DISTRIBUTION SYSTEM AND LOSSES

By

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Declaration by the Guide

This is to certify that the **Mr Marrapu Udaya Bhanu Naidu** , a student of Executive MBA (Power Management) Roll No of **500024907** of UPES has successfully completed this dissertation report on" **DISTRIBUTION SYSTEM AND LOSSES** " under my supervision.

Further I Certify that the work is based on the Investigation made, data collected and analyzed by him and it has not been submitted in any other university or institution for award of any degree. In my opinion it is fully adequate , in scope and utility , as a dissertation towards partial fulfilment for the award of degree of Executive MBA.

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ABSTRACT

Electric power is the most important commodity in our daily life. Electric power is generated at different voltage levels like 6.6KV, 11KV, 25KV etc. Electric power is transmitted through the transmission Lines.. Generally the electric power is generated at 11KV Voltage. The voltage of the generated power is Steped up to 400KV by using the step up transformers and Transmitted through the Lines to the Load centers and at the load centers the voltages are stepped down by using step down Transformers i.e 400/220 KV and 220/132 KV and 132/33KV and 33/11KV. Then the Power is supplied to the Consumers by using the Distribution Transformers and by LT Lines. The Power Transmission i.e from 400KV to 33KV Lines system comes under Transmission System and losses in these lines are only Technical losses (mainly I^2R Losses) , which are very less.

Where as in Distribution System, the losses consists of Technical and Commercial Losses. The technical losses comprises of line losses (I^2R Losses), losses in the equipment (Distribution Transformers Losses), Improper size of conductor and bad workmanship and commercial losses mainly because of defective metering, improper billing and pilferage of energy. The Technical losses in Distribution System can be reduced by load balancing of Distribution Transformers and preventive maintenance of Distribution Transformer structures and lines etc. and Commercial losses can be reduced by providing of High accuracy meters to the services and proper inspection of low specific consumption services.

This project is mainly aimed at identifying the reasons for technical and commercial losses in the distribution system and to know the remedies to reduce the technical and commercial losses and also to get idea on Distribution lines. In this project a 33/11 KV sub station is considered on pilot basis which consists of 4 Nos out going 11KV distribution feeders namely 1) 11KV Kothapeta, 2) 11KV Gajularega, 3) 11KV B. Koneru Town 4) 11KV Tank Bund feeders were taken and the input and sales of the above feeders were observed and the technical and commercial losses on these feeders are calculated.

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1. INTRODUCTION OF PROJECT

1.1 INTRODUCTION :- Distribution System is the network used to supply the electric power to the consumers. Distribution System is very essential in the electrical power system. Today in our daily life power is becoming the most important thing. As the technology is developing all the equipments were came into market and are useful to our daily activities i.e lifts , electric cookers , washing machines ,heaters , etc and electrical trains in transportation point of view and most advanced soft ware system i.e Computers etc and all industries which are used to manufacture equipments and also provide employment to the peoples, Agriculture all were primarily depends on electric power. So we can't do any thing with out electric power and we can't imagine our daily life without electric power.

Today we are facing the problem of shortage of electric power. The generated power in India is not met with the demand of electric power. So it has two solutions one thing is to generate more power which is very costly affair and another is to reduce the losses in the present system. Distribution system should be aimed at to provide quality power supply to the consumers with minimum interruption. Our project mainly aimed at reducing the losses in distribution system and to provide quality power.

1.2 Sub Station :- In Distribution network , A Sub Station is a component of power system which receives electric energy at a relatively higher voltage and delivers energy to the consumers at low voltage. It is a link between the Transmission and Distribution System and converts higher voltage electric power into low voltage electric power.

Depending upon the physical features which in fact are governed by the Operating voltages , the sub stations are mainly classified as 1)Out Door 2)IN Door 3)Pole Mounted.

Normally for the voltages 33KV and above , out door substations are recommended because of the large air clearance is required. All the equipments lies open in the air. Such Sub Station situated near a power station (Step Up Station) or near a large load centre (Step down Sub Station)

The equipment in the indoor sub station lies in a room. The operating voltages are 400V, 3-phase, 4 wire , LT and HT Voltages may range any thing between 3.3KV to 11KV. These Sub stations are located in Towns.

Pole mounted Sub Stations are step down sub stations where all the equipment is mounted on poles. The Sub Station is used whenever a high voltage line is running and from it a small load such as a village or a small locality or factory is to be supplied.

These Sub stations are quite simple and cheap as no building for housing the equipments is required. The main disadvantage of such sub station is that they are low capacity usually up to 500KVA as the size of the transformer for larger capacity becomes quite big and it cannot be mounted on poles.

1.2.1 Bus Bar System :- The bus bar system affects the sub station design to a large extent . Some of the systems are used are given below.

Single Bus Bar System :- This system is simple and cheap as it needs minimum number of circuit breakers. It is normally used for small AC Circuits .

The main disadvantages of this system are 1) A fault on the bus bar will completely shut off the supply to the feeder 2) Maintenance of the bus bar will require complete shut down of the supply to the feeders.

Sectionalized Single Bus Bar System :- Each section can be Operated independent of the other sections. Fuller advantage of the scheme can be obtained if the incoming and the out going feeders are evenly distributed on the sections. Each section can be completely shut down for maintenance or repair with out interfering with other sections.

Duplicate bus bar :- In the more important sub stations the use of duplicate feeders is almost universal. The advantage of the scheme from an operation and maintenance point of view more than out weight the additional cost.

In this system each load can be fed from either bus . Maintenance and repairs on any bus is easier. The in feed and load circuits may be divided into two separate groups , if required from operational point of view.

1.2.2) Sub Station Grounding :- In an electrical substation grounding is provided to all the equipments structures and installations so that it can provide a path by which grounding currents are conducted to remote areas. It is there for very important to see that the su station grounding has a low resistance adequate current carrying capacity and safety of personal operating in the sub station is assured. It is very important to see that the grounding resistance is kept at a low value so that rise in ground potential remains with in safe limits for personal safety. The other reasons for sub station grounding is as follows.

1) The neutral of the Transformers , reactors or capacitor (if connected in star) are provided in ground connection.
2) Maintenance of equipment becomes safe if these equipments are discharged through ground, other wise there is a possibility of experiencing electric shock.

3) The Over voltage protection devices like lighting arrestors , rod gaps should discharge to the ground when ever these experience over voltages.

4) To ensure safety to Operating personnel by limiting potential differences that can exist in a sub station.

5) To provide a sufficiently low resistance path to ground to minimize rise in ground potential with respect to remote ground.

The Sub Station grounding system mainly consists of either stranded galvanized steel wires buried into the ground up to the depth of 30 to 45 cm and there are ground rods to which these wire are brazed so that it forms a continuous grid system also known as mat. Some times more than one ground rod is used as these form parallel circuit and effective earth resistance is reduced. It is to be noted that continuous wire surrounds the grid perimeter to enclose as much ground as possible and to prevent current concentration and thus high gradients at the ground wire terminals. With in the grid , wires are buried in parallel lines and with uniform spacing of about 3m X 6m . All these substation equipments and structures are connected to the ground grid with thick conductor to minimize the grounding resistance, and limits the potential between equipment and the ground to a safe value under all operating conditions. All Sub station fences are built inside the ground grid and attached to the grid at short intervals to protect the public and operating personnel. One can always see the surface of the sub station covered with concrete to the potential gradient when large currents are discharged to ground and also to increase contact resistance to the feet of personnel in the sub station. Due to this step potential becomes negligibly small and personal safety is assured. It is found that when an extra high voltage transmission line is passing through a field and the ground of the field is conducting because of soft or moist soil, the animals grazing in the field and moving radially to the transmission tower get electrocuted where as the one moving round the tower the animal is moving along equipotential points where as one moving radially has a high step potential and gets electrocuted.

The ground potential rise depends on various factors eq diameter and length of conductor , spacing between each conductor , fault current , ground system resistance , soil resistivity , System voltage etc.

According to IEEE standard 80-1976 , the grid resistance to ground is given as $R = \rho/4r + \rho/L$.

Where R is grid resistance to ground

L is the Length of grid conductors in Ohm – m.

r is the radius in m of circle with area equal that of grid.

1.3. Distribution System :-

Distribution System has two components 1) Feeder 2) Distributor

1.3.1 Feeder :- A Feeder in a distribution net work is a circuit carrying current from a main sub station to a secondary sub station, such that the current loading is the same all along its length. Therefore the main criterion for the design of a feeder is its current carrying capacity.

1.3.2)Distributor :- A Distributor has variable loading along its length due to the service connections , tapped off at intervals by the individual consumers. The voltage variation at consumers terminals must be with in +/-5 % in order to avoid un satisfactory operation of equipment. A reduction in voltage will adversely effect the output of the induction motor of light from a filament lamp. Therefore the main criterion for the design of a distributor is the voltage drop., which must be kept within certain limits.

The distribution system occupies an important place in any electric power system. The effectiveness with which it achieves its objective of distributing electric energy to various consumers , is measured in terms of voltage regulation, flexibility , security of supply efficiency and cost.

1.3.3) Types of Distribution System :-

Depending upon the type of supply , distribution system can be classified as follows.

1. A.C Single phase (Single phase loads only)
2. 3-phase , 3 Wire (3 Phase loads only)
3. 3 Phase , 4 Wire (all types of loads)

The distribution system can be classified depending upon the connections . These are the following two systems.

1) Radial System.
2) Ring Mains System.

Radial System :- The energy distribution is originally through radial system. The advantages of radial system are its simplicity and low cost, which result from a straight forward circuit arrangements where a single or radial path is provided between the consumer and the source or bulk power supply. With such an arrangement , the amount of switching equipment required is small and the protective relaying is simple. The major disadvantage of radial system is its lack of security of supply. When a fault occurs on any section of the feeders , remaining consumers on the healthy section feeders will be with out supply for a considerable period. The radial system is normally used for rural distribution these days.

Ring Mains System :- The system is most used frequently , to supply bulk loads such as small industrial loads and the medium or large commercial buildings where continuity of supply is of considerable importance. When an inter connector is used in a ring main system it reduces the voltage drop between the points to which it is connected. The ring mains system is used for urban distribution in contrast to the radial system.

A.C Distribution Single phase :- In Case of a AC Distribution as the distance separation between the wires is relatively smaller as compared to the over head lines , the resistance component is normally higher than the inductive reactance component and hence both R and X Components contribute to the voltage drops. Also the current is at some phase angle with respect to the voltage , and there fore the both the components i.e in phase and quadrature component of the current contribute to voltage. If the current is

$I(\cos\Phi - j\sin\Phi)$ and the series impedence is $(R+jX)$.

$$\text{Drop} = IZ = (I\cos\Phi - JI\sin\Phi)(R+JX)$$

$$= IR\cos\Phi + IX\sin\Phi + j\,IX\cos\Phi - j\,IR\sin\Phi$$

for the most of the systems $IX\cos\Phi \approx IR\sin\Phi$

There for drop $IZ = IR\cos\Phi + IX\sin\Phi$.

<u>3-Phase , 4Wire System :-</u> Usually A.C .Distribution is through 3-phase 4 wire system as there is possibility of single phase and 3–phase loads in almost in every locality. The fourth wire is the return conductor for all the three phases ,which connected to the star point of the load and the neutral of the supply system. Under the balanced condition the net current through the neutral is zero. The electric utilities try to balance the load on each phase , as the balanced load voltage results due to unbalanced load voltage results due to unbalanced loading which is dangerous for the proper working of 3-phase induction motors. Yet it is practically impossible to obtain the perfect balancing , some amount of unbalance is always present in the system. The unbalance is due to the presence of single phase loads.

2. LOSSES IN DISTRIBUTION SYTEM

2.1 Energy Audit :-

The first step is to carry out the energy audit of the distribution system to segregate and pinpoint the commercial and technical losses. Having identified the causes of technical losses, we must analyze all the causes of the technical losses and develop them in the form of several DPRs (detailed project reports). Finally a list of projects showing gestation period, investment, and benefits must be listed so that the projects can be prioritized. The prioritization must be such that the external funding requirements are kept at minimum.

2.2) Network Design :-

The projects must take into account the future developments and changes in the ground realities (such as changes in demand due to increase in population and improvements in standard of living). One must be aware that as the population is increasing there would be more people living per square kilometers. The same people are going in for new appliances, which use electricity. Thus the transformer loading is going to go up. The current being carried by the conductors would also increase. These two would have impact on transformer losses and I^2R losses. Thus any time after 5 years or 10 years, there may be a need to revamp the network. How to envisage, what factors must be considered today, and how to design today's network so that changes required in network should be minimal leading to less investment. Otherwise, the technical losses would go up.

2.3) Factors Contributing High Technical Losses :-

The main factors that contribute for high technical losses are

usage of lower size conductors,

low voltage pockets,

lack of reactive power control, etc.

The methods to reduce technical losses in the order of priority based on cost impact are

Re configuration (change over of loads or feeding source).

Re conductoring (Replacing existing conductor by higher size or conversion of single to double circuit).

Shunt or series capacitor installation (switched and fixed).

Auto voltage booster.

Additional link lines.

Combination of two or more of the above.

As a last resort to go in for another sub-station followed up by reconfiguration.

The Following are the main factors for the Technical loss in Distribution System :-

2.3.1) Over Loading of Distribution Transformers :-

All the Distribution Transformer should be loaded upto 80% of its rating only . if DTR is loaded more than 80% of its capacity, the full load losses will increases and temperature gets raise and the DTR may fail at any time.. The consumers may also suffer from low voltage problem .

2.3.2 Improper utilization of Distribution Transformers :-

Studies on 11 KV feeder have revealed that often the rating of distribution transformer is much higher than the maximum KVA demand on the feeder. Over rated transformers draw an unnecessary high iron losses. In addition to this iron losses in over rated transformers the capital costs locked up is high.

2.3.3 Un balanced loads on Distribution Transformers :-

Load should be equally shared between the all the three phases in a Distribution Transformer. If it is not done the consumers who are getting supply from the over loaded phase suffers from low voltage problem. Line losses also increases in that phase.

2.3.4 Distribution Transformers not Located at Load center on the Secondary Distribution System:-

Often Distribution Transformers are not located centrally with respect to consumers. Consequently, the farthest consumers obtain an extremity low voltage even though a reasonably good voltage levels maintained at the transformers secondaries. This again leads to a higher line losses.

2.3.5) Lengthy Distribution lines:-

In practice, 11 KV and 415 volts lines, in rural areas are hurriedly extended over long distances to feed loads scattered over large areas. Thus the primary and secondary distribution lines in rural areas; by and large radially laid, usually extend over long distances. This results in high line resistance and therefore high I2R losses in the line.

2.3.6) Non Maintananace of DTRs and LT Lines :- All the Distribution Transformers and LT Lines should be properly maintained periodically . There should not be any looses connections and jumperings etc in lines which causes unnecessary line losses. There should not be any defective AB Switches and loose terminations at sub stations and DTRS as the loose terminations causes the power loss.

2.3.7)Improper Tap Position of OLTC :- Tap position Should be properly maintained other wise voltage fluctuation may occurs. During off load periods tap position should be lowered and during on load periods the tap position should be higher other wise low voltage problem may occurs which in directly causes full load losses.

2.3.8) over loading on the Feeders :- If any feeder is overloaded the consumers may be suffer from the frequent interruptions of the supply due to the trippings of the feeders and the low voltages problems may occurs to the consumers who are at tail end and also copper losses increases due to the low voltage.

2.3.9) Low Voltage (less than declared voltage) Appearing at Transformers and Consumers Terminals: -Whenever the voltage applied to induction motor varied from rated voltage, its performance is affected. Within permissible voltage of +/- 6% of the affect practice, the supply voltage varies by more than 10% in many distribution systems. A reduced voltage in case of induction motor results in higher currents drawn for the same output.

For a voltage drop of 10%, the full load current drawn by the induction motors increase by about 10% to 15% the starting torque decreases by nearly 19% and the line losses in the distributor increases by about 20%. As the bulk load of rural areas and small scale industrial areas consists of induction motors, the line losses in the concerned distribution systems may even touch 20%.

2.3.10) Lenghty LT Lines :- Lengthy LT Lines makes the low voltage problem to the consumers and also make the high losses.

2.3.11) Low Power Factor:-In most LT distribution circuits, it is found that the PF ranges from 0.65 to 0.75. A low PF contributes towards high distribution losses. For a given load, if the PF is low, the current drawn is high. Consequently, the losses proportional to square of the current, will be more.

2.3.12) Inadequate Size of Conductors:- Rural loads are usually scattered and generally fed by radial feeders. The conductor size of these feeders should be adequate. Because of lower size conductor line losses also increases.

2.3.13) Bad Workmanship Resulting in Poor Contacts at Joints and Connections:- Bad Workmanship contributes significantly towards increasing distribution losses. The joints in the conductors makes the high copper losses.

2.4) Reasons for commercial loss :- The commercial losses in power distribution utilities involves the following reasons:

1. Direct tapping by the non customers.
2. Pilferage by the existing customers.
3. Defective metering, billing and collection functions.

2.4.1) Direct tapping by non customers:-

In certain areas, direct tapping of power by non customers is widely prevalent. This is mainly in domestic and agricultural categories. Geographical remoteness, mass basis for theft, poor law enforcement capability and inaction on the part of utility are helping this phenomenon.

These factors result in poor voltages, burnt motors, failed transformers and dried crops.

2.4.2) Pilferage of power by the existing customers:-

Theft by the existing consumers is the predominant cause of loss of revenue to the electrical utilities. Almost all categories of the consumers are involved in this.

2.4.3) Totally bypassing the meter:-

The meter is not tampered. It is like direct tapping. From the supply lines, the tapping is made and part or full load is fed from that. This can be proved only when it is observed at the time of inspection. The consumer can erase all traces of theft if the inspection is known in advance.

2.4.4) Tampering the meter:-

1. Bypassing at the terminal block.
2. Damaging the meter internal mechanism.

There are umpteen methods for tampering the meter. New methods are being constantly evolved. All these makes the commercial losses.

2.4.5) Defective meters :- Genererally after some period of time the meters may struck up or due to the overload usage by the consumers the meters may burnt. This causes the problem in the recording the units by the consumer. This also the reason for the commercial loss.

2.4.6) Improper Billing :- In some rural areas billing is not properly done . This makes the incorrect energy audit calculation . this is also comer under the commercial loss.

3) The Following are the steps to be taken for the Technical loss reduction in Distribution System :-

3.1.1)Reduce Over Loading of Distribution Transformers :-

All the Distribution Transformer should be loaded upto 80% of its rating only. No Distribution Transformers should be loaded more than 80% and if found any DTR loaded more than 80% of its rating, propose another Distribution Transformer or shift the existing loads to near by DTR with lesser loading.

3.1.2) Over-rated Distribution Transformers and hence their Under-Utilization:

The rating of distribution transformer should be judiciously selected to keep the losses with the permissible limits. For an existing distribution system the appropriate capacity of distribution transformer may be taken as very nearly equal to the maximum KVA demand at good PF (say 0.85) Such an exercise has been carried out for a number of distribution systems and transformers with capacity of 25, 63, 100, 160, 315 KVA and standardized for different with power factors and diversity factors.

3.1.3) Load Balancing of Distribution Transformers :-

Load should be equally shared between the all the three phases in a Distribution Transformer. If it is not done the consumers who are getting supply from the over loaded phase suffers from low voltage problem. Line losses also increases in that phase.

3.1.4) Distribution Transformers should be Located at Load center on the Secondary Distribution System:-

In order to reduce the voltage drop in the line to the farthest consumers, the distribution transformer should be located at the load center to keep voltage drop within permissible limits.

3.1.5) Bifrucation of the Distribution lines:-

Due to the lengthy lines results in high line resistance and therefore high I2R losses in the line. It is better to reduce the length of the lines by bifurcations of the feeders and also by providing interlinking lines etc to reduce the losses in the system.

3.1.6) Preventive Maintananace of DTRs and LT Lines :- All the Distribution Transformers and LT Lines should be properly maintained periodically .

3.1.7) Amorphous Core Transformers :- Recently DTRs with amorphous core have entered Indian market which has low constant losses The core (magnetizing or no load losses) get substantially reduced. However the high cost is coming in the way for large scale introduction. Efforts are being made to make amorphous core material indigenously and the cost is expected to go down considerably

3.1.8) Removal of Idle DTRs :- No Distribution Transformer should be Kept idle. due to this some power was wasted in the form of Constant losses i.e Iron losses and small amount of copper losses also.

3.1.9) Proper Tap Position of OLTC :- As per the requirement of the voltage and also as per the load the tap position may be changed.The proper voltage level is maintained by operating an "on-load-tap changing" in the power transformers situated at high voltage sub-stations and providing on the 11 KV feeders a combination of switched capacitors and automatic voltage regulators.

Further, the "off load tap changing" in distribution transformers is adjusted prior to the commencement of agricultural load season, which is readjusted before the one-set of monsoons when the rural load is small the off-load tap changing gear is available

3.1.10) Proposing of New Sub Stations :- If the Length of the 11KV lines are very large better to provide new 33/11KV Sub-Stations for providing of better voltage to the consumers. If the length of the 11KV Lines are very large it forces the system to the low voltage which directly causes the increased losses. To avoid this it is better to provide 33/11KV Sub stations at load centers.

3.1.11) Relieving over load on the Feeders :- No feeder should be overloaded and found if any, bifurcate them by providing interlinking lines. If there is no provision for the interlinking lines in the field, it is better to run the parallel line to the existing line and distribute the existing load on the both the feeders which reduces the line losses.

3.1.12) High Voltage Distribution System :- The distribution systems shall be at high voltage and the L.T. system shall be the least or eliminated as far as possible. High voltage distribution systems by converting existing Low voltage distribution system reduces the technical losses appreciably. This can be explained by one single illustration that for a 100 KVA load the amperage at 11KV is 5 Amps where as it is 140 Amperes at L.T. voltage of 415 Volts.

3.1.13) Providing of three phase DTRs inplace of Single phase DTRs :- All the single phase DTRS should be replaced with three Phase DTRS there by reducing the iron and copper losses . And Load carrying capacity also more for a three phase DTR than by a single phase DTR.

3.1.14) Running 2nd LT Circuit for LT Line Carrying grater than 75Amps and Length greater than 0.5KM :- Lengthy LT Lines makes the low voltage problem to the consumers and also make the high losses. Hence it is better to Provide 2nd LT Circuits for the LT Lines where length of the LT Line is greater than 0.5Km and current carrying is greater than 75A

3.1.15) Measures for improvement of Power Factor:-

The power factor can be improved by the following methods

This can be done by application of shunt capacitors.

Shunt capacitors can be connected in the following ways:

Shunt capacitors are connected on the secondary side (11 KV side) of the 33/11 KV power transformers.

ii). Line losses in LT distribution lines may also be considerably reduced by installing shunt capacitors of optimum rating at vantage points.

The optimum rating of capacitor banks for a distribution system is 2/3rd of the average KVAR requirement of that distribution system. The vantage point is at 2/3rd the length of the main distributor from the transformer.

iii) A more appropriate manner of improving this PF of the distribution system and thereby reduce the line losses is to connect capacitors across the terminals of the consumers having inductive loads. The extent of reduction of line losses in this manner depends mainly on the extent to which the PF of consumers is improved. In this case, the capacitor is connected in parallel to the terminals, the capacitors being switched on and off together with the equipment itself.

Many electricity supply authorities are modifying their tariff conditions to make it compulsory for the consumers to provide capacitors for all types of installations with connected loads of 5 HP and above.

By connecting the capacitors across individual loads, the line loss is reduced depending upon the extent of PF improvement.

3.1.16) Utilization of proper Size of Conductors:-

The size of the conductors should be selected on the basis of KVA X KM capacity of standard conductor for a required voltage regulation. Presently all the 11KV Urban feeders were provided with 55 SQmm Conductor . But it in some rural areas 11KV lines was with 34 Sqmm Conductor only and better to replace the lower size conductor with higher size as per the voltage level.

3.1.17)Avoid the loose connections and Tightening the jumpers:-

i) Proper jointing techniques should be used to ensure firm connections.

ii) Connections to the transformer bushing-stem, drop out fuse, isolator, and LT switch etc. should be periodically inspected and proper pressure maintained to avoid sparking and heating of contacts.

iii). Replacement of deteriorated wires and services should also be made timely to avoid any cause of leaking and loss of power.

3.2) Remedies for commercial loss reduction:-

The reduction in commercial losses in power distribution utilities involves the following steps:

1 Educate the consumers to avoid the Direct tapping .

2. Providing of AB Cable in the theft prone areas.

3.Tackling of power theft.

3. Replacement of Defective meters, and monitoring of spot billing and collection functions.

3.2.1 Educate the consumers to avoid the Direct tapping .:-

Some amount of public relations work by the utility is needed to tackle this menace. It is to be widely publicized that theft will increase the tariff for the genuine consumers, result in poor voltages, burnt motors, failed transformers and dried crops. The scarce resources of the state, meant for social welfare, are diverted to feed these power thieves.

Some change in the value systems of the society is also needed. The opinion makers and social leaders are to be involved to effectively tackle this massive social evil.

Direct theft is an insult and thus a challenge to the utility engineer. It speaks volumes about the inefficient functioning of the company. Tackling it brooks no delay. Other works can be stopped and total attention diverted for this purpose.

3.2.2) Providing AB Cable in theft / Interruption Prone Areas :- Generally in rural areas consumers were committed to the theft i.e they may utilize the supply with out meters or by directly tapping from the existing LT lines, In those areas it is better to replace the conductor with the AB Cable where the chances were very less for theft of energy

The details of legislation, procedure to inspect, detect and prosecute the criminals are discussed separately.

3.2.3)Tackling Power Theft : Theft of energy is almost the single cause of all ailments afflicting power utilities. The transformer failures, breakdowns, poor collection of revenue, financial losses, the wide spread customer dissatisfaction, the recurring crisis in summer crop period, the poor creditworthiness resulting in inability to raise the funds needed for the required growth, increased technical losses and the corroded integrity of employees... are all the manifestations of the theft. These can include low frequency, cascade trippings in grid and unscheduled shutdowns. The whole bad image of the utilities is due to theft. In the districts where theft is non existent, the utility is having good reputation and vice versa.

Magnitude

In the nation around Rs.40, 000 crores are lost by the utilities annually. In any other sector - be it private, public or joint - or be it in the state or the nation — no other company is losing money in this magnitude. In the world over power utilities are making profits. Those shares are considered as retired people's and widows' shares. They make money whether it is famine or flood, though not excess profits. With just half of this amount employment guarantee scheme is being planned. Within two and half years of this money all the 444 pending irrigation projects can be completed, irrigating millions of acres.

Beneficiaries

The beneficiaries of theft are anti social elements, immoral political abettors and unscrupulous industrialists. The bad money is driving out the good money from the market. This is a social menace crippling all other developmental and social welfare activities.

Forerunner

A.P., as usual, is the forerunner in recognizing this menace and established a separate wing for pilferage detection as early as in early sixties. Even now in some states there is no such separate cadre for detecting pilferage. The local officer, either operation or construction or MRT, is very much preoccupied with his busy day-to-day activities and cannot spare time for detection of theft. The social and political influences are more easily brought on the local officer who has, perforce, to deal with them in other fora regularly. A specialized knowledge on the functioning of various meters and the latest M.O. of power theft can be acquired by a dedicated band only.

***Personnel*:** While filling up DPE (Detection of Pilferage of Electricity) wing extra care is to be taken so as to have only officers having the required technical knowledge, tact, tenacity and integrity: at times, they would be detecting, dealing and deciding the cases involving crores of rupees on the spot.

Opportune time: With the advent of Electricity .Regulation Commission , the functioning of electrical utility is now transparent. Its financial performance is in public gaze. The necessity of eradicating theft is realized by all.

After realizing this, state governments are coming out in a big way to support the electrical engineers entrusted with the arresting of power pilferage. The opposition parties, farmers' organizations, colony welfare associations and industrialists are one with us in this errand. If we do not move now, our very sincerity will be debated. One cannot be guilty of inaction on the notion that attempting to control theft is dangerous to ones self. Actually the test of ones loyalty to the organization is the number of cases she books in a month.

***Functions*:** Though originally **DPE** wing was meant only for detection of pilferage, of late its functioning is covering many other facets:

1. Malpractice.
2. Back billing.
3. Excess connected loads.
4. Poor power factors in all categories.
5. Running of captive generator sets without adequate safety arrangements etc.
6. Non sealing of AB switches, meter boxes, and terminal covers.
7. Line losses in selected towns, industrial feeders etc.
8. Functioning of border meters, capacitor banks etc.
9. Bus, P.T. and C.T. facilities for efficient metering.
10. Inspection of high value UDC services.

11. Study of MRBs.

12. Applying CAT for HT & LT services and inspecting class F services, etc.

13. Maintenance of assets by local officers.

14. Billing irregularities in transformer repairs, maintenance and construction works.

15. Non standard releasing of services.

16. Releasing of services in UDC premises.

17. Releasing of services in wrong categories.

18. Coordinating massive inspections with all engineers and APTS personnel wherever required.

19. Involvement of employees in various irregularities.

20. Payment and billing pattern of services of VIPs.

3.2.4 } Replacement of Defective meters, and monitoring of spot billing and collection functions.

These losses are not due to any deliberate actions of the customers.

They are due to internal shortcomings and hence are that much easier to tackle.

They thrive due to the fact that the boards did not function on commercial lines though they were supposed to do so.

Metering:-

There are many services unmetered. A large scale drive is necessary to bring all unauthorized consumers on to the rolls. Such drive in Andhra Pradesh during a single month of June 2000 resulted in metering of 20 lakh new consumers and regularization of 2.57 lakh agricultural services.

Instructions are to be issued to not to release any new service without meter. All the existing unmetered services shall be stopped to be so immediately. The utility should concentrate on purchasing of adequate quantity of meters both for fresh services and for replacement of the defective meters in the existing services. Purchasing of other materials shall be given low priority, if the financial position demands it. Other materials can be purchased by the consumers.

Unmistakable instructions are to be given on the standards to be adopted at the time of releasing of new services. The service wire is to be brought in a pipe which shall be visible throughout and end in the meter box with a gland. The meter, preferably electronic, shall be fixed in a box visible and accessible from outside. The meter shall be fixed in a box at a height of 5'to 6' from the ground. The particulars of seal bits used are to be noted and attested by the consumer. Proper earthing is needed at the installation. This earth, body earth and neutral are to be clubbed up on the meter board. If all these precautions are taken, possibility for theft and defective metering are reduced drastically.

An exhaustive note on releasing of high value services is given separately.

The meters tend to get sluggish over a period of time. Old meters are to be replaced in a phased manner by high accuracy meters, specially for high value services and at places where the load varies substantially.

C.T. meters are to be adopted in stead of whole current meters for L.T. high value services.

A comprehensive energy audit will pinpoint the areas of high commercial losses. Important services, feeders and towns are to be taken up early for this exercise. Actually, the biggest ever theft case was detected while on one such exercise.

Following are the general defects observed in metering.

- Many stuck up meters are allowed for years.
- For a good number of services, no readings are furnished by the meter reader, at times, continuously.
- Constant nil consumption cases are reported without any comment.
- There are progressive readings in disconnected services.
- There is considerable voltage drop in metering cables.
- The meter capacity and the load have no relation.

- Wrong multiplication factors are adopted. After the M. F. is changed, it is not intimated to the billing agency.
- Fixing of meters at LV Side Distribution Transformers :- All the Distribution transformers should be provided with LV Side energy meters. By comparing the input energy with the sum of the distribution transformers energy meters sales we can calculate the losses . By comparing the consumption of distribution transformer LV side meter with the sum of sales of the services existing under this distribution transformer , we can calculate the losses distribution transformer wise and also provision for us to concentrate on high loss distribution transformer.

BILLING :-

Correct billing and timely serving will go a long away in improving the collections. The normal complaints in the billing process are: non receipt/ late receipt of bills, receiving of wrong bills, wrong reading/ status, table readings and wrong calculations. All these can be avoided in a single go by going for computerized spot billing as is already done in some states. This can be introduced in stages starting from cities. A thorough understanding by the readers on the various statuses of the meter is a sine qua non for the success of the system.

Common billing software adoption is to be achieved so as to have a meaningful control, review, storage and retrieval of the consumer database. Even the application of CAT would be more effective this way.

Monthly billing is to be achieved for the convenience of the consumer and also for psychological reasons. Stringent checks are to be adopted in the billing process so as to plug the leaks.

The first bill is not issued or is issued late in many cases. The customer service number is to be noted on the meter at the time of issue in the section office.

The utilities adopt the last 3 months average in case of abnormal meter status. A meter becomes initially sluggish and then slowly drifts to stuck up position. So the last three months average would not give a correct picture of the consumption. A study in A. P. revealed that the utilities are annually losing scores of crores on this count alone.

. Very high consumption when compared to the similar connected loads indicates unauthorized additional loads. The services, where the standard deviation in consumption is less than 2%, are to be targeted. Similar action when there is abnormal variation. Constantly getting less than minimum in good areas should attract our intention.

Identification and Clubbing of multiple services :- Some people may use more than one service for the same premises , because of that consumption was recorded by the two energy meters there by comes under the low slab rate in billing system and also the cost of the energy charges were reduced which is lost to the Distribution systems. Hence it is better to identify those services and merge then into single service.

The power distribution companies have a unique advantage of contacting millions of citizens at least once in a month. This is to be utilized fully to explain the latest initiatives and seek their support in their own interest and in the interest of the company. The Tirupathi based company spared some space in the reverse of the bill to an advertiser and thus the bill making cost is saved.

Collection:-

Unbundling and corporatisaion will give a real boost for the collection effort. Every citizen would feel it to be her normal duty to pay for the commodity she purchased. The poor now have a tendency to feel that they have a natural right to enjoy the government bonanza. But even the poorest man will not dream of having a soap freely from the seller. After reforms, there was phenomenal increase both in demand and in collection percentage in A. P.

Increased customer convenience shall be the guiding factor for smooth collections. Drop box facilities and roping in more collection agencies make the lengthy queues vanish. E seva centers are a relief to the customer as around 25 types of bills are accepted in a cool atmosphere at convenient hours in the holidays too. On line facilities like icici bill junction are extended.

Special collection drives, coupled with intensive inspections, in the areas where the payment history was bad, brought terrific results. Effective disconnection of defaulters shall be a norm rather than a chance occurrence. CAT is to be applied and high arrears services are to be targeted. Class F services, where the consumer is availing supply without any payment from last one year are to be initially tackled for more impact. Reversal entries in the case of non paying consumers demand immediate attention.

The worst villages are to be adopted by DPE and vigilance wings and make them as model villages. This will be a spark for others to act.

Every house shall have the service connection no. painted at the pole, gate and meter. In fuse off call offices, before attending a fuse off call, they verify the defaulters' list. Only when these two conditions are fulfilled, the complaint would be attended.

The electricity revenue officials are to work and they are to be pin pointed for poor collections. The revenue recovery act is to be made use of. There shall be compulsory and immediate prosecution in the case of bounced cheques. It is interesting to note that no witness, except the bounced cheque, is necessary for imprisoning the offender promptly, in these cases.

The problem of fraud ever lingers on in the collection process. In one case, a single employee in electricity revenue office could knock off more than one crore rupees in about a year. Computerized monitoring system will help here.

Increased booking of cases on thieves and defaulters will bring real change in collection scenario. Anti power theft police stations (APTS) to deal exclusively with these cases are desirable to have any meaningful effect.

4. CALCULATION OF THE LINE LOSSES

Now Days power sector plays very important role in the development of any nation. Industrial devolpment and Agricultural power sector were mainly depends mainly on the electricity . Power is generated by Conventional energy sources and Non Conventional energy sources. Conventional energy sources includes Thermal power generation and hydal power generation and Nuclear power generation. Non Conventional power generation includes Tidal power generation and solar Power generation and Geothermal power generation ,Magneto hydro power generation and etc. 80% of the generated energy in india is due to conventional energy soures.

Remaining 20% is due to the Non Conventional energy sources. But the conventional energy sources are day by day decreasing and in future it may be the severe problem to the country for power generation. So the alternate is to reducing the power consumption so as to extend the time of availability of conventional energy sources.

Power consumption reduction is not easily possible but the losses in the power system can be reduced. Saving of one unit of energy is equivalent to the production of 1.5 units of energy is the slogan in the present power sectors. So Losses reduction in the power sector is very essential in the practical applications. Losses reduction plans are applicable in the Transmission system and also in Distribution system.

In this project to calculate the line losses KPMG methodology is followed. On the part of project line losses of four numbers 11KV feeders namely 11KV Kothapeta , 11KV Gajularega ,11KV B.Koneru Town ,11KV Tank Bund feeders losses in Vizianagaram Town were calculated and also find the technical and commercial losses separately. Here we can Observe the Losses of the above four numbers feeders from April 2014 to May 2015 and also discussed the reasons behind the losses.

4.1) HISTORY SHEET OF 11KV KOTHAPETA FEEDER

1

A.	NAME OF THE 33/11KV SUB-STATION.	⟹	B.koneru	
B	NAME OF THE EHT SUB-STATION.	⟹	EHT SS:132/33 KV Vontithadi	**S.S.Code: 021111**
C.	NAME OF THE FEEDER.	⟹	11 KV Kothapeta	**Feeder Code :02111101**
D.	TYPE OF THE FEEDER	⟹	Town	
E.	PEAK LOAD IN AMPS.	⟹	45 A	
F.	AVERAGE POWER FACTOR.	⟹	0.965	
G.	SIZE OF THE CONDUCTOR.	⟹	55Sqmm AAAC	
H.	DETAILS OF ALTERNATIVE SUPPLY.	⟹	1. RECEIVING FROM 2. SENDING TO	11 KV Dasannapeta P & T
I.	LENGTH OF 11KV LINE.	⟹	1. Trunk line in KM. 2. Spur Line in KM.	1.085 Km 0.85 Km
J.	LENGTH OF LT LINE.	⟹	1. Trunk line in KM. 2. Spur Line in KM.	11.2 KM 6.1Km
K.	% TECHNICAL LOSSES.	⟹	1.93%	
	% REGULATIONS.	⟹	0.69%	

Names of the villages being fed from this feeder (For Town/MHQ feeder only)f : Town

Names of all the Sections being fed from this feeder : D1

No of Distributions being fed from this feeder: 13

Wheteher all sections and distributions have Codes in PAA Data and all consumers are indexed : Yes

I **No. of the DTRs - Capacity wise :**

Capacity	250	200	160	100	75	63	25	Total No.	Total Capacity
No. of DTRs	0	0	1	11	0	0	1	13	1285

Category wise consumers &Sales (Present)

	Cat.	I	II	III	IV	V	VI	VII	HT	Total
Mai.15	No. of Scs.	2624	220	16	0	0	8	11	0	2879
	Sales	267008	62684	8711	0	0	2828	1405	0	342636
	Sp.Con	102	285	544	0	0	354	128	0	119

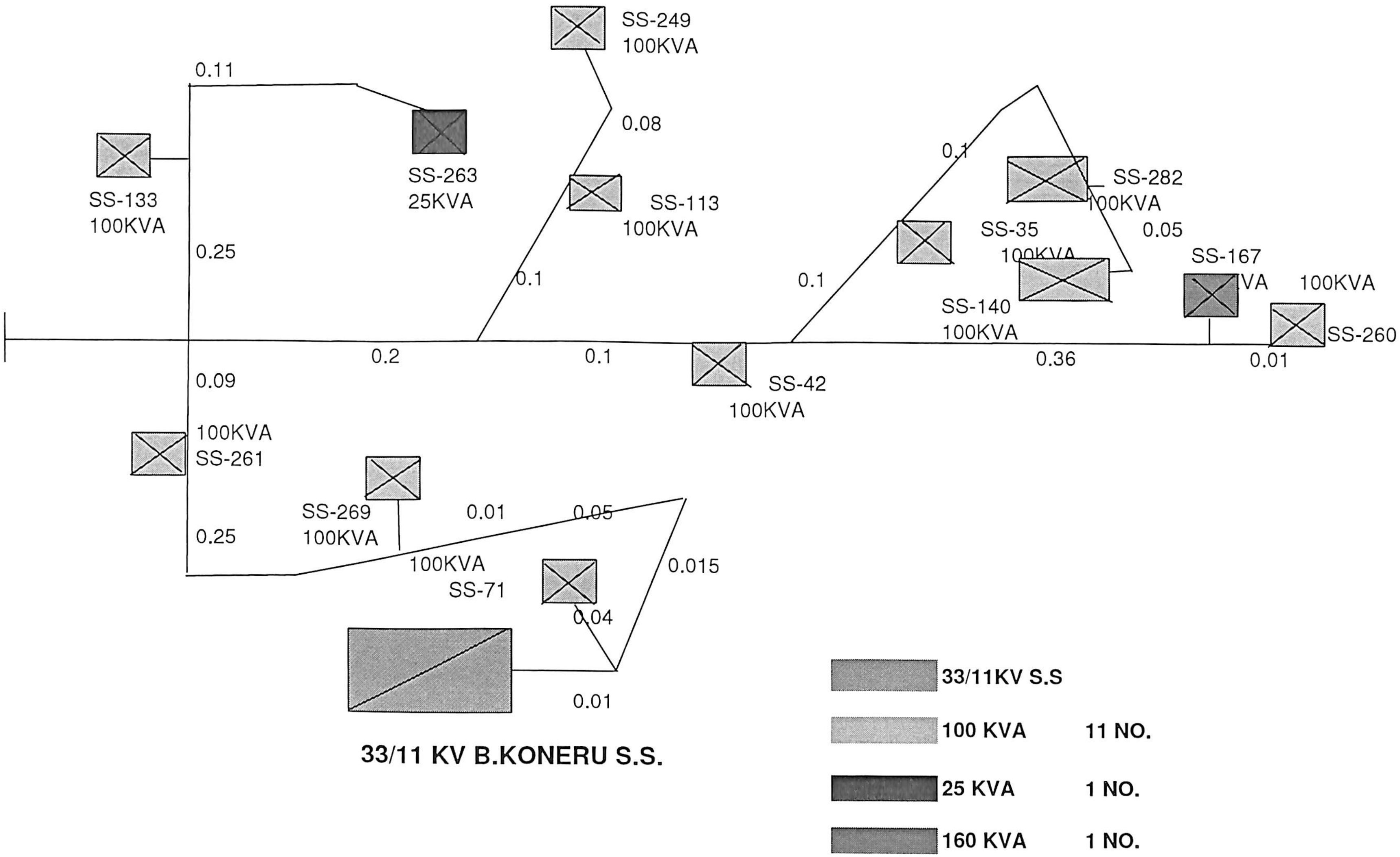
II LOSSES THIS YEAR :

SI.No.	Month	Input to 11KV Feeder	11KV Direct Sales	Metered Sales	Connected load in AGL services	AGL.Sales	Assessed Units	Total Sales	Loss	% Loss for the month
1	2	3	4	5	6	7	8	8	9	10
1	Jän.15	215640	0	203044	0	0	0	203044	12596	5.84
2	Feb.15	263760	0	245637	0	0	0	245637	18123	6.87
3	Mär.15	295000	0	277861	0	0	0	277861	17139	5.81
4	Apr.15	354560	0	334428	0	0	0	334428	20132	5.68
5	Mai.15	363120	0	342636	0	0	0	342636	20484	5.64

AL SERVICES UNDER FEEDER :-

Details of Agl Consumers					services availing 24 Hours supply.
No of metered services	Total HP of metred services	No of un metered services	total HP of Un metered services	Assesed Agrl. Sales	

4.1.1) 11KV Kothapeta feeder Sketch



4.1.2) 11KV Kothapeta Feeder Regulation Chart

0.01	0.075	0.25	0.09	0.2	0.1	0.1	0.36	0.01
100	100	100	125	200	100	300	160	100

33 / 11kv
B.Koneru SS
1x8MVA

1285	1185	1085	985	860	660	560	260	100

Sl.No	MOMENTS KVA	KM	Total
1	1285	0.01	12.85
2	1185	0.08	88.88
3	1085	0.25	271.25
4	985	0.09	88.65
5	860	0.20	172.00
6	660	0.10	66.00
7	560	0.10	56.00
8	260	0.20	52.00
9	100	0.01	1.00
		TOTAL	808.63

HT Regulation 0.08566 808.63 **0.69**

100.00

Hence, Satisfactory **0.69%**

4.1.3) TECHNICAL LOSSES CALCULATION OF 11KV KOTHAPETA FEEDER
Month: MAY - 2015

Name of the Feeder : KOTHAPETA
Name of the sub station : 33/11KV B.KONERU
Name of the Section : D1, VIZIANAGARAM

1) Units sent out from the 11kv system during a particular month (30 days) = 363120

2) Average Demand = (363120) / (30*24*0.965) = 522.625

3) Peak Demand during the month (1.732*11*45) = 857.34 KVA

4) Load factor of the month =Average Demand / Peak Demand = 522.625 /(1.732*11*45) = 0.609589213

Step:-1

5) Distribution Transformer in the 11KV system - Number and Rating :

No	KVA	Total
0	250	0
0	200	0
1	160	160
11	100	1100
0	75	0
0	63	0
1	25	25
Total Transformers Capacity =		1285

6) Losses when the Demand is equal to total Transformer Capacity:

i) Transformer Iron Losses (ISI Specification)

No of DTRS	DTR Capacity(in KVA)	Iron Loss (Watts/Each)	Per	Total
0	250	1000	E	0
0	200	825	E	0
1	160	650	E	650
11	100	450	E	4950
0	75	385	E	0
0	63	350	E	0
1	25	195	E	195
Total Iron Loss (Watts) =				5795

ii) Transformer Copper losses:

No of DTRS	DTR Capacity(in KVA)	Copper losses (Watts/Each)	Per	Total Copper Losses(in Watts)
0	250	4500	E	0
0	200	3750	E	0
1	160	3000	E	3000
11	100	2000	E	22000
0	75	1600	E	0
0	63	1400	E	0
1	25	700	E	700
Total Copper Loss =				25700

11 KV side

250 KVA = 13.13 Amps --------------75 KVA =3.94 Amps
200 KVA = 10.5 Amps --------------63 KVA =3.30 Amps
160 KVA = 8.4 Amps -------------50 KVA = 2.62 Amps
100 KVA = 5.25 Amps -------------15 KVA = 0.79 Amps

11 KV Line Losses (as per Statement -1) 1061.0177 Watts
6(iii) Losses for 3 Conductors = 3183.053089 Watts

Step - II

7) Max Demand During the Month = 857.34 KVA
Total Transformer Capacity= 1285 KVA
Ratio of Max.Demand to the Transformer Capacity = Max. Demand / Total Trans Capacity= 0.667190661

i)Transformer Copper Losses (Correct to M.D) = Item (6) (ii) * (Ratio)2 = 11440.18483

ii)Line Copper losses (Corrected M.D) = Item (6) (iii) * (ratio)2 = 1416.915007

Step-III

8) The Losses Calculated above have to be corrected to actual loading conditions by multiplying it with loss factor

i) Loss Factor Calculated according to the hourly meter Readings of a typical day in the month = 0.309510031
(As per the statement-2)
ii) Loss factor according to formulae loss factor = 0.8 (L.F)2 + 0.2* (L.F) 0.419
L.F - Load factor (4)
Loss Factor [8(i)] = 0.309510031

In Case the typical day meter readings are not available then the loss factor has to be calculated by the formulae given above.

i) Corrected transformer copper losses (actual loading condition) = 7 (i) * L.F = 3540.852
ii) Corrected line Copper losses (actual loading Conditions)= 7 (ii)* L.F = 438.549

9) (i) Units handled during the month (1) = 363120

Iron Losses [6 (i)] = 5795

Copper losses [8 (i)] = 3540.852

Losses [6 (i) + 8 (i)] = 9335.852

(ii) For one Month =Losses * 720 / 1000 = 6721.813 KWH

% Transformer Losses = [9 (ii) / 9 (i)] * 100 = 1.851

(iii) 11KV Line Losses 438.549

11KV Line losses per month = 8 (ii) * 720/1000 = 315.756

% 11 KV Line losses = [Losses per month / 9(i)] *100 = 0.087

10) (i) Units handled during the month (1) = 363120

Units billed = 342636

Actual losses in 11KV line , Transformer & L.T = Handled - Billed = 20484.000

(ii) L.T Distribution losses 13446.431

% L.T Distribution losses =[Losses per month] / 9(i)] * 100 - 3.703

%Technical +Comm Losses = [Total loss per month]/9(i)*100 5.641110377

STATEMENT : 1

11KV Line losses ;

Resistance of line = 0.365 Ohms/Km for 100Sq,mm
0.5149 Ohms/Km for 55Sq.mm
0.9116 Ohms/Km for 7/2.59 ACSR
1.37 Ohms/Km for 7/2.11 ACSR

Section	Length in KM	Resistance in Ohms	Current (I)	Full load I2R Watts	KVA
	0.01	0.0051	5.25	0.1419	100
	0.01	0.0051	8.4	0.3633	160
	0.36	0.1854	13.65	34.5375	260
	0.05	0.0257	5.25	0.7096	100
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	29.4	44.5059	560
	0.1	0.0515	34.65	61.8201	660
	0.08	0.0412	5.25	1.1354	100
	0.1	0.0515	5.25	1.4192	100
	0.2	0.1030	45.15	209.9270	860
	0.11	0.0566	1.3125	0.0976	25
	0.1	0.0515	5.25	1.4192	100
	0.25	0.1287	6.5625	5.5437	125

	0.09	0.0463	51.7125	123.9243	985
	0.25	0.1287	56.9625	417.6774	1085
	0.1	0.0515	5.25	1.4192	100
	0.065	0.0335	62.2125	129.5363	1185
	0.04	0.0206	5.25	0.5677	100
	0.01	0.0051	67.4625	23.4341	1285
				1061.0177	

STATEMENT ;-2

Hourly Demand in Amps on the 11 KV feeder on a typical day in the month

Time in Hours	Current (1) Amps	(Current)2 (1)2
1.00	15	225
2.00	13	169
3.00	12	144
4.00	12	144
5.00	15	225
6.00	20	400
7.00	22	484
8.00	20	400
9.00	18	324
10.00	14	196
11.00	15	225
12.00	15	225
13.00	16	256
14.00	16	256
15.00	15	225
16.00	15	225
17.00	18	324
18.00	25	625
19.00	36	1296
20.00	28	784
21.00	27	729
22.00	27	729
23.00	24	576
24.00	21	441
		9627

Loss Factor (L.F) = Total 2/(Max 2 * 24)= 0.309510031

4.2) HISTORY SHEET OF 11KV TANK BUND FEEDER

1

A.	NAME OF THE 33/11KV SUB-STATION.	⟹	Indoor SS	
B	NAME OF THE EHT SUB-STATION.	⟹	EHT SS:132/33 KV Vontithadi	**S.S.Code: 021122**
C.	NAME OF THE FEEDER.	⟹	11 Tank Bund	**Feeder Code :02112203**
D.	TYPE OF THE FEEDER	⟹	Town	
E.	PEAK LOAD IN AMPS.	⟹	30 A	
F.	AVERAGE POWER FACTOR.	⟹	0.965	
G.	SIZE OF THE CONDUCTOR.	⟹	55Sqmm AAAC	
H.	DETAILS OF ALTERNATIVE SUPPLY.	⟹	1. RECEIVING FROM 11 KV Vontithadi Town 2. SENDING TO	
I.	LENGTH OF 11KV LINE.	⟹	1. Trunk line in KM. 1.22 KM 2. Spur Line in KM. 0.57 KM	
J.	LENGTH OF LT LINE.	⟹	1. Trunk line in KM. 3.1 KM 2. Spur Line in KM. 4.2 KM	
K.	% TECHNICAL LOSSES.	⟹	2.40%	
	% REGULATIONS.	⟹	0.64%	

Names of the villages being fed from this feeder (For Town/MHQ feeder only)f : Town

Names of all the Sections being fed from this feeder : D1

No of Distributions being fed from this feeder: 8

Wheteher all sections and distributions have Codes in PAA Data and all consumers are indexed : Yes

I **No. of the DTRs - Capacity wise :**

Capacity	315	250	160	100	75	63	25	Total No.	Total Capacity
No. of DTRs	0	1	0	8	0	0	0	9	1050

Category wise consumers &Sales (Present)

	Cat.	I	II	III	IV	V	VI	VII	HT	TOTAL
Mai.15	No. of Scs.	977	404	13	3	0	7	10	0	1414
	Sales	83384	88546	8161	184	0	1723	2646	0	184644
	Sp.Con	85	219	628	61	0	246	265	0	131

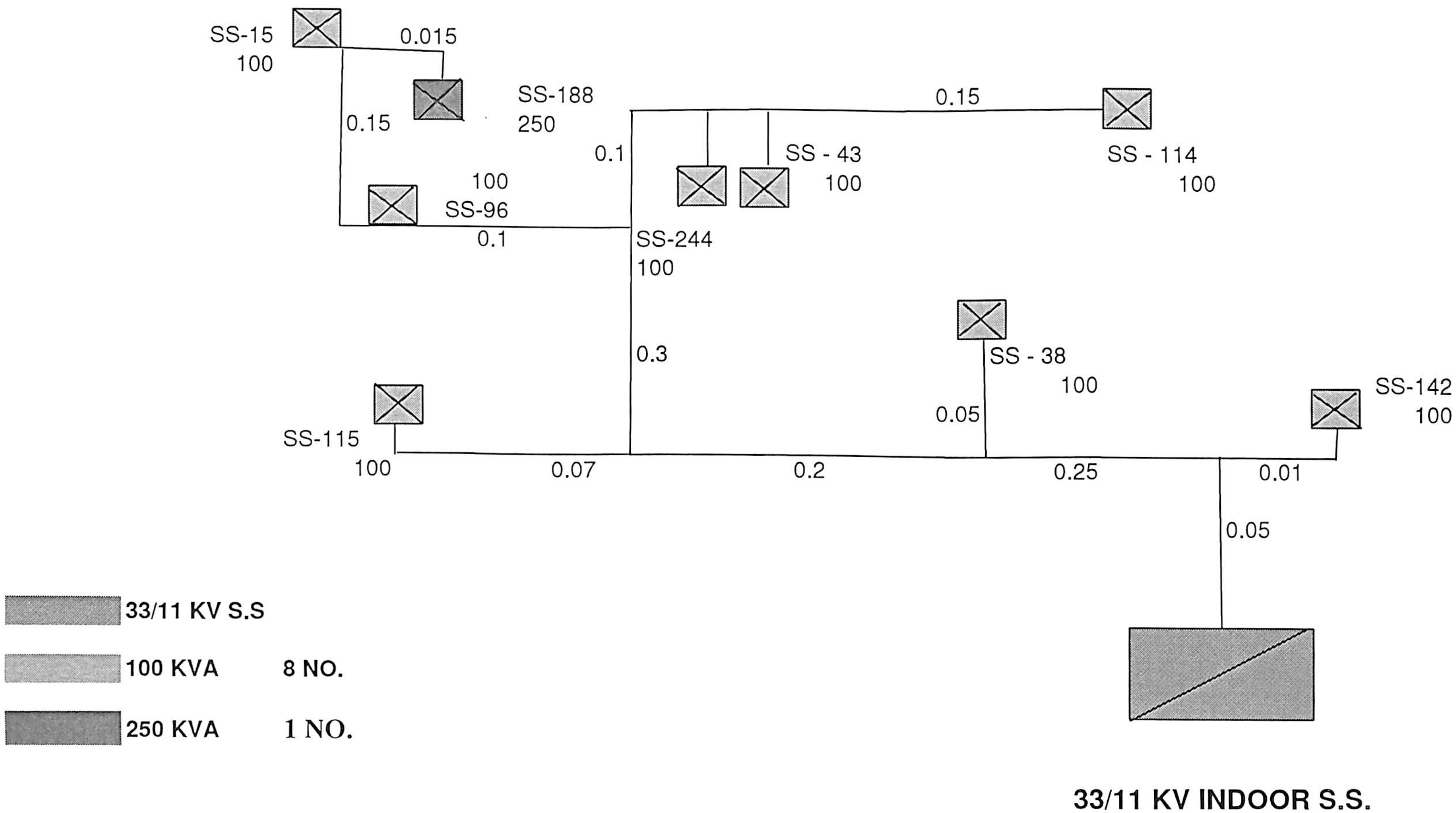
II LOSSES THIS YEAR :

Sl.No.	Month	Input to 11KV Feeder	11KV Direct Sales	Metered Sales	Connected load in AGL services	AGL.Sales	Assessed Units	Total Sales	Loss	% Loss for the month
1	2	3	4	5	6	7	8	8	9	10
1	Jän.15	131600	0	124196	0	0	0	124196	7404	5.63
2	Feb.15	127200	0	120128	0	0	0	120128	7072	5.56
3	Mär.15	178400	0	168305	0	0	0	168305	10095	5.66
4	Apr.15	227800	0	216155	0	0	0	216155	11645	5.11
5	Mai.15	193600	0	183855	0	0	0	183855	9745	5.03

FORMATE- 5 **TOTAL AGRICULATURAL SERVICES UNDER FEEDER :-**

s.No.	Catgory	Details of Agl Consumers					services availing 24 Hours supply.
		No of metered services	Total HP of metred services	No of un metered services	total HP of Un metered services	Assesed Agrl. Sales	
1	IT assesses.						
2	Corporate.						
3	Tatkal.						
4	Other paying Scs..		NIL				
5	Free.						
6	Total.						

4.2.1) 11KV Tank Bund Feeder Sketch



4.2.2) 11KV Tank Bund Feeder Regulation Chart

	0.05	0.25	0.2	0.3	0.1	0.1	0.2
	100	100	100	450	100	100	100

33 / 11kv
Indoor SS
1 X 5 MVA

1 X 5 MVA	1050	950	850	750	300	200	100

Sl.No	MOMENTS KVA	KM	Total
1	1050	0.05	52.50
2	950	0.25	237.50
3	850	0.20	170.00
4	750	0.30	225.00
5	300	0.10	30.00
6	200	0.10	20.00
7	100	0.15	15.00
		TOTAL	750.00

HT Regulation

<u>0.08566</u> <u>750.00</u> **0.64**

100.00

0.64%

Hence, Satisfactory

4.2.3) TECHNICAL LOSSES CALCULATION OF 11KV TANK BUND FEEDER

Month: MAY -2015

Name of the Feeder :Tank bund feeder
Name of the sub station : 33/11KV Indoor Sub Station
Name of the Section : D1, VIZIANAGARAM

1) Units sent out from the 11kv system during a particular month (30 days) = 193600
2) Average Demand = (193600) / (30*24*0.965) = 278.641
3) Peak Demand during the month (1.732*11*30) = 571.56 KVA
4) Load factor of the month =Average Demand / Peak Demand = 278.641 /(1.732*11*30) = 0.48751021

Step:-1

5) Distribution Transformer in the 11KV system - Number and Rating :

No	KVA	Total
1	250	250
0	200	0
0	160	0
8	100	800
0	75	0
0	63	0
0	25	0
Total Transformers Capacity =		1050

6) Losses when the Demand is equal to total Transformer Capacity:

i) Transformer Iron Losses (ISI Specification)

No of DTRS	DTR Capacity(in KVA)	Iron Loss (Watts/Each)	Per	Total
1	250	1000	E	1000
0	200	825	E	0
0	160	650	E	0
8	100	450	E	3600
0	75	385	E	0
0	63	350	E	0
0	25	195	E	0
Total Iron Loss (Watts) =				4600

ii) Transformer Copper losses:

No of DTRS	DTR Capacity(in KVA)	Copper losses (Watts/Each)	Per	Total Copper Losses(in Watts)
1	250	4500	E	4500
0	200	3750	E	0
0	160	3000	E	0
8	100	2000	E	16000
0	75	1600	E	0
0	63	1400	E	0
0	25	700	E	0
Total Copper Loss =				20500

11 KV side

250 KVA = 13.13 Amps -------------75 KVA =3.94 Amps
200 KVA = 10.5 Amps -------------63 KVA =3.30 Amps
160 KVA = 8.4 Amps ------------50 KVA = 2.62 Amps
100 KVA = 5.25 Amps ------------15 KVA = 0.79 Amps

11 KV Line Losses (as per Statement -1) 924.4092 Watts
6(iii) Losses for 3 Conductors = 2773.227546 Watts

Step - II

7) Max Demand During the Month = 571.56 KVA
Total Transformer Capacity= 1050 KVA
Ratio of Max.Demand to the Transformer Capacity = Max. Demand / Total Trans Capacity= 0.544342857

i)Transformer Copper Losses (Correct to M.D) = Item (6) (ii) * (Ratio)2 = 6074.337496

ii)Line Copper losses (Corrected M.D) = Item (6) (iii) * (ratio)2 = 821.7326861

Step-III

8) The Losses Calculated above have to be corrected to actual loading conditions by multiplying it with loss factor

i) Loss Factor Calculated according to the hourly meter Readings of a typical day in the month = 0.275277489
(As per the statement-2)
ii) Loss factor according to formulae loss factor = 0.8 (L.F)2 + 0.2* (L.F) 0.288
L.F - Load factor (4)
Loss Factor [8(i)] = 0.275277489

In Case the typical day meter readings are not available then the loss factor has to be calculated by the formulae given above.

i) Corrected transformer copper losses (actual loading condition) = 7 (i) * L.F = 1672.128
ii) Corrected line Copper losses (actual loading Conditions)= 7 (ii)* L.F = 226.205

9) (i) Units handled during the month (1) = 193600

Iron Losses [6 (i)] = 4600

Copper losses [8 (i)] = 1672.128

Losses [6 (i) + 8 (i)] = 6272.128

(ii) For one Month =Losses * 672 / 1000 = 4515.932 KWH

% Transformer Losses = [9 (ii) / 9 (i)] * 100 = 2.333

(iii) 11KV Line Losses 226.205

11KV Line losses per month = 8 (ii) * 720/1000 = 162.867

% 11 KV Line losses = [Losses per month / 9(i)] *100 = 0.084

10) (i) Units handled during the month (1) = 193600

Units billed = 183855

Actual losses in 11KV line , Transformer & L.T = Handled - Billed = 9745.000

(ii) L.T Distribution losses 5066.200

% L.T Distribution losses =[Losses per month] / 9(i)] * 100 - 2.617

%Technical +Comm Losses = [Total loss per month]/9(i)*100 5.03357438

STATEMENT : 1

11KV Line losses ;

Resistance of line = 0.365 Ohms/Km for 100Sq,mm

0.5149 Ohms/Km for 55Sq.mm

0.9116 Ohms/Km for 7/2.59 ACSR

1.37 Ohms/Km for 7/2.11 ACSR

Section	Length in KM	Resistance in Ohms	Current (I)	Full load I2R Watts	KVA
	0.015	0.0077	13.125	1.3305	250
	0.15	0.0772	18.375	26.0777	350
	0.1	0.0515	23.625	28.7387	450
	0.15	0.0772	5.25	2.1288	100
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	10.5	5.6768	200
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	15.75	12.7727	300
	0.3	0.1545	39.375	239.4888	750
	0.07	0.0360	5.25	0.9934	100
	0.2	0.1030	44.625	205.0734	850
	0.05	0.0257	5.25	0.7096	100
	0.25	0.1287	49.875	320.2054	950
	0.01	0.0051	5.25	0.1419	100
	0.05	0.0257	55.125	78.2330	1050
				924.4092	

STATEMENT ;-2

Hourly Demand in Amps on the 11 KV feeder on a typical day in the month

Time in Hours	Current (1) Amps	(Current)2 (1)2
1.00	6	36
2.00	6	36
3.00	6	36
4.00	6	36
5.00	7	49
6.00	9	81
7.00	13	169
8.00	10	100
9.00	8	64
10.00	14	196
11.00	18	324
12.00	19	361
13.00	20	400
14.00	18	324
15.00	17	289
16.00	16	256
17.00	20	400
18.00	27	729
19.00	27	729
20.00	31	961
21.00	22	484
22.00	12	144
23.00	9	81
24.00	8	64
		6349

Loss Factor (L.F) = Total 2/(Max 2 * 24)= 0.275277489

4.3) HISTORY SHEET OF 11 KV GAJULAREGA FEEDER

A.	NAME OF THE 33/11KV SUB-STATION.	⟹	B.Koneru		
B	NAME OF THE EHT SUB-STATION.	⟹	EHT SS:132/33 KV Vontithadi		**S.S.Code: 021111**
C.	NAME OF THE FEEDER.	⟹	11 KV Gajula Rega		**Feeder Code :02111102**
D.	TYPE OF THE FEEDER	⟹	Town		
E.	PEAK LOAD IN AMPS.	⟹	68A		
F.	AVERAGE POWER FACTOR.	⟹	0.965		
G.	SIZE OF THE CONDUCTOR.	⟹	55Sqmm AAAC		
H.	DETAILS OF ALTERNATIVE SUPPLY.	⟹	1. RECEIVING FROM	11 KV Butchanna Koneru	
			2. SENDING TO	Gajula Rega	
I.	LENGTH OF 11KV LINE.	⟹	1. Trunk line in KM.	8.2 KM	
			2. Spur Line in KM.	5.0 KM	
J.	LENGTH OF LT LINE.	⟹	1. Trunk line in KM.	25.05 KM	
			2. Spur Line in KM.	20.2 KM	
K.	% TECHNICAL LOSSES.	⟹	3.70%		
	% REGULATIONS.	⟹	7.53%		

Names of the villages being fed from this feeder (For Town/MHQ feeder only)f :	Town
Names of all the Sections being fed from this feeder :	D1
No of DTRs	51
Wheteher all sections and distributions have Codes in PAA Data and all consumers are indexed :	Yes

I **No. of the DTRs - Capacity wise :**

Capacity	160	100	75	63	50	25	250	Total No.	Total Capacity
No. of DTRs	2	38	1	6	1	3	0	51	4698

Category wise consumers &Sales (Present)

	Cat.	I	II	III	IV	V	VI	VII	HT	TOTAL
Mai.15	**No. of Scs.**	4676	270	60	0	4	22	23	0	5055
	Sales	441247	54251	79895	0	806	8412	1790	0	586401
	Sp.Con	94	201	1332	0	202	382	78	0	116.0042

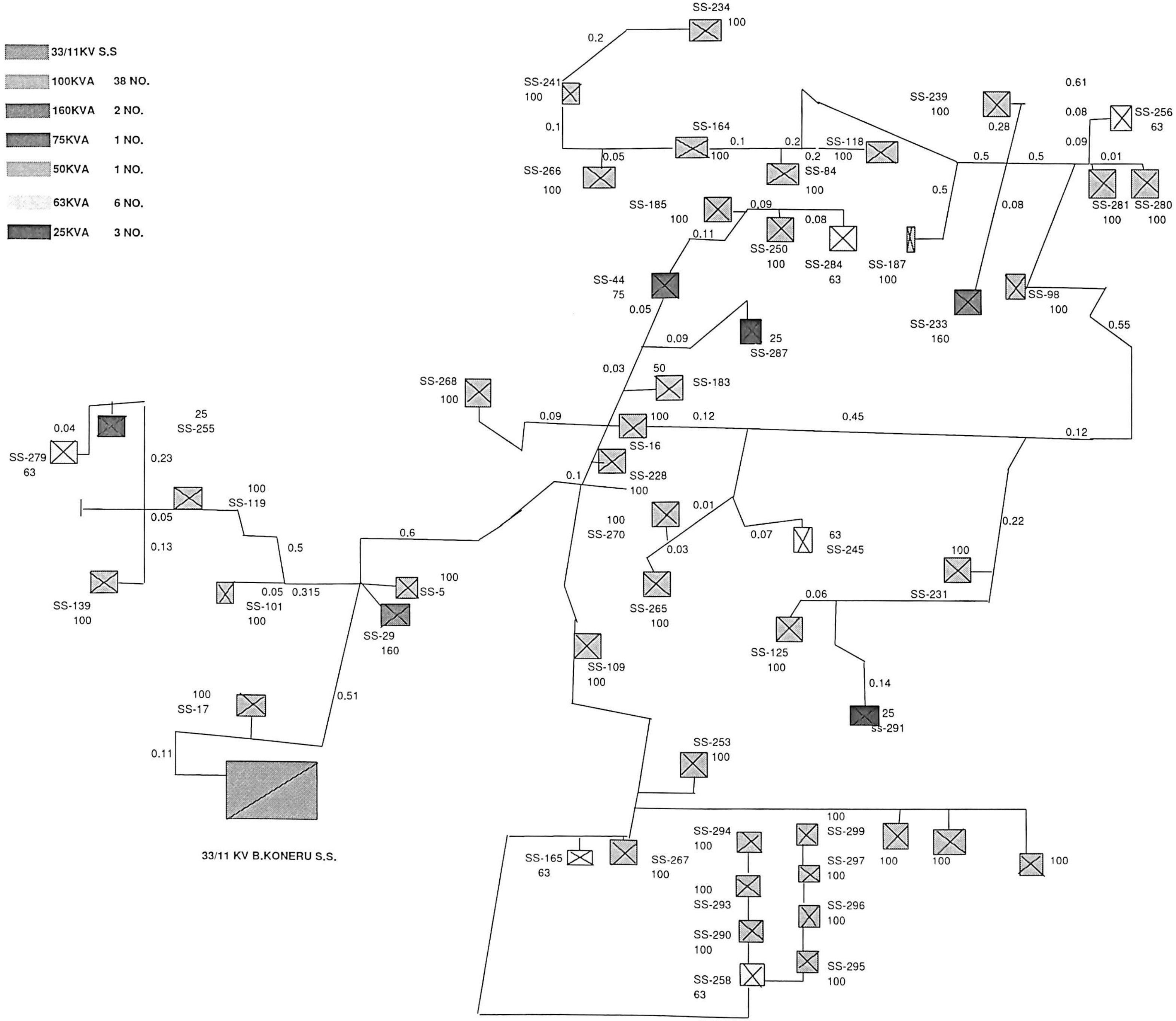
II LOSSES THIS YEAR :

Sl.No.	Month	Input to 11KV Feeder	11KV Direct Sales	Metered Sales	Connected load in AGL services	AGL.Sales	Assessed Units	Total Sales	Loss	% Loss for the month
1		3	4	5	6	7	8	8	9	10
1	Jän.15	456320	0	429200	11	565	0	429765	26555	5.82
2	Feb.15	524240	0	487474	11	451	0	487925	36315	6.93
3	Mär.15	553480	0	522035	11	568	0	522603	30877	5.58
4	Apr.15	633520	0	595011	11	715	0	595726	37794	5.97
5	Mai.15	624080	0	585595	11	806	0	586401	37679	6.04

FORMATE- 5 TOTAL AGRICULATURAL SERVICES UNDER FEEDER :-

s.No.	Catgory	Details of Agl Consumers					services availing 24 Hours supply.
		No of metered services	Total HP of metred services	No of un metered services	total HP of Un metered services	Assesed Agrl. Sales	
1	IT assesses.						
2	Corporate.						
3	Tatkal.	3	**11**	**0**			
4	Other paying Scs..						
5	Free.	1	3	0			
6	Total.						

4.3.1) 11 KV GAJULAREGA FEEDER SKETCH



4.3.2) 11KV Gajularega Feeder Regulation Chart

33 / 11kv B.Koneru SS 1 X 8 MVA																		
	0.11	0.51	0.60	0.10	0.10	0.10	0.12	0.45	0.67	0.20	0.50	0.50	0.30	0.20	0.10	0.10	0.10	0.20
	100	648	1426	100	513	100	263	225	100	263	260	100	100	100	100	100	100	100
	4698	4598	3950	2524	2424	1911	1811	1548	1323	1223	960	700	600	500	400	300	200	100

MOMENTS

Sl.No	KVA	KM	Total
1	4698	0.11	516.78
2	4598	0.51	2344.98
3	3950	0.60	2370.00
4	2524	0.10	252.40
5	2424	0.10	242.40
6	1911	0.10	191.10
7	1811	0.12	217.32
8	1548	0.20	309.60
9	1323	0.67	886.41
10	1223	0.20	244.60
11	960	0.50	480.00
12	700	0.50	350.00
13	600	0.30	180.00
14	500	0.20	100.00
15	400	0.10	40.00
16	300	0.10	30.00
17	200	0.10	20.00
18	100	0.20	20.00
	TOTAL		8795.59

HT Regulation $\frac{0.086 \times 8795.59}{100.00}$ **7.53**

Hence, Satisfactory **7.53%**

4.3.3)TECHNICAL LOSSES CALCULATIONS OF 11KV GAJULAREGA FEEDER
Month: MAY 2015

Name of the Feeder: Gajularega

Name of the sub station : B.KONERU

Name of the Section: D1,

1) Units sent out from the 11kv system during a particular month (30 days)= 624080
2) Average Demand = (624080) / (30*24*0.965) = 898.215
3) Peak Demand during the month (1.732*11*68) = 1295.536 KVA
4) Load factor of the month =Average Demand / Peak Demand = 898.215 /(1.732*11*68) = 0.693315596

Step:-1

5) Distribution Transformer in the 11KV system - Number and Rating :

No	KVA	Total
0	315	0
0	250	0
2	160	320
38	100	3800
1	75	75
6	63	378
1	50	50
3	25	75
0	15	0
Total Transformers Capacity =		4698

6) Losses when the Demand is equal to total Transformer Capacity .

i) Transformer Iron Losses (ISI Specification)

No of DTRS	DTR Capacity(in KVA)	Iron Loss(Watts/Each)	Per	Total
0	315	1200	E	0
0	250	1000	E	0
2	160	650	E	1300
38	100	450	E	17100
1	75	385	E	385
6	63	350	E	2100
1	50	130	E	130
3	25	195	E	585
0	15	60	E	0
Total Iron Loss (Watts) =				21600

ii) Transformer Copper losses

No of DTRS	DTR Capacity(in KVA)	Copper losses(Watts/Each)	Per	Total Copper Losses(in Watts)
0	315	5700	E	0
0	250	4500	E	0
2	160	3000	E	6000
38	100	2000	E	76000
1	75	1600	E	1600
6	63	1400	E	8400
1	50	880	E	880
3	25	700	E	2100
0	15	600	E	0
Total Copper Loss =				94980

11 KV side

315 KVA = 16.54 Amps -------------75 KVA =3.94 Amps
250 KVA = 13.13 Amps -------------63 KVA =3.30 Amps
160 KVA = 8.4 Amps ------------50 KVA = 2.62 Amps
100 KVA = 5.25 Amps ------------15 KVA = 0.79 Amps

11 KV Line Losses (as per Statement -1) =21799.8691 43430.7458 Watts
6(iii) Losses for 3 Conductors = 130292.2374 Watts

<u>Step - II</u>

7) Max Demand During the Month = 1295.536 KVA
Total Transformer Capacity= 4698 KVA
Ratio of Max.Demand to the Transformer Capacity = Max. Demand / Total Trans Capacity= 0.275763
i)Transformer Copper Losses (Correct to M.D) = Item (6) (ii) * (Ratio)2 = 7222.792052

ii)Line Copper losses (Corrected M.D) = Item (6) (iii) * (ratio)2 = 9908.125256

Step-III

8) The Losses Calculated above have to be corrected to actual loading conditions by multiplying it with loss factor

i) Loss Factor Calculated according to the hourly meter Readings of a typical day in the month = (As per the statement-2)		0.646343
ii) Loss factor according to formulae loss factor = 0.8 (L.F)2 + 0.2* (L.F)		0.385
L.F - Load factor (4)		
Loss Factor [8(i)]	=	0.646342593

In Case the typical day meter readings are not available then the loss factor has to be calculated by the formulae given above.

i)Corrected transformer copper losses (actual loading condition) = 7 (i) * L.F =	4668.398	
ii)Corrected line Copper losses (actual loading Conditions)= 7 (ii)* L.F =	6404.043	
9) (i) Units handled during the month (1) =	624080	
Iron Losses [6 (i)] =	21600	
Copper losses [8 (i)] =	4668.398	
Losses [6 (i) + 8 (i)] =	26268.398	
(ii) For one Month =Losses * 720 / 1000 =	18913.247	KWH
% Transformer Losses = [9 (ii) / 9 (i)] * 100 =	3.031	
(iii) 11KV Line Losses	6404.043	
11KV Line losses per month = 8 (ii) * 720/1000 =	4610.911	KWH
% 11 KV Line losses = [Losses per month / 9(i)] *100 =	0.739	
10) (i) Units handled during the month (1) =	624080	
Units billed =	586401	
Actual losses in 11KV line , Transformer & L.T = Handled - Billed =	37679	
(iv) L.T Distribution losses	14154.842	
% L.T Distribution losses =[Losses per month] / 9(i)] * 100 -	2.268	
%Technical +Comm Losses = [Total loss per month]/9(i)*100	6.03752724	

STATEMENT : 1

11KV Line losses ;

Resistance of line = 0.365 Ohms/Km for 100Sq,mm
0.5149 Ohms/Km for 55Sq.mm
0.9116 Ohms/Km for 7/2.59 ACSR
1.37 Ohms/Km for 7/2.11 ACSR

Section	Length in KM	Resistance in Ohms	Current (I)	Full load I2R Watts	KVA
	0.2	0.1030	5.25	2.8384	100
	0.1	0.0515	15.75	12.7727	300
	0.05	0.0257	5.25	0.7096	100
	0.1	0.0515	21	22.7071	400
	0.1	0.0515	26.25	35.4798	500
	0.01	0.0051	5.25	0.1419	100
	0.2	0.1030	31.5	102.1819	600
	0.2	0.1030	5.25	2.8384	100
	0.3	0.1545	36.75	208.6214	700
	0.5	0.2575	5.25	7.0960	100
	0.5	0.2575	42	454.1418	800
	0.08	0.0412	8.4	2.9065	160
	0.28	0.1442	5.25	3.9737	100
	0.5	0.2575	50.4	653.9642	960
	0.09	0.0463	3.3075	0.5069	63
	0.01	0.0051	10.5	0.5677	200
	0.2	0.1030	64.2075	424.5457	1223
	0.55	0.2832	69.4575	1366.2302	1323
	0.06	0.0309	5.25	0.8515	100
	0.14	0.0721	1.3125	0.1242	25
	0.1	0.0515	6.5625	2.2175	125
	0.1	0.0515	5.25	1.4192	100
	0.22	0.1133	11.8125	15.8063	225
	0.45	0.2317	81.27	1530.3682	1548
	0.07	0.0360	3.3075	0.3943	63
	0.03	0.0154	5.25	0.4258	100
	0.01	0.0051	5.25	0.1419	100
	0.01	0.0051	13.8075	0.9816	263
	0.12	0.0618	95.0775	558.5469	1811
	0.1	0.0515	100.3275	518.2781	1911
	0.08	0.0412	3.3075	0.4506	63
	0.1	0.0515	5.25	1.4192	100
	0.09	0.0463	8.5575	3.3936	163
	0.1	0.0515	13.8075	9.8164	263
	0.05	0.0257	17.745	8.1067	338
	0.09	0.0463	1.3125	0.0798	25
	0.03	0.0154	19.0575	5.6102	363

	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	24.3075	30.4231	463
	0.09	0.0463	5.25	1.2773	100
	0.1	0.0515	129.885	868.6421	2474
	0.1	0.0515	135.135	940.2830	2574
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	5.25	1.4192	100
	0.2	0.1030	15.75	25.5455	300
	0.3	0.1545	21	68.1213	400
	0.3	0.1545	19.0575	56.1017	363
	0.6	0.3089	40.0575	495.7261	763
	0.1	0.0515	43.365	96.8281	826
	0.2	0.1030	48.615	243.3848	926
	0.5	0.2575	64.365	1066.5776	1226
	0.1	0.0515	69.615	249.5333	1326
	0.3	0.1545	74.865	865.7685	1426
	0.6	0.3089	210	13624.2540	4000
	0.04	0.0206	3.3075	0.2253	63
	0.23	0.1184	1.3125	0.2040	25
	0.13	0.0669	5.25	1.8450	100
	0.05	0.0257	15.12	5.8857	288
	0.05	0.0257	5.25	0.7096	100
	0.32	0.1648	20.37	68.3683	388
	0.1	0.0515	10.5	5.6768	200
	0.51	0.2626	241.395	15302.0497	4598
	0.1	0.0515	5.25	1.4192	100
	0.11	0.0566	246.645	3445.5631	4698
				43430.7458	

STATEMENT ;-2

Hourly Demand in Amps on the 11 KV feeder on a typical day in the month

Time in Hours	Current (1) Amps	(Current)2 (1)2
1.00	47	2209
2.00	45	2025
3.00	41	1681
4.00	37	1369
5.00	35	1225
6.00	37	1369
7.00	38	1444
8.00	47	2209
9.00	46	2116
10.00	46	2116
11.00	46	2116
12.00	48	2304
13.00	48	2304
14.00	48	2304
15.00	48	2304
16.00	48	2304
17.00	46	2116
18.00	50	2500
19.00	58	3364
20.00	58	3364
21.00	68	4624
22.00	58	3364
23.00	53	2809
24.00	48	2304
		55844

Loss Factor (L.F) = Total 2/(Max 2 * 24)= 0.646342593

4.4) HISTORY SHEET OF 11KV B.Koneru TOWN FEEDER

1

S.S.Code: 021111
Feeder Code :02111103

A.	NAME OF THE 33/11KV SUB-STATION.	⟹	B.koneru	
B	NAME OF THE EHT SUB-STATION.	⟹	EHT SS:132/33 KV Vontithadi	
C.	NAME OF THE FEEDER.	⟹	11 KV Town	
D.	TYPE OF THE FEEDER	⟹	Town	
E.	PEAK LOAD IN AMPS.	⟹	85	
F.	AVERAGE POWER FACTOR.	⟹	0.92	
G.	SIZE OF THE CONDUCTOR.	⟹	55Sqmm AAAC	
H.	DETAILS OF ALTERNATIVE SUPPLY.	⟹	1. RECEIVING FROM	11 KV Vontithadi Town
			2. SENDING TO	Zilla parishad
I.	LENGTH OF 11KV LINE.	⟹	1. Trunk line in KM.	2.47 Km
			2. Spur Line in KM.	2.12 Km
J.	LENGTH OF LT LINE.	⟹	1. Trunk line in KM.	8.8 Km
			2. Spur Line in KM.	14.25 Km
K.	% TECHNICAL LOSSES.	⟹	1.90%	
	% REGULATIONS.	⟹	4.39%	

Names of the villages being fed from this feeder (For Town/MHQ feeder only)f : Town

Names of all the Sections being fed from this feeder : D1

No of Distributions being fed from this feeder: 28

Wheteher all sections and distributions have Codes in PAA Data and all consumers are indexed : Yes

I **No. of the DTRs - Capacity wise :**

Capacity	315	250	160	100	63	25	15	Total No.	Total Capacity
No. of DTRs	1	3	2	15	5	1	0	27	3225

Category wise consumers &Sales (Present)

	Cat.	I	II	III	IV	V	VI	VII	HT	Total
Mai.15	**No. of Scs.**	3471	1110	26	0	0	60	18	2	4687
	Sales	349378	277027	21009	0	0	17939	3037	26584	694974
	Sp.Con	101	250	808	0	0	299	169	13292	148

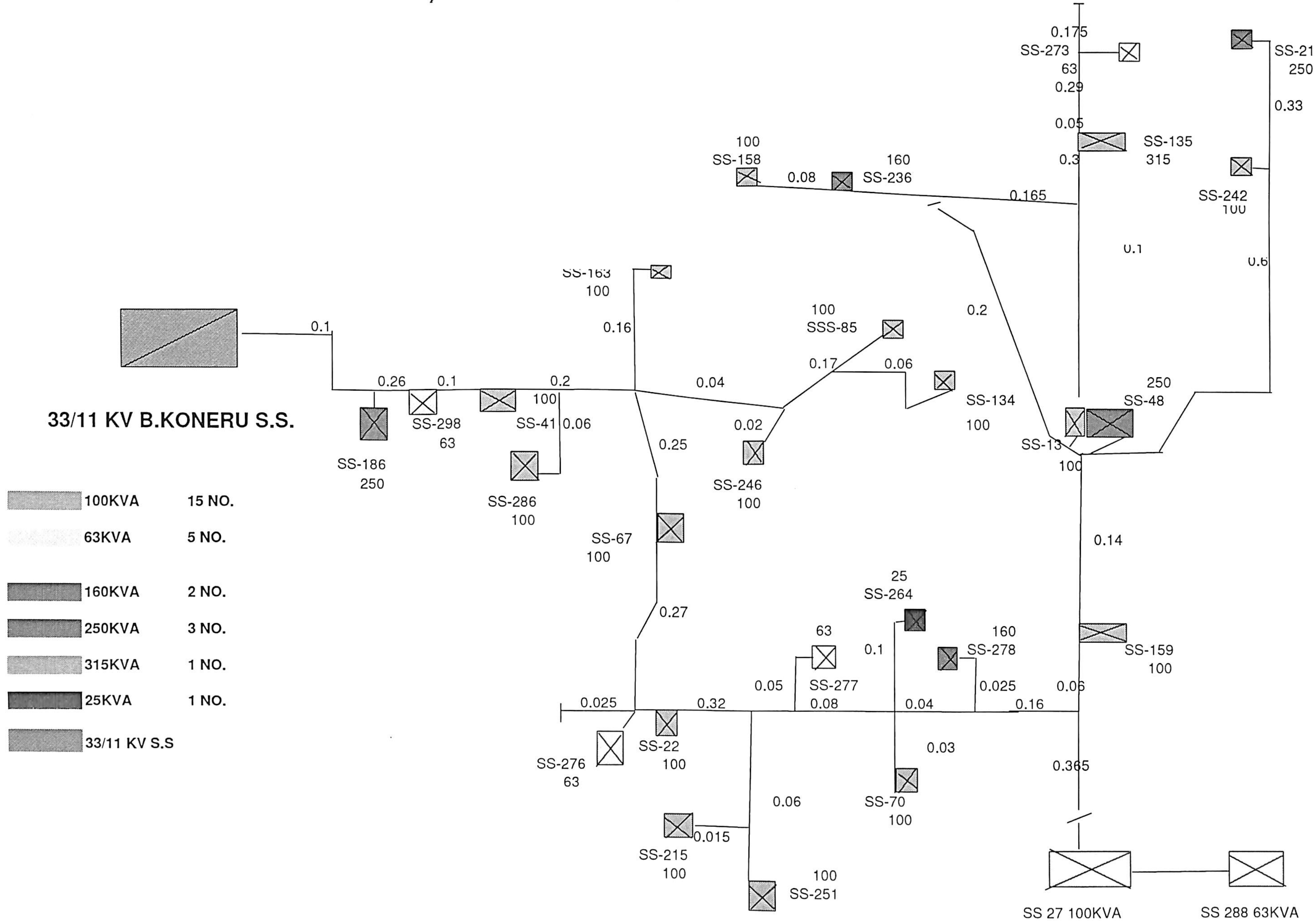
II LOSSES THIS YEAR :

Sl.No.	Month	Input to 11KV Feeder	11KV Direct Sales	Metered Sales	Connected load in AGL services	AGL.Sales	Assessed Units	Total Sales	Loss	% Loss for the month
1	2	3	4	5	6	7	8	8	9	10
1	Jän.15	448920	11761	413481	0	0	0	425242	23678	5.27
2	Feb.15	519440	14998	475923	0	0	0	490921	28519	5.49
3	Mär.15	525280	20568	474750	0	0	0	495318	29962	5.70
4	Apr.15	636640	22457	577653	0	0	0	600110	36530	5.74
5	Mai.15	732520	26584	668390	0	0	0	694974	37546	5.13

FORMATE- 5 **TOTAL AGRICULATURAL SERVICES UNDER FEEDER :-**

s.No.	Catgory	Details of Agl Consumers					services availing 24 Hours supply.
		No of metered services	Total HP of metred services	No of un metered services	total HP of Un metered services	Assesed Agrl. Sales	
1	IT assesses.						
2	Corporate.						
3	Tatkal.						
4	Other paying Scs..						
5	Free.						
6	Total.						

4.4.1) 11 KV B.KONERU - TOWN FEEDER SKETCH



4.4.2) 11KV B.Koneru - Town Feeder Regulation Chart

	0.1	0.26	0.1	0.2	0.2	0.3	0.27	0.1	0.32	0.05	0.1	0.04	0.16	0.06	0.14	0.1	0.1	0.17	0.08
	250	63	100	100	400	100	63	100	200	63	125	160	163	100	350	250	378	160	100
33 / 11kv B.Koneru ss 1x 8 MVA	3225	2975	2912	2812	2712	2312	2212	2149	2049	1849	1786	1661	1501	1338	1238	888	638	260	100

MOMENTS

Sl.No	**KVA**	**KM**	**Total**
1	3225	0.10	322.50
2	2975	0.26	773.50
3	2912	0.10	291.20
4	2812	0.20	562.40
5	2712	0.20	542.40
6	2312	0.25	578.00
7	2212	0.27	597.24
8	2149	0.20	429.80
9	2049	0.32	655.68
10	1849	0.05	92.45
11	1786	0.08	142.88
12	1661	0.04	66.44
13	1501	0.16	240.16
14	1338	0.06	80.28
15	1238	0.14	173.32
16	888	0.10	88.80
17	638	0.10	63.80
18	260	0.17	42.90
19	100	0.08	8.00
		TOTA	5751.75

HT Regulation $\frac{0.086 \times 5751.75}{100.00}$ **4.93**

Hence, Satisfactory **4.39%**

4.4.3) TECHNICAL LOSSES CALCULATIONS OF 11KV B.KONERU TOWN FEEDER

Month: MAY 2015

Name of the Feeder: TOWN

Name of the sub station : B.KONERU

Name of the Section: D1, VIZIANAGARAM

1) Units sent out from the 11kv system during a particular month (30 days)= 732520
2) Average Demand = (732520) / (30*24*0.965) = 1054.289
3) Peak Demand during the month (1.732*11* 85) = 1619.42 KVA
4) Load factor of the month =Average Demand / Peak Demand = 1054.289 /(1.732*11*75) = 0.651028766

Step:-1

5) Distribution Transformer in the 11KV system - Number and Rating :

No	KVA	Total
1	315	315
3	250	750
2	160	320
15	100	1500
5	63	315
1	25	25
Total Transformers Capacity =		3225

6) Losses when the Demand is equal to total Transformer Capacity .

i) Transformer Iron Losses (ISI Specification)

No of DTRS	DTR Capacity(in KVA)	Iron Loss(Watts/Each)	Per	Total
1	315	1200	E	1200
3	250	1000	E	3000
2	160	650	E	1300
15	100	450	E	6750
5	63	350	E	1750
1	25	195	E	195
Total Iron Loss (Watts) =				14195

ii) Transformer Copper losses

No of DTRS	DTR Capacity(in KVA)	Copper losses(Watts/Each)	Per	Total Copper Losses(in Watts)
1	315	5700	E	5700
3	250	4500	E	13500
2	160	3000	E	6000
15	100	2000	E	30000
5	63	1400	E	7000
1	25	700	E	700
Total Copper Loss =				62900

11 KV side

315 KVA = 16.54 Amps --------------75 KVA =3.94 Amps
250 KVA = 13.13 Amps --------------63 KVA =3.30 Amps
160 KVA = 8.4 Amps ------------50 KVA = 2.62 Amps
100 KVA = 5.25 Amps -------------15 KVA = 0.79 Amps

11 KV Line Losses (as per Statement -1) =21799.8691 14838.9363 Watts
6(iii) Losses for 3 Conductors = 44516.80897 Watts

Step - II

7) Max Demand During the Month = 1619.42 KVA
Total Transformer Capacity= 3225 KVA
Ratio of Max.Demand to the Transformer Capacity = Max. Demand / Total Trans Capacity= 0.502146
i)Transformer Copper Losses (Correct to M.D) = Item (6) (ii) * (Ratio)2 = 15860.25642

ii)Line Copper losses (Corrected M.D) = Item (6) (iii) * (ratio)2 = 11224.92854

Step-III

8) The Losses Calculated above have to be corrected to actual loading conditions by multiplying it with loss factor

i) Loss Factor Calculated according to the hourly meter Readings of a typical day in the month = 0.224867
(As per the statement-2)

ii) Loss factor according to formulae loss factor = 0.8 (L.F)2 + 0.2* (L.F) 0.339

L.F - Load factor (4)

Loss Factor [8(i)] = 0.224867359

In Case the typical day meter readings are not available then the loss factor has to be calculated by the formulae given above.

i)Corrected transformer copper losses (actual loading condition) = 7 (i) * L.F = 3566.454

ii)Corrected line Copper losses (actual loading Conditions)= 7 (ii)* L.F = 2524.120

9) (i) Units handled during the month (1)		=	732520
Iron Losses [6 (i)]		=	14195
Copper losses [8 (i)]		=	3566.454
	Losses [6 (i) + 8 (i)]	=	17761.454
(ii) For one Month	=Losses * 720/ 1000 =		12788.247 KWH
% Transformer Losses	= [9 (ii) / 9 (i)] * 100 =		1.746
(iii) 11KV Line Losses			2524.120
11KV Line losses per month	= 8 (ii) * 720/1000 =		1817.366 KWH
% 11 KV Line losses	= [Losses per month / 9(i)] *100 =		0.248
10) (i) Units handled during the month (1)		=	732520
Units billed		=	694974
Actual losses in 11KV line , Transformer & L.T	= Handled - Billed	=	37546
(iv) L.T Distribution losses			22940.387
% L.T Distribution losses	=[Losses per month] / 9(i)] * 100 -		3.132
%Technical +Comm Losses	= [Total loss per month]/9(i)*100		5.12559384

STATEMENT : 1

11KV Line losses ;

Resistance of line =	0.365	Ohms/Km for	100Sq,mm
	0.5149	Ohms/Km for	55Sq.mm
	0.9116	Ohms/Km for	7/2.59 ACSR
	1.37	Ohms/Km for	7/2.11 ACSR

Section	Length in KM	Resistance in Ohms	Current (I)	Full load I2R Watts	KVA
	0.29	0.1493	3.3075	1.6335	63
	0.3	0.1545	19.845	60.8340	378
	0.08	0.0412	5.25	1.1354	100
	0.165	0.0850	13.65	15.8297	260
	0.1	0.0515	33.495	57.7674	638
	0.1	0.0515	46.62	111.9096	888
	0.33	0.1699	13.125	29.2709	250
	0.6	0.3089	18.375	104.3107	350
	0.14	0.0721	64.995	304.5165	1238
	0.06	0.0309	70.245	152.4421	1338
	0.2	0.1030	3.3075	1.1266	63
	0.365	0.1879	8.5575	13.7629	163
	0.16	0.0824	78.8025	511.5910	1501
	0.025	0.0129	8.4	0.9083	160
	0.04	0.0206	87.2025	156.6177	1661
	0.1	0.0515	1.3125	0.0887	25
	0.03	0.0154	5.25	0.4258	100
	0.08	0.0412	93.765	362.1549	1786
	0.05	0.0257	3.3075	0.2816	63
	0.1	0.0515	97.0725	485.1939	1849
	0.15	0.0772	5.25	2.1288	100
	0.015	0.0077	5.25	0.2129	100
	0.06	0.0309	10.5	3.4061	200
	0.32	0.1648	107.5725	1906.6694	2049
	0.1	0.0515	112.8225	655.4119	2149
	0.1	0.0515	3.3075	0.5633	63
	0.27	0.1390	116.13	1874.8888	2212
	0.25	0.1287	121.38	1896.5189	2312
	0.06	0.0309	5.25	0.8515	100
	0.07	0.0360	5.25	0.9934	100
	0.1	0.0515	10.5	5.6768	200
	0.02	0.0103	5.25	0.2838	100
	0.04	0.0206	15.75	5.1091	300
	0.16	0.0824	5.25	2.2707	100
	0.1	0.0515	142.38	1043.8086	2712
	0.06	0.0309	5.25	0.8515	100
	0.1	0.0515	147.63	1122.2048	2812
	0.06	0.0309	5.25	0.8515	100
	0.1	0.0515	152.88	1203.4394	2912
	0.1	0.0515	156.1875	1256.0746	2975
	0.1	0.0515	13.125	8.8700	250
	0.1	0.0515	169.3125	1476.0495	3225
				14838.9363	

STATEMENT ;-2

Hourly Demand in Amps on the 11 KV feeder on a typical day in the month

Time in Hours	Current (1) Amps	(Current)2 (1)2
1.00	28	784
2.00	26	676
3.00	26	676
4.00	25	625
5.00	28	784
6.00	31	961
7.00	35	1225
8.00	33	1089
9.00	31	961
10.00	30	900
11.00	33	1089
12.00	36	1296
13.00	36	1296
14.00	35	1225
15.00	34	1156
16.00	34	1156
17.00	38	1444
18.00	65	4225
19.00	85	7225
20.00	55	3025
21.00	50	2500
22.00	43	1849
23.00	40	1600
24.00	35	1225
		38992

Loss Factor (L.F) = Total 2/(Max 2 * 24)= 0.224867359

5.1) LOSS CALCULATIONS OF 11KV FEEDERS IN VIZIANAGARAM TOWN

				Apr-14.				May-14.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	394720	349179	45541	11.54	330600	300568	30032	9.08	0.4Km 34sqmm conductor replaced with 55sqmm
2	B.Koneru	P & T - II (Gajularega)	T	602240	549701	52539	8.72	535920	503557	32363	6.04	0.8 Km 34sqmm conductor replaced with 55sqmm
3	B.Koneru	Town Feeder	T	736640	683092	53548	7.27	657280	610007	47273	7.19	
4	Indoor SS	TANKBAND	T	237220	216229	20991	8.85	212200	194383	17817	8.40	

5.1) LOSS CALCULATIONS OF 11KV FE

				Jun-14.					Jul-14.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	370880	330877	40003	10.79	Loss raised due to improper billing and commercial loss	323600	301524	22076	6.82	DPE Drive conducted and 0.5Km conductor replaced
2	B.Koneru	P & T - II (Gajularega)	T	586120	543315	42805	7.30	Loss raised due to improper billing and commercial loss	532320	502239	30081	5.65	DPE Drive conducted
3	B.Koneru	Town Feeder	T	726880	672817	54063	7.44		646400	610518	35882	5.55	0.5Km 34sqmm conductor replaced with 55sqmm
4	Indoor SS	TANKBAND	T	228600	209950	18650	8.16		190600	178911	11689	6.13	0.4 Km 34sqmm conductor replaced with 55sqmm

5.1) LOSS CALCULATIONS OF 11KV FE

				Aug-14.					Sep-14.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	305513	283516.5	21996.5	7.20		341720	320273	21447	6.28	0.2Km conductor replaced
2	B.Koneru	P & T - II (Gajularega)	T	564000	525661	38339	6.80	Loss raised due to commercial loss	568720	539670	29050	5.11	DPE Drive conducted
3	B.Koneru	Town Feeder	T	667760	625838	41922	6.28		650240	607303	42937	6.60	
4	Indoor SS	TANKBAND	T	206000	192181.5	13818.5	6.71		198000	183117	14883	7.52	Loss raised due to commercial loss

5.1) LOSS CALCULATIONS OF 11KV FE

				Oct-14.					Nov-14.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	334600	315376	19224	5.75		298440	279851	18589	6.23	
2	B.Koneru	P & T - II (Gajularega)	T	568160	529198	38962	6.86	Loss raised due to improper billing	554160	522738	31422	5.67	
3	B.Koneru	Town Feeder	T	598920	565044	33876	5.66	0.4 Km 34sqmm conductor replaced with 55sqmm	542120	514308	27812	5.13	
4	Indoor SS	TANKBAND	T	195800	182264	13536	6.91	DPE Drive conducted	181600	169999	11601	6.39	

5.1) LOSS CALCULATIONS OF 11KV FE

				Dec-14.					Jan-15.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	246280	231472	14808	6.01		215640	203044	12596	5.84	
2	B.Koneru	P & T - II (Gajularega)	T	477360	450481	26879	5.63		456320	429765	26555	5.82	
3	B.Koneru	Town Feeder	T	546480	517355	29125	5.33		448920	425242	23678	5.27	
4	Indoor SS	TANKBAND	T	82800	77801	4999	6.04		131600	124196	7404	5.63	

5.1) LOSS CALCULATIONS OF 11KV FE

				Feb-15.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	263760	245637	18123	6.87	Loss raised due to improper billing
2	B.Koneru	P & T - II (Gajularega)	T	524240	487925	36315	6.93	Loss raised due to improper billing
3	B.Koneru	Town Feeder	T	519440	490921	28519	5.49	
4	Indoor SS	TANKBAND	T	127200	120128	7072	5.56	

5.1) LOSS CALCULATIONS OF 11KV FE FY :- 2014-2015

				Mar-15.					Cummulative Up to MAR-15.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	295000	277861	17139	5.81		3720753	3439179	281574	7.57	Losses calculated for one year
2	B.Koneru	P & T - II (Gajularega)	T	553480	522603	30877	5.58		6523040	6106853	416187	6.38	
3	B.Koneru	Town Feeder	T	525280	495318	29962	5.70		7266360	6817763	448597	6.17	
4	Indoor SS	TANKBAND	T	178400	168305	10095	5.66		2170020	2017465	152556	7.03	

5.1) LOSS CALCULATIONS OF 11KV FE

				APR -15.					MAY-15.				
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss	Remarks	Input	Sales	Loss units	% Loss	Remarks
1	B.Koneru	P & T - I (Kothapeta)	T	354560	334428	20132	5.68		363120	342636	20484	5.64	
2	B.Koneru	P & T - II (Gajularega)	T	633520	595726	37794	5.97		624080	586401	37679	6.04	
3	B.Koneru	Town Feeder	T	636640	600110	36530	5.74		732520	694974	37546	5.13	
4	Indoor SS	TANKBAND	T	227800	216155	11645	5.11		193600	183855	9745	5.03	

5.1) LOSS CALCULATIONS OF 11KV FE FY :- 2015-2016

				Cummulative Up to MAY-15.			
SL NO	Name of the S/S	11 kV Feeder Name	Type of Feeder (T/M)	Input	Sales	Loss units	% Loss
1	B.Koneru	P & T - I (Kothapeta)	T	717680	677064	40616	5.66
2	B.Koneru	P & T - II (Gajularega)	T	1257600	1182127	75473	6.00
3	B.Koneru	Town Feeder	T	1369160	1295084	74076	5.41
4	Indoor SS	TANKBAND	T	421400	400010	21390	5.08

6. FEASIBILITY STUDY

6. Introduction: On the part of this project, 4 Nos 11KV feeders will be studied and the statistics data of the feeders like length of 11KV feeders and Distribution Transformers existing on that feeders and the materials used in the feeders are surveyed physically and then the reports were submitted on the losses of the each feeders in the previous chapters.

In this feasibility study, the line loss of the 11KV Kothapeta Feeder which is emanating from 33/11 KV B.Koneru SS was calculated with based on the conductor size. The energy losses calculated by using the Kelvin's law and also suggestions were made for replacement of conductor with proper size to reduce the energy losses.

Comparative Studies:

6.1) Technical Loss calculation of 11KV Kothapeta feeder with 34 SQmm Conductor
Month: MAY - 2015

Name of the Feeder : KOTHAPETA
Name of the sub station : 33/11KV B.KONERU
Name of the Section : D1, VIZIANAGARAM

1) Units sent out from the 11kv system during a particular month (30 days) = 363120

2) Average Demand = (363120) / (30*24*0.965) = 522.625

3) Peak Demand during the month (1.732*11*45) = 857.34 KVA

4) Load factor of the month =Average Demand / Peak Demand = 522.625 (1.732*11*45) = 0.609589213

<u>**Step:1**</u>

5) Distribution Transformer in the 11KV system - Number and Rating :

No	KVA	Total
0	250	0
0	200	0
1	160	160
11	100	1100
0	75	0
0	63	0
1	25	25
Total Transformers Capacity =		1285

6) Losses when the Demand is equal to total Transformer Capacity:

i) Transformer Iron Losses (ISI Specification)

No of DTRS	DTR Capacity(in KVA)	Iron Loss (Watts/Each)	Per	Total
0	250	1000	E	0
0	200	825	E	0
1	160	650	E	650
11	100	450	E	4950
0	75	385	E	0
0	63	350	E	0
1	25	195	E	195
Total Iron Loss (Watts) =				5795

ii) Transformer Copper losses:

No of DTRS	DTR Capacity(in KVA)	Copper losses (Watts/Each)	Per	Total Copper Losses(in Watts)
0	250	4500	E	0
0	200	3750	E	0
1	160	3000	E	3000
11	100	2000	E	22000
0	75	1600	E	0
0	63	1400	E	0
1	25	700	E	700
Total Copper Loss =				25700

11 KV side

250 KVA = 13.13 Amps --------------75 KVA =3.94 Amps
200 KVA = 10.5 Amps --------------63 KVA =3.30 Amps
160 KVA = 8.4 Amps -------------50 KVA = 2.62 Amps
100 KVA = 5.25 Amps -------------15 KVA = 0.79 Amps

11 KV Line Losses (as per Statement -1) 1752.7707 Watts
6(iii) Losses for 3
Conductors = 5258.312211 Watts

Step - II

7) Max Demand During the Month = 857.34 KVA
Total Transformer Capacity= 1285 KVA
Ratio of Max.Demand to the Transformer Capacity= Max. Demand / Total DTR Cap= 0.667190661

i)Transformer Copper Losses (Correct to M.D) = Item (6) (ii) * (Ratio)2 = 11440.18483

ii)Line Copper losses (Corrected M.D) = Item (6) (iii) * (ratio)2 = 2340.702864

Step-III

8) The Losses Calculated above have to be corrected to actual loading conditions by multiplying it with loss factor

i) Loss Factor Calculated according to the hourly meter Readings of a typical day in the month = 0.309510031

(As per the statement-2)

ii) Loss factor according to formulae loss factor = 0.8 (L.F)2 + 0.2* (L.F) 0.419

L.F - Load factor (4)

Loss Factor [8(i)] = 0.309510031

In Case the typical day meter readings are not available then the loss factor has to be calculated by the formulae given above.

i) Corrected transformer copper losses (actual loading condition) = 7 (i) * L.F = 3540.852

ii) Corrected line Copper losses (actual loading Conditions)= 7 (ii)* L.F = 724.471

9) (i) Units handled during the month (1) = 363120

Iron Losses [6 (i)] = 5795

Copper losses [8 (i)] = 3540.852

Losses [6 (i) + 8 (i)] = 9335.852

(ii) For one Month =Losses * 720 / 1000 = 6721.813 KWH

% Transformer Losses = [9 (ii) / 9 (i)] * 100 = 1.851

(iii) 11KV Line Losses 724.471

11KV Line losses per month = 8 (ii) * 720/1000 = 521.619

% 11 KV Line losses = [Losses per month / 9(i)] *100 = 0.144

10) (i) Units handled during the month (1) = 363120

Units billed = 342636

Actual losses in 11KV line , Transformer & L.T = Handled - Billed = 20484.000

(ii) L.T Distribution losses 13240.567

% L.T Distribution losses =[Losses per month] / 9(i)] * 100 - 3.646

%Technical +Comm Losses = [Total loss per month]/9(i)*100 5.641110377

STATEMENT : 1

11KV Line losses ;

Resistance of line =			
	0.365	Ohms/Km	100Sq,mm
	0.5149	Ohms/Km	55Sq.mm
	0.8506	Ohms/Km	34Sq.mm
	0.9116	Ohms/Km	7/2.59 ACSR
	1.37	Ohms/Km	7/2.11 ACSR

Section	Length in KM	Resistance in Ohms	Current (I)	Full load I2R Watts	KVA
	0.01	0.0085	5.25	0.2344	100
	0.01	0.0085	8.4	0.6002	160
	0.36	0.3062	13.65	57.0549	260
	0.05	0.0425	5.25	1.1722	100
	0.1	0.0851	5.25	2.3445	100
	0.1	0.0851	5.25	2.3445	100
	0.1	0.0851	29.4	73.5225	560
	0.1	0.0851	34.65	102.1249	660
	0.08	0.0680	5.25	1.8756	100
	0.1	0.0851	5.25	2.3445	100
	0.2	0.1701	45.15	346.7934	860
	0.11	0.0936	1.3125	0.1612	25

	0.1	0.0851	5.25	2.3445	100
	0.25	0.2127	6.5625	9.1581	125
	0.09	0.0766	51.7125	204.7194	985
	0.25	0.2127	56.9625	689.9911	1085
	0.1	0.0851	5.25	2.3445	100
	0.065	0.0553	62.2125	213.9903	1185
	0.04	0.0340	5.25	0.9378	100
	0.01	0.0085	67.4625	38.7124	1285
				1752.7707	

STATEMENT ;-2

Hourly Demand in Amps on the 11 KV feeder on a typical day in the month

Time in Hours	Current (1) Amps	(Current)2 (1)2
1.00	15	225
2.00	13	169
3.00	12	144
4.00	12	144
5.00	15	225
6.00	20	400
7.00	22	484
8.00	20	400
9.00	18	324
10.00	14	196
11.00	15	225
12.00	15	225
13.00	16	256
14.00	16	256
15.00	15	225
16.00	15	225
17.00	18	324
18.00	25	625
19.00	36	1296
20.00	28	784
21.00	27	729
22.00	27	729
23.00	24	576
24.00	21	441
		9627

Loss Factor (L.F) = Total 2/(Max 2 * 24)= 0.309510031

6.2Technical Loss calculation of 11KV Kothapeta feeder with 55 SQmm Conductor
Month: MAY - 2015

Name of the Feeder : KOTHAPETA

Name of the sub station : 33/11KV B.KONERU
Name of the Section : D1, VIZIANAGARAM

1) Units sent out from the 11kv system during a particular month (30day) = 363120

2) Average Demand = (363120) / (30*24*0.965) = 522.625

3) Peak Demand during the month (1.732*11*45) = 857.34 KVA

4) Load factor of the month =Average Demand / Peak Demand = 522.625 /(1.732*11*45) = 0.60958921

Step:-1

5) Distribution Transformer in the 11KV system - Number and Rating :

No	KVA	Total
0	250	0
0	200	0
1	160	160
11	100	1100
0	75	0
0	63	0
1	25	25
Total Transformers Capacity =		1285

6) Losses when the Demand is equal to total Transformer Capacity:

i) Transformer Iron Losses (ISI Specification)

No of DTRS	**DTR Capacity(in KVA)**	**Iron Loss (Watts/Each)**	**Per**	**Total**
0	250	1000	E	0
0	200	825	E	0
1	160	650	E	650
11	100	450	E	4950
0	75	385	E	0
0	63	350	E	0
1	25	195	E	195
Total Iron Loss (Watts) =				5795

ii) Transformer Copper losses:

No of DTRS	DTR Capacity(in KVA)	Copper losses (Watts/Each)	Per	Total Copper Losses(in Watts)
0	250	4500	E	0
0	200	3750	E	0
1	160	3000	E	3000
11	100	2000	E	22000
0	75	1600	E	0
0	63	1400	E	0
1	25	700	E	700
	Total Copper Loss =			25700

11 KV side

250 KVA = 13.13 Amps --------------75 KVA =3.94 Amps
200 KVA = 10.5 Amps ---------------63 KVA =3.30 Amps
160 KVA = 8.4 Amps -------------50 KVA = 2.62 Amps
100 KVA = 5.25 Amps -------------15 KVA = 0.79 Amps

11 KV Line Losses (as per Statement -1) 1061.0177 Watts
6(iii) Losses for 3
Conductors = 3183.053089 Watts

Step -II

7) Max Demand During the Month = 857.34 KVA
Total Transformer Capacity= 1285 KVA
Ratio of Max.Demand to the Transformer Capacity = Max. Demand / Total Trans Capacity= 0.66719066

i)Transformer Copper Losses (Correct to M.D)=Item (6) (ii) * (Ratio)2 = 11440.1848

ii)Line Copper losses (Corrected M.D) = Item (6) (iii) * (ratio)2 = 1416.91501

Step-III

8) The Losses Calculated above have to be corrected to actual loading conditions by multiplying it with loss factor

i) Loss Factor Calculated according to the hourly meter Readings of a typical day in the month = 0.30951003
(As per the statement-2)

ii) Loss factor according to formulae loss factor = 0.8 (L.F)2 + 0.2* (L.F) 0.419

L.F - Load factor (4)
Loss Factor [8(i)] = 0.30951003

In Case the typical day meter readings are not available then the loss factor has to be calculated by the formulae given above.

i) Corrected transformer copper losses (actual loading condition) = 7 (i) * L.F = 3540.852

ii) Corrected line Copper losses (actual loading Conditions)= 7 (ii)* L.F = 438.549

9) (i) Units handled during the month (1) = 363120
Iron Losses [6 (i)] = 5795
Copper losses [8 (i)] = 3540.852
Losses [6 (i) + 8 (i)] = 9335.852

(ii) For one Month =Losses * 720 / 1000 = 6721.813 KWH
% Transformer Losses = [9 (ii) / 9 (i)] * 100 = 1.851

(iii) 11KV Line Losses 438.549
11KV Line losses per month = 8 (ii) * 720/1000 = 315.756
% 11 KV Line losses = [Losses per month / 9(i)] *100 = 0.087

10) (i) Units handled during the month (1) = 363120
Units billed = 342636
Actual losses in 11KV line , Transformer & L.T = Handled - Billed
= 20484.000

(ii) L.T Distribution losses 13446.431

% L.T Distribution losses =[Losses per month] / 9(i)] * 100 - 3.703

%Technical +Comm Losses = [Total loss per month]/9(i)*100 5.64111038

STATEMENT : 1

11KV Line losses ;
Resistance of line
= 0.365 Ohms/Km 100Sq,mm
0.5149 Ohms/Km 55Sq.mm
0.9116 Ohms/Km 7/2.59 ACSR
1.37 Ohms/Km 7/2.11 ACSR

Section	Length in KM	Resistance in Ohms	Current (I)	Full load I2R Watts	KVA
	0.01	0.0051	5.25	0.1419	100
	0.01	0.0051	8.4	0.3633	160
	0.36	0.1854	13.65	34.5375	260
	0.05	0.0257	5.25	0.7096	100
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	5.25	1.4192	100
	0.1	0.0515	29.4	44.5059	560
	0.1	0.0515	34.65	61.8201	660
	0.08	0.0412	5.25	1.1354	100
	0.1	0.0515	5.25	1.4192	100
	0.2	0.1030	45.15	209.9270	860
	0.11	0.0566	1.3125	0.0976	25
	0.1	0.0515	5.25	1.4192	100
	0.25	0.1287	6.5625	5.5437	125
	0.09	0.0463	51.7125	123.9243	985
	0.25	0.1287	56.9625	417.6774	1085
	0.1	0.0515	5.25	1.4192	100
	0.065	0.0335	62.2125	129.5363	1185
	0.04	0.0206	5.25	0.5677	100
	0.01	0.0051	67.4625	23.4341	1285
				1061.0177	

STATEMENT ;-2

Hourly Demand in Amps on the 11 KV feeder on a typical day in the month

Time in Hours	Current (1) Amps	(Current)2 (1)2
1.00	15	225
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5.00	15	225
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18.00	25	625
19.00	36	1296
20.00	28	784
21.00	27	729
22.00	27	729
23.00	24	576
24.00	21	441
		9627

Loss Factor (L.F) = Total 2/(Max 2 * 24
)= 0.309510031

RESULTS

6.3) Saving of Energy due to Providing of second LT Circuit :-

If One Circuit Carries 80 Amps current

Then Copper losses in the Circuit will be(I*I*R) = 80*80*0.5149 = 9695 Watts

Then energy Loss Per month will be =(9.6*720)/1000 = 6.912 KWH

If the second circit was run and some load was diverted on that feeder

let load on the first circuit = 50A

let load on the second circuit = 30A

Then Copper losses on the first Circuit will be(I*I*R) = 50*50*0.5149 = 1287 Watts

Then Copper losses on the second Circuit will be(I*I*R) = 30*30*0.5149 = 463 Watts

Total Losses due to Both the circuits will be = 1287 Watts + 463 Watts = 1750 Watts

Then energy Loss Per month will be =(1.75 *720)/1000 = 1.26 KWH

Then Saving of energy per month after run the second circuit will be = 6.912 - 1.26 = 5.652 KWH

6.4) Saving of Energy due to conductor replacement

In Kothapeta feeder when ever the conductor was 34 Sqmm Size the losses due to conductor was 5258 Watts then per month it will become = (5258) *720/1000 Units = 3785 units

In Kothapeta feeder when ever the conductor was 55 Sqmm Size the losses due to conductor was 3183 Watts then per month it will become = (3183) *720/1000 Units = 2291 units

Then Saving of Units per month due to conductor replacement was = (3785 - 2291) = 1494 Units

Amount Saved per month due to replacement of conductor was = 1494* Rs 3.82 = Rs 5707/-

Total Expenditure on Replacement of coductor

Length of the line		2 Km
55 Sq mm Conductor required		6 Km
Cost of the 6 Km Conductor (Rs19086/- per Km)	Rs	114516
Labour Charges for relacing the 6KM Conductor (Rs 1785/-per KM)		10710
Total Expenditure on Replacement of coductor		125226

Revenue Return due to conductor replacemet

Amount Saved per month due to replacement of conductor was = Rs 5707/-

In No of Months the amount of expenditure for conductor replacement was returned = Rs 125226/ Rs 5707 = 22 Months

7. CONCLUSION :-

1) From the above it is observed that by providing of 2nd LT Circuit the saving of energy is 5.652 KWH per month.

2) It is also observed that by replacing the 34 sqmm conductor on 11KV Kothapeta feeder with 55 Sqmm conductor the saving of energy is 1494 units per month.

3) Amount Saved per month due to replacement of conductor was Rs 5707/-.

4) And also observed that amount of expenditure for conductor replacement was returned in 22 months.

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