FORUM OF REGULATORS (FOR)

REPORT ON

"LOSS REDUCTION STRATEGIES"

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EXECUTIVE SUMMARY

A high level of losses in the distribution system has been a matter of concern for the electricity regulators. The National Electricity Policy and the Tariff Policy framed under the Electricity Act, 2003, lay the roadmap and action plan for various stakeholders to make concerted efforts towards reduction of losses.

In compliance with the policies and the Act regarding loss reduction strategies, some utilities have taken steps towards: (i) AT&C loss reduction; (ii) High Voltage Distribution System (HVDS), Supervisory Control and Data Acquisition System (SCADA) and database management; (iii) energy audit and third party verification of technical and financial data; and (iv) incentive and disincentive scheme linked to performance on loss reduction etc.

The Forum of Regulators (FOR) has been deliberating on issues specific to loss reduction strategies on a regular basis. In its meeting held in June 2008, the Forum felt the need to review the steps taken in various states and address the issues which required clarification so as to evolve consensus and uniformity on approach to the methodology adopted for loss reduction. The Forum thus constituted a Working Group consisting of chairpersons of a few State Commissions with the mandate to examine all such issues in detail and present a report before the Forum. The Group submitted its report which was considered by the FOR in its meeting held in September, 2008.

The report as adopted by the Forum examines in detail the various legal and policy provisions in this context and their implementation status. The report also reviews the best practices in this regard based on the interaction with stakeholders. The report identifies the important issues in terms of evolving a strategy for loss reduction, namely (i) the definition of distribution loss and the method of computation of AT&C loss; (ii) segregation of technical and commercial loss; (iii) compilation of baseline data; (iv) third party verification of data and energy audit; (v) methodology for achieving loss reduction in a time-bound manner; and (vi) relative appropriateness of technical solutions etc. The report also deliberates on: (i) the technical interventions made by different states/utilities; (ii) theft control measures; and (iii) suitable incentive/disincentive scheme for rewarding/penalizing the areas with low/high loss levels etc.

After identification and examination of issues, the report strongly recommends that transmission losses should not be clubbed with distribution losses and for correct AT&C loss estimation, it is essential that losses should be segregated into technical and non-technical (commercial) losses. The report places emphasis on third party verification of the technical and financial data submitted by the utility, and on compilation of baseline data for energy accounting and audit. The State Electricity Regulatory Commissions (SERCs) need to pay special attention to systematic estimation of the energy supplied to un-metered agricultural consumers. The report also suggests that the trajectory for loss reduction should be determined keeping in view the actual loss levels, the capital expenditure made in the past for improving the network and the future capital expenditure plans. Though the technical and commercial losses should be monitored

separately, the trajectory could give a combined target for technical and commercial losses in the first control period of multi-year tariff (MYT). The report also recommends that the pay back period and life cycle cost analysis should be carried out for selecting the appropriate technological intervention aimed at reducing the technical losses. It specifically recommends that the segregation of feeder for agriculture supply should be resorted to especially in states where the proportion of supply to agriculture sector is substantial. The report also suggests that under-achievement of the loss reduction target should be borne by the licensee and recommends that the SERCs may also encourage suitable local area based incentive and disincentive schemes for the staff of the utilities linked to reduction in losses.

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CHAPTER - 1

INTRODUCTION

1.1 In its meeting held on June13, 2008 at New Delhi, FOR deliberated on the issues involved in loss reduction strategies with specific reference to the provisions of the Electricity Act, 2003, the National Electricity Policy and the Tariff Policy. The Forum reviewed the steps taken by various State Commissions in this regard and felt that there were a number of issues which demanded detailed examination. It constituted a Working Group consisting of chairpersons of State Commissions with the mandate to examine all such issues in detail and submit a report before the Forum within a period of three months.

1.2 See **APPENDIX-I** for the order constituting the Working Group.

1.3 The mandate for the Working Group was :

- The suggested methodology for achieving loss reduction in a time-bound manner;
- relative appropriateness of technical solutions, such as separation of agricultural supply feeders, single phase supply, HVDS etc.,
- development of baseline data and its verification by a third party;
- suitable incentive/disincentive schemes for rewarding/penalizing the areas with low/high loss levels; and
- any other relevant issue.

CHAPTER - 2

APPROACH

2.0 Approach

The Working Group adopted the following approach to understand the issues relating to loss reduction strategies:

2.1 ***Review of provisions in the Electricity Act, 2003:*** The starting point of deliberations in the Working Group was the review of the relevant provisions in the Electricity Act, 2003, the National Electricity Policy and the Tariff Policy with specific reference to issues relating to loss reduction. The Group also reviewed the provisions relating to metering, energy audit and accounting, treatment of losses for the purpose of tariff, third party verification of energy audit, technological intervention suggested for reduction of losses, etc.

2.2 ***Status of implementation of the provisions of the Act, National Electricity Policy and Tariff Policy:*** The Group reviewed the status of implementation of the various provisions of the Electricity Act, National Electricity Policy and Tariff Policy, especially the initiatives taken by the State Commissions in inducing the utilities to take steps for loss reduction. A detailed status was compiled on the actions taken by SERCs to lay down a time-bound programme for AT&C loss reduction, status of implementation of technological and scientific interventions such as HVDS, SCADA, database management in various states, status of energy

audit, third party verification of technology and financial data, incentive/disincentive schemes linked to performance on loss reduction etc.

2.3 ***Review of state of affairs on losses:*** The Group also reviewed the state of affairs on losses in various states. It relied on the various orders passed by SERCs for compiling data in this regard. The various reports, namely the draft report by the Power Finance Corporation (PFC), and the P. Abraham Committee Report were also looked into by the Group for the purpose of understanding the extent of loss reduction.

2.4 ***Interaction with stakeholders:*** The Group interacted with various stakeholders to gain first-hand experience of the issues at stake. It had the advantage of the Central Electricity Authority (CEA) being associated with the deliberations, as a special invitee and relied on various inputs received from CEA, especially on energy audit and strategy for segregation of losses. This helped the Group in appreciating the issues involved before finalizing the recommendations.

2.5 ***Review of best practices:*** Based on the interaction with the stakeholders and review of various orders of SERCs and reports available on the subject, the Group endeavored to collect information on the best practices on some specific issues. These included feeder renovation programme, steps taken towards separation of feeders, incentive/disincentive schemes linked to performance of loss reduction etc.

2.6 ***Identification of issues:*** The Group identified the issues based on the above approach and made recommendations after taking into account the vision of the Act and policies, constraints involved in ensuring loss reduction etc.

CHAPTER - 3

PROVISIONS IN THE ACT AND POLICIES

3.0 Provisions in the Act and Policies

3.1 The Group, with due regard to its terms of reference, adopted the following approach to arrive at conclusions and recommendations on the specific issues referred to it for detailed examination and findings:

3.2 Recapitulation of provisions in the Electricity Act, 2003, the National Electricity Policy and the Tariff Policy

3.2.1 The Group took note of the specific provisions in the Electricity Act, National Electricity Policy and Tariff Policy pertaining to loss reduction. The relevant provisions in the Electricity Act, 2003 on metering and energy accounting, which were considered an important tool of measuring accurate consumption and ensuring discipline in terms of usage of electricity, are quoted below:

"Section 55. (Use, etc., of meters): *--- (1) No licensee shall supply electricity, after the expiry of two years from the appointed date, except through installation*

of a correct meter in accordance with the regulations to be made in this behalf by the Authority:

Provided that the licensee may require the consumer to give him security for the price of a meter and enter into an agreement for the hire thereof, unless the consumer elects to purchase a meter:

Provided further that the State Commission may, by notification, extend the said period of two years for a class or classes of persons or for such area as may be specified in that notification.

(2) For proper accounting and audit in the generation, transmission and distribution or trading of electricity, the Authority may direct the installation of meters by a generating company or licensee at such stages of generation, transmission or distribution or trading of electricity and at such locations of generation, transmission or distribution or trading , as it may deem necessary.

(3) If a person makes default in complying with the provisions contained in this section or the regulations made under sub-section (1), the Appropriate Commission may make such order as it thinks fit for requiring the default to be made good by the generating company or licensee or by any officers of a company or other association or any other person who is responsible for its default."

" Section 62. (Determination of tariff*): --- (1) ……*

(2) ……

(3) The Appropriate Commission shall not, while determining the tariff under this Act, show undue preference to any consumer of electricity but may differentiate according to the consumer's load factor, power factor, voltage, total consumption of electricity during any specified period or the time at which the supply is required or the geographical position of any area, the nature of supply and the purpose for which the supply is required."

3.2.2 The National Electricity Policy and the Tariff Policy deal with this issue on loss reduction extensively. The relevant provisions in the National Electricity Policy are reproduced below:

"5.4.4 ……. Multi-Year Tariff (MYT) framework is an important structural incentive to minimize risks for utilities and consumers, promote efficiency and rapid reduction of system losses..... Private sector participation in distribution needs to be encouraged for achieving the requisite reduction in transmission and distribution losses and improving the quality of service to the consumers.

5.4.6 A time-bound programme should be drawn up by the State Electricity Regulatory Commissions (SERCs) for segregation of technical and commercial losses through energy audits. Energy accounting and declaration of its results in

each defined unit, as determined by SERCs, should be mandatory not later than March 2007. An action plan for reduction of the losses with adequate investments and suitable improvements in governance should be drawn up. Standards for reliability and quality of supply as well as for loss levels shall also be specified, from time to time, so as to bring these in line with international practices by year 2012.

5.4.11 High Voltage Distribution System is an effective method for reduction of technical losses, prevention of theft, improved voltage profile and better consumer service. It should be promoted to reduce LT/HT ratio keeping in view the techno economic considerations.

5.6.1…… Application of IT has great potential in reducing technical & commercial losses in distribution and providing consumer friendly services."

3.2.3 The Tariff Policy issued under the Act also provides a roadmap and suggests methodologies for factoring the Aggregate Technical and Commercial (AT&C) losses in computation of tariff. The relevant provisions of the Tariff Policy are reproduced below:

"8.2.1 The following aspects would need to be considered in determining tariffs:

(1) All power purchase costs need to be considered legitimate unless it is established that the merit order principle has been violated or power has been

purchased at unreasonable rates. The reduction of Aggregate Technical & Commercial (AT&C) losses needs to be brought about but not by denying revenues required for power purchase for 24 hours supply and necessary and reasonable O&M and investment for system upgradation. Consumers, particularly those who are ready to pay a tariff which reflects efficient costs have the right to get uninterrupted 24 hours supply of quality power. Actual level of retail sales should be grossed up by normative level of T&D losses as indicated in MYT trajectory for allowing power purchase cost subject to justifiable power purchase mix variation (for example, more energy may be purchased from thermal generation in the event of poor rainfall) and fuel surcharge adjustment as per regulations of the SERC.

(2) AT&C loss reduction should be incentivised by linking returns in a MYT framework to an achievable trajectory. Greater transparency and nurturing of consumer groups would be efficacious. For government owned utilities improving governance to achieve AT&C loss reduction is a more difficult and complex challenge for the SERCs. Prescription of a MYT dispensation with different levels of consumer tariffs in succeeding years linked to different AT&C loss levels aimed at covering full costs could generate the requisite political will for effective action to reduce theft as the alternative would be stiffer tariff increases. Third party verification of energy audit results for different areas/localities could be used to impose area/locality specific surcharge for greater AT&C loss levels and this in turn could generate local consensus for effective action for better governance.

The SERCs may also encourage suitable local area based incentive and disincentive scheme for the staff of the utilities linked to reduction in losses.

The SERC shall undertake independent assessment of baseline data for various parameters for every distribution circle of the licensee and this exercise should be completed latest by March, 2007.

The SERC shall also institute a system of independent scrutiny of financial and technical data submitted by the licensees. As the metering is completed up to appropriate level in the distribution network, latest by March, 2007, it should be possible to segregate technical losses. Accordingly technical loss reduction under MYT framework should then be treated as distinct from commercial loss reduction which requires a different approach."

CHAPTER - 4

IMPLEMENTATION OF THE PROVISIONS IN THE ACT AND POLICIES

4.0 Status of implementation of the provisions in the Act and Policies

4.1 The Electricity Act, 2003 makes elaborate provisions of ensuring that all electricity supplied be metered within a stipulated timeframe. The Group noted that un-metered supply had been one of the factors responsible for high loss levels in the country. The agricultural supply in various states remained un-metered and as such it became difficult to compute accurately the loss reduction level in the utility. The provisions in section 55 of the Act mandating metered supply within a stipulated timeframe and also the requirement of energy accounting and audit are important inducements to reduction of losses. The status on metering in various states is given in **APPENDIX -II**.

4.2 The National Electricity Policy and the Tariff Policy have laid down special emphasis on the need for concerted efforts towards review of losses. The policies also make some suggestion on loss reduction strategies and suggested

methodology for factoring the losses for the purpose of tariff determination. The policies lay special emphasis on the following areas:

4.2.1 Need for a time-bound programme on AT&C loss reduction by SERCs.

4.2.2 Need for intervention like HVDS, SCADA and database management.

4.2.3 Energy audit and third party verification of technical and financial data.

4.2.4 Incentive and disincentive schemes linked to performance on loss reduction.

The status on each of these issues are given in **APPENDIX-III, IV, V &VI**.

CHAPTER - 5

Loss Reduction Strategy in States: Review

5.0 Review of loss reduction in states

5.1 The Group endeavored to assess the extent of loss reduction in various states. Most SERCs covered this extensively in their annual tariff order. In general, targets were set for loss reduction. When the tariff is issued for a particular year, the actual achievement by the utilities vis-à-vis the target set is reviewed by the Commissions and allowances on account of such losses are allowed against the targets set.

5.2 The Committee constituted by the Government of India under the chairmanship of Shri P. Abraham, former Secretary (Power) in its study on 'Restructuring of Accelerated Power Development and Reforms Programme' focuses on the issue of loss reduction and links the release of funds to the Accelerated Power Development and Reforms Programme (APDRP) with the attainment of the target of loss reduction. (See **APPENDIX-VII** for the status of AT&C losses in various states according to the Abraham Committee Report.)

5.3 The PFC also publishes Report on the Performance of the State Power Utilities.

CHAPTER - 6

INTERACTION WITH STAKEHOLDERS

6.0 Interaction with stakeholders

6.1 The Group had the advantage of associating with the CEA, which was a special invitee. Various technical inputs as well as the work done by CEA on the strategies for segregation of technical and commercial energy losses in the distribution system, and energy audit were made available to the Committee for better appreciation of the issues at stake.

6.2 The detailed note provided by the CEA on two specific issues (segregation of losses and energy audit) are given in **APPENDIX- VIII and IX.**

6.3 The Group also interacted with those utilities which have taken important steps towards reduction of losses. For instance, the Madhya Gujarat Vij Company Ltd. was invited to make a presentation on the steps taken by the utility for reduction of losses especially in rural areas. The Jaipur Vidyut Vitran Nigam Ltd. was asked to make a presentation on the feeder renovation programme undertaken by the utility. The WBEDCL was requested to share experience on the loss reduction strategy and incentive/disincentive scheme in West Bengal.

6.4 Such an interaction gave the Group an idea of the state of affairs on the ground and helped formulate its views.

CHAPTER - 7

REVIEW OF BEST PRACTICES

7.0 Review of best practices

Based on the interaction with stakeholders and the data and information available on the websites of the utilities and Regulatory Commissions, the Group endeavoured to find out the best practices on specific issues relating to loss reduction. In this regard, the following practices and success stories were compiled:

a) Pilot studies carried out in Andhra Pradesh on methodologies for assessing load served on the basis of un-metered supply (**APPENDIX- X**).

b) Paper issued by the Madhya Pradesh Electricity Regulatory Commission (MPERC) (**APPENDIX - XI**).

c) Incentive/disincentive scheme of Maharashtra (**APPENDIX - XII**).

d) Feeder renovation programme at Jaipur (**APPENDIX - XIII**).

CHAPTER - 8

IDENTIFICATION AND ANALYSIS OF ISSUES

8.0 Identification and Analysis of Issues

The Group, based on the detailed study highlighted in the previous chapters, identified the important issues in order to evolve a strategy for loss reduction.

8.1 Definition of loss: AT&C loss or T&D loss

The Group found that the definition of loss varied from state to state. Two expressions, namely Aggregate Technical and Commercial (AT&C) loss and Transmission and Distribution (T&D) loss were generally being used. The method of computation of AT&C loss or T&D loss also varied.

8.1.1 AT&C loss is basically the difference between energy input and energy for which revenue is realized after accounting for collection efficiency and it is to this extent that it differs from T&D loss. T&D loss takes into account the losses in the T&D system including commercial loss up to the point of billing and does not take into account the units for which revenue is actually collected or realized.

8.1.2 The Group deliberated on the issue and reached the consensus that the transmission losses should not be clubbed with distribution losses in order to have a clear focus on reduction of the distribution losses. Therefore, the State Commissions should deal with distribution losses separately and the practice of

clubbing transmission losses and distribution losses needed to be immediately discontinued. The Group reiterated the need for drawing up a roadmap by each SERC for ensuring installation of meters at the premises of all categories of consumers in a time-bound manner.

8.1.3 The Group agreed that AT&C loss should be adopted as the measure for monitoring the distribution losses till the time metering was completed. However, while computing the AT&C loss figure, there is a need for differential analysis of technical losses, non-technical losses and collection efficiency. AT&C loss should be calculated by subtracting the energy realized from the energy input where energy realized should be equal to the product of energy billed and collection efficiency (collection efficiency being the ratio of amount collected to the amount billed). The Group also agreed with the suggestion of CEA that while calculating the energy input, the energy traded should be excluded. Further, it should be ensured that the methodology for computing the AT&C loss figure should exclude the disputed amount (amounts which are disputed in any forum including courts etc.) from the demand raised for calculation of collection efficiency. In accordance with para 8.2.1 (iv) of the Tariff Policy, the collection efficiency should take into account provision for bad debts as per the policies developed and subject to the approval of the State Commission. (See Annexure-XIV for an explanation of the recommended method of calculating the AT&C loss, which is on lines of the method suggested by CEA.)

8.2 Segregation of technical and commercial loss

8.2.1 The Group felt that for correct AT&C loss estimation, it was essential that losses were segregated into technical and non-technical (commercial) losses. Such segregation of loss was in fact, the starting point of energy accounting and audit.

8.2.2 To segregate the losses, the first step should be to compute the technical losses. The technical losses so computed should be subtracted from the total energy loss at the distribution network (i.e. from AT&C loss) to derive the commercial loss.

8.2.3 There are different ways of computing technical losses. As suggested by CEA, one method could be to compute technical losses - at Extra High Voltage (EHV) system (33 kV network of the distribution utility), at 11 kV system and at distribution transformer (DT) level.

8.2.3.1 Technical loss in the EHV system (33 kV and above system) of a Distribution Company (DISCOM) can be calculated as the difference of energy recorded by the energy meters at the injection points and the energy sent out. Before computing such losses, it should be ensured that metering deficiencies have been rectified.

8.2.3.2 Technical losses at 11 kV system can be computed as the difference between energy input at the 11kV system and energy billed to 11kV consumers plus the energy sent out to LV systems. Even at this stage, that is, at 11kV system, commercial losses should first be eliminated by better metering and supervision by the licensee. Technical losses so determined can be corroborated by a sample study of 11kV system.

- Alternatively, 11kV feeders having no commercial losses consistently should be identified and technical losses in such feeders may be arrived at as the difference between the sending end energy and receiving end energy at the consumer end plus energy recorded at the LV side of DTs.

8.2.4 The technical losses in the distribution network could also be estimated by computer aided system studies through simulation of the network equipment. This would involve/require inter alia network mapping, load data, load flow analysis at different voltage levels etc. Software is available in the market for system studies and load flow analysis. Estimation of losses in LT network may be done initially for sample network emanating from representative DTs covering different categories of consumers and load density. The methodology for estimation of technical loss through this method has been explained by CEA in **APPENDIX-IX**.

8.2.5 The non-technical (commercial) loss should be calculated as the difference between the total energy loss (AT&C loss) and the technical loss computed by following the method as explained above.

8.3 Baseline data, third party verification of data and energy audit

8.3.1 The Group felt that after segregation of the technical and non-technical loss, base line data should be compiled for each electricity division. The Group also noted that third party verification of the technical and financial data submitted by the utility was crucial, before such data was taken into account for the purpose of determination of tariff.

8.3.2 Compilation of baseline data is the starting point for energy accounting and audit. While energy accounting gives the overall picture of energy availability and its use, energy audit enables analysis of data in a meaningful manner to evolve a measure to: (i) introduce checks and balances in the system; (ii) reduce distribution losses; and (iii) improve technical performances of all elements of the distribution network. Energy audit at the sub-station level and DT level has to start from DTs to 11kV feeders to 33/11kV sub-stations of the entire area selected for auditing. Energy audit should be undertaken to calculate the difference between the DT-wise energy sent out and total of all the consumers' consumption. (A detailed note prepared by the CEA in this regard is given in **APPENDIX-VIII**.)

8.4 Methodology for achieving loss reduction in a time-bound manner

8.4.1 State Commissions have generally been providing a trajectory for loss reduction in their respective tariff orders. The Group felt that the trajectory for loss reduction should be determined keeping in view the actual loss levels, the capital expenditure made in the past for improving the network infrastructure, and the future capital expenditure plans for the purpose. This was important keeping in view the Orissa experience, where the loss level allowed in tariff at the beginning of the reforms process was much below the actual loss level and this completely distorted the revenue requirement and the utility went into a perennial loss.

8.4.2 Once the actual loss level has been identified by following the methodology suggested above, a trajectory for loss reduction could be specified and followed rigorously.

8.4.3 The Working Group also noted the resolution of the Chief Ministers' Conference on Power held in May 2007 which had resolved to achieve and sustain drastic reduction in the overall AT&C losses over the next five years, and at least to a level of 15 percent in the APDRP project areas. It was generally felt that, as a rule of thumb, reduction of loss level should be at least 10 percent of the existing loss levels every year till the losses are reduced below 20 percent. The actual loss levels at the beginning of the MYT trajectory should be scientifically established on the basis of a separate study for every licensee. In this context the Group referred to the judgment of the Appellate Tribunal in the case relating to Reliance Energy.

8.4.4 Though the technical and commercial losses should be monitored separately, the trajectory could give a combined target for technical and commercial losses in the first control period of MYT. The MYT trajectory has to be specific to every distribution licensee and preferably the same should be specified by the SERC as part of its regulations.

8.4.5 In view of the fact that the trajectory for loss reduction will be specified, inter alia, keeping in view the capital expenditure plans, the monitoring of capital expenditure should invariably be linked to loss reduction achieved, project-wise and division-wise.

8.5 Relative appropriateness of technical solutions

8.5.1 The technological interventions being adopted in some states for reduction of AT&C loss were examined. The suggested strategies for reduction in technical losses, theft control, metering, billing process, collection process, new connection process, revenue recovery process etc., involving both technical and other interventions, have been discussed in detail in **APPENDIX- XV**.

8.5.2 The Group observed that pay back period and life cycle cost analysis should be carried out for selecting the appropriate technological intervention aimed at reducing technical losses. The Group also recognized that HVDS was expensive and required larger safety clearance and as such recommended that this system would be more appropriate for areas where Low Tension (LT) to High Tension (HT) ratio was poor, for rural areas and for areas having low connection density. In other areas LT Aerial Bunched Conductor (ABC) conductors might be used for controlling theft.

8.5.3 The Group also agreed that the load balancing of feeders had also been proved useful in reducing technical losses. There was a general view that the cost of sophisticated metering should not be passed on to an individual consumer and the same should be recovered through the Aggregate Revenue Requirement (ARR).

8.5.4 ***Technical Interventions for Urban Supply:***

8.5.4.1 Punjab was reported to have used low-cost techniques to reduce loss. It was brought to the notice of the Group that the utility reduced loss significantly by

putting the meter outside the premise or in the poles outside the premise. (See **APPENDIX- XVI**.)

8.5.4.2 Delhi has also used various technical interventions which have led to significant reduction of distribution losses in the state. The measures adopted include: (i) replacing and revamping old equipment – Ring Main Unit's (RMU's) installation; (ii) improvement in system reliability by regular maintenance of feeders and transformers / creating N-1 network redundancy; (iii) LT ABC, HVDS and system augmentation for meeting growth requirements; (iv) remote LT load shedding in high loss areas; (v) Global System for Mobile (GSM) based switching of street lighting; (vi) automation / installation of SCADA for operating and controlling entire power system network at 66 kV, 33 kV and 11 kV; (vii) GIS mapping; and (viii)automated grids for speedy resolution of faults, etc.

8.5.4.3 In Jaipur key technical interventions under the Urban Focus Programme included: (i) segregation of urban feeders from rural feeders; (ii) replacement of slow and sluggish meters by push-fit type meters; and (iii) replacement of overhead bare conductors by insulated wires in theft prone areas, etc. (See - XVII.)

8.5.4.4 The experiences of West Bengal have also been impressive. Measures have been taken for loss reduction with minimal investment and minimum impact on tariff. This involved installation of capacitors, rationalization of 11 kV feeders, conversion of 6.6kV or 6kV system to 11kV system and use of AB

cable, installation of smaller capacity DTs, DT phase balancing, etc. (See **APPENDIX- XVIII**.)

8.5.5 ***Technical Interventions for Rural Supply***

8.5.5.1 In Jaipur (Rajasthan) a feeder renovation program was undertaken with the objective of: (i) reducing distribution losses on 11kV feeders to a level below 15 percent; (ii) improving quality of power supply; and (iii) making available 24-hour domestic and non-domestic single phase supply in rural areas so as to remove disparity between urban and rural areas. The domestic and agricultural supply system was segregated and the technical interventions supported by investments were made for preventing theft of electricity and consequently reducing commercial losses. The program has yielded revealing results. The DT burning rate has reduced substantially. Theft of electricity by hooking, tampering of meters and bypass of meters has declined in the Jaipur District Circle. The T&D loss has been reduced by 8.66 percent in the last two years, and 12,874 villages out of 13,147 electrified villages have been given 24-hour supply of electricity. The feeder renovation program is also being carried out in other two DISCOMS namely, DISCOMS of Ajmer and Jodhpur. As a result of the program, the T&D losses of the State of Rajasthan have been reduced by 10.13 percent during 2006-07 and 2007-08. (See **APPENDIX-XIII**.)

8.5.5.2 The Gujarat model of loss reduction also relied on technological – macro level as well as micro level – interventions. The Group noted that the Jyoti Gram Yojana (JGY) was launched in the state as an effort for `Load Management

and Regulation of Agricultural Consumption'. Three phase quality power supply for 24 hours was made available to all the villages and all suburbs attached to the villages of Gujarat for non-agricultural activities while ensuring improved quality power supply to agriculture. This resulted in bringing about reduction in distribution loss (See **APPENDIX-XIX**). The Group also noted deployment of automatic capacitor switching panels in rural areas. However, effective operation of these devices in the rural environment over long periods of time needs to be closely monitored.

8.5.6 *Technical Interventions for Agricultural Supply*

8.5.6.1 The Group observed that a large number of agricultural consumers were still un-metered and as such assessment of load being supplied on the basis of un-metered supply needed special attention. This could be done easily in cases where agricultural feeders had been separated. In other areas, the estimation had to be on the basis of scientific sampling. The Working Group studied the pilot studies carried out earlier in Andhra Pradesh (See **APPENDIX-X**) and the Working Paper of the MPERC (See **APPENDIX-XI**) in this respect.

8.5.6.2 The pilot project in Andhra Pradesh sought to introduce HVDS to improve the quality of power supply of agricultural consumers along with the replacement of existing inefficient pumps, with higher efficiency and lower capacity pumps to reduce energy consumption for the same water delivery. An outreach programme explaining the benefits of the new distribution system and a voluntary efficient pump sets scheme was being offered to farmers in

close coordination with local groups/banks involved in outreach activities for other agricultural and rural development initiatives.

8.5.6.3 The MPERC submitted a discussion paper on 'Billing of Agricultural Consumption on the Basis of Group Metering.' The Commission stated that individual metering to such a large number of un-metered agricultural consumers was a time consuming process. In any case, it would not be appropriate to continue indefinitely with the method of billing on a flat rate assessment per Horse Power (HP). The Commission therefore suggested an alternative, that is provision of a meter on the DT for the group of agricultural consumers served by it. The consumption recorded in the DT meter could be pro-rated amongst the individual connections on the basis of connected load of their pump sets. The issue in question was, however, as to whether group metering could be covered under the provision of section 55 of the Electricity Act, 2003. The MPERC sought to solicit the consent of the consumers before adopting group metering.

8.5.7 The Group appreciated these innovative methods and recommended their adoption by others with necessary modifications, if required, till such time individual meters were installed.

8.5.8 The Group noted that agriculture feeder separation was emerging to be an effective method of loss reduction. It recommended that the segregation of feeder for agriculture supply should be adopted especially in states where the proportion to supply for agriculture was substantial.

8.5.9 The Group also felt that CEA be requested to compile the steps taken/technologies used by different states to prevent unauthorized use of equipment requiring three phase supply, when only single phase supply was made available. The status in this regard made available to the Group by the CEA is given in **APPENDIX-XX**.

8.6 Other measures (other than technical interventions) to control commercial loss, especially theft of electricity

8.6.1 The Group strongly felt that a multi-pronged strategy should be adopted to control AT&C loss. The strategy should include both technical interventions and administrative/governance measures. Theft of electricity the biggest menace in the commercial loss component of AT&C loss and should be tackled sternly and with actions having a deterrent effect.

8.6.2 The Electricity Act, 2003 has been amended in 2007 to make the penal provisions for theft of electricity all the more stringent. Power has now been given specifically to the licensee or supplier to immediately disconnect the supply of electricity upon detection of theft of electricity. In the event of second or subsequent conviction (where the load extracted, consumed or used exceeds 10 KW), the person indulging in theft can be debarred from receiving electricity supply for a period – not less than three months and up to two years – and such a person can also be debarred from getting electricity supply for that period from any other source or generating stations. A provision has also been made for

cancellation of a license or certificate of competency or permit or authorization of the electrical contractor, supervisor or worker convicted of abetting an offence (Section 150). Theft is now a cognizable and non-bailable offence and the police can investigate such an offence.

8.6.3 The Group felt that the utilities should be directed to effectively use these provisions in appropriate cases to reduce commercial losses. The Group also noted the salutary steps taken by some states in this regard, which had yielded significant results in terms of increase in collection and reduction in loss level.

8.6.4 Andhra Pradesh, Delhi, Karnataka, Rajasthan, Uttar Pradesh and West Bengal have enacted anti-theft laws and many of them have set up special courts and special police stations.

8.6.4.1 In West Bengal the anti-theft legislation provides inter alia for disconnection of supply without notice in case of detection of theft, debarring the offender to draw power from any source for the next two years for committing offence more than once, Electricity Utility Protection Force with powers of Police Station for captive use of this force against energy theft by the utilities. The anti-theft measures taken by the utilities in the state include raid with the help of civil administration, and strict enforcement of anti-theft legislation. All this is reported to have helped significantly in reduction of theft of energy**.** The tariff order for WBSEB for 2007-08 provides that for reducing overall AT&C loss, the Security & Loss Prevention (S & LP) wing has been strengthened. Theft of electricity of around 20 million unit (MU) every year by unauthorized means has been detected by S & LP activity. It has been stated that S & LP

wing had organized 7,223 raids in 2005-06 in the licensed area of the licensee and the target for conducting such raids has been further raised to 8,000 and 9,600 in the year 2006-07 and 2007-08, respectively. Important meetings are stated to have been held with high police officials like DIG & SP at the district levels for cooperation during detection and prevention of theft. Spot billing facility introduced in some of the electric supply stations of the licensee has also been stated to be utilized for reducing commercial loss. It has been further reported that due to the cumulative effect of all the above activities AT&C loss of WBSEB reduced from 37.86 percent in 2004-05 to 33.395 percent in 2005-06.

8.6.4.2 In Gujarat, the Vigilance Department of Gujrat Urja Vikas Nigam Ltd. (GUVNL) is headed by an IPS officer of the rank of Inspector General of the Gujarat Police (on deputation). The main function of the Vigilance Department, GUVNL is to keep close watch on pilferage of electricity from the network of subsidiary companies. To keep vigil over the pilferage of energy, the Vigilance Department co-ordinates with all subsidiary companies that is Madhya Gujarat Vij Company Ltd. (MGVCL), Pachim Gujarat Vij Company Ltd. (PGVCL), Dakshin Gujarat Vij Company Ltd.(DGVCL) and Uttar Gujarat Vij Company Ltd.(UGVCL). A central control room is operative where anyone can give information regarding theft of electrical energy. Information received is handled confidentially and should the informer desire, his/her anonymity is preserved. In the GUVNL website also there is provision of submission of information regarding power theft. To encourage people to

come forward and submit information the erstwhile Gujarat Electricity Board (GEB) had introduced a scheme of cash reward (based on the recovered amount due to submission of information) as an incentive. For eligibility for getting cash, the power theft informer has to submit detailed information on a prescribed format. The name, address and amount paid to the informer are kept strictly confidential. To take appropriate confidential actions on such power theft related information, installation checking squads are functioning in each O&M circle in each subsidiary company MGVCL, PGVCL, DGVCL and UGVCL. Engineers from group companies have been deputed to the GUVNL headquarters to co-ordinate centralized mass checking drives in so-called head strong areas. For dealing with cases of power and property theft, the Government of Gujarat has created five dedicated police stations at Vadodara, Surat, Sabarmati, Rajkot and Bhavnagar. The Vigilance Department of GUVNL co-ordinates with the state government for effective functioning of these police stations. Officers of the rank of DySP, PI, PSI, level and staff in ASI, HC cadre from the state police department are working on deputation to facilitate the functioning of these police stations. Some of the retired officers from the state police department are also posted as Officers on Special Duty.

8.6.4.3 In Delhi, in the case of the North Delhi Power Limited (NDPL), the enforcement machinery has been strengthened and streamlined with teams of enforcement officers dedicated for the purpose of detection of theft and bringing the offending consumers to book. The licensee has also established a

helpline for reporting specific instances of electricity theft. Intervention of information technology (IT) is being utilized for detection and booking of cases of theft. The BSES Rajdhani Power Ltd. (BRPL) has initiated a special project called "Parivartan" for reducing losses in high theft prone areas. This project envisages, among other things, enforcement action against illegal connections and theft. There are now two Special Courts for BRPL and 4,381 cases have been registered with these two Special Courts till October, 2007; out of these 1,152 cases have been resolved, that is offenders have agreed to make the payment of assessed amount of theft. It is noteworthy that 116 persons were remanded to judicial custody and six convictions have taken place. In FY 2006-07, the licensee has collected Rs. 37 crore (approximately) from enforcement activity. This additional revenue will be counted for the purpose of tariff fixation and passed on to the consumers in the ARR. Internal objectives are being set and management performance will be measured and rewarded based on loss reduction. The licensee has also established a helpline for reporting of specific instances of electricity theft. In FY 2005-06, an intensified drive against electricity theft has resulted in an increased recovery of 45 percent over FY 2004-05. There are two Special Courts for BRPL; 3,101 cases have been registered with these two Special Courts till October, 2007, out of which 628 cases have been resolved, that is offenders have agreed to make the payment of assessed amount of theft; 158 persons were remanded to judicial custody, and six convictions have taken place. In FY 2006-07, the licensee has collected Rs. 25 crore (approximately) from

enforcement activity. This additional revenue will be counted for the purpose of tariff fixation and passed on to the consumers in the ARR.

8.7 Suitable incentive/disincentive scheme for rewarding/penalizing the areas with low/high loss levels:

8.7.1 The Group noted that the incentives/disincentives schemes had been introduced by some SERCs for inducing the utilities to improve loss reduction. The general stipulation was that under-achievement of the loss reduction target was to be borne by the licensee and in case of achievement over and above the targets, the gain was to be shared between the licensee and the consumers (e.g. in Tamil Nadu this ratio was 50:50; in Uttar Pradesh excess profit was shared in the ratio of 50 percent for the licensee, 25 percent credited to the licensee's contingencies and 25 percent to the consumers; in Madhya Pradesh this ratio was 50:50; in Orissa one-third amount of profit was retained by the licensee, one-third the consumer, and one-third for tariff balancing reserve etc.). (See **APPENDIX- VI**.)

8.7.2 The Group also studied the incentive/disincentive scheme adopted by some utilities to induce their employees to reduce losses. The Maharashtra State Electricity Distribution Company Ltd. (MSEDCL) defined an efficiency parameter (based on the ratio of collection to billing rate) and also defined the threshold level of loss reduction beyond which incentive was payable to the employees, corresponding to the efficiency parameter. Disincentive was linked to the under-achievement of the loss reduction target. Another important feature was the non-executive posting at least for two years for repeated under-achievement of

the loss reduction target. (A detailed note on the scheme of MSEDCL is given in **APPENDIX-XII**.)

8.7.3 The West Bengal Electricity Distribution Company Ltd. (WBEDCL) has also launched an incentive/disincentive scheme for employees linked to loss reduction. The scheme is spread over the various groups of employees including meter readers. (A detailed note on the scheme of WBEDCL is given in **APPENDIX-XXI**.)

8.7.4 The Group also noted the Mahrashtra Electricity Regulatory Commission (MERC) order dated January 9, 2003 in the matter of 'Determination of Tariff [2001-2002] Applicable to various categories of consumers of Maharashtra State Electricity Board and, Levying of T & D Loss charges on the basis of differential (Circle/Zone) T & D Losses Evaluation' in which MERC has determined the differential tariff for MSEB on the basis of the area-wise T&D losses which has been also upheld by the Hon'ble High Court in its order dated February11, 2004. The Hon'ble High Court has the following views on the matter:

a)

……

29. The Commission appears to have made a sincere effort for improving the social culture and ethos and encouraging the consumers to report thefts of power which happen to their knowledge. After analysing the data carefully, the Commission has noted that in certain areas of the State, T & D losses are much higher than the other areas. This would probably be in account of higher theft of electricity in certain pockets. Certain areas have reported

much lesser T & D losses probably on account of better culture in the Society and less thefts. The Commission has also noted that it will be improper to require the consumers in areas which show better compliances to pay for the thefts by the consumers in other areas which show less compliances and higher thefts. The Commission has therefore, proposed that it would be proper to fix higher energy charges in less complying areas than the energy charges in better complying areas." The Commission has proposed to do this by fixing basic fixed tariff and additional variable charge on account of T & D losses. In an area where T & D losses are more, probably on account of theft, variable T & D charges would be more and in better complying areas the variable charge would be less. This would achieve two purposes. Firstly, the consumers would know that they are required to pay more for higher T & D losses on account of thefts and they would report thefts of neighbours. Secondly, it would help in improving culture of the society wherein the consumer would know that he would be required to pay less if he and his neighbours accurately report the consumption.

30. We are inclined to ignore the criticism that the Commission has proposed to do something which has not been done before. When a first precedent is made, it is always new. It breaks path from the existing traditions. Law and Society are not static, they change. New remedies must be found for new menaces. An effort to find a remedy for a new growing wrong of electricity theft cannot be criticized on the ground that the approach is unorthodox and

the remedy has never been tried before. If the method adopted on experience is proved to be ineffective, it can be modified in future and we have no doubt that the Commission would do so in future but we cannot prevent adoption of the new method only on the ground that it was not done before.

……

8.7.5 The Group also noted the recommendations of the Investment Commission which emphasized the need for "implementing differential tariff to incentivize and launch an all India campaign against power theft." The salient features of the recommendations were as follows:

- *Implementing differential tariffs to incentivize loss reduction and launch an all India campaign against power theft.*
- *Power theft contributes over 50 percent of the AT&C losses.*
  - *Implement differential tariffs that incentivize power theft reduction across all states.*

    As an example, the introduction of Akshay Prakash Yojana in Maharashtra, driven by consumer participation and self monitoring, has resulted in a significant reduction in power theft:

    - *Mandate a differential tariff mechanism through the forum of regulators (SERCs, headed by Chairman CERC).*
    - *Provide incentives of reduced load shedding and a discount on tariff for areas that have lower loss levels (larger discounts for lower theft/loss levels).*

- *In rural areas, SERCs will need to push discoms for feeder separation and distribution transformer (DT) metering, prior to implementation.*

8.6.6 The Group suggested that incentive for the staff for performance above the set targets might be operationalized taking an electricity division as the unit.

CHAPTER – 9

Findings and Recommendations

9.1 Transmission losses should not be clubbed with distribution losses in order to have a clear focus on reduction of distribution losses. Therefore, the State Commissions should deal with distribution losses separately and the practice of clubbing transmission and distribution losses (T&D) needs to be immediately discontinued. Need for drawing up a roadmap by each SERC is reiterated for ensuring installation of meters at the premises of all categories of consumers in a time-bound manner.

9.2 While computing the AT&C loss figure, there is a need for differential analysis of technical losses, non-technical losses and collection efficiency. AT&C loss should be calculated by subtracting the energy realized from the energy input where energy realized should be equal to the product of energy billed and collection efficiency (collection efficiency being the ratio of amount collected to the amount billed). As suggested by CEA while calculating the energy input, the energy traded should be excluded. Further, it should be ensured that the methodology for computing the AT&C loss figure should exclude disputed amounts (amounts which are disputed in any forum including courts etc.) from the demand raised for calculation of collection efficiency. In accordance with para 8.2.1 (iv) of the

Tariff Policy, the collection efficiency should take into account provision for bad debts as per the policies developed and subject to the approval of the State Commission.

9.3 For correct AT&C loss estimation, it was essential that losses were segregated into technical and non-technical (commercial) losses. To segregate the losses, the first step should be to compute the technical losses at the distribution network level. The technical losses so computed should be subtracted from the total energy loss at the distribution network (i.e. from AT&C loss) to derive the commercial loss. Technical losses could be computed by the bottoms up approach by computing losses - at EHV system (33 kV network of the distribution utility), at 11 kV system and at the DT level.

9.4 11kV feeders having no commercial losses consistently should be identified and technical losses in such feeders may be arrived at as the difference between the sending end energy and receiving end energy at the consumer end plus energy recorded at the LV side of DTs.

9.5 The technical losses in the distribution network could also be estimated by computer aided system studies through simulation of the network equipment.

9.6 The non-technical (commercial) loss should be calculated as the difference between the total energy loss at the distribution level (AT&C loss) and the technical loss computed by following the method explained above.

9.7 To segregate the technical and non-technical loss, baseline data should be compiled for each electricity division. Third party verification of the technical and financial data submitted by the utility was crucial, before such data was taken into account for determination of tariff.

9.8 Compilation of baseline data should be the starting point for energy accounting and audit. Energy audit has to start from DTs to 11kV feeders to 33/11kV sub-stations of the entire area selected for auditing. Energy audit should be undertaken to calculate the difference between the distribution transformer-wise energy sent out and total of all the consumers' consumption.

9.9 The trajectory for loss reduction should be determined keeping in view the actual loss levels, the capital expenditure made in the past for improving the network and the future capital expenditure plans. This was very important keeping in view the Orissa experience where the loss level allowed in tariff at the beginning of the reforms process was much below the actual loss level. This completely distorted the revenue requirement and the utility went into a perennial loss. Once the actual loss level has been identified by following the methodology suggested above, a trajectory for loss reduction could be specified and followed rigorously.

9.10 The resolution of the Chief Ministers' Conference on Power held in May 2007 resolved to achieve and sustain drastic reduction in the overall AT&C losses through the next five years, and at least to a level of 15 percent in the APDRP project areas. It was generally agreed that, as a rule of thumb, reduction of loss level should be at least 10 percent of the existing loss levels every year till the losses are reduced below 20 percent. The actual loss levels at the beginning of the MYT trajectory should be scientifically established on the basis of a separate study for every licensee.

9.11 Though the technical and commercial losses should be monitored separately, the trajectory could give a combined target for technical and commercial losses in the first control period of MYT. The MYT trajectory has to be specific to every distribution licensee and preferably the same should be specified by the SERC as part of its regulations.

9.12 In view of the fact the trajectory for loss reduction will be specified, inter alia, keeping in view the capital expenditure plans, the monitoring of capital expenditure should invariably be linked to loss reduction achieved, project-wise and division-wise.

9.13 Pay back period and life cycle cost analysis should be carried out for selecting the appropriate technological intervention aimed at reducing the technical losses.

HVDS was expensive and required larger safety clearance. It was recommended that this system would be more appropriate for areas where LT to HT ratio was poor, rural areas and areas having low connection density. In other areas LT ABC conductors might be used for controlling theft. The load balancing of feeders had also proved useful in reducing technical losses. There was a general view that the cost of sophisticated metering should not be passed on to an individual consumer and the same should be recovered through ARR.

9.14 The technical interventions adopted by some states for – urban, rural and agricultural sectors were studied. Case studies of some states (Delhi, Punjab, West Bengal and Rajasthan for the urban area; Rajasthan and Gujarat for the rural area; and Andhra Pradesh and Madhya Pradesh for the agricultural area) were highlighted as models for emulation by other states.

9.15 A large number of agricultural consumers were still un-metered and as such assessment of load being supplied on the basis of un-metered supply needed special attention. This could be done easily in cases where agricultural feeders had been separated. In other areas, the estimation had to be on the basis of scientific sampling. Agricultural feeder separation was emerging to be an effective method of loss reduction. Segregation of feeder for agriculture supply should be resorted to especially in states where proportion of supply to agriculture sector was substantial.

9.16 A multi-pronged strategy should be adopted to control theft of electricity. Theft of electricity is the biggest menace in the commercial loss component of AT&C loss and should be tackled sternly and with actions having a deterrent effect. The strong penal provisions in the Electricity Act, 2003 especially after the 2007 amendment were noted. It was recommended that the utilities should effectively use these provisions to curb theft and pilferage of electricity. Specific steps taken by the utilities in some states towards controlling theft were also noted**.**

9.17 The incentives/disincentives schemes introduced by some SERCs for inducing the utilities to improve loss reduction were reviewed. It was agreed that under-achievement of the loss reduction target should be borne by the licensee, and in case of achievement over and above the targets the gain was to be shared between the licensee and the consumers in the ratio to be determined by SERCs.

9.18 SERCs might also encourage suitable local area based incentive and disincentive schemes for the staff of the utilities linked to reduction in losses, as stipulated in para 8.2.1(ii) of the Tariff Policy.

9.19 The MERC order dated January 9, 2003 in matter of *"Determination of Tariff [2001-2002] Applicable to various categories of consumers of Maharashtra State Electricity Board and, Levying of T & D Loss charges on the basis of differential (Circle/Zone) T & D Losses Evaluation"* was also noted, in which MERC has determined the differential tariff for MSEB on the basis of the area-wise T&D

losses which has been also upheld by the Hon'ble High Court in its order dated February11, 2004.

9.20 Incentive for the staff for performance above the set targets might be operationalized taking an electricity division as the unit.

List of Abbreviations

ABC	Aerial Bunched Conductor
AERC	Assam Electricity Regulatory Commission
APDRP	Accelerated Power Development and Reforms Programme
APERC	Andhra Pradesh Electricity Regulatory Commission
ARR	Aggregate Revenue Requirement
AT&C	Aggregate Technical & Commercial
ATE / APTEL	Appellate Tribunal of Electricity
BERC	Bihar Electricity Regulatory Commission
BRPL	BSES Rajdhani Power Limited
CERC	Central Electricity Regulatory Commission
CSERC	Chhatisgarh State Electricity Regulatory Commission
DERC	Delhi Electricity Regulatory Commission
DGVCL	Dakshin Gujarat Vij Company Limited
DISCOM	Distribution Company
DT / DTR	Distribution Transformers
EHV	Extra High Voltage
ERC	Electricity Regulatory Commission
FOR	Forum of Regulators
GERC	Gujarat Electricity Regulatory Commission
GIS	Geographical Information System
GSM	Global System for Mobile
GUVNL	Gujarat Urja Vikas Nigam Limited
HERC	Haryana Electricity Regulatory Commission
HPERC	Himachal Pradesh Electricity Regulatory Commission
HT	High Tension
HVDS	High Voltage Distribution System
IT	Information Technology
J&KSERC	Jammu and Kashmir Electricity Regulatory Commission
JGY	Joyti Gram Yojana
JSERC	Jharkhand Electricity Regulatory Commission
KERC	Karnataka Electricity Regulatory Commission
KSERC	Kerela State Electricity Regulatory Commission
KV	Kilo Voltage
LT	Low Tension
MERC	Maharashtra Electricity Regulatory Commission
MGVCL	Madhya Gujarat Vij Company Limited
MPERC	Madhya Pradesh Electricity Regulatory Commission
MSEDCL	Maharashtra State Electricity Distribution Company Limited
MsERC	Meghalaya State Electricity Regulatory Commission
MU	Million Unit
MYT	Multi-Year Tariff

NDPL	North Delhi Power Limited
NEP	National Electricity Policy
O&M	Operation and Maintenance
OERC	Orissa Electricity Regulatory Commission
PGVCL	Pachim Gujarat Vij Company Limited
PSERC	Punjab State Electricity Regulatory Commission
RERC	Rajasthan Electricity Regulatory Commission
RMU	Ring Main Unit
S&LP	Security and Loss Prevention
SCADA	Supervisory Control and Data Acquisition System
SERC	State Electricity Regulatory Commission
T&D	Transmission and Distribution
TERC	Tripura Electricity Regulatory Commission
TNERC	Tamil Nadu Electricity Regulatory Commission
TP	Tariff Policy
UERC	Uttarkhand Electricity Regulatory Commission
UGVCL	Uttar Gujarat Vij Company Limited
UPERC	Uttar Pradesh Electricity Regulatory Commission
WBEDCL	West Bengal Electricity Distribution Company Limited
WBERC	West Bengal Electricity Regulatory Commission
WBSEB	West Bengal State Electricity Board

APPENDIX

APPENDIX-I

FORUM OF REGULATORS (FOR)

Secretariat : C/o. Central Electricity Regulatory Commission (CERC)
Core-3, 6th & 7th Floors, SCOPE Complex, Lodhi Road, New Delhi 110 003
Tele No.:24361051 / Fax No.:24360010

No.:15/2(7)/2008-FOR-WG/LRS Dated : 23rd June, 2008

SUB : CONSTITUTION OF THE WORKING GROUP ON "LOSS REDUCTION STRATEGIES".

Sir,

The Forum of Regulators (FOR) decided in its meeting held on 13th June, 2008 to constitute a Working Group on "Loss Reduction Strategies". The Chairperson of the Forum was authorized to nominate various SERCs on the Working Group.

2. The Chairperson, FOR, has constituted the Working Group as indicated below :-

(i)	Chairperson, CERC	...	Chairman of the Working Group
(ii)	Chairperson, HERC	…	Member
(iii)	Chairperson, KERC	…	Member
(iv)	Chairperson, KSERC	…	Member
(v)	Chairperson, MERC	…	Member
(vi)	Chairperson, OERC	…	Member
(vii)	Chairperson, RERC	…	Member
(viii)	Chairperson, TNERC	…	Member
(ix)	Chairperson, UPERC	…	Member
(x)	Secretary, CERC	…	Member
(xi)	Deputy Chief (RA), CERC	…	Coordinator.

3. Shri K. Venugopal, Member, DERC will be a Special Invitee to the Working Group. In the SERCs where the post of Chairperson is vacant, the senior Member of the SERC would be the Member of the Working Group.

4. The Working Group would inter-alia consider the relevant provisions of the National Electricity Policy, National Tariff Policy, various franchisee models being adopted in the States and would give its recommendation on -

- The suggested methodology for achieving loss reduction in time bound manner,

- Relative appropriateness of technical solutions such as separation of agricultural supply feeders, single phase supply, HVDS etc.,
- Development of base line data and its verification by a third party,
- Suitable incentive/disincentive scheme for rewarding/penalising the areas with low/high loss levels, and
- Any other relevant issue.

5. The Secretariat of the Forum would provide secretariat to the Working Group. The Working Group would submit its recommendations by 30th September, 2008 for consideration of the Forum.

(Alok Kumar)
Secretary

To :

(1) Chairperson, HERC.
(2) Chairperson, KERC.
(3) Chairperson, KSERC.
(4) Chairperson, MERC.
(5) Chairperson, OERC.
(6) Chairperson, RERC.
(7) Chairperson, TNERC.
(8) Chairperson, UPERC.
(9) Shri K. Venugopal, Member, DERC, New Delhi.

Copy for information to -

Chairperson, CERC/FOR.

APPENDIX-II

METERING STATUS

S. No.	SERC	Metering Plan
1.	APERC	Issued a proceeding under section 55 of the Electricity Act 2003, extending the time limit to fix correct meters for all unmetered agricultural services up to 31-03-2008, after which the Discoms shall not supply power to any consumer except through installation of a correct meter.
2.	AERC	(1) TOD meters placed for HT categories such as Tea, Coffee, Rubber, Oil & Coal and industry. Third party arrangement for meter testing done at E.T.D.C (GoI org.). (2) Action taken by utilities to convert all electromechanical meters to static meters. All new connections are released through static meters.
3.	BERC	Directive for cent percent metering has been given to BSEB in Tariff Order of 2006-07. BSEB has been directed to provide no new connection without meter.
4.	CSERC	Target date of 100% meterisation has been extended up to March, 2009. No new connection without meter. Commission is the process of putting in place a third party meter testing arrangement.
5.	DERC	100% meterization has been achieved at 11 KV feeders at all Discoms & for other consumers three Discoms viz. BRPL, BYPL and NDPL has achieved 98.23%, 99.35%, and 97.63% meterization.
6.	GERC	All categories metered. For metering of all Agricultural consumers time limit extended up to Dec '07. TOD metering for HT with load above 500kVA, exclusive night use tariff for HT with load above 100kVA already exists. In agriculture sector, 30% (approx.) connections are metered. The Commission has extended the date for 100% metering upto 31/12/2007 and the matter is under consideration of the Commission.
7.	HERC	HERC has made it mandatory for the Discoms to release only metered supply connections. The Discoms are in the process of putting meters on the un-metered agriculture pump-set supply.
8.	HPERC	TOD meters installed for all categories of consumers having

<table>
<tr><td></td><td></td><td>connected load above 20KW, except domestic consumer. Electronic meters being installed for all new domestic consumer and old electro-mechanised meters being replaced in phased manner.</td></tr>
<tr><td>9.</td><td>JSERC</td><td>JSEB has no metering plans. Commission is trying to put in place a third party meter testing arrangements.</td></tr>
<tr><td>10.</td><td>J&KSERC</td><td>The commission has directed the J&K state Utilities to furnish details of metering plan and to install TOD meters.</td></tr>
<tr><td>11.</td><td>KERC</td><td>Discoms have installed meters for all the installations except IP sets and BJ/KJ. Specific metering plan is yet to be furnished by Discoms</td></tr>
<tr><td>12.</td><td>KSERC</td><td>TOD meters made compulsory for all HT and EHT consumers across the State.</td></tr>
<tr><td>13.</td><td>MPERC</td><td>MPERC had extended the time period for 100% meterization to all unmetered consumers vide Gazette notification dated 18/10/2005. The time limit to achieve 100% meterization for domestic and agricultural consumers had been fixed by the Commission by March 2006 and September 2007, respectively. The licensees could not complete the 100% meterization program and have again filed a petition with MPERC seeking further extension of the time limit to achieve 100% meterization in domestic and agricultural category by March 2010 and March 2011, respectively. MPERC has sought the reasons for non achievement of meterization target and a firm metering plan vis-à-vis meter procurement program from the licensee before further notification. MPERC encourages use of pre-paid meters and spot billing. TOD meters have been installed for all HT consumers. However TOD tariff is not applied to railways, coal mines, irrigations, public water works and bulk supply exemptees till FY 07-08.
MPERC has authorized M/s. CPRI, Bhopal and M/s. ERDA, Vadodara as third party independent meter testing agencies.</td></tr>
<tr><td>14.</td><td>MERC</td><td>SERC has directed MSEDCL to comply with the statutory provisions as well as the National Tariff Policy in respect of individual consumer metering. The Commission also directed MSEDCL to install appropriate tri-vector meters capable of recording maximum demand for LT industrial consumers.</td></tr>
<tr><td>15.</td><td>MsERC</td><td>
<table>
<tr><th>S. No.</th><th>Particulars</th><th>33 KV</th><th>11 KV</th></tr>
<tr><td>1.</td><td>Total no. of ummetered HT Feeders</td><td>8</td><td>41</td></tr>
</table>
</td></tr>
</table>

			as on 01.04.07		
		2.	Program of Meterisation of Feeders during FY 07-08	4	41
		3.	Progress up to 31.12.07	0	8
		4.	Program of Meterisation of Feeders during FY 08-09	8 / 7* 25	33
		*-17 new 33 KV feeders were commissioned without meters during the year 2007-08.			
16.	OERC	The provisions have been incorporated in OERC Distribution Code, 2004 in line with CEA (Installation & Operation of Meters) Regulation, 2006. The progress is monitored from Grid substations upto consumer end. Status being reviewed in every two months.			
17.	PSERC	Utility has installed electronic meters on all industrial consumers. Replacement of electro mechanical meters with electronic meters in respect of NRS and DS consumers is in progress. Metering of AP consumers is yet to be undertaken.			
18.	RERC	All metered except agriculture consumers, time extended up to 09-06-08			
19.	TNERC	Time extended to 31-03-09 for installation of meter in agricultural & hut services by the Commission. Submission of metering plan extended up to 31-12-07. TOD meters installed in all HT consumers. With regards to DT metering, out of the total 1.71 Lakhs Nos. of DTs (as on 30.11.06),89738 Nos. have been metered as on 30.11.07. The metering of balance DTs is under process.			
20.	TERC	Completion of energy metering of consumer premises in progress. Significant computerized billing achieved in the urban sector and in most of the rural areas.			
21.	UERC	Directions issued for 100% metering. Penalty imposed for non compliance. TOD implemented on a large scale.			
22.	UPERC	All 11 KV Feeders have been metered, TOD meters for Large and Heavy Power Consumers (HV-2) have been installed. Directions have been issued for 100% metering; Discoms are in the process of installing electronic meters on all consumers but have not submitted any specific metering plan for metering of unmetered consumers.			
23.	WBERC	Completed			

APPENDIX-III

Time bound program on AT&C losses

<table>
<tr><th>S. No</th><th>SERC</th><th>Status</th></tr>
<tr><td>1.</td><td>APERC</td><td>Following targets has been decided by SERC:
Distribution Losses:
<table>
<tr><td colspan="4">CPDCL</td></tr>
<tr><td></td><td>2006-07</td><td>2007-08</td><td>2008-09</td></tr>
<tr><td>33 KV</td><td>4.21%</td><td>4.00%</td><td>3.81%</td></tr>
<tr><td>11 KV</td><td>11.34%</td><td>10.73%</td><td>10.25%</td></tr>
<tr><td>LT</td><td>22.37%</td><td>20.33%</td><td>19.58%</td></tr>
<tr><td colspan="4">EPDCL</td></tr>
<tr><td>33 KV</td><td>6.10%</td><td>5.92%</td><td>5.78%</td></tr>
<tr><td>11 KV</td><td>10.85%</td><td>10.51%</td><td>10.27%</td></tr>
<tr><td>LT</td><td>19.11%</td><td>17.84%</td><td>17.11%</td></tr>
<tr><td colspan="4">NPDCL</td></tr>
<tr><td>33 KV</td><td>5.45%</td><td>5.18%</td><td>4.92%</td></tr>
<tr><td>11 KV</td><td>11.40%</td><td>10.83%</td><td>10.29%</td></tr>
<tr><td>LT</td><td>21.24%</td><td>19.28%</td><td>18.29%</td></tr>
<tr><td colspan="4">SPDCL</td></tr>
<tr><td>33 KV</td><td>4.85%</td><td>4.67%</td><td>4.49%</td></tr>
<tr><td>11 KV</td><td>10.34%</td><td>9.94%</td><td>9.56%</td></tr>
<tr><td>LT</td><td>18.92%</td><td>17.47%</td><td>16.64%</td></tr>
</table>
Transmission Losses :
<table>
<tr><td></td><td>FY 2006-07</td><td>FY 2007-08</td><td>FY 2008-09</td></tr>
<tr><td>Transmission Losses %</td><td>4.45%</td><td>4.30%</td><td>4.20%</td></tr>
</table></td></tr>
<tr><td>2.</td><td>AERC</td><td>Discoms have initiated a study on AT&C losses in selected 11kV feeders through Consultant M/s Price Water House Coopers. Actions were taken as per report submitted by the Consultant.</td></tr>
<tr><td>3.</td><td>BERC</td><td>Road map for reduction of AT&C loss and also segregation of AT&C losses given to BSEB.</td></tr>
<tr><td>4.</td><td>CSERC</td><td>Board proceeding with T&D loss study. Targets for loss reduction 3% have been given up to 2007-08 bringing it down to 32.54%.</td></tr>
<tr><td>5.</td><td>DERC</td><td>The Commission has finalised the AT&C loss targets and incentivisation framework for the Control Period 2007-11 ending 31st March, 2011:</td></tr>
</table>

<table>
<tr><td></td><td></td><td>(a) AT&C loss levels have been specified at 17 percent for NDPL and BRPL, 22 percent for BYPL and 10 percent for NDMC at the end of the Control Period;
(b) Equal sharing of benefits between the licensee and the contingency reserve (which is used for consumers benefit), on account of gains arising out of better performance vis-à-vis the approved AT&C loss target; and
(c) Licensees to retain all gains accruing out of achieving loss levels below 15 percent for NDPL and BRPL, 20 percent for BYPL and 9 percent for NDMC.</td></tr>
<tr><td>6.</td><td>GERC</td><td>In Tariff Order dated, 31-03-2007, the distribution licensees are directed to prepare a road map to reduce the distribution losses over the next five years (2007-08 to 2011-12).
Details regarding Energy Audit also called from unbundled licensees.</td></tr>
<tr><td>7.</td><td>HERC</td><td>Set target of 30.5% distribution loss level to be achieved in FY 2006-07. A view on AT&C loss shall be taken once segregation of feeder is completed by the Discoms by the end of the year.</td></tr>
<tr><td>8.</td><td>HPERC</td><td>Draft Report for T&D loss submitted by Consultant and is under examination.</td></tr>
<tr><td>9.</td><td>JSERC</td><td>No action taken by Licensee</td></tr>
<tr><td>10.</td><td>J&KSERC</td><td>Likely to take more time.</td></tr>
<tr><td>11.</td><td>KERC</td><td>KERC has furnished a road map to CEA for reduction in T&D losses. ESCOM have been directed to segregate Technical & Commercial losses suitably justified by relevant studies.</td></tr>
<tr><td>12.</td><td>KSERC</td><td>Implemented in those parts where APDRP is implemented.</td></tr>
<tr><td>13.</td><td>MPERC</td><td>Time bound program issued. The State Govt. has notified milestones for distribution losses for three Discoms of the State for the period from 2006-07 to 2010-11, as given below:
Loss Targets (in %)
<table>
<tr><th>Year</th><th>Discom East</th><th>Discom Central</th><th>Discom West</th></tr>
<tr><td>2006-07</td><td>34.5</td><td>43</td><td>30.0</td></tr>
<tr><td>2007-08</td><td>32.5</td><td>40</td><td>28.5</td></tr>
<tr><td>2008-09</td><td>29.5</td><td>37</td><td>27.0</td></tr>
<tr><td>2009-10</td><td>26.5</td><td>34</td><td>25.5</td></tr>
<tr><td>2010-11</td><td>23.5</td><td>31</td><td>24.0</td></tr>
</table></td></tr>
</table>

APPENDIX-III

<table>
<tr><td>14.</td><td>MERC</td><td>Targeted loss reduction levels for FY 2007-08:
<table>
<tr><th>Utilities</th><th>Current level of Distribution loss during FY 2006-07</th><th>Targeted % loss reduction Trajectory during FY 2007-08</th><th>Target Distribution loss during FY 2007-08</th></tr>
<tr><td>MSEDCL</td><td>31.70 %</td><td>4.00</td><td>27.70 %</td></tr>
<tr><td>REL</td><td>12.00 %</td><td>0.50</td><td>11.50 %</td></tr>
<tr><td>BEST</td><td>11.50 %</td><td>0.50</td><td>11.00 %</td></tr>
</table></td></tr>
<tr><td>15.</td><td>MsERC</td><td>
<table>
<tr><th>Description</th><th>2006-07</th><th>2007-08</th><th>2008-09</th><th>2009-10</th><th>2010-11</th><th>2011-12</th></tr>
<tr><td>T & D Loss %</td><td>33.95</td><td>28.41</td><td>24.42</td><td>20.05</td><td>15.69</td><td>11.32</td></tr>
<tr><td>AT & C Loss %</td><td>36.80</td><td>35.62</td><td>31.29</td><td>26.68</td><td>22.05</td><td>15.11</td></tr>
</table></td></tr>
<tr><td>16.</td><td>OERC</td><td>The commission had conducted sample energy audit initially on five feeders through an independent group of professionals which was followed up for another 20 nos. of 11kV feeders with mixed loads. The Commission has fixed the following targets for AT&C loss for different utilities for FY 2008-09.
<table>
<tr><th>Utility</th><th>Target AT&C loss for FY 2008-09</th><th>Actuals for 2006-07</th><th>Actuals for 2007-08 (Upto 9/07)</th></tr>
<tr><td>NESCO</td><td>29</td><td>40.9 %</td><td>35.7 %</td></tr>
<tr><td>WESCO</td><td>28</td><td>40.0 %</td><td>40.3 %</td></tr>
<tr><td>SOUTHCO</td><td>34.6</td><td>47.4 %</td><td>51.4 %</td></tr>
<tr><td>CESU</td><td>32.84</td><td>47.1 %</td><td>46.7 %</td></tr>
<tr><td>All Orissa</td><td>30.36</td><td>43.3 %</td><td>42.4 %</td></tr>
</table></td></tr>
<tr><td>17.</td><td>PSERC</td><td>The T&D loss reduction trajectory for utility was fixed for a period of four years upto 2007-08. The same is due for a review in Tariff Order for 2008-09.</td></tr>
<tr><td>18.</td><td>RERC</td><td>SERC has assigned the targets for loss reduction by the Distribution Licensee for the year 2007-08 & 2008-09 in its order issued for MYT.</td></tr>
<tr><td>19.</td><td>TNERC</td><td>SERC is discussing with the Board and is in the process of setting targets for reduction of AT&C losses.</td></tr>
<tr><td>20.</td><td>TERC</td><td>The licensee has able to quantify HT input energy by installing meter. The report of the energy auditor appointed by the licensee is yet to be received. The programme for reduction of ATC loss from the present level of about 35% may come to 25% overall by 2011-12. In urban area, the loss would figure better than that of rural and hilly areas.</td></tr>
</table>

<table>
<tr><td>21.</td><td>UERC</td><td>Trajectory for loss reduction fixed by the Commission in T.O. dt. 08.09.2003 to reduce losses by 4% each year to arrive at a distribution loss level of 24.32% by 2007-08. For 2008-09, the Commission considered a loss reduction target of 2%. For Energy audit exercise, the Commission has given direction to the licensee.</td></tr>
<tr><td>22.</td><td>UPERC</td><td>In consultation with Distribution Licensee, the Commission had fixed AT&C trajectory for six years in the year 2000-01. In the current tariff order for 2006-07, the loss levels that should have been achieved as per that trajectory have been allowed. Accordingly AT&C loss of 27.4% has been allowed by the Commission.</td></tr>
<tr><td>23.</td><td>WBERC</td><td>Time bound program on AT&C losses:
<table>
<tr><td colspan="9">Norms of Distribution loss in % for Distribution Licensee</td></tr>
<tr><td>Discoms</td><td>2008-09</td><td>2009-10</td><td>2010-11</td><td>2011-12</td><td>2012-13</td><td>2013-14</td><td>2014-15</td><td>2015-16</td></tr>
<tr><td>WBSEDCL</td><td>18.75</td><td>18.25</td><td>17.75</td><td>17.50</td><td>17.25</td><td>17.00</td><td>16.75</td><td>16.50</td></tr>
<tr><td>CESC LTD.</td><td>15.11</td><td>14.90</td><td>14.75</td><td>14.60</td><td>14.25</td><td>14.30</td><td>14.15</td><td>14.00</td></tr>
<tr><td>DPL</td><td>6.10</td><td>5.90</td><td>5.70</td><td>5.50</td><td>5.30</td><td>5.20</td><td>5.10</td><td>5.00</td></tr>
<tr><td>DPSC LTD.</td><td>5.54</td><td>5.40</td><td>5.25</td><td>5.10</td><td>4.95</td><td>4.90</td><td>4.65</td><td>4.50</td></tr>
<tr><td>DVC</td><td>2.78</td><td>2.60</td><td>2.50</td><td>2.40</td><td>2.30</td><td>2.20</td><td>2.10</td><td>2.00</td></tr>
</table></td></tr>
</table>

APPENDIX-IV

Implementation of HVDS, SCADA & Data base management

S. No.	SERC	HVDS	SCADA & Data Base Management
1.	APERC	HVDS Phase-1 and Phase-2 works were already completed. The Discoms are now took HVDS Phase-3 works. Under this scheme, all agricultural service lines are being converted to HVDS, so that both technical and commercial losses would come down.	All Discoms are implementing SAP. GIS/GPS works are under progress. Computerisation of Discom offices is under progress in phased manner.
2.	AERC	HT tariff rates are separately notified & kept lower to encourage the consumers to opt for supply at a higher voltage with effect from 2005-06. As a result, HT consumers increased from 6,641 in 2006-07 to 10,704 in 2007-08.	SCADA implemented in phases.
3.	BERC	HVDS is being provided under rural electrification.	SCADA & Database Management work is under progress.
4.	CSERC	Board has started converting LT system to HVDS. Scheme prepared for two areas for availing REC funds.	SCADA implemented. Sub-station automation in process
5.	DERC	HVDS-Implemented in the past but not favoured now. Low Tension Aerial Bunched Cables (LT ABC) introduced in a big way due to cost effectiveness.	SCADA –Implemented in the three Discoms.
6.	GERC	N/A	SCADA work is almost completed through consultancy assignment to PGCIL.

7.	HERC	HVDS is being implemented by the Discoms.	SCADA & Database Management for all intra- state generating stations and limited no. of 220KV/132KV Grid sub-stations operational at SLDC Panipat (Sewah). SCADA and database management scheme for sub-transmission system envisaged to be part of Area LDC established by the Discoms for which necessary directions have been issued by the Commission.
8.	HPERC	Directions issued to board on HVDS, SCADA is limited to data acquisition as done by SLDC. DBM to take place in MYT which has been initiated in 2007. (i) As a first step, the HPSEB has completed the study on SCADA on the unnamed substation at Nagwain (Kullu) and submitted the report to the Commission. The report being examined by the Commission. (ii) The IT pilot project in Shimla operation Circle is expected to be completed by June, 2008. The same would be replicated to majority of the other operation circle.	
9.	JSERC	Not yet decided	Not yet decided
10.	J&KSERC	To be taken care in the 1st Tariff Order.	Commission has already directed licensees to furnish details upon the matter. Results awaited
11.	KERC	KERC has been monitoring LT/HT ratio.	KPTCL has taken up the upgradation of SCADA under integrated SCADA scheme. For data base management, ESCOM's have taken up computerization for implementation of MIS and the Commission is monitoring the status.
12.	KSERC	Being implemented	SCADA implemented in one city. Data acquisition from sub

			stations implemented in areas covered by APDRP
13.	MPERC	As per the directives given by MPERC in respect of reducing LT/ HT ratio and loss level through HVDS, all the three distribution companies have included several HVDS schemes in their investment plan filed with the Commission and now approved by the Commission. Some pilot projects of HVDS in each Discoms have been completed and encouraging results have been observed after execution of the scheme. The Commission has also seen a few of them during the Commission's visit to the areas of all three distribution licensees.	The Commission has reviewed the status of implementation of SCADA earlier and found that it was not feasible to implement SCADA in the distribution system in the present scenario. However, the licensees have been directed to review the matter and prepare a plan for implementation of SCADA. As far as data base management of the Discom is concerned, it has been given to understand that the work in this direction is going on with the help of their consultants KPMG under DFID phase II programme.
14.	MERC	MSEDCL has proposed the HVDS/ Infrastructure scheme for 119 divisions in rural areas of Maharashtra, which have been approved by the Commission.	Information through SCADA is available for all generating stations and grid substations of MSETCL at MSLDC. In respect of distribution, REL has implemented SCADA under disaster management scheme, which covers 50 receiving stations. As regards data base management, the Commission has initiated process of implementation Regulatory Information Management Schemes (RIMS).

<table>
<tr><td>15.</td><td>OERC</td><td>The Commission has directed in the ARR & RST order for 2008-09 that “In case the electrification (rural) is done by extending the grid supply then the extension should be on HVDS by extending the HT lines up to the load centre of the village.”</td><td>Commission in its order dated 13.03.2008 observed that all agencies connected to or planning to connect to STS shall provide Remote Terminal Units (RTUs) and other communication equipments for sending real time data. They shall make available output of their respective operational meters to SCADA interface equipment installed by the STU/Transmission Licensee.</td></tr>
<tr><td>16.</td><td>PSERC</td><td>REC has sanctioned DPRs worth Rs. 1000 crores (out of Rs.2387 crires) for HVDS for AP connections in the month of sept.,2006</td><td>Real time SCADA system along with Communication system already in operation in the utility is the state of art system and support all the functional features as available in SCADA system of North Regional Control Centre at New Delhi. SCADA system meets with requirements of NEP guidelines. Implementation of SCADA for distribution with Ludhiana city as a pilot project is being taken up/completed by the utility during 2008-09 and 2009-10.</td></tr>
<tr><td>17.</td><td>RERC</td><td colspan="2">SERC in its regulations for investment approval has prescribed the appointment of plan expenditure for related schemes under which the works are taken up by the Discoms for technological upgradation as under :
<table>
<tr><td>S. No.</td><td>Catagory</td><td>Ceiling limit of outlay</td></tr>
<tr><td>1</td><td>Load dispatch metering</td><td>5%</td></tr>
<tr><td>2</td><td>Consumer servicing</td><td>1%</td></tr>
<tr><td>3</td><td>Institutional strengthening</td><td>1%</td></tr>
</table>
The Discoms have also undertaken feeder renovation programme with rural focus, urban focus and industrial focus,</td></tr>
</table>

		which include HVDS, Metering etc.	
18.	TNERC	Licensee has been directed to improve HT/LT ratio 1:1.5 in the distribution code	Provision of SCADA and communication facility to all substations is likely to be completed by June 2008 by TNEB.
19.	TERC	Schemes under preparation by the licensee and yet to be furnished. This would take some time for this State due to limitation of size and consumers spread uneven.	
20.	UERC	The commission has directed all loads above 75kW on HT.	Centralised commercial Database MIS has been implemented at corporate office of the distribution licensee and integration to divisional MIS is under progress. The DISCOM has taken up the project for AMR and data logging for high value consumers in accordance with the directions of the Commission. Consumer indexing and GIS mapping has been completed in few circles and is under progress in other circles.
21.	UPERC	HT tariff rates are fixed so as to encourage the consumers to opt for supply at a higher voltage. Licensees have informed about adoption of HVDS for rural network.	SCADA and Database Management are available at 400 KV and 220 KV Transmission System.
22.	WBERC	In new extension of network HVDS concept is being in practice. For old network upgradation to HVDS is taking place as where it is felt necessary.	Action not yet started

APPENDIX-V

Status of Energy Audit/Third party verification of technical and financial data in the States

Sl. No.	Name of State	Comments
1.	Assam	• Energy audit of entire system is not yet completed; • SERC proposes to engage independent agencies for verification after completion of the energy audit schemes.
2.	Bihar	• Directive to replace all defective meters and provide correct meters and also take up energy audit in all towns with a population of fifty thousand & above; • System of independent scrutiny to be put in place after receipt of report on energy audit.
3.	Chhattisgarh	• Discoms asked to conduct energy audit; • System of independent scrutiny after the report of energy audit; • Independent scrutiny of financial and technical data at the time of tariff determination.
4.	Delhi	• Regular monitoring by SERC of progress by Discoms on conduct of energy audit; • In NDPL area, complete metering at Distribution Transformer (DT) level, as also indexing; • Efforts to intensify monitoring of performance of Discoms viz-a-viz. Standards laid down in Supply Code & Performance Standards Regulation.
5.	Gujarat	• At present energy audits are being done in-house by the licensees and the results are utilized for R&M Vigilance etc; • Since beginning, SERC is engaging experts/ independent consultants like TERI, PWC, ASCI for scrutiny and analysis of the data submitted by the licensee for tariff determination.
6.	Haryana	• The licensees are in the process of segregating rural/ domestic and non-domestic load from agriculture load by segregating 11 KV feeders serving the rural areas. Subsequently third party verification of energy audit shall be considered; • The financial and technical data are currently verified/checked by the staff and technical consultants of the SERC; • SERC is also in the process of empanelment of consultancy firms for the purpose.
7.	Himachal Pradesh	• Not started the third party verification of energy reports; • An independent T&D loss study has been commissioned by the Commission.

8.	Jammu & Kashmir	• Utility is a Government department and due to prevailing conditions much progress could not be made in this regard.
9.	Jharkhand	• SERC has institutionalized a system of scrutinizing of financial and operational data submitted by the licensee; • Latest tariff order of SEB includes finding of independent financial scrutiny.
10.	Karnataka	• Services of third parties availed by SERC for validation and scrutiny of data furnished by licenses for tariff determination under MYT framework.
11.	Kerala	• SEB's accounts audited by Accountant General through concurrent audit. Truing up allowed based on AG's report; • For survey of technical loss, CPRI has been engaged by SERC.
12.	Madhya Pradesh	• Discoms asked to conduct energy audit; • System of independent scrutiny of energy audit to be instituted after receipt of report of energy audit; • Consultants appointed by SERC for independent scrutiny of financial and technical data provided by licensees/gencos.
13.	Maharashtra	• SERC start to carry out study of the typical sample distribution networks in MSEDCL area for assessing impact of APDRP schemes and estimation of distribution losses. However, MSEDCL refused to cooperate with the technical consultants; • SERC is taking further steps for third party verification of energy audit results for different area/locality and is also in the process of institutionalization the system of independent scrutiny of financial and technical data submitted by the licensees.
14.	Meghalaya	• SERC operationalised in 2006. Hence comments on the issue may not be possible.
15.	Orissa	• Third party verification of energy audit, carried out by PWC appointed by SERC; • A panel of Chartered Accountant (CA) firms approved by the SERC to conduct audit of consumer variables of Discoms upto 31.03.2005; • Analysis by SERC after receipt of audit report; • For ascertaining terminal liabilities of employees of TRANSCO and DISCOMS, SERC appointed an independent actuary to the valuation of corpus.
16.	Punjab	• Energy audit undertaken by the licensee after installation of reliable metering at sub-station end of all EHT & HT feeders; • SERC gets licensee's financial and technical data, validated by independent agency before allowing them

		through ARR;
17.	Rajasthan	• Accounts of Genco, Transco and Discom audited by Chartered Accountants and reported upon by C&AG. Hence third party verification of financial statements not considered necessary; • Technical losses in transmission system are measured through appropriate meters, obviating need for third party verification; • To analyse losses in distribution system, Feeder Renovation Programme introduced by Discom in rural, urban and industrial sector. On completion of the programme in 2009, Discoms to carry out their own or third party energy audit for such renovated feeders.
18.	Tamil Nadu	• Third Party verification of energy audit results (which has not been used by the Commission so far) and system of independent scrutiny of financial and technical data will be instituted as and when licensee files petition for determination of tariff under MYT.
19.	Tripura	• The licensee has engaged third party to carry out energy audit, however they have been able to account for energy flow through all feeders upto 11KV and account of loss by installing meter and keeping account as submitted in AAR petition filed.
20.	Uttar Pradesh	• Energy audit undertaken by third party in two districts of Agra and Kanpur; • Financial audit undertaken in 15 distribution divisions on a sample basis; • Various directives and schemes by SERC to curb losses and incentivise performance; • Directives to licensee to do rostering based on AT&C losses of a particular division/district; • Incentive/disincentive schemes linked with loss levels at the distribution transformers for the benefit of consumers and staff of licensees; • Efforts initiated to institute third party energy audit of sample 11KV and 33KV feeder; • Licensees asked to prepare baseline data and conduct every audit on their own.
21.	Uttarakhand	• SERC issued a Concept Paper in 2005 on area-wise loss based surcharge/rebate in tariff; • An independent Auditor appointed by SERC to examine the quantum of surplus revenues records of licensee from 2001-02 to 2004-05. The report revealed that excess revenue generation of Rs. 755.53 crores were given in the order dated 12.07.06 and consumers were given benefit of interest on this surplus in 2006-07 tariff order.
22.	West Bengal	• The Commission feels that even if in a particular locality AT&C loss is very high, it may not be prudent

		to conclude that all consumers in the locality are guilty of power theft. As such it would not be advisable to impose a surcharge on tariff in those areas where AT&C loss level is high. Also, the Commission would like to retain the prerogative of deciding when, where and under which circumstances the energy audit results are to be got verified by a third party.

APPENDIX-VI

Status of Incentive and disincentive scheme linked to performance on loss reduction

Sl. No.	Name of State	Comments
1.	Assam	• No power purchase cost in excess of approved AT&C loss granted to licensees; • For excess loss, no amount is granted after prudent check; • For excess profit, benefits shall be passed to the consumers after meeting the related expenditure and provisions.
2.	Bihar	• MYT framework is yet to be put in place. However, Directions given to BSEB for reduction of AT&C losses in a specified time frame.
3.	Chhattishgarh	• MYT has not been enforced in the absence of requisite base data. Would be introduced from 1/04/2009; • Mechanism for sharing of excess profits/Losses on the basis of the efficiency parameters is being provided in draft MYT regulations; • CSEB has entrusted the work of study of AT&C losses and cost of supply to a consultant; • Provision for profit sharing and refund of excess amount provided in tariff regulations, 2006; • Incentive (50% retained by the licensee and 50% kept for reducing ARR in future years) is to be provided to the licensee in case income is more than ARR; • Tariff is being determined after prudent checking of ARR; • Commission has so far issued three tariff orders FY 2005-06, 2006-07, 2007-08. Reduction of ARR after Commission's scrutiny led to the reduction of tariff (from 3.45 Rs./Kwh to 3.20 Rs./Kwh and finally to 2.98 Rs./Kwh).
4.	Delhi	• Discoms were given a target of 17% reduction over the last 5 years 2002-07; • All three Discoms have been able to achieve the targets. NDPL has been able to over achieve.; • In the MYT regulations, 2007, Discoms have been given a target (NDPL 17%, BRPL 17%, BYPL 22%) to bring down the AT&C losses by the end of the control period; • Incentive/disincentive linked to performance on loss reduction.

APPENDIX-VI

5.	Gujarat	• The tariff and fuel surcharge are determined on the basis of the T&D losses fixed by the SERC and in case of higher T&D losses, utilities are not allowed to pass on this burden to consumers; • The MYT Regulations notified by the SERC in Dec, 2007 provide for detailed methodology related to sharing of excessive profits/losses with consumers.
6.	Haryana	• AT&C losses of licensee have declined and T&D losses benchmark has been set by SERC; • Collection efficiency of the Utility has improved
7.	Himachal Pradesh	• T&D loss targets across circles would be fixed in the MYT framework; • No penalty has imposed on non meeting of targets by the Licensee; • Mechanism for sharing benefits of achieving better T&D loss targets has been specified in the MYT regulations.
8.	Jammu & Kashmir	• T&D and AT&C losses in the utility are extremely high; • Attempts are being made. However, due to prevailing conditions much progress could not be achieved to reduce losses.
9.	Jharkhand	• SEB never attempted to reduce the AT&C loss. However, some action is being taken after being threatened of reducing the tariff ; • MYT will be implemented from April'08 wherein profit sharing mechanism in case of earning profit due to over efficiency by the licensee has been laid down.
10.	Karnatka	• T&D loss reduction target for licensees; • Penalty/Incentive for under-achievement/ over-achievement of loss targets by allowing power purchase cost with reference to loss targets; • Incentive/disincentive for performance on loss reduction, in MYT; • To take care of surplus profits, truing up exercise for past years undertaken and only permissible ROE and surplus/deficit being carried forward to next year. This obviates need for sharing of surplus profits.
11.	Kerala	• MYT Principles, not applicable to the KSEB; • Incentive regulations are followed for approving the ARR (2003-04 & 2004-05) of the Licensee; • Loss on account of under achievement of AT&C loss reduction target to be borne by the licensee; • Excess profit (If any) earned over the approved level, shall be adjusted to allowable level during the truing up process.

12.	Madhya Pradesh	• Profit Sharing Mechanism (excess profit) for a period of three years from FY 2007-08; • 50% of the excess profit will be retained by the utility and 50% will be passed on to the consumer through tariff commencing from the next tariff period; • Targets for distribution losses (technical and non-technical) for 3 distribution companies for 5 year (2006-07 to 2010-11) period are set by state government; • Commission to disallow at the time of truing up the amount on account of excess purchase due to not adhering to annual loss reduction target.
13.	Maharashtra	• Mechanism for sharing of gains or losses on account of controllable factors are specified in the Regulations (Terms & Conditions of Tariff); • SERC monitors distribution losses and collections efficiency separately in stead of AT&C loss.
14.	Meghalaya	• MSERC operationalised in 2006. Not possible to comment on this issue.
15.	Orissa	• Licensee, allowed an approved return. Profit over and above approved return is shared in the following manner: • 1/3rd amount to be declared by the licensee as dividends to the shareholder; • 1/3rd amount to be returned to consumers by way of reduction in the consumer bills as rebate; and • 1/3rd amount to be kept as tariff balancing reserve to be used to reduce sharp rise in ARR in future • Target set for the reduction of AT&C loss has not been achieved. Thus, No incentive sharing with the consumer. However, regarding under achievement of the target, losses are entirely born by the licensee.
16.	Punjab	• Utility shall retain the entire gain/ bear the loss for any variation in respective norms including T&D losses trajectory; • Penalty imposed for not achieving specified loss trajectory.
17.	Rajasthan	• The Commission may revise the tariff if the current tariff results in excessive profits to licensees so as to allow only reasonable return; • While truing up of the ARR of the licensees the commission has allowed only target losses as specified by the Commission and accordingly their cumulative deficit up to the year 2004-05 as allowed by the Commission has been reduced by disallowing amount

		toward not achieving the desired targets of loss reduction.
18.	Tamil Nadu	• The trajectory for reduction of loss under the multi-year tariff framework is yet to be stipulated; • AT&C loss reduction targets during the control period shall be determined with reference to the loss level for base year and such level shall have the flexibility to accommodate changes due to completion of metering arrangements for accurate measurement of losses.; • Losses due to under achievements of the target shall be borne by the licensee and gain shall be shared with the beneficiaries at the rate of 50:50.
19.	Tripura	• Licensee has taken an action plan under APDRP Scheme to reduce AT&C loss to 25% which at present is 40%.
20.	Uttar Pradesh	• Excess profit (i.e. Profit over and above the approved returns by way of reduction of distribution losses collection efficiency etc.) is as follows: • 50% of the additional profit to the licensee; • 25% credited to the licensees contingency; • 25% passed on to the consumer by reducing ARR provided to the Licensee; • Does not allow losses to be passed on to the consumer.
21.	Uttarakhand	• In its first order in Sept.,2003, SERC fixed a trajectory for loss reduction of 4% every year for the next five years for the licensees; • Over the years, SERC has not allowed loss to the licensee in excess of the trajectory approved by it.
22.	West Bengal	• The targets for reduction in AT&C losses are fixed in individual tariff orders; • The licensee can retain the difference if the target of reducing losses has been over achieved. However, in the case of under achievement licensee shall bear the losses.

APPENDIX-VII

AT&C Loss, Billing & Collection Efficiency of Distribution Utilities (By Abrahim Report)

Region/State	2001-02			2002-03			2003-04			2004-05		
	Bill.Eff. (%)	Coll. Eff. (%)	AT&C Loss (%)	Bill.Eff. (%)	Coll. Eff. (%)	AT&C Loss (%)	Bill.Eff. (%)	Coll. Eff. (%)	AT&C Loss (%)	Bill. Eff. (%)	Coll. Eff. (%)	AT&C Loss (%)
Eastern												
Bihar	61.80	54.99	66.02	61.09	36.60	77.64	63.96	35.98	76.99	62.12	41.70	74.10
Jharkhand	53.04	75.02	60.21	53.06	51.59	72.63	45.65	72.11	67.08	46.85	65.65	69.24
Orissa												
CESCO	51.19	100.00	48.81	56.99	123.89	29.40	60.23	83.06	49.97	58.51	41.03	75.99
NESCO	48.98	100.00	51.02	58.61	101.92	40.26	56.35	101.27	42.93	60.58	98.34	40.42
SESCO	59.53	100.00	40.47	60.86	103.91	36.76	57.56	107.35	38.21	59.52	108.13	35.65
WESCO	53.58	100.00	46.42	61.70	97.73	39.70	60.99	101.13	38.32	63.61	100.78	35.89
Sikkim	43.33	43.08	81.33	45.34	43.84	80.12	77.78	42.86	66.67	84.62	43.02	63.60
West Bengal	63.90	101.27	35.29	65.96	111.25	26.62	69.07	97.19	32.87	69.86	108.92	23.91
Total	**58.74**	**89.64**	**47.34**	**61.25**	**90.81**	**44.37**	**62.68**	**84.90**	**46.79**	**63.28**	**87.15**	**44.85**
North-Eastern												
Arunachal Pr.	48.39	78.67	61.94	48.77	78.48	61.73	81.99	102.03	16.34	64.46	97.27	37.30
Assam	57.50	109.63	36.97	60.94	99.39	39.43	63.72	88.90	43.35	61.69	98.38	39.31
Manipur	37.72	68.64	74.11	33.67	68.86	76.81	36.97	81.97	69.70	49.15	23.27	88.56
Meghalaya	79.42	98.72	21.60	76.60	75.21	42.39	74.54	81.37	39.35	74.01	83.61	38.12
Mizoram	52.99	45.11	76.10	55.22	91.22	49.63	61.30	96.65	40.75	79.53	98.05	22.02
Nagaland	41.94	93.27	60.89	45.20	102.36	53.74	47.89	92.65	55.63	63.61	95.34	39.35
Tripura	61.73	110.82	31.60	59.35	110.75	34.27	70.09	97.66	31.55	70.40	98.18	30.88
Total	**58.31**	**101.79**	**40.65**	**59.68**	**93.66**	**44.10**	**64.36**	**89.52**	**42.39**	**64.93**	**89.95**	**41.59**
Northern												
Delhi	52.55	76.00	60.06									
BRPL				56.92	84.70	51.78	56.84	95.50	45.72	64.47	90.00	41.98
BYPL				42.05	89.21	62.49	48.11	92.41	55.54	52.88	91.32	51.70
NDPL				53.72	81.18	56.39	57.56	94.18	45.79	67.31	99.65	32.92
Haryana												
DHBVNL	66.14	89.65	40.70	64.97	90.20	41.40	66.67	94.92	36.72	67.33	94.47	36.39
UHBVNL	64.34	84.04	45.93	64.98	88.43	42.54	67.64	88.56	40.09	69.47	81.87	43.12
H.P.	77.14	92.95	28.30	78.97	89.24	29.52	83.55	108.60	9.26	82.57	94.82	21.71
J&K	52.96	60.01	68.22	52.96	60.01	68.22	52.03	59.99	68.79	52.78	60.01	68.33
Punjab	74.46	97.16	27.66	75.92	96.87	26.45	75.41	98.77	25.52	76.30	99.59	24.02
Rajasthan												

AVVNL	65.93	77.30	49.03	60.10	97.81	41.22	54.49	98.73	46.21	52.95	94.88	49.76
JDVVNL	60.39	78.20	52.77	59.05	98.24	41.99	57.44	94.45	45.75	54.35	96.48	47.57
JVVNL	61.49	66.17	59.32	60.76	98.77	39.99	60.15	96.96	41.68	58.46	97.13	43.22
Uttar Pradesh												
UPPCL	63.01	84.24	46.92	67.79	100.63	31.78						
DVVN							59.18	82.02	51.46	67.41	62.27	58.02
MVVN							73.07	82.82	39.48	73.24	78.53	42.48
PaVVN							65.38	94.39	38.29	73.12	92.44	32.40
PoVVN							71.55	71.88	48.57	71.80	60.28	56.72
Uttaranchal				70.79	88.15	37.59	70.48	84.35	40.55	61.04	93.61	42.86
Total	**64.04**	**84.30**	**46.01**	**65.91**	**94.29**	**37.85**	**65.47**	**91.76**	**39.92**	**66.96**	**88.65**	**40.64**
Southern												
A. P.												
APCPDCL	72.96	97.45	28.90	77.12	90.52	30.19	79.12	102.39	18.99	80.21	94.81	23.96
APEPDCL	85.06	100.54	14.48	84.98	96.94	17.62	86.33	96.64	16.57	86.12	99.54	14.27
APNPDCL	76.71	95.83	26.50	78.76	92.56	27.09	79.75	113.10	9.80	80.80	96.65	21.91
APSPDCL	78.11	96.70	24.47	78.77	92.11	27.44	80.66	102.83	17.06	81.88	97.03	20.55
Karnataka												
KPTCL	65.11	91.38	40.50									
BESCOM				75.47	85.20	35.70	73.56	96.64	28.91	77.92	96.47	24.83
GESCOM				64.46	87.61	43.53	61.29	91.59	43.86	62.96	90.55	42.99
HESCOM				68.39	76.44	47.72	70.86	96.45	31.65	72.50	80.49	41.65
MESCOM				76.88	83.66	35.68	79.13	93.74	25.82	78.50	93.48	26.63
Kerala	67.85	100.46	31.83	69.59	91.69	36.19	71.55	94.02	32.73	73.77	92.01	32.12
Pondicherry	87.19	70.03	38.94	83.34	69.99	41.67	84.26	70.01	41.01	84.98	70.01	40.51
Tamilnadu	83.56	96.63	19.26	82.00	97.53	20.02	82.00	96.78	20.64	82.00	99.00	18.82
Total	**75.57**	**95.76**	**27.63**	**77.99**	**92.26**	**28.05**	**78.56**	**97.96**	**23.04**	**79.64**	**95.67**	**23.81**
Western												
Chattisgarh	67.75	90.01	39.02	69.48	89.99	37.48	73.18	90.65	33.66	68.35	102.46	29.97
Goa	76.83	66.99	48.53	80.65	95.49	22.99	81.55	96.53	21.28	82.36	100.45	17.27
Gujarat	77.16	99.43	23.28	68.87	99.85	31.24	71.04	97.16	30.97	70.84	98.36	30.32
M. P.	58.06	88.52	48.60	56.89	88.92	49.42	56.69	103.16	41.52	56.52	83.52	52.79
Maharashtra	60.45	88.77	46.34	63.64	87.60	44.25	63.37	96.34	38.95	66.01	111.16	26.62
Total	**65.58**	**92.11**	**39.60**	**64.71**	**92.03**	40.45	**65.37**	**97.21**	**36.46**	**66.06**	**101.84**	**32.73**
Grand Total	**67.25**	**90.91**	**38.86**	**68.37**	**92.68**	**36.64**	**68.80**	**94.80**	**34.78**	**69.87**	**94.72**	**33.82**
										(Source: PFC)		

Segregation of technical and commercial energy losses in distribution system – A methodology (By CEA1)

1. OVERALL ENERGY LOSSES:

The overall energy loss may be computed from the actual meter readings of the meters installed at various locations in the system. Determination of Aggregate Technical and Commercial Losses (AT&C) involves estimation of (i) Distribution and Billing losses (D&B) as difference between units input and units billed and (ii) Collection efficiency as the ratio of amount collected to amount billed. (iii) Units realized as the product of units billed and collection efficiency. (iv) AT&C loss as difference between units input and units realized.

Distribution and billing losses are due to technical losses, theft and metering deficiency.

For better understanding, the above principles can be translated in to the following equations

$$\text{D\&B Loss} = UI - UB$$

$$\text{D\&B loss}_{pu} = \frac{UI - UB}{UI}$$

$$\%\ \text{D\&B loss} = \frac{UI - UB}{UI} \times 100$$

Where UI is Units Input **(excluding units traded)**
UB is unit billed **(to consumers in its licensed area)**

$$(CE)_{pu} = \frac{\text{Amount Realised}}{\text{Amount Billed}}$$

Units Realised (UR) = Units billed x Collection Efficiency

AT&C loss = UI – UR

$$\text{AT\&C loss}_{pu} = \frac{UI - UR}{UI}$$

2. ENERGY LOSSES

2.1 Technical losses in EHV systems of Discom (33 kV & above System)

a. All the consumers at 33 kV and above are high end consumers (railways, big industries) and are billed regularly. Meters are regularly tested and as such there are no commercial losses in this system.

b. All the metering deficiencies have been rectified prior to carrying out the exercise of segregation of losses.

c. 0.5 Accuracy Class Energy Audit Meters to be provided at all interface points in the DISCOM's EHV network and step down ICTs connecting with 11 kV system .

d. Technical energy losses can be computed from the difference of energy recorded by the energy meters at the injection points and energy sent out.

e. Energy loss may be computed as follows from the actual meter readings of the meters installed at various locations in the system.Technical loss can be estimated as difference in energy input and energy sent out.

Total energy received from Transco	$= X_1$
Total energy received from Gencos	$= X_2$
Total energy received from other utilities	$= X_3$
Total energy received from all sources	$\mathbf{= X_T = X_1+X_2+X_3}$
Total energy sent out to 11 kV system	$= Y_1$
Total energy sent out to other utilities	$= Y_2$
Total energy sent out	$\mathbf{= Y_T = Y_1+Y_2}$
Energy lost in EHV System of DISCOM	$\mathbf{= X_T - Y_T}$

2.2 Technical losses in 11 kV System of Discom

a. Based on the actual meter readings, over all energy losses (Technical & commercial losses) from the 11 kV bus to the consumer level may be arrived at.

b. Commercial losses at 11 kV systems can also be eliminated by better metering and supervision by licensee.

c. All consumers at 11 kV are bulk consumer and Licensee may install remote metering module at these high-end consumers. Any attempt to tamper the meter can be transmitted to licensee.

d. Before segregating technical and commercial loss in the 11 kV system metering deficiencies be eliminated by periodical testing of meters.

e. As the number of consumers at 11 kV level is small, collection efficiency should also be 100%. Thus chances of commercial losses can be minimized.

f. Technical losses in 11 kV can be determined as difference between units input in the 11 kV system and units billed to 11 kV consumers plus units sent out to LV system.

g. Technical losses so determined can also be corroborated by sample studies of 11 kV System.

2.2.1 Alternate method :

a. Based on the actual meter readings, over all energy losses (Technical & commercial losses) from the from 11 kV bus to the consumer level may be arrived at.

b. A walk through survey may be carried out in respect of 11 kV system and such feeders may be identified where there is no commercial loss.

c. Licensee to ensure that meter of all consumers on these sample feeders are tested and incorrect/burnt/stopped meter, if any, is replaced by correct meter and there is no case of direct theft etc.

d. Technical losses in such feeders may be arrived at as difference between the sending end energy and receiving end energy at consumer end plus energy recorded at LV side of distribution transformers.

e. Weighted average of such results can be applied to all the energy handled to arrive at total technical energy loss in11kV systems. This can also be corroborated by sample studies of the 11 kV systems. This can be applied to all the energy handled to arrive at total technical energy loss in 11 kV systems.

h. The commercial losses are identified as the difference between overall energy losses and the technical losses calculated .

2.3 Technical losses in LV System of DISCOM

a. Technical Losses in LV system can be estimated either by system studies for sample feeders or by using actual meter reading on sample feeders. The merits and demerits of system studies on sample feeders are given as under :

- **Advantages**
  - Easy and Fast and no additional cost is involved.
  - Studies can be carried out on many feeders for more than one loading conditions.

- **Disadvantages**
  - Results would depend on accuracy of data.
  - Single-phase loads are difficult to be represented truly in studies.
  - Effect of harmonics present in the system cannot be determined
  - Would not be helpful in segregation of commercial losses.
  - Losses in LT system due to loose connections would not be reflected.

b. Technical Losses in LV system may be estimated by identifying some sample feeders such as:

- Lightly loaded
- Medium Loaded
- Overloaded

Feeding

- Domestic and Commercial loads
- Industrial loads
- Agricultural Loads.

- **Seasonal variation in load shall also be considered while selecting sample feeders.**

c. A sample of adequate size of LV feeders (say 2 or 3 feeders of each category) and consumers is to be chosen.
d. Meters of all consumers under the sample to be tested using 0.2 class reference meter and results of testing recorded.
e. Burnt/stopped meters to be replaced by correct tested meters.
f. Un-metered consumers are to be provided with correct tested meters (for audit purpose).
g. Meter reading of all consumers fed from the feeder to be done as quickly as possible and in any case within one day.
h. Meter reading of feeder to be done at beginning (1st consumer read) and at end (last consumer read). Average of two readings would be taken as reading for feeder
i. Sample Study for Calculation of Technical losses in LV Distribution System is given in Annexure-I.

3. ESTIMATION OF LOSSES IN DISTRIBUTION TRANSFORMERS (DTs)

Meters at HV and LV sides of DTs would be required to determine total loss in DTs. Difference between the energy recorded by meters on HV side and LV side would give loss in DTs. Most of DTs are located outdoor (pole mounted or plinth mounted and installation of meters on HV side would involve installation of instrumentation class CTs and PTs. These are

expensive and provision at each DT would involve huge expenditure without any tangible and fruitful results. Loss in DTs is generally of order of 2-3% depending upon loading conditions. Sample study may be carried out on different size of DTs and for different loading conditions and results of this study may be applied to whole DISCOM. HVDS is being used by DISCOMs. This system involves installation of large number of small single phase transformers. The pilferage or theft in these systems are unlikely. Total loss occurred in the system may be considered as technical loss at 11 kV (including loss in DT and service lines of consumers). Loss can be determined as difference in energy input and energy delivered to consumers from the said feeder.

4. SEGREGATION OF COMMERCIAL ENERGY LOSSES

Segregation of commercial energy losses due to theft/pilferage, metering, billing and collection deficiencies are given as under:

4.1 Loss due to inefficient metering :

a) Certain categories of consumers are unmetered. For example,

-Street lights,

- Street lighting are billed on point basis. i.e. 'No. of points x average hours of burning x average wattage of each lamp'. There may be small variation in actual and estimated usage.

- Common facilities (stair case lighting, compound lighting etc) in High rise buildings and Cooperative Group housing Societies (CGHS).

- There is no billing for common facilities in CGHS and these are to be treated as losses. Consumption by these facilities can be estimated on number of point basis till these facilities are also metered and brought in to billing net.

b) Losses due to defective meters can be estimated by selecting sample feeders as suggested above.

4.2 Due to Billing inefficiency:

Provisional bills raised for one or two billing cycles are self-adjusting and do not cause any loss. Provisional bill raised for less amount get adjusted in subsequent bills raised on actual meter reading basis. Similarly bills raised on wrong reading are also self-adjusting.

Bills raised on provisional basis over a long period of time may result in losses. These may be due to defective meter not being replaced or meter not being made available by consumer (premises locked). Consumer billed on provisional basis has tendency to misuse/overuse of energy. SERC Regulations on Supply Code may include a suitable provision that provisional bills cannot be raised for more than two billing cycles. This would minimize the losses due to billing.

4.3 Losses due to Collection Inefficiency:

As mentioned above, Losses due to Collection can be estimated as difference between Amount Billed and Amount Realized. However, there could be small inaccuracy in this estimation. Disconnected Connections are continued to be billed by Licensee and amount billed to such consumers is also reflected in total amount billed by licensee. As this amount would not be realized, Collection efficiency thus calculated get slightly distorted. Licensee has to update its database and discontinue billing of disconnected connections.

4.4 Losses due to theft/pilferage of energy:

Losses due to theft/pilferage can be arrived at as the difference between the total AT & C losses and losses due to Defective / Inaccurate Metering, Billing and collection inefficiency.

APPENDIX-VIII

ANNEX-I

Sample Calculation of Technical losses in LV Distribution System

Example: Number of consumers connected to a feeder = 100

Initial reading of feeder meter	at beginning (meter of 1st consumer read) =	X1
	at the end (meter reading of last consumer read) =	X2
	Average reading Xi =	(X1+X2)/2
Final reading of feeder meter	at beginning (meter of 1st consumer read) =	Y1
	at the end (meter reading of last consumer read) =	Y2
	Average reading Yi =	(Y1+Y2)/2
	Energy supplied by feeder Ui =	Xi –Yi

Calculation of energy consumed by consumers

Energy recorded by meters having accuracy with in permissible limits (± 3%)

Consumer No.	Recorded Consumption (kWh)	Meter Accuracy (%)	Actual consumption (kWh)
1	316	2	309.80
2	618	-3	637.11
3	256	-1.3	259.37
4	435	1.7	427.73
5	564	1.4	556.21
6	988	-0.8	995.97
7	756	2.2	739.73
8	1423	-2.8	1463.99
9	598	-1.9	609.58
10	782	-1.8	796.33
…			
Total	**269440**		**261639.55**

APPENDIX-VIII

Since the accuracy of meters sampled indicated in above table is within the prescribed limits of ± 3 %, the above variation in consumption need not be reflected in assessment of commercial loss, this variation is to be reflected in the technical losses of the system.

Energy recorded by defective meters having accuracy beyond permissible limits (± 3%)

Consumer No.	Recorded Consumption (kWh)	Meter Accuracy (%)	Actual consumption (kWh)
1	1324	4	1273.08
2	546	-4.5	571.73
3	324	3.4	313.35
4	867	-6	922.34
5	657	4.2	630.52
6	387	-5.2	408.23
7	1278	-5.4	1350.95
8	1265	4.5	1210.53
9	278	-4.8	292.02
10	1234	-5.2	1301.69
…			
…			
Total	8160		8274.42
Loss due to defective metering			114.42

Energy recorded by stopped/burnt meters: billing done on provisional basis.

Consumer No.	Provisional consumption (kWh)	Recorded Consumption by new meter (kWh)	New Meter Accuracy (%)	Actual consumption (kWh)
1	310	1324	1	1310.89
2	245	546	1.3	538.99
3	567	324	2.2	317.03
4	321	867	2.1	849.17
5	211	657	1.1	649.85
6	96	387	0.7	384.31
….				
…				
Total	3471	6926		7055.01
Loss due to provisional billing			7055.01-3471	3584.01

APPENDIX-VIII

Energy Lost due to un-metered supply (Flat Rate Billing)

Consumer No.	Units billed on flat rate (kWh)	Recorded Consumption (kWh)	Meter Accuracy (%)	Actual consumption (kWh)
1	100	1324	1	1310.89
2	200	546	1.3	538.99
3	250	324	2.2	317.03
4	150	867	2.1	849.17
5	300	657	1.1	649.85
6	100	387	0.7	384.31
7	150	1278	0.3	1274.18
8	200	1265	2.1	1238.98
9	100	278	2.5	271.22
10	300	1234	0.9	1222.99
…				
Total	1850	8160		8057.61

Loss due to Flat Rate billing 6207.61

The above description is summarized as below:

	Recorded/Billed Consumption	Actual Consumption
Meters Within Limits	269440	261640
Defective Meters	8160	8274
Stopped/burnt meters &Provisional billing	3471	7055
Flat Rate Billing	1850	8057
Total	**282921**	**285027**

Loss due to metering and billing = 285027-282921 = 2106 units (0.69 %)

Energy Input as recorded by Feeder meter (UI) =	302128 (say)
Energy consumed =	285027
Technical Loss in LT system =	302128 – 285027= 17101
% Technical loss =	100x17101/302128 = 5.66%

APPENDIX-VIII

Weighted average of results of different sample feeders:

Sample Feeder	Input	Consumed	% Loss
Feeder 1	302128	285027	5.66
Feeder 2	1823457	1795677	7.00
Feeder 3	276345	253458	6.11
Feeder 4	2178653	1987345	8.78
Feeder 5	4567834	4324567	9.70
Total	**9148417**	**8352074**	**8.70**

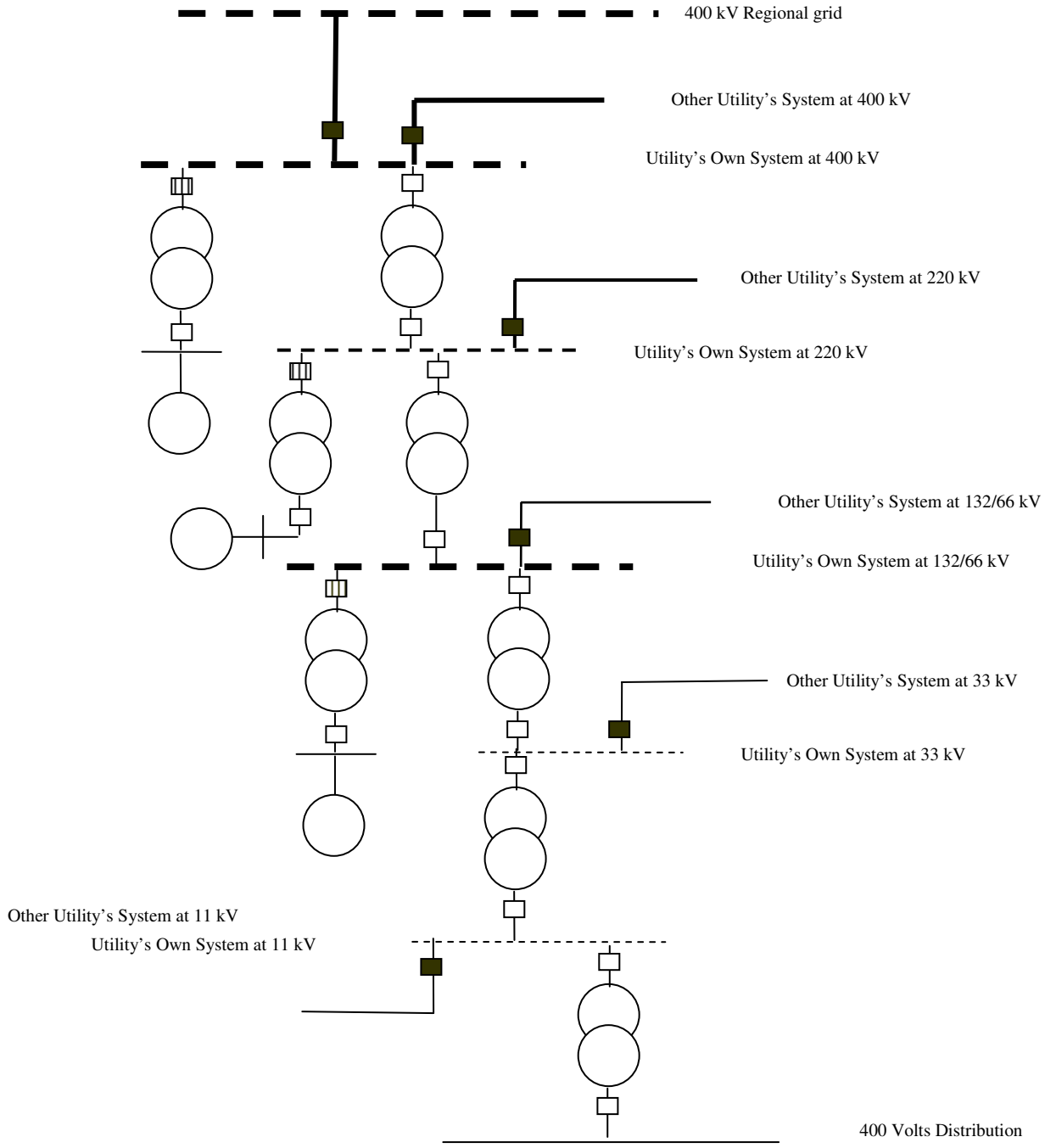
Based on above sample study the results can be extrapolated to entire LT system.

APPENDIX-VIII

Determination of Loss due to Theft and Pilferage

	Particulars	**Measured Loss (%)**	**Energy (MU)**	**% loss on Total Energy Input**
	A	**B**	**C**	
1.	Total Energy Input to DISCOM		7156.396	
2.	AT&C Losses	35.00%	2504.739	
3.	Collection Efficiency	97.00%		
4.	Units realized		4651.657	
5.	Units Billed		4795.523	
6.	Loss due to Collection in-efficiency		143.866	2.01
7.	Tech Losses at 33 kV and above level (say)	2.30%	164.597	2.30
8.	Energy Input at 11kV level		6991.799	
9.	Tech Losses at 11 kV level (say)	3.40%	237.721	3.32
10.	Energy input at LT level		6754.078	
11.	Tech Losses at LT level	8.70%	587.605	8.21
12.	Loss Due to Metering & Billing	0.69%	46.603	0.65
13.	AT&C Losses excluding loss due to theft		1180.392	**16.49**
14.	Loss due to Theft		1324.347	**18.51**

APPENDIX-VIII



0.2 Class meters at all interface points. Input is recorded positive and output is recorded as negative.

0.2 Class meters at ICTs. Input is recorded positive and output is recorded as negative consumption

0.2 Class meters at GTs. Input is recorded positive and output is recorded as negative consumption

Loss at Particular Voltage level would be sum of energy recorded by all meters installed at that voltage

IT based Energy Auditing in Power Distribution Systems

The main issue in Distribution systems or rather more appropriately the issue confronting the power sector as a whole, is the reduction of Aggregate Technical and Commercial losses (AT&C losses) to acceptable minimum levels. The AT&C losses at the beginning of the reform process stood at 38.18% in 2001-02. With the initiatives taken the AT&C losses have reduced to 32% in the year 2006-07. Even then the losses continue to remain high and these high losses are neutralizing all other efficiency improvement initiatives thus making it the biggest challenges for distribution entities. It is estimated that more than 75 percent of the total losses take place at the distribution stage and 50% of those losses are commercial in nature. Nationwide, theft of energy services costs utilities and consumers billions of Rupees each year.

The loss estimation drives the loss reduction initiatives and therefore correct loss estimation through energy accounting and auditing is the starting point for the loss reduction process. Once the losses are estimated and segregated into technical losses and non-technical losses and their location identified, suitable measures can be devised for reduction of these losses.

Energy audit

Energy Audit is the technique to establish the current status of energy efficiency of the various elements in the system. It involves identifying high loss areas, segregating the losses into technical and commercial losses, estimating energy conservation potential and proposing visible and economically attractive solutions. The segregation is a very complicated exercise and that is why to date very few utilities have carried out this segregation.

The ultimate end result of such an exercise is to improve system performance, increase its efficiency and introduce design changes leading to renovation, modernisation and upgradation. Energy accounting gives the overall picture of energy availability and its use. Energy audit enables analysis of the data in meaningful manner to evolve measure to introduce checks and balances

in the system to reduce leakages and losses and also to improve technical performances**.**

Segregation of losses into technical and non technical losses

The energy account gives the total losses (technical + commercial) over any element. To segregate the losses into losses due to commercial and technical losses, the first step is to compute the technical losses.

Computation of technical losses

The technical losses in distribution network may be estimated by computer aided system studies through simulation of the network equipment. The essential input for estimation of technical losses is;

- Network map with length and conductor sizes
- Equipment data
- Load data
- Peak and average loadings
- Power flow at critical buses of the network
- Load flow analysis for complete 66/33 kV network emanating from 220/132 kV grid substation, 11 kV lines and distribution transformers to determine peak power loss
- Load flow analysis for low voltage network emanating from distribution transformer under typical 11 kV feeder covering high, medium and low load density area of the circle to determine peak power loss. The results of this low voltage typical network may be extrapolated for the complete low voltage network on the circle.
- Validate the load flow results by measurement of voltages at selected buses or/and measurement of currents at selected distribution transformers.
- Computation of technical energy loss using appropriate load factors and loss load factors.

APPENDIX-IX

System studies are carried out through well established distribution system analysis softwares available in the market. Load flow studies for the distribution system can be carried out utilising the data from 11 kV feeder's meter and field data of distribution transformer loading (through tong testers) and energy losses may be worked by applying load and loss load factors suitably. With availability of software, load flow studies can be carried out for different loading conditions during the energy accounting period for more reliable results. Estimation of losses in LT network may be done initially for sample network emanating from representative distribution transformers covering different category of consumers and load density. With full computerisation of database it would be feasible to cover the whole LT system as per needs.

Computation of commercial loss

The difference of energy input measured at feeder end and the recorded consumption, is the total loss. The difference of total loss and the loss obtained from simulation studies **(technical loss)** is an indication of the **non- technical loss** in each distribution feeder.

- Energy loss as calculated from meter readings = A
- Technical loss as computed from system studies = B
- Commercial loss = A-B

It is not possible to conduct energy audit for the entire power systems of a utility in one go due to financial, organizational and logistical constraints. Hence it has to be conducted in stages. A compact area of the power system would have to be identified and energy audit studies taken up.

STEPS FOR CONDUCTING ENERGY AUDIT

The fundamental approach to energy accounting should be bottoms-up and related to organizational and responsibility structure of the utility. Energy audit has to start from Distribution transformers to 11 kV feeders to 33/11 kV Substations to the entire area selected for Auditing . The steps to Energy Audit would be :

- Install energy meters on Distribution Transformers wherever not installed. DT meters should have facility for downloading data locally/ remotely depending upon utility practice
- Complete consumer indexing so as to identify which consumers are connected on a particular DT
- Ensure meters are installed on all the consumers connected to DT
- Non functioning or malfunctioning meters in the system may also causes distortion in loss estimations. The meters need to be checked for their accuracy, before conducting energy audit studies. The defective meters need to be replaced by correct meters
- Record energy sent out from DT for the period for which energy audit is being carried out.
- For the above period calculate the energy consumption of all the consumer connection to a particular DT
- Consumer reading which have been taken at times different than the starting and ending of the period need to be extrapolated to match with the energy accounting period
- Implement software tools for compilation of DT wise report giving total energy sent out and category wise consumers consumption
- Calculate the difference between the DT wise energy sent out and total of all the consumer's consumption to arrive at total losses
- Calculate the technical loss as per above
- Subtract Technical losses from the above to arrive at commercial losses.

APPENDIX-X

REPORT NO. 22171-IN

INDIA
POWER SUPPLY TO AGRICULTURE

VOLUME 3 ANDHRA PRADESH CASE STUDY

JUNE 15, 2001

Energy Sector Unit South Asia Regional Office

Document of the World Bank

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CHAPTER 1

OVERVIEW AND CHARACTERISTICS OF SAMPLE FARMERS

A. Introduction

1.1 The supply of electric power to agricultural consumers is often thought to be the source of the crisis in the power sector in India. Farmers are estimated to pay tariffs (agricultural tariffs) that represent a fraction of the increasing cost of power supply, and some states, such as Tamil Nadu and Punjab, supply power to agricultural consumers free of charge. In Haryana farmers pay just 12 per cent of the cost of supply yet they use nearly half of the electricity produced. In Andhra Pradesh, farmers pay about 4.5 per cent (FY2000) of the cost of supply and use 40 per cent amount of the electricity produced in the state. Obviously the decision to increase tariffs is among the measures that generate the strongest political opposition.

1.2 The agricultural sector is key to the economic development of the state of Andhra Pradesh. In FY1999, agriculture contributed 28 per cent of the State Gross Domestic Product (GSDP), and employed about 70 per cent of the workforce in the State. Continued agricultural growth, therefore, is viewed to be critical not only to sustaining economic growth in the State, but also to reducing rural poverty as it drives rural employment and income growth. In FY1994 it was estimated that half the total poor population of AP, about 7.7 million people, lived in rural areas. AP, like Haryana, is one of the major surplus producers of rice, accounting for about 13 per cent of India's total production in FY1999 (CMIE 1999b).

1.3 The agricultural sector in Andhra Pradesh has grown significantly in the past two decades, in part due to increased access to irrigation. The gross irrigated area (GIA) in FY1999 accounted for about 45 per cent of total cultivated area, or 6.1 million ha, up from 30 per cent (4.7 million ha) of GIA in FY1982. The more widespread use of irrigation also contributed to yield growth, reduced production variability and diversification to higher value crops (oilseeds, cotton, fruits and vegetables). In FY1999, about 95 per cent of rice and sugarcane area was irrigated, 75 per cent of wheat, 34 per cent of maize, 20 per cent of groundnut and 17 per cent of cotton.

1.4 The power sector, therefore, exerts a critical influence on the performance of the agricultural sector as it influences farmer access to, and use of, power for a variety of agricultural operations but most importantly for pumping groundwater for irrigation purposes. A large share of the increase in irrigated area in the State came from the expanded use of groundwater. Net irrigated area using groundwater pumped from wells increased 140 per cent to 1.9 million ha between FY1982 and FY1999. During the same period, the share of farms with wells in net irrigated area doubled from 21 per cent to 42 per cent. By the most recent estimates (FY1995), AP has a high density of pumps, with a ratio of 125 electric pumps per 1000 ha of gross irrigated areas. As much of the groundwater is pumped using electric pumps sets, the supply of power, therefore, is key to the production performance of a major sector of the farm population. The diesel pumps in the state of Andhra Pradesh were estimated around 165,000 in 1993 (Directorate of economic and Statistics, GOAP) whereas the electric pumpsets are estimated to reach about 2 million in the year 2000.

1.5 This study has been done in collaboration with the government of Andhra Pradesh to facilitate the decision making process on agricultural tariffs and, more generally, to help formulate recommendations on power policy reforms as well as irrigation and agricultural measures which could complement power sector reforms to improve rural development opportunities. In this chapter the methodology used in the study is discussed along with a description of the characteristics of farmers that

were surveyed, such as land ownership, cultivation practices and pump ownership. A separate report describes in detail the methodology and sampling.

1.6 In Andhra Pradesh, the study used data collected from an Attitude survey and six Recall surveys undertaken during the year 1999/2000. In Haryana which also collected data from farmer surveys, a separate metering study of both electricity consumption and supply was conducted in parallel. This was not possible in AP because of delays in pump selection due to a change in the sample, delays and difficulties in meter installation and incomplete meter readings. In addition, the recall surveys were also not as complete as the ones conducted in Haryana because of the difficulties in reaching farmersbecause of the flooding that affected many regions in the summer of 2000. and hostilities faced by the survey teams in some of the villages, which are known to be affected by serious order problems. These problems led to shortcomings in the completeness and reliability of the recall survey data. This, coupled with the lack of information from a metering study, meant there were inadequate data for building an accurate econometric model, as was done for Haryana. As a result it was not possible to produce policy simulations for Andhra Pradesh. However, a metering program is underway in AP and is expected to generate results in the next fiscal year and data collected through the survey will be further reviewed. Therefore, there may be a possibility to conduct policy simulations in AP when these data become available in 2002.

1.7 In the following chapter, the relationship between irrigation choices and farm incomes is discussed. It describes the regressive nature of the current flat rate tariff and shows the costs associated with different irrigation choices. It also shows that farmers who use electric pumps have the highest incomes.

1.8 The conclusions and broad recommendations discussed in Chapter Three are similar to those presented in the report on Haryana. Despite the absence of an econometric model for AP it is reasonable to suggest that the recommendations posited for Haryana can also be made for AP since the state faces the same problems in power sector and there are enough similarities in the make up of its farm population and cropping patterns.

B. Methodology

1.9 **Farmer Household Survey.** The study collected data from farmer household recall surveys undertaken during the year 1999/2000, covering the 1999 Summer season, 1999 Kharif season and 2000 Rabi season.[1] Two recall surveys were conducted in each season, one in the beginning and the other at the end of the season. The survey included 1,819 farmers using combined technologies for irrigation (groundwater using electric pumpsets or diesel pumpsets, canal and other surface water irrigation, water purchasing) and 301 farmers cultivating under rainfed conditions, in six regions (Table 2.1). The sampling methodology and procedures, included in the Methodological Framework and Sampling Report, were discussed and agreed with the government of AP. The regions were selected to ensure farming conditions, such as cropping patterns, types of irrigation used, rainfall and water quality, were more or less similar within a region.

1.10 Farmers were classified into several categories according to irrigation choices and the amount of land they owned and/or cultivated. A small number of pump owning farmers (electric and diesel) also use canal irrigation as an additional source of water. There were no farmers who owned both electric and diesel pumpsets in the sample. Since the primary focus of this study is on the impact of power supply on agriculture, a larger sample was selected for electric pump owners.

[1] Summer season-April to June; Kharif season – June to November; Rabi season – November to April .

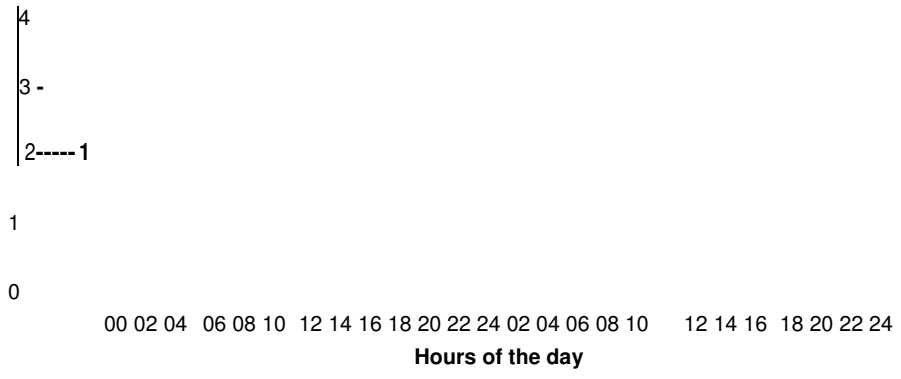
Table 1.1 - Distribution of sample farmers by source of water

	Electric pump owners			Non-electric diesel pump owners			Non-Pump Owners			Total Sample
	Electric pumps only	Electric pumps & canal only	Total 132 212 135 122 134 181 916	Diesel pumps only	Diesel pumps & canal	Total 47 74 43 31 27 43 265	Canal user only	Water purchasers	Rainfed	
I	116	16		43	4		67	37	46	329
II	207	5		74			104	76	70	536
III	135			43			67	16	**44**	305
IV	122			31			59	22	42	276
V	134			27			52	17	41	271
VI	172	9		41	2		85	36	58	403
TOTAL	886	30		259	6		434	204	301	2120

Source: Farmers recall survey

1.11 **Electricity supply conditions in AP**. Power supply to agriculture is allocated through rostering. This involves supplying power during pre-announced and restricted hours. Adherence to the rostering schedule by the utility is critical for farmers to ensure that adequate water is available, particularly during critical periods in the crop growth cycle. Any delays could adversely affect crop performance and the ability to achieve the optimum yields. Rostering generally involves: (i) dividing farmers into groups and (ii) supplying power (outside of peak load periods) to a particular group only for a fixed number of hours at a pre- announced "scheduled" time during the day or night . Access to power by farmers is regulated by providing the "three phase" supply for operating the electric pumps only during the pre-scheduled hours. At other times, only "two phase" supply is provided or power is cut off completely[2]. This arrangement reduces the power demand to one half or one third of the total coincident maximum demand of the whole sector. The utilities use an ingenious technical mechanism to implement this arrangement, which is probably unique to India (see Box 1.1). In AP, farmers are divided into two groups, rotating every two days, following a schedule of 9 hours of three-phase supply (6 & 3 hours), 9 hours of two-phase supply and 6 hours of no power (Figure 1.1).

Figure 1.1 - Power supply Rostering in Andhra Pradesh



[2] The two phase mode is supplied so that only the single phase domestic/commercial requirements are met. However, this approach also restricts the access by the three phase industrial consumers in the same area, if they are provided with power supply from the same rural feeder.

Box 1.1 - Power Supply Rostering Arrangement for Agricultural Consumers

The agricultural pumping load is mostly supplied through three phase system and the consumers use three phase induction motors of varying horse power to suit their irrigation requirements. This unique technical arrangement used to restrict power supply hours to the agricultural consumers employs switching of specially designed load make/ break switches, which with the help of a single lever operation, snaps the power supply to one phase from the source side and connects to one of the remaining two phases. (Generally a three phase power supply system would have in each line power with same magnitude as the other line but with different directional orientation (technically with phase angle separation of 120 degrees from each other). These phases are traditionally known as R, Y & B designated with the name of three different colors. Although the current European practice is to designate these as L1, L2 and L3. After this arrangement comes in operation the feeder has all the three lines charged, but two of them are running in same phase and in parallel. This arrangement hinders the farmers from running three phase motors, but allows other single phase supply users like domestic and shops etc. to use the electricity for their consumption. This arrangement puts tremendous stress on the phase which supplies power to two lines and also could be a contributor for high equipment failure rate in the distribution system. Notably, some of the farmers have developed a way out to pump water, when it is needed most by them, by converting this two phase system to three phase system by using phase split capacitors.

C. Characteristics of Farmers

Land Ownership and leasing

1.12 Farmers were classified into four categories according to the amount of land they owned. These categories, and the percentage of sample farmers in each category, are as follows:

(i) marginal if they own less than 1 ha –39 per cent; (ii) small if they own greater than 1 but less than 2 ha – 29 per cent; (iii) medium if they own greater than 2 but less than 5 ha—26 per cent; (iv) large if they own greater than 5 ha –5 percent.

1.13 Farmers were also classified by operational holdings, that is the sum of land owned and leased. This changed only slightly the distribution in the sample: marginal – 38 per cent, small –30 per cent, medium –27 per cent, large –5 per cent. This compares with the population distribution of farmers by operational holding in AP (FY1996), which is marginal—59 per cent, small—21 per cent, medium—13 per cent, and large—6 per cent.

1.14 The land market in AP is not very active as compared to Haryana where the distribution in the sample for operational holding changes significantly when compared to that based on land ownership. In Haryana, for example, marginal farmers who owned electric pumps were able on average to increase their holding from one to five hectares through leasing. Electric and diesel pump users in AP, on average, own more land than other technology categories. (Table 1.2) However, a comparison of farmers' operational holdings in the sample, with that of the total population reveals that although 50 per cent of the sample of marginal and small farmers own an electric tubewell, they represent a smaller portion compared to the entire population of farmers in the state (small and marginal represent almost 80 per cent of the population). Sample farmers using other technologies have a smaller land size, more in line with the overall population proportion.

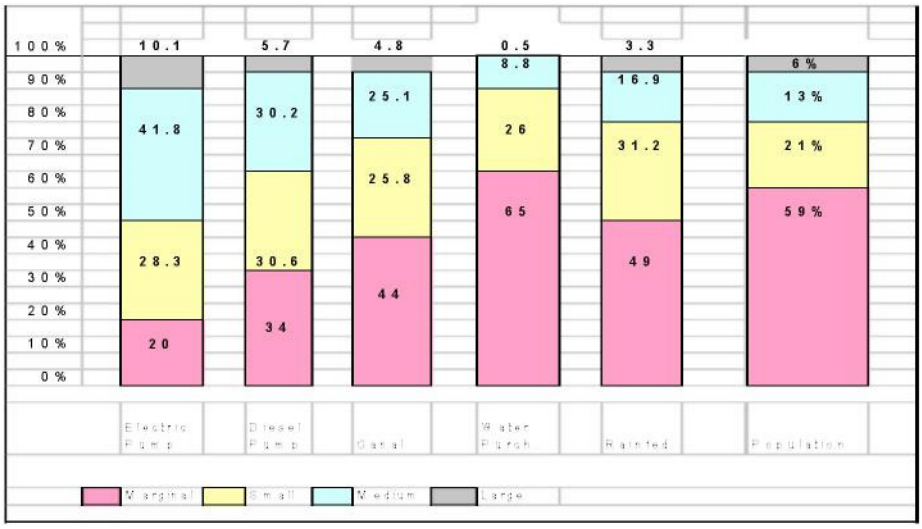
Table 1.2. - Average land owned by type of technology (hectares)

Farm Size	Electric pump owners			Non-electric diesel pump owners			Non Pump Users			Total
	Electric pumps only	Electric& canal only	Total 0.7 1.4	Diesel pump only	Diesel and canal	Total 0.6 1.3	Canal user only	Water purchasers	Rainfed 0.6 1.3	
Marginal	0.7	0.7	2.8	0.6	0.8	3	0.6	0.5	2.8 8.2	0.6
Small	1.5	1.4	7.2 2.2	1.3	1.4	7 1.9	1.4	1.3	1.4	1.4
Medium	2.8	3.2		3	3.7		3	2.7		2.9
Large	7.1	7.7		7			7.4	6.1		7.3
	2.1	3.3		1.9	2.8		1.7	0.9		1.8

Source: Farmers Recall survey

1.15 As noted, the farm sector in AP is dominated by marginal and small farmers who make up 2/3 of the farmers sampled and 80 per cent in the state population. This compares to Haryana where half the farmers are marginal and small. Reflecting this, the average farm holding in AP at 1.8 hectares is one

Fig. 1.2 - AP Distribution of Farmers by Technology and Operational Holding*



*** Defined as land owned minus land rented out plus land rented in**

hectare less than the average land owned in Haryana. However, as in Haryana, pump ownership is not confined to larger sized farms, as shown in Figure 1.2, Among the farmers sampled, marginal farmers account for 20 percent of those who used electric pumps. However, marginal farmers constitute 44 per cent of sample farmers who use canal water and 65 per cent of the sample farmers who are water purchasers.

1.16 The survey also found that across technologies, there are insignificant differences in the average land owned by small (1.3-1.4 ha) and marginal farmers (0.6-0.7 ha). However, there is greater variation in farm size owned by medium and large farmers. In Haryana, though the landholdings are slightly larger, the pattern of ownership is the same: electric pump users own more land than farmers in other categories.

1.17 The relatively small size of the average land owned in the State overall (1.8 ha) and across technologies (1.4 ha to 2.2 ha) is also consistent with the findings of other studies. They also reinforce concerns about the increasing marginalization/fragmentation of land in AP. This has several implications, not only in terms of decreasing economic viability of extremely small farms, but also in terms of limiting incentives for on-farm productivity enhancing investments (e.g. pumps and tubewells). Access to lease markets could partly compensate for declining farm sizes, but as discussed below, extensive restrictions on leasing limit this option.

1.18 Unlike in Haryana where there is an active land leasing market, although it is permitted in AP, there is very limited leasing happening on the ground. Only about 0.1 per cent of farmers using electric pumps, diesel pumps, canal irrigation and water purchasers participate in the lease market (see Annex 1, Table 2.3). As the legal framework for formal leasing in the state is highly restrictive, not only in terms

of area but also duration (only renewable 5 years terms are permitted), it creates disincentives for official leasing. This is confirmed by the results of the study, which show that the average net area leased in is 0.1 ha. Limited access to land leasing has important implications. Due to the short-term nature of arrangements, it discourages productivity enhancing investments (including fixed investments such as wells and pumps). It could also impose constraints to accessing credit, by the inability to show recognized rights to land.[3]

D. Gross cultivated area and cropping intensity

1.19 0n average, electric pump users in the sample cultivated a larger area per year (3.7 ha) relative to other technologies. The average area cultivated annually by diesel pump and canal users was 3.3 ha. Rainfed farmers cultivated 2.2 ha on average, while water purchasers cultivated 1.8 ha.

1.20 Small and marginal farmers with access to electric pumps are able to irrigate and cultivate a larger area than farmers using other technologies, although the differences are not as great as in Haryana where electric pumps owners can lease land in. Although there is insignificant difference in the size of land owned by small and marginal farmers across technology categories, small and marginal farmers using electric pumps cultivate a larger area per year—2.1 ha and 3.2 ha respectively—compared to 1.3 ha and 2.3 ha for diesel pump users, and 1.6 ha and 2.7 ha for canal users (Table 1.3).

Table 1.3 - Average gross area cultivated annually (ha)

Farm Size	Electric pumps only	Diesel pump only	Canal user only	Water purchasers	Rainfed
	2.1	1.3	1.6	1.2	1.7
Small	3.2	2.3	2.7	2.4	2.1
Medium	4.5	5.3	4.8	3.3	2.8
Large	7.9	9.2	12.5	12.1	5.5

Note: cultivated for rainfed farmers

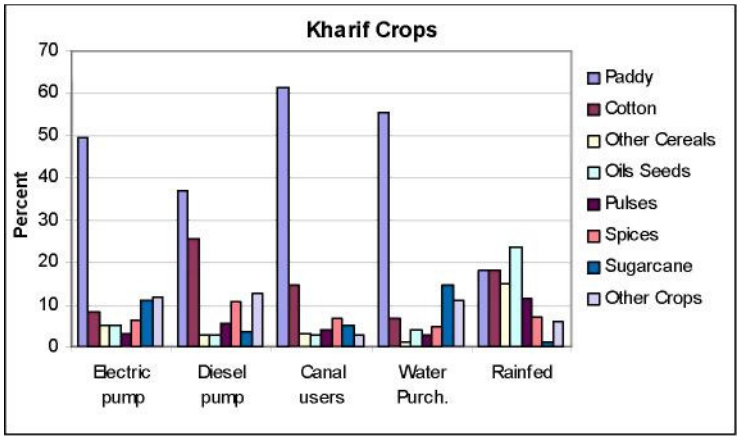
Source: AP Recall Survey

Marginal and small farmers who own electric pumps have the highest cropping intensity, ie. cultivating the same land over different growing seasons. They use all their land (0.7 ha and 1.4 ha, respectively) for cropping during each of the three cropping seasons which gives them annual gross cultivated areas of 2.1 ha and 3.2 ha, respectively. Farmers who use other irrigation technologies do not use their land as intensively. However, supplementary irrigation permits farmers to cultivate a proportion of their land in Kharif, when rainfall is more plentiful, and in the Rabi and summer seasons when rainfall is scarce. This increased cropping intensity is demonstrated by the significantly larger amounts of land under cultivation across all technologies compared to solely rainfed farmers.

SeeWorld Bank, Andhra Pradesh Rural Poverty Report, May 17th,2000 (mimeo) for more detailed discussion.

1.21 **Cropping Patterns.** Rice, a highly water intensive crop, dominates the cropping pattern in AP. Cotton is the second largest crop cultivated. Among the sample farmers, during the Kharif season, when rainfall is plentiful, rice was the largest single crop for all farmers, with the exception, as expected, of rainfed farms who put just 18 per cent of their land down to paddy and planted 23 per cent of cropped area with oilseeds, a less water intensive crop. Access to irrigation and the cost of that form of irrigation clearly affects cropping decisions. For canal users who use the cheapest source of water, rice accounted for 61 per cent of cropped area; for water purchasers it was 55 per cent. For electricity pump users, 50 per cent of cropped area went to rice and for diesel pump users, 37 per cent (see Fig.1.3).

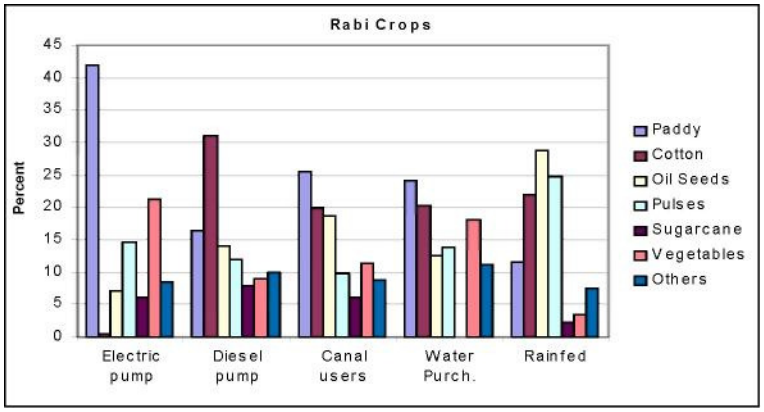
Fig 1.3 - Cropping Pattern during Kharif Season



Source: AP Farmer recall survey.

1.22 Rice is similarly favored during the Rabi season, especially among electric pump users. It accounted for 42 per cent of cropped area (Figure 1.4). Greater control over water availability when using electric pumps may partly explain this preference. Notably, there is a significant shift to less water intensive and higher value crops like oilseeds, cotton, vegetables in the non-electric pump using categories. Among diesel pump users, there is a decline in area devoted to rice (from 37 per cent to 16 per cent of the area) in the Rabi season, with a shift to other major crops such as cotton (31 per cent), oilseeds (14 per cent), pulses (12 per cent), and vegetables (9 per cent). Among canal users, there is also a sharp decline in area devoted to rice: 26 per cent compared to 61 per cent in the Kharif season. Instead, cotton (20 per cent) oilseeds (19 per cent), vegetables (11 per cent), and pulses (10 per cent) take up most of the area. This is probably partly due to the increasing scarcity of water during the Rabi season for diesel pump owners and canal users and water purchasers. However, other factors may also be driving the shift, such as improved access to markets for these higher margin crops and attractive prices. In the summer, due to limited water supply, few crops are grown. They consist mainly of oilseeds and sugarcane, the later confined to areas with assured irrigation.

Fig 1.4 - Cropping Pattern during Rabi Season



Source: AP Farmer recall survey.

1.23 **Crop Yields.** There is very little variation in yields across technologies for rice (Table 1.4). There is greater variation in yields among other crops, although no clear pattern or trend is identifiable. For oilseeds and cotton, those using diesel pumps post the highest yields, followed by electric pump users and canal users. Fruit and vegetable yields are highest among electric pump users. Given that yields are determined by many other factors (e.g. agro-climatic conditions, soil quality, output prices, socio-economic characteristics of farmers, etc), linkages between source of water and productivity cannot be clearly established without more rigorous analysis.

Table 1.4 - Yields of selected major crops in study area, quintal/ha

Crop	Electric pump	Diesel pump	Canal users	Water Purchasers	Rainfed	TOTAL
Paddy	25.0	27.8	25.8	26.3	26.8	25.6
Pulses	85.7	54.6	29.2	37.7	77.6	76.7
Other Cereals	77.6	47.9	43.3	21.9	47.7	84.1
Oil Seeds	57.0	63.8	24.4	55.3	28.3	64.1
Cotton	3.9	4.0	3.6	4.0	3.9	3.9
Flowers	3.9					3.9
Fruits	17075.6	12491.8	17.3	199.0		15976.9
Vegetable	768.6	502.2	341.0	281.8	266.1	767.4
Spices	212.1	230.2	234.0	82.5	165.3	253.0
Sugarcane	484.1	291.3	463.1	437.9	404.1	468.4
Tobacco	15.6	14.4	12.4	14.0	15.2	15.1
Coconut	6929.0	7968.6	10097.8	6188.1		7237.1

Note: quintal =100 kg
Source; AP Recall Survey

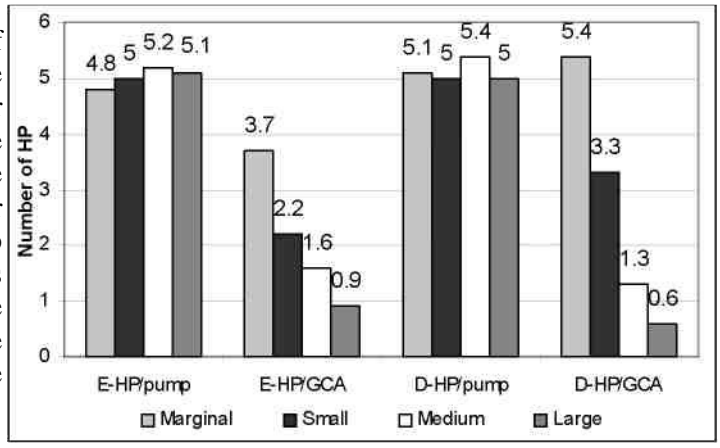
E. Characteristics of Pump Ownership

1.24 In the study, the number of pumps exceed the number of farmers who own pumps in the sample: the 916 electric pump owners have 946 pumps, while the 265 diesel pump owners have 293 pumps. This is due to multiple-pump ownership and/or joint ownership. Well depth is an important factor in the choice between using electric or diesel pump. Electric pumps are more predominant in areas where the groundwater depth is higher. Diesel pumps are more efficient and cost effective to use in areas where the water table is not so deep.

1.25 The majority of farmers who own electric pumps, regardless of size category, generally own just one electric pump. This does not differ much by farm size category (See Annex 1 Table 1.5). Multiple electric pump ownership was limited, unlike in Haryana where nearly half electric pump owners have more than one pump. A few farmers in all farm size categories own more than one pump. The study found that around between 4 per cent and five per cent of marginal, medium and large farmers own more than one pump, but just one per cent of small farmers own an additional pump. About one per cent of farmers own less than one pump—this is made feasible through joint ownership. Only six farmers, out of the more than 1,800 farmers surveyed in the study report joint ownership of electric pumps. Among farmers who own diesel pumps, they all own only one pump.

1.26 **Distribution of pump horsepower (HP) reported by farmers.** On average, there is little variation in electric pump capacity across farm size. Among electric pump owning farmers, the HP of pumps of marginal and small farmers on average are 4.8 and 5.0 HP respectively, in contrast to 5.2 to 5.1 HP for medium and large farmers (Figure 1.5). The absolute size of pumps, however, vary significantly across regions. The average size of pumps in Region I and II, where the groundwater depth is higher than other regions, is around 6 HP, while the average size of pumps in the rest of the state is around 4.3 to 4.8. A similar trend is found among diesel pump users. The average size of pumps among small and marginal farmers are 5.0 and 5.1 HP respectively, while those of medium and large farmers are 5.4 and 5.0 HP respectively.

Fig1.5 - Distribution of horsepower of pumps by farm size (hp) and gross cultivated area (hp/ha)



Note: E- electric pump, D- diesel pump, GCA-gross cropped area
Source: APfarmer recall survey.

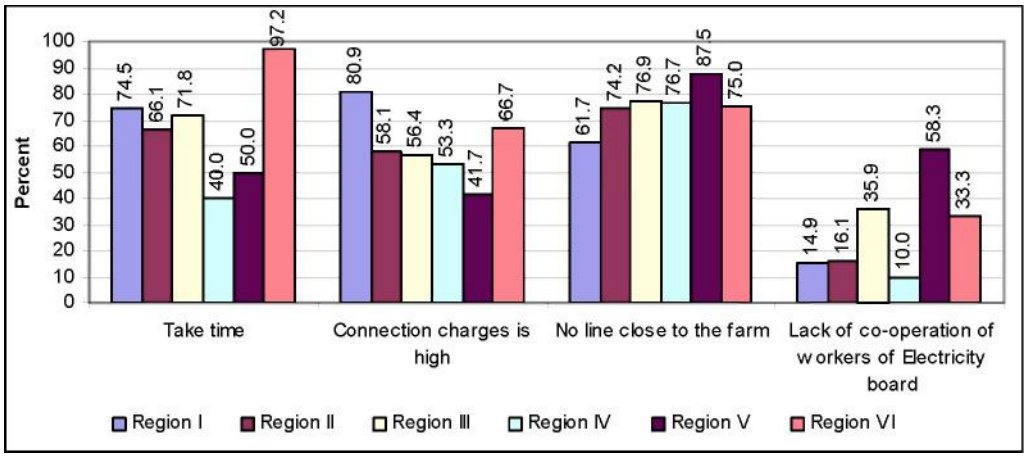
1.27 Although small and marginal farmers generally operate pumps with lower HP in absolute terms, there appears to be an inverse relationship between farm size and the horsepower per hectare of gross cultivated are. Marginal farmers using electric pumps invest in more than three times greater HP (3.7 HP) than large farmers (0.9 HP). Small farmers also had comparatively more powerful pumps per cultivated hectare at 2.2 HP. A similar trend is observed among diesel pump owners. The average HP per cultivated area among marginal farmers is 5.4 HP per ha compared to 0.6 HP per ha for large farmers.

1.28 There are several possible reasons for this investment behavior. First, small and marginal farmers who tend to be more risk averse, may be investing in higher HP to cope with the limited availability and reliability of power supply. This permits them to pump larger volumes of water in a shorter period of time. Second, the minimum size of pumps available (i.e. 3 HP for electric pumps), and the indivisibilities in pump sizes available places a lower bound on the choice of pump size for small farmers, relative to their farm size. Third, larger HP may be necessary in regions where groundwater depth is higher. Fourth, there is limited prevalence of joint ownership in AP (as compared to Haryana, and fifth, there is a limited capacity for smaller farmers to lease land.

1.29 **Pump Choice Between Diesel vs Electric Pumps**. Diesel pump owning farmers were asked why they invest in diesel pumps. Three quarters cited the unavailability of an electricity connection. This was cited by more farmers in regions III, V and VI. Other factors cited by farmers as influencing their choice of the diesel pumps are the ease of bringing the engine to the field (18 per cent overall but nearly 30 per cent in Region II), reliability (14 per cent) and availability of diesel fuel (14 per cent). Nearly 45 per cent of farmers in region II cited the availability of diesel as a key reason for investing in diesel pumps. In Haryana the responses to the same question were slightly different though the biggest reason by far was also the availability of an electricity connection (40 per cent). Farmers in Haryana were less concerned with the ease of bring a pump to the field (5 per cent) and more interested in the reliability of supply (about 20 per cent).

1.30 When the same farmers were asked what are the problems in getting a connection, three quarters again cited the lack of lines close to the farm, followed by the length of wait to be connected (69 per cent) and high connection charges (61 per cent[4]) as the main stumbling blocks. Only about a quarter of diesel owners cited lack of cooperation of Utility employees as a problem. According to AP, since 1996 until recently, there has been no regular allotment for new connections of pumpsets. This could explain some of the farmers' responses (see Fig. 1.6)

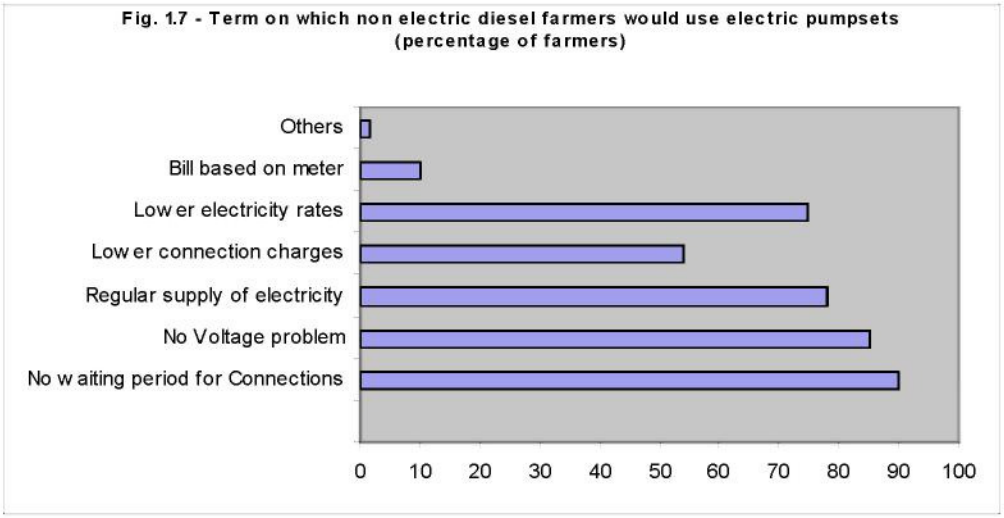
Fig 1.6 - Problems cited by Diesel Pump Owners in Getting an Electricity Connection



Source: AP Recall Survey.

1.31 Diesel farmers recognized several disadvantages of using diesel pumps over electric pumps. About 88 per cent of the diesel owners cited high operating cost; about 67 per cent cited increased difficulty in starting the engine and about 64 per cent cited its lower effectiveness when the groundwater is deeper as disadvantages of using diesel. When diesel pump owners were asked what would encourage them to shift to electric pumps, more than 90 per cent said they would do it if there was no waiting time for a connection and an elimination of voltage fluctuations. The regular supply of electricity was the third most frequently cited factor (78 per cent) closely followed by lower electricity tariffs (75 per cent) and lower connection charges (54 per cent) as reported in Fig 1.7 below. In Haryana, farmers had very similar responses to the same question. About 90 per cent cited waiting period for connections and voltage problems as their main concerns about electricity. They were more worried about connection charges (about 80 per cent) than lower tariffs (60 per cent).

In cases where connection to a pumpset is further than a distance three poles from the grid, farmers have to pay a one time charge of Rs. 30,000.



1.33 **Water Markets**. Buying and selling water is very limited in the study area. Only 199 farmers (11 per cent) reported buying water compared to 22 per cent in Haryana. Water buying appears to be more wide spread in Region 1 and 2. As expected, a large share of marginal (7 per cent) and small farmers (3 per cent) are water purchasers compared to medium and large farmers, very few of whom reported buying water. Of the total 199 water purchasers, 185 farmers rely exclusively on water purchasing as the source of their water requirements. However, there are 10 canal users and 4 electric pump users who also reported purchasing water. Only 32, or 1.8 per cent, of pump owners reported selling water and these are all electric pump owners. Farmers may be downplaying the sale of water, possibly for social reasons, as water is considered a natural resource available to all, because there is a clear disparity between the number of water purchasers and water sellers. Albeit limited in scope, water selling is occurring in all farm size categories, with a larger share of small and marginal farmers involved in water sales (Table 1.5).

Table 1.5 - Percentage of Farmers, who reported purchasing water

Farm Size	**Percentage of Farmers, who reported purchasing water by Region**						
	I	**II**	**III**	**IV**	**V**	**VI**	**Overall**
Marginal	9.9	10.1	3.1	4.3	5.7	6.6	7.1
Small	3.2	4.5	1.5	3	1.7	2.3	2.9
Medium	1.8	1.3		0.4	0.9		0.8
Large		0.4				0.3	0.2
Overall	14.8	16.3	4.6	7.7	8.3	9.2	10.9
Farm Size	**Percentage of Pump Owners who reported Selling water in at least one season by Region**						
	I	**II**	**III**	**IV**	**V**	**VI**	**Overall**
Marginal	1.1	0.2	2.7	1.7			0.8
Small		0.4	1.1	2.1		0.3	0.6
Medium		0.9					0.2
Large		0.4					0.1
Overall	1.1	1.9	3.8	3.8		0.3	1.8

Source: AP farmer recall survey

1.34 Average water charges vary significantly across regions and seasons. In both the Kharif and Rabi seasons, water charges per acre range from about Rs. 350 to Rs. 850 per acre and from Rs. 20 to Rs. 60 per hour (Table 1.6). Note however that the lack of volumetric measures does not allow more rigorous comparisons. In Haryana, water purchase rates are more modest in the range of Rs. 18 to Rs. 27 per hour.

Table 1.6 - Average Water Purchase Rate by Region

Farm Size	Region						Overall
	I	II	HI	IV	V	VI	
Kharif Season							
RateofWP/Hour	20	35	35	54	48	44	36
RateofWP/Acre	351	425	646	775	761	577	515
Rabi Season							
RateofWP/Hour	23	31		58	58	44	34
RateofWP/Acre	345	476	465	853	700	581	554
Summer Season							
RateofWP/Acre	325	270	363		500		329

Source: AP farmer recall survey

CHAPTER 2 COSTS AND RETURNS ACROSS DIFFERENT TECHNOLOGICAL OPTIONS

A. Introduction

2.1 This section presents the results of the analyzes made on the main indicators of farmers' activity, such as gross income, production costs and, in particular, irrigation cost components. Gross and net farm incomes are observed to vary according to the irrigation methods used by farmers. In general, electric pump owners in the sample had both the highest gross and the highest net annual incomes. Electric pump users have gross incomes three times that of farmers who rely on water purchases or are solely rain fed. Input costs for pump users are also significantly higher, as one would expect. Analysis of the production cost components indicates the relative importance of rewinding expenses and pump maintenance costs and shows how the quality of the electricity supply adversely affects farmers' bottom lines. Despite higher production costs, the net farm incomes for farmers who use pumps, and in particular electric pumps, are still higher than those of farmers who do not. The analysis of the flat rate tariff structure, as a component of production costs, shows it to be regressive with marginal and small farmers paying more per hectare of land under cultivation for their power than medium and large farmers.

B. GROSS FARM INCOME ACROSS FARM SIZES

2.2 Irrigation choices across the sample of farmers affect the gross value of production or gross farm income, defined as the sum of the price times the volume of all crops produced during the survey year (see Table 2.1)[5]. Electric pump owners in the sample have the highest average annual gross incomes (Rs.111,889), followed by diesel pump users at (Rs.91,167). Water purchasers and rainfed farmers have the lowest average gross income. Canal[6] users fall in the middle at Rs.53,766). In Haryana, the breakdown is similar with electric pump owners reporting the highest average gross incomes. However, In AP have the lowest gross incomes, whereas in Haryana canal users have higher gross incomes than water purchasers and rain fed farmers. On average, the gross income of electric pump owners was almost three times that of their counterparts in the rainfed and water purchasers category[7].

Table 2.1 - Average Annual Gross Income by Farm Size (Rs.)

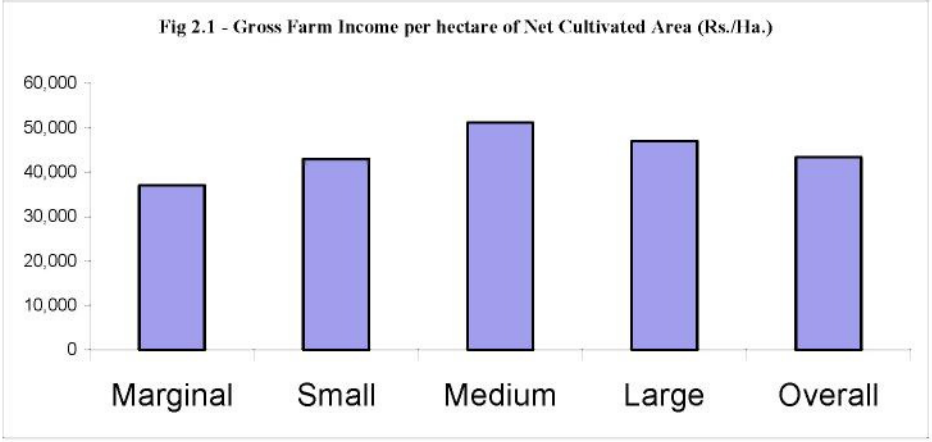
	Average Annual Farm Gross Income by Farm size					
Farm size owned	**Electric**	**Diesel**	**Canal**	**Water Purchaser**	**Rainfed**	**Total**
Marginal	39,420	34,109	17,308	25,070	19,701	27,663
Small	78,630	66,514	43,176	49,189	40,304	63,736
Medium	153,776	153,072	97,237	58,895	55,928	132,769
Large	285,504	197,895	198,652		158,668	247,710
Overall	111,889	91,167	53,766	34,420	38,116	80,807

Source: Farmers' recall data
Gross income is defined as the sum of the price times the production volume of all crops produced

[5] The gross farm income does not include proceeds from the sale of crop by-products, non-crop activities (e.g. livestock) and sale of water. Total crop production was taken into account here irrespective of whether it was used for self-consumption, as seed for next year or as marketable surplus. Crop production was valued at the price as reported by farmer for the marketed portion.
[6] Canal users in Andhra Pradesh also include farmers who use minor and major irrigation sources, mostly canals and tanks surface irrigation like ponds etc.
[7] Tables in the Annex 1give region wise distribution.

2.3 The average gross income of marginal farmers who own electric pumps is more than double that of farmers who use canal water or are rain fed. Small farmers with electric pumps also have almost the same advantage over canal and rainfed farmers. Medium sized farmers who use pumps, whether electric or diesel have the same gross incomes. But large farmers who use electric pumps have gross incomes 44 per cent higher than large size farms with diesel pumps or that use canal water for irrigation.

2.4 When gross returns for alternative sources of water, normalized on a per hectare of net cultivated land, are analyzed, farmers with access to irrigation show the highest incomes due to several reasons. First, it is likely to increase the yields of many crops (particularly those that are water intensive), keeping everything else constant. Secondly, it helps to reduce some of the risks associated with variations in rainfall. Thirdly, it enables the land to be cultivated more intensively through multiple cropping. However, it should also be recognized that there are a large number of variables that could influence income levels such as agro-climatic conditions affecting yields, farmer specific socio-economic characteristics, availability and quality of infrastructure and services, including electricity, etc Fig 2.1 presents the average annual gross farm income per hectare of net cultivated area for alternative sources of water[8]. On average, diesel pump owners had the highest gross returns per unit of net cultivated area, followed by electric pump owners and water purchasers.



C. PRODUCTION COSTS

2.5 This subsection examines the structure of production costs across different alternative sources of water. Total farm production costs were aggregated into three major categories: hired labor, materials and irrigation costs. To compare across different types of technologies, these costs are presented as a percentage of gross income (Table 2.2).

2.6 Irrigation costs for pump users dwarf those for canal users and water purchasers. Irrigation costs are the largest component of costs for pump owners, accounting for about 36 per cent of gross income of electric pump owners and 48 per cent of gross income of diesel pump owners.[9] In Haryana, irrigation

[8] Net cultivated area is the maximum area cultivated by a farmer in any season. Normalization by net cultivated area as opposed to gross
cultivated area helps to capture the returns associated with multiple cropping.

[9] Since the sample of electric pump owners who use canal and/or diesel pumps conjunctively is rather small, production could not be separately

costs are also the largest component of costs for pump owners, however, the proportions are significantly lower. For pure electric and diesel pump owners, they average about 18 per cent of production costs.

2.7 Irrigation costs for non-pump categories are much lower accounting for less than 11 per cent of gross income for water purchasers and just 4 per cent for canal users. The same is true in Haryana, where irrigation costs for water purchasers are about 9 per cent, and less than one per cent for canal users. For these non-pump categories, the cost of other materials (such as fertilizers, pesticides, farm cultivation services like tractors and animal draft, non-irrigation diesel, etc) is the most important component of cost. Compared to Haryana, however, material costs as a percentage of gross income are nearly four times more for farmers in AP. In general, for all categories, the costs of materials like fertilizers, pesticides, tractor and bullock services is higher in AP which is less agriculturally advanced than Haryana. For rain fed farmers in AP, they account for 43 per cent of production costs compared to 15 per cent in Haryana. The high ratio of material costs as a percentage of gross income for canal users may be because of the overall lower gross incomes, as compared to Haryana. In AP, canal users include farmers who use minor and major irrigation sources, mostly canals and tanks that are poorly maintained. On average, hired labor costs account for less than 8 per cent of gross income for all categories, except for diesel pump owners where these costs are somewhat higher at 13 per cent. Annex 1 provides the regional results across different irrigation technologies for both total production costs and the irrigation cost components.

Table 2.2 - Production Cost as Percent of Gross Income

Region/ farm size category	Hired Labor	Materials	Irrigation Cost		
			Variable Costs	Annualized Fixed Cost of Pump and Well	Total
1. Electric pump owners					
Marginal	1.8	27.7	17	47.1	64.1
Small	1.9	25.6	8.6	26.1	34.7
Medium	2.8	23.3	5.9	16.9	22.8
Large	4.1	20.7	5.3	12.6	17.9
Overall	2.4	24.9	9.4	26.9	36.3
2. Diesel pump owners					
Marginal	9.3	32.4	13	65.1	78.1
Small	22.1	34.8	11.3	35.5	46.8
Medium	8.4	27.9	7.7	16.5	24.1
Large	17.6	28.7	7.6	10.4	18.1
Overall	13.2	31.4	10.5	37.7	48.2
3. Canal users					
Marginal	11.4	66.6	4.1	n.a[1].	4.1
Small	6.7	65.0	4	n.a[1].	4
Medium	4.5	62.4	5.2	n.a[1]	5.2
Large	2.6	45.9	3.8	n.a[1]	3.8
Overall	8.1	64.0	4.3	n.a[1]	4.3
4. Water Purchasers					
Marginal	6.8	47.6	11.1	0	11.1
Small	6.1	47.2	12.4	0	12.4
Medium	3.1	29.9	7.4	0	7.4
Large					
Overall	6.3	46.2	11.2	0	11.2
5. Rainfed					
Marginal	5.5	40.1	0	0	0
Small	6.9	43	0	0	0
Medium	5.4	49.5	0	0	0
Large	8.7	46	0	0	0
Overall	6	43	0	0	0
State Wide					
Marginal	6.5	43	9.5	21.6	31.1
Small	6.2	37.2	7.4	17.3	24.7
Medium	4.1	33.3	5.5	11.9	17.5
Large	5.9	28.5	4.9	8.9	13.8
Overall	5.7	37.7	7.5	16.9	24.4

Notes: * Imputed at village level wages for male and female labor. Material costs include fertilizers, pesticides, etc. In general canal users do not pay for the fixed costs of canal construction and maintenance. However in some minor irrigation schemes, canal users are now paying about 15% of rehabilitation costs. Data on these costs was not collected during the survey.

D. DECOMPOSITION OF IRRIGATION COSTS

2.8 Total irrigation costs can be decomposed into two broad categories: fixed and variable costs. The fixed cost component refers to the annualized amortized value of the initial investment in well, pumps and related equipment (such as sheds, collection tank if any etc.). For the non pump owning sample categories this component is almost zero. Variable costs refer to the yearly expenses on electricity tariffs, motor rewinding after a burnout, pump maintenance, diesel used for pumping, water purchases (if any) and canal fees.

2.9 For the pump-owning categories, the irrigation costs are particularly high because of the large annualized fixed costs of investing in a well and a pump. The burden of these fixed costs is particularly high for marginal farmers who cultivate very small plots of land. For marginal electric pump owners in particular, these costs account for about 47 per cent of gross income while for marginal diesel pump owners these costs account for about 65 per cent of gross income (check the data based on computation of fixed cost annuity) . In contrast to this, for large electric and diesel pump owners these costs account for less than 13 per cent of gross income. The non-pump categories do not bear these fixed costs and thus their irrigation cost share is much lower. The irrigation cost share for pure canal users, at about 4 per cent, is significantly lower than all other sources of irrigation. This points to the large disparity between the cost of irrigation using canal as opposed to private owned pumps.

2.10 **Electricity tariff rates in AP** Farmers in AP are charged for their electricity consumption on the basis of a flat rate per month. The flat rate varies according to the installed HP as shown in Table 2.3.

Table 2.3 - Electricity tariff rates for agricultural sector in AP

HP of pump	Tariff rate/BHP/year	
	DPAP districts[1]	Non - DPAP districts
0-3	Rs 100	Rs 150
>3 - 5 HP	Rs 200	Rs 250
>5 - 10 HP	Rs 300	Rs 350
> 10 HP	Rs 400	Rs 450

Notes: [1]DPAP are drought prone districts. There are 14 such districts in AP: Prakasham, Medak, Anantapur, Adilabad, Khamam, Cudappha, Mehboobnagar, Chittor,Rangareddy, Nalgonda, Nellore, Karimnagar, Kurnool, Srikakulam

During the survey, a number of difficulties were encountered to arrive at a precise calculation of the tariff paid by farmers. Problems in recording payments based on different period of recalls, which compounded with the lack of metering make any rigorous estimate difficultThus the amount reported by the farmer in any season may not be a true indicator of the total amount due to him. The procedure for imputing the cost of tariff is explained in Box 2.1. While it is difficult to say very much about the exact magnitude of the discrepancy between the actual amount paid by farmers and the tariff cost imputation here, it is clear that the latter defines the upper bound on the actual cost borne by farmers. The results on tariff costs in this section need to be interpreted keeping this in mind.

Box 2.1 - Tariff Cost Computation

The tariff cost for electric pump owners in this study was computed in the following way. The district wise official tariff rate per HP was multiplied by the electric HP reported by the farmer. This tariff cost imputation may differ from the actual amount paid by farmer because of several reasons:

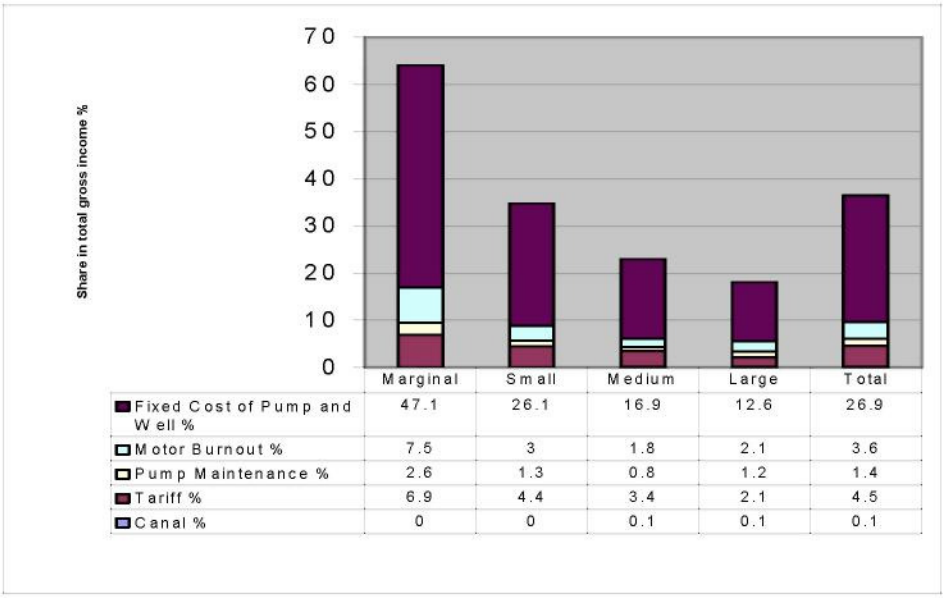
- The HP reported by farmer in the survey might be different from the HP in utility records on the basis of which the tariff cost is actually assessed.
- There might be some illegal connections for which the farmer bears very little cost (in form of bribes) or no cost at all.
- Very often farmers do not pay the full amount due in any payment cycle. Payment arrears often accumulate over time. Although default of payments often result in disconnecting the supply, the exact policy here is not clear and probably depends a lot on the discretion of the field staff. There have been instances where politicians have forgiven part or whole of past arrears.

2.11 On average, electricity tariffs account for 4.5 per cent of gross income of electric pump owners. Because of the regressive nature of the flat rate tariff, the share of tariff costs as a percentage of gross farm income is highest for marginal farmers (7 per cent) and lowest for large farmers (2 per cent). Figures 2.2 and 2.3 show a detailed breakdown of irrigation costs for electric and diesel pump owners

respectively.[10] Electricity tariff costs have therefore a much lower incidence on gross income than in Haryana[11], where for marginal tariffs is over 13% and for large is over 6 percent. For diesel pumps owners, the incidence of the the fuel cost for diesel is progressive rather than regressive. The cost share of fuel for diesel pump owners is higher than electricity tariffs, but varies only between 5 per cent to 6 per cent across the different farm size categories. The conclusions are the same for pump owners in Haryana.

2.12 For electric pump owners, the cost of repairing burnt motors at 3.6 per cent of gross income is only slightly less, in percentage terms, than the share of electricity tariffs in total costs. However, the cost of rewinding electric pumps affects smaller farmers more than larger farmers. For marginal farmers, the cost share of repairing burnt motors is 7.5 per cent of gross income, which is higher than their tariff cost share. In effect, marginal farmers are paying more to a mechanic than they are to the utility. Hence, although farmers are paying quite low tariffs, their effective costs are considerably higher due to these additional indirect costs. In Haryana, burnout cost incidence was higher by a third, and tariff cost incidence was double.

Figure 2.2 - Electric Pump Owners: Breakup of Irrigation Cost as a Percent of Gross Farm Income



	Marginal	Small	Medium	Large	Total
Fixed Cost of Pump and Well %	47.1	26.1	16.9	12.6	26.9
Motor Burnout %	7.5	3	1.8	2.1	3.6
Pump Maintenance %	2.6	1.3	0.8	1.2	1.4
Tariff %	6.9	4.4	3.4	2.1	4.5
Canal %	0	0	0.1	0.1	0.1

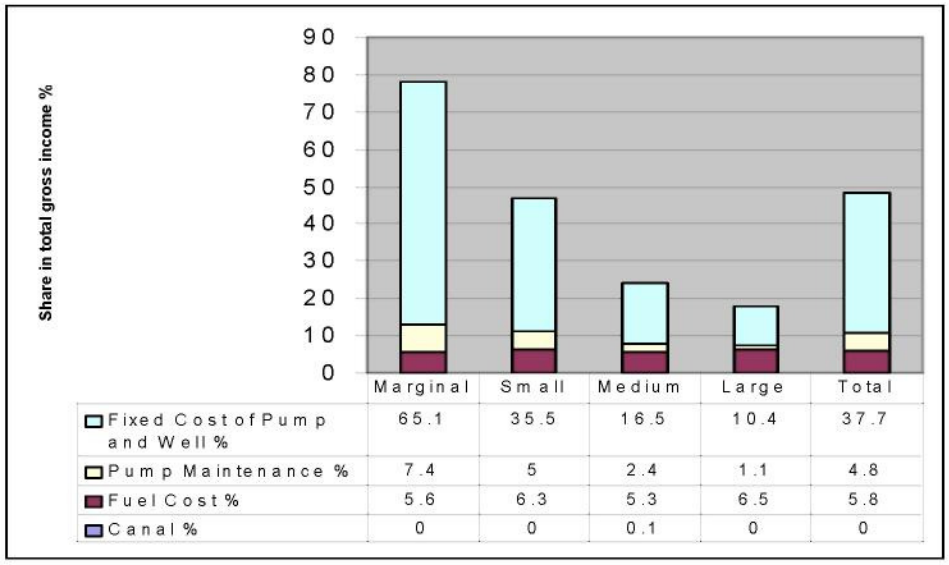
Source: Recall survey

Notes: The electric pump repair and expenditure includes travel costs for repair and other costs. Rewinding cost and tariff cost is listed separately but included in the total variable irrigation costs. Some farmers have zero fixed costs, as pumps are fully depreciated (assuming 20 yrs lifespan).

[10] These figures show the breakdown of irrigation costs for all electric pump owners and all diesel pump owners. Annex 1, table
A show the breakdown for the category of pure electric and pure diesel pump owners, respectively. The tariff cost share for pure electric pump owners was found to be the same as that for the category of all electric pump owners (around 4.5%).

[11] For Haryana, the comparison is made with electricity pump owners only.

Figure 2.3: Diesel Pump Owners: Breakup of Irrigation Cost as a Percent of Gross Farm Income



Source: Recall survey
Notes: The diesel pump maintenance expenditure includes belting cost, oil and greasing cost and bearing replacement cost. Fuel cost includes the expenditure on diesel for running the pump

E. COMPARISON OF VARIABLE IRRIGATION COST PER HECTARE OF PADDY CULTIVATION AND PER QUINTAL OF PADDY PRODUCTION

2.13 To get further insights into the comparative cost of irrigation across technology groups, it is helpful to analyze the per hectare irrigation costs of cultivation of an important water intensive crop, namely paddy grown in Kharif season in AP[12]. Rice,(used interchangeably, one of the words rice or paddy should be used) as noted in Chapter I, dominates cropping patterns in the sample. All farmers who use irrigation technology plant more rice than any other crop. In the survey year, canal users, who have the lowest irrigation costs, allocated 61 per cent of their land to rice. Electric pump owners devoted half their acreage to paddy and diesel pump owners 37 per cent. The average cost of irrigating a unit hectare of paddy is found to be Rs. 2,543 (Table 2.4).

Table 2.4 - Variable irrigation costs per hectare of Kharif paddy cultivation (Rs/Ha)

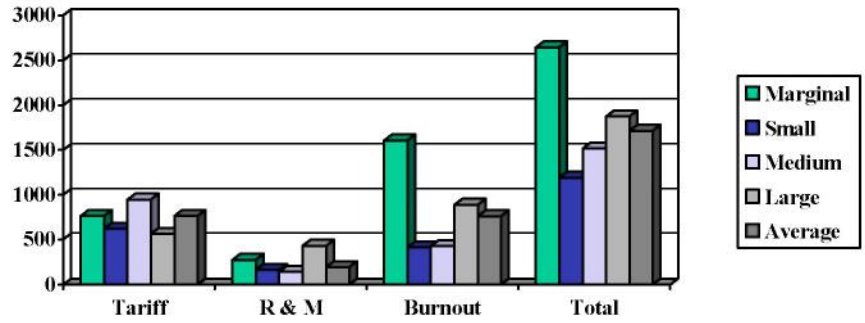
Farm Size	Electric pump only	Electric pump & canal only	Total Electric pump owners	Diesel pump only	Diesel pump & canal only	Total Diesel pump owners	Canal users	Water purchasers	Total
Marginal	3011	788	2947	1588		1588	492	1318	1524
Small	1410	1236	1406	1109		1109	492	984	1132
Medium	1445	722	1395	927	864	924	492	1026	1112
Large	1389	348	1295	559		559	492		882
Overall	1919	818	1873	1250	864	1246	492	1234	1299

Source: Recall survey
Notes: Table pertains to those farmers who cultivate only paddy in kharif season. For pump owning categories, the above irrigation costs do not include the annualized fixed investment costs of well and pump.

[12] The per hectare cost of rice is based on the subset of sample farmers who only grew rice in Kharif. Similarly the per hectare cost of wheat is based on the subset of sample farmers who only grew wheat in Rabi. This was done because in the data files, the costs of irrigation are available on a per pump or per farmer basis. The costs of irrigation are calculated as = seasonal electricity tariff + canal costs (if used canal) + diesel costs (if used diesel pump)+ cost of pump repair and maintenance + 1/3annaulized investment cost of pump and well. The tariff cost for electricity was calculated on the basis of the official rate. The canal cost is based on what farmers reported in the survey.

2.14 This cost varies considerably across the different technology groups. The cost of rice irrigation per hectare for pure canal users at Rs. 492/ha, is just 12 per cent of the irrigation cost borne by pure electric pump owners on average. The cost of irrigating a unit hectare of rice is highest for exclusive users of electric pumps (Rs. 4,102/Ha.), followed by pure water purchasers (Rs. 1,907/Ha.) and then exclusive users of diesel pumps (Rs.1,352/Ha). Canal users who do not own pumps have the lowest costs (Rs. 492/Ha.). Among the pump owning categories, access to canal reduces the cost of paddy irrigation substantially. Thus, for instance, the cost of irrigation for electric pump owners who use surface water conjunctively is about 30 per cent of that borne by electric pump owners who do not have access to any surface water source. (Fig 2.4)

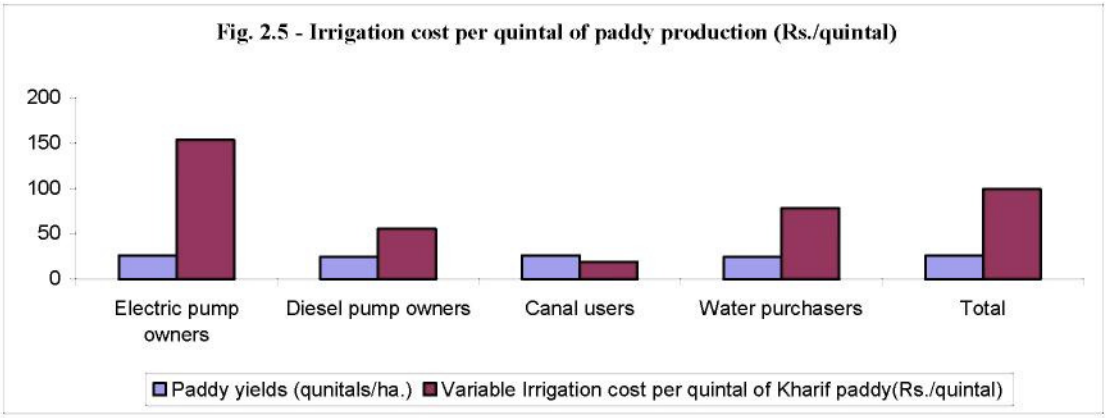
Fig. 2.4 - Pure Electric Pump Owners Variable Irrigation Costs for Kharif paddy (Rs./Ha.)



On a per hectare basis, the variable irrigation costs for electric pump owners was much higher for marginal farmers due to the regressive nature of the flat rate tariff structure and the cost of poor quality power (motor burnouts) Motor burnouts for marginal farmers cost, on per hectare basis, twice the electricity tariff cost.

2.15 Although there does not appear to be any systematic relation between paddy irrigation cost per hectare and farm size within each technology group, in most cases the costs are highest for marginal farmers (and in some cases medium farmers) and lowest for large farmers. This may probably be due to more intensive use of inputs (including water) by marginal farmers.

2.16 It is often argued that the quality of irrigation service in terms of reliability and adequacy of supply differs significantly across irrigation sources. Thus although a unit of water received from canals is the least expensive, its quality in terms of the control that farmers have on its timing and volume is also generally the lowest. But given that yields for Kharif paddy do not differ significantly across irrigation sources, it is not surprising that variable irrigation costs per quintal of paddy production mimics the pattern observed for irrigation costs per hectare of cultivation (see Fig 2.5). Thus Per quintal of paddy production, variable irrigation costs are highest for electric pump owners (Rs.153/qunital), followed by that for water purchasers (Rs.78/qunital) and then diesel pump owners (Rs.55/qunital). The costs are lowest for canal users (Rs.19/quintal).



F. COSTS OF POOR QUALITY OF SUPPLY IN OPERATION OF ELECTRIC PUMPS

2.17 This section analyzes some of the direct costs resulting from the poor quality of supply in the specific form of motor rewinding costs and days lost due to transformer burnouts. There are several causes of motor burnouts, and thus the need for motor rewindings. These include the quality of electricity supply, age and type of the pump (branded versus local), and care and maintenance practices. On average motor burnouts cost 3.6 per cent of gross income for electric pump owners. It is especially critical for marginal farmers for whom it amounts to as much as 7.5 per cent per cent of gross farm income. Hence, although farmers are paying low tariffs, their effective costs are considerably higher due to these additional indirect costs.

2.18 Almost half the pumps operated during the Rabi season and almost all of those operated during the Kharif and summer season were rewound at least once during the season (Table 2.5). The highest frequency of pump rewindings occurred during the Kharif season and summer season (actually system demand is highest during Rabi in Andhra). One possible reason for this high incidence of failure is the adverse conditions of weather, which significantly affect the performance of motors. In summer, the ambient temperatures are very high and in Kharif, the motors are exposed to rains/ moisture and the poor quality of the motors are not able to withstand long hours of working. In the summer season all the pumps needed to be rewound at least once, while in kharif season around 97 per cent had to be rewound at least once. The situation was most severe in Regions VI with more than one third of the pumps having to be rewound twice during the summer season and around one-fifth of the pumps having to be rewound twice in Kharif season[13]. In Haryana, motor burnout frequencies were significantly lower, but rewinding costs are twice those faced by farmers in AP.

[13]The data did not permit measuring how many times a single pump had to be rewound during the year. Since not all the pumps are used in every season, the sample of pumps differs somewhat across seasons. Because of this difference in sample and the fact that not all the pumps can be matched across seasons, it was not possible to calculate the number of times a single pump had to be rewound during the year.

Table 2.5 - Frequency Distribution of Number of Rewindings per Pump (% of Sample Farmers)

	No Rewinding		Two / year	Three / year	Four / year
Kharif	**3.2**	**79.7**	**14.4**	**2.4**	**0.3**
Summer	**0.0**	**85.7**	**13**	**1.3**	**0.0**
Rabi	**54.3**	**27.8**	**15.5**	**1.6**	**0.8**

2.19 Sample farmers reported paying around Rs. 1,300 to Rs. 1400 to get the motor rewound each time it burned out (Figure 2.6). The price paid for rewinding varies a lot across across regions and across seasons. Across seasons, the price paid for rewinding is highest during Kharif and Rabi season when the largest number of rewindings occur. Across regions, on average the highest price for rewinding was observed in regions I and II. The average cost of motor burnouts of the sample farmers is estimated to be Rs.237/HP/year, which is 115 per cent of the average cost paid by farmers for purchase of electricity (Rs.206/HP/year). The poor quality of power supply, thus, imposes a significant financial burden on the farmers in Andhra Pradesh, resulting in effective cost of power supply to be more than twice of their electricity bill.

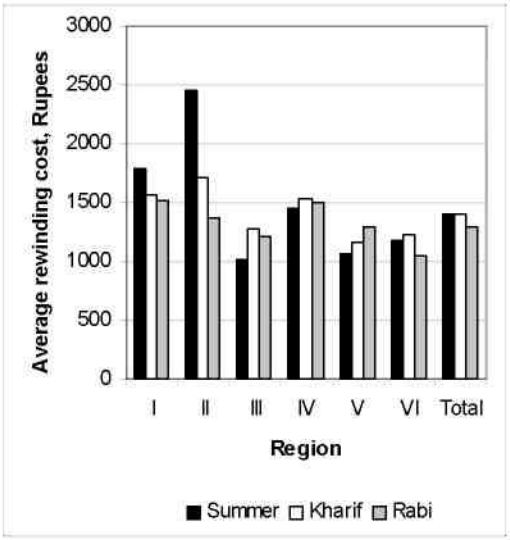


Fig 2.6 - Average price paid for each rewinding (Rs. per rewinding)

Source: Village questionnaire

2.20 Voltage fluctuations are one of the main causes for motor burnouts. Between 83 per cent and 96 per cent of all farmers experienced voltage fluctuations during the three growing seasons. This varied slightly across regions and seasons, however, there was a consistently large portion of the farm population affected by the poor quality of power supply (see Table 2.6). The situation on voltage fluctuations experienced by the farmers in Haryana is similar, where farmers across regions and seasons face high incidence of voltage fluctuations.

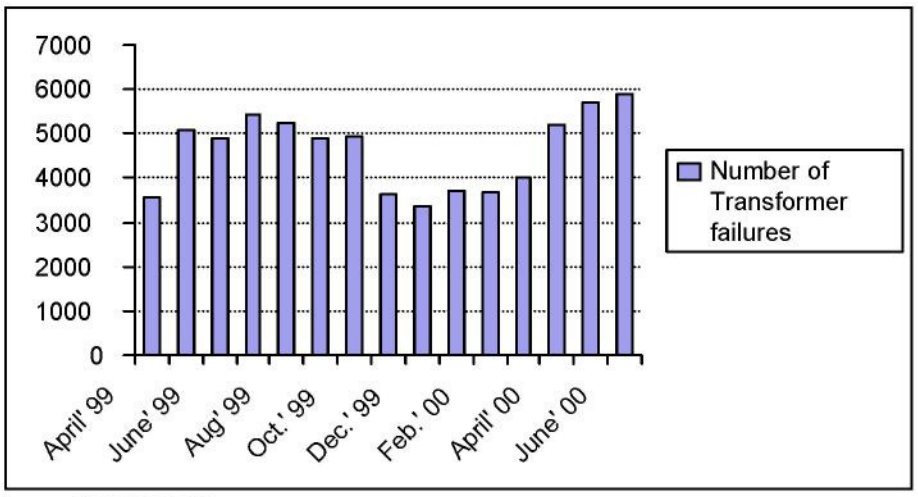
Table 2.6 - Voltage fluctuations Experienced by Farmers (percentage distribution)

	Regions						
	1	2	3	4	5	6	State Average
Summer season							
% of farmers experienced voltage fluctuations	97.78	95.24	96.15	100	97.22	94.12	96.22
Kharif season							
% of farmers experienced voltage fluctuations	80.3	92.92	90.37	99.18	88.06	88.4	89.96
Rabi season							
% of farmers experienced voltage fluctuations	78.79	85.38	85.93	94.26	82.84	75.69	83.41

G. TRANSFORMER BURN OUTS

2.21 The high frequency of transformer burnouts has been cited by farmers as one of the main reasons for interruptions in power supply. There are many reasons for failure of transformers like overloading, non existent protection, no maintenance, lightening strokes, unbalanced load during single or two phasing arrangements, presence of harmonics etc. In AP distribution transformer failure rate in FY2000 was about 29 per cent[14]. Thus, on average each transformer has a life of about 3.6 years. Figure 2.7 provides for the period April 1999 through June 2000, the month-wise failure of distribution transformers in AP out of about 187,00 total installed as on March, 2000. The transformer failure rate is higher in the rural areas and the frequency of burn outs is greater during the months of April to August, which is the Summer and early Kharif time, when the soaring ambient temperatures and the high humidity during the Kharif, with windy conditions highly stress the performance of poorly maintained transformers. The transformer failures are reported to be highest in region V, where about 82 per cent experienced the transformer failure problem, while it is the lowest in region 4, where only 42 per cent faced the transformer failures.

Fig 2.7 - Transformer Burnout in Andhra Pradesh (Month wise details for April 1999 to June 2000)



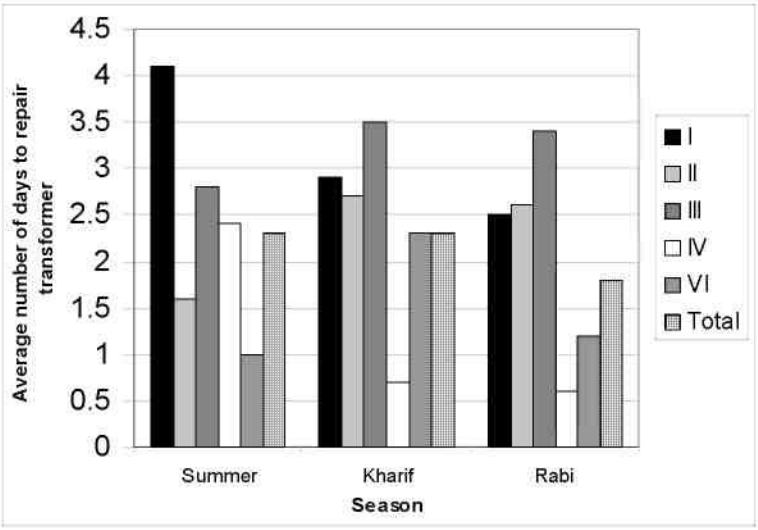
Source: APTRANSCO data

In western utilities, transformer failure rate is below 2%.

In the village questionnaire canvassed at the end of the survey, a group of farmers from each village was asked about the number of transformer burnouts that occurred over the different seasons in the survey period and the average time it took to repair the transformer. (Annex 1, Table 3.8-9 shows regional and per season frequency distribution of transformer burnouts) On average across regions, around two-third of the villages reported at least one transformer burnout during the year and around 30 per cent reported two or more burnouts during the year. The situation was observed to be worst in region V where more than 90 per cent of villages reported at least one burnout. Over loading of transformer by way of increased number of pumpset per transformer and use of higher HP of pumpset than that sanctioned was reported to be the prime reason. In Kharif, short circuit was also reported to cause transformer burnouts in a few villages. Across seasons, the situation was observed to be worst in summer and Kharif, when more than one-third of the villages reported at least one burnout as opposed to summer when only around a quarter of the villages reported at least one burnout.

2.22 **Average Number of Days Taken to Repair Transformers.** Transformer burnouts adversely affect farmers, because they cut the power and thus water supply to all electric pump users connected to the transformer. The speed at which the transformers are repaired is, therefore critical, because it determines the speed at which water supply is resumed and hence the potential yield losses and income reductions farmers bear due to the unavailability of water to meet crop needs. On average, it takes about 2.3 days to repair burnt out transformers during the Kharif and summer season and 1.8 days during the Rabi Season (Figure 2.8). In the case of Haryana, the time taken to repair burnout transform was much higher (on average 6.4 days during the Rabi season and 10.1 days in the Kharif season)

Figure 2.8 - Average Number of Days taken to Repair Transformers by Region



H. NET FARM INCOME ACROSS FARM SIZES

2.23 Electric pump owners report the highest net farm incomes as well as the highest gross farm incomes. Net farm income is defined as gross farm income minus annualized fixed costs and all variable costs (except the imputed cost of family labor and land cultivated). This definition of net farm income measures the net returns to family labor and cultivated land. Costs of other owned inputs such as machinery, bullocks, seeds etc. is imputed at the prevailing market rate and deducted from the gross income under this definition. Thus, this is an economic definition of net income which takes into account

the opportunity costs of all inputs except family labor and cultivated land. Another useful income measure is the net cash flow measure which is defined as: (price*marketed production)-(paid out cost of all inputs).[15] In this section, tables on net farm income alone are discussed(detailed tables are given in Annex 1).

2.24 The average net farm income of farmers in the sample is Rs. 58,900 with pump owners earning significantly more than non-pump owners. Electric pump owners report the highest average income (Rs. 88,320), followed by diesel pump owners (Rs. 63,670). As expected, the net income of rainfed and water purchasers is found to be the lowest. The net income of the electric pump owners is found to be 1.35 times that of the non-electric diesel pump owners, 2.8 times that of non-pump canal users, three times that of the rainfed farmers and four times that of the water purchasers. (Table 2.7)

Table 2.7 - Annual net farm income per farm (Rs.)

Farm size owned	Electric	Diesel	Canal	Water Purchaser	Rainfed	Total
Marginal	22,880	17,800	8,040	15,490	14,820	16,080
Small	57,610	44,270	22,860	32,770	29,540	44,490
Medium	123,950	115,100	61,290	38,390	38,400	102,030
Large	232,200	138,040	117,460		129,710	190,600
Overall	86,320	63,670	31,150	22,090	28,130	58,900

Source: Farmers' recall data

2.25 Net farm income, like gross income, is highly dependent on the area cultivated, hence the above values are normalized to a per hectare basis in Table 2.8. This table compares the net returns to a unit of cultivated area across technology groups. On average, net farm income per net cultivated area is highest among electric pump owners at Rs. 35,220 per ha, followed closely by diesel pump owners (Rs. 35,060) and water purchasers (Rs.26,460). Although pure canal users have higher net farm incomes than water purchasers and rainfed farmers (Table 2.7), on a per hectare basis they have much lower net incomes in large part because they are only able to cultivate their land when rainfall is available. The results suggest that rainfed farmers cutlivate their land with relatively greater intensity than canal users, given that they report higher gross incomes per net cultivated area but canal users have higher net annual incomes.

Table 2.8 - Net Farm Income per Net Cultivated Area (Rs./Hectare)

	Average Annual Farm Gross Income by Farm size					
Farm size owned	**Electric**	**Diesel**	**Canal**	**Water Purchaser**	**Rainfed**	**Total**
Marginal	20,340	30,250	14,270	26,560	18,440	20,750
Small	33,890	32,660	16,240	24,710	22,660	28,640
Medium	44,720	43,650	22,300	32,250	23,290	38,440
Large	43,780	26,800	17,790		19,210	34,780
Overall	35,220	35,060	16,990	26,460	20,670	28,910

Source: Farmers' recall data

I. Costs and returns excluding drought affected areas

2.26 In AP in any given year it is common that regions are affected by drought. A drought-affected district is defined as a district that received less than 70 per cent of its average. During the survey year, the government of AP declared 688 mandals our of a total of 925 mandals in 18 districts as drought hit. Some of the farmers in these regions took part in this study. With the data available at this stage, it is not possible to assess the exact magnitude of the production loss suffered by these farmers due to this

[15]Under this definition annualized value of fixed costs of pump and well are not accounted for. Similarly the opportunity costs of all owned inputs is not accounted for.

drought. It is likely, therefore, that the tables on costs and returns presented in the previous sections, may not be representative of an average year. The key point, however, is that the trends identified using the total sample of farmers, including those in drought affected areas, remain the same: on average, electric pump owners have higher gross and net incomes. When the drought affected areas are excluded, these incomes increase even more than the incomes across other technologies (see Annex 2. Drought conditions in AP during survey year).

2.27 In this section, some of the important costs and returns tables are presented just for the non-drought areas and compared with the tables presented in earlier sections which covered the entire state. annual rainfall during the survey year. The following five districts were designated drought-hit and were excluded in the computation of the tables below: Nellore, Cuddapah, Mahabubnagar, Medak and Nalgonda.

2.28 When the drought-hit areas are excluded from the computations, the average gross income of electric pump owners increases more than other technology groups. Table 2.9 presents the gross income, net income and irrigation costs in the non-drought areas.[16] The percentage change in net farm income after excluding drought affected areas is shown in Fig. 2.9. On average across technology groups, gross and net incomes are about 8 per cent higher when drought areas are excluded. Electric pump owners show a much steeper increase (around 14 per cent) than other irrigation technology groups. Within the category of electric pump owners, the net incomes of marginal farmers shows the highest increase (around 20 per cent) when drought affected areas are excluded. However, marginal farmers who own diesel pumps report a 13 per cent drop in net farm incomes.

Table 2.9 - Costs and Income in Non-Drought Areas

(Figures in parenthesis give percentage difference between excluding and including drought areas)

	Electric		**Canal**	**Water Purchaser**	**Rainfed**	**Total**
Gross income(Rs.)	127,630 (14.1)	94,590 (3.8)	57,020 (6.1)	36,790 (6.9)	38,740 (1.6)	87,020 (7.7)
Net income (Rs.)	100,730 (14.3)	66,210 (3.8)	33,560 (7.2)	24,250 (8.9)	28,490 (1.2)	64,350 (8.5)
Irrigation costs as % of gross income (excluding drought areas)	32.1	44.6	4.2	9.5	0	21.4
Irrigation costs as % of gross income (not excluding drought areas)	36.3	48.2	4.3	11.2	0	24.4

Source: Recall data

2.29 Irrigation costs account for about 21 per cent of gross income in non-drought areas as opposed to 24 per cent in the state as a whole. For electric pump owners, irrigation costs constitute about 32 per cent of gross income in non-drought areas and 36 per cent in the entire state (see Annex 1, table A.2.26) Table 2.10 shows a further breakup of irrigation costs in non-drought areas for electric and diesel pump owners, by farm size categories. For marginal and small electric pump owners irrigation costs account for about 60 per cent and 32 per cent of gross income, respectively, in non-drought areas (as compared to 64 per cent and 35 per cent) in the state as a whole. The share of electricity tariffs in gross income shows hardly any difference whether drought affected areas are included or excluded. For diesel pump owners there is virtually no difference between the irrigation costs in non-drought areas and the state as a whole.

Detailed tables on costs and income after excluding the drought affected areas are given in Annex 1.

Fig 2.9 - Percentage change in net farm income after excluding drought affected areas

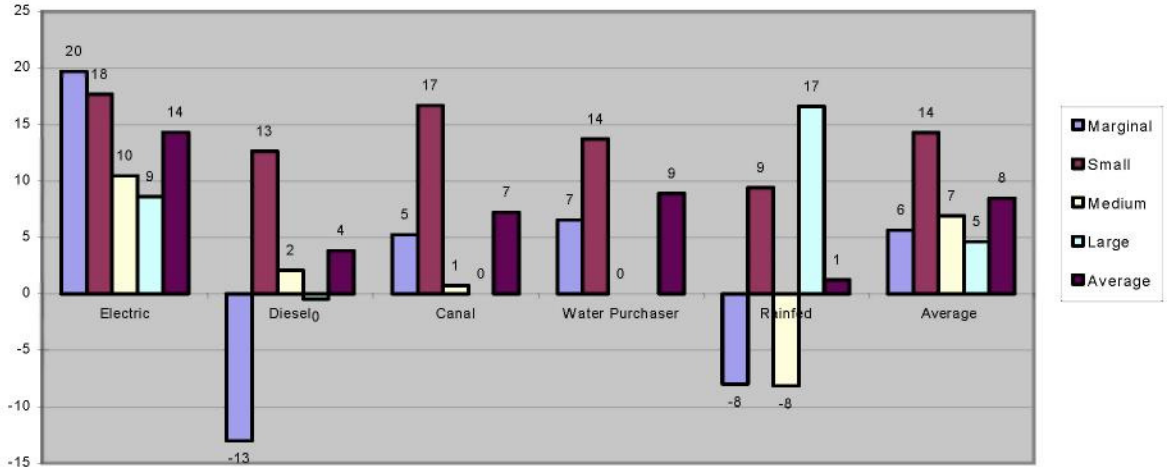


Table 2.10 - Break up of irrigation cost as percentage of gross income in non-drought areas

Region/ farm size category	**Canal**	**Tariff**	**Pump Maintenance**	**Motor Burnout**	**Variable Costs**	**Fixed Cost**	**Total Cost**
1. Electric pump users							
Marginal	0.1	6.4	1.8	6.5	14.6	45.4	60
Small	0.1	4.2	1.2	2.7	8.1	23.9	32.1
Medium	0.1	3.3	0.7	1.4	5.3	13.1	18.4
Large	0.2	2.1	1.6	2.7	6.3	10.5	16.7
Overall	0.1	4.2	1.2	3.1	8.4	23.7	32.1
2. Diesel pump users	**Canal**	**Diesel Cost**	**Pump Maintenance**	**Motor Burnout**	**Variable Costs**	**Fixed Cost**	**Total Cost**
Marginal	0	5.9	7.6	0	13.5	61.1	74.6
Small	0	6.3	5.2	0	11.6	29.2	40.8
Medium	0.1	5.2	2.3	0	7.4	15.5	22.9
Large	0	6.7	0.8	0	7.5	9.8	17.3
Overall	0	5.8	4.8	0	10.6	34	44.6

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Andhra Pradesh faces the same problems in the power sector as Haryana. Furthermore, while it is true that Haryana is a smaller state and that farming is relatively more advanced than in AP, there are fundamental similarities in the make up of its farm populations, pump ownership and cropping patterns, gross and net income and composition of irrigation costs that it is reasonable to suggest that most of the recommendations for Haryana can also be applied to AP.

3.2 **Metering.** The difficulties of metering a state as large as AP where the number of agricultural consumers is almost 2 millions, are enormous. However, the lack of metering provides an incentive to utilities to camouflage non-technical losses (i.e. theft) under the estimated electricity consumption by agriculture consumers. The recent Tariff Order of the APERC mandates universal metering to be completed by March 2003 and also provide any new connection with metering only.

3.3 **Tariff Structure.** As in Haryana, the present tariff based on a flat rate structure in AP is regressive, penalizing marginal and small farmers who are using less electricity for a given connected capacity. It also discourages farmers from conserving groundwater resources, as the marginal cost of pumping is zero. In AP, where some regions are drought prone and where water is a scarce resource, over-pumping in the long run will adversely affect agriculture.

3.3 The introduction of universal metering would allow utilities to charge agricultural consumers on the basis of the energy consumed and, therefore, remove the inequity associated with the present tariff regime.

3.4 Metering and the conversion to an energy charge in place of the present flat rate, would also allow the Electricity Regulatory Commission to devise methodologies and test different mechanisms for targeting subsidies more efficiently and effectively to the more vulnerable farmers, particularly the marginal farmers who constitute about 20% of the farmers using electricity for irrigation. For example, it could be possible to define "lifeline rates". A meter based tariff regime would also allow the elimination of misreporting/under-reporting of installed horsepower capacity by farmers.

3.5 **Raising Electricity Tariff.** The current tariff level for agriculture consumers in AP as in Haryana is inadequate to cover the cost of supply. Efforts to rectify this have already caused political upheaval in AP. Nevertheless, because the tariffs that farmers pay represents only about 4.5 per cent of the average cost of power supply, it results in a significant burden on the finances of the utilities. The total estimated subsidy for supply of power to agriculture consumers is estimated to be Rs.2850 crores[17] (FY2000),

3.6 Farmers in AP, similar to the ones in Haryana, are paying a higher price for electricity than stated by the utility, because the poor quality of electricity supply increases their costs mainly due to. One way by which it increases cost is through frequent pump motor burnouts. Another is through power interruptions due to transformer burn outs and the time required to repair them and other unscheduled power cuts, which impose an additional cost to farmers in terms of the potential loss in crop yields. While farmers in Andhra Pradesh face more frequent motor burnouts and transformer failures, the days taken to repair a burnt transformer is significantly lower in Andhra.

3.7 Adopting measures to improve electricity supply conditions would increase the acceptability of power tariff increases. These could involve a number of technical measures for improving the

[17] A part of this subsidy is made good by cross-subsidy from industrial and commercial consumers. In FY2001 as per APERC's order Rs.703 crores of subsidy was allocated to agriculture sector.

distribution infrastructure to target reduction in transformer failure rates and improve voltages. AP is already moving in this direction. The four distribution companies are formulating plans for the rehabilitation of the distribution system to improve the reliability and quality of power supply. Stricter monitoring of the scheduled supply hours in Andhra Pradesh shall help increase the reliability of power availability and equity across regions.

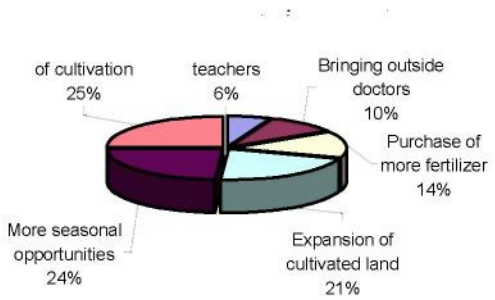
3.8 Improving technical and operational efficiency are critical to lower the cost of supply. The earlier privatization of the distribution companies would speed up the process of improving conditions of power supply and also introduce a different and equally important managerial culture and commercial orientation.

3.9 **Canal Water Pricing.** The Government of Andhra Pradesh has made considerable progress in raising water charges to recover a large share of O&M costs of the surface irrigation system, beginning in 1997. The challenge for the future is to strengthen the efforts to raise the water charge collection efficiency and to undertake the regular periodic adjustments of water rates by the Water Charges Review Committee of the Irrigation Department to ensure that the water charges cover the full O&M requirements of the irrigation system. The present subsidized pricing of canal water puts electric pump owners at a disadvantage and does not encourage water conservation. These actions are critical to (i) enable appropriate execution of O&M activities and thus ensure the longer term sustainability of surface irrigation systems; and (ii) eliminate the fiscal burden and contribute to the improved fiscal health in the State. It would also foster more efficient use of water in areas dependent on surface irrigation.

A. Complementary Measures to Improve Returns to Agricultural Production Activities

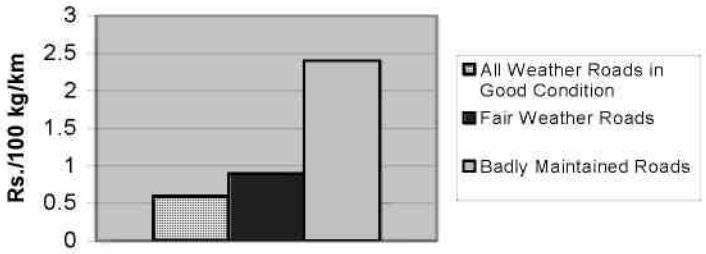
3.10 In the short- to medium term, the state should invest in improving rural infrastructure such as all-weather rural roads, village markets, and telecommunications. These investments would significantly reduce the cost of marketing of both agricultural inputs (fertilizer, seeds, etc) and agricultural products. Poor infrastructure increases marketing costs due to associated higher physical losses (spoilage, spillage, wastage, etc) and bottlenecks (loading and transport) created in the system due to the inadequate capacity in meeting demand for marketing services. Such investments would in turn benefit both producers and consumers by reducing marketing margins, and translating to higher farm and lower consumer prices (Figure 3.1).

Figure 3.1 - Impact of Rural Roads Improvement in Andhra Pradesh



Impact of Improvement of Rural Roads
(Opinion Survey of the Rural Population)
Higher intensity Bringing outside

Fig 3.2 - Average Freight Charges



Source: Rural Transport Surveys (1997) – Andhra Pradesh Economic Restructuring Project

3.11 The state should increase efforts in the short to medium term to improve the delivery of public and private agricultural support services, particularly agricultural extension programs to increase the productivity of irrigated agriculture and to enhance farmer capabilities to diversify production to higher value crops. For example, diversification to higher value crops and the adoption of improved agricultural technologies that would facilitate increased on-farm efficiency and productivity would enhance farm incomes and thus enable farmers absorb increasing electricity tariffs. Measures should include dissemination of improved technologies (such as higher yielding seeds, farm equipment, more efficient pumps), transferring knowledge to foster diversification to higher value crops and providing training on on-farm management practices, such as improved on-farm nutrient and water management, integrated pest management, and post-harvest practices. Government efforts could involve both improving public extension services as well as promoting the enabling environment for private delivery (including subcontracting to the private sector some activities).

3.12 Over the medium-term, the Government of India should lift various regulations related to marketing as this would improve marketing efficiency and would be critical to the longer term sustainability of power sector reform. These would include lifting controls on marketing activities, such as storage, movement, credit, export and import controls and the small-scale reservation of selected industries. At the state level, this would include phasing out the levy on rice mill output, currently at 50 per cent and permanently removing restrictions of rice exports to other states. Elimination of these controls will reduce transaction costs of marketing and hence allow better prices for farmers and consumers. They will also encourage greater private sector investments in marketing infrastructure (e.g. storage) that will reduce marketing losses. Improved electricity supply in rural areas would also facilitate growth of such industries. Progress in the reform of these restrictions, however, has been slow. The on-going WTO negotiations on agriculture are likely to necessitate some reform of domestic regulatory policies, thereby hastening the process. Collaborative efforts across states to move the reform process forward would be critical. The State should not resort to offering higher commodity support prices to compensate farmers for the increase in power tariffs to agriculture for three key reasons.

3.13 The increasing fragmentation of land in AP also merits a review and re-evaluation of the current State land policy particularly the restrictions on land leasing. This could serve as a first step to developing a new land policy that better meets the needs for the rural sector in the 21th century. As noted earlier, the increasing fragmentation of land sizes, with limited access to leasing, reduce the incentives for adopting modern productivity enhancing methods for farming that could help improve both farm incomes and competitiveness.

B. Integrated Demand Side Management Programs

3.14 There are several measures that would help improve the use of groundwater resources. Metering, as noted above, whether for surface irrigation or water extracted by electric pumps, would permit improved pricing of the water to better reflect its scarcity value. A further advancement of graduated tariff rates (higher per unit rates at higher consumption levels), could help deal with the "rebound effect", that is farmers will irrigate more area with improved electricity supply leading to groundwater resource degradation.

3.15 Regulating access to water through registration of wells and regulation of well depth, spacing and pump capacity could also help limit over use of water. These regulations, however, would be administratively difficult to enforce in India due to large number of small farmers. Equity is also an important concern, as registration would favor current pump owners vs new ones.

3.16 Organization of regional/local groundwater user groups could provide a mechanism for workable collective self-enforcement. The organization of community-based groundwater conservation districts is being piloted in Rajasthan and would provide useful lessons in the future. These could be complemented by information and education campaigns to generate greater awareness on the importance of sustainable groundwater use. Pilot projects in Haryana have already demonstrated the benefits of Integrated Agricultural DSM (see Haryana Report, Chapter 5). Similar programs could be initiated in Andhra Pradesh (see Box 3.1).

Box 3.1 -Agricultural DSM Experience in Andhra Pradesh

In early 1990s, Andhra Pradesh recognized the potential benefits of introducing end use efficiency for agricultural. The requirement of a steady quality power supply as prerequisite was also appreciated. The state pioneered the concept of integrated energy efficiency in India by introducing High Voltage Distribution System (HVDS) to improve the quality of power supply to agricultural consumers along with replacement of existing inefficient pumps with higher efficiency and lower capacity pumps to reduce energy consumption for the same water delivery. Under this plan, existing three phase Low Voltage Distribution System (LVDS) was to be converted as single phase HVDS as close to consumer as possible. Small capacity single phase transformers (10 or 15 KVA) were to be installed to supply a group of few consumers and the existing three phase pumpsets were to be replaced with energy efficient single phase models.

A technology demonstration involving 7,200 pumpsets was undertaken in Warangal district with the support from the Japanese OECF (now JBIC). The response from consumers to this forced conversion program was mixed and only about 2,010 pumpsets were replaced by efficient single phase models. A similar demonstration was attempted with the support from UK DfID in Nalgonda district involving 3,200 pumpsets connected to one 33/11 kV substation. Losses were brought down to about 2-2.5% in the LT section. However, only about 850 consumers participated in the demonstration project. The less than adequate response from farmers is attributable to a combination of factors including the resistance to change by unauthorised consumers, use of higher than required or declared horse power etc. Other issues faced during the implementation of these programs included farmers' apprehension of the single phase system, some problems with contractor for the repair and maintenance of the new pumpsets, APTRANSCO/DISCOM's inability to roster and manage agricultural consumption in these areas, interference from local mechanics whose livelihood was affected by the contractor implemented pumpset program etc.

Learning from this experience, Andhra Pradesh is now adapting a modified approach in the AP Integrated Agricultural Energy Efficiency Pilot project funded through a US$ 4.6 million grant by the Government of Norway under its Activities Implemented Jointly (AIJ) Program. This pilot covers approximately 5,800 pumpsets connected to two 33/11 kV substations in Chittoor and Karim Nagar districts. Under this pilot project, HVDS will be developed in a three phase configuration, to eliminate one of the main concerns of farmers for participating in the program.

An outreach program explaining the benefits of the new distribution system and a voluntary efficient pumpset scheme will be offered to farmers in close coordination with local groups/banks involved in outreach activities for other agricultural and rural development initiatives. On an average, it is expected that the end-use efficiency will go up from about 25% to about 50%. This pilot is in early stages of implementation and is expected to be completed by December 2002.

DISCUSSION PAPER

Subject: Billing of Agricultural Consumption on the basis of Group Metering:

Introduction: There are about twelve lakh permanent agricultural connections in the State. In addition about 5 to 6 lacs temporary connections are availed during agricultural season every year. Supply to these agriculture connections is catered through one lakh distribution transformers approximately. The prevailing tariff for agricultural pumps provides energy rates per units of consumption for metered agricultural consumers. The tariff also provides assessment units per horse power of sanctioned load for un-metered agricultural consumers. The rate of assessment units per horse power of sanctioned load for un-metered agricultural consumers is uniform across the State as there has been no scientific basis to evaluate differential rate of assessment units for different areas . There are about seven Lacs un-metered agricultural connections. Individual metering to such large number of agricultural connections is a time consuming exercise. It will however not be appropriate to continue with method of billing on flat rate assessment per HP indefinitely. An alternative interim and quite fair solution to this problem could be to provide meter on the Distribution Transformer for the group of agriculture consumers served by the DTR. The consumption recorded by the DTR meter could be divided amongst the connections on per HP pro-rata basis. The paper discusses possible pro & cons of the solution suggested hereinbefore.

2. Legal Provision: Section 55 (1) of the Electricity Act 2003 provides that, *"no licensee shall supply electricity, after expiry of two years from the appointed date, except through installation of correct meter in accordance with the Regulation to be made in this behalf by the authority: "*

There have been a large number of un-metered domestic and agricultural category of connections in the State. As per the provisions of the Electricity Act, all these un-metered connections were supposed to be provided with meters within two years of the appointed date, i.e. before 10th June'05. The Distribution companies of the State had made a request to the Commission to extend the time period for installation of meters on un-metered consumers expressing difficulties in providing meters within 2 years of the appointed date of the Electricity Act'2003. This request was made under the powers conferred to

the Commission under second proviso of section 55 of the Act. The Commission considering the difficulties expressed by the Distribution companies, issued a notification on 18.10.2005 and extended the time period for installation of meters on un-metered connections of domestic and agricultural categories of consumers.

3. Constraints in providing individual meter to agricultural connections:

The Distribution licensees in the State have reported following constraints in providing individual meters to all unmetered agricultural consumers:

(a) No permanent structure is available in agricultural field for installation of meters.

(b) Soon after the agricultural season is over, the farmers remove all the accessories with pump from the well side including the main switch.

(c) Providing meters on pole is an alternative but there are chances of its damage by miscreants being situated in rural areas and unguarded. Such meters on pole shall also get exposed to adverse atmospheric conditions/weathering effect leading to damage.

(d) Reading of individual pump connection every month with meter on pole is also a big constraint because of scattered geographical areas as well as difficulties in approach. Moreover it shall be considerable time consuming making it difficult to ensure timely readings.

(e) Chances of malpractices, with unattended installed meters even by persons other than consumer with intention to harass the consumer cannot be ruled out because of animosity.

4. Status of meterisation: Mentioning the above constraints in providing individual metering to agricultural consumers, the licensees have again approached the Commission for further extension of above time period and also to cover agricultural consumers through DTR metering. The status of unmetered consumers as on March'2007 and the time extension sought by the Distribution licensees is given as below:

Name of Company	**Total no. of unmetered connections as on March'07**		**Percentage unmetered as on March'07**		**Time period extension sought by the Distribution licensees**	
Category	**Domestic**	**Agriculture**	**Dom.**	**Agri.**	**Domestic**	**Agricultural consumers through DTR**

East Discom	**322580**	**139733**	**18.36%**	**51.50%**	**31st March 2010**	**31st March 2010**
West Discom	**49934**	**412117**	**3.05%**	**83.8%**	**31st December 2008**	**31st March 2011**
Central Discom	**55205**	**158393**	**4.28%**	**57.06%**	**31st December 2008**	**31st March 2011**

As per the provisions under second proviso of section 55 of the Electricity Act 2003, "*the Commission may, by notification, extend the time period to supply electricity to unmetered consumers for a class or classes of persons or for such areas as may be specified in that notification"*. While considering the meterisation plans of the Distribution licensees, the Commission invited the comments/suggestion from various stakeholders through a public notice in news papers as also from all the members of State Advisory Committee. The Commission has not received any response in the matter from the stakeholders.

5. **Proposed interim solution to agriculture metering:**

As mentioned earlier about a lac of DTRs are catering supply to the agriculture connections. These Distribution transformers catering supply to agricultural consumers could be provided with a meter at its secondary side to measure the output supply. Consumption of all agriculture connections connected to a distribution transformer shall be recorded in the meter provided on the DTR. In order to workout individual consumption of the agriculture connections, connected load of all irrigation pumps is required to be known. This will be available from the connection records of the licensee. It has to be assumed to make a fair and just assumption that normally the consumption of individual consumer per HP shall be almost same for the consumers fed from one DTR. This is so because the crop pattern, water table and availability of water from the rains during the season, working pattern, proximity to river belt/ canal etc. in a small localized area fed by a DTR would be similar. Thus the consumption recorded in the DTR meter could pro-rated amongst the individual connections on the basis of connected load of their pump sets. However the distribution loss, say to the tune of 5 to 6%, in LT lines that are emanating from the DTR and are feeding agriculture pumps connections may have to be accounted for from the consumption recorded in the DTR meter. However in order to implement such a scheme it may be necessary to obtain consent/ agreement of the individual agriculture consumers whose connection is fed from the DTR.

This proposition shall also take care of the following:

(i) The billing would be based on actual consumption recorded in the DTR meter instead of some theoretical calculations based on small sampling and applied uniformly all across the State.

(ii) Such a procedure would discourage the theft of electricity, which will be not be allowed by the regular consumers connected to the DTR.

(iii) Consumer as an individual shall be motivated to adopt Demand side Management by the other consumers in that group.

(iv) Billing will be based on actual reading recorded by DTR meter and as such fixing an assessment based on presumed supply hours shall not be required.

(v) The consumers would also free to opt for "Own your transformer" scheme as per prevailing practices to own and maintain transformer.

The temporary connections, which are being served every year by the three Discoms, are of the order of about 5 to 6 lakhs. These connections are availed by the cultivators for a period of about three months. It is very difficult and time consuming job to install individual meters and remove it after the period is over, for such huge quantum of connections with in short span of about one to two months during the season. Normally these connections are also served from the transformers which are feeding to permanent connections. The consumption of such temporary connections could also be worked out pro-rata based on connected load of their pump sets from the consumption recorded by the DTR meter.

Since, the Distribution Companies have submitted a quarterly plan to the Commission to provide meters on DTRs, the billing to agricultural consumers on this concept, could be initiated for those DTRs, which have been provided with DTR meters. This could be rolled out across the State after observing initial results. The Commission may consider including this concept in the tariff for agricultural category of consumers after taking views of the stakeholders.

PERFORMANCE BASED EMPLOYEE INCENTIVE / DISINCENTIVE SCHEME

1. BACKGROUND

a. The Maharashtra Electricity Regulatory Commission (MERC) issued the Operative Tariff Order for FY 2006-07 on 29th September 2006, applicable from 1st October 2006 to 31st March 2007.

b. In determination of the ARR and Tariff for FY 2006-07, the Commission has assessed the Distribution loss level for MSEDCL at 34.97 % for FY 2005-06. The Commission, expressing concern over the high loss levels and the efforts being undertaken, ***noted that more positive steps have to be taken for reduction of Distribution loss levels. In this regard, the Commission has directed MSEDCL to introduce a Staff Incentive Scheme so as to make the Staff more responsible and focussed on Distribution loss reduction.***

c. The scheme was submitted by MSEDCL on 14th November 2006 to Hon'ble MERC for approval. MERC vide letter no MERC/LEG/MSEDCL/Case 54 of 2005/202 dated 22nd January 2007, has directed to carry out certain modifications in this scheme. The suggested modifications to the extent possible have been incorporated in the following note.

2. PROPOSED PERFORMANCE BASED EMPLOYEE INCENTIVE / DISINCENTIVE SCHEME

a. MSEDCL initiated the Ten Point Action Plan, which include Distribution Infrastructure work Plan and Distribution system loss reduction, collection efficiency improvement and has formulated several programs to give effect to the Action Plan. So as to achieve the desired goals in a time bound manner and evaluate Company &

individual performance, MSEDCL has designed the following staff incentive scheme as directed by Hon'ble commission.

b. **Principles for Proposed Incentive**

A Division-wise incentive scheme is proposed to be introduced to reward improvements in Aggregate Technical and Commercial Efficiency (ATCE) at a Division level. ATCE has been defined as the ratio of Realisation per Unit of Energy Input (RUEI) into the system to Average Billing Rate (ABR) for a specified period.

$$ATCE_i = RUEI_i / ABR_i$$

ATCEi is the Aggregate Technical and Commercial Efficiency of a Division for a specified period

$RUEI_i$ shall be computed as the ratio of actual cash collected (excluding non-tariff collection such as, service connection charge, Out Right Contribution by Consumers, etc) by the Division during the specified period to the energy input to the division as recorded in the input meters ABRi shall be computed as the ratio of total revenue billed (as per actual bills sent to the consumers) by the D ivision to the quantity (units of energy) of energy billed

In this scheme, as all the inputs for the computation shall be based on factual information (cash collected, energy input, total revenue billed and quantity of energy billed) that is available to all the employees, it shall bring about transparency in measurement and reward for performance.

The improvement in ATCE shall indicate actual improvement brought about by the division in operational efficiency in terms of reducing distribution losses and improving collection efficiency. As the efforts required in bringing about improvements in ATCE is a function of the base level of ATCE loss at the time of introducing the scheme, the incentive scheme shall classify the divisions into various categories where the incentives shall be payable beyond a threshold minimum improvement

required. The applicable threshold beyond which incentive is payable is annexed in annexure 1. The incentive payable to the division shall be 10% of the incremental revenue brought about by operational efficiency beyond the threshold specified for respective divisions. The maximum incentive that can be availed by a division is capped at sum of one basic salary of all the employees in the respective division at end of the quarter. Accordingly, the maximum incentive that an employee can receive in a quarter shall not be more than his one month's basic salary. The incentives shall be payable quarterly by considering improvements brought in a quarter as compared to the same quarter of last year as computed using the following formula:

IP = {10%* [(ATCEi – ATCEi-1)- THIm] * CC }

IP is Incentive Payable to the all employees in the division. However, the maximum incentive payable for a Quarter for a particular Division shall not be more than the sum of one month's basic of all the employees in the Division. This incentive shall be distributed among all the employees in proportion of their basic salary. It is further clarified that the maximum incentive payable to an employee for a quarter shall not be more his one month's basic salary.

ATCEi is the Aggregate Technical and Collection Efficiency in Quarter i
ATCEi-1 is the Aggregate Technical and Collection Efficiency in the same Quarter last year
THIm Threshold minimum improvement applicable for the Division as specified in Annexure 1
CC shall be th e total cash collected in the Division during the quarter (excluding non-tariff collection such as service connection charge, Out Right Contribution by Consumers, etc)

c. **Principles for Proposed Disincentive** There shall be disincentive for non-performance of a Division as reflected in deterioration of Aggregate Technical and Commercial Efficiency (ATCE) at a Division level. The disincentive shall be recoverable quarterly by considering non-performance in a quarter as compared to the same quarter of last year and shall be computed using the following formula:

DR = {10 %* [(ATCEi – ATCEi-1)- THDm] * CC }

DR is Disincentive to be recovered from all the employees in the division. However, the maximum dis incentive recoverable for a Quarter for a particular Division shall not be more than 15 % of the sum of one month's basic salary of all the employees in the Division. This dis incentive shall be recovered from all the employees in proportion of their basic salary. It is further clarified that the maximum disincentive recoverable from an employee for a quarter shall not be more 15 % of his one month's basic salary.

ATCEi is the Aggregate Technical and Collection Efficiency in Quarter i
ATCEi-1 is the Aggregate Technical and Collection Efficiency in the same Quarter last year
THDm Threshold minimum non-performance for the division as specified in Annexure 2
CC shall be th e total cash collected in the Division during the quarter excluding non-tariff collection (such as service connection charge, Out Right Contribution by Consumers, etc)

3. IMPLEMENTATION DETAILS

1. All staff under O & M division will be brought under the Incentive / Disincentive Scheme presently.
2. All the base parameters, i.e., ABR, REUI and the derived ATCEs for each Division shall be notified to all on the day on introduction of the scheme.
3. At the end of each Quarter, the applicable ABR, REUI and ATCEs for the quarter shall made available in the website after the end of the quarter.

4. The area EDs with the help of CGM (IT) / Zonal CEs will prepare the quarterly result sheet for their areas and submit it to Director (Op.) and Hon'ble Managing Director.
5. The incentive / disincentive computed shall be payable along with / recoverable from the salary payment of successive month after the approval of competent authority.
6. The staff of the nonperforming sub divisions (rated by the concerned Chief Engineer) within the eligible division shall not be eligible for receiving the incentive for that particular quarter. Similarly for disincentive, the recovery of the disincentive shall be made from the staff of non performing sub divisions (rated by the concerned chief engineer)
7. In addition to the applicable disincentive, th e staff of the Division showing persistent non-performance for a financial year, i.e. no improvement in performance or deterioration in performance as reflected in ATCE will be transferred to non-executive posts or elsewhere at the discretion of management. They will not be brought back to executive posts at least for the next two years subsequent to the transfer.
8. During Employee transfer / promotions, the performance as reflected in ATCE shall be taken into consideration.
9. The scheme is presently being implemented on Division level and will be extended to feeder level on stabilisation of feeder wise energy accounting. It is submitted that the feeder wise energy accounting information is being gathered and the base level data for all feeders for all four quarters will be available by December 2007. Secondly the feeder wise collection efficiency information is not being computed. IT Department is being directed to start working on data for base for first four quarters by end of December 2007.
10. At the end of every year, the threshold for different category and percentage of improvement to be paid as incentive / recovered as disincentive shall be reviewed by MSEDCL
11. This scheme will supersede all other incentive schemes in force as on date.
12. An example for computation of incentive / disincentive is provided in Annexure 3

The scheme is proposed to be submitted to the MERC for perusal.

ANNEXURE 1

Opening level of ATCE	**Threshold Improvement in % above which incentive is payable**
Above 90%	0.5%
>80%-90%	1%
>70%-80%	2%
>60%-70%	3%
>50%-60%	4%
Below 50%	5%

ANNEXURE 2

Opening level of ATCE	**Threshold Deterioration in % below which disincentive is recoverable**
Above 90%	3%
>80%-90%	2.75%
>70%-80%	2.50%
>60%-70%	2.25%
>50%-60%	2.0%
Below 50%	1.75%

ANNEXURE 3

Incentive

ATCE of a Division in Q1 of 2006 is 75%
ATCE of the same Division in Q1 of 2007 is 82%
One Months' Basic Salary of all employees in the Division is 30 Lakhs
Cash Collected in the Quarter Q1 of 2007 is 35 Crore

Then the incentive payable is

IP = {10%* [(ATCEi – ATCEi-1)- THIm] * CC }

= {10%* [(82% – 75%)- 2%] * 35 } Crore
= 0.175 Crore = 17.5 Lakhs

Total incentive payable is less than 30 Lakhs, hence the incentive payable is 17.5 Lakhs

An employee with Rs.10,000 as basic salary shall receive Rs. (17.5/30)* 10,000, i.e. Rs. 5833/- only as incentive for the quarter.

Disincentive

ATCE of a Division in Q1 of 2006 is 85%
ATCE of the same Division in Q1 of 2007 is 80%
One Months' Basic Salary of all employees in the Division is 30 Lakhs
Cash Collected in the Quarter Q1 of 2007 is Rs. 35 Crore

Then the disincentive recoverable is

DR = {10 * [(ATCEi – ATCEi-1)- THDm] * CC }

= {10* [(85% – 80%)- 2.75%] * 35 } Crore =
0.0788 Crore = 7.88 Lakhs

Total disincentive recoverable from the Division is more than 4.5 Lakhs (i.e, 15% of 30 Lakhs), hence the disincentive recoverable is 4.5 Lakhs

The disincentive recoverable from an employee with Rs.10,000 as basic salary shall be Rs. (4.5 /30)* 10,000, i.e. Rs. 1500/- only for the quarter.

FEEDER RENOVATION PROGRAMME :

AN AMBITIOUS PROJECT OF GOVERNMENT OF RAJASTHAN

In the state of Rajasthan distribution system was suffering badly from very high distribution losses as well as poor quality of supply and electrical net work which needed to be improved by making proper capital investment on a techno-economic consideration to finally affect a turn around of the Discom and quality services to the consumers. Feeder Renovation Programme (FRP) has been conceived as one of the key activities besides other programme to achieve this end result.

The main theme of FRP was to segregate electrical network for three phase agriculture load and single phase D.S. NDS etc. load besides so many other interventions.

MAIN OBJECTIVES OF FRP

Following are the key objectives of FRP :

1 To ultimately reduce distribution losses on 11 KV feeders to a level below 15%
2 To reduce burning rate of distribution transformers
3 To improve quality of power supply and make it interruption free
4 To make available 24 hours domestic and non domestic single phase supply in rural areas so as to remove disparity between urban and rural areas
5 To make investment supported technical interventions for preventing theft of electricity and consequently reduction in commercial losses
6 Preventing unauthorized use of capacitors during peak load hours by agriculture consumers thereby reducing power requirement during peak load hours and saving money on purchase of costly power during peak load hours
7 Segregation of domestic and agriculture supply system
8 To reduce accident risks associated with snapping of conductor in rural areas Increasing consumer satisfaction level

KEY TECHNICAL INTERVENTIONS :

1. To develop single phase H.T. system for D.S. & NDS consumers of rural areas by extending one phase of HT system and neutral wire from the existing three phase 11 KV H.T. system

2. Installation of low rating, low loss copper wound single phase distribution transformers on this extended one phase H.T. system.
3. Providing of 25 KVA distribution transformers with a M&P box attached to its body, having provision for installation of two meters, MCBs and capacitor in the M&P box. The LT bushings of these transformers are completely concealed thus maximum two consumers on each transformer.
4. Laying of separate 3 Phase AB cable for each AG consumer from distribution transformers with a maximum length of 270 meters.
5. Replacement of bare conductor LT over head lines by AB cables and insulated rabbit conductor
6. Laying of single phase AB cable from single phase distribution transformers for providing supply to Domestic and non domestic consumers of rural area
7. Replacement of existing obsolete service line of consumer by armoured XLPE cable
8. Installation of push fit type static meters by replacing the existing slow and sluggish old type meters. To keep the serial number of seals of meter box, meter body, meter terminal plate same as that of meter number. Use of double anchor special seals for meter box
9. Installation of roaster switch on 132 KV sub station and 33/11 KV S/S for every 11 KV rural feeder emanating from GSS and sub station.
10. Installation of metering equipment at the emanating point of all feeders for feeder metering to calculate T&D losses of feeders.

IMPLEMENTATION :

Following steps are involved in the implementation of programme :

1 Feeder wise detailed survey reports are prepared

2 As far ass possible work is being executed on turn key basis in exceptional cases

Where work on turn key basis is not possible work than awarded to a labour

Contractor on CLRC (Central Labour Rate Contract)

On the basis of survey report and single line diagram of feeder detailed project reports are being prepared which contain the following data :

1. Details of existing system
2. Details of proposed system
3. Bill of material
4. Bill of material to be retrieved.

5. Details of material proposed to be reused
6. Techno economic viability of project

These project reports are prepared departmentally where sufficient manpower is available otherwise this work is outsourced to competent agencies who prepared a comprehensive report containing reliable details on the basis of actual data collected from the field. This project report (s) is being utilized for inviting of tenders, posing it to the funding agencies such as REC, PFC and commercial Bank(s). Tenders are invited for as many numbers of feeders or a group of feeders as felt convenient and necessary depending upon the strategy to complete these works.

As these are high investment projects, therefore it was felt that it would not be proper to fully depend upon the contractor or agencies, it is preferable to supply vital equipments such as three phase and single phase distribution transformers, single phase and three phase ordinary and push fit type meters departmentally so as to ensure proper quality because these are the backbone of revenue of Discom and transformers play an important role in T&D losses of a utility.

This being capital intensive work and directly related to the health and image of Discom, all the material being procured by TW contractors are got inspected by the Engineers of Discom and IIIrd party inspectors at the works of manufacturers and further after receipt of material by consignees again samples are drawn from the lots of received material and got tested in Discom Central Testing Lab. Besides this construction activities being carried out by the contractors are strictly supervised for ensuring good workmanship and implementation of standard construction practices and norms. Further the work carried out by TW and CLRC contractors are inspected by the engineers (Internal Audit-Technical) of Jaipur Discom and M/s RITES Ltd, a third party agency to check quality of work and overall workmanship of feeder renovation work. Further the details of feeder, quantum of work done, quality of supply, supply hours etc. are being got checked by a third part M/s Research and Development Initiative(RDI), Delhi appointed by State Government to assess the quality of work, supply position and actual benefits accrued to the public at large. A photo copy of such report prepared by M/s RITES Ltd. and M/s RDI of a feeder are also enclosed herewith as a sample.

Working Arrangement for Single Phase System In The State of Rajasthan

APPENDIX-XIII

For establishing single phase system in rural area a rostering switch (isolator) has been installed for each rural feeder on the beginning point of feeder. i.e. at 33/ 11KV Sub-station / 132 KV. G.S.S. This switch has been installed after feeder metering so that there should be recording of energy drawl, demand, and other parameters of feeder during single phase mode of operation of feeder. The rostering switches are outdoor type single break roistering (three phase to single phase) isolators without earth blade and with post insulators and neutral affectively grounded. There are triple pole and separate neutral gang operated, single break, two post with one post rotating, banging type suitable for outdoor horizontal mounting. These are provided with fixed type arcing horns with make before and break after arrangement. The operational Mechanism is in following three modes.

(i) **Normal Operation Mode:-**

Under normal operation when three phase supply is to be given to feeder for agriculture purpose all the three phase (R,Y,B) and neutral blades are in closed position as shown in drawing-stage-Ist.

(ii) **Roster Operation Mode:-**

Under this mode of operation the feeder will get single phase supply and neutral only, the blades of R & B Phase of feeder disconnects from incoming R & B phase and connects with Y phase at outgoing side of isolator. Thus at this stage Y phase supply connects to all the three outgoing phases as indicted in drawing-stage-IInd.

These isolators have been designed in such a manner that some isolators connects 'R' phase supply, some connects 'Y' phase supply and some connects 'B' phase supply to all the three outgoing phase so that balancing of load could be done on power transformer.

(iii) **All three phase and neutral open Mode:-**

In this mode of operation the feeder does not get supply at all. This is complete shut down position of the feeder. In this stage, all the three phase and neutral remains in disconnected position (blades open) as shown in drawing-stage-IIIrd.

Further for giving single phase supply to the rural house holds and non-domestic consumers one phase of H.T. and neutral wire is extended from the nearest tapping point of 11 KV feeder of that area and a low loss and low rating copper wound single phase transformer is installed on a PCC Pole of 9 meter length. From this transformer single phase AB Cable is laid on 8 meter length PCC Poles upto the houses/ premises of consumers and from pole to the house/premises of consumer a service line of 2x4 Sq. mm. XLPE armoured cable is being laid upto the meter of consumer. This system works perfectly during both three phase supply block hours and single phase 11KV supply hours for rural house holds and small non-
domestic consumers whereas the agriculture consumers get supply during three phase block hours and thereafter their three phase transformer does not work on one phase H.T. supply.

Benefits:

1) Transformers burning rate reduced drastically.
2) Tempering possibilities of AG metered connection is reduced.
3) System is segregated for single phase (domestic) and three phase (agriculture) supply so it become possible to prevent use of capacitors by agriculture consumers during peak load hours.
4) Theft of electricity by hooking of bare conductor is eliminated
5) Consumers are induced to take regular connection and reconnection of old disconnected connections.
6) Rural households are getting 24 hours supply at par with urban area which resulted into comforts to ladies in doing their works, students in their studies, upliftment of rural economy etc. etc.
7) Prevention of theft of electricity by tempering of meter and bypass of meter by cutting service line
8) Less maintenance of over head L.T. line due to AB cables
9) Minimum interruption of L.T. supply during bad weather due to insulated conductor & A.B. cable which is not possible with bare conductor L.T. lines.

10) Reduction in chances of accidents due to possibilities of snapping of conductor/AB cable which too much in case of bare conductor.
11) Reliable and better quality of electricity supply.
12) Reduction in accident of workers while working on line & poles because of bunching of insulated wire in place of spreaded bare conductor.
13) Laying of more than one L.T. circuit on the same support & cross arms etc. which is not possible with bare conductor lines.

Monitoring of End Results for Sustainability :

1. The energy audit of the renovated feeders are being carried out regularly on monthly basis.
2. FRP registers are being maintained at each 33/11 KV sub stations containing feeder wise details of energy drawn, energy sold (billed) and T&D losses, besides condition of equipments like VCB.OCB, metering system, roaster switches etc. installed on the sub station.

3. These registers , feeders meters are being checked by Feeder Managers regularly and by other officers from time to time.
4. The stored data in feeder meters are downloaded through C.M.R.I. in computers to check the supply hours, voltage, current and load profile of feeder, energy drawn etc.
5. The feeders are being checked by Feeder Manager, Vigilance officers to detect stray cases of theft of electricity by cutting of AB cable, breaking of welding of transformer, tempering of meters etc.
6. The salary to Consumer Complaint attendants deployed in field is given in the presence of concerned Executive Engineers after obtaining report about damage to transformer, meters, cutting of AB cable etc. and after obtaining a certificate that there are no other such cases besides reported by them.
7. FIRs are being compulsorily lodged against the defaulters in A.T.P.S. thanas created specially in each Circle/District and transformers are given only after arrest of culprits and depositing of amount assessed against theft of energy.

8. Provision has also been made to withdraw the 24 hours single phase supply of feeders where T&D losses increased to more than 20% so as to keep the consumers alert against the persons indulged in theft of electricity.
9. To regularly take feedback from Sarpanches & other local persons about supply position and keeping them alert against the persons indulged in theft of electricity.
10. Distribution Transformers wise T&D loss monitoring in semi urban and Urban areas.

Urban Focus Programme:

In the state and area of Jaipur Discom there are good number of consumers living in semi Urban area i.e. small Municipal towns and localities having more than 5000 population, In these area the load of individual consumer is more than load of consumers residing in rural area and also small industries runs. Therefore in these area three phase L.T.
supply is given for 24 hours regularly. Therefore, as a part of FRP programme in these area "Urban Focus" programme has been launched. Under "Urban focus" programme following activities are being carried out –

1. Seperation of 11 KV feeder of rural consumers and consumers of these semi Urban areas
2. Installation of separate small M&P Box type distribution transformers for Agriculture consumers who are lying in semi Urban area and maximum two consumers on each transformer
3. Replacement of L.T. Line bare conductor by insulated rabbit and 3 phase AB cable
4. Change of old & sluggish meters by new tyhpe of push fit meters
5. Change of old type service line by armoured XLPE cable
6. Installation of small distribution trasnsformers in place of higher rating transformer

7. To reduce the length of long L.T. feeders
8. Metering of each distribution transformer and calculation of T&D losses for each D.T.

For ensuring better quality work, yielding full benefit of investment for FRP work some stringent pre-requisite were made essential to be complied with for declaring a feeder renovated. The pre-requisites are as under :

(i) Distribution T&D losses should not be more than 15%

(ii) 24 hours single phase supply for household and non domestic consumers is made available

(iii) A certificate has to be obtained about completion of work and making available 24 hours single phase supply from the Sarpanch of concerned Grampanchayat

(iv) A joint declaration about work done and basic parameters of feeder in prescribed format is to be given by the concerned XEN, AEN and JEN.

Case History of FRP Works Executed in Jaipur District Circle:

Jaipur District Circle is the largest Circle of Jaipur Discom in Rajasthan State. The net work of JPDC is very large. There are 18 No. 220/132 GSS, 175 Nos. 33/11 KV sub stations and about 750 Nos. 11 KV feeders out of which on 637 rural feeders FRP work was to be carried out. There is about 1675.35 Kms., 11797.34 Kms., and 27547.90 Kms. net work of 33 KV, 11 KV and L.T. lines respectively serving about 1,77,389 Nos. of DL,24893 Nos.NDS, 83403 Nos.Ag.,5383 Nos. Industrial and 16875 Nos.Misc. category of consumers respectively. This position of Circle involved massive work and posed a big challenge to the officers & staff of the Circle. The work was taken up in hand by all in the month of April,2005 with full dedication and the target was achieved by the Circle at the end of July,2008 within a short period of about three years. Before taking up the work FRP of 11KV Badhal feeder was carried out as a sample in Jaipur Discom. On the basis of results and benefits observed from this renovated feeder this work was launched in entire Discom.

APPENDIX-XIII

The following major activities were carried out in execution of FRP.

1) Provided about 35,000 Nos. small 25 KVA M&P Box type distribution Transformers.
2) Installed 16,600 Nos. single phase transformers
3) 5000 Kms. AB cable laid by replacing LT overhead lines
4) All slow and sluggish meter replaced by push fit meter. 1,35,000 Nos. push fit meters have been installed and provided with XLPC armoured cable, service line
5) 360 Nos. Roaster switches installed
6) Feeder metering provided on 749 feeders

Impact of FRP after its implementation

1) The drawl of the Circle increased by 27.16 % against which the sale increased by 84.66% resulting in T&D losses reduced by 21.71%
2) Assessment increased by 119.46%
3) Realization increased by 119.13%
4) The 4215 Nos.PDC consumers have come forward for reconnection
5) Transformers burning rate reduced drastically.
6) Tempering possibilities of AG metered connection reduced to a great extent.
7) System is segregated for single phase (domestic) and three phase (agriculture) supply so it become possible to prevent use of capacitors by agriculture consumers during peak load hours.
8) Theft of electricity by hooking of bare conductor almost eliminated
9) Consumers are induced to take regular connection
10) Rural households of all the 2075 electrified villages of Jaipur District are getting 24 hours supply at par with urban area which resulted into comforts to Ladies in doing their works, students in their studies etc. etc
11) Theft of electricity by tempering of meter and bypass of meter by cutting Service line is prevented.

(Comparative statement of performance parameters before and after FRP is attached at Annexure "A")

In Jaipur Discom progress of FRP work is very good and the work is near completion. Out of 2200 Nos. 11KV feeders work on 2177 Nos. feeders have been

completed and 12874 Nos. villages are being given 24hours supply out of 13147 Nos. total electrified villages. As a result of this work the T&D losses have been reduced by 8.63% in last two years. The T&D losses of Jaipur Discom was 28.68% by the end of 2007-08 which are targeted below
20% in next two years. A brief comparison of year wise results due to benefit of FRP work is as under:

Particulars	2003-04	2004-05	2005-06	2006-07	2007-08
Distribution Loss	39.85%	37.71%	37.31%	33.71%	28.68%
Collection Efficiency	100.21%	99.68%	99.25%	99.55%	98.97%
AT&C Loss	39.72%	37.91%	37.78%	34.01%	29.41%

The FRP work is also being carried out in other two Discoms. The progress of FRP work achieved by all three Discoms is as under:

Name of Discom	FRP Targets		Progress upto March-08				Balance work	
	No of Feeders	No of Villages	No of Feeders on which FRP work completed	Villages getting 24 Hrs. supply	%age completion of work		No of Feeders	No of Villages
					Feeder	Village		
JAIPUR	2200	13147	2177	12874	98.95	97.92	23	273
AJMER	2975	12162	2005	7118	67.39	58.53	970	5044
JODHPUR	3300	10848	2298	7568	43.60	69.76	1002	3280
TOTAL	8475	36157	6480	27560	76.46	76.22	1995	8597

A brief comparison of year wise results due to benefit of FRP work in respect of other two Discoms are as under:

DISCOM	Particulars	2003-04	2004-05	2005-06	2006-07	2007-08
AJMER	**Distribution Loss**	45.51%	43.58%	42.09%	37.68%	34.16%

	Collection Efficiency	98.37%	98.73%	98.98%	100.61%	98.39%
	AT&C Loss	46.40%	44.30%	42.68%	37.30%	35.22%
JODHPUR	**Distribution Loss**	42.56%	42.38%	41.72%	32.47%	27.42%
	Collection Efficiency	97.89%	96.51%	96.35%	99.81%	97.19%
	AT&C Loss	43.77%	44.39%	43.85%	32.60%	29.46%
All Discoms	**Distribution Loss**	42.62%	41.10%	40.22%	34.65%	30.09%
	Collection Efficiency	98.96%	98.50%	98.35%	99.95%	98.30%
	AT&C Loss	43.22%	41.98%	41.21%	34.68%	31.28%

As a result of this work the T&D losses of Rajasthan State have been reduced by 11.01% in last three years.

The above results and benefits accrued consequent to implementation of FRP work by pouring in huge amount and technical intervention themselves speak out the success and utility of FRP programme.

Recommended method of calculating the AT&C loss

OVERALL ENERGY LOSSES:

The overall energy loss may be computed from the actual meter readings of the meters installed at various locations in the system. Determination of Aggregate Technical and Commercial Losses (AT&C) involves estimation of (i) Distribution and Billing losses (D&B) as difference between units input and units billed and (ii) Collection efficiency as the ratio of amount collected to amount billed. (iii) Units realized as the product of units billed and collection efficiency. (iv) AT&C loss as difference between units input and units realized.

Distribution and billing losses are due to technical losses, theft and metering deficiency.

For better understanding, the above principles can be translated in to the following equations

$$\text{D\&B Loss} = UI - UB$$

$$\text{D\&B loss}_{pu} = \frac{UI - UB}{UI}$$

$$\%\ \text{D\&B loss} = \frac{UI - UB}{UI} \times 100$$

Where UI is Units Input **(excluding units traded)**
UB is unit billed **(to consumers in its licensed area)**

$$\text{Collection efficiency } (CE)_{pu} = \frac{\text{Amount Realised}}{\text{Amount Billed (less disputed amount)}}$$

Units Realised (UR) = Units billed x Collection Efficiency

AT&C loss = UI – UR

$$\text{AT\&C loss}_{pu} = \frac{UI - UR}{UI}$$

AT&C LOSS REDUCTION - STRATEGIES

(I) Reduction in Technical losses:

- Replacing & revamping old equipment – RMU's installation
- Improvement in System Reliability by regular Maintenance of Feeders & Transformers / Creating N-1 Network Redundancy
- Critical Asset Surveillance
- LTABC, HVDS & System Augmentation for Meeting Growth Requirements
- CAPEX in Critical Priority Areas
- Remote LT Load Shedding in High Loss Areas
- GSM based switching of Street Lighting
- Power Factor improvement (Addition of Shunt Capacitors)
- Automation / Installation of SCADA for operating & controlling entire Power System Network at 66 KV, 33 KV & 11 KV
- Regular monitoring of reliability indices like SAIDI/SAIFI/CAIFI
- GIS
- Network improvement – Project Last Mile
- Integration of OMS / SCADA (Proposed)
- Unmanned Automated Grids for speedy resolution of faults
- Hot Line Maintenance
- Addition of Grids
- Underground Cabling

(II) **Theft Control:**

- LT ABC
- HVDS
- Regular Inspections / Enforcement at Zonal & Corporate Level
- Service Line replacement
- Installation of Bus-Bar Boxes
- Mass Raids in association with CISF
- New Connection Camps

(III) Metering:

- Replacement of Faulty, Stopped, Slow and all Old Meters with Accurate Electronic Meters
- Installation of Meters in Meter Boxes
- Installation of Meters which are more intelligent with better tamper proof measures

- Capturing Metering Data in Protocol Sheets for Updating in Database
- Split Metering
- Pre-Paid Metering

(IV) Billing Process:

- Re-engineering of Commercial Processes and Centralization
- Consumer Segmentation for Differentiated Services & Focus
- Automatic Meter Reading for Key Consumers & High Revenue Based Consumers
- Reading through Hand Held Device for Domestic Consumers
- Reducing Not Read, Premises Locked and Not Traceable Cases
- Address correction and address formatting
- Second attempt on Unread cases / undelivered bills
- DT wise Meter Reading
- Cleaning of Database

(V) Collection Process:

- Increased number of Customer Friendly Collection Centers
- Addition of Payment Avenue for Consumer Conveniences
  - Drop Boxes
  - Any Time Payment Machines (ATPM's)
  - Online Payment
- Revenue Recovery Group (Initiated steps for Disconnection on non-payment) & analysis of post DVB arrears

(VI) New Connection Process:

- Reduced time
- Convenience – Services at Consumer Doorstep
- Drive for providing New Connection like New Connection Camps etc.
- Providing un-metered 2 Amp connection
- New Connection Dues Verification Process
- Providing Metered Connection in JJ Clusters through Waiver of Old Dues / Relationship Building

(VII) Revenue Recovery Process:

- System driven Disconnection Notice & Process & Disconnection Advice Process
- Persuasion through Call Centre by Soft Calling
- Issue of Disconnection Notice within 5 days of default of payment
- Prompt Issue of Disconnection Advice
- Prompt Disconnection & Reconnection
- Post disconnection Quality Check / Surveillance
- Monitoring of Cheque Bounce Cases and Legal Recourse
- Color Coding of bills – Red Bills for defaulters

(VIII) Other Initiatives:

- Energy Audit & Accounting
- "No Supply" & "Commercial" Call Centre
    - SMS based Fault Management System
    - Integrated Tracking & Escalation of Complaints
- Public participation in controlling Theft through the concept of Social Audit.
- Collaboration with NGOs for creating awareness in Slums/JJ clusters regarding the dangers associated with Direct Tapping of electricity from live wires
- Creation of Revenue Assurance Group for identifying revenue leakages & process gaps
- Creation of AT&C Loss Mitigation to exclusively focus on Loss Reduction
- Regular Meeting with RWAs/IWAs
- Formation of dedicated team for speedy settlement of Legal Cases
- Regular Communication to Consumers through various modes

Subject: Low cost strategy to reduce Distribution Losses (By PSEB)

Reduction of Distribution losses is a major challenge for Distribution Engineers since the T&D losses are very high in our country. The high T&D losses have invited the attention at the highest level in the country since these are a big drain on our scarce national resources as well. India can ill afford such high losses in the deficit Electricity scenario that is prevailing across the country.

The T&D losses of PSEB are in the range of 23-25% for the last couple of years and PSEB has not been able to reduce them further. As per CEA norms, the losses should be in the range of 14-15% and thus there is need to reduce the losses by around 8-10%. PSERC also imposes stiff reductions while deciding annual tariffs due to non-achievement of targets of reduction of losses.

The Transmission losses in PSEB are estimated to be in the range of 5%, thus the Distribution losses are estimated to be around 18-20%. Around 26% of the total energy sold in PSEB is supplied on HT; wherein the losses are around 6-8% and around 50% of total energy sold is supplied on LT, wherein the losses are in the range of 50% and there is vast scope of improvement wherein energy is supplied on LT voltage.

One very effective and low cost method to reduce the Distribution losses is by installing meters outside consumer premises. It has been realized by Distribution Engineers across PSEB for last 6-8 years that installing meters outside consumer premises reduces losses and also reduces input energy. PSEB adopted this as a policy decision; vide C.C. no. 37/06 and subsequently some progress was made in installing meters on poles and in pillar boxes. However, no study at Feeder Level was carried out to specifically establish the effect of installing meters outside consumers' premises.

With a view to establish irrefutably the effect of installing meters outside consumers' premises, the following feeders were selected for executing these projects in different localities:

A) **URBAN POSH AREAS:**

i) 11 KV Hospital Feeder.

ii) 11 KV Bhupindra Road Feeder.

B) **Urban Kundi Area:**

11 KV Badungar Feeder.

C) **Rural Area:**

11 KV Ablowal UPS Feeder.

I) **11 KV HOSPITAL FEEDER**:

i) Name of S/Divn: Cantt

ii) No. of consumers

BS	1 (Rajindra Hospital)
DS/NRS	970
SP/MS	4

iii) Existing losses 37%

iv) Expected losses 15-20%

Detail of works performed

1) All the meters of 970 DS/NRS consumes have been installed on poles alongwith complete consumer indexing.
2) Work carried out during Dec. 07-Jan. 08.
3) Expenditure of Rs. 5.0 Lac has been incurred.

4. Work carried out departmentally.

Results achieved
(Losses for Cycle 1, 2 and 3)

	Year 2007 **Feb-July**	**Year 2008** **Feb-July**
Input Energy (in LU)	62.12	48.84
Billed Energy (in LU)	41.05	43.72
Feeder losses	33.91%	10.48%
LT losses (excluding Bulk Supply Energy of Rajindra Hospital)	43.86%	15.77%

PAY BACK PERIOD

Expenditure Incurred	=	5.0 Lac
Savings (Feb-May,08)	=	11.33 LU
Amount @ Rs. 4/Unit	=	Rs. 45 Lac
Pay back period	=	**Less than 1 month**

II) **11 KV ABLOWAL UPS FEEDER**

1)	Name of S/Divn	Kalyan
2)	No. of consumers:	
	DS/NRS	2222
	SP/MS	19
	Total	2241
3)	No. of Villages	10
4)	Existing losses	52%
5)	Expected losses	15-20%

DETAIL OF WORK CARRIED OUT

1) All the meters of consumers of 10 villages have been installed in Pillar Boxes or on poles & consumer indexing done up to Pillar Box level.
2) Providing 12 no. additional smaller rating T/Fs (25 KVA).
3) 141 no. Pillar Boxes installed.
4) 85 no. Meters installed on poles.
5) Minimum LT achieved in villages.
6) Work carried out during Jan-April 2008, departmentally.

RESULTS ACHIEVED

The readings of consumers' meters and Grid meter recorded on 22-04-2008 and 07-05-2008.
Losses achieved = 17.85%
(It is possible to reduce losses by further around 2-3% by changing old meters.)

CYCLE-3 LOSSES

Input units	10.25 LU
Billed units	8.21 LU
Losses	19.9%

PAY BACK PERIOD

1)	Expenditure incurred	=	50.0 Lac
2)	Savings:		
	Energy pumped (2007-08)	=	68.38 LU
	Energy billed (2007-08)	=	32 LU
	Expected pumped Energy (08-09) =	48 LU	
	Billed Energy at 16% losses	=	40.32 LU
	Savings in pumped energy	=	20.38 LU
	Increase in billed energy	=	8.32 LU
3)	Total energy saved per anum	=	28.70 LU
4)	Savings	=	109.92 Lac
5)	Pay Back period	=	6 months
6)	Pay Back period at peak rates	=	Less than 3 months

There is great improvement in voltage profile in villages with tail end voltage improving from 170 V. to 220 V. and reduction in maximum demand of the feeder to the extent of 20-25 on 11 KV side and reduction in outages.

III) OTHER PROJECTS BEING EXECUTED:

1) 11 KV Badungar Feeder (Urban KUNDI Area):

Status :		Completed on 10-09-2008
Present losses	=	65%
Expected losses	=	15%

2) 11 KV Bhupindra Road Feeder (Urban Area)

Status		90% meters installed on poles
Present losses	=	35-40%
Expected losses	=	15%

3) 11 KV Dakala Feeder

Status Expected to be executed during July-August 2008		
Present losses	=	87%
Expected losses	=	15%

CONCLUSION:

1) Taking the work of zero/minimum LT work on UPS Feeders on war footing, assuming there will be average reduction of 25 A on Grid side will de-load the system by around 300 MW.
2) Villages covered under this scheme should be provided supply on pattern of cities in reality.
3) Similarly installing meters outside consumers' premises and in Pillar Boxes on city feeders shall further de-load the system by around 400 MW (assuming 15 A reduction in load of around 1500 feeders).
4) The work should be carried out at FEEDER LEVEL for ensuring that the targeted results are achieved in reduction of losses.

(Er. Bhupinder Singh),
Senior Executive Engineer,
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A Case history of Rajasthan's Loss Reduction Efforts Through Feeder Renovation Programme with Urban & Industrial focus

Jaipur Vidyut Vitran Nigam Ltd.

Ajmer Vidyut Vitran Nigam Ltd.

Jodhpur Vidyut Vitran Nigam Ltd.

Sept-2008

In this presentation...

- Some Special Characteristics of Rajasthan
- EHV System
- Sub Transmission & Distribution
- Loss Reduction Programme
  - Metering initiatives for feeder-DT
  - *Feeder Renovation Programme*
  - *Urban Focus Programme*
  - *Industrial Focus Programme*

Rajasthan

3

Some Special Characteristics

- Largest State of India
  - 60% is arid and semi arid
- Sparsely populated
  - Density of population being 165 per sq. km
- Low and erratic rainfall and recurring droughts
- Far away from coal fields
  - High Distribution Losses
  - Per Capita consumption:- 534
  - Consumption Sharing
    - Ds.:- 18.87%
    - Ag.:- 34.43%
    - Ind.:- 29.04%
    - Oth.:- 17.66%

EHV System

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Network Strengthening

Particulars	As on 31 Mar 2001	As on 31 Mar 2008
400 kV Sub-station	1	4
400 kV capacity in MVA	1065	2955
400 kV lines (Ckt Kms.)	287	1097
220 kV Sub-station	41	58
220 kV sys Capacity in MVA	7655	10855
220 kV lines (Ckt Kms.)	6482	8913
132 kV Sub-station	180	269
132 kV sys Capacity in MVA	7741	12614
132 kV lines (Ckt Kms.)	10252	12296

Sub Transmission & Distribution

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Network Strengthening

Particulars	As on 31 Mar 2001	As on 31 Mar 2008	% Increase
33 kV Sub-station	1564	2752	75.96
33 kV capacity in MVA	7009	11918	70.04
33 kV lines	25772	34754	34.85
11 kV Sub-station	213819	451652	111.2
11 kV sys Capacity in MVA	10617	19120	80.09
11 kV lines	157490	218801	38.93
LT lines	216359	245973	13.69
HT to LT Ration	0.84	1.03	22.62

High HT to LT line ratio of 1.03 depicts effective HVDS

Loss Reduction Programme

1.Metering initives for feeder & DT

2.Feeder Renovation Programme

(Shyama Prasad Mukharji Vijay Jyoti Feeder Sudhaar Abhiyan)

3.Urban Focus Programme

4.Industrial Focus Programme

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Metering Initives

- Feeder Metering
  - 100% 11 kV distribution feeders metered.
- Distribution Transformer Metering
  - Distribution transformers metering implemented in all Municipal Towns.
  - Work in progress for other villages with population more than 5000.
- Consumer Metering
  - Out of 76.03 lac consumers 73.3 lac (96.4%) are metered.
  - All unmetered consumers are of Agriculture category.
  - All agricultural consumers to be metered by June, 2009.as allowed by RERC as per the Electricity Act 2003.

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FRP: key objectives of FRP

- To ultimately reduce distribution losses on 11 kV feeders to a level below 15%
- To reduce burning rate of distribution transformers
- To improve quality of power supply and make it interruption free
- To make available 24 hours domestic and non domestic single phase supply in rural areas so as to remove disparity between urban and rural areas
- To make investment supported technical interventions for preventing theft of electricity and consequently reduction in commercial losses

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FRP: key objectives of FRP (Contd….)

- Preventing unauthorized use of capacitors during peak load hours by agriculture consumers thereby reducing power requirement during peak load hours and saving money on purchase of costly power during peak load hours
- Segregation of domestic and agriculture supply system
- To reduce accident risks associated with snapping of conductor in rural areas Increasing consumer satisfaction level

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FRP: Key Technical Interventions

- To develop single phase H.T. system for D.S. & NDS consumers of rural areas by extending one phase of HT system and neutral wire from the existing three phase 11 kV H.T. system
- Installation of low rating, low loss copper wound single phase distribution transformers on this extended one phase H.T. system.
- Providing of 25 kVA distribution transformers with a M&P box attached to its body, having provision for installation of two meters, MCBs and capacitor in the M&P box. The LT bushings of these transformers are completely concealed thus maximum two consumers on each transformer.
- Laying of separate 3 Phase AB cable for each AG consumer from distribution transformers with a maximum length of 270 meters.
- Replacement of bare conductor LT over head lines by AB cables and insulated rabbit conductor

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Shyama Prasad Mukharji Vijay Jyoti Feeder Sudhaar Abhiyan (FRP): Installation of small DTs

- Specially designed 25 kVA distribution transformers for two agriculture connections installed.
- Metering cum protection box has been provided on transformer with lock and sealing arrangements with housing for installation of energy meters .
- LT terminals of the transformers totally concealed.
- MCCB & 6 kVAR Capacitor also provided on LT side.
- Supply to each of the two Agriculture Consumers provided through LT Aerial Bunched Cables (ABC) directly from the transformer.

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FRP: Key Technical Interventions (Contd….)

- Laying of single phase AB cable from single phase distribution transformers for providing supply to Domestic and non domestic consumers of rural area
- Replacement of existing obsolete service line of consumer by armoured XLPE cable
- Installation of push fit type static meters by replacing the existing slow and sluggish old type meters. To keep the serial number of seals of meter box, meter body, meter terminal plate same as that of meter number use of double anchor special seals for meter box
- Installation of roaster switch on 132 kV sub station and 33/11 kV S/S for every 11 kV rural feeder emanating from GSS and sub station.
- Installation of metering equipment at the emanating point of all feeders for feeder metering to calculate T&D losses of feeders.

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Shyama Prasad Mukharji Vijay Jyoti Feeder Sudhaar Abhiyan (FRP): Installation of Single Phase Transformers

Segregated Single Phase Domestic & Non Domestic Connections from Three Phase Agricultural & Industrial Connection by installation of Single Phase Transformers.

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FRP: Implementation

- Identifying of High Loss Feeders
- Priotrisation
- Feeder wise detailed survey / Project reports.
  - Details of existing system
  - Details of proposed system
  - Bill of material
  - Bill of material to be retrieved.
  - Details of material proposed to be reused
  - Techno economic viability of project
  - Project approval and funding
- Awarding of Contract
  - Details of existing system
  - Details of proposed system
  - Bill of material

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FRP: Operationalisation of 1-Ph System

- Providing of specially designed 11 kV roster switches
  - Normal Mode
  - Single Phase Mode
  - Three Phase Mode
  - Interlock of sequence operation.

Urban Focus Program

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Key Technical Interventions

- Segregation of Urban Feeders from Rural Feeders
- Total 33 District Headquarters, 180 Municipal and big towns covered
- Replacement of slow and sluggish meters by Push-Fit type meters
- Replacement of Overhead bare conductors by Insulated wires in theft prone areas.
- Change of obsolete Service Line by armoured cable.
  - Losses to be brought below 20% through Urban Focus Programme to be completed by Mar 08

Industrial Focus Program

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Key Technical Interventions

- Segregation of Industrial Feeders from Rural Feeders.
- Fault Free Feeder scheme
  - Incentive @ Rs. 1000/- per fault free feeder to AEn/ JEn/ Staff.
- Monthly Energy Audit for each feeder
- Installation of 25 KVA Distribution Transformers for SIP Consumers
- One Consumer,one Transformer scheme for MIP with check meter introduced
- Expeditious release of new industrial connections
- Replacement of slow and sluggish meters by Push-Fit type meters
- Change of obsolete Service Line by armoured cable.
- Out sourcing of Meter reading & load survey analysis of important industrial areas

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FRP: Benefits

- Transformers burning rate reduced drastically.
- Tempering possibilities of AG metered connection is reduced.
- System is segregated for single phase (domestic) and three phase (agriculture) supply so it become possible to prevent use of capacitors by agriculture consumers during peak load hours.
- Theft of electricity by hooking of bare conductor is eliminated
- Consumers are induced to take regular connection and reconnection of old disconnected connections.
- Rural households are getting 24 hours supply at par with urban area which resulted into comforts to ladies in doing their works, students in their studies, upliftment of rural economy etc. etc.

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FRP: Benefits (Contd…)

- Prevention of theft of electricity by tempering of meter and bypass of meter by cutting service line
- Less maintenance of over head L.T. line due to AB cables
- Minimum interruption of L.T. supply during bad weather due to insulated conductor & A.B. cable which is not possible with bare conductor L.T. lines.
- Reduction in chances of accidents due to possibilities of snapping of conductor/AB cable which too much in case of bare conductor.
- Reliable and better quality of electricity supply.
- Reduction in accident of workers while working on line & poles because of bunching of insulated wire in place of spreaded bare conductor.
- Laying of more than one L.T. circuit on the same support & cross arms etc. which is not possible with bare conductor lines.

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FRP: Monitoring

- Departmental
  - Energy Audit on monthly basis by Sub-Division
  - Maintain FRP register at S/S have complete history and present status of each feeder
  - Feeder checking by Feeder Managers regularly
  - Feeder checked by Feeder Managers, Vigilance officers for theft of Electricity
- By Outsource Agency
  - M/s RITES for quality check of material and work completion.
  - M/s RDI for completeness of Programme.
  - Audit by CA's for material utilization & retrieved material accounts as per project report .

Mechanism for Feedback of Power Supply in Rural Areas (FY 2008-09 up to July 08)

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- Through CMRI
  - Zonal Vigilance Officer 60 S/S per month
    - No of feeders checked- 1984(96.7 % Found good)
  - Feeder Manager 30 S/S per month
    - No of feeders checked- 186(100 % Found good)
- Telephonic feedback from Sarpanchs
  - ZCEs & SEs contact daily 5 Sarpanchs of different areas
    - 2959 Surpachs contacted (No adverse report)
- Daily telephonic feedback from consumers by Central Control Room, Jaipur
  - **1098 consumers** of different areas **contacted** on random basis (No adverse remark for supply)

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Results of survey conducted by RDI (Feb-Mar, 08)

- Status of Voltage
  - Good 92.9%
  - Average 5.3%
  - Bad/Don't Know 1.8%
- Replacement of DTs
  - Good 69.4%
  - Average 17.8%
  - Bad/Don't Know 12.8%
- No Fluctuation status
  - Good 63.1%
  - Average 22.9%
  - Bad/Don't Know 14.0%
- Control over theft
  - Good 75.2%
  - Average 15.3%
  - Bad/Don't Know 9.5 %
- Status of Lines/wires
  - Good 81.6%
  - Average 11.7%
  - Bad/Don't Know 6.5%
- Getting new Connection
  - Good 56.7%
  - Average 20.8%
  - Bad/Don't Know 17.8%/4.6%

Declining Distribution Losses

In %age

DISCOM	2005-06	2006-07	2007-08	Cumulative Loss Reduction after FRP	Targets for Loss reduction 2008-09	Reduction in losses during FY 2008-09 up to July
1	2	3	4	5	6	
Jaipur	37.30	33.65	28.64	8.66	5.00	5.43
Ajmer	42.09	37.25	34.16	7.93	5.00	6.83
Jodhpur	41.72	33.03	27.42	14.30	5.00	4.43
Sector as a whole	40.22	34.64	30.09	10.13	5.00	5.64

Trend of Reduction in AT&C Losses

Particulars	2003-04	2004-05	2005-06	2006-07	2007-08
Distribution Loss	42.62%	41.10%	40.22%	34.65%	30.09%
Collection Efficiency	98.94%	98.49%	98.35%	99.94%	98.29%
AT&C Loss	43.23%	41.99%	41.21%	34.69%	31.29%
Reduction in AT&C Loss		1.24%	0.78%	6.52%	3.40%

Total reduction in T&D loss is 10.13 % during 2006-07 & 2007-08 combined

Expected Reduction in AT&C Losses

Particulars	2008-09	2009-10	2010-11
Distribution Loss	25.23%	22.00%	20.00%
Collection Efficiency	99.95%	99.95%	99.95%
AT&C Loss	25.27%	22.04%	20.04%
Reduction in AT&C Loss	5.04%	3.23%	2.00%


Thank You

WBSEDCL

LOSS REDUCTION

STRATEGIES

1

.

LOSS REDUCTION MEASURES ARE BEING TAKEN WITH MINIMAL INVESTMENT AND MINIMUM IMPACT ON TARIFF

2

INSTALLATION OF CAPACITORS

INSTALLATION OF CAPACITORS

- At 11KV Bus of 33/11KV Sub-Stations.
- With Distribution Transformers.
- At all LT Industrial consumers' premises.

THIS WILL RESULT

- Reduction of T&D loss as VAR loading and line current are reduced.
- Improvement of voltage profile at consumers end.
- More consumers can be served with same installed Transformers and Lines as loading of line and transformers is reduced.

3

EFFECT OF CAPACITOR INSTALLATION

Installation of capacitors will finally contribute towards:

- Savings in energy cost
- Savings in installation cost of transformers etc.
- Reduction in carbon emission and gaining carbon credit.
- Consumers satisfaction (better voltage)
- Pay-back periods of these works are more or less one year.

4

RATIONALIZATION OF 11KV FEEDERS

- **The work for bifurcation of over loaded feeders and reorientation of long feeders is in progress.**
- **Augmentation of conductor size is also considered when necessary. This will reduce line loss and at the same time improve voltage profile, with a very little investment.**

5

CONVERSION OF 6.6 OR 6KV SYSTEM TO 11KV SYSTEM AND USE OF A B CABLE.

- **The work for conversion of old 6.6 /6 KV System to 11KV is nearing completion. Due to voltage up-gradation, line loss will be less.**
- **In theft prone and congested areas, A B cables are being used to reduce chances of theft of energy, break-down and accident.**

6

INSTALLATION OF SMALLER CAPACITY DISTRIBUTION TRANSFORMERS

- **Transformer of smaller capacities are installed at the respective load centers.**
- **This will reduce LT line length and thereby improve HT/LT ratio.**
- **Reduce technical loss and chances of energy pilferage.**

Such schemes have been executed through APDRP also.

7

DISTRIBUTION TRANSFORMER PHASE BALANCING

Phase loading of Distribution Transformers are available from DTR meters, otherwise they are physically checked.

- ✓ **Balancing of phase loadings of Distribution Transformers are done periodically.**
- ✓ **This reduces technical loss and also improves voltage profile at the consumer end,**
- ✓ **Reduces the transformer failure rate.**

8

REPLACEMENT OF DEFECTIVE AND SLUGGISH ENERGY METERS

- **Conditions of the energy meters at the consumers' premises are checked.**
- **Defective and sluggish meters are replaced by static meters.**
- **This ensures correct recording of energy consumption .**

9

ANTI-THEFT DRIVE

- **Identification of revenue leakage points**
- **Raid with the help of civil administration**
- **Strict enforcement of anti-theft legislation**
- **Provision have been made more stringent including imprisonment.**
- **It has helped in reduction of theft of energy in a big way**

10

ENERGY AUDITING AND MONITORING

Energy audit is done to assess the quantum and source of losses ,which helps management to take decision for reduction of losses.

- **Meters have been installed at every transition points from inter-utility boundary points upto 11KV outgoing feeders of all 33/11 KV Sub-Stations.**
- **Meters are also being installed at Distribution Transformer level.**

Recording by those meters are utilized for energy auditing as follows:

11

Contd..

- **Sub-Station wise monthly energy balance is examined and losses are estimated**
- **Line losses(400 KV to 33KV) are assessed.**
- **Monthly energy accounting and calculation of T&D and AT&C Losses of each Zone, Circle, Division and Supply are ascertained.**
- **With the help of Feeder Metering quality of power supplied to the consumers (voltage, interruptions etc.) are also monitored**.

.

12

CONSUMER SERVICE INITIATIVES.

A number of initiatives have been taken to offer improved services to the consumers, at the same time collection of revenue will improve. Some of them are as follows:

- **Easy Bill Payment Options**
- **Spot- Billing**
- **Alternate Service Delivery Model in Rural Areas.**

13

EASY BILL PAYMENT OPTIONS

Convenient bill payment options will contribute to higher collection efficiency

- **On-Line cash collection at Supply Offices - quicker, error free and also direct payment posting.**
- **24 Hors Open Bill Payment Kiosks**
- **Payment through ECS , Post Offices and Rural Co-operative Banks.**
- **Prepaid meters**
- **Through Village Community Service Centres**
- **Web based and SMS activated payment of bills are also under consideration.**

14

SPOT-BILLING

- **Spot billing has been introduced in 53 supply areas, and expansion of this to other areas is being processed.**
- **Consumers will get their bills on the spot at the time of meter reading**
- **Bill delivery time is nil and consumers get more time for payment.**
- **Spot billing will ensure 100% meter reading**
- **Collection efficiency will also improve.**

15

ALTERNATE SERVICE DELIVERY MODEL IN RURAL AREAS

Self Help Groups and Co-operatives are being engaged and they will ultimately be responsible for:

- **Maintenance of local electric installation for supply of good power.**
- **Meter reading and collection of payment**
- **This will help maintaining steady power supply in rural areas and better revenue collection.**

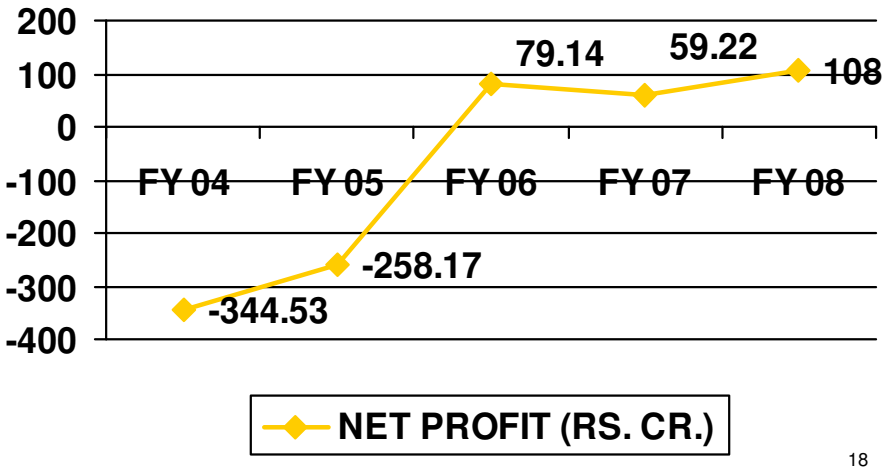
16

IMPROVEMENT

- FY 03
  - Initial Loss levels very high
  - Low Collection efficiency
  - Financial Situation Grim
  - No debt servicing of GoWB loans
  - Subsidy support from Government
- FY 08
  - T & D Loss levels at 23.91%
  - Collection efficiency 98.3%
  - Rs 270 crore of debt servicing to GoWB

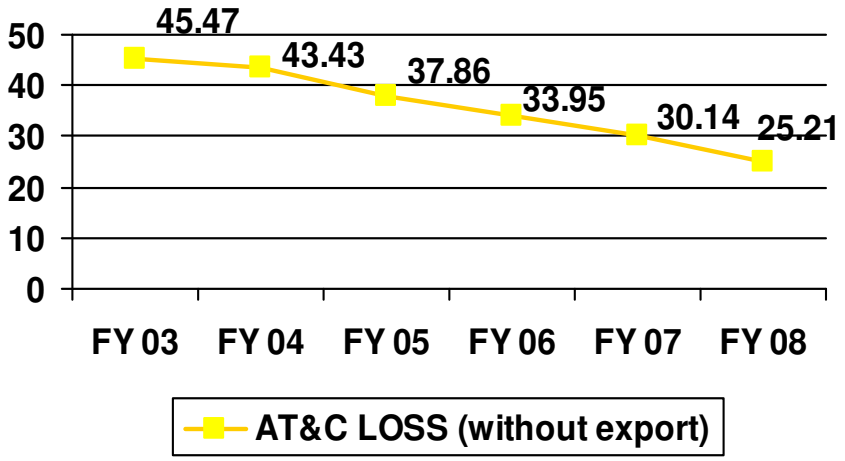
17

NET PROFIT



18

AT&C LOSS



19

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THANK YOU

20

Madhya Gujarat Vij Company Ltd.

An ISO 9001:2000 Certified Company

Corp. Office
S.P. Vidyut Bhavan
Race Course
Baroda- 390 007

website: www.mgvcl.com

- **Critical Power Position in State and because of ill health, MD could not attend the meeting, but, sending Two Technical Officers closely attached to him, who have been all the time with MD during his visits to field offices and meetings.**
- **The progress of the company in all the sectors right from loss reduction to Customer care is due to change in the mindset of the officers. Even Jr. Engineers from the field are coming to the Corporate Office and contributing in the meeting with their innovative ideas.**

- **MGVCL has reduced losses in all the sectors. The various strategies are being adopted to bring down the losses. Now our efforts are to maintain or lower the losses of Industrial and Urban sector. Major emphasis is now given to bring down the losses on Rural sector i.e. Jyoti Gram feeders and Dominant feeders.**

- **The losses in Baroda City have reduced from 14.25% in year 04-05 to 8.17% in year 07-08.**
- **Ambience in offices and improved working conditions have contributed significantly in making the officers more dedicated.**
- **MGVCL is recipient of Gold Shield for outstanding performance in Distribution Sector for the year 2006-07 from GOI.**
- **The Company's case study on 'Power Sector reforms and Initiatives in Gujarat' was** awarded First prize for power India Excellence Award – 2007 by India-tech Foundation **which focuses on the development of the infrastructure sector in India.**
- **MGVCL have been audited by TUV India Pvt. Ltd and** accredited ISO certification **for its field offices and Corporate Office. During the Audit, NO non confirmity (Requirement Not Full Filled) was found.**

ALKAPURI SUB-DIVISION OFFICE

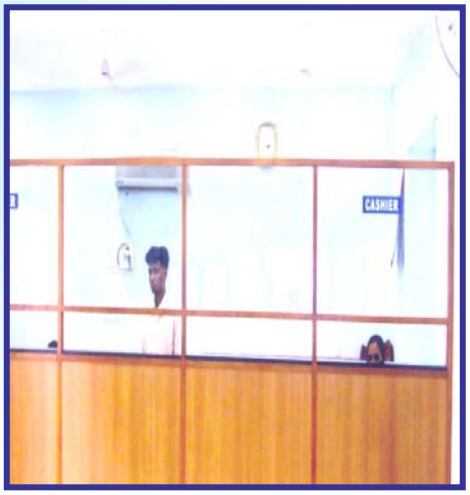
KARELIBAG SUB-DIVISION OFFICE

DOME Structure for Customer services

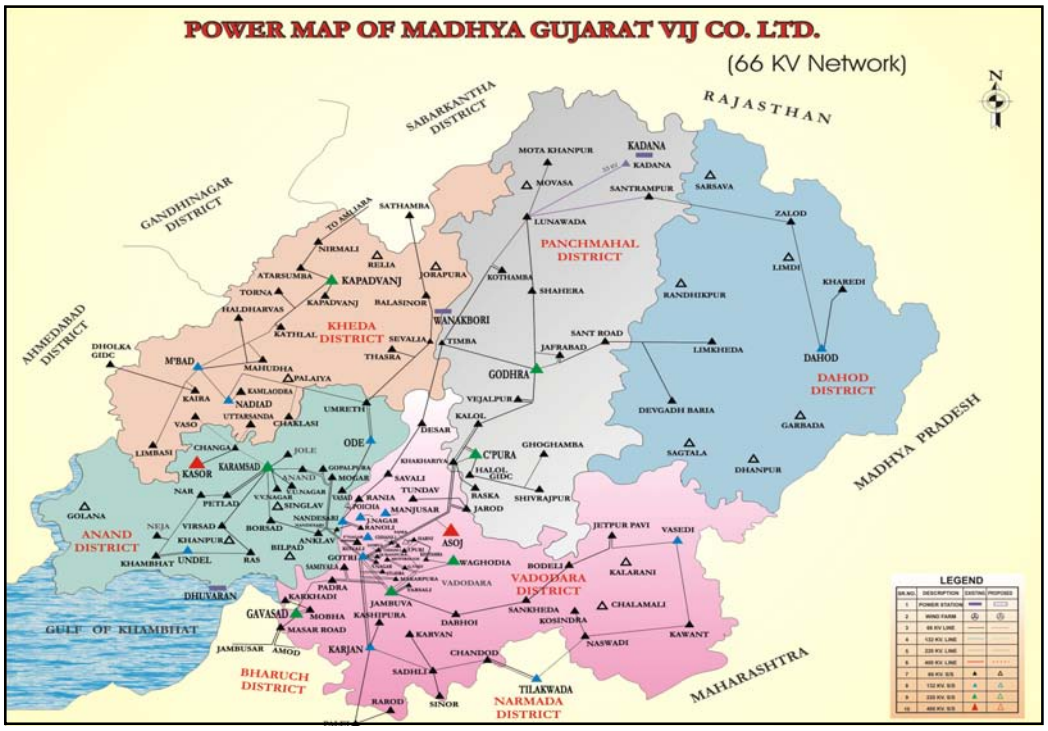
- *Enhanced Facility for Cash Collection by Establishing Dome structure at different sub-divisions*
- *Common Cash Collection Point for consumers of Rural and Town Sub Divisions*

CUSTOMER CARE CENTER

ALKAPURI



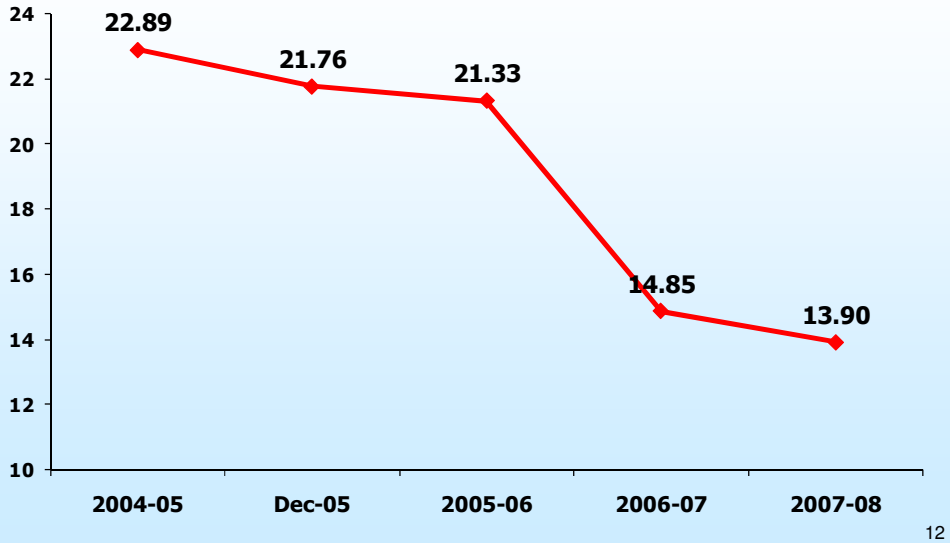
FATEHGUNJ


POWER MAP OF MADHYA GUJARAT VIJ CO. LTD.
(66 KV Network)
RAJASTHAN
MADHYA PRADESH
MAHARASHTRA
GULF OF KHAMBHAT
SABARKANTHA DISTRICT
GANDHINAGAR DISTRICT
AHMEDABAD DISTRICT
PANCHMAHAL DISTRICT
KHEDA DISTRICT
DAHOD DISTRICT
ANAND DISTRICT
VADODARA DISTRICT
BHARUCH DISTRICT
NARMADA DISTRICT
KADANA
MOTA KHANPUR
MOVASA
SANTRAMPUR
SARSAVA
ZALOD
LUNAWADA
LIMDI
KHAREDI
RANDHIKPUR
SHAHERA
KOTHAMBA
SATHAMBA
NIRMALI
REELIA
JORAPURA
ATARSUMBA
KAPADVANJ
TORNA
HALDHARVAS
BALASINOR
WANAKBORI
KATHLAL
SEVALIA
TIMBA
THASRA
SANT ROAD
JAFRABAD
LIMKHEDA
DAHOD
GODHRA
DHOLKA GIDC
M'BAD
MAHUDHA
PALAIYA
KAMLAGORA
KAIRA
NADIAD
UTTARSANDA
CHAKLASI
VASO
UMRETH
VEJALPUR
KALOL
DESAR
DEVGADH BARIA
GARBADA
SAGTALA
DHANPUR
LIMBASI
CHANGA
JOLE
ODE
C'PURA
GHOGHAMBA
KARAMSAD
KASOR
ANAND
GOPALPURA
MOGAR
KHAKHARIYA
HALOL GIDC
SAVALI
TUNDAV
RASKA
SHIVRAJPUR
NAR
PETLAD
V.V.NAGAR
UNAGAR
UMAD
RANIA
POICHA
MANJUSAR
JAROD
GOLANA
SINGLAV
NANDESARI
JNAGAR
KANOLI
NEJA
VIRSAD
BORSAD
ANKLAV
ASOJ
JETPUR PAVI
VASEDI
KHANPUR
BILPAD
KHAMBHAT
UNDEL
RAS
GOTRI
SAMIYALA
WAGHODIA
BODELI
KALARANI
VADODARA
DHUVARAN
PADRA
KARKHADI
JAMBUVA
SANKHEDA
CHALAMALI
GAVASAD
MOBHA
KASHIPURA
MASAR ROAD
DABHOI
KOSINDRA
KARVAN
NASWADI
KAWANT
JAMBUSAR
AMOD
KARJAN
CHANDOD
SADHLI
RAROD
SINOR
TILAKWADA
LEGEND

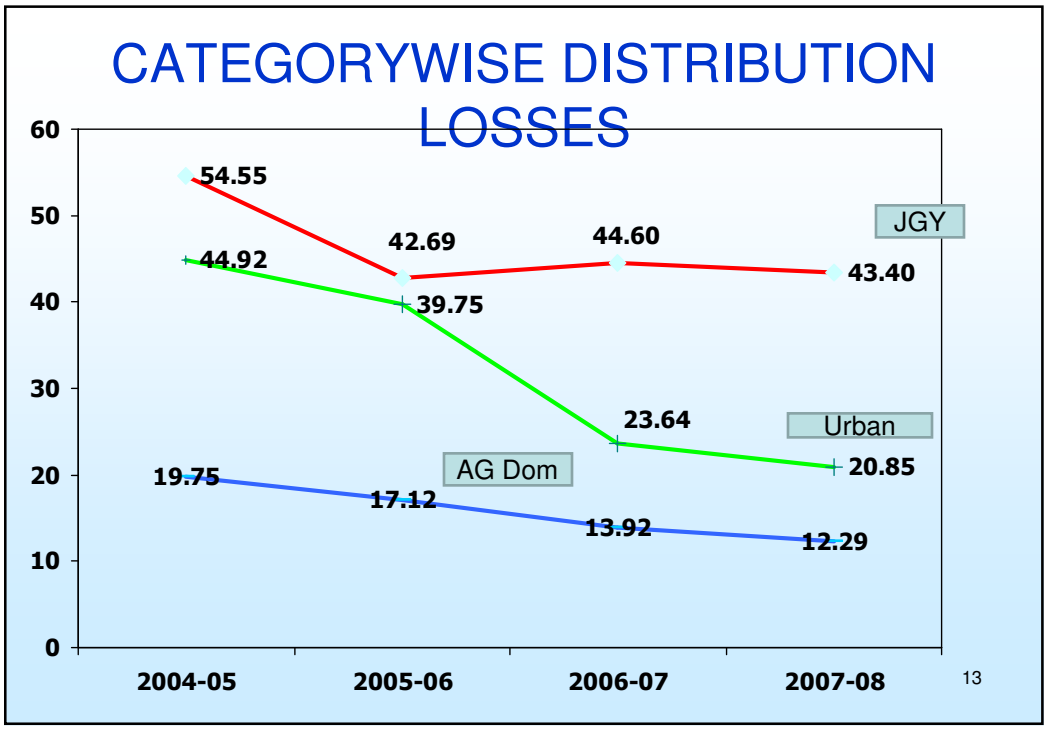

Madhya Guj.Vij Co.Ltd.
MGVCL
An ISO 9001:2000 Company

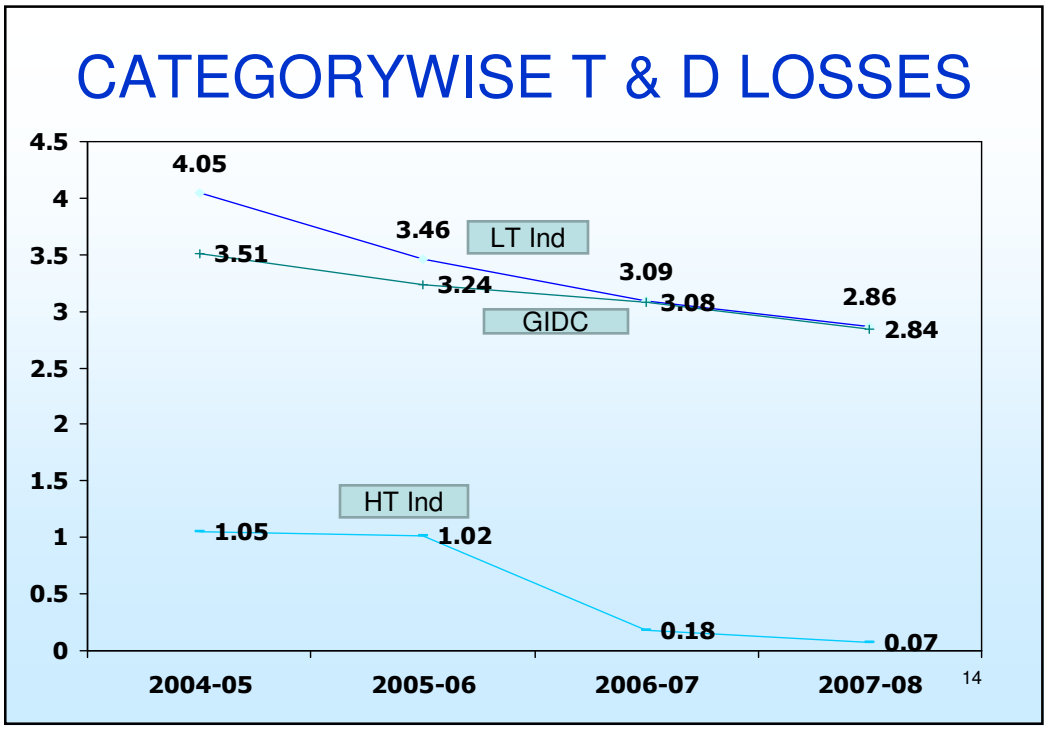
ACHIEVEMENT IN LOSS REDUCTION

Distribution Losses in %

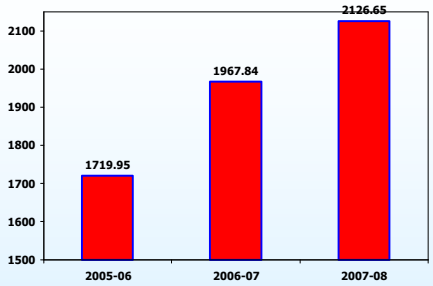


12

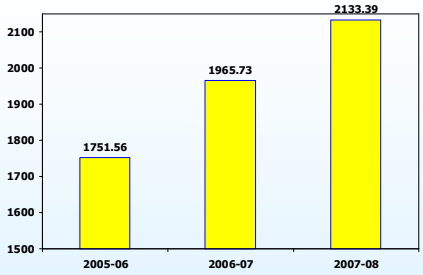

CATEGORYWISE DISTRIBUTION LOSSES
60
50
40
30
20
10
0
54.55
42.69
44.60
43.40
JGY
44.92
39.75
23.64
20.85
Urban
19.75
17.12
13.92
12.29
AG Dom
2004-05
2005-06
2006-07
2007-08
13


CATEGORYWISE T & D LOSSES
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4.05
3.46
LT Ind
3.51
3.24
3.09
3.08
2.86
2.84
GIDC
HT Ind
1.05
1.02
0.18
0.07
2004-05
2005-06
2006-07
2007-08
14

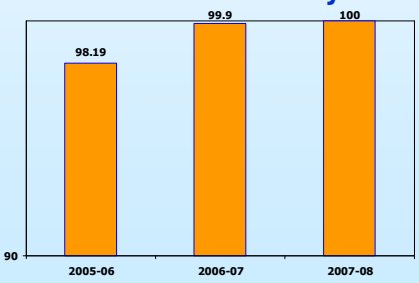
Assessment in Rs Cr. Year wise



Collection in Rs Cr. Year wise



Collection Efficiency in %



15

Segregation of Agriculture Load

Jyoti Gram Yojana

The Jyoti Gram Yojana (JGY) is a unique initiative introduced in the form of **an innovative scheme** by Government of Gujarat to make available ***three phase quality power supply*** for 24 hours to all the villages and also all suburbs **attached to the villages of Gujarat for non-agricultural activities while ensuring improved quality power supply to agriculture implemented** in a record time of just **30 months**!

The scheme involved laying of a parallel rural distribution network across the state to separate agricultural consumers to facilitate load management and regulation over agricultural consumption without affecting power supply to other consumers by laying 56599 Kilometers of new lines and 12621 nos of new transformer centers

SDT: Special Design Transformer

Farmers residing in farm houses get continuous three phase power supply through agriculture-dominant feeders for Minimum 8 hours and thereafter are also catered through **Specially Designed Transformers made by the Distribution Company** that supply single phase electricity to farmers living in their fields for the remaining period of the day.

Loss Reduction Strategies

For

TECHNICAL

AND

COMMERCIAL

LOSSES

➢ TECH LOSS REDUCTION ACTIVITIES

- ❖ **Reconductoring of Network (HT & LT)**
- ❖ **Installation of APFC (AUTOMATIC POWER FACTOR CONTROLER) PANNEL**
- ❖ **Use of XLPE Cable**
- ❖ **Adoption of HVDS System**
- ❖ **Optimum location of DTR**
- ❖ **Load balancing of DTR**
- ❖ **De-energization of DTR**

➢ Automatic Power Factor Controller (APFC):

Installed Automatic Power Factor Controller (APFC) panels for rural feeders having high Technical Losses. APFC panels are used for improvement in Power Factor, there by reducing Technical Losses. Auto Power Factor Controllers are capable to switch ON and OFF the capacitors in stages and automatically maintain the desired power factor.

Fault Passage Indicator

Fault Passage Indicator is an equipment which is installed at starting point of tap line. At the time of fault, LEDs gives signals. This helps in reducing the power restoration time as patrolling time of locating the fault is reduced. This ultimately improves one of the KKPIs i.e. Sustained Fault duration.

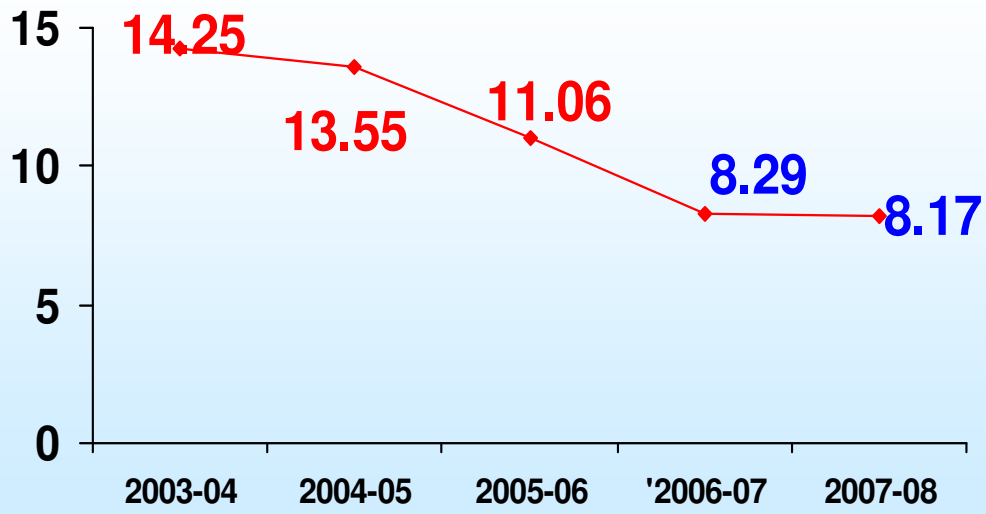
➢ COMM. LOSS REDUCTION ACTIVITIES

- ❖ **Use of AB Cable and Coated conductors**
- ❖ **DTR Metering**
- ❖ **Feeder wise / DTR wise billing**
- ❖ **Use of smaller capacity of Dist Transformers**
- ❖ **Intensive Quality checking**

➢ Energy Accounting:

Meters are provided on Transformer Centres to find out weak pockets on feeders. Along with regular meter reading programs, meter reading of transformers are taken and TC wise losses are calculated. This help us to have clear vision of weak pockets and help in qualitative installation checking.

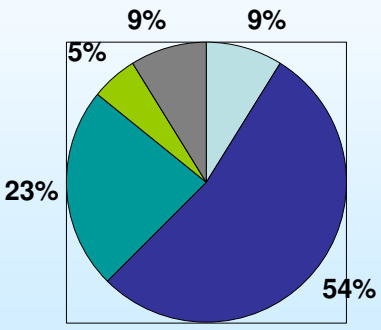
ACHIEVEMENT IN AT&C LOSSES BY USING GIS



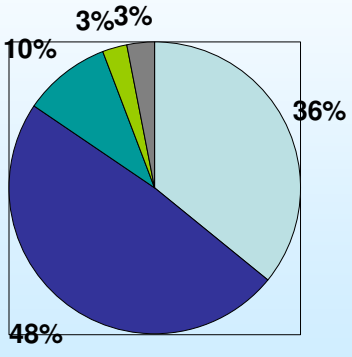
25

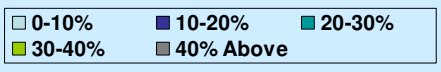
TRANSFORMERS LOSSES OF BARODA CITY

Mar-07



Mar-08





26

Surveillance

MGVCL has formed surveillance team consisting of 72 nos. of Corporate and field engineers to have information of Theft and other irregularities adopted by various consumers. This helps in identifying theft prone consumers/areas which results in effective installation checking.

Sub-Station Monitoring

Study of ampere loading of each feeder according to the monthly/ seasonal consumption is prepared as well as total contracted load of each feeder is worked out. The loading of feeder should be in accordance with the contracted load. Accordingly, **Bench marking** of feeders is decided. These Bench Marks will be reviewed periodically. Field Engineers are directed visit the **sub-stations** regularly and study loading pattern of feeders. If it does not match the above condition, they are instructed to check the feeder for any irregularities i.e. tapping of power, etc.

Projects for High Loss Feeders

The projects finalized for reduction of High losses for (58+111) 169 no of 11 KV feeders. All the activities of these feeders are being closely monitored and accordingly system improvement, meter replacement, providing AB cables, HVDS etc. are suggested and executed. This has helped in over all reduction of Distribution losses.

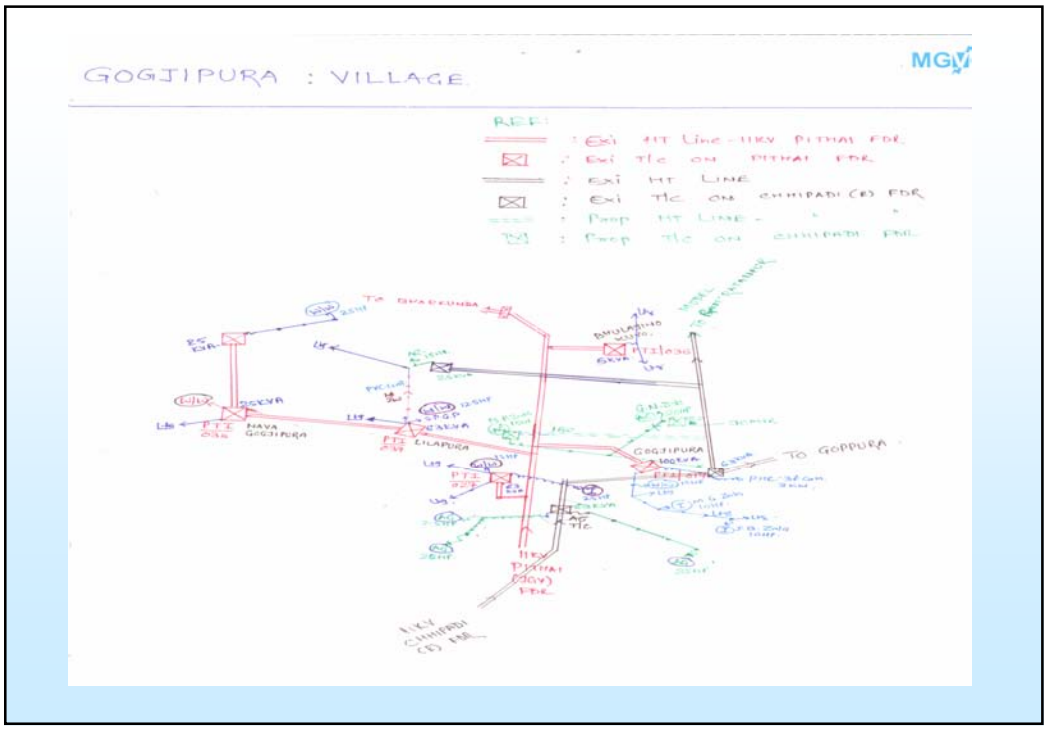
HVDS

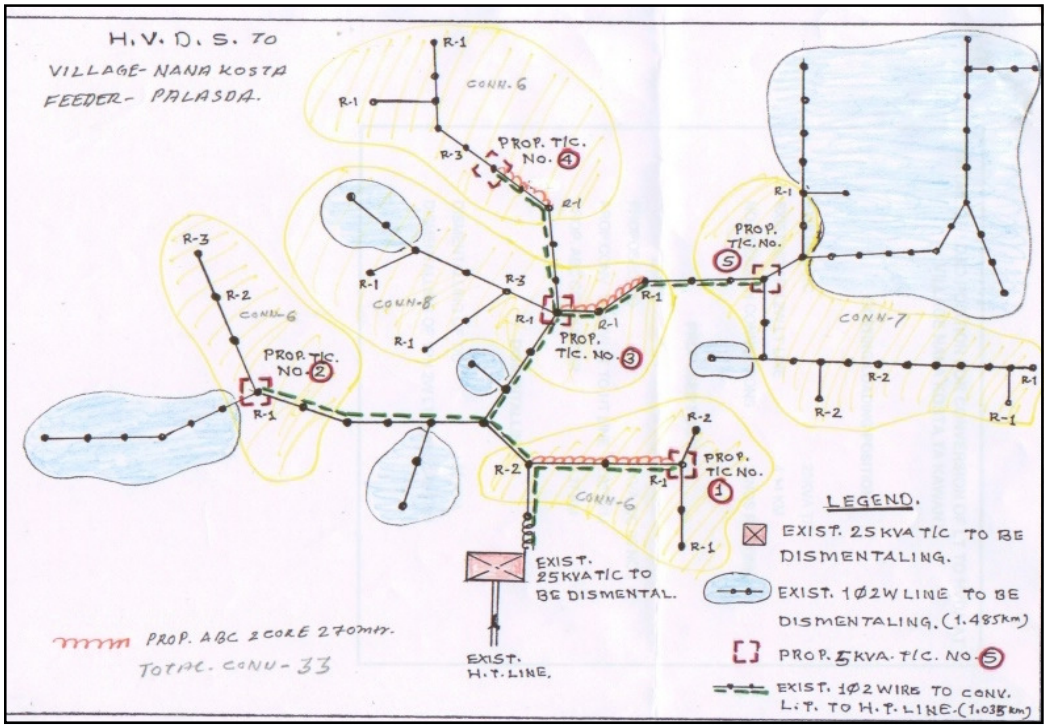
HVDS is being implemented in MGVCL to reduce hooking in rural areas as well as to reduce the LT line losses. In order to implement HVDS system, sum of contracted load of feeders and sum of connected KVA of each TC is worked out and if there is an exorbitant difference between these two, de-augmentation of the transformer is recommended by way of providing **appropriate capacity of TC** in accordance with contract load.

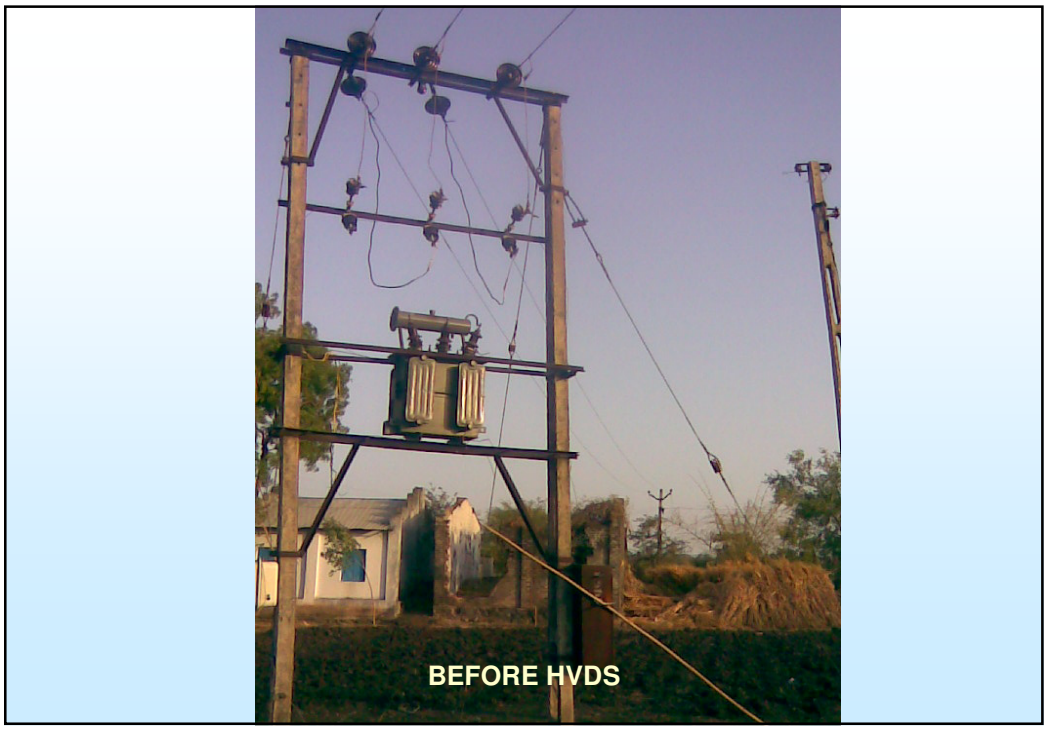
MGVCL has already installed 5 KVA single phase transformer for Zupadpatti and small clusters areas. MGVCL is further going to install 5000 nos of 5 KVA single phase transformer after very care full study of the network village wise.

10 KVA, 16 KVA, transformer are also started receiving.

Till date 1047 No. of 5 kVA , 545 No of 10 kVA & 486 No of 16 kVA Transformers are installed


GOGJIPURA : VILLAGE
MGVCL
TO GOPPURA


H.V.D.S. TO
VILLAGE- NANA KOSTA
FEEDER- PALASDA.
PROP. T/C. No. 4
PROP. T/C. No. 2
PROP. T/C. No. 3
PROP. T/C. No. 5
PROP. T/C. No. 1
CONN-6
CONN-8
CONN-7
EXIST. 25KVA T/C TO BE DISMENTAL.
EXIST. H.T. LINE.
PROP. ABC 2 CORE 270mtr.
TOTAL CONN-33
LEGEND.
EXIST. 25KVA T/C TO BE DISMENTALING.
EXIST. 1Ø2W LINE TO BE DISMENTALING. (1.485km)
PROP. 5KVA. T/C. NO. 5
EXIST. 1Ø2 WIRE TO CONV. L.T. TO H.T. LINE. (1.035km)


BEFORE HVDS


AFTER HVDS

Micro Level Planning for year 2008-09

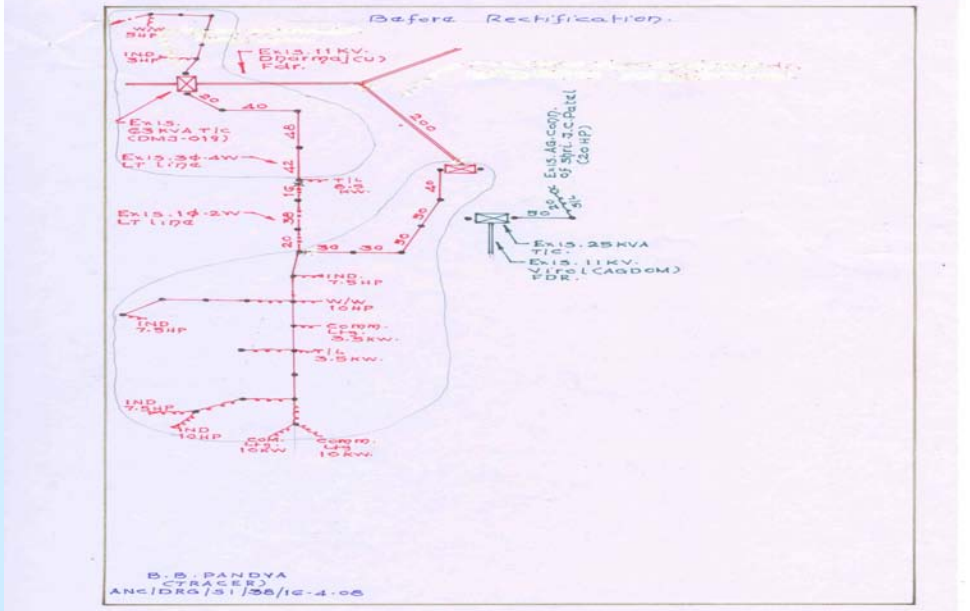
Target for Distribution Loss is below 11.50%

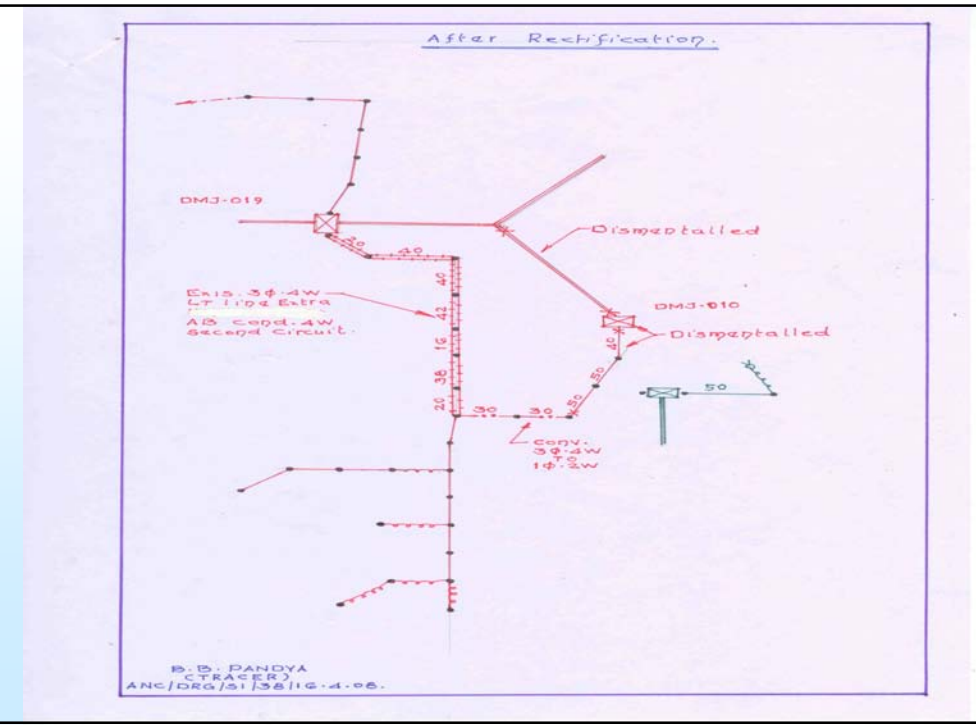
Micro level strategies

1. **For the year 2008-09, Micro level planning is done for Mainly Two categories where losses are more :**
   1. **JGY Feeders**

- Providing AB Cable / Coated Conductor.
- Study consumption of Ind Consumers incl. Ice factory and Cold storages.It must be in accordance with cont. load and Nature of Ind, working shifts.
- Energy Acct. of DTR having 1-2-3 industrial consumers.
- Shifting of Agriculture Connections from JGY to Agr. Dominent Feeder.
- No extension of JGY LT Line for small cluster .Implement HVDS with 5 kVA DTR.
- JGY – Agr. Feeder Crossing.
- Attending Agr. T/C in the vicinity of JGY T/C.
- Monitoring of ampere loading JGY feeder. Abrupt rise must be studied.
- Providing appropriate rating of T/C
- W/w & Street Ltg. Consumption of SPGP

Dharmaj Map


Before Rectification.
Exis. 11 KV. Dharmaj Fdr.
Exis. 25 KVA T/C. (DMJ-019)
Exis. 3φ-4W LT line.
Exis. 1φ-2W LT line
Exis. AG cond. of Shri. N.C. Patel (20 HP)
Exis. 25 KVA T/C.
Exis. 11 KV. V/C to Fdr. (AGGOM)
IND 7.5 HP
W/W 10 HP
Comm. Ltg. 3.5 KW.
Mix 3.5 KW.
IND 7.5 HP
IND 7.5 HP
IND 10 HP
Comm. Ltg. 10 KW.
B.B. PANDYA (TRACER) ANC/DRG/SI/38/16-4-08


After Rectification.
DMJ-019
Dismentalled
DMJ-010
Dismentalled
Exis. 3φ-4W LT line Extra AB cond. 4W Second Circuit.
Comy. 3φ-4W 1φ-2W
50
B.B. PANDYA (TRACER) ANC/DRG/SI/38/16-4-08.

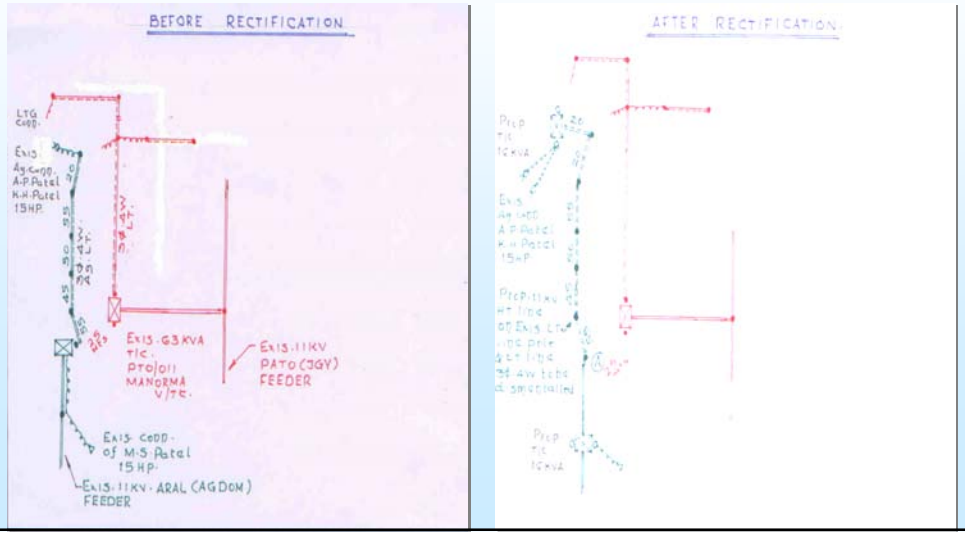
Micro level strategies...contd

2. Ag Dom

- Study Contract Load of Agr. Consumers
- Study capacity of all DTR.
- Feeder Loading must be in accordance with contract Load.
- Deaugment DTR according to Contract Load.
- Study the Failure of Ag. T/C. Check Agr. Connection on it for unauthorized Load.
- Implement HVDS pocketsize. Propose 10kVA, 16kVA or 25 kVA T/C for HVDS
- Rectification work on Agr. Metered Tariff Consumers.
- Static Meter
- Last span Insulated
- Meter outside Room
- MMB & Sealing
- Agr. DTR in the vicinity of JGY / IND DTR
- No bypassing of SDT- In no case two phase power supply is given during load shedding on Ag. Dominant feeder.

Rectification of JGY feeder-Sample case-Pato feeder

Village wise maps are prepared for all the villages where JGY and AG Dom feeders are in vicinity and there is possibility of hooking from near by feeder.



Micro level strategies...contd

3. Industrial

- Segreggate LT Loss keeping 0.5 % HT Loss
- DTR Metering of 1-2-3 Ind. consumers
- Surveillance
- Study LT Consumption and HT consumption register.
- Study of MRI of HT & LT consumers.
- Metering Error
  - Pannel Meter
  - Consumer Meter
- Adopt HVDS for industrial consumers
- Make foolproof DP and metering Installation.
- No joints/ switch/ Kit Kat fuses before Meter.
- AMR on High contract Load consumers.

Further Planning for the year 2008-09

- Reduction of Distribution Loss below 11.5%
- Installation of 5000 APFC panels
- Installation of 16000 nos of Small capacity transformers under HVDS scheme
- Implementation of GIS in all Towns of MGVCL
- Centralized Monitoring Unit for all HT/ LT consumers at Corporate level through AMR System
- Monitoring of high loss JGY feeders by SE and above officers

- **Automatic Meter Reading**:

All the major Extra High Tension and HT consumers and all high valued LT industrial consumers shall be provided Automated Remote Metering (AMR) for quick and accurate meter reading without visiting the site of consumer. This will contribute to significant process improvements for load survey, tamper and theft billing with on line monitoring and immediate access to data.

All the HT consumers of MGVCL (1050 NOS) are billed through AMR only, hence our engineers are not required to visit sites for meter reading. The saved man hours are utilized for other loss reduction activities.

MGVCL has also planned to installed 6000 nos. LT AMR in high consumption industrial & commercial consumers on high losses feeders.

GIS IS COMPLETED FOR 19 TOWNS

- **Baroda Circle:** Dabhoi,Karjan,Padara Savli
- **Godhra Circle**: Godhra,Dahod,Halol Kalol
- **Anand Circle**: Anand,V V Nagar,Nadiad C'bay,P'lad,K'vanj,M'bad Anklav,Umreth,Borsad Dakor

GIS is Implemented in Baroda City.

Customer Care Centers

- Customer care centers are started in all Sub Divisions, Divisions and Circle offices of MGVCL.
- It takes care of consumer's quarries related to New connection, Change of Name Procedures.
- It guides for Addl Load-Red of Load-PDC reconnection.
- It also guides for Billing and Technical related quarries.

Trouble Call Management Center

- Abbreviated number (155333) is provided for launching any power supply related complaints on hunting telephone line.
- Interactive Voice Response System (IVRS) welcomes each call while they are lending to TCM. (Skilled operators are receiving the calls)
- From consumer no. it is possible to have other detail of a consumer viz. Name, address and sub-division and N/W details etc.
- After registering the complaint, it is dispatched to concerned s/dn through CUG mobile for resolving
- Once the complaint is resolved, feedback is given to/ from site/sdn to TCM
- Status of each and every complain is available.
- Consumers are treated in time up to their satisfaction.

CENTRALISED TCM CENTER AT CIRCLE OFFICE

- ***Round the clock, centralized TCM Centre is started at All Circle.***
- ***Complaints from approx. 20 Lacs will be taken care by this Customer Care Centre.***

Any Time Payment Centre (ATP):

M.G.V.C.L. has put into operation Any Time Payment Centres in Baroda City area. These Centres are like Bank's ATM Centres, where payment of Energy Bills can be made by the consumers at any time and the Receipt for the amount paid is issued immediately. The Company envisages to set up these Centres in all Urban areas of the Company.

Few More Initiatives being taken by MGVCL:

- HT Consumers Meet
- Customer Care Centers
- Consumer Satisfaction Survey

Customer Care Center

HT Consumers Meet

Mobile Bill Cash Collection Van

Few More Initiatives being taken by MGVCL:

- Consumer satisfaction survey
- Customer Care Centre
- Website
- Hand Held Instruments

Web Site

Customer Care Center in Dome Structure

Hand Held Instruments

SAMPARK

Sampark a programme . . . .

- to meet the consumers at unconventional places
- to have a direct contact with the consumers
- to understand the difficulty / aspirations and needs of the consumers.
- Sampark specifically aimed at LT consumers
- Sampark will help us in identifying the specific problems of the consumers and thus help us design future schemes and projects for the betterment of consumers.
- Sampark will give a sense of pride and belongings to our consumers.

M.E.G.A. / Individual Franchisee

MEGA: For improvement in customer services and to improve network through better maintenance, the scheme called MEGA (Management of Electricity with Gramya Associate) has been approved, where in the co-operative societies, NGO, a group of prominent villagers would act as distribution franchisee.

Individual franchisee: Individual franchisee for the feeders has been adopted and already more than 70 feeders have been allotted for individual franchisee. Either individual person or group of entrepreneurship can come forward and take up the work for a feeder.

An Outstanding Achievement at National Level...

Madhya Gujarat Vij Company Ltd. with its head quarter at Vadodara, is a Flagship Distribution Company of Central Gujarat. **MGVCL** is an ISO 9001-2000 Certified Company and has many Awards to its credit. The recent and the most prestigious being **" GOLD SHIELD "** and a **"Certificate of Merit Award"** by ministry Of Power, Government of India, for the Meritorious Performance During 2006-07 for the Power Distribution in the Country.

AWARDS & ACHIEVEMENTS

- The Company's case study on 'Power Sector reforms and Initiatives in Gujarat' was **awarded First prize for power India Excellence Award – 2007 by India-tech Foundation** which focuses on the development of the infrastructure sector in India.
- MGVCL have been audited by TUV India Pvt. Ltd and **accredited ISO certification** for its field offices and Corporate Office. During the Audit, NO non confirmity (Requirement Not Full Filled) was found. TUV India Pvt. Ltd have also identified the Strength of MGVCL:
  - Commitment & involvement of people
  - Initiative for New Improvement Schemes for service/ Infra structure
  - Excellent Monitoring System through MIS

AWARDS & ACHIEVEMENTS contd…

- **High Tech Meter Testing** Laboratory at Baroda City Circle is equipped with fully automatic computerized test bench of accuracy class 0.05 for quality testing of all type of single phase and three phase static as well as precession electromechanical meters as per Indian / International Standard Specification. Recently the NABL accreditation certificate is received for energy meter Testing & Calibration. The Company has procured class 0.2 universal accu check meter for testing of LT/HT all type of meters to check the consumer installation.

Delegation…..

Rajasthan

Singapore,Pakistan,Nepal

Hariyana

Karnataka

Bihar

Chhatishgarh

Madhya Pradesh

Maharashtra

…. Had visited MGVCL for studying new initiatives and strategies .

- In Nutshell, segregation of JGY, AG Dom feeders, SDT, HVDS, AMR, Energy Accounting, Surveillance and many more (more than 30 nos) of activities have brought results which we have shown right now.
- Our MD has invited the August Gathering to visit MGVCL for more discussion on new initiatives of MGVCL.


MGVCL
THANK YOU

Innovative methods of Power supply to rural consumers

Drawbacks in the power supply to rural consumers

- Poor voltage regulation
- Frequent power cuts.
- Non-availability of power to rural domestic consumers during peak hours.
- Disconnection of rural domestic supply during scheduled power cut to agricultural consumer.
- Frequent failures of distribution transformers

State Power utilities have devised different schemes for improved supply to domestic consumters.

Rajasthan

Feeder Renovation Programme

- Installation of small capacity single phase Distribution (11/0.4 kV) transformers for supply to domestic consumers
- Installation of 25 kVA three phase Distribution transformer 11/0.4 kV for supply to agricultural pump sets (2 pump set connections to one transformer)
- Single phasing of 11 kV feeders manually for period other than schedule for agricultural pumpsets

Feeder Renovation Programme

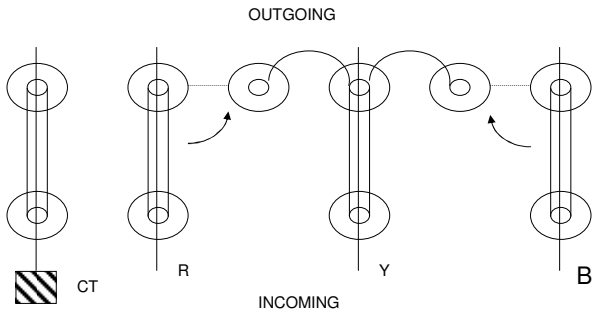
- **A special type of isolator "Roster Switch" is used**
- **Single break roistering (three phase to single phase) isolators without earth blade and with post insulators and neutral affectively grounded.**
- **This switch (isolator) is installed for each rural feeder on the 11 kV feeder at 33 / 11 KV Sub-station / 132/11 KV GSS**
- **Two 3 Phase meters provided in enclosure in M&P Box attached to the Distribution transformer.**
- **For domestic consumers connection is given through aerial bunched cable**

Feeder Renovation Programme

- During Single phasing the 11 kV feeders are grouped so that one group of feeders gets 'R' phase other group gets 'B' phase and other group gets 'Y' phase to ensure balance loading on the 33/11 kV Substation.
- All Rural domestic consumers gets power supply at par with Urban consumers.
- AT&C losses down 10%
- No increase in peak load even after catering to additional supply to rural domestic consumers.

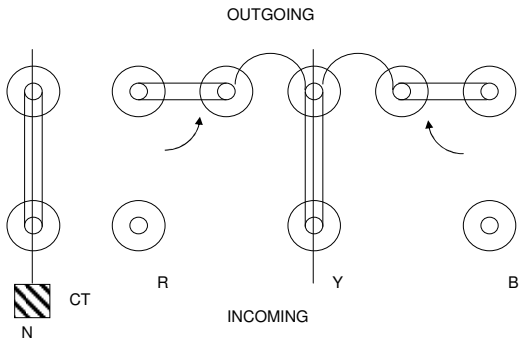
Normal Operation Mode

- **Under normal operation when three phase supply is to be given to feeder for agriculture purpose all the three phase (R,Y.B) and neutral blades are in closed position as shown below:**



Roster Operation Mode:

- **Under this mode of operation the feeder will get single phase supply and neutral only, the blades of R&B Phase of feeder disconnects from incoming R&B phase and connects with Y phase at outgoing side of isolator. Thus at this stage Y phase supply connects to all the three outgoing phases as shown below:**



Gujarat

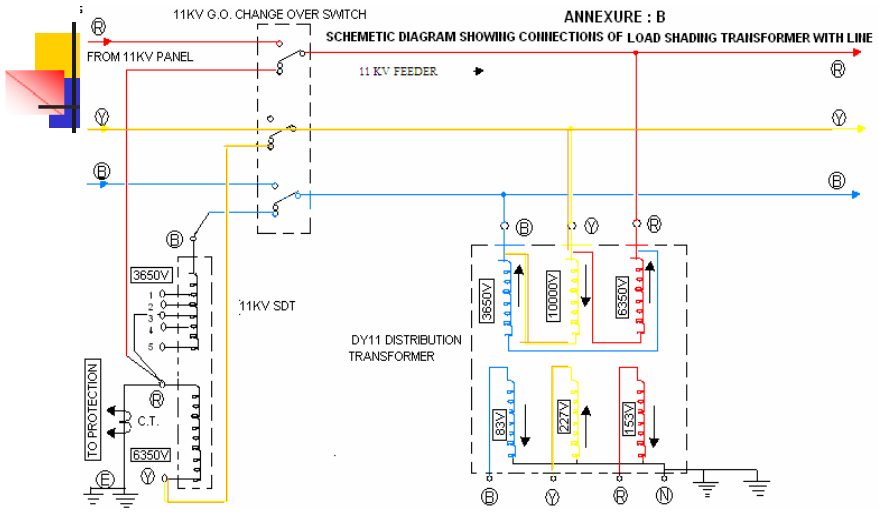
Scheme I

Jyotigram Yojna

24 hrs power Supply to the residential, industrial and commercial category of consumers by segregation of agricultural load from the existing rural feeders is done by laying link lines, new 11 KV feeders.

Scheme II

- Specially designed transformer (SDT), having only one HT winding and no LT winding with the HT winding solidly earthed is provided at the Sub-Station end itself.
- A CT and an earth fault relay is also provided in the earthed wire
- SDT enables to charge the line at 11 KV or even at a reduced voltage (as per tapping selection) and charges all the DY 11 transformers of the feeder
- Since only one phase will get desired voltage with other phases getting reduced voltage the single phase consumer loads are run on one phase only.



Andhra Pradesh

Scheme 1

- In this scheme only one phase of a 11KV feeder is put in service and the other two phases are disconnected by means of Air Break switch at the Substation.
- Tapping of the live phase wire is done by means of a single phase 10 kVA/15 kVA 6.3 kV/ 250 V transformers fed from live phase to feed the rural domestic and other loads and one or more single phase 10kva/15kva transformers (6.3kV/250V) are erected in the village.

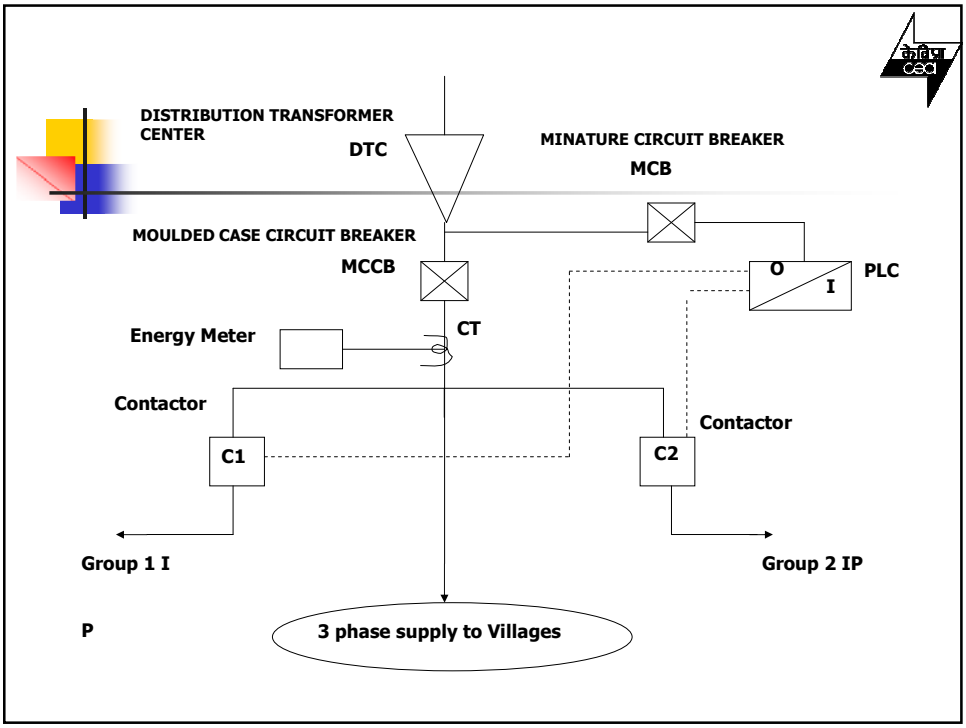
Scheme II

- The existing 3-phase DTR is replaced with 3 numbers single phase DTRs. For example one 63 KVA,3 phase DTR is replaced with 3-single phase,25 KVA DTRs.
- These are connected in Y-Y configuration.
- At the substation suitable arrangement is made such that the same phase (which ever phase is chosen) is extended to all the three wires instead of three different phases.
- When this arrangement is switched on the villages will get single phase supply for lighting and since all the three wires have the same phase the Agriculture pump sets (which are three phase motors) cannot be run.
- During scheduled supply hours (two spell) timing the arrangement at the substation is switched back to normal mode thus extending 3-phase supply.

Karnataka

Scheme using PLC

- Consumers on each transformer into rural, industrial, domestic, commercial and Irrigation pump set consumers
- The irrigation pump sets are grouped into two groups and one contactor each is installed for each group
- Programmable logic Controllers (PLC) are used to control the contactors.
- During scheduled hours of power supply to agriculture one of the contactor remains charged and the contactors are rotated over the period of supply so that inone period only one group gets supply.
- Other than the scheduled hours both the contactor remain de-energised and power is supplied only to loads other than irrigation pumpsets



Haryana and Punjab

- **Haryana is implementing a scheme of segregation of feeders**
- **Separate three phase feeders shall provide agricultural power supply to all irrigation pump sets in the village as per scheduled hours of power supply**
- **Other feeders shall provide supply to non-agricultural consumers in such a way that round the clock power supply is ensured to non-agricultural consumers in the village.**
- **Punjab has already implemented the scheme**

THANK YOU

WBSEDCL

INCENTIVE SCHEME
FOR
DISTRIBUTION WING

1

OBJECTIVE

MOTIVATION OF THE EMPLOYEES TO PERFORM THEIR BEST.

RESULTING:

- REDUCTION OF TECHNICAL AND COMMERCIAL LOSSES.
- BETTER CONSUMER SERVICES, BETTER RELIABILITY OF POWER, QUICKER CONNECTION ETC.
- IMPROVEMENT OF FINANCIAL HEALTH OF THE COMPANY.

2

KPIs FOR AWARDING INCENTIVE

- REDUCTION OF AT&C LOSS.
- INCREASE IN NUMBER OF METER READINGS PER MONTH PER METER READER.
- REDUCTION OF DISTRIBUTION TRANSFORMER FAILURE RATE.
- INCREASE IN RATE OF DISCONNECTION OF DEFAULTING CONSUMERS.
- REDUCTION IN TIME TAKEN TO RELEASE NEW SERVICE CONNECTIONS.

3

IMPLEMENTATION PROCESS

- THE DRAFT SCHEME WAS PLACED BEFORE THE JOINT MANAGEMENT COUNCIL(CONSTITUTING ALL UNIONS AND ASSOCIATIONS) FOR DISCUSSION.
- OPINIONS OF ALL UNIONS AND ASSOCIATIONS WERE RECOGNISED AND INCORPORATED IN THE INCENTIVE SCHEME.
- FINAL SCHEME WAS AGAIN PLACED TO JMC AND IT WAS APPROVED BY THE COUNCIL TOWARDS IMPLEMENTATION.
- FINALLY BOARD OF DIRECTORS APPROVED THE SCHEME

4

INCENTIVE FOR REDUCTION OF AT&C LOSS

- THE INCENTIVE SCHEME WAS ANNOUNCED IN THE EARLY PART OF THE FY 2007-08 WITH THE FOLLOWING GUIDELINES FOR REDUCTION OF AT&C LOSS ON SHORT TERM BASIS AND WITH MINIMUM INVESTMENT

- SEGGREGATION OF LONG AND OVERLOADED 11 KV FEEDERS
- USE OF HVDS IN MORE AREAS,SMALLER SIZE DTRs
- ENSURING 100% METER READING & BILLING
- DISCONNECTION OF ALL DEFAULTING COSUMERS
- REPLACEMENT OF DEFECTIVE / SLUGGISH METERS
- CONDUCTING MORE RAIDS / DETECTION OF THEFT OF ENERGY

5

INCENTIVE FOR REDUCTION OF AT&C LOSS

- AT THE END OF FY 2006-07 AT&C LOSSES OF SOME SUPPLIES WERE HIGH UPTO 60%
- EMPLOYEES ARE TO DELIVER THEIR BEST FOR REDUCTION OF AT&C LOSS TO THE DESIRED LEVEL
- PRESENT TARGET IS TO REDUCE AT&C LOSS TO THE LEVEL OF

15% FOR URBAN SUPPLIES
22% FOR MIXED SUPPLIES
27% FOR RURAL SUPPLIES

6

CONTD..

THE MODE OF CALCULATION OF THE AWARD

LET FOR A SUPPLY

A = AT&C LOSS IN FY 2006-07 IN %
B = AT&C LOSS IN FY 2007-08 IN %
C = ENERGY INPUT TO THE SUPPLY IN FY 2007-08

THEN THE NET AMOUNT OF AWARD WILL BE
D = 15% OF { A – B } X C IN UNITS X AVERAGE TARIFF
CONSIDERING B < A

7

CONTD..

- **THIS NET AWARD 'D' FOR THE SUPPLY WILL BE SHARED BY THE EMPLOYEES OF THE SUPPLY ITSELF AND ALSO THE EMPLOYEES OF THE CONCERNED SUB DIVISION, DIVISION AND CIRCLE PROPORTIONATE TO THEIR CONTRIBUTION, AS FOLLOWS.**

Share of the Award

Unit	Percentage of Net Award
Group. E/S.	65%
O&M Sub-Divn	21%
Division	10%
Circle	4%

8

CONTD..

THE SCALE OF INCENTIVE

Considering all the above, this Scheme has been tabulated as follows

SCALE OF INCENTIVE :

UNIT	URBAN		MIXED		RURAL	
	% of ATC Loss	% of Award	% of ATC Loss	% of Award	% of ATC Loss	% of Award
Group Electric Supply	20	20	27	20	32	20
	19	30	26	30	31	30
	18	40	25	40	30	40
	17	50	24	50	29	50
	16	60	23	60	28	60
	15	100	22	100	27	100
	14	105	21	105	26	105
	13	110	20	110	25	110
	12	115	19	115	24	115
	11	120	18	120	23	120
	10	125	17	125	22	125
	9	130	16	130	21	130
	8	135	15	135	20	135
	7	140	14	140	19	140
	6	145	13	145	18	145
	5	150	12	150	17	150

9

CONTD..

- Table for Calculation

UNIT	2006 - 07 (M.U)			2007 - 08 (M.U)			Reve - nue without previ- ous arrear 2006-07	Reve- nue without previ- ous arrear 2007-08	% ATC LOSS 2006 - 2007	% ATC LOSS 2007 - 2008	Differen ce in ATC LOSS		Total Unit saved Input of 2007-08 x differ- ence in ATC Loss(%)
	INPUT	SALE	COLLECTION	INPUT	SALE	COLLECTION					+	–	
Gr. E/S.													
(O&M) S/Divn.													
Divis- ion													
Circle													

Incentive for the Supplies whose ATC Losses are not reduced but are maintained within the set target, will get a part of the revenue collected, as incentive and will be distributed as per above formula.

10

INCENTIVE FOR METER READERS

- EARLIER METER READING YARDSTICK WAS

  URBAN AREA : 1200 NOS PER READER PER MONTH
  RURAL AREA : 800 NOS PER READER PER MONTH

- DUE TO SHORTAGE OF METER READERS AND GROWTH OF CONSUMERS, METER READING JOB HAD TO BE OUTSOURCED
- INCENTIVE SCHEME IS INTRODUCED TO MOTIVATE METER READERS TO TAKE MORE READINGS
- NEW YARDSTICK, URBAN :1300 NOS
  RURAL : 900 NOS

11

CONTD.. BENEFITS

- IDLE PERIOD OF THE MONTH WILL BE UTILISED,
- READING WILL BE THROUGHOUT THE MONTH
- BILL GENERATION WILL BE SPREAD OVER THE MONTH, STAGGARD DUE DATES FOR PAYMENT, LESS CONGESTION IN CASH COUNTERS
- DISCONNECTION ORDERS WILL ALSO BE ISSUED FOUR TIMES IN A MONTH INSTEAD OF ONCE IN A MONTH
- CASH FLOW AND COLLECTION EFFICIENCY IN THE MONTH WILL IMPROVE

12

SCALE OF AWARD

Award : - Award will be given in % of basic pay of the Meter Readers

Unit / Supply	Percentage of Meter Reading			Addl. Meter Reading
	Above 90%- Below 95%	Above 95%- below 100%	100% and above	
Urban	3%	6%	8%	Rs.2/- per M.R.
Mixed	4%	6%	8%	Rs.2.5/- per M.R.
Rural	5%	6%	8%	Rs.3/- per M.R.

13

CONTD..

- NUMBER OF EMPLOYEES ELIGIBLE : 2166 NOS
- PAYMENT ON MONTHLY BASIS
- METER READERS WILL CERTIFY THAT THEY HAVE TAKEN ALL THE METER READINGS PHYSICALLY
- THEY WILL ALSO GIVE DETAILS OF THEIR FINDING REGARDING DEFECTIVE METERS, LOCKED PREMISES, OR ANY ABNORMALITIES NOTICED

14

INCENTIVE SCHEME FOR REDUCTION OF DISTRIBUTION TRANSFORMER FAILURE

- *IN 2006-07*

TOTAL NO. OF DTRs : 84685 NOS

RATE OF FAILURE : 13.08%

- TO MOTIVATE EMPLOYEES TO TAKE QUICK ACTIONS TO REDUCE FAILURE OF DISTRIBUTION TRANSFORMERS, THIS INCENTIVE SCHEME HAS BEEN FRAMED
- GUIDELINES FOR ACTIONS TO BE TAKEN ARE REMINDED
  - REGULAR BALANCING OF TRANSFORMERS
  - CHECKING AND CORRECTION OF EARTHING, JUMPER CONNECTIONS
  - USE OF LIGHTENING ARRESTERS, PROPER FUSES
  - CHECKING OF TRANSFORMER OIL
  - MAINTENANCE OF LINES

15

INCENTIVE SCHEME FOR REDUCTION OF DISTRIBUTION TRANSFORMER FAILURE

- *TARGET* :
- FAILURE RATE TO BE REDUCED TO

URBAN SUPPLIES : 2%

MIXED SUPPLIES : 4%

RURAL SUPPLIES : 6%

- 50% OF SAVINGS ON DTR REPAIR COST BY EACH SUPPLY WIIL BE AWARDED AS INCENTIVE

16

INCENTIVE SCHEME FOR REDUCTION OF DISTRIBUTION TRANSFORMER FAILURE

AWARD AMOUNT IN %

UNIT	URBAN		MIXED		RURAL	
	% of failure rate	Award – % of Repairing Cost	% of failure rate	Award - % of Repairing Cost	% of failure rate	Award – % of Repairing Cost
Group Electric Supply	5	20	7	20	9	20
	4	30	6	30	8	30
	3	40	5	40	7	40
	2	50	4	50	6	50
	1	60	3	60	4	60
	0	70	2	70	3	65
					2	70
					1	75

17

INCENTIVE SCHEME FOR REDUCTION OF DISTRIBUTION TRANSFORMER FAILURE

- **Scale of Incentive** :

In this Incentive Scheme, the following points have been considered :

a) Supplies having very high failure rates will also be awarded if they are unable to reach the target, but reduce failure rate substantially.

b) Supplies having failure rates within the target, will be awarded a fixed amount as incentive if they can maintain it.

c) The award will be calculated Group Elec. Supply-wise and it will be divided among Group E/S., O&M Sub-Division, Division and Circle.

d) In this Scheme, incentive will be paid annually.

18

INCENTIVE SCHEME FOR REDUCTION OF DISTRIBUTION TRANSFORMER FAILURE

Share of the Award

Unit	Percentage of Net Award	Number of employees eligible
Group. E/S.	70%	9416 Nos
O&M Sub Divn.	22.5%	2226 Nos
Division	5%	460 Nos
Circle	2.5%	170 Nos

19

AVERAGE RATING WISE DTR REPAIR COST.

Average repairing charge of DTRs collected from data base is furnished below :

1000 KVA	Rs. 80,000/-
630 KVA	Rs. 45,000/-
500 KVA	Rs. 40,000/-
315 KVA	Rs. 24,000/-
250 KVA	Rs. 19,000/-
100 KVA	Rs. 12,000/-
50 / 63 KVA	Rs. 9,200/-
25 KVA	Rs. 6,200/-
10 KVA	Rs. 4,000/-
5 KVA	Rs. 2,000/-

20

TOTAL COST OF REPAIR OF DISTRIBUTION TRANSFORMER

Cost incurred for repairing of defective DTRs in 2006-07 is furnished below:

RATING	NO X REP COST	TOTAL COST
1000 KVA	Nil	Nil
500 KVA	3 x 40,000/-	Rs. 1,20,000/-/-
315 KVA	42 x 24,000/-	Rs. 10,08,000/-/-
250 KVA	66 x 19,000/-	Rs. 12,54,000/-/-
100 KVA	2039 x 12,000/-	Rs. 2,44,68,000/-/-
50 / 63 KVA	2532 x 9,200/-	Rs. 2,32,94,400/-/-
25 KVA	5343 x 6,200/-	Rs. 3,31,26,600/-/-
10 KVA	226 x 4,000/-	Rs. 9,04,000/-/-
5 KVA	2 x 2,000/-	Rs. 4,000/-/-
	Total :	Rs. 8,41,79,000/-/-

21

INCENTIVE FOR INCREASING THE RATE OF DISCONNECTION OF DEFAULTING CONSUMERS.

- DISCONNECTION ORDERS ARE ISSUED TO 1% OF THE URBAN AND 3% OF THE RURAL CONSUMERS
- SOME DISCONNECTION ORDERS REMAINED PENDING AT END OF EACH MONTH
- 100% DISCONNECTION WILL ENSURE IMPROVEMENT IN COLLECTION EFFICIENCY AND CASH FLOW
- *TARGET SET FOR PHYSICAL DISCONNECTION / MONTH*

  RURAL: 525 NOS.
  MIXED : 375 NOS
  URBAN : 150 NOS

22

DISCONNECTION *CONTD..*

Condition for award

i. **ELIGIBILITY CRITERIA SET FOR A GR.. E/S FOR BEING CONSIDERED TO GET INCENTIVE**

All the disconnection orders issued during a calendar month except those issued during the last three days of that calendar month must be physically disconnected within the said calendar month for the Gr. E/S. becoming eligible to get incentive on this score.

ii **Mode of Award - in % of total amount of the outstanding dues of the defaulting consumers disconnected as per order.**

iii **Award will be calculated Gr. Electric Supply-wise and it will be divided among the employees of Gr. E/S. except Meter Reader. The employees of Supply and D.C.C. will get 95% and 5% of the calculated amount respectively.**

23

DISCONNECTION *CONTD..*

AMOUNT OF AWARD

Sl. No.	ITEM	AWARD		
		URBAN	MIXED	RURAL
i)	Actual physical disconnection not less than 95%	1.5%	1.75%	2%
ii)	Above 95% to 98%	2%	2.25%	2.5%
iii)	Above 98% to 100%	2.5%	2.75%	3%

24

INCENTIVE FOR REDUCTION OF SERVICE CONNECTION TIME

- FOR SPEEDY DISPOSAL OF PENDING CONNECTION
- CONSUMERS WILL BE SATISFIED
- NUMBER OF GRIEVANCES WILL BE REDUCED
- REGULATORY GUIDELINE WILL BE MAINTAINED

25

SPEEDY CONNECTION *CONTD..*

For Non Pole Cases and pole cases, optimum time for disposal of connections may be considered 3(three) days and 7 (seven) days respectively from the date of deposition of service connection charge. Employees of Electric Supply shall be eligible for incentive as indicated below.

No. of days	Rate of disposal of pending connection	
	Non Pole Case	Pole Case
15 days	Rs. 15/-	Rs. 25/-
10 days	Rs. 20/-	Rs. 25/-
7 days	Rs. 25/-	Rs. 35/-
3 days	Rs. 35/-	Rs. 45/-

26

SUMMARY

- **Nos. of employees estimated to be benefited for introduction of the Incentive Scheme**
- **1. At Group Elec. Supply Level - 13068 Nos.**
- **2. At (O&M) Sub-Divn. Level - 4512 Nos.**
- **3. At Divisional Level - 1798 Nos.**
- **4. At Circle Level - 773 Nos.**
- **Total : - 20,151 Nos.**

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SUMMARY

- *TOTAL ESTIMATED ANNUAL PAYOUT*

- *SCHEME FOR METER READER : RS. 1.01 CR*
- *SCHEME FOR AT&C LOSS REDUCTION : RS. 28.89 CR*
- *SCHEME FOR DISCONNECTION : RS. 1.62 CR*
- *SCHEME FOR REDUCTION OF DTR FAILURE : RS. 2.41 CR*
- *SCHEME FOR SPEEDY SERVICE CONNECTION : RS. 1.85 CR*

TOTAL : RS. 35.78 CR

ACTUAL PAYOUT FOR THE YEAR : RS. 10.00 CR

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THANK YOU
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