CONSUMPTION PER HOUSHOLD PER ANNUM

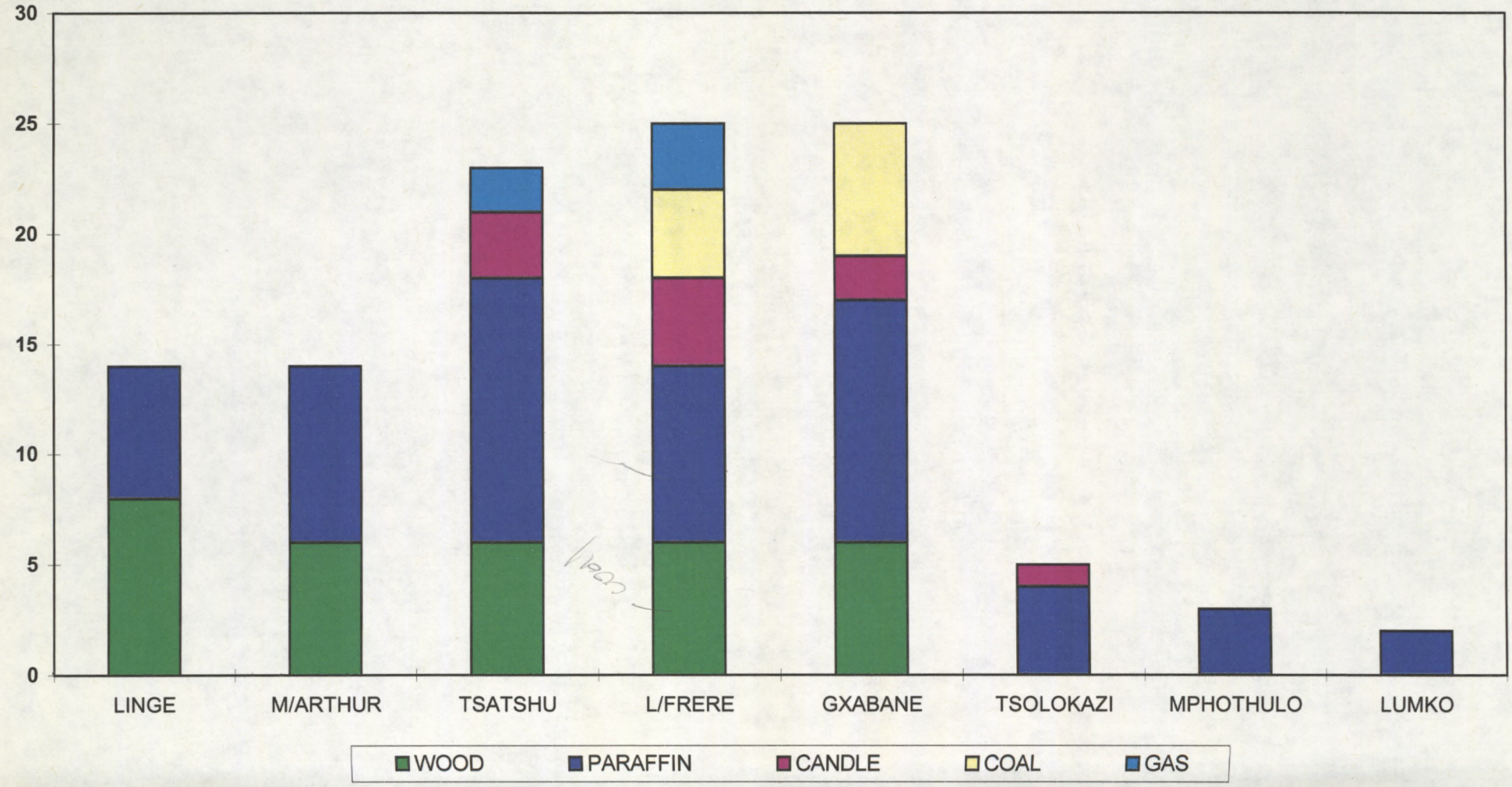
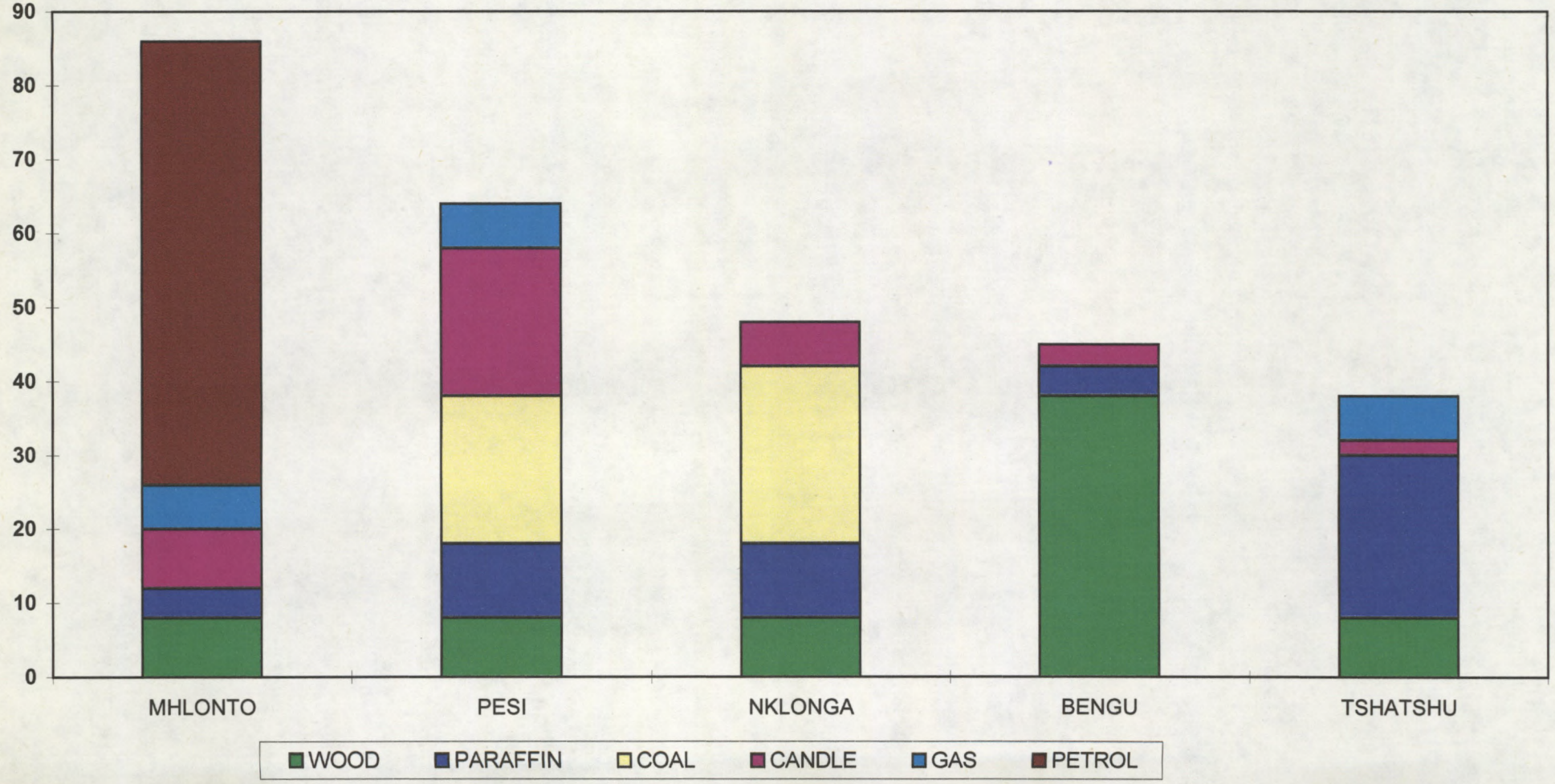


FIGURE 2.3 : MONTHLY DOMESTIC ENERGY EXPENDITURE PER HOUSHOLD



2.3 HOUSING STRUCTURES

The position in this country is that the low income populations have generally been forced by their situation into three types of housing which are, high density slums, squatter areas and street living. The study has concentrated on the high density slum areas which are called rural areas in South Africa. The slum areas are characterised by high densities and a high use of shared space. In Suplarlan's [11] study he states that these people are the community that is primarily engaged in collecting all sorts of discarded commodities.

He comments, "In front of their huts one could always see heaps of paper, small pieces of zinc, wires and so forth. These scraps reflect the search for a livelihood. The income of these people is not stable, but depends on luck and individual diligence in collecting valuable items[12]". These people accept their conditions of living as strategy to cope with their low incomes.

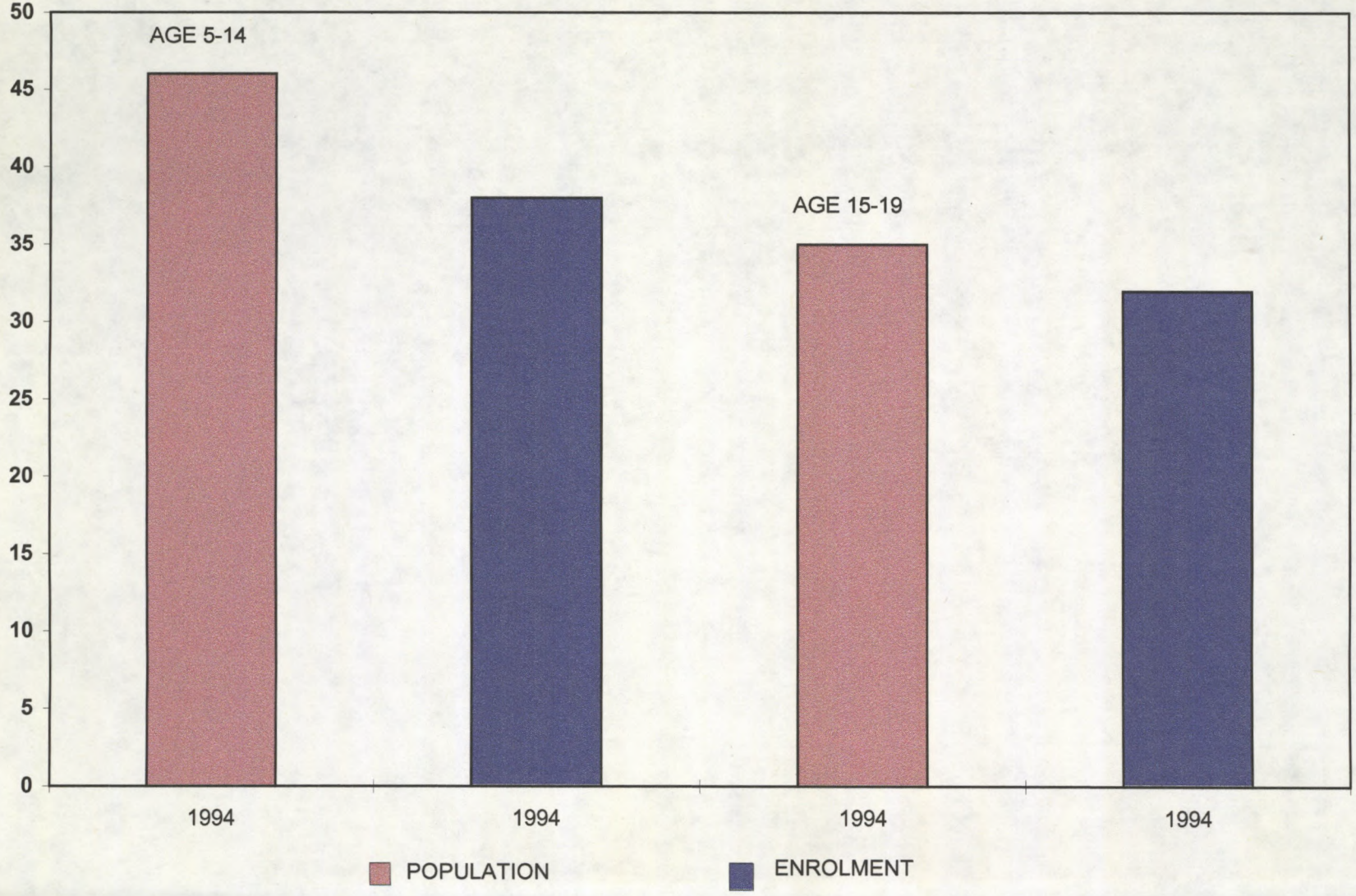
2.4 EDUCATION LEVELS

Rural areas are characterised by illiteracy because of socio-economic and spatial factors which prevent children from attending school. Many rural schools lack basic resources such as books. The buildings are dilapidated. There are places that are still using church buildings as school during the week. Many senior schools have been operating for a number of years in church buildings, and some cases in community members homesteads.

These problems contribute to a high failure rate in Transkei. School attendance is not compulsory, and this results in few children reaching standard 10. At primary school pupils in the age group 5-14 years are at 69,2 percent enrolment. A secondary enrolment of 52,5 percent indicates the population in the age 15-19 years. From these figures one can observe a blockage of pupils in lower standards. Figure 2.4 shows the enrolment of children. The stated blockage above is further reflected in table 2.3.

What these tables are showing is that in Transkei, of 100 pupils in primary school, 10 will enter the matric and 5 will pass. In white schools, of every 100 pupils in primary school, 85 will enter the matric year and 70 of those will pass.

FIGURE 2.4 : ENROLEMENT OF CHILDREN



School education is an integral part of the culture of the community and is an indispensable channel of education through which the adult purposely and systematically reaches mental maturity. Human development or education is the accumulation of human expertise. Thus education on the one hand serves the economy, by providing man with the required skills, knowledge and competance[13].

The South African Government has already indicated that it will be prepared to provide free and compulsory education as soon as possible within its financial capacity. The high costs associated with the introduction of a compulsory system of education makes it impossible, for the moment, for the South African Government to do so within the limited resources currently available[14]. The pupils of Nkolonga offered to attend primary schools in big numbers, but the rate of drop-outs is alarming compared to those who achieved their goal. The high cost and knowledge of their environment are one of the reasons for the drop-outs. The rural people have all their senses and good memory of what has happened which is usually transmitted from generation to generation through teaching and story telling. Chamber states that:

"For them (rural people) to be able to better participate, control and benefit requires reversal. Among these, one first step is for outside professionals, the bearers of modern scientific knowledge, to step down off their pedestals, and sit down, listen and learn."

There is no lack of evidence that the poor are aware of the possibility that education may give their children an opportunity for upward mobility, but they withdraw their children from schools. In rural areas there is a large number of people who react to inflation by withdrawing their children from school and sending them out to work or to shepherd their sheep[15].

The second sub-problem is to evaluate the community's affordability to pay for electrical installation per household.

There is, one resource which for a variety of reasons is not abundant, and that is the financial resource that is necessary to ensure the success of electrification. The electricity that is generated and distributed needs to be paid to ensure not only the continuity of the electricity supply but also the extension, maintenance and upgrading of the supply network. Cloete[16] states that:

"Development also means to promote wealth by exploiting of natural resources, creating job opportunities, providing job skills for the community so as to help to acquire jobs to enable them to meet their basic demands such as food, water, clothing and shelter".

The foregoing implies that human beings have the ability, not only to adapt to changes in the environment, but to purposefully modify their environment and to introduce innovations into their own lives in their pursuance of goods[17].

2.4.1 **Employment**

The table below shows the distribution of work by age and occupation.

AGE	ALL MEMBERS OF COMMS.	WORKER N %	SEEK N %	NOT WORK N %	SCHOLAR N %	UNDER N %
5 14	316	2 0,6	- -	3 0,9	281 89,0	30
15 24	222	9 4,1	14 6,3	45 20,3	125 56,3	-
25 34	177	98 55,4	12 0.7	57 32,2	10 5,6	-
35 44	130	82 63,1	3 2,3	45 34,6	- -	-
45 54	87	42 47,1	2 2,3	44 50,6	- -	-
55 64	78	25 32,1	1 1,3	55 70,5	-	-
65 +	65	12 18,5	1 1,5	52 80,0	- -	-

TABLE 2.3 DISTRIBUTION OF WORK BY AGE AND OCCUPATION.

Of the 177 in the age group between 25 and 34, only 55,4 percent were economically active. The 5,6 percent scholars in the age group were studying on a part-time basis. What Table 2.3 means is that in Transkei 100 pupils in primary school, 10 will enter the matric and 5 will pass. In white schools, of every 100 pupils in primary school, 85 will enter the matric year end examination and 70 of these will pass.

Although the energy problem in the rural areas is apparently a problem of poverty, it appears that it would be an oversimplification to relate it to income alone[18].
Energy consumption and choice of fuels appears to be largely dictated by modification.

Viljoen[19] further states that the fuel used changes in a series of phases from rural biomass depending in relation to the socio-economic characteristic of the population at a particular stage of progress. With cash incomes being limited, arising mainly from migrant workers, expenditure on energy communities may account for less expenditure per household.

Concerning a high percentage of electricity consumers falling into a relatively low income bracket, it could be some years before the availability of electricity can show its impact in improving affluence and hence greater consumption of this energy source.

Lastly, the study will analyse other viable economic means that could uplift the standard of living, like farming and sewing workshops, etc. Bromley[20] gives us clear definition of economic development as:

"It is a process by which countries with low per capita national incomes may increase their production goals and service so as to raise their material standard of living". Economic development in this study means provision of infrastructure such as electricity, to enable the community to develop economically.

2.5 ANALYSIS OF DEVELOPMENT POTENTIAL

2.5.1 Agricultural potential

The agricultural potential of the country is regarded as the base of the country's economy and this has repeatedly been stated. The homelands are mainly situated in the Eastern regions, the better agricultural regions in South Africa. The climate varies between warm, moderate and humid. The annual rainfall varies between 500 millimetres and 1200 millimetres for the Transkei[21]. In the early stages of development a country is basically dependent on the primary sector to make a contribution to its development. According to Rostow[22]; it is one of the characteristics of a country in its "pre-take-off" and "take-off" stages that 75 percent or more of its labour force is active in agriculture.

The basic function of agriculture is to supply food and enable the consumer to keep spending less of each additional rand he earns on obtaining more food.

The agricultural potential of the homeland is estimated at more than 23 percent of the total in South Africa, whereas at present they produce only 5,8 percent of South Africa's agricultural contribution to Gross Domestic Product. The Transkei soil yields many riches, viz. fertile grounds, a large water supply and a good climate means Nkolonga has the potential to become a maize producer in the region[23].

Agriculture is one mean that would seem to offer the highest potential for future development as there are no significant known mineral resources[24].

2.5.2 Commercial Potential

Prior to the independence of Transkei, the commercial sector was dominated by non-Transkeian traders and businessmen. The situation has altered considerably with an ever increasing number of Transkeians taking over commercial operations and the consequent creation of a Transkeian entrepreneurial class[25]. South Africa's industries are heavily concentrated in the four regions, Pretoria, Witwatersrand, Durban and Port Elizabeth.

These regions contain 75 percent of all manufacturing enterprises and generate 80 percent of total industrial production.

The Industrial Development Corporation had earlier been given primary responsibility for creating the infrastructure, housing, and making loans in the border areas.

The government has set a target of 8,5 percent annual growth of gross domestic product, a rate that could be attained only by moving African workers into more highly skilled jobs[26] .

The fourth sub-problem is to establish the preferred methods, materials and equipment to be used to provide an economical system which, however, is safe, reliable and requires minimal maintenance.

The Transkei Electricity Supply Corporation (Tescor) was established in 1979 and fulfils the role previously undertaken by Eskom. According to the Managing Director, Mr S.T. Collins, Tescor has a multi-purpose scheme, it is not only for electricity export, but for water irrigation and future water suppliers to South Africa. The main problem of Transkei with regard to the provision of electricity to rural areas is the shortage of developed infrastructure[27]. The problem relating to electrical distribution has been with design standards and specifications that are not met.

Description of how schemes are built and the design parameters used is important. Schwartz gives us a clear explanation of design as:

"Design is essentially a compromise between improved technical performance and additional cost. Good design takes a wide ranging approach to the definition of the need and formulation of the solution". In addition careful attention is paid in detail. Good design is distinguished from ordinary design by innovation[28].

Two different approaches for electricity distribution will be examined which are assumed below:

The first approach is to build a 10 Mva substation, from which the area is to be supplied. This area is sub-divided into 5 sections, each with approximately 52 customers. Five, 11 kilovolts feeders run from the sub-station to each section.

A 11 kv/1.1 kv transformer is used to step down the voltage in each section. Due to construction and cost consideration, the 1.1 kilovolts line will be pulled as close to the customer as possible. A 1.1 kv/230 volts transformer will be used for tapping power for each customer from the 1.1 kilovolts line.

The second approach is similar to the first one except for the following differences:

1. The area has five, 2 Mva substations with one substation at each section instead of one 10 Mva substation.
2. Aerial Bundle conductors are used to transmit power instead of Bare conductors.
3. The substations are connected in a ring system instead of a radial system.

A lot will depend on the planning, which, due to construction and cost consideration, would decided the type of design to implement. In order to analyse the performance of each approach, losses have to be considered. The material and labour per kilometre to supply each customer will be calculated. Types of poles and structure to be used will depend on considerations such as telephone lines, infrastructure and type of soil[29]. The sale of electricity to domestic customers in Southern Africa has up to now been through a process of meter-read, bill, payment receipt.

The business processes, system and work practices within the Electricity Distribution Industry have long been established to support this method of sale. The introduction of electricity dispenser led to a huge growth in the number of domestic consumers who buy electricity. The product takes the form of a prepaid token sold to a customer. The token transfers the credit amount to the customer's meter, equal to the amount of money paid at the point of sale. The customer is then able to consume electricity to the value of the credit contained in the meter.

The low power demand and highly dispersed loads, however, means that revenues may be insufficient to cover operating expenses let alone recover the high capital costs involved. A most cost effective approach must thus be sought. There are key factors which have to be taken into consideration during a design of a power distribution system. These factors are:

(a) Diversity.

(b) Voltage drop.

(c) Coincidence factor.

2.6 DESIGN PARAMETERS

2.6.1 Diversity

Due to the stable income of Nkolonga rural residents, the initial use of electrical appliances is expected to be small and the growth in electricity consumption is low as well. Therefore a system is usually designed to supply an assumed maximum load.

Most of the time the load will be less than the design load. However, there is always a risk that the maximum load will exceed the design load for a short period. The higher load may occur randomly for an individual customer or, under abnormal conditions for the whole system. The choice of an appropriate ADMD seems to be one of the distribution design engineer's main problems[30].

Selection of the design ADMD for any particular residential area will influence all major sizing parameters and influence the initial capital costs significantly. Table 2.4 shows the different classes which customers are classified. The people of Nkolonga will be falling under low consumption class which is basically using electricity for internal lighting and the limited range of appliances such as hot plates, iron and a kettle. The table shown below serves as a guide towards the selection of design ADMD.

1	2	3	4
CONSUMPTION CLASS (NOTE 1)	APPROX. FINAL LOADING & DESIGN ADMD	APPROX. ANNUAL LOAD FACTOR	APPROX. KWH PER ANNUM
Very high	6 to 9 KVA	30 % to 35%	> 19000
High	3,5 to 6 KVA	28 % to 32 %	7 500 to 19000
Medium	2 to 3,7 KVA	25 % to 30 %	3 000 to 7 500
Low	1 to 2,5 KVA	15 % to 25 %	< 3000

TABLE 2.4 ADMD FOR DIFFERENT CONSUMPTION CLASS.

Consumers are divided into classes according to annual consumption. The classes exclude the use of load control and methods of restricting consumption.

Consumers are classified as follows:

1. Consumers in the low consumption class would typically use electricity for internal lighting and a limited range of appliances such as hot plates, an iron and a kettle.

2. Consumers in the medium consumption class would typically use electricity for a fridge, television and a stove, in addition to those items mentioned in 1.

3. Consumers in the high consumption class would typically use electricity for a hot water cylinder, a washing machine, a space heating, in addition to those mentioned in 2.

4. Consumers in the very high consumption class would for example have a second or third geyser, air conditioning, flood lighting, Jacuzzi, etc., in addition to the items in 3.

2.6.2 Voltage drop

When electrical engineers started building distribution system, they had no formal guidelines to follow.

This resulted in, among other problems, unacceptable voltage deviations and out of balance currents or zero sequence currents flowing in the neutral conductors resulting in frequent power interruptions during peak load demand seasons[31].

Voltage drop calculations (Table 2.5) at planning stage therefore are important for electricity distribution because of the following reasons:

Voltage = 400/230 Power Factor = 1 Max. Conductor Temp. = 30

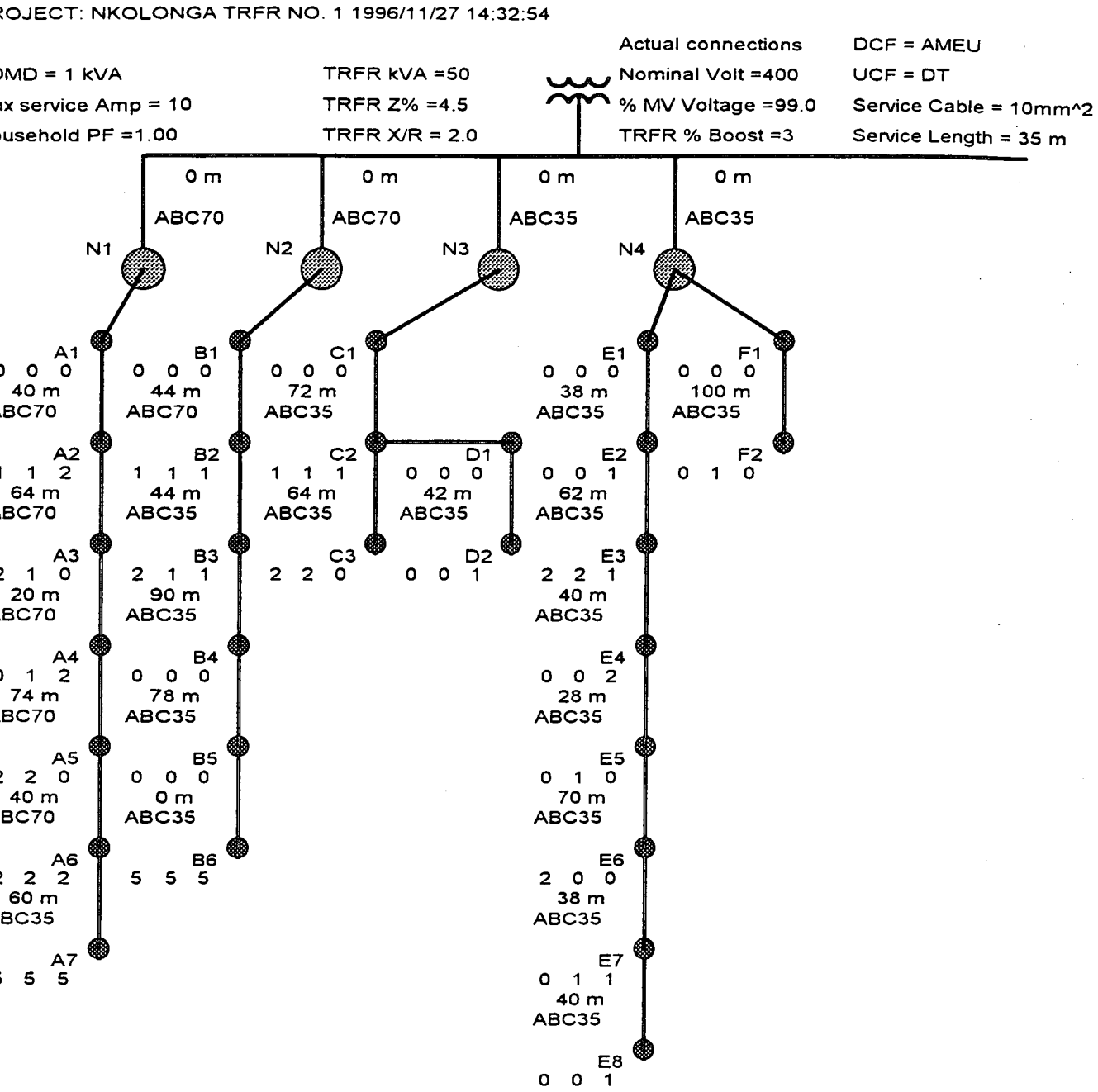
This table gives us the % voltage drop per 100 metres of cable for the conductors cross sectional areas in mm^2 and materials listed in 3 to 7 degrees.

Figure 3.1 shows the transformer volt drop calculation for each zone.

1	2	3	4	5	6	7
Design KVA	PHASE ANGLE	PERCENTAGE VOLTAGE DROP				
		CONDUCTOR AREA				
ADMD		16/16 AL	25/25 AL	10/10 CU	16/16 CU	25/25 CU
O,50	4,9	0,878	0,552	0.838	0,526	0,333
O,75	7,3	1,317	0,827	1.256	0,790	0,499
1,00	9,8	1,756	1,103	1,657	1,053	0,666
1,25	12,2	2,195	1,379	2,094	1,316	0,832
1,50	14,7	2,634	1,930	2,513	1,579	0,998
1,752	17,1	3,073	2,206	2,932	1,842	1,165
2,00	19,6	3,511	2,482	3,351	2,106	1,331
2,25	22,0	3,950	2,758	3,769	2,369	1,497
2,50	24,5	4,389	3,033	4,188	2,632	1,664
2,75	26,9	4,828	3,309	4,607	2,895	1,830
300	29,3	5,267	3,585	5,026	3,158	1,997
3,25	31,8	5,706	3,861	5,445	3,422	2,163
3,50	34,2	6,145	3,8161	5,864	3,685	2,329
3,75	36,7	6,584	4,137	6,282	3,948	2,496
4,00	39,1	7,023	4,412	6,701	4,211	2,662
4,25	41,6	7,462	4,688	7,120	4,474	2,829
4,50	44,0	7,901	4,964	7,539	4,738	2,995
4,75	46,5	8,340	5,240	7,958	5,001	3,161
5,00	48,9	8,779	5,515	8,377	5,264	3,328
5,25	51,4	9,218	5,791	8,795	5,527	3,494
5,50	53,4	9,657	6,067	9,214	5,790	3,661
5,75	56,2	10,096	6,343	9,633	6,054	3,827
6,00	58,7	10,534	6,619	10,052	6,317	3,993
6,25	61,1	10,973	6,894	10,471	6,580	4,160
6,50	63,3	11,412	7,170	10,890	6,843	4,326
6,75	66,0	11,851	7,446	11,308	7,106	4,492
7,00	68,5	12,290	7,722	11,727	7,370	4,659
7,25	70,9	12,729	7,997	12,146	7,633	4,825
7,50	73,4	13,168	8,272	12,565	7,896	4,992
7,75	75,8	13,607	8,549	12,984	8,159	5,158
8,00	78,3	14,046	8,825	13,403	8,422	5,324
8,25	80,7	.....	9,100	.....	8,686	5,491
8,50	83,2	.....	9,376	.....	8,949	5,657
8,75	85,6	.....	9,652	.....	9,212	5,824
9,00	88,0	.....	9,928	.....	9,475	5,990
9,25	90,5	.....	10,204	.....	9,738	6,156
9,50	92,2	.....	10,479	.....	10,002	6,323
9,75	95,4	.....	10,755	.....	10,265	6,489
10,0	97,8	.....	11,031	.....	10,528	6,656

TABLE 2.5 PERCENTAGE VOLTAGE DROP FOR

DOMESTIC CUSTOMERS.



gure 2.5 (A) Voltage drop calculation zone

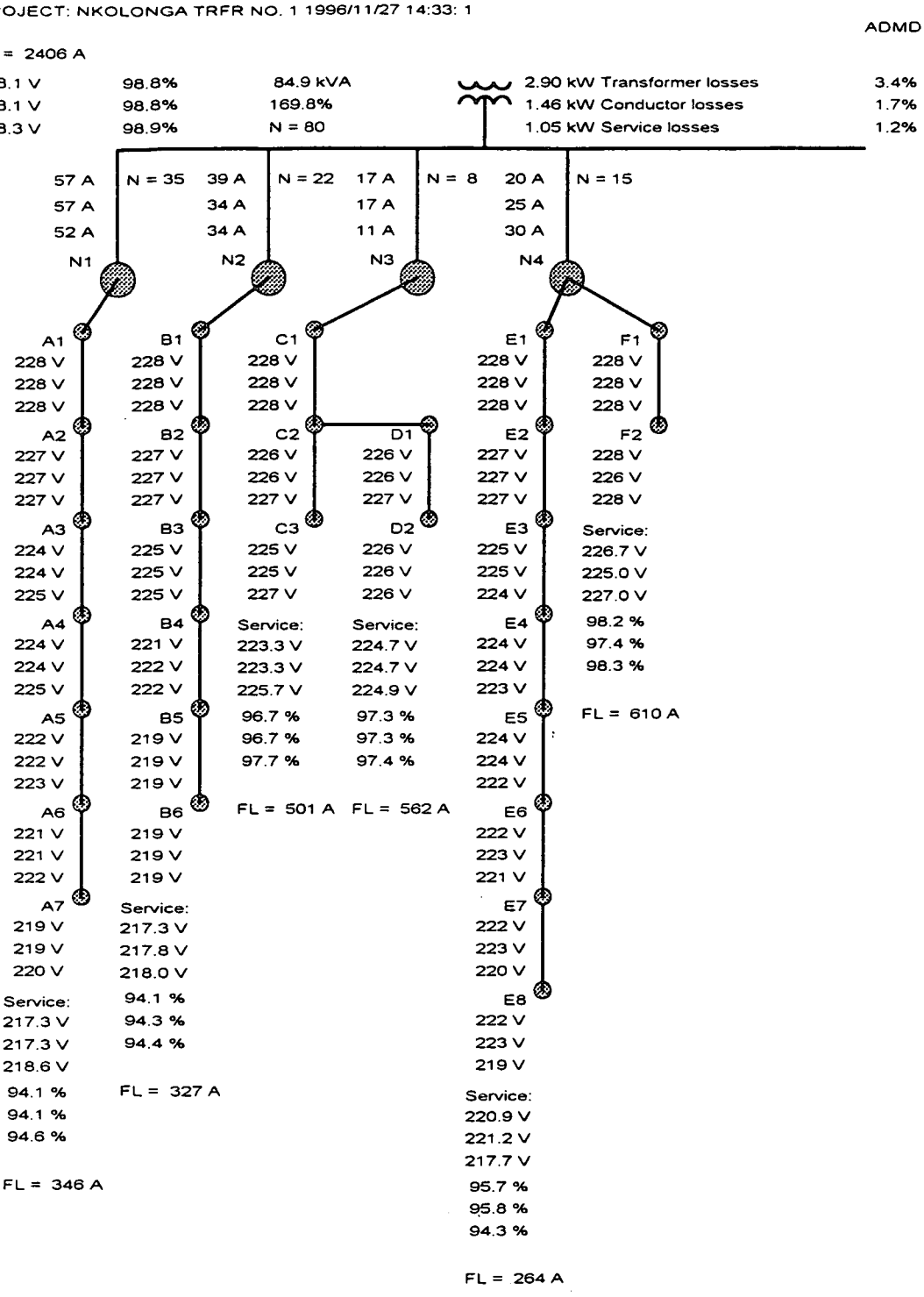
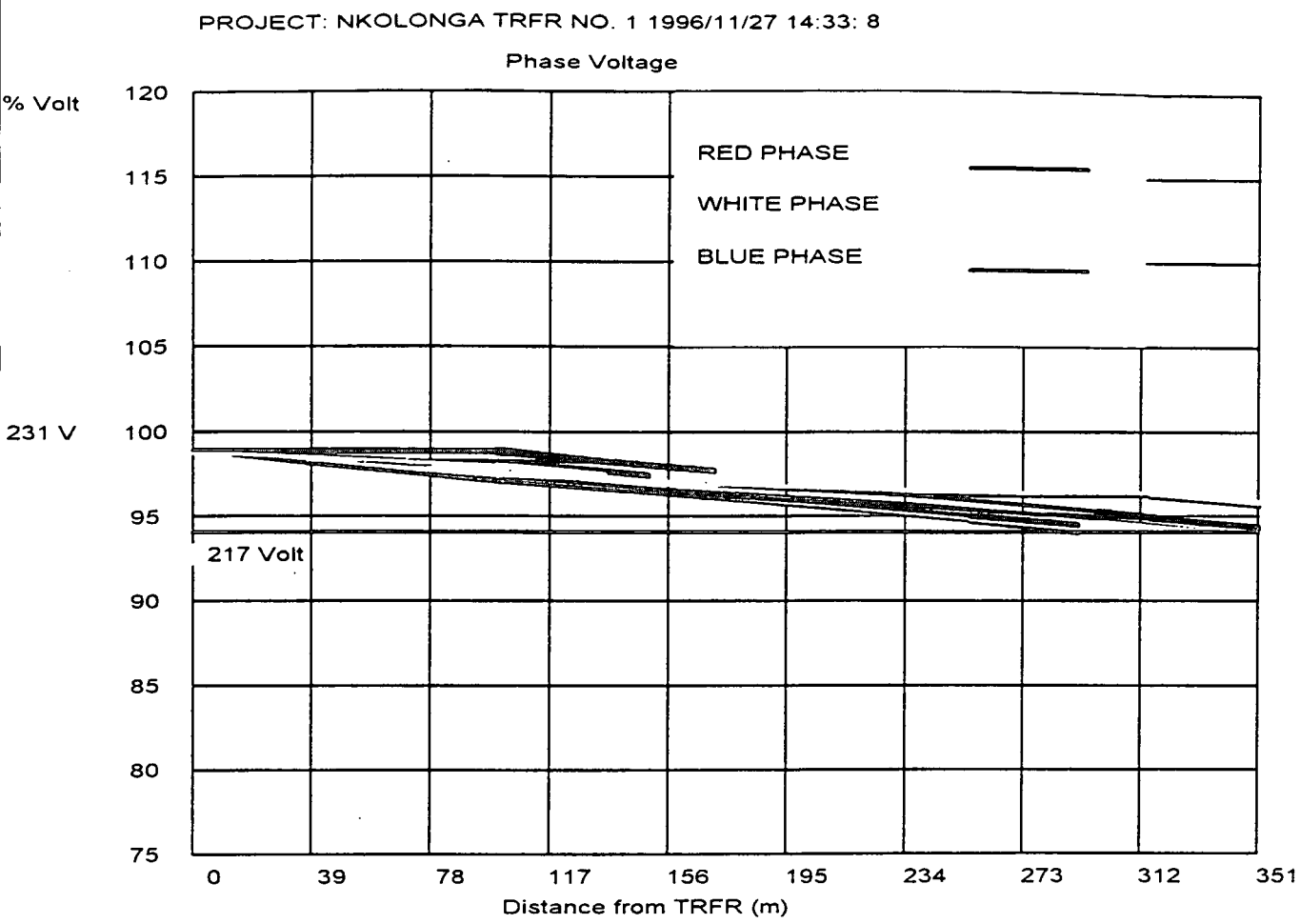


Figure 2.5 (B) Voltage drop calculation zone



able 2.6. Voltage drop profile

1. The capital needed for electrification development is a scarce resource, so that the distribution cables need to be optimised.

2. A network with insufficient capacity to supply electricity to consumers at voltages within the working range of their equipment will incur high costs in system losses and for system reinforcement[32]. The ADMD is the most important factor affecting the voltage drops.

2.6.3 Coincidence factor

Barry [33] gives us a clear definition of coincidence factor as:

"It is a ratio of the maximum coincidence total power demand of a group of consumers to the sum of the maximum power demand of the individual consumers comprising the group both taken at the same point of supply and for the same period of time".

In simple terms coincidence factor is the average contribution made by each consumer at the simultaneous maximum demand, compared with his individual maximum demand

$CF = MD/NI = ADMD/I$

where

MD = maximum demand

N = number of consumers

I = individual max. demand at different times

CHAPTER THREE

GENERAL PROCEDURE

3.1 OVERVIEW

In this chapter a number of methods on how to capture the data are described in order to investigate the cost effective way of electrifying rural areas. Data concerning perception of and need for electricity is obtained from the rural residents by means of questionnaires.

Affordability to pay for electricity is also determined by analysing other resources that could be used to generate a stable income like:

(i) Agriculture

(ii) Indoor business.

The affluence of communities and affordability of major energy intensive appliances would be determined by the growth of their appliances at home. Therefore all the results will enable the researcher to design a suitable approach for the area under investigation.

3.2 DESCRIPTION OF THE DATA NEEDED FOR THE FORMULATION OF A STRATEGY FOR RESEARCH.

3.2.1 The data

The data is made up of two kinds, the primary and secondary data.

3.2.1.1 The primary data

The primary data is obtained from the rural residents in a form of questionnaires related to sub-problems.

Questionnaires

(i) The perception and need of rural residents to the questionnaire of electricity related issues in their area.

(ii) The affordability of Nkolonga residents to the questionnaires of major energy intensive appliances, electrical installation and pay for the energy required.

(iii) The response of the Local Authority to the questionnaire of electricity distribution to the rural area of Nkolonga.

3.2.1.2 The secondary data

The secondary data is drawn from published reports and periodicals, carrying out related solutions to the topic under investigation

The publications in the government gazettes, S.A.B.S. specifications on approved approaches and also a reliable system which comply according to Act 41 of 1987 made under the Machinery and Occupational Safety Act.

3.2.1.3 **The criteria governing the admissibility of the data**.

For the data to be accepted, only the information obtained from the families is used. The information is obtained personally by the researcher in the form of questionnaires.

The perception of and need for electricity, the affordability and response of Local authority to the distribution of electricity. This information had been gathered and evaluated according to recommended methods or standards.

3.3 RESEARCH METHODOLOGY

In order to provide information to obtain data to solve sub-problems one to three, a case study approach has been chosen as means for research, the methods utilised are:

(a) Descriptive interviews;

(b) A study of literature and records. The report is accompanied by diagrams where appropriate.

The descriptive interviews method is used to collect data on the perception of and need for rural residents in having their area electrified. Questionnaires are designed by the researcher, having referred to the relevant sections of the literature study.

3.3.1 Sample

The process of selecting a sample is based on the system known as randomisation in which each family in the sample stands on equal chance of being selected.

NO of members/house		No of H/H	%
1	3	13	6.5
3	4	38	19.0
5	6	59	29.5
7	8	61	30.5
9	10	24	12.0
11+		5	2.5
TOTAL		**200**	**100,0**

TABLE 3.1 HOUSEHOLD SIZE.

Table 3.1 shows the size of the households of the sample at Nkolonga Administrative Area. From each of these samples, which are made up of at least nine people staying in one Erf number, the whole family or heads of the family were used on the sample, amounting to the sample of twenty per class.

The Local Authority is used as an extra sample where possible. These sample sizes provide an information for the smoothing of the event.

3.4.1 **Feeling and Reactions**

In determining the feelings and reactions of the rural residents, some demonstrations had to be done. A survey study is taken which is made up of different ages in each class of sample. Each sample is given a period of about twenty to thirty minutes being interviewed and an extra twenty minutes to watch the demonstrations which are the following:

(i) Use of electrical appliances,

(ii) Use of electricity in farming and schools.

3.4.2 **Attitudes**

The method of using the demonstrations to rise up the attitudes of rural residents is selected. Each sample is even given a chance to handle and operate the appliances whilst under supervision. These demonstrations are designed to solve their problems concerning the use of electricity at home.

The second sub-problem is to establish the community's affordability to pay for electrical installations per household.

This can be achieved by formulating questionnaires concerning their personal earnings and responsibilities at home. To address that see information at Appendix One. Monthly visits were done to each sample to see their affordability of major energy intensive appliances.

This was deduced with the use of electricity dispensers, from a sample's record of purchasing the cards. Although the communities fall in the low bracket income, the affordability will be realised after some time.

3.4.3 **Technical Procedure**

The technical procedure describes the procedural prescriptions, the material required for the electrical reticulation system and the ways of installing these materials. The criterion provides the following assurances:

(i) That a reliable electrical reticulation system or approach will comply with to the electricity Act 41 of 1987.

(ii) That all the materials specified will comply with the SABS specifications, or with the relevant IEC or British Standard specifications.

An essential aspect is the comparison of two systems which could be used to achieve the aim and objectives of the study.

For the purposes of comparison, it is assumed that the area to be electrified is a circle of 2 to 3 kilometres radius representing a maximum demand of 10 Mva with a power factor of 0,8 lagging.. The distribution system comprises 11 kilovolts lines equipped with Hare and ABC conductors respectively.

The customer densities range from 3 000 square metres to 5 000 square metres per customer with an average of 4 000 metres per customer in this region.

The first approach is called the short feeder method, where, however the area is served by five radial 11 kilovolts lines supplying a number of 260 consumers in all. The line to transmit power is equipped with Hare conductors.

3.5 MATERIAL

The material should be selected from the ranges covered by the applicable standards. All items should be selected to have characteristics that are appropriate to the conditions and the parameters on which the design of the distribution system is based, in particular with regard to the following:

(i) Voltage

(ii) Current

(iii) Fault effects

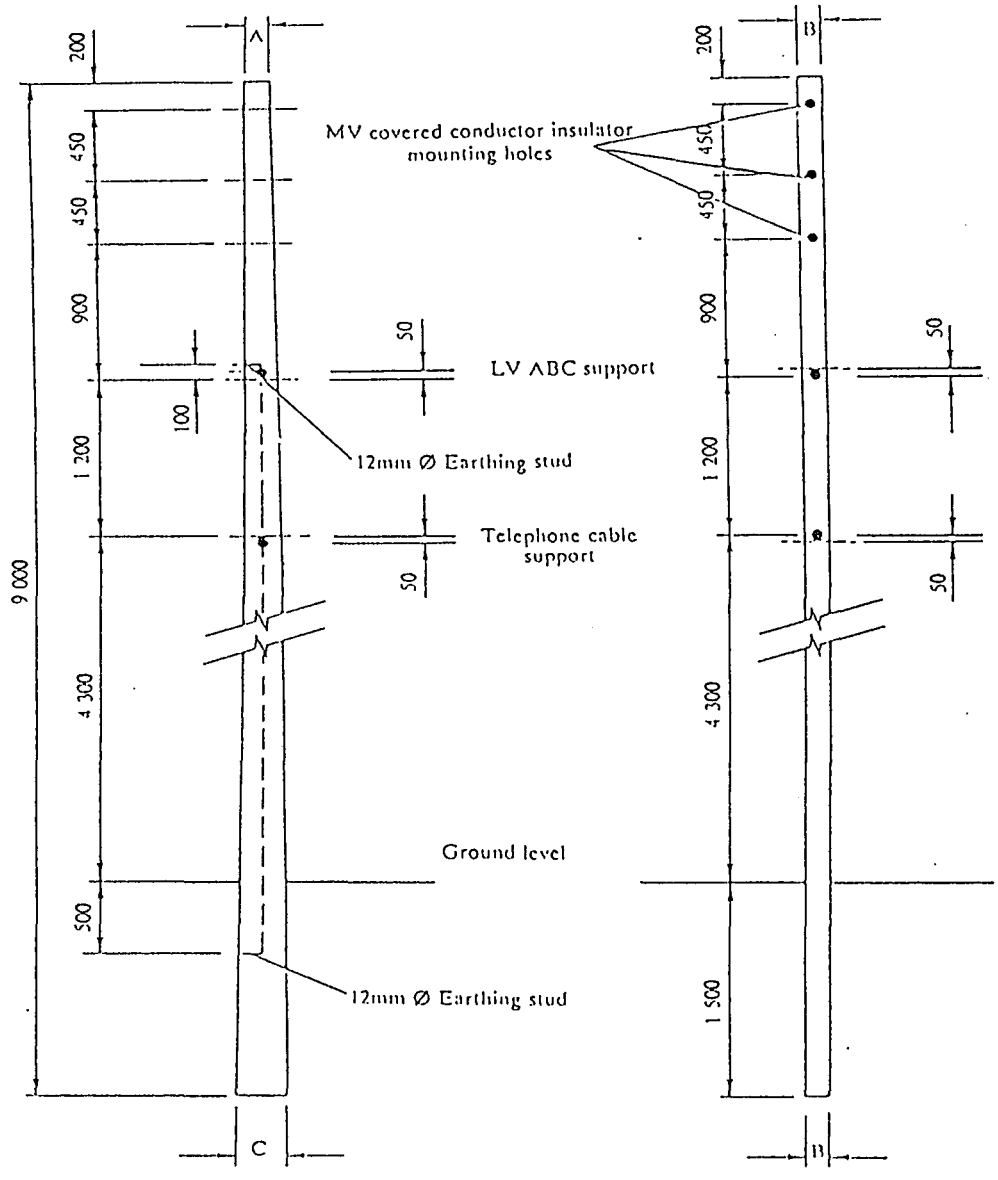
(iv) Clearances

(v) Factors of safety

3.5.1 **Poles**

Reinforced concrete poles are used in this approach and they should conform to SABS 470, and the preferable pole length is 9 metres. The pole planting depth should be a minimum of 600 millimetres plus 10 percent of the pole length. Figure 3.1 shows the standard planting depth.

FIGURE 3.1 STANDARD POLE DEPTH



Poles have to be planted within a distance of about 5 metres between each other. Excavation for poles shall be in line with the route of the overhead line and shall cause minimum ground disturbance.

When the ground is soft or marshy a concrete base should be installed under the pole. Staywires, stayrods are required at terminal poles and should also be used in conjunction with a strut when any line crosses a commonly used track or road.

3.5.2 **Transformer**

In the case where there are many customers being supplied from a single transformer an advantage can be taken of the overloading and diversity. The After Diversity Maximum Demand (ADMD) per customer is:

$$\text{ADMD} = \frac{2}{1,5}$$

$$= 1,3 \text{ Kva}$$

The size for a 11 kilovolts transformer phase to neutral voltage for a three phase transformer is:

$$\text{Transformer Kva} = \text{number of customers} \times \frac{\text{ADMD}}{\text{overload}}$$

$$= 260 \times \frac{1,3}{1,3}$$

Transformer Kva = 260 Kva

The size of the 1000 volts to 230 volts transformer is:

$$\text{Transformer Kva} = \text{number of customer} \times \frac{\text{MD}}{\text{overload}}$$

$$= 1 \times \frac{2}{1,5}$$

$$= 1,54 \text{ Kva}$$

Therefore one customer will require 1.54 Kva transformer. This grows from 2 Kva to 3,5 Kva over five years per customer and then remains at this value.

Area = number of customers x density per customer.

= 100 x 4000

= 400 000 m^2

Therefore the length of one side of the square of the area is 400 metres or 0,4 kilometres with the 100 Kva transformer at the beginning.

For the same density a 200 Kva transformer could supply an area of 800 000 square metres and have a length of 0,6 kilometres. It can be deduced that a transformer can be designed to optimize its mass, losses life span and cost. The life of the transformer can be extended by designing cooling which can take away the heat generated by losses. Transformer earthing is to be in accordance with the earthing standard practices.

3.5.3 System losses

In order to analyse the performance of the system, daily and seasonal load curves have to be assumed. The shape of such curves is open to considerable speculation, therefore figures 3.2 and 3.3 have been adopted for that purpose.

FIGURE 3.2 : DAILY LOAD CURVE

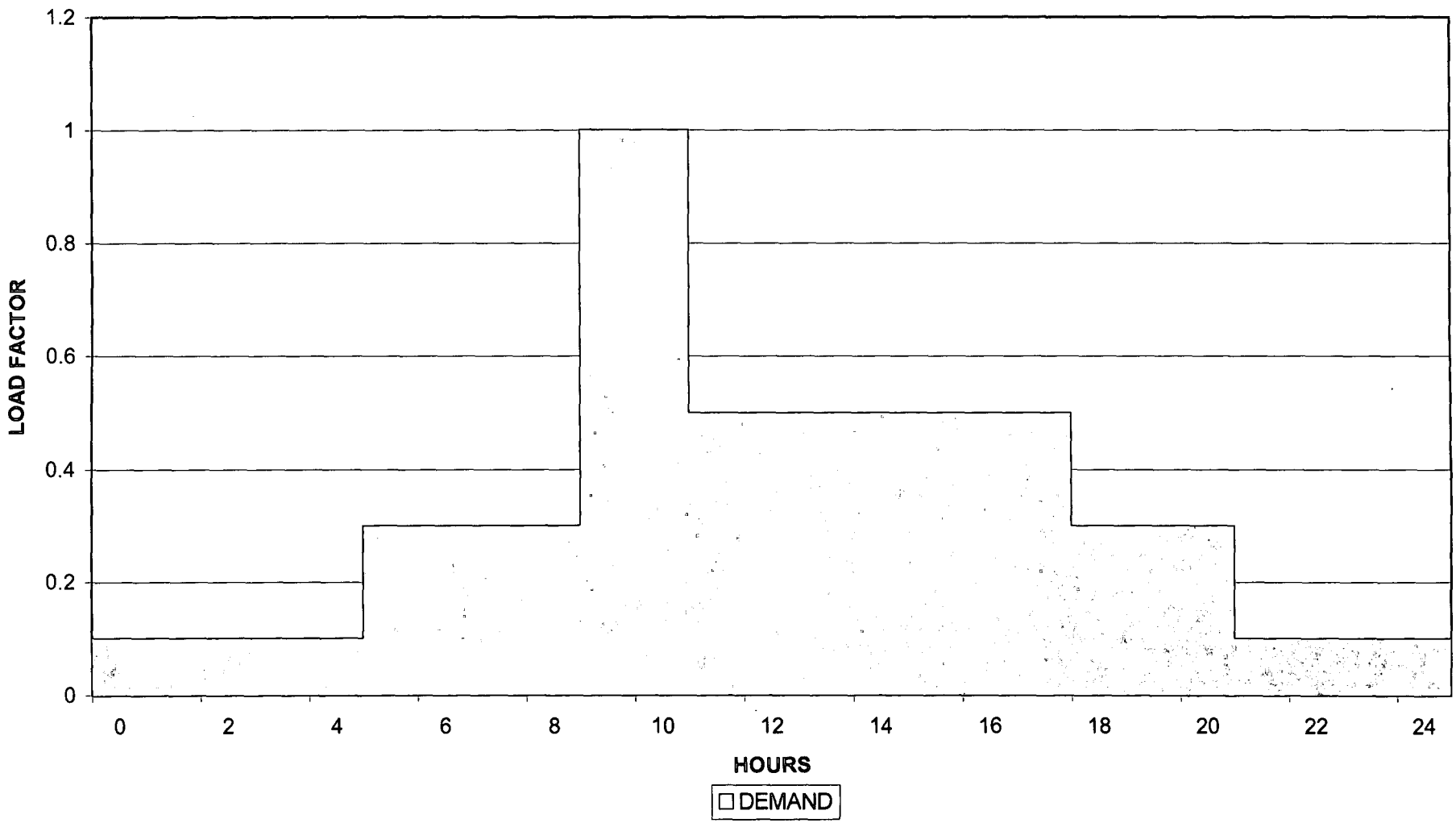
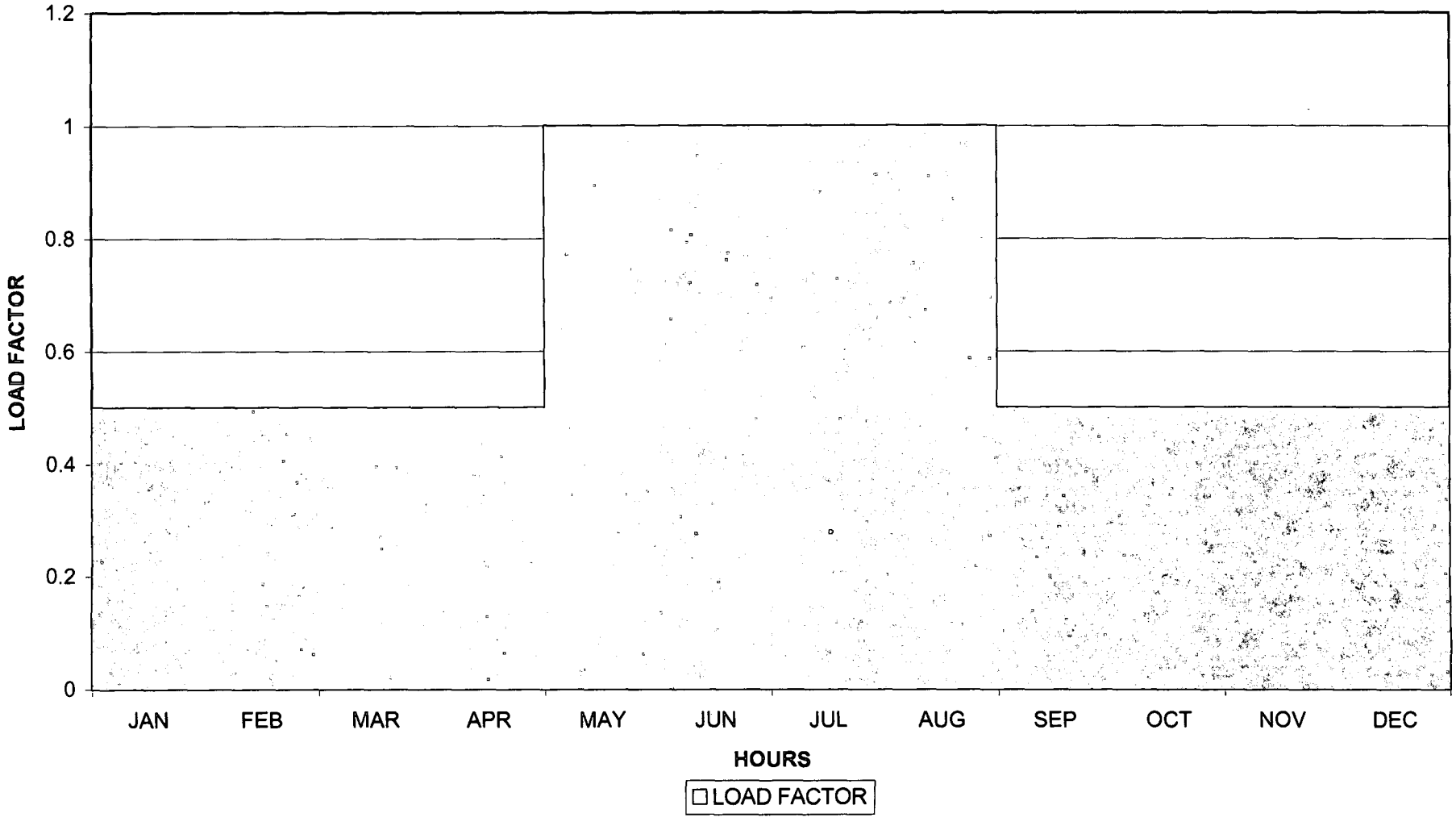


FIGURE 3.3 : DAILY LOAD CURVE



The three phase fault at the high voltage terminal of the 100 Kva transformer is assumed to be 1590 Amps.

Assume the impedance of the 100 Kva transformer = 4%

Assume the impedance of the 1,5 Kva transformer = 5%

Fault at high voltage terminal of the 100 Kva transformer.

$$\text{Mva} = \frac{1.732 \times 11\,000 \times 1590}{1\,000\,000}$$

$$= 30{,}3 \text{ Mva}$$

$$Zs = \frac{100}{30{,}3}$$

$$= 3{,}3$$

Fault at L.V. terminals of the 100 Kva transformer

$$Zt = \frac{4\,000}{100}$$

$$= 40$$

$$Zt = 40 + 3{,}3$$

$$= 43{,}3$$

$$\text{Mva} = \frac{100}{43{,}3}$$

$$I = \frac{23109{,}4688}{1{,}732 \times 11000}$$

$$= 121 \text{ Amps}$$

3.6 The second approach is called the long feeder method where, however the area is served with one 11 Kilovolts line supplying a number of 260 customers in all. The line to transmit power is equipped with Aerial Bundle Conductor (ABC).

3.6.1 **Pole**

In this approach, wood poles are preferred with a length of 11 metres and 180 millimetres top diameter. They shall comply with SABS 753 for pine poles. The pole structure is a single-pole with wood crossarms or H pole where a transformer is to be placed. All wood poles, crossarms, struts shall have been correctly protected against rot.

3.6.2 **Transformer**

The same transformer size will be used except that the transformer is pole mounted and connected directly to the overhead line.

The droppers from the overhead line are also connected to surge arrestors mounted on the transformer tank to prevent damage to the transformer. Each transformer is protected by a high voltage expulsion fuses and a low voltage circuit breaker which are all directly mounted on the transformer core and winding assembly and immersed in the transformer oil.

3.7 **CLEARANCE**

The clearance should be about 1,8 metres to telephone lines at crossing.

The ground clearance should be increased where the vegetation under the line is subject to fires and alongside roads, as such are major causes of power failure on lines. The minimum clearances detailed in the Mos Act are given in figure below.

Maximum (rated) phase-to-phase voltage Kv rms.	Clearance to ground.		Above roads and railway lines.	Clearance to communication lines and other power lines.	Clearance to buildings and structures not forming part of power lines.
	Outside Town-ships. (m)	Inside Townships. (m)	(m)	(m)	(m)
1.1 or less	4.9	5.5	6.1	0.6	3.0
7.2	5.0	5.5	6.2	0.7	3.0
12	5.1	5.5	6.3	0.8	3.0
24	5.2	5.5	6.4	0.9	3.0

TABLE 3.2 MINIMUM CLEARANCE ALONG ROADS.

The clearance is to be in accordance with regulation 15 (Electricity Machinery Regulation) of the Mos Act. What this means is that the area of Nkolonga must have a clearance of 5.1m because of high fire risks possibilities. Where suspension insulators are used the broken conductor formula given below must be used to calculate clearance:

$$D = (d^2 + 0{,}37 \times pl)^{0.5}$$

where: d = sag under healthy condition

p = length in insulator assembly

l = length of the crossing span

D = final sag under broken conductor condition.

3.8 METERING

The electricity that is generated and distributed by utility, needs to be paid for, to ensure not only the continuity of the electricity supply, but also the extension, maintenance of the supply network. The customers are falling into a relatively low income group bracket, therefore the concept of prepayment (known as Electricity Dispensers) metering electricity is practically impressive. The board consist of a light and three plug sockets for appliances or extension leads to the rest of the house. The system is installed in every house and enables the customer to budget for his electricity.

3.9 SERVICE CONNECTION

A1 & PAC

The service cable will be 10 square millimetres Airdac split concentric service cable, service connections being overhead to dwelling on the same side of the road as the pole.

Three, 80 amperes circuit breakers (one per phase of the ABC), are installed in each distribution box for residence with up to three consumers to each circuit breaker. A galvanised steel wire will be installed as a separate trench earth.

CHAPTER FOUR

THE RESULTS

4.1 Overview

This chapter is concerned with the presentation of the data. There are samples which are investigated in this study, namely ;

(i) Families

(ii) Local authority.

Data obtained from the different families of Nkolonga concerning the need of and affordability of electricity were tabulated. Two different approaches were compared. The data concerning the responses of the Local Authority to the distribution of electricity to rural residents is discussed. Finally, selected information from the sample's questionnaires were presented to determine the correct electrical approach for the area under investigation. Certain limitations regarding the investigation were also mentioned.

4.2 CLASS QUESTIONNAIRES

4.2.1 Samples

The class of the samples is determining the understanding of its people.

Twenty samples from each class were interviewed and shown the demonstrations and classified into two basic categories. Since each of these two classes have different attitudes to the need for electricity, the standard of judging, for example will be "good, and fair" as shown in figure 4.1.

It was apparent on completion of questionnaires that about 10 percent of residents did not see the need of electricity at their age level. It is considered an important requirement that the Local Authority advises the consumers about the usage of electricity. To address this, questions in Appendix One are used.

4.2.2 Age Distribution

There is a tendency that as the age increases in a person, the state of exploring will decrease.

It is therefore important to establish age distribution in this particular study. Table 2.3 shows the age distribution of twenty samples. The largest group is between the age twenty five to forty four years. The members of the interviewed families that are under fifteen years were not considered. The other groups are between thirty four years and sixty five years respectively.

4.3 **COSTS**

Having discussed the possible technical possibilities and having seen many feasible arrangements, the question to be answered now is, at what cost? The costs are calculated for material and labour. With the actual situation in the country, prices change quite frequently and only budget prices can be obtained from the equipment suppliers on enquiry. Therefore the numbers quoted herein are only to illustrate the concept. The costs were calculated for material and labour only. Note that these costs typically only account for 85 percent of a project's costs, and the remaining 15 percent is made up of transport, interest and overheads.

1. The costs per customer for the Nkolonga project for a 1 000 volts insulated system are :

HV	R 290	12%
1 000 V	R1 070	43%
SERVICE CONNECTION	R1 140	46%
	R2 500	

2. The cost per customer for the conservative ABC system are:

HV	R 830	24%
ABC	R1 220	35%
SERVICE CONNECTION	R1 410	41%
	R3 460	

3. The costs per customer for the Optimum ABC with Webbing System are:

HV	R 655	24%
ABC	R 805	29%
SERVICE CONNECTION	R1 320	47%
	R2 780	

4. The costs per customer for a 1 000 volts bare system are:

HV	R 290	11%
1 000 V	R1 100	44%
SERVICE CONNECTION	R1 140	45%
	R2 530	

TABLE 4.1 COSTS ANALYSIS.

This arrangement with one main substation was taken as a price basis. The cost savings were achieved in the following areas.

(1) Over 5 years costs will be lesser than a short feeder approach.

(ii) Supply is made available to customers in a shorter time.

(iii) Only one large substation is necessary and the pole mounted equipment is quickly installed.

4.4 KNOWLEDGE OF AND ATTITUDE TOWARDS SERVICES

The surveyed area is aware of the service to be provided. In a question asking whether electricity offers what is needed by the community, 83,5 percent said yes, the service offered were needed. Only 15 percent of the total sample were not happy with the services. One of the reasons given by those who were not happy with the services was that, (a) there is inadequate income per household and they are used to do without electricity. (b) The rural residents would have to travel about 40 kilometres to buy the prepaid meter cards during emergency.

Of those respondents who were happy with the services, 69,4 percent said electricity was of assistance when their children are at school, 10,6 percent were satisfied as it brings light especially during the night to decrease the crime rate. Only 3,5 percent stated that electricity is good because it uplifts and betters the standard of living in the community. The remaining people were also happy because the presence of electricity would encourage the government to build clinics and hospitals in their area.

4.5 ACCEPTABILITY OF SERVICES

In rendering electrical services the Transkei Electricity Corporation (Tescor) responds to applications made by individual residents in order to be certain that there is need for the services and it would be acceptable to the community. A similar form, Appendix Two is enclosed.

To test whether electricity is not for urban community only, members were asked whether they would ask for street lighting within the area. Of the total sample, 83,5 percent claim that they would seek for street lighting. Of this number thirty three respondents claim they have contributed towards rendering these services and as such would seek street lighting in their area.

Sixty eight maintain that they would do so because Tescor management is friendly and behave as part of the community. Twenty of the respondents said they will never seek street lighting from Tescor because that would increase the installation costs of the services. The remaining respondents indicated that they never thought of seeking street lighting since there are no proper roads in the area. What this suggests is the acceptance of the services in the area interviewed, which is an important indicator of development.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The researcher will attempt to draw conclusion by examining different facts: first, the development and underdevelopment of Transkei as a whole, the electricity services in particular; second by getting to understand the imbalances between urban and rural areas in South Africa; lastly by assessing the attitudes of rural people towards the standard of electricity services. In the light of the completed investigations the conclusion evaluates the combined results and receives certain procedures.

Consideration and discussion is based on related literature, published subsequent to the running of the investigation. According to the literature it has been demonstrated that a more cost effective way of electrifying rural areas would be appropriate, thus assisting in the development of rural people, in particular, their electricity needs.

Since there are positive and negative opinions, it was necessary to interview Tescor officials for their own feelings so as to be able to compare their attitudes.

From the study, it is clear that consumers are more interested in the service than in any approach. To eliminate poverty and unemployment, the Transkei government has to consult development strategies that are oriented towards the fulfilment of the basic needs. This chapter will address the following aspects and pose some recommendations regarding future electrification in Transkei.

5.2 Development Sectors

5.3 Affordability of expensive structures (electricity)

5.4 Conclusion

5.5 Recommendations

5.2 **DEVELOPMENT SECTORS** (The first to third sub-problem)

It is clear from this study that even if all the financial resources could be directed to the provision of electricity to the rural people, their need will never be fulfilled. A developed infrastructure is necessary to the provision of basic human needs. The respondents in the area surveyed identified their basic needs as, education, roads, agriculture, better housing and income generating projects. This community is characterized by lack of education and inadequate resources, these in turn are among the causes of underdeveloped countries.

The essence of electricity is how people deal with the situation in which they find themselves, and opportunities which are available for them to act and improve their living conditions.

The public corporations should consider rural people in the same manner as urban people when development is taking place. Electricity in urban areas is wholly built by the government, there is no contribution by urban residents. The urban areas are taxed in a form of property rates and those monies are ultimately used for relevant services including electrification. However, rural people are also taxed every year and the Magistrate's Office is responsible for collecting rural taxes. How the money is spent is unknown to the rural people.

5.3 **AFFORDABILITY OF EXPENSIVE STRUCTURES** (The fourth sub-problem)

From an analysis of the survey it became clear that the community prefer a reliable structure which could require an economical or minimal maintenance. From Table 4.1, the results prove that for densities less than one customer per 5000 square metres, the 1000 volts system is more cost effective than any other system.

The material saving in the bare 1000 volts system is offset by the labour required compared to the insulated 1000 volts system. The insulated 1000 volts system is superior in terms of quality, reliability and cost as compared to the bare 1000 volts system.

5.4 CONCLUSION

Both the Local Authority and the community subscribe to the principle of community involvement and participation in the electrification of their area. The participation is in the manner of involving people in decision making and through the provision of labour. The community have selected representatives in the district in identifying their needs. This means that the representatives like headman and the chief are responsible for identifying needs. This was reflected in responses of people during survey(Appendix One) For example, in responding to the question "Do you know what is electricity" some people even wanted street lighting in the area. This was their way of saying we need electricity, therefore we can afford to pay for the service.

Although the Republic has attempted in recent years to make the homelands more self sufficient economically, its efforts have yielded slow and uneven forward movement in agriculture, industry and education. There has been no generation of cumulative, self sustaining growth because of little grants and high standards of competence. With the fund donated by the RDP for development in rural areas, electrification at Nkolonga would be afforded by the Local Authority. In a question asking whether they think this service can improve their life style, the community said yes the service to be offered is needed.

Therefore in the monthly visits which are done in seeing the affordability of major energy intensive appliances, the community are gradually improving.

To solve the problem of the rural people and to be able to achieve the implementation of the cheapest, safe and reliable system, there is a need for all concerned that both the developer and the community to sit down and listen to the needs, the potential capabilities and the weaknesses of each other. The 1 000 volts system is more cost effective for customers of less than one customer per 5 000 square metre. The advantage of this system is that, when the load or density grows it can easily be added at cost effective amount. Looking at the situation in rural areas where there are fire problems, the 1 000 volts system will be applicable.

5.5 RECOMMENDATIONS

It is therefore recommended that the taxation system in Transkei should be reviewed. The rural people should levy themselves for all the development in their areas through the Tribal Authority (rural authority). The annual paid monies should be reinvested in the community to provide for necessary developments in the area. To handle the situation it would need to be improved or strengthened with the employment of qualified personnel.

For the economic and cultural development of the rural areas in Transkei, electrification must proceed at a fast rate. This implies the servicing of the largest possible area in the shortest time with the least amount of money. Therefore, the 1000 volts approach appears the best system in the district of Lady Frere at Nkolonga with customers of less than 5 000 square metres. The 1 000 volts approach offers additional advantage that the supply is made available in a much shorter time.

M.L. SULTAN TECHNIKON

A SURVEY OF NKOLONGA: A RURAL PEOPLES' PERCEPTION OF AND AFFORDABILITY OF ELECTRICITY.

SAMPLE SURVEY

SEPTEMBER 1994

INTRODUCTION

With the assistance of Tescor Outreach Workers, information would be obtained on the peoples' perception of, affordability and their attitude towards the electrical services. The questions asked are trying to obtain information on the acceptability of electricity, the ability to afford the costs during installation and the ability to pay the required energy.

The survey does not necessary mean that the area surveyed will benefit. The information received is for academic purposes and hopefully will enable the planners to evaluate their approach in the electrification of rural areas, in particular.

All the information will be treated as confidential as possible, therefore the provided information will only enable the interviewer to complete the questionnaire

SURVEY INFORMATION

INTERVIEWER'S NAME:	
DISTRICT:	ADMIN. ARE:
NAME OF SAMPLE:	
DATE:	

IF YOU ANSWER "YES" IN ANY OF THE FOLLOWING QUESTIONS, PLEASE EXPLAIN, BUT IF YOU CHOOSE "NO" OR "NOT SURE" THE RESEARCHER WILL EXPLAIN TRYING TO SHOW THE IMPORTANCE OF THE SERVICES.

A. Community's Perception and Need

Answer the following questions by saying "yes" "no" or "not sure":-

1. Do you know what electricity is ?
2. Have ever seen electricity in use?
3. Where, in what areas can electricity be used?
4. How do you think this service could improve your life style?
5. Do you know that electricity can improve your income?

B. Affording the installation of electricity

1. A sum of R40-00 (Fourty Rand) is required for connection to each household. Can each household afford that amount?
2 Can they afford to buy energy intensive appliances?

2.2.1 List 5 (five) appliances you need in order of importance:

No.	Name of Appliances
1.	Iron
2.	Kettle
3.	Flat plate
4.	Radio
5.	

3. How much is the total earning per household? R750
4. What are the responsibilities of the head of the family?

C. Community's Participation /Involvement

If this service could be rendered in your area:
5.1 List 5(Five) needs of your community in order of their importance.

No.	Needs of the Community
1.	
2.	
3.	
4.	
5.	

5.2 Who is responsible for identifying the needs of your community?

a. Government
b. Tribal Authority
c. Chief/Headman ✓

ESKOM

Application Number	APPENDIX 2

PREPAYMENT APPLICATION AND AGREEMENT

Surname	Phenyu	Title	MR
First Names	Zeph		
ID Number	6502140607 14		
Street Address:			
Postal Code:		Zone	Extension

Structure Type (Tick were applicable)	*Formal*		*School*		*School Type (Specify)*		
	Informal		*Business*		*Clinic*		
	Domestic		*Church*		*Other (Specify)*		

Township Code	

Transformer number			
Installation number			
Existing Customer	*Yes*	*No*	
Ready board required	*Yes*	*No*	

I HEREBY AGREE THAT ESKOM MAY INSTALL A SERVICE CABLE, PRE-PAID METER AND READYBOARD IN THE ABOVE PREMISES AND TO DO ALL NECESSARY WORK ASSOCIATED WITH SUCH INSTALLATION. I ALSO AGREE TO LOOK AFTER AND BE RESPONSIBLE FOR SUCH METER AND READYBOARD THE VALUE OF WHICH IS AGREED AT R600-00. THE CONDITIONS OF SUPPLY FOR SMALL SUPPLIES ON A PREPAYMENT BASIS ON THE OVERLEAF HAVE BEEN READ BY ME / EXPLAINED TO ME. I FULLY UNDERSTAND THE CONDITIONS AND HEREBY ACKNOWLEDGE THAT I CONSIDER THEM PART OF THE CONTRACT.

Date	Signature

Receipt Number			
Date		Amount	

GEM INSTANT PRINT 6101

T35/L1
25kVA

SMZ 18
25kVA

SMZ 17
50kVA

NOTE: RESTRING WITH 3PHASE 35mm BUNDLE IF EXISTING SINGLE PHASE

REMOVE

+8400 Y

+8400 X

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