



ELECTRICITY REGULATORY AUTHORITY

UGANDA

**STUDY ON DISTRIBUTION SYSTEM
LOSSES AND COLLECTION RATES BY
UMEME LTD**

FINAL REPORT

Revision 3

24 October 2011

Parsons Brinckerhoff Africa (PTY) Ltd (PB)

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

The study of Umeme's loss reduction efforts was undertaken in order to achieve the following: -

- a. Establish the level of technical losses, and identify the required investments to reduce the technical losses to optimal levels for such a network.
- b. Establish the level of non-technical losses and identify measures to eliminate them. Establish the required inputs to achieve the desired levels of commercial losses.
- c. Propose a loss reduction as well as the collection rates path or trajectory over the eight years that can be followed to reach a target on losses that is consistent with the current National Development Plan and a Target on non-collection rates that is consistent with an effectively run utility.

Umeme's performance in reducing the levels of technical and non technical (commercial) losses during the period 2005 to 2009 did not achieve the results required.

Prior to Umeme taking over the Concession loss levels were estimated to be around 40%.

At the time of takeover in March 2005, the starting levels of distribution losses allowable to Umeme for the first year of operation were tentatively set at 33% and were expected to be reducing by 0.83% per annum to reach 28% in the seventh year.

For the period 2005 to 2009 the losses as measured by Umeme started at 31% and ended 2009 at 35%.

It would appear that the stakeholders initially underestimated the poor condition of the network and also underestimated the resilience of the Ugandan customer to resist paying for electricity.

Clearly Umeme were not achieving the loss reduction targets required but over this period many initiatives were started including the following: -

- High loss circuits - focus and Capex
- Large user inspections & meter audits leading to Network & Customer Verification Project (2005/9)
- New Billing & Customer Data System (2009)
- Measurement – Statistical Metering (2008/9)
- Remote Reading Meters – top 200 customers (2011)
- AMR (2011)
- GIS & Billing & Customer Data Linked (2011)
- SCADA & CMS (2009 – 2011)

The fact that these initiatives plus the focussed restructuring of the organisation are showing results can be seen in the losses achieved in 2010 which averaged 30% at the end of the year.

The non collection rates were set at 25% for the first year and were expected to reduce to 7.5% in the sixth year.

Umeme's efforts in this regard started showing good results with the procurement and installation of the new Billing and Customer Data System starting 2010 at an average collection rate of 87% and ending the year with collection rates of 94% for November and December.

Our audit of the Billing and Customer Data System indicated that between 10% and 20% of the meter readings were estimated as access to the meter was not possible and a similar number of meter reading entries were "highlighted" by the system, ie entries that the system identified as being inconsistent with previous entries for that installation. Some of these meter reading errors will no doubt be due to the fact that meter readers often note the meter reading on a slip of paper and later enter the readings onto the Route Sheet.

It was also noted that a relatively high number of data entry errors occurred when the Route Sheet meter readings were input into the system but these were generally recognised by the Billing System and rectified.

It is estimated that these anomalies may account for around a 5% error in the billing and these errors can be either over or understating the billing data.

It is noted that the data used to produce the monthly statistical data did not align with the Umeme Annual Report data for 2009. The energy billed by the district offices in each month during 2010 matches with the total energy billed reported to ERA in the monthly spread sheets. In the case of revenue billed, the total revenue billed by the district offices does not match with the revenue shown in the monthly spread sheets. The revenue billed reported in the monthly spread sheets is underestimated by 4% for 2010.

Umeme have developed a comprehensive set of procedures for the connection, disconnection, meter reading data entry and billing activities including the management of revenue meters. The extent to which each procedure is being complied with was not audited in detail for all activities but for those that were audited it would appear that the procedures are generally being adhered to.

Umeme need to address the meter management process as although the procedure is quite specific as to the installation of new meters and removal of meters for disconnection there was some indication that the procedures were not always adhered to.

The billing data is used to derive the monthly loss and billing efficiency statistics and it can be noted that the loss level computed for each month during 2010 does not show a continuous declining trend, and within the same year, there are a few months where the loss level is higher than the previous month. This may be due to the delay in the billing cycle or the delay in meter reading at the customer premises.

The billing efficiency ratio is defined as the total energy billed as against the total energy purchased. It is noted that the range of variation between the maximum billing efficiency (75%) vis-à-vis the minimum billing efficiency (67%) reported by Umeme during 2010 is less than the range of variation reported in 2009. The maximum monthly billing efficiency was 69% and the minimum was 57% during 2009. This shows that there has been an improvement in customer-billing.

For a few months in 2010 the billing efficiency declined as compared to the previous months of the same year. The months that have registered a lower billing efficiency also show an increase in the loss level as compared to the previous month during 2010, as already explained. Thus it can be seen that the increase in the monthly loss level will affect the other operational performance areas as well.

From our audit of the activities at the District level, as already noted, Umeme need to address the issue of the high number of estimated bills. Umeme in its previous loss reduction strategies (2006 to 2009) indicated that at least 90% monthly actual reading level would be achieved, but it would appear that Umeme is struggling to achieve this target.

It was also observed that a significant number of customers generally receive their bills after the due date. Umeme's staff also confirmed that the Central Billing office sometimes does not dispatch the full lot of customer bills connected with the same feeder and they have to wait for the complete lot to arrive, resulting in a delay in the distribution of customer bills.

Long queues of customers complaining about disconnection of electricity at their premises because of non-payment of electricity bill were noted. It was confirmed that Umeme disconnects the supply based on the past history of the customer and there were some cases where the electricity supply of customers was disconnected without providing them the latest bill.

It was observed that at the Umeme District offices visited there were long queues for bill payment and this issue needs to be addressed.

In our audit of a sample number of substations to review the extent of the statistical metering we noted that of the 133 feeders inspected 10.5% of the feeders at the substations visited had no statistical meters installed. In addition 25% of the meters inspected had some form of deficiency.

The installation of the statistical and boundary metering is critical to Umeme's initiative at District level to monitor feeder performance and the issue of missing or defective meters needs to be addressed.

The full extent of our findings and recommendations are contained in Section 5 but notable are the following observations: -

- Not all substation auxiliary supplies are metered and therefore this consumption is currently accounted for as non technical losses.
- Some transformer installations were operated with one transformer on "soak" and not connected in parallel with the other transformer. This results in unnecessary

transformer losses although it is recognised that there may be instances where, for operational reasons the “spare” transformer is kept energised.

- The standard size for rural transformers is currently 50kVA which in many instances is far greater than the load. We understand that Umeme are investigating the use of smaller transformers where appropriate.

The energy audits suggested in Section 7.7 will allow Umeme to identify feeders with high loss and also, after District staff intervention, they will be able to break down these losses by cause (meter tampering, billing error, theft etc). This will allow Umeme to focus their efforts on solutions giving the best “return” in terms of loss reduction. Accurate and comprehensive statistical metering is therefore very important to Umeme’s loss reduction efforts.

The *Cost of Service Study, Phase 2 (January 2009)* by PPA Energy derived technical and commercial loss factors, as follows: -

- HV system – 8.1%, and
- LV system – 7%.

Total Technical Losses therefore are around 15.1% as at 2009. Total losses for 2010 amounted to 30% and therefore non technical (commercial) losses are around 14.9% for 2010.

Umeme have no way, at present, of measuring or estimating the breakdown of these non technical losses by type.

The *Power Sector Investment Plan (PSIP)* described in Section 7.8 assumes that non technical losses will reduce to 2% by 2020 and that technical losses will reduce to 14.4% by 2020. Thereafter losses are assumed to remain at these levels to 2030 and we agree with these targets.

For the estimation of 11kV and LV system losses in the *Cost of Service Study*, individual load flow studies were made by Umeme for a representative 68, 11kV feeders and 74, LV feeders. The study was therefore not comprehensive and included, for the obvious reason that the data was not then available, assumptions based on a representative sample of data.

We believe that Umeme should implement a comprehensive system study to repeat the exercise undertaken in 2008/9 by the *Cost of Service Study, Phase 2*. The new study will be based on much more accurate network data and should be undertaken by feeder by substation for the entire network.

This will result in two important achievements: -

- The current level of technical losses will be established with a much better degree of accuracy, and
- Knowing feeder and substation technical loss levels will allow Umeme to develop an energy audit process that will closely monitor the levels of non technical (commercial) losses by feeder, by substation.

As a result the District loss reduction efforts will be much more effective and will be able to identify and focus on specific issues causing losses.

At the Steering Committee Meeting held to discuss the Draft Report it was agreed that Umeme and UETCL need to address the expenditure requirements for both the extension of the networks in order to accommodate customer growth and also the requirements for the replacement of aged assets in their collaborative Masterplan.

Transmission network reinforcement projects are identified but Umeme indicated that these projects are not always completed within the time frames required.

This is perhaps an area where the ERA could intervene and provide support to Umeme in pressing UETCL to progress transmission projects.

Umeme's loss reduction efforts as declared in their Loss Reduction strategies over the years required considerable investment but the initiatives are beginning to show positive results as can be seen from the 2010 statistics.

The 2010 Strategy was aimed at maximizing use of their initiatives and included the following: -

- Bill millers. Umeme estimate that they have around 3000 millers and based on experience in Kisenyi, this sector consumes about 15% of energy in Uganda and the majority of this energy is being stolen;
- Target shopping malls and markets with high loss levels. Compulsory bulk metering for office blocks, shopping malls, markets;
- New connection process time. Reduce opportunities for illegal activity by fast turn-around time [7 days];
- Customer power factor improvement. The new tariff providing for penalties for poor power factor for high energy users above 500kVA capacity;
- Installation audits to check metering integrity;
- Improve loss measurement at feeder and District level
- Improve meter management;
- Improve revenue cycle management: meter reading, billing, bill delivery, and
- Street lights – introduce flat/wattage billing.

In December 2009 Umeme submitted an application to the ERA for the introduction of a flat rate tariff which was included in their 2010 loss reduction strategy but the ERA rejected the tariff as in their opinion Umeme had not satisfactorily addressed the impact on low income households, the impact on introduction of prepayment metering, consumption thresholds, the mechanics of the tariff, lessons from other countries and ability of the tariff to send efficient pricing signals.

UMEME is currently reviewing its plans for loss reduction for the medium term, with the aim of making a step change in its performance over the next 7 years have engaged a firm to work with the Company's staff to compile/organize/enhance UMEME's existing plans, which are in various stages of completeness, into a comprehensive 7-year

business plan, detailing timing of key activities and associated operational and capital costs.

At the commencement of the Umeme concession on 1 March 2005 a centralized business architecture and structure was introduced based on the Eskom business model.

In September 2009 the Umeme Board approved the formation of the Customer Service and Energy Loss Reduction Committee as committee of the Board. Umeme also appointed a Transformation Manager to oversee the restructuring and transformation process as part of the redefining of their business processes.

Key to the loss reduction initiative was the restructuring exercise initiated in June 2009 that saw the appointment of Area Managers as well as District Managers, with clear KPI's.

The effectiveness of this restructuring and decentralisation can clearly be seen in the improved loss statistics achieved by Umeme in 2010.

The Rural Electrification Agency projects will have an impact on the level of Umeme losses. Umeme comment that they generally work well with REA and in particular Umeme load flow studies inform REA reinforcement requirements for the new REA projects.

Umeme also claim to have a good working relationship with UETCL and have recently updated the Master Plan in close corroboration with UETCL and REA.

Umeme currently have no say in the design of REA projects which may not be optimally designed from a loss perspective. They also have previously, for example, not been able to test transformers installed under REA projects and are therefore unaware of their losses. They are in discussion with REA in order to arrive at a solution to this.

Umeme commissioned PPA Energy to undertake a study to estimate the impact on the Umeme system of the connection of rural electrification schemes. The results of the studies carried out in the Bombo District indicate a low level of technical losses on the 8 transformer feeders studied due to the relatively low level of customers connected and low levels of energy demand.

Umeme have indicated that they intend proceeding with a further study in order to inform their discussions with the ERA.

Provided that rural electrification schemes are optimally designed and constructed with respect to losses the connection of rural schemes should have no impact overall on Umeme's technical losses. In particular, as loadings on rural schemes are generally low and increase slowly technical losses should be low.

The *Energy Loss Introduced by Rural Electrification Schemes* report suggested that there could be a high level of non technical (commercial) losses on some of the feeders studied.

This is perhaps due to the fact that in some areas it would appear that there is a "culture" of theft and non payment for electricity.

Umeme need to become involved in these "new" rural areas at an early stage in order to introduce the need for payment and to make known the penalties for theft of energy.

Umeme have submitted several letters to both the ERA and to the Minister of Energy and Mineral Development regarding the theft of electricity and asking for assistance in both supporting their drive to educate customers as well as support in prosecuting offenders.

Umeme indicated that, in their opinion, the GoU has not been fully supportive of their efforts and this is an area where we believe the ERA should participate in discussions between Umeme and the respective ministries of the GoU.

In Section 7.8 we suggest that Umeme undertake two studies: -

- A technical losses study to determine the current levels of losses by feeder by substation. This would provide them, in addition to the ability to undertake energy audits by feeder, with a very good idea of the capital expenditure requirements required to bring the level of technical losses within acceptable limits, and
- A Cost of losses Study to determine the actual cost of losses and hence the effect that losses are having on inflating the tariff.

The results of these studies will provide Umeme with a case to take to the GoU for assisted financing.

Clearly, at present Umeme, are budgeting annually to the extent that the tariff will support the capital expenditure.

We believe that it would be possible for Umeme to justify to the GoU an accelerated capital expenditure programme for refurbishment on the basis of a lower tariff increase in the short term.

In order to achieve this, however, Umeme will require assistance in financing the loan.

Umeme indicate that the “Millers” account for 15% Of the energy consumed and a considerable part of the Miller’s consumption remains unbilled.

Umeme have tried several initiatives in their attempts to resolve this but the issue is not fully resolved and we believe that this is an area where GoU intervention is essential.

We note also the comments by the World Bank in their Aide Memoire of 22 November 2010 that there had been no progress on discussions between MEMD and Umeme on developing a framework which outlines roles and responsibilities of the GoU and Umeme with regard to actions targeting power theft.

A Power Loss Reduction Forum was held on 18 July 2008 and attended by Members of Natural resources Committee of Parliament, Resident DC, LC Chairmen and Mayors from areas with major load centres, various ministries, ERA, UMEME, UEDCL, UEDGL, UEDTL etc. Certain actions were agreed upon of which some were actions on Umeme. Umeme have addressed these in their Loss reduction activities but it was not confirmed that the respective GoU agencies had addressed the actions assigned to them, supporting again Umeme’s statement that GoU support was lacking in substance.

A full list of the actions agreed for GoU attention is included in Section 9.

At the Steering Committee Meeting held to present the Draft of this Report it was agreed that Umeme would advise the Ministry (MEMDS) the “bad” areas where their District

audits indicate high levels of theft and meter tampering. The Ministry agreed to apply pressure in these areas.

At the same meeting it was agreed that Umeme would submit to MEMDS a list of issues where they believe that GoU support would assist their loss reduction efforts.

In Section 10 we suggest a trajectory for Umeme’s technical and non technical losses based on what Umeme has achieved to date in respect of their loss reduction efforts and expenditure and taking into account our recommendations for further work: -

Year	2011	2012	2013	2014	2015	2016	2017	2018
	Proj.	Proj.	Proj.	Proj.	Proj.	Proj.	Proj.	Proj.
Total Purchase (GWh)	3088	3201	3316	3487	3691	3941	4219	4516
Total Energy Sales (GWh)*	2254	2433	2620	2842	3082	3340	3618	3918
Distribution Loss Level	27.0%	24.00%	21.00%	18.50%	16.50%	15.25%	14.25%	13.25%
Technical Loss	15.0%	14.0%	13.0%	12.0%	11.0%	10.5%	10.0%	9.5%
Non Technical Loss	12.0%	10.0%	8.0%	6.5%	5.5%	4.8%	4.2%	3.8%
% of Energy Collected on Billed (6 months Lagged)	96.9%	97.4%	97.9%	98.4%	98.9%	99.0%	99.2%	99.4%

* Source: PSIP Report

Based on our analysis, audits and taking into account the best practices followed by utilities globally, Umeme will be able to achieve the desired loss reduction target if our recommendations are addressed through appropriate interventions as described in detail in Section 10.2.

In summary our recommendations include the following: -

- Creation of “Check Meter Reading Teams” to perform random audit and mitigate exceptions;
- Rotation of meter readers across districts to prevent connivance with consumer;
- Umeme should consider the introduction of longer meter reading cycles for their domestic customers. Few utilities in South Africa, and indeed internationally, read domestic meters on a monthly cycle. Extending the domestic meter reading cycle to 3 months with estimated reading in the interim months would greatly relieve the billing and meter reading activities at District level. Eskom in South Africa currently read domestic meters every three months and in the UK most energy companies read meters only once a year.

Umeme have indicated that they do not favour this as they believe that they detect more meter tampering and theft by monthly visits and meter inspections.

- Outsourcing of the meter reading function. Very few utilities use “own staff” to read meters. The outsourcing of this activity has been a success wherever it has

occurred around utilities. Umeme could consider facilitating the formation of specialist meter reading companies by their existing meter reading staff. This would relieve Umeme of the issue of staff redundancies caused by outsourcing.

- Extend handheld meter reading devices across all districts;
- Creation of backup rooms in district offices where handheld devices (HHDs) can be charged and data can be directly uploaded into the system without human intervention;
- Deployment of Automated Meter Reading (AMR) in the high revenue base consumer segment. In order to justify the advancement of the expenditure on remote metering Umeme may consider focussing District audits on the Large and Medium customers in order to assess the potential savings that the AMR would achieve;
- Umeme should carry out the audit of large customers on a regular basis, and the government should join hands with Umeme and fight against electricity theft;
- Creation of Centralized Special Enforcement Group to detect thefts on regular basis;
- Routine Energy Audits to allow Districts to accurately identify the areas of losses and then prioritize their efforts accordingly;
- Use of tamper proof metering technologies with tamper recording capabilities;
- Usage of AMR based pole mounted group meters with display at consumer premises.
- Use of “Prepaid Meters” for those consumers who engage in theft of electricity (Compulsory);
- Bring existing meters outside premises where access is a problem;
- Creation of an Audit Meter Reading Team to verify the meter readings entered in the selected route sheet by visiting the customer premises.
- Web based system providing billing information and payment options;
- SMS to high revenue base consumers;
- Collection vans for areas located remotely;
- Electronic Clearing Service (ECS) options including Website payment option, and
- Umeme can also consider the “Spot Billing” option. This option is extremely effective in reducing the reading to collection cycle to one day. Under this option the Meter Reader has the ability to generate bills on the spot. Customers can also make payment to the reader based on the bills received and this takes care of the total transaction.

At the Workshop held to present the findings of this study held on 7th June 2011 requests were made for the Consultant to prioritise their recommendations for Umeme’s loss reduction efforts as well as to provide a capital; expenditure forecast for these initiatives.

Umeme were requested to provide their forecast savings, expenditure requirements and cost benefit analysis for their various loss reduction efforts. This information was not provided by Umeme, who have indicated that they have engaged a consultant to determine this information.

Without this information it is impossible for the Consultant to prioritise the loss reduction efforts or to provide expenditure requirements.

With the considerable expenditure committed by Umeme on their AMR project it could be assumed that this effort has some priority.

Umeme's "Feeder Loss Reduction Initiative" at the District should indicate the major sources of losses but Umeme did not provide any indications that this information was available.

Appendix A to this Report includes comments by Umeme to the Draft Report and comments by ERA and PB Power to these Umeme comments.

Appendix B to this Report presents the minutes of the Workshop held on 7th June 2011.

Appendix C contains Umeme's comments to the Workshop and the request for additional information and the Consultants response to this to ERA.

1 INTRODUCTION

1.1 Background

Umeme Limited was incorporated on 6th May 2004 as a joint venture between Globeleq Holdings and Eskom Enterprises. On 28th November 2006 Eskom sold its 44% investment in Umeme to Globeleq. In October 2009 the ownership of Globeleq was transferred to CDC Group Plc and on 15 October Globeleq was renamed Umeme Holding Limited.

On 3rd December 2009 the ownership of Umeme Holding Limited was transferred to Actis Infrastructure. Actis is a leading private equity investor in emerging markets and has been investing exclusively in these markets for nearly 60 years.

Umeme took over the distribution system and license to distribute and supply power in the Authorised Territory from UEDCL under a Concession Agreement from 1st March 2005 for a period of 20 years. Under the Concession Umeme is required to repair, upgrade and expand the distribution system within the Authorised Territory.

UEDCL owns the distribution and transmission equipment not exceeding 33kV included in the Concession and Umeme purchases energy from Uganda Electricity Transmission Company (UETCL), which owns the transmission assets from 33kV to 132kV, and from other generators.

The distribution and supply licenses issued by ERA to Umeme Ltd contain a tariff methodology which outlines the principles of retail tariff determination. Amongst the other variables, the retail tariff is driven by the levels of distribution losses and non-collection rates. At the time of takeover in March 2005, the starting levels of distribution losses allowable to Umeme for the first year of operation were tentatively set at 33% and was expected to be reducing by 0.83% per annum to reach 28% in the seventh year as per schedule A-4 to annex A of the Distribution Supply License. Within the first two years of operation, Umeme was expected to propose changes to the schedule of losses based on the experience. The non collection rates were set at 25% for the first year and were expected to reduce to 7.5% in the sixth year contained in annex A-5 to the Distribution Supply license. This was however overtaken by unforeseen circumstances arising from the power supply shortages that were experienced particularly in 2006 and the subsequent expensive mitigation measures (i.e. diesel based generation).

As a result of these measures the tariffs were increased substantially. Umeme Ltd later argued that the prevailing circumstances were likely to undermine their loss reduction efforts. The agreements were subsequently renegotiated and schedules A-4 and A-5 to Annex A were replaced with a new mechanism for setting loss targets and non-collectable rates respectively, under the Special Provisions Period (SPP).

The SPP ended in the first quarter of 2010, Umeme and ERA was supposed to agree to a new schedule of losses and collection targets. The initial 7-year period of concession will end in March 2012, which calls for a new schedule of losses and non-collectable rates to be agreed on for the next seven years.

Whereas Umeme has made significant efforts towards improvements in collection rates, The Government of Uganda (GoU) is concerned that the level of distribution losses, which impact on tariffs, have remained relatively high as compared to the levels of losses in the other countries in Sub-Saharan Africa which have similar characteristics to the Ugandan Economy. In addition, GoU is concerned that if losses are not significantly reduced, the benefits from any additional generation such as low tariff and capacity will not be realized. GoU in its National Development Plan for 2010/11-2014/15 has set a target to reduce distribution losses to 16%. At the same time GoU, in collaboration with the Royal Norwegian Embassy, engaged Norconsult AS consultants at the beginning of 2006 who proposed certain measures on how to reduce distribution losses. Umeme is required to submit an annual loss reduction strategy to ERA, outlining the various approaches aimed at reducing losses.

For this purpose the ERA has engaged Parsons Brinkerhoff to undertake a Study on the Distribution System Losses and Collection Rates for the Umeme distribution concession. Essentially the project is an audit to confirm the figures used in Umeme's loss calculations and the effectiveness of their loss reduction measures and, where appropriate, recommend improvements to the strategy.

This Report presents the findings of our investigations and audit and a Draft Report was presented to the Steering Committee on 31st March 2011.

Comments received at this meeting have been incorporated in this Draft Report Revision 1.

Umeme's comments to the draft Report, together with comments from ERA and PB are attached as Appendix A to this Report.

1.2 Objectives of the Study

Umeme are required to implement best practices in the field of revenue protection and credit control in order to comply with their licence obligations and to enable the Government to achieve the targets contained in the National Development Plan for 2010/11-2014/15 to reduce distribution losses to 16%.

The Electricity Regulatory Authority (ERA) has appointed Parsons Brinckerhoff (Pty) Ltd (PB) to:-

- d. Establish the level of technical losses, and identify the required investments to reduce the technical losses to optimal levels for such a network.
- e. Establish the level of non-technical losses and identify measures to eliminate them. Establish the required inputs to achieve the desired levels of commercial losses.
- f. Propose a loss reduction as well as the collection rates path or trajectory over the eight years that can be followed to reach a target on losses that is consistent with the current National Development Plan and a Target on non-collection rates that is consistent with an effectively run utility.

2 THE SCOPE OF WORK AND METHODOLOGY

2.1 The Terms of Reference

The actions required to undertake the audit were detailed in the Terms of Reference as follows: -

- To analyze and document Umeme's billing processes and assess whether they conform to best utility practice.
- To verify and validate the billing statistics/data including customer numbers of Umeme.
- To verify and validate the cash collections by Umeme.
- To establish the extent of bulk metering done by Umeme on each of the feeders and assess the usefulness of such bulk metering in establishing losses by feeder and the extent to which Umeme has made effective use of such data.
- To establish and provide a separation between technical and non-technical losses and identify the sources by consumer category and by region.
- To review and assess the effectiveness of the loss reduction measures being implemented by Umeme. The consultant should identify and document the strengths and weaknesses of the current loss reduction strategy that Umeme is implementing and advise on how challenges can be addressed.
- To quantify the impact of the new billing system on loss reduction and provide a separation between administrative losses and those attributed to theft.
- To assess the impact of billing anomalies (i.e. Accounts in suspense, customers billed with zero consumption, customers on direct consumption, customers connected but not billed, estimated bills, wrong bills issued per month, etc.) on non- technical losses.
- To analyze the capital investment schedules of Umeme for quality, value and impact of these capital investments made by Umeme since 2007 on loss reduction and improvements in collections.
- Assess the impact of the rural electrification program on loss reduction.
- To formulate an appropriate loss reduction and collection path with clear and discernable milestones that will ensure that Umeme as a private company reaches target loss level as per the National Development Plan taking into account generation and demand assumptions in the Power Sector Investment Plan. The consultant should outline any support from the GoU that Umeme may require and amount of investment that will be needed in each of the eight years.

- To review the adequacy of the current organizational initiatives geared to loss reduction and collection efficiency and to maintain a desired quality of supply service in accordance with existing regulations.

2.2 Methodology

We have combined the requirements of the Terms of Reference into distinct activities with assigned responsibilities as follows: -

- Review and audit of the Billing and Customer Data System and Cash Collection figures
- Quantify the impact of the new billing system on loss reduction
- Establish the extent of statistical metering and audit a percentage of substations in order to verify the condition and accuracy of the metering.
- Establish and provide a separation between technical and non-technical losses
- Review and assess the effectiveness of the loss reduction measures being implemented by Umeme, including the organisational structure and capital expenditure related to loss reduction.
- Review the impact of the rural electrification program on loss reduction

In the following Sections we record the results of the above review and audit and provide our comments on the effectiveness of Umeme's endeavours to reduce losses in the short and long term in each area.

In addition we outline any support from the GoU that Umeme may require and amount of investment that will be needed in each of the eight years.

Finally we formulate an appropriate loss reduction and collection path with clear and discernable milestones that will ensure that Umeme as a private company reaches target loss level as per the National Development Plan taking into account generation and demand assumptions in the Power Sector Investment Plan.

3 AUDIT OF THE BILLING AND CUSTOMER DATA SYSTEM AND CASH COLLECTION FIGURES

3.1 General

Umeme decentralized its operations into 6 regions, 3 within the Kampala area, and extended its customer service network to 25 district offices geographically arranged across its distribution network so as to provide prompt retail and technical services. To review and audit the billing and customer data system and cash collection data, the following two Umeme district offices in Kampala were visited:

- I. Banda District Office (Kampala East Region) (Date Visited: 15th December 2010)
- II. Najjanankumbi, Entebbe Road District Office (Kampala South Region) (Date Visited: 16th December 2010)

As it was difficult to visit each district office of Umeme, two district offices were selected on a sample basis, and the results of the audit will be extended to the other district offices.

3.2 Procedure Followed for Billing the Customers:

For auditing the billing and customer data system for any distribution utility, it is essential to understand the procedure followed by the utility for billing its customers. This involves numerous activities from taking meter readings at customer premises to issuing monthly energy bills; these activities vary from utility to utility. Further, these activities play a vital role in the total distribution loss of a utility. The following activities were observed in the selected district offices in order to audit the billing and customer data system and cash collection data: -

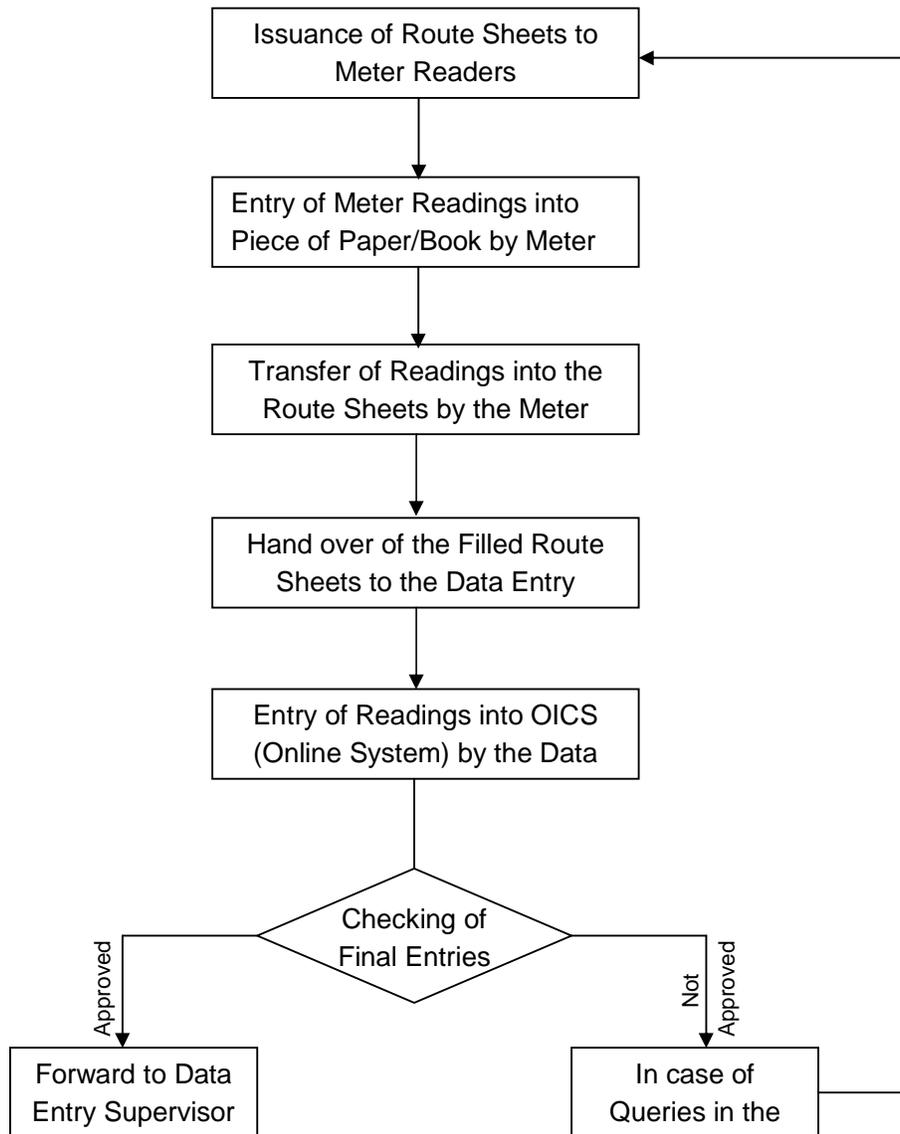
- I. Taking meter readings
- II. Data entry into the system from meter reading sheets by the data entry operator
- III. Preliminary validation of the data (if required) by the data entry operator/supervisor
- IV. Submission of daily meter readings to the Central Billing Unit through the central processing facility available at the district offices
- V. Collection of payment (energy dues) from the customers

All the aforesaid activities are covered in detail in the following sections.

3.2.1 Taking meter reading:

The customer meter is a critical resource for distribution companies, as it enables both internal accounting of losses in the distribution system and proper accounting of sales to customers. In contrast to power systems in developed countries, metering deficiencies are common throughout the Africa region, as in most developing economies. The procedure followed by both the district offices of Umeme for taking customer meter readings is summarized below in .

Figure 3-1: Meter Reading Procedure



Each district office provides route sheets¹ to meter readers on a daily basis. After receiving the route sheets, the meter readers visit the area to be billed as per the details of the customers given in the sheets. During the visit, they directly note the readings on a piece of paper/notebook to save time. They then enter all the meter readings into the route sheets only after taking all the meter readings of the area specified in the route sheets. Thus, meter readings are written twice, which increases the probability of human errors. Finally, the meter readers hand over the completed route sheets to the data entry operator to perform the remaining activities.

¹ Route sheets cover feeder name, transformer details, customer/meter no., etc. Each route sheet is provided with an itinerary number.

3.2.2 Data entry into system from meter reading sheets by data entry operator & preliminary validation of the data

As depicted in Section 3.2.1, once the meter reader completes the route sheets, the data entry operator enters the meter readings from the sheets into OICS (online system). In both the district offices, there was only one data entry operator, who performs this activity on a daily basis. The online system also provides the summary of customer's consumption for the previous month and does the initial validation like comparison of current month's meter reading with that of the previous month. Further, the online system highlights the meter readings of those customers whose current reading is lower than the previous month's reading and current reading is too high, too low, or nil. In case the meter reader is unable to take reading in some of the customer premises, the readings of the unread meters will be left blank at this stage. In case meter readings of any of the customers are lower than the previous month's readings, the meter readers are asked to validate the readings. Once the data entry operator enters all the readings into the system, it goes to the supervisor for the final validation.

3.2.3 Submission of daily meter readings to the Central Billing Unit through central processing facility available at district offices

At this stage, the supervisor handles the specific queries raised by the data entry operator regarding the meter readings and validates the data entered by the operator on a broad level. The supervisor sends all the completed route sheets (entered into the system) to the Central Billing Unit through the central processing facility available at the district offices for preparing monthly customer bills. The Central Billing Unit validates the meter reading based on certain predefined parameters as well as estimates the consumption in case the meter reader is unable to take the readings. The Unit also prints the monthly customer bills for each district office of Umeme.

3.2.4 Collection of payment (energy dues) from the customers

The district office provides the facility of cash collection counters to the customers for paying energy dues. Umeme's employees engaged in cash collection at the district office also tally the total amount received during a single day with the total entries made in the system. Further, Umeme has an arrangement with certain banks that enables the customers to make direct payments. No wrong entries have been noticed in the cash collection counters of both the districts during our audit.

3.3 Audit of Data maintained at District Offices

For the purpose of audit, the activity related to data entry into the system from meter reading sheets (route sheets) by the data entry operator was audited. Since this activity plays an important role in customer billing and can be audited on a real-time basis, it has been primarily considered for the analysis of audit.

In both the district offices, the meter readings entered by the data operator from the meter reading sheets to the system on the day of our visit was audited. Further, the data entered by the data operator in the second week of November 2010 for few feeders (selected randomly) in the system was reviewed and verified with the meter reading sheets for the same period. The month of November was selected as the online system

provides the meter readings of the customer for the previous month only. The summary of some of the route sheets audited in the district offices is given below.

Table 3-1: Summary of Route Sheets Audited in Banda District

Itinerary No.	3351
Tx	106 (A, B)
Feeder No.	38
Area	Kisasi Kyanga Road
Total Expected Readings	242
Actual Readings Taken	196
Meters Not Read	46
Readings Highlighted	46

Itinerary No.	23933
Tx	TX 82
Feeder No.	38
Area	Mutsea Road
Total Expected Readings	116
Actual Readings	107
Meters Not Read	9
Readings Highlighted	22

Itinerary No.	3302
Tx	Tx 55 (A,B,C D)
Feeder No.	39
Area	Kinwataka Zone
Total Expected Readings	145
Actual Readings	124
Meters Not Read	21
Readings Highlighted	21

Itinerary No.	32799
Tx	177 (A, B)
Feeder No.	31
Area	Bulali Zone
Total Expected Readings	63
Actual Readings	57
Meters Not Read	6
Readings Highlighted	9

Table 3-2 Summary of Route Sheets Audited in Najjanankumbi, Entebbe Road District Office

Itinerary No.	3687	Itinerary No.	3617
Tx	17 (C)	Tx	20 (A, B) & 21 (B)
Feeder No.	19	Feeder No.	16
Area	Entebbe Road	Area	Entebbe Road
Total Expected Readings	153	Total Expected Readings	181
Actual Readings	126	Actual Readings	125
Meters Not Read	27	Meters Not Read	56
Readings Highlighted	25	Readings Highlighted	46

3.4 Key observations of the audit analysis are as follows:

- In all the route sheets, there are ample instances of the meter reader being unable to take the reading because of various reasons like locked customer premises etc.
- A considerable number of readings entered by the operator in the current month were highlighted by the online system. Some of the highlighted readings were not important such as the current month's consumption entered is negligibly high or low as compared to the consumption pattern of the customer in the past months, and these highlighted readings were ignored by the data operator.
- Further, the online system highlighted the meter readings of those customers whose current reading is lower than the previous month's reading. In such cases, the data operator either transfers it back to the meter reader or some times applies his/her own judgment.
- At certain instances, the data entry operator entered wrong readings in the system vis-à-vis readings reported in the route sheets.
- While entering readings into the system for the aforementioned sheets, the data entry operator made a few wrong entries; these errors were sometimes noticed and rectified by the data entry operators themselves.

The frequency of data entry operator errors depends on the number of entries in a route sheet. It has been observed during the audit that if the readings are less than 100 in the

route sheet, the probability of error is 1%, but if the readings are more than 100, the probability of error is 2%.

Further, an analysis of the previous month's data recorded in the system showed a few instances of entry of wrong readings in the system as against the data maintained in the route sheets in the district offices. The frequency of errors was more in Najjanankumbi as compared to Banda.

Apart from the data entry operator error, the readings highlighted by the online system at the time of data entry also contributed to non-technical losses. The percentage of highlighted readings in the total actual readings in a single route sheet raises concern on the efficiency level of meter readers. The table below summarizes the percentage of total highlighted readings as against the actual readings taken by a meter reader.

Table 3-3 Actual Billing Percentage and Highlighted Reading Percentage

Route Sheet	1	2	3	4	5	6	Total
Itinerary No.	3351	32799	23933	3302	3687	3617	(1 to 6)
(A) Total Readings	242	63	116	145	153	181	900
(B) Actual Readings	196	57	107	124	126	125	735
Actual Billing (B/A)	81%	90%	92%	86%	82%	69%	82%
(C) Readings Highlighted By System	46	9	22	21	25	46	169
Highlighted Reading Percentage (C/B)	23%	16%	21%	17%	20%	37%	23%

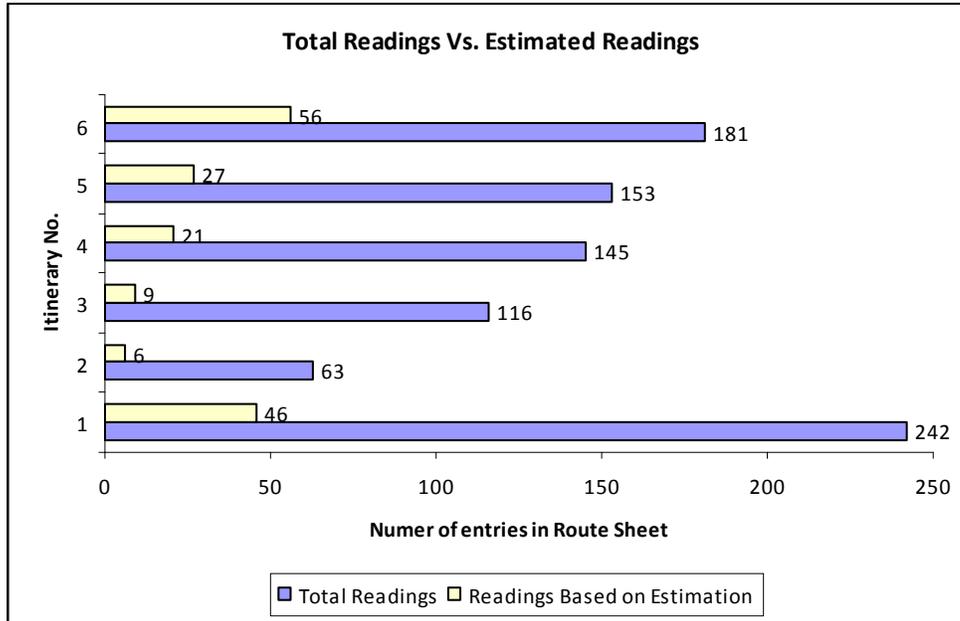
During the audit, it was observed that the data entry operator rectified 80% of the highlighted readings at the data entry stage (considering 80% of the highlighted readings are not important as the highlighted readings entered are negligibly high or low as compared to the readings for the past months). These 80% rectified readings can be easily ignored because of the predefined queries in the new system; however, the remaining 20% of the meter readings leads to billing errors. Based on the sample size considered in Table 3-3, it is found that 20% of the highlighted readings contribute to 5% (23% × 20%) error in the total actual billing done by both the district offices.

The objective of the above exercise was to check the accuracy level of the data entered by the operators on a daily basis, from the meter reading sheets into the system, as well as to compare the previous month's data maintained in the district offices with the data being recorded in the system. The incorrect entries in the system either increase or decrease the loss level. In both the cases, it will distort the accurate loss level of the utility.

The second area of concern for Umeme is that a considerable amount of meter readings are based on estimation. This will not only impact the actual consumption but also reduce the total number of actual readings in the route sheet; therefore, the probability of

aforesaid human error in total actual readings as against the total expected readings will further increase. This is not a best practice and also impacts the loss level of the utility. The graph below summarizes the actual readings taken by a meter reader as against the total expected readings to be taken in the route sheet.

Figure 3-2 Total Expected Readings vs. Actual Readings Reported by Meter Reader



The result of the audit shows that in both the districts:

- Human error is introduced while transferring meter readings from the route sheet to the system and substantiates the gaps observed in the meter reading process.
- The audit exercise does not validate the readings taken by the meter readers from the customer premises as these were not audited. There is a probability that some degree of human error is introduced in this process also.

Based on the prevalent procedures followed by the district offices for data capturing and the audit analysis of sample route sheets, it can be concluded that the loss level reported by Umeme on a monthly basis would not be completely accurate and would involve some degree of human error. It was not possible to estimate the extent of this error.

3.5 Audit of Umeme’s Spreadsheet:

The audit analysis done at the district level, as mentioned above, captures the processes followed by the district offices and the accuracy of data reported to the Central Billing Unit.

As an extension of the district-level audit, it is important to understand and validate data maintained at the head office of Umeme. For this exercise, we have used the data provided by Umeme to ERA on a monthly basis. Umeme provides data on energy purchased and energy billed to ERA in a spreadsheet format on a monthly basis. The data is used to generate the following performance indicators: Distribution Losses (%), percentage of distribution losses (3 months Average), % of Energy Collected on Billed (6

months Lagged),) Gross Profit Margin (%), Billing Efficiency Ratio (Billed/Purchased), Performance Efficiency Ratio (% Collected x Billing Eff. Ratio), Cash Collection/Energy Bulk Purchase (Shs/per kWh), etc.

These performance indicators are used by ERA to monitor Umeme's performance and are critical for the successful administration of Umeme's concession agreement. Spreadsheets containing Umeme's performance indicators for the previous years have been analyzed, and the recent data in these spreadsheets has been audited. The audit was divided into stages.

In the first stage, we tried to validate the total energy sales, purchase, and revenue billed during 2008 and 2009 using Umeme's annual accounts. It is noted that the revenue billed shown in the performance indicator sheet does not match that captured in the annual accounts, whereas in both the cases, the revenue billed is shown as the net of VAT. In the spreadsheets, the revenue billed is underestimated in both the cases.

In the second stage, the monthly data maintained at the district level for 2010 would be matched with the monthly data reported in the spreadsheets. The objective is to validate the monthly information provided to ERA and to establish the accuracy of performance indicators.

The monthly data related to the total energy billed and revenue billed by each district office was collected and validated.

Table: Energy Billed & Revenue Billed by District Offices during 2010

District Office	Energy Billed (Units)	Revenue Billed
Banda	168,646,504.97	59,667,521,031.16
Bombo	27,369,819.78	10,121,565,736.18
Bushenyi	13,389,927.94	4,571,364,552.52
Entebbe	61,638,247.92	20,099,258,842.05
Fort Portal	24,534,140.46	8,056,394,105.42
Gulu	12,413,266.54	5,394,763,749.43
Hoima	7,478,800.31	2,819,059,354.52
Iganga	47,018,502.74	12,907,678,399.11
Jinja	171,522,981.54	45,973,764,849.36
Kabalagala	105,068,073.56	33,438,699,933.68
Kabale	11,083,256.16	4,746,173,311.50
Kampala Metro	194,059,477.55	68,813,276,232.33
Kamuli	5,029,148.95	2,105,637,869.27
Kapchorwa	1,049,339.61	458,641,646.79
Kasese	69,981,128.51	17,621,896,383.78
Kayunga	4,418,974.37	1,886,734,345.81
Kisoro	485,376.00	211,149,218.14
Kitgum		

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District Office	Energy Billed (Units)	Revenue Billed
	3,054,147.15	1,249,615,006.69
Kitintale	122,630,140.07	40,401,665,488.34
Lira	14,596,329.63	5,854,189,578.18
Lugazi	30,045,634.87	7,979,895,855.78
Masaka	26,666,259.67	11,268,731,319.51
Masindi	6,647,260.25	2,905,318,306.83
Mbale	31,405,964.43	12,930,729,441.86
Mbarara	35,033,149.97	13,829,537,567.17
Mityana	13,651,542.12	5,860,578,826.78
Mpigi	3,730,847.13	1,176,534,803.96
Mubende	5,480,059.29	2,297,750,617.89
Mukono	56,819,005.08	18,400,561,511.94
Najjanankumbi	74,747,947.77	30,092,535,114.55
Nakulabye	53,189,672.68	20,667,532,068.99
Natete	70,053,894.98	26,295,068,110.05
Rukungiri	2,402,007.79	1,030,999,766.28
Soroti	8,364,862.79	3,604,042,053.74
Tororo	64,783,832.31	17,429,955,621.70
Wandegeya	78,148,851.01	29,197,280,447.28
Grand Total	1,626,638,375.90	551,366,101,068.57

Source: Umeme

It is noted that the energy billed by the district offices in each month during 2010 matches with the total energy billed reported to ERA in the monthly spread sheets. There is negligible variation observed in the energy billed by the district offices in the month of July with the total energy billed reported to ERA. In the case of revenue billed, the total revenue billed by the district offices does not match with the revenue shown in the monthly spread sheets. The revenue billed reported in the monthly spread sheets (531,173,822,610) is underestimated by 4% as against the total revenue billed (551,366,101,068.57) details provided by the district offices.

Based on the analysis above it can be concluded that the revenue billed reported by the district offices is different from the spreadsheets submitted to ERA. At the same time, the data from the district offices has been considered in the case of energy billed while monthly reporting to ERA.

3.6 Recommendations to improve Meter Reading and Billing Efficiency

Umeme need to address the issue of meters not read during the billing cycle as well as the data input errors. The dual entry on meter reading should be eliminated and meter readings should be made onto the meter readings into the route sheets.

In Section 10.2 we make recommendations for Umeme to consider improving their billing and metering reading process.

4 THE IMPACT OF THE NEW BILLING SYSTEM ON LOSS REDUCTION

4.1 General

Umeme recently implemented its new customer care and billing system (NCBS) to perform all the billing and customer care operations. The application can be divided into three parts:

- Open Integrated Customer Care System (OICS)
- Meter Management System (MMS) and
- Incident Management System (IMS)

The main intention behind implementing NCBS is to improve the customer service quality by shortening the network breakdown resolution time and providing real-time feedback for customer complaints. At present, NCBS supports the entire commercial operation of Umeme and supports other departments such as finance, internal auditing, and engineering. The key features of NCBS are as follows:

- The system can operate in three modes: online, i.e., direct access to the centralized databases at the head office; offline, i.e., a stand-alone version of the application; and completely offline, i.e., no connection with the head office.
- This system captures real-time data, which is stored in one common database and can be accessed by all application users.
- The application users can generate a variety of MIS reports by using query criteria.

As per Umeme, considerable improvement has been made in the area of billing, customer services, and MIS reporting after the implementation of new billing system.

Deloitte, in their audit report, have indicated that most of the applications covered under NCBS have been implemented. Deloitte has also recommended that to reap the full benefit of NCBS, attention should be paid to user training, interfacing with other applications in Umeme, system administration, and security.

Umeme have developed a comprehensive set of procedures including the following: -

RS_001 PROCEDURE FOR NEW SUPPLY

RS-002 PROCEDURE FOR MODIFICATION OF SUPPLY

RS-003 PROCEDURE FOR ACTIVATION OF CONTRACT

RS-004 PROCEDURE FOR MOVEIN-MOVEOUT

RS-005 PROCEDURE FOR MODIFICATION OF CONTRACTS

RS-006 PROCEDURE FOR MODIFICATION OF CUSTOMER DATA

RS-007 PROCEDURE FOR MODIFICATION OF BILL SENDING DATA

RS-008 PROCEDURE FOR TERMINATION OF CONTRACT

RS-009 PROCEDURE FOR REVENUE COLLECTION AND RECONCILIATIONS

RS-010 PROCEDURE FOR UNALLOCATED CASH

RS-011 PROCEDURE FOR BOUNCED CHEQUE
RS-012 PROCEDURE FOR NON TECHNICAL CUSTOMER COMPLAINT
MR-001 PROCEDURE FOR METER READING
MR-002 PROCEDURE FOR ROUTE AND ITINERARY
MR-003 PROCEDURE FOR DAMAGED AND FAULTY
CC-001 PROCEDURE FOR DISCONNECTION
CC-002 PROCEDURE FOR RECONNECTION
CC-003 PROCEDURE FOR MATERIAL RECOVERY
CC-004 PROCEDURE FOR INSTALMENT AGREEMENT
CC-005 PROCEDURE FOR CREDIT APPLICATION AND
CC-006 PROCEDURE FOR CONTRACT TERMINATION
FR-001 PROCEDURE FOR FRAUD
FR-002 PROCEDURE FOR LOSS REDUCTION CAMPAIGN
MM-001 PROCEDURE FOR METER REQUISITION AND INTER-STORE TRANSFER
MM-002 PROCEDURE FOR METER REPLACEMENT
MM-003 PROCEDURE FOR ISSUE OF NEW METER

It is noted that the above procedures cover the acquisition and issue and replacement of energy meters. We have not audited this aspect of Umeme's operation. We assume that as this is essentially a District function the activities will be closely monitored in accordance with the decentralised activities and accountabilities.

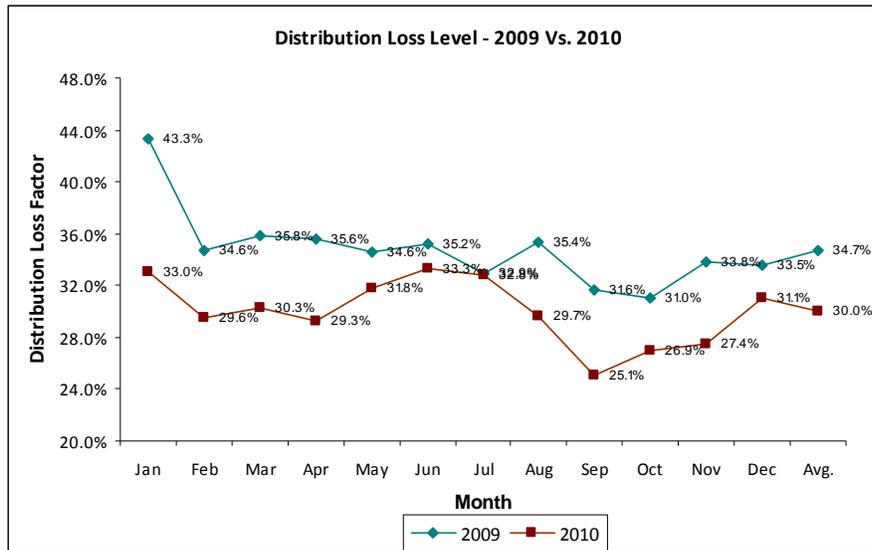
The new billing system implemented by Umeme has certainly played a vital role in loss reduction. Umeme, in its loss reduction strategy for 2006–2009, had acknowledged that non-technical losses would be reduced after the implementation of new system. As a part of this study, the following parameters have been analysed, to determine the impact of the new billing system on loss reduction:

- I. Performance indicators reported by Umeme in the monthly spreadsheets
- II. Processes followed by Umeme at the district offices

4.2 Performance Indicators Reported in the Monthly Spreadsheets:

Distribution Loss Level: Umeme has made significant improvements in loss reduction in 2010. The average distribution loss factor has reduced from 34.7% in 2009 to 30.0% in 2010. This shows a substantial reduction of ~4.7% during the period January–December 2010. Much of the progress has been registered in the last four months, with losses reaching an average of 26.5% over the period September–November 2010.

Figure 4-1 Monthly Distribution Losses



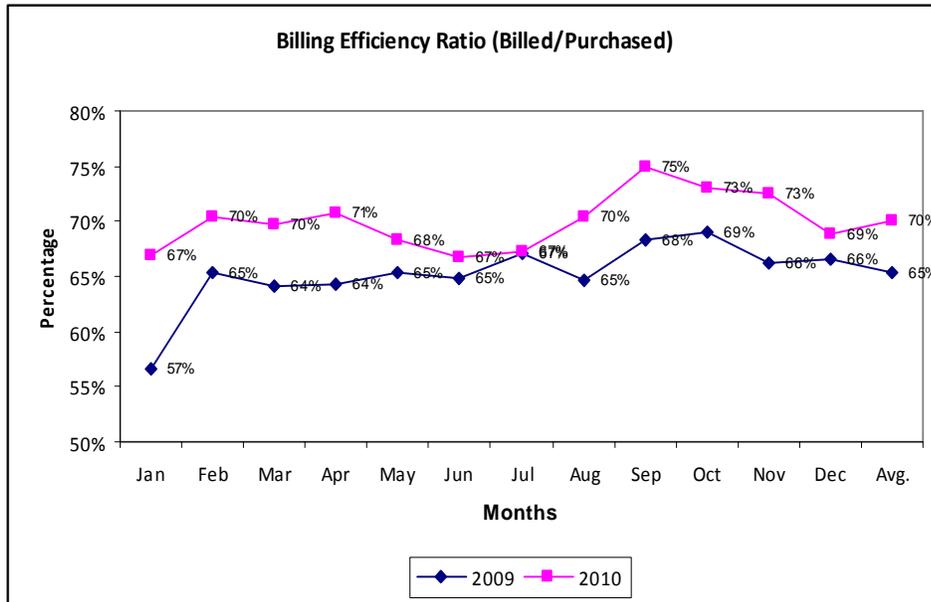
As depicted in Figure 4-1 the variation between the maximum monthly loss level vis-à-vis the minimum loss level reported by Umeme during 2010 is lower than the loss level reported in 2009.

Further, it can be noticed that the loss level computed for each month during 2010 does not show a continuous declining trend, and within the same year, there are few months wherein the loss level is higher than the previous month. This may be due to the delay in the billing cycle or the delay in meter reading at the customer premises.

Billing Efficiency Ratio: The billing efficiency ratio is an important parameter based on which Umeme’s performance can be monitored. The billing efficiency ratio is defined as the total energy billed as against the total energy purchased. The figure below shows a comparison of the monthly billing efficiency ratio during 2009 and 2010.

It can also be noticed that the range of variation between the maximum billing efficiency (75%) vis-à-vis the minimum billing efficiency (67%) reported by Umeme during 2010 is less than the range of variation reported in 2009. The maximum monthly billing efficiency was 69% and the minimum was 57% during 2009. This shows that there has been an improvement in customer-billing.

Figure 4-2 Billing Efficiency Ratio



As depicted in Figure 4-2 for few months in 2010, the billing efficiency declined as compared to the previous months of the same year. The months that have registered a lower billing efficiency also show an increase in the loss level as compared to the previous month during 2010, as already explained. Thus, it can be seen that the increase in the monthly loss level will affect the other operational performance areas as well.

4.3 Processes followed by Umeme at the District Offices

The observations made during the audit at the district offices and the results of the audit have also been considered to identify the improvement made by the introduction of the new billing system. To identify the impact, this parameter is divided into two parts:

Part 1: Results of Audit

Part 2: Observations Made at the District Offices & Interaction with Customers/Staff

4.3.1 Part 1: Results of Audit

Number of Customers Billed based on Estimated Consumption: Though the new billing system has been implemented, a significant number of customers still continued to be billed by Umeme on the basis of estimated consumption, and not on actual monthly consumption. This may be because of various reasons like locked customer premises etc., but this is not a best practice and also impacts the loss level of the utility. From Table 3-3 it can be noted that the actual billing percentage of the selected itineraries varies from 69% to 92%. Out of the six route sheets (itineraries) analyzed, there are only two route sheets where the meter reader has taken actual meter reading of more than 90%.

It is important to understand that Umeme in its previous loss reduction strategies (2006 to 2009) had committed that at least 90% monthly actual reading level will be achieved, but to date, Umeme is struggling to achieve this target.

Preparation of Meter Reading Schedules for all Districts: The other area of concern is that the new system defines a particular date for printing the route sheet as well as reading of meters for each feeder. However, a delay to the tune of 3 to 4 days in providing the route sheet to the meter readers from the date of meter reading has been observed in the district offices. This is because of non-completion of the route sheets already provided to the meter reader for other feeders.

Though the dates for customer meter readings are specified for each month in the new system to achieve a higher billing efficiency, the delay in taking meter readings hinders achievement of the desired results.

4.3.2 Part 2: Observations Made at the District Offices & Interaction with Customers/Staff

Delay in Bill Delivery: The customer bills are printed centrally in the new system. The printed bills are then delivered to the respective districts on either the same day or the next day. The district office then hands over the printed bills to an external agency for dispatching it to the customers. Customers are supposed to make payment within 14 days of the bill production. The accepted modes of payment include payment by cash, cheque, or electronic funds transfer.

It has been observed that a significant number of customers in both the district offices generally receive their bills after the due date. Umeme's staff also confirmed that the Central Billing office sometimes does not dispatch the full lot of customer bills connected with the same feeder. Therefore, the external agency has to wait for the complete lot to arrive, resulting in a delay in the distribution of customer bills.

During the interaction with the customers, it was found that there were some cases wherein the electric supply of customers was disconnected without providing them the bills.

Disconnection of Electricity: There were long queues of customers complaining about disconnection of electricity at their premises because of non-payment of electricity bill. It was observed that Umeme disconnects the electric supply based on the past history of the customer. There were some cases wherein the electricity supply of customers was disconnected without providing them the bills.

Long Queues: It was observed that Umeme district offices have long queues for bill payment.

There are very long queues when it comes to paying electricity bills, which in turn discourages the customers and makes them resort to power theft.

An analysis of the current situation and the results of audit indicate that Umeme can move to the next level only if the aforesaid areas are addressed properly.

4.4 Recommendations to improve Revenue Collection Efficiency

In Section 10.2 we make recommendations for Umeme to consider in order to improve their billing, meter reading and revenue collection processes.

5 THE EXTENT OF STATISTICAL METERING AND AUDIT OF SUBSTATIONS IN ORDER TO VERIFY THE CONDITION AND ACCURACY OF THE METERING

5.1 General

In order to establish the extent of statistical metering and audit a percentage of substations to verify the condition and accuracy of the metering and adequacy of statistical metering, a number of substations were chosen to be visited. As Umeme has decentralized their operations into six regions substations were sampled from each region. The following substations were visited

5-1 Substations Visited by Region

No.	Region	Substation
1	Kampala	Lugogo 132/33/11kV
2	Kampala	Kampala North 132/33/11kV
3	Kampala	Mutundwe 132/33/11kV
4	Kampala	Gaba 33/11kV
5	Kampala	Kireka 33/11kV
6	Kampala	Kisugu 33/11kV
7	Kampala	Port bell 33/11kV
8	Eastern Region	Njeru 33/11kV
9	Eastern Region	Nile Breweries 33/11kV
10	Eastern Region	Jinja Industrial 33/11kV
11	Eastern Region	Nalubaale 132/33/11kV
12	Western Region	Masaka Central 33/11kV
13	Western Region	Masaka West 33/11kV
14	Western Region	Mbarara North 132/33/11kV
15	Western Region	Mbarara Central 33/11kV
16	Northern Region	Lira Main 132/33/11kV
17	Northern Region	Lira Spinning Mill 33/11kV

The following activities were carried out at each substation: -

- The configuration of the network at the particular substation was confirmed, and
- The statistical meters were checked for substation name, feeder, meter number, CT ratio, primary voltage, installed hardware i.e. modem or not, connection mode and in some cases the exposure of the meter and meter wiring to vandalism(sealing) to confirm whether they are in accordance with the information provided to the consultant by Umeme.

Checking of the Umeme statistical meters involved: -

- Validating whether the meters in the visited substations are in place;
- Whether the correction mode of these meters is valid or active;
- Inspection of the physical condition of the meters, i.e. whether they are in good condition, damaged, or not working;
- Verifying whether the sum of the energy received is equal to the energy sent out plus losses due to meter error;
- Confirming that the meters are time synchronized, where appropriate
- Recording (interrogating) the meter data to be used in verifying meter reading and meter errors within Umeme network (Grid metering), and
- The adequacy of the meter to measure the feeder energy delivered.

We also confirmed that station auxiliaries at UETCL and Umeme substations were metered.

5.2 Key Observations from Meter Inspections

Single line diagrams – it was noted that single line diagrams at substations did not always conform to the network configuration.

Feeder names – it was noted that not all feeders were named on the feeder panel.

Current Transformer (CT) ratios – it was noted that some CT ratios were inappropriate for the loading of the feeder.

Meter numbers– it was noted that some meter numbers were interchanged ie the meter number did not correspond to the feeder on which it was connected.

Modems – it was noted that some modems were inoperative.

As a result of the comments above we conclude that in the present state the statistical metering at substations is inadequate for use in obtaining reliable energy balance at feeder and substation level.

Time synchronizing – it was noted that a number of meters were not time synchronized. This means that it would not be possible to calculate the real value of losses taking into account the time of use tariffs.

Meter local display – it was noted that some meters did not display locally although the meters could be read remotely

Meter Batteries – it was noted that some meter batteries were inoperative.

Meter sealing – it was noted that some meters were not sealed.

Meter Accuracy – it was noted that the majority of meters installed were Elster accuracy class 1 or 2. In some cases these meters were connected to class 5 accuracy VT's and CT's which does not correlate with the meter accuracy.

5-2 Summary of Findings from Substations Visited

Total number of feeders inspected	133
Feeders with no meters	14
Total number meters inspected	119
Number of meters with deviations	30
% of meters with deviations	25.2
% feeders with no meters	10.5
Meters with programming errors	15
Meters with display problems	5
Meters with time setting problems	9
Meters with interchanged meter numbers	1
Meters with defective batteries	3

5.3 Other Site Visit Observations

Other observations affecting the technical losses of the Umeme network include the following: -

High loss transformers - it was noted that some recently purchased transformers were not particularly low loss transformers. It is normal practice to capitalize transformer losses when adjudicating transformer tenders as it can be shown that in general low loss transformers have the least lifetime cost. High loss transformers were noted at Masaka Central, Nile Breweries and Njeru substations.

Unmatched Transformers – it was noted that at Gaba, Njeru, Port Bell, Masaka Central and Mbarara Central substations of the two transformers in parallel one was on soak and energized and not connected on the low voltage side of the transformer. This is an inefficient mode of operation and increases the technical losses of the substation. We accept that if this is being done due to the incompatibility of the transformer impedances then from an operational perspective it is advantageous to keep the “standby” transformer energized. However, if the transformer impedances are compatible then for minimum losses the transformers should be paralleled.

Oversized transformers - it was noted that the smallest rural transformers installed are 50 kVA. These over capacity transformers are often installed in areas of low power consumption where a small capacity transformer could have served. This introduces unnecessary transformer losses as transformer losses are proportional to the transformer rating.

Un-metered auxiliary supplies - it was noted at Port Bell 33/11kV, Kireka 33/11kV, Masaka West, Masaka Central and Mbarara North substations auxiliary supplies were not metered. This consumption is therefore being reflected in the technical losses figure. Metering of auxiliary supplies allows these “operational” costs to be apportioned

appropriately, including billing UETCL where they are “consumer” of Umeme at their substations.

6 SEPARATION OF TECHNICAL AND NON-TECHNICAL LOSSES

6.1 Measurement of Total Losses

Umeme currently submit monthly performance reports to the ERA which contain billed by UETCL and billed by Umeme quantities in both Uganda shillings and kWhrs.

The spreadsheet provides the ERA with the monthly performance statistics including the following:-

- Distribution Losses (%)
- Distribution Losses% (3 months Average)
- Revenue Collected (Million Ug.Shs)- inc VAT
 - Energy
 - Pre-transfer net receivables
 - GOU Debtors Offset from UEDCL Lease payment
- % of Energy Collected on Billed (Simple)
- % of Energy Collected on Billed (6 months Lagged)
- Average collection rate YTD (%)

The following statistics are also provided: -

- Live Customers
- Active/billed Customers
- Number of Employees as per payroll (i.e. paid)
- Customers/Employee
- Average Selling Price per kWh (Excl Vat)
- Average Purchase Cost per kWh (Excl Vat)
- Gross Profit Margin (%)
- Billing Efficiency Ratio (Billed/Purchased)
- Performance Efficiency Ratio (% Collected x Billing Eff. Ratio)
- Cash Collection/Energy Bulk Purchase (Shs/per kWh)

These monthly produced spreadsheets provide Umeme's performance with respect to their Total Losses and Collection Rates.

In Section 3 we examine the derivation of the data used in these spreadsheets.

In the following section we describe the manner in which the level of Technical Losses on the Umeme 33kV, 11kV and low voltage system was established.

6.2 Origin and Magnitude of Technical losses

Technical losses occur naturally and consist mainly of power dissipation in electricity system components such as transmission and distribution lines, transformers, and measurement systems.

Optimization of technical losses in electricity transmission and distribution grids is an engineering issue, involving classic tools of power systems planning and modelling. The driving criterion is minimization of the net present value (sum of costs over the economic life of the system discounted at a representative rate of return for the business) of the total investment cost of the transmission and distribution system plus the total cost of technical losses. Technical losses are valued at generation costs.

The level of technical loss depends on many variables including voltage levels and network design but as can be seen from the figure below ranges generally between 3% and 8%.

Figure 6-1 United States Distributors - Reported Technical Losses

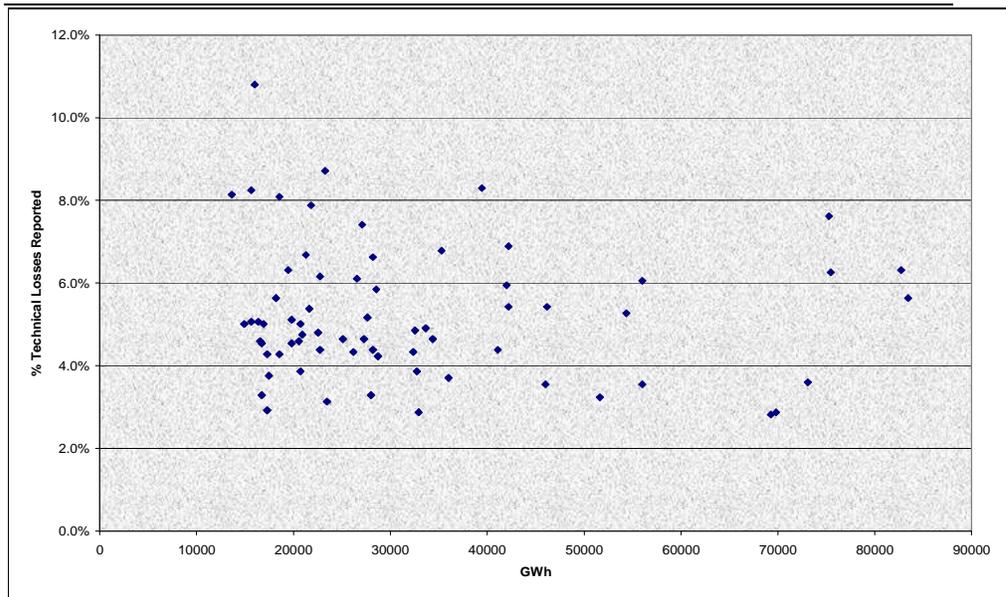


Table 6-1 Error! Reference source not found. below shows the location of the technical losses for a typical network: -

Table 6-1 Energy Australia’s Location of Losses

Location of Losses	Loss %	Loss Contribution %
Transmission	0.37%	6.9%
132kV Network	0.12%	2.2%
Sub-transmission Substations	0.25%	4.7%
Sub-transmission Network	0.56%	10.4%
Zone Substations	0.39%	7.3%
High Voltage Network	0.47%	8.8%
Distribution Substations	1.19%	22.2%
Low Voltage Network	1.53%	28.5%

Location of Losses	Loss %	Loss Contribution %
Meters & Load Control	0.29%	5.4%
Non-Technical	0.19%	3.5%
TOTAL	5.32%	100%

Clearly the most significant contribution to total losses arises from the distribution substations and low voltage networks (figures in bold in the table).

Comparing “entering” energy, measured up to the hour, against ‘exit’ energy, smeared across a billing cycle is also prone to error and this makes it difficult to determine loss levels accurately.

For this reason, Energy Australia applied a methodology whereby the distribution losses were calculated on the basis of a 5 year rolling average. This method was modified to be carried out on a 3 year rolling average, and on this basis it was accepted by the New South Wales Regulator.

Umeme, in their performance reports, produce a 3 month rolling average in order to account for the difficulty on aligning purchases from UETCL and Umeme billing cycles.

6.3 Measures to Reduce Technical Losses

The following technical measures are generally employed to optimize technical losses:-

- ♦ Low loss transformers (i.e. low fixed or magnetizing loss) – particularly in the case of distribution transformers where transformers with different loss ranges are offered by manufacturers;
- ♦ Re-conductor overhead lines with larger cross-sectional area conductors; use of lower resistance conductors such as all aluminium alloy conductor (AAAC);
- ♦ Installation of cables having larger conductor sizes;
- ♦ Use of cables and capacitors with lower dielectric losses;
- ♦ The use of a higher sub-transmission system voltage further into the network, alternatively (and where possible) up-rating of 11kV networks to 33kV;
- ♦ The establishment of new 132kV substations to augment the supply;
- ♦ Reactive power compensation (in practice the installation of (generally switched) shunt capacitor banks, either at substations or on the network (pole top capacitors);
- ♦ Tariffs with maximum demand and/or power factor clauses for medium and large customers thereby encouraging correction of power factor at source;
- ♦ Reconfiguration (normally open points) of 11kV feeders to reduce system losses, commensurate with other operational requirements;
- ♦ Balancing of load between phases on feeders; and

- ♦ Load shifting – reduction of maximum demand through the use of off-peak tariffs.

Procedures for capitalisation of losses, as used for transformer design purposes for example, are well established and appear in many textbooks and reference papers. Losses should generally be valued at the long run marginal cost (LRMC) of power and energy at the point in question on the network.

Not all of these approaches are applicable to all utilities. Scottish Power holds the following view:-

Figure 6-2 Scottish Power - Network Technical Losses Toolkit

Tool	Relative Cost	Relative Opportunity
Transformers – new and replacement	Small Incremental	High
Network Voltage Uprating	High	Medium
Network Optimization – Planning Timescales	Small Incremental	Low
Network Optimization – Operational Timescales	Medium	Medium
Transformer Switching	Medium but significant risk	Low
Cable Oversizing	Very High	Very Low

Umeme have largely followed the above solutions in their loss reduction strategy and this is examined in more detail in Section 7.

6.4 Quantifying Umeme’s Level of Technical Losses

The *Cost of Service Study, Phase 2 (January 2009)* by PPA Energy describes the methodology for the calculation of the retail tariff schedules including technical and commercial loss factors, time of use factors, maximum demand charges, standing charges and HV and LV cost allocation factors. The study also includes a review of the impact of changes in the loss and time of use factors on the Power Supply Price (PSP) reconciliation.

The Study developed a methodology to determine the technical losses on the Umeme system and divided technical losses into three major components -33kV system losses, 11kV system losses and low voltage (LV) system losses.

The methodology adopted for the Umeme system was to determine initially the natural peak losses for the various components. A load flow study was carried out using an integrated model of the 132kv and 33kV systems and a comprehensive analysis was made to determine the proportions of the Umeme system demand supplied from the 33kV, 11kV and LV systems. For the estimation of 11kV and LV system losses individual load flow studies were made by Umeme for a total of 68, 11kV feeders and 74, LV feeders.

The Umeme load flow model of the 11kV and 33kV systems in Uganda was developed using PowMaster and ReticMaster power system analysis software.

The 132kV and 33kV system load flow analysis and the 11kV and LV feeder load flow analysis resulted in estimates of peak power losses and loss load factors were calculated based on typical daily load curves.

This resulted in the following energy based technical loss factors: -

- HV system – 8.1%, and
- LV system – 7%.

Total Technical Losses therefore are around 15.1% as at 2009.

These loss factors are expressed as a percentage of energy purchased from UETCL.

As noted in Section 5 some of the “technical losses” are administrative losses arising out of the energy consumed by Umeme at some substations where there is no metering on the auxiliary supplies. Rough estimates of these administrative losses indicate that they could account for up to 1% of the current technical losses

The loss factors resulting from the study above provide Umeme with their best estimate of the technical losses on their network at this time. The extensive field work undertaken is a result of the Network Verification Project which was undertaken over 5 years and completed in 2008 provided Umeme with sufficient data on their networks to enable the above analysis to be undertaken.

It should be noted, however, that even with the data obtained from the Network Verification Project Umeme acknowledge that they still do not have 100% accurate information on their network. The quality of network data is improving constantly due to the work being done at district level.

To some extent this fact is borne out by the ERA letter to Umeme dated 2 February 2011 titled “Outcome of Inspection July, 2009 – June 2010” wherein ERA noted the following: -

- The distribution network is dilapidated and a safety risk;
- Quality of supply is an issue, and
- There appears to be no Environmental Plan.

Umeme were instructed, amongst other things, to provide a status update on the actions taken to rectify the state of the network and to improve the Quality of Supply.

6.5 Non Technical Losses (Commercial Losses)

Non technical, or commercial losses, vary from utility to utility and from country to country. Table 6-2 provides examples of non technical losses across 13 countries ranked according to Purchasing Price Parity (PPP per capita): -

6-2 Relationship of Distribution Losses to Economic Prosperity

Country	Estimated NTL's in 2007	PPP per capita 2007
India	20% to 40%	2,700
Philippines	3.5%	3,300
Indonesia	5.5%	3,400
Jordan	3% to 5%	4,700

Country	Estimated NTL's in 2007	PPP per capita 2007
Jamaica	13.2%	4,800
China	10%	5,300
Thailand	0.32%	8,000
Brazil	0.5% to 25%	9,370
Turkey	6% to 64%	9,400
South Africa	~ 10%	10,600
Venezuela	12.74%	12,800
Russia	10%+	14,600
UK, Aus, US	0.2% to 1%	> 30,000

The above shows clearly that the “wealth” or otherwise of a country does not always dictate the levels of non technical losses. The Table is included to provide an indication of the levels achieved in some countries and, to some extent identify the goals for Umeme to achieve.

In Section 6.4 above the levels of technical losses are established at 15.1%. The Umeme performance statistics for 2010 give the total losses at 30% which means that the levels of non technical (or commercial) losses are around 14.9%.

6.6 Comments on the Separation of Technical and Non Technical (Commercial) Losses

Umeme, unfortunately, have not been able to determine the level of non technical (commercial) losses other than by the above method, nor has it been possible to break down the non technical losses any further to determine the principal causes.

Schedule A4 of Annexure A of the Tariff Methodology suggests a percentage for the High Voltage Technical Loss Factor starting at 7% in Year one and reducing to 6.5% in Year 7.

The Power Sector Investment Plan (PSIP) described in Section 7.8 assumes that non technical losses will reduce to 2% by 2020 and that technical losses will reduce to 14.4% by 2020. Thereafter losses are assumed to remain at these levels to 2030.

The focus at District level as described in Section 7.3 is providing Umeme with a better insight into the causes of losses and a better idea of “poor performing feeders”

In addition, the capital expenditure on network refurbishment over the past several years has been focussed specifically at reducing technical losses. At the same time refurbishment of the distribution network makes the direct theft of energy more difficult and therefore indirectly commercial losses have also been reduced by refurbishment.

The capital expenditure will have reduced the levels of technical losses but although Umeme estimate the impact of the expenditure on the losses when justifying the expenditure the actual impact is never quantified.

We believe that Umeme should implement a comprehensive system study to repeat the exercise undertaken in 2008/9 by the *Cost of Service Study, Phase 2*.

The new study will be based on much more accurate network data and should be undertaken by feeder by substation for the entire network. In the *Cost of Service Study*, for the estimation of 11kV and LV system losses, individual load flow studies were made by Umeme for a representative 68, 11kV feeders and 74, LV feeders.

This will result in two important achievements: -

- The current level of technical losses will be established with a much better degree of accuracy, and
- Knowing feeder and substation technical loss levels will allow Umeme to develop an energy audit process that will closely monitor the levels of non technical (commercial) losses by feeder, by substation.

As a result the District loss reduction efforts will be much more effective and will be able to identify and focus on specific issues causing losses.

This suggestion is also addressed in Section 7.7.

The study suggested above will also provide Umeme with a much more accurate estimate of the total expenditure required in order to achieve levels of technical losses in line with best practice.

7 THE EFFECTIVENESS OF THE LOSS REDUCTION MEASURES BEING IMPLEMENTED, INCLUDING THE ORGANISATIONAL STRUCTURE AND CAPITAL EXPENDITURE RELATED TO LOSS REDUCTION.

7.1 General

Starting levels of distribution losses allowable to Umeme for the first year of operation were set at 33% and these were expected to be reducing by 0.83% per annum to reach 28% in the seventh year

For the period 2005 to 2009 the losses as measured by Umeme were as follows: -

7-1 Umeme losses 2005 to 2009

Year	2005	2006	2007	2008	2009
Distribution Losses	31%	34%	35%	34%	35%

Clearly Umeme were not achieving the loss reduction targets required but over this period many initiatives were started including the following: -

- High loss circuits - focus and Capex
- Large user inspections & meter audits leading to Network & Customer Verification Project (2005/9)
- New Billing & Customer Data System (2009)
- Measurement – Statistical Metering (2008/9)
- Remote Reading Meters – top 200 customers (2011)
- AMR (2011)
- GIS & Billing & Customer Data Linked (2011)
- SCADA & CMS (2009 – 2011)

The fact that these initiatives plus the focussed restructuring of the organisation are showing results can be seen in the losses achieved in 2010 which show a marked improvement: -

7-2 Umeme 2010 Total Losses

Monthly 2010	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	2011
Distribution Losses	33%	30%	30%	29%	32%	33%	33%	30%	25%	27%	27%	31%	Ave
3 Month Average	33%	32%	31%	30%	30%	31%	33%	32%	29%	27%	26%	28%	30%

In December 2010 the ERA set the following collection and loss targets for Umeme: -

- A target distribution loss factor of 27.2% (27% input value), and
- A target uncollected debt factor of 4.4% (3.8% input value) for 2011.

The purchase and implementation of the new billing and customer data system has similarly had a positive effect on the collection rate as shown in 7-3 below: -

7-3 Umeme 2010 Collection Rates

	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
Ave collection rate	87%	87%	88%	88%	89%	90%	91%	92%	93%	93%	94%	94%

7.2 Umeme 2011 Loss Reduction Strategy

It was reported that the Umeme Loss Reduction Strategy for 2011 would be presented to the Umeme Board in late November and should be available for release to ERA in early December. The Umeme Board have not approved the 2011 Loss Reduction Strategy and we have been instructed to use the 2010 strategy in this review.

The strategy 2010 Strategy included the following: -

- Bill millers. Umeme estimate that they have around 3000 millers and based on experience in Kisenyi, this sector consumes about 15% of energy in Uganda and the majority of this energy is being stolen;
- Target shopping malls and markets with high loss levels. Compulsory bulk metering for office blocks, shopping malls, markets;
- New connection process time. Reduce opportunities for illegal activity by fast turn-around time [7 days];
- Customer power factor improvement. The new tariff providing for penalties for poor power factor for high energy users above 500kVA capacity;
- Installation audits to check metering integrity;
- Improve loss measurement at feeder and District level
- Improve meter management;
- Improve revenue cycle management: meter reading, billing, bill delivery, and
- Street lights – introduce flat/wattage billing.

In December 2009 Umeme submitted an application to the ERA for the introduction of a flat rate tariff which was included in their 2010 loss reduction strategy. Umeme cited the following advantages with regards to loss reduction with the flat rate tariff: -

- The tariff was simple and easy to understand;
- Better value for honest customers;
- Eliminate the incentive to tamper with meters, and

- Reduce losses and therefore tariffs.

On 11 November 2010 the ERA advised Umeme that they had rejected the tariff as in their opinion Umeme had not satisfactorily addressed the impact on low income households, the impact on introduction of prepayment metering, consumption thresholds, the mechanics of the tariff, lessons from other countries and ability of the tariff to send efficient pricing signals.

UMEME is currently reviewing its plans for loss reduction for the medium term, with the aim of making a step change in its performance over the next 7 years. As part of this exercise Umeme have engaged a firm to work with the Company's staff to compile/organize/enhance UMEME's existing plans, which are in various stages of completeness, into a comprehensive 7-year business plan, detailing timing of key activities and associated operational and capital costs.

The scope of consulting activities includes the following: -

- Review of UMEME's existing plans in a comprehensive 7-year business plan;
- Advising UMEME on additional needs/processes to achieve the company's goals;
- Providing international standards/metrics information regarding CAPEX & OPEX for companies with similar characteristics providing service to similar markets;
- Reviewing the loss reduction plan and providing recommendations as required, and
- Providing strategies/best practice insights for collection improvement.

The Consultant will review the loss reduction plans in order to identify possible additional actions/ enhancements, and investments that would be necessary to achieve UMEME's goals.

Each of the loss scenarios, detailing key activities, costs associated and expected loss reduction profile on a project by project basis will be assessed.

The consultant will analyze the existing and proposed plans regarding meter management, data improvement and implementation of a GIS, fault reporting managing and energy non technical losses (fraud, energy theft, and vandalism).

7.3 Restructuring and Loss Reduction Focus at District Level

At the commencement of the Umeme concession on 1 March 2005 a centralized business architecture and structure was introduced based on the Eskom business model.

In September 2009 the Umeme Board approved the formation of the Customer Service and Energy Loss Reduction Committee as committee of the Board. Umeme also appointed a Transformation Manager to oversee the restructuring and transformation process as part of the redefining of their business processes.

Key to the loss reduction initiative was the restructuring exercise initiated in June 2009 that saw the appointment of Area Managers as well as District Managers, with clear KPI's.

The key feature of the new structure is that of a devolved organization with distinct areas (6) and smaller districts (25).

During July and August senior managers met with staff and reviewed the Companies strategy and a special initiative for July to December was launched based on safety and loss reduction targets which gave staff the opportunity to earn an additional 30% of their salary for the period.

Umeme also introduced a “Feeder Loss Reduction Initiative” whereby each member of the Senior Management Team (SMT - comprising: the Managing Director and all his direct reports) was assigned a feeder. Each SMT member liaises closely with the respective Area Manager and District Manager. The activities under the Feeder Loss Initiative involve periodic inspection visits by the SMT member walking the feeder accompanied by the relevant District Manager. The SMT member gets involved in the development of specific loss reduction action plans for the feeder and monitors implementation of the action plans with District Manager and Area Manager of the area involved.

In addition, SMT members participate in monitoring the implementation of the Umeme loss Reduction action Plans at a corporate level. Meetings are held, monthly, involving all SMT members and Area Managers, to review progress against the major Key Performance Indicators (KPI's) focusing on progress on the implementation of Distribution Loss reduction action plans.

Area Managers make power point presentations to the meeting, covering every component of the Loss Reduction Implementation Plans, and interactive discussions are held on achievements of each area.

Each member of the SMT is also assigned a maximum demand customer to visit, along with Area Manager, each month. Training on maximum demand customer inspections has been provided to SMT members and technical back up is provided during the visits to ensure that key parameters are covered. The visits are complimented by analytical reviews of the respective maximum demand accounts to identity any anomalies in consumption patterns. Follow up actions are progressed with the respective District and Area Managers.

Senior management responsibilities with respect to loss reduction are also enshrined in their job descriptions and below is an example of the involvement of the General Manager – Corporate & Regulatory Affairs in Loss Reduction activities as defined in the job description for the position: -

- In conjunction with the Regional Manager and Network Planning Manager, participate in the development of the Company's Loss Reduction Strategies and Implementation Plans.
- In conjunction with the Umeme Senior Management Team, coordinate and take lead in the presentations to ERA on the Umeme Loss Reduction Strategies
- As part of the Stakeholder management activities, take lead in involving relevant key stakeholders in reviewing Umeme's progress in the implementation of the Loss Reduction Strategies: The key stakeholders include : The World Bank,

Ministry of Energy and Mineral Development, Ministry of Finance. The review meetings are also linked to the World Bank Supervisory Missions held quarterly.

- In conjunction with Managing Director, take lead in interactions with Members of Parliament, especially members of the Parliamentary Natural Resources Committee, in discussions on the Umeme Loss Reduction Implementation Plans.
- Coordinate interactions with the Rural election Agency (REA) on the Rural programmes and on the impact of rural schemes on distribution losses. Also coordinate interactions with UEDCL and UETCL on issues that impact on Loss Reduction Strategies.
- Participate in the implementation of the Loss Reduction Action Plans: Specifically participate in the Feeder Loss Reduction Initiative and in conjunction with the District Manager and the Area Manager
- Coordinate and liaise with the relevant Government of Uganda security agencies in providing support to Umeme in its loss reduction initiatives, including apprehension of power theft culprits
- Billing and Collections – In conjunction with the Retail Section, Billing Section and ICT Department monitor and oversee monthly billing and monthly cash collections

A principal accountability of the District Manager is to enforce the achievement and implementation of the Company's Energy Loss strategies and targets is also prescribed in the job description for that position as follows by: -

- Ensuring maximum sales revenue collections
- Ensuring the proper installation of appropriate Meters taking into account the customer consumption category.
- Ensuring that the Meters installed are promptly and accurately set up in the Company's Customer Care and Billing System
- Ensuring that all Meters are promptly and accurately read as scheduled
- Expediting resolution of customer billing exceptions
- Enforcing the Company's Credit Control Procedures
- Ensuring staff adherence to Company and/or manufacturers' established standards regarding the installation, maintenance, operation and retirement of the distribution network

One of the key requirements to enable the District Manager to carry out their responsibilities is the ability to measure the amount of energy imported into each Area and District and this was achieved by installation of boundary metering. This project was completed and every district now has clear purchases, sales and loss level on a month by month basis.

In order to provide focus to the loss reduction activities, a feeder loss reduction model was developed with the following guidelines: -

Losses = Dispatches – Sales, and the unit of measure is kWh or GWh

At District Level; total dispatches & total sales are used to compute district losses. A district is composed of one or more feeders.

Each feeder has a meter at the substation from which the total amount of power dispatched on the feeder is measured. Where feeders cover more than one district boundary meters are used to apportion the feeder dispatches appropriately. The following steps are used in computing Feeder Losses: -

- Align itineraries for domestic & ordinary commercial accounts to Technical Feeders
- Align Industrial & ToU customers to Technical Feeders: Account by Account. (*This due to the fact that all Industrial & ToU customers are grouped in 1 Itinerary yet the accounts are spread across different feeders*)
- After Alignment, obtain consumption/Sales/Billing per Technical Feeder month by month
- Obtain the dispatch report and extract Dispatches by Feeder in your district – month by month
- Compute feeder losses by deducting sales from dispatches: Compute both units lost & percentage losses.
- Analyze the results
- Strategize on how to get quick gains and areas of focus.

Also focussed at District level is the meter reading and billing functions and these are described in Section 3.

At the Workshop held to present the findings of the Study Umeme were asked to provide a breakdown of losses by customer category, area and by cause of loss.

Umeme have provided a breakdown of losses by feeder for each Region and District as follows: -

Region	District	Feeder Name	LOSS [GWH]
Kampala South	Najja	Kigo/Entebbe 1/Kla South	1.89
Kampala East	Kitintale	Lugogo - Bugolobi	1.86
Kampala Central	Metro	Pioneer Mall	1.82
Kampala Central	Wandegeya	Kampala North Kololo	1.52
Kampala Central	Natete	Buddo	1.29
Kampala Central	Nakulabye	Kampala North	1.09
Kampala Central	Natete	Natete	1.09
Kampala East	Mukono	Mukono Town	1.06
Kampala Central	Metro	Dewinton/Kitante	1.00
Kampala South	Najja	Qnsway - Lukuli	0.97
Kampala Central	Wandegeya	Kawanda Interconnector	0.97
Kampala Central	Wandegeya	Gayaza Rd	0.96
Kampala South	Kabalagala	Kansanga	0.90
Kampala Central	Natete	Kabowa	0.90

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Region	District	Feeder Name	LOSS [GWH]
Kampala Central	Wandegeya	Kawanda Kawempe	0.85
Kampala Central	Metro	South Street	0.84
Kampala Central	Metro	Downtown & Wilson	0.84
Kampala South	Kabalagala	Kibuli	0.83
Kampala South	Kabalagala	Nsambya	0.80
Western	Masaka	Mitala Maria	0.79
Kampala East	Banda	Kiwatule	0.79
Kampala Central	Nakulabye	Queensway	0.75
Kampala Central	Natete	Mityana	0.72
Kampala South	Najja	Salaama Road	0.69
Kampala East	Kitintale	Lugogo - Kampala Ind	0.68
Kampala East	Banda	Portbell Kireka	0.68
Kampala Central	Nakulabye	Kawanda	0.67
Kampala South	Entebbe	Township	0.67
Kampala South	Najja	Gabba - Lukuli	0.64
Kampala South	Najja	Najja	0.63
Western	Masaka	Mbarara Central	0.63
Kampala East	Mukono	Seeta	0.61
Kampala Central	Natete	Kabusu	0.61
Kampala Central	Natete	Masaka	0.55
Kampala Central	Nakulabye	Kampala North	0.54
Kampala Central	Wandegeya	Kawempe	0.54
Kampala Central	Metro	Lugogo Kololo	0.53
Kampala South	Entebbe	Kisubi	0.53
Kampala East	Banda	Bukoto	0.52
Northern	Bombo	Namulonge	0.52
Kampala East	Kitintale	Lugogo Kololo	0.47
Kampala Central	Natete	Bunamwaya	0.46
Kampala Central	Metro	Wandegeya Mkt	0.46
Kampala East	Kitintale	Lugogo - Cmb	0.45
Kampala Central	Nakulabye	Namungoona	0.44
Northern	Lira	Spining Mill	0.41
Kampala South	Najja	Bunamwaya	0.41
Kampala Central	Metro	Amber House/Ucb	0.40
Western	Masaka	Kalungu Feeder	0.36
Kampala East	Banda	Kireka Namugongo	0.34
Kampala East	Banda	Britania	0.33
Kampala Central	Natete	Katwe 2	0.33
Northern	Gulu	Gulu Tx1	0.33
Kampala Central	Wandegeya	Ntinda Kisaasi	0.33
Western	Kabale	Kabale 33kv Incomer	0.32
Western	Masaka	Rakai Feeder	0.32
Western	Masaka	Upper Ring	0.32

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Region	District	Feeder Name	LOSS [GWH]
Kampala Central	Nakulabye	Namungoona	0.30
Kampala Central	Wandegeya	Kawanda Namulonge	0.30
Kampala East	Banda	Naguru	0.29
Kampala Central	Nakulabye	Queensway	0.26
Kampala Central	Nakulabye	Namungoona	0.26
Kampala South	Kabalagala	Muyenga	0.26
Northern	Gulu	Gulu Hospital	0.26
Northern	Bombo	Luwero Kyampisi	0.25
Northern	Masindi	Msd/Town	0.25
Kampala South	Entebbe	Entebbe 1 & Others	0.24
Kampala Central	Wandegeya	Wandegeya Market	0.24
Western	Kasese	Kasese Central/Ishaka	0.23
Kampala Central	Natete	Nalukolongo	0.22
Kampala East	Mukono	Nakifuma	0.22
Northern	Bombo	Bombo Wabigalo 33kv	0.22
Western	Mityana	Kibibi/Kabulasoke (11kv)	0.21
Eastern	Tororo	Town Ring	0.21
Eastern	Iganga	Kaliro	0.20
Western	Mityana	Mityana Towm (11kv)	0.20
Western	Mityana	Mityana (33kv)	0.19
Kampala East	Kitintale	Port Bell - Breweries	0.19
Kampala Central	Wandegeya	Makere Univ	0.19
Western	Kabale	Kabale Town Feeder 11kv	0.19
Kampala South	Kabalagala	Kansanga	0.19
Kampala Central	Wandegeya	Nakulabye	0.18
Eastern	Tororo	Busia/Tiira	0.18
Western	Mityana	Kasanda (33kv)	0.18
Kampala Central	Nakulabye	Queensway	0.17
Kampala South	Entebbe	Botanical	0.16
Kampala East	Mukono	Namanve	0.16
Northern	Lira	Gulu-Aboke	0.15
Eastern	Iganga	Bugiri	0.15
Kampala South	Entebbe	Kisubi Mission	0.15
Western	Kisoro	Rwanda Chanika 30 Kv	0.15
Western	Mubende	Mubende Town Feeder	0.14
Western	Kasese	Fortportal	0.14
Eastern	Iganga	Incomer	0.13
Northern	Lira	Apac-Masindi	0.13
Kampala East	Kitintale	Port Bell - Butabika	0.13
Northern	Hoima	Hoima Town	0.13
Eastern	Iganga	Incomer	0.12
Eastern	Iganga	Town	0.12
Northern	Masindi	Msd/Apach/Kinyara	0.12

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Region	District	Feeder Name	LOSS [GWH]
Eastern	Tororo	Mbale1	0.11
Kampala South	Kabalagala	Gaba Ww1	0.11
Kampala East	Kitintale	Lugogo - Kitante Road 1	0.10
Kampala East	Banda	Kyambogo Ntinda	0.10
Western	Kasese	Kasese Town	0.10
Kampala South	Najja	Roofing Ltd	0.10
Western	Mubende	Nkonge	0.10
Kampala South	Entebbe	Sisa	0.09
Western	Mityana	Hoima (33kv)	0.08
Kampala Central	Nakulabye	Mutundwe	0.08
Eastern	Tororo	Town Via Quarry	0.08
Eastern	Tororo	Tororo Ring1	0.07
Western	Mubende	Kakumiro	0.06
Kampala Central	Wandegeya	Mulago Hosp 2	0.06
Eastern	Iganga	Kasolwe	0.06
Kampala South	Najja	Kabowa	0.06
Western	Mityana	Busunju (33kv)	0.05
Western	Mityana	Kiriri - Mityana (33kv)	0.05
Kampala Central	Metro	Namirembe Road	0.05
Eastern	Iganga	Namwendwa	0.05
Eastern	Tororo	Mbale2	0.04
Northern	Lira	Lira-Kitgum	0.04
Kampala Central	Natete	Katwe1	0.04
Northern	Bombo	Bombo Kawanda 33kv	0.04
Eastern	Iganga	Namasagali	0.04
Northern	Bombo	Ndejje	0.04
Kampala South	Entebbe	Airport	0.04
Northern	Lira	Kwania	0.03
Western	Kasese	Hima2	0.03
Northern	Masindi	Nyamigisa	0.03
Northern	Hoima	Munteme	0.03
Western	Masaka	Lower Ring	0.03
Kampala East	Mukono	Mpoma	0.02
Eastern	Iganga	Bulopa	0.01
Kampala East	Mukono	Banda-Mukono	0.01
Western	Mityana	Katera/Kiziba (11kv)	0.01
Kampala South	Entebbe	State House	0.01
Western	Kasese	Hima 1	0.01
Kampala South	Najja	Munyonyo	0.00
Eastern	Tororo	Petro Stn	0.00
Western	Masaka	Masaka Central	0.00
Kampala East	Kitintale	Kitante Rd - Kampala Ind.	0.00
Kampala East	Kitintale	Port Bell - Kireka	0.00

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Region	District	Feeder Name	LOSS [GWH]
Kampala South	Kabalagala	Gaba Ww3	0.00
Kampala South	Kabalagala	Gaba 1 S/By	0.00
Western	Kasese	Kasese Cobalt Co.	0.00
Western	Kasese	Kilembe Mines	0.00
Kampala South	Kabalagala	Gaba Ww 2	-0.01
Kampala East	Banda	Lugogo-Namanve	-0.01
Kampala Central	Metro	Uganda House	-0.02
Kampala East	Banda	Kyambogo Kireka	-0.02
Kampala East	Banda	Kisaasi	-0.02
Eastern	Tororo	Tci	-0.04
Northern	Gulu	Gulu Layibi	-0.06
Kampala East	Banda	Namboole	-0.06
Kampala South	Kabalagala	American Embassy	-0.07
Kampala Central	Metro	Mulago 1	-0.10
Kampala East	Banda	Kololo Kla North	-0.25
Kampala East	Banda	Jinja Rd	-0.40
Kampala East	Banda	Kololo Lugogo	-0.43
Kampala Central	Metro	Neeta Cinema	-0.55
Kampala East	Kitintale	Port Bell - Kitintale	-0.76
Kampala East	Banda	Seeta	-0.86
Western	Mityana	Namutamba (11kv)	
			48.03

Losses by District have been recorded as follows: -

DISTRICT	PURCHASES	LOSS (GWH)	LOSS (%)
HOIMA	0.7	0.14	21.0%
MASINDI	0.7	0.31	41.0%
BUSHENYI	2.0	0.37	19.0%
KABALE	1.4	0.40	28.0%
GULU	1.4	0.42	30.0%
KASESE	9.0	0.45	5.0%
LIRA	1.8	0.50	28.0%
FORT PORTAL	2.8	0.52	19.0%
TORORO	5.1	0.58	11.3%
IGANGA	4.7	0.72	15.3%
BOMBO	3.6	1.20	33.0%
KITINTALE	12.2	1.53	12.6%
MUKONO	7.5	1.55	20.6%
MITYANA	3.1	1.77	57.0%
MBARARA	5.1	1.87	37.0%
ENTEBBE	7.0	2.04	29.0%
JINJA	20.0	2.12	10.6%
MASAKA	4.3	2.36	55.0%
MBALE	5.7	2.60	45.8%

DISTRICT	PURCHASES	LOSS (GWH)	LOSS (%)
KABALAGALA	12.1	3.14	26.0%
METRO	19.2	3.94	20.5%
BANDA	18.9	4.54	24.0%
NAKULABYE	9.1	4.90	54.0%
NAJJA	11.2	5.28	47.0%
NATETE	12.3	6.03	49.0%
WANDEGEYA	13.8	6.76	49.0%

The above information allows Umeme to focus their efforts on the worst performing feeders and districts and has been achieved as a result of their District Loss Reduction initiatives.

It would appear that Umeme have no further breakdown of losses by cause as indicated in their comments in Appendix C.

7.4 Automated Meter Reading Project

Umeme plans to implement an Automated Meter Reading (AMR) project and we understand that their intention is to provide remote metering for their top 200 customers.

Automatic meter reading, or AMR, is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices (water, gas, and electric) and transferring that data to a central database for billing, troubleshooting, and analyzing. This advance mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is billing can be based on near real time consumption rather than on estimates based on previous or predicted consumption. This timely information coupled with analysis, can help Umeme and their customers better control the use and production of energy consumption.

AMR technologies include handheld, mobile and network technologies based on telephony platforms (wired and wireless), radio frequency (RF), or power line transmission.

A service provider will be appointed to manage the AMR system and provide billing data as well as customer consumption tracking and meter exception information. In addition we are informed that the AMR service provider will manage the reading and production of reports on the statistical and boundary metering at substations.

Umeme's customer mix is as shown below: -

Customer type	% of Total Billed	Number of customers
Domestic	26%	347,433
Commercial	15%	28,810
Large Scale Industry	44%	324
Medium Scale Industry	16%	1,194
Street Lighting	0.1%	195

The installation of remote reading meters and the AMR project will certainly help in revenue collection and metering of 200 of the, we believe, Large Scale Industrial customers but consideration should be given to extending this to include the balance of

these customers and also the Medium Scale Industrial customers who together account for 60% of the billed revenue.

In order to justify the advancement of the expenditure on remote metering Umeme may consider focussing District audits on the Large and Medium customers in order to assess the potential savings that the metering would achieve.

7.5 Prepaid Metering Pilot Project

Umeme presented the ERA with a Draft Consultants Report on the feasibility of introducing Prepaid Metering on 17 September 2007.

The Report concluded that prepaid metering: -

- Is not a cure-all for non technical losses;
- Requires a large up-front investment;
- Requires considerable specialised resources and organisational change, and
- Is unlikely to improve financial performance if applied to low consumption meters.

Umeme have recently embarked on a prepaid metering test site and on 1st August 2010 announced to their customers that they were proceeding with a Pilot Prepayment Energy System to 10,500 existing domestic and three-phase ordinary customers in the Kitintale Umeme District.

The success of this pilot project will influence Umeme's decision on the long term plan to have all domestic and ordinary three phase customers converted from post-paid to prepaid system.

The objectives of the pilot project in addition to the major objective of having the pilot assess how realistically this business solution can impact positively on the operational set up of Umeme's Customer Service delivery and energy loss reduction, are to: -

- Assess if Pre-payment Metering is an applicable option for the domestic energy consumers of Uganda, as it has been in other African countries, and its impact on the operational set up of UMEME.
- Determine what benefits UMEME can expect in terms of increase of revenue and net reduction of operational costs.
- Evaluate the security of the solution (meter / system) in terms of management, access and potential fraud.
- Respond with a trial to the inputs and calls of various UMEME Stakeholders, who have requested Pre-payment implementation.
- Assess from the implementation process, how this business solution can be extended to the rest of the Umeme's domestic customer base.

The original budget, which has been approved by the ERA, was \$1,7m but Umeme, on the 23rd December 2010, submitted a revised budget for approval of \$3,49m to include the network modifications necessary for the project and which were brought forward from the Capex budget.

Prepayment systems have proven to be advantageous in many countries around the world. The systems are simple to operate, meters are difficult to tamper, individual and group consumption audits are relatively simple to implement and Umeme will receive their payment in advance.

For this reason it would be advantageous for Umeme to implement prepayment metering systems in any new area developed under the REA projects.

The retrofitting of prepayment metering is, however, expensive, and it will be interesting to see the results of the Umeme pilot project.

7.6 SCADA/DSM Project

On 01 August 2008 the ERA approved the award of the SCADA/DSM contract and the first stage of the project has been completed. The expenditure required for the completion of the project which includes the installation of Remote Terminal Units at the remaining substations is to be included in Umeme's 2011 capital expenditure budget.

Justification for the expenditure included the following: -

- Increased response and reduced outage times (un-served energy – 30% saving);
- Reduced switching times for planned outages;
- Allow network optimisation and therefore reduce Technical Losses.
- Improved automatic data collection of meter data, and
- Better use of statistical metering and measurement of losses

We have not sighted any plans for Umeme to implement operational procedures to take full advantage of the SCADA/DSM project with respect to loss reduction but we agree with Umeme's justification for the expenditure.

7.7 Energy Audits

Umeme plans are advanced to create a live link between the GIS and the Billing and Customer Data systems. Both systems use X and Y co-ordinates for asset and customer identification and this will be the basis of the link between the two data sets.

We have not sighted Umeme's plans to use this integrated system to measure and monitor energy losses and their strategy to reduce losses through energy audits at substation and feeder level.

We believe that the implementation of real time energy audits will facilitate the feeder loss reduction model being implemented at District level, which, for many reasons has some inherent inaccuracies. The feeder loss reduction model currently uses the meter reading itineraries and billing data and requires manual aligning with the energy purchase periods.

This process could be automated and feeder loss levels produced routinely. The Planning section has accurate system information and technical loss levels can be calculated by feeder. This would only be required initially and when the feeder was modified.

The level of non technical loss by feeder can then be monitored and any increases can be followed up by field inspection.

7.8 Capital Expenditure

Umeme indicate that the main cause of high Technical Losses is due to transformer imbalance, small conductors, mix of conductors, long sections with small conductors and high loss steel conductor. In the initial stages of operation little was known about the network and technical losses were estimated. Umeme's initial estimates of Capex for refurbishment for loss reduction were \$65m but after completion of the Network Verification Project this increased to \$450m.

The Network Verification Project was undertaken over 5 years and started with 10 persons and ended with 120 persons employed in the Project in 2010. The Project involved a comprehensive data collection exercise although Umeme admit that they are still finding assets not recorded. Umeme have also made considerable investments in hardware and software applications to ensure that they obtain maximum benefit from the Network Verification Project data.

The availability of reliable data on the network has allowed Umeme to develop comprehensive load flow models of the 11kV and 33kV systems.

The Cost of Service Study undertaken by PPA Energy in 2008 provided the basis for the Technical Losses and Non-Technical Losses loss factors applied by Umeme.

Umeme generate their capital expenditure budgets related to loss reduction annually by selecting worst case circuits and after designing the network change undertake a before and after system study. This identifies the potential for loss reduction in GWh against a cost for the projects.

The revised capital expenditure budget for 2010 is as follows: -

Capex Expenditure YTD	Actual cumulative expenditure as at 31 Aug 2010		Technical Loss Projection for 2010 (GWh)
	\$ 12,618,483		
Capex expenditure projection Sep - Dec	Expenditure projection	Committed Roll Overs	
CAPEX CATEGORY	AMOUNT	AMOUNT	GWh
Emergency Capex	\$ 500,000		7.50
LV Loss Reduction and Safety Phase 1	\$ 172,348		5.37
LV Loss Reduction and Safety Phase 2	\$ 2,523,489	\$ 1,392,963	4.92
Loss Reduction Miller & Groups	\$ 400,000		
MV Loss Reduction and Safety Phase 1	\$ 3,179,948	\$ 3,179,948	7.10
MV Loss Reduction and Safety Phase 2	\$ -		
Loss Reduction- Safety schemes from Area Managers	\$ 954,156	\$ 954,156	
Capacitor Banks on Feeders	\$ 32,881		2.88
SUBSTATIONS	\$ 15,721		
Direct Customers	\$ 1,537,500		
Pre-payment (10,000)	\$ 539,115	\$ 2,529,626	
Automated Meter Reading (Phased)	\$ 295,835	\$ 612,335	
Asset procurement	\$ 1,361,895		
Total Expenditure Projection Dec 2010	\$ 11,512,888	\$ 8,669,028	27.762
Committed Roll Over to 2011	8,669,028		
Projected Year End Expenditure	24,131,371		
Full Commitment for 2010	32,800,399		

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The original target for 2010 was 57.7GWh but this was not achieved due to a cash flow problem resulting in 2010 reinforcement projects only being started in May 2010.

The initial budget for 2011 was as follows: -

Category	Budget Amount	Comment	Technical loss Projection for 2011 (GWh)
Emergency Capex	4,000,000		10.00
LV Loss Reduction 2011 (ABC projects replaced by Nyendo)	1,587,832	Total roll over from 2010	2.14
LV Loss Reduction Phase 2 Roll Over ABC	1,468,670	Committed and contract active	5.905
Commercial Loss Reduction	1,000,000		
MV Loss Reduction Phase 1 Roll Over	3,179,948	Committed and contract active	8.55
MV Loss Reduction Phase 2 Roll Over	3,500,000	Planned, scoped and costed - Safety Risks	
MV Loss Reduction 2011	1,000,000		
Interconnectors	1,922,660		
Substations	13,301,503		8.93
Sub Total Network Related Capex	30,960,613		
Direct Connections	4,250,000	50 000 connections	
Pre-paid Metering Pilot Project	2,529,626	Roll over from existing budget	
AMR project	424,165	Roll over from existing budget	
Meter Reading HHS	650,000		
Area Safety	954,156		
Asset Procurement	5,000,000	Still to be finalized	
GRAND TOTAL	44,768,560		35.53

For various reasons this budget has had to be reduced and although the official revised budget has not been received by the ERA Umeme have indicated that the budget will be in the order of \$32m with projected loss reduction of 22.87 GWh.

It is impossible to estimate the level of expenditure required to reduce technical losses without undertaking specific studies as Umeme do at present.

In order to address the challenges that are faced by the power sector the Ministry of Energy and Mineral Development of Uganda (MEMD) embarked on a process to develop a Power Sector Investment Plan (PSIP). PB Power was appointed to undertake the study and the PSIP is aimed at:

- Enabling the provision of adequate and reliable power while anticipating the demand based on the country's vision for economic development;
- Developing a plan that would enable a shift from a project by project and donor by donor approach, to a sector-wide framework encompassing programmatic funding in a coordinated, comprehensive and harmonized manner; and
- Translating the strategic sector plans into a series of carefully-costed and actionable projects or activities over a period of up to twenty (20) years.

The development of the PSIP involves a series of inter-related studies comprising forecasting of the demand for electricity, development of the least cost generation, transmission and distribution plans that would be required to reliably serve the demand and the costing, timing and financing plan for these generation, transmission and distribution projects.

The National Development Plan (NDP) is a comprehensive plan compiled with the objective of providing a framework plan for accelerated economic growth to support socioeconomic transformation for prosperity.

The NDP interventions is targeted at creating employment, raising average income per capita, improving labour force distribution, raising the country's human development and improving country's competitiveness to that of middle income countries.

In April 2010 the National Development Plan was published. PB produced an addendum to the PSIP report which aligns the PSIP with the NDP.

In the addendum a PSIP scenario that is aligned with the development targets of the NDP is presented. This alignment provides a comprehensive appreciation of the magnitude of investment required in the power sector to support NDP targets.

The NDP is based on ambitious targets of economic growth accompanied by very high growth in electricity consumption. The NDP projects an increase in the electricity consumption from 75kW per capita in 2010 to 3668kWh per capita by 2040 – an average growth rate of around 13.8% per annum. In developing the demand forecast PB derived an electricity sales forecast per customer category such that the total electricity sales correlates with the total energy consumption from the NDP per capita consumption projections. For residential customers, PB assumed the same connection rate as was assumed in the Vision 2035 scenario.

The Power Sector Investment Plan (PSIP) assumes that non technical losses will reduce to 2% by 2020 and that technical losses will reduce to 14.4% by 2020. Thereafter losses are assumed to remain at these levels to 2030.

Based on these assumptions the PSIP Section 8.5.1, Cost of Loss Reduction states the following:-

“High levels of commercial losses have a severe impact on industry revenue that can be used to fund new infrastructure required. The loss reduction assumed in the demand forecast (commercial losses down to 2% by 2020) is coupled to an investment plan specifically targeted at reducing commercial and technical losses.

The programme is focussed on replacing conductors where appropriate with larger diameter conductors, disconnection of illegal connections and replacing it with legal connections, upgrading and updating the billing system information and installing prepayment systems. From the distribution investment plan the costs that can be linked to loss reduction are presented in Table 8.4 below.

Table 7-4 Loss reduction investment plan (US\$ million)

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
3.28	4.65	4.60	4.98	2.83	3.77	12.05	19.43	7.88	13.05

It should be noted that the above investment plan was based on load flow studies undertaken by Umeme for the PSIP project.

There are no connection rate assumptions (customer figures) or loss assumptions required for the NDP addendum since the results are derived directly from NDP consumption/capita and no build up is done from basics as per PSIP report. We have

therefore used the energy growth figures from the PSIP Report in our assumptions for the loss reduction and collection trajectories suggested in Section 10.

In Section 6.6 we suggest that Umeme commission a study in order to verify, using the more accurate network data now available, levels of technical losses by feeder by substation.

This study will also provide Umeme with the opportunity to estimate the levels of expenditure required to achieve acceptable levels of technical losses.

In addition to this study we suggest that Umeme commissions a study to determine the actual cost of losses. The cost of losses varies over the day according to the time of use tariffs in place.

It may be that when the AMR project is completed non technical losses due to the top 200 customers will be largely eliminated.

However, it is unlikely that theft and meter tampering will sudden stop but rather Umeme's efforts will have to intensify.

If the actual cost of losses is known a cost benefit analysis can be done in order to identify the pay back period for the expenditure required to rehabilitate the medium and low voltage Umeme network in a relatively short period.

This would achieve two objectives: -

- Technical losses would be reduced to acceptable levels, and
- A "tidy" network would make theft more difficult and more easy to identify and thus reduce non technical losses.

The energy audits suggested in Section 7.7 would allow Umeme to closely monitor the performance of their networks and hence to contain theft.

Umeme rely to a large extent also on transmission network expansion for the provision of new supplies to customers and also to provide network strengthening to reduce technical losses due to long or overloaded lines.

Umeme report that the co-operation from UETCL in this regards is very good and a joint load forecast is undertaken.

At the Steering Committee Meeting held to discuss the Draft Report it was agreed that Umeme and UETCL need to address the expenditure requirements for both the extension of the networks in order to accommodate customer growth and also the requirements for the replacement of aged assets in their collaborative Masterplan.

Transmission network reinforcement projects are therefore identified but Umeme indicated that these projects are not always completed within the time frames required.

This is perhaps an area where the ERA could intervene and provide support to Umeme in pressing UETCL to progress transmission projects.

8 THE IMPACT OF THE RURAL ELECTRIFICATION PROGRAM ON LOSS REDUCTION

8.1 Background

In order to facilitate the rural electrification effort the Government of Uganda established three inter-related mechanisms for management of Uganda's rural electrification program namely, the Rural Electrification Fund (REF), the Rural Electrification Board (REB) and the Rural Electrification Agency (REA) in 2001.

The REA has prepared a 7-year Strategic Plan covering the period 2005/06-2014/12 to provide a clear decision platform for carrying out its mandate and that of the Board. The Plan also provides entry points for collaboration with key stakeholders.

An approved Indicative Rural Electrification Master Plan (IREMP) was put in place in mid-2006. The Plan required the achievement of rural connections of at least 20,000 for FY 2006, increasing steadily by approximately 70,000 per annum by 2012.

Rural customers connected through the REA are handed over to, amongst others, Umeme for connection and billing etc.

Umeme's Distribution Operations and Maintenance Costs (DOMC) are fixed for 7 years and the addition of the REA customers and their losses impacts on their DOMC. Most REA completed projects do not have many customers when connected and loads are low but as customers are connected losses increase and these impact on projected DOMC.

The issue of the impact of REA schemes on Umeme's DOMC is outside the scope of this Loss Study.

The impact on the DOMC is under discussion with ERA and this is the reason for the current study.

Umeme comment that they generally work well with REA and in particular Umeme load flow studies inform REA reinforcement requirements for the new REA projects.

Umeme also claim to have a good working relationship with UETCL and have recently updated the Master Plan in close corroboration with UETCL and REA. In particular Umeme wished to ensure that all three organisations worked from the same Load Forecast.

Umeme developed a bottom-up load forecast internally which they consider to be very comprehensive using Dept of Statistics data plus local knowledge and was undertaken by geographic area, by Parish (village).

Umeme currently have no say in the design of REA projects which may not be optimally designed from a loss perspective. They also have previously not been able to test transformers installed under REA projects and are therefore unaware of their losses. They are in discussion with REA in order to arrive at a solution to this.

Umeme commissioned PPA Energy to undertake a study to estimate the impact on the Umeme system of the connection of rural electrification schemes and work commenced

in November 2009 (*Energy Loss Introduced by Rural Electrification Schemes – August 2010*).

The results of the studies carried out in the Bombo District indicate a low level of technical losses on the 8 transformer feeders studied due to the relatively low level of customers connected and low levels of energy demand.

However, a preliminary non-rigorous analysis indicates that there could be a high proportion of commercial losses on some of the feeders studied.

The Report concludes that it had not been possible to estimate the impact of incremental losses on the Umeme network resulting from the rural electrification schemes and recommends that additional work be done.

Umeme have indicated that they intend proceeding with this further study in order to inform their discussions with the ERA.

8.2 The Impact of REA Schemes on Technical Losses

Provided that rural electrification schemes are optimally designed and constructed with respect to losses the connection of rural schemes should have no impact overall on Umeme's technical losses. In particular, as loadings on rural schemes are generally low and increase slowly technical losses should be low.

As discussed in Section 5.3 the use of standard transformer sizes can contribute to increased (unnecessary) losses and Umeme have indicated that they are considering introducing smaller transformers appropriate for the forecast load.

Critical to the above comment that the connection of rural electrification schemes should not adversely affect Umeme's technical losses is the requirement for the rural schemes to be designed for optimal losses and for Umeme have a say in design standards. In addition procurement of transformers should be in accordance with the optimal specifications of the design.

We recommend that Umeme and the REA maintain continuous contact during the design and execution of rural schemes and that Umeme have the "right" to approve rural scheme designs.

8.3 The Impact of REA Schemes on Non Technical (Commercial) Losses

The *Energy Loss Introduced by Rural Electrification Schemes Report* suggested that there could be a high level of non technical (commercial) losses on some of the feeders studied.

This is perhaps due to the fact that in some areas it would appear that there is a "culture" of theft and non payment for electricity.

Umeme need to become involved in these "new" rural areas at an early stage in order to introduce the need for payment and to make known the penalties for theft of energy.

This will mean incorporating these rural areas into the closest District area of responsibility as early as possible. This also, of course, has a cost implication as there

will initially be no revenue from these areas but this will have to be balanced by the revenue loss when customers do not pay.

9 SUGGESTIONS ON GOVERNMENT OF UGANDA SUPPORT TO UMEME LOSS REDUCTION

Umeme have submitted several letters to both the ERA and to the Minister of Energy and Mineral Development regarding the theft of electricity and asking for assistance in both supporting their drive to educate customers as well as support in prosecuting offenders. Umeme record that in one case 23% of those customers disconnected for non payment and meter tampering had been reconnected when revisited. In addition Umeme noted that they were continuously frustrated by their inability to prosecute offenders in the courts.

Umeme indicated that, in their opinion, the GoU has not been fully supportive of their efforts and this is an area where we believe the ERA should participate in discussions between Umeme and the respective ministries of the GoU.

In Section 7.8 we suggest that Umeme undertake two studies: -

- A technical losses study to determine the current levels of losses by feeder by substation. This would provide them, in addition to the ability to undertake energy audits by feeder, with a very good idea of the capital expenditure requirements required to bring the level of technical losses within acceptable limits, and
- A Cost of losses Study to determine the actual cost of losses and hence the effect that losses are having on inflating the tariff.

The results of these studies will provide Umeme with a case to take to the GoU for assisted financing.

Clearly, at present Umeme are budgeting annually to the extent that the tariff will support the capital expenditure.

We believe that it would be possible for Umeme to justify to the GoU an accelerated capital expenditure programme for refurbishment on the basis of a lower tariff increase in the short term.

In order to achieve this, however, Umeme will require assistance in financing the loan.

Umeme indicate that the “Millers” account for 15% Of the energy consumed and a considerable part of the Miller’s consumption remains unbilled.

Umeme have tried several initiatives in their attempts to resolve this but the issue is not fully resolved.

We believe that this is an area where GoU intervention is essential. The Millers are in Umeme’s words “a law unto themselves”. Political involvement would seem the only way to resolve this standoff.

We note also the comments by the World Bank in their Aide Memoire of 22 November 2010 that there had been no progress on discussions between MEMD and Umeme on developing a framework which outlines roles and responsibilities of the GoU and Umeme with regard to actions targeting power theft.

A Power Loss Reduction Forum was held on 18 July 2008 and attended by Members of Natural resources Committee of Parliament, Resident DC, LC Chairmen and Mayors

from areas with major load centres, various ministries, ERA, UMEME, UEDCL, UEDGL, UEDTL etc. Certain actions were agreed upon some of which were actions on Umeme. Umeme have addressed these in their Loss reduction activities but it was not confirmed that the respective GoU agencies had addressed the actions assigned to them.

Included in the actions agreed by the Forum were the following: -

Measures to reduce technical losses:

Actions to be undertaken by Government

1. Provide additional investments in the sector to improve reliability and availability of power supply.
2. Adjust the tariff to give incentives to big consumers who implement energy saving and efficiency measures like installation of capacitor banks that generate reactive power at their premises.

Action to be undertaken by Umeme and UETCL

Utilities should continue to invest more money in the Network to reduce technical losses.

Measures to reduce commercial losses:

Actions to be undertaken by Government.

1. Institute legal measures like special courts for speedy prosecution and stiff penalties for power thefts.
2. The involvement of Security Agencies in tracking down those who steal electrical materials and those with illegal connections has to be enhanced.
3. Conduct consultative meetings to address the issue of power losses at regional levels.
4. Make prominent and robust public declarations to condemn theft of electricity.
5. Continue with Energy Efficiency/Demand Side Management programs to create awareness on what needs to be done to reduce electricity consumption.
6. Completion of Rural Electrification Schemes which were started by Government.

Actions to be undertaken by the General Public.

1. Those with illegal connections should have them regularized by Umeme. Failure to do so will lead to prosecution.
2. Report illegal use of electricity and theft of materials physically or at Umeme Office by ringing a toll free number 0773251535 or 0772200185
3. Do not engage non – Umeme staff while handling issues of power failure or power connection.

Umeme believe that more active GoU support would greatly assist them in their loss reduction efforts.

At the Steering Committee Meeting held to present the Draft of this Report it was agreed that Umeme would advise the Ministry (MEMDS) the “bad” areas where their District

audits indicate high levels of theft and meter tampering. The Ministry agreed to apply pressure in these areas.

In Section 7.3 we include a list of the losses by Area and by District as provided by Umeme.

At the same meeting it was agreed that Umeme would submit to MEMDS a list of issues where they believe that GoU support would assist their loss reduction efforts. It was suggested that the ERA could facilitate GoU support to Umeme.

10 AN APPROPRIATE LOSS REDUCTION AND COLLECTION PATH

10.1 Proposed Trajectory

Distribution losses are an important indicator of the state of a distribution utility's infrastructure, metering, and collection functions. Globally, distribution losses are considered as one of the most important indicators of performance. The actual distribution loss level achieved by Umeme during 2009 and 2010 is summarized below.

Figure 10-1 Actual Distribution Loss Level for 2009 & 2010

Year	2009	2010
	Actuals	Actuals
Total Purchase (GWh)	2146	2324
Total Energy Sales (GWh)	1400	1626
Distribution Loss Level	34.7%	30.0%
Distribution Losses (GWh)	745	697
Technical Loss *		16.0%
Non-Technical Loss		14.0%
% of Energy Collected on Billed (6 months Lagged)	88.9%	96.4%

* Based on the information provided by Umeme

Based on the results provided by UMEME, we note that there is a considerable increase in the collection efficiency in 2010. This is no doubt due to the implementation of the new billing system during 2010. Based on these figures and assuming continued improvements the distribution loss level trajectory for the next seven years has been projected as shown below in .

The loss level trajectory has been further segregated into technical and non-technical losses. Umeme is investing a significant amount of capital every year to reduce the distribution losses, especially technical losses. The technical loss level has been reduced in the recent past, and this can be directly linked with the amount of capital investment made by Umeme. A reduction in the range of 1% to 0.5% per year has been assumed for projecting the technical loss trajectory.

While projecting the trajectory for the non-technical loss level for the period 2012–2018 the following factors have been considered: -

- Current level of energy theft;
- Current level of billing errors;
- Meter tampering;
- Number of customers billed based on estimated consumption;

- Initiatives taken by Umeme such as the AMR project, prepayment pilot project, and meter replacement;
- Improvement of customer service, and
- Frequency of bill delivery errors

Assuming that Umeme will be able to control billing errors, reduce the number of customers billed based on estimation, and improve customer service, higher reduction has been projected in the overall distribution losses during 2012–2015. Umeme can achieve a reduction of 3% per annum until distribution losses reduce to the level of 20%. International experience has shown that once the utility achieves a loss level of 15% to 16%, it becomes quite difficult to reduce losses by more than 1% to 1.25% per annum, due to the low base loss level. For this reason, in the later years, a reduction of 1% per annum in the distribution losses has been projected for Umeme.

In addition collection targets of energy billed have been projected for Umeme during the period 2012 to 2018. It is assumed that consumers will likely shift to prepaid metering and this response will escalate in later years due to roll out of the proposed incentive framework by ERA. ERA is expected to eliminate the working capital allowance given to Umeme and is in the process of creating an incentive framework that will ensure fast roll out of Prepayment Metering. It is therefore expected that UMEME will attain a collection target closer to 100% collection rates in the next few years. It is also noted that KPLC of Kenya have shown that collection rates of near 100% are achievable. It is important for Umeme to focus on the implementation of such parameters in order to increase collection targets along with the reduction in distribution losses. Umeme should also make bill payments easier for customers in order to reduce the collection period for meeting the collection targets projected for the ensuing years.

Table 10-1 Loss Reduction Trajectory for the Period 2012–2018

Year	2011	2012	2013	2014	2015	2016	2017	2018
	Proj.	Proj.	Proj.	Proj.	Proj.	Proj.	Proj.	Proj.
Total Purchase (GWh)	3088	3201	3316	3487	3691	3941	4219	4516
Total Energy Sales (GWh)*	2254	2433	2620	2842	3082	3340	3618	3918
Distribution Loss Level	27.0%	24.00%	21.00%	18.50%	16.50%	15.25%	14.25%	13.25%
Distribution Losses (GWh)	834	768	696	645	609	601	601	598
Technical Losses (GWh)	463	448	431	418	406	414	422	429
Non Technical Losses (GWh)	371	320	265	227	203	187	179	169
Technical Loss	15.0%	14.0%	13.0%	12.0%	11.0%	10.5%	10.0%	9.5%
Non Technical Loss	12.0%	10.0%	8.0%	6.5%	5.5%	4.8%	4.2%	3.8%

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Year	2011	2012	2013	2014	2015	2016	2017	2018
	Proj.							
% of Energy Collected on Billed (6 months Lagged)	96.9%	97.4%	97.9%	98.4%	98.9%	99.0%	99.2%	99.4%

* Source: Umeme

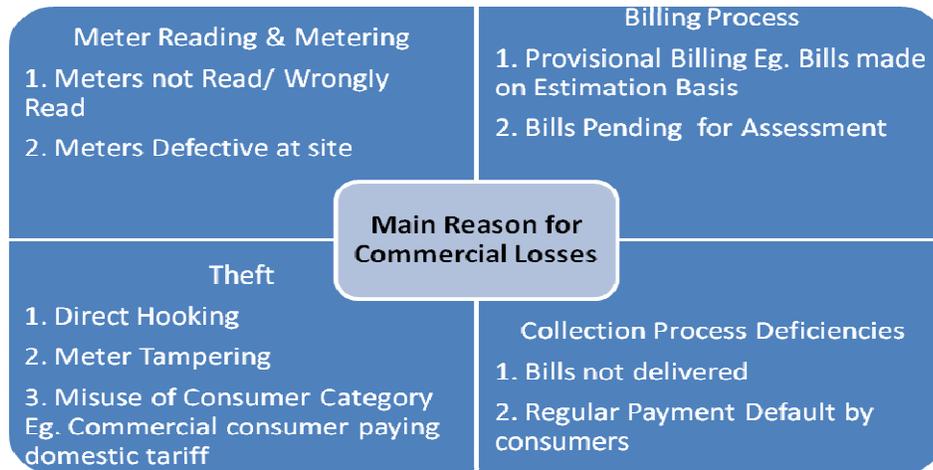
Based on the Loss trajectory shown in **Error! Reference source not found.** above, losses have been segregated further into HT, LT & commercial losses based on Annexure A of the Tariff methodology. As the details of segregation of losses were not available the total technical losses of 16% confirmed by Umeme for 2010 have been considered. The segregation of technical losses further into HV & LV can also be shared with Umeme at the time of finalization of loss trajectory for the next seven years.

Table 10-2

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Item	Actuals	Projected							
Overall Distribution Loss Factor	30.02%	27.00%	24.00%	21.00%	18.50%	16.50%	15.25%	14.25%	13.25%
HV Customer Sales	716	992	1071	1153	1250	1356	1470	1592	1724
Commercial Losses of HV Customers	143	163	141	117	100	90	83	79	76
Technical Losses of HV customers	128	157	150	141	134	126	126	126	125
HV Technical Loss Factor	13.0%	12.0%	11.0%	10.0%	9.0%	8.0%	7.5%	7.0%	6.5%
HV Commercial Loss Factor	16.7%	14.1%	11.7%	9.2%	7.4%	6.2%	5.4%	4.7%	4.2%
LV Customer Sales	911	1262	1362	1467	1592	1726	1870	2026	2194
Commercial Losses of LV Customers	183	207	180	149	127	114	106	100	96
Technical Losses of LV customers	243	306	298	290	284	280	286	297	302
LV Technical Loss Factor	18.2%	17.2%	16.2%	15.2%	14.2%	13.2%	12.7%	12.3%	11.6%
LV Commercial Loss Factor	16.7%	14.1%	11.7%	9.2%	7.4%	6.2%	5.4%	4.7%	4.2%

10.2 Recommendations to Achieve Loss Level Trajectory:

Based on our analysis, audits and taking into cognizance the best practices followed by utilities globally, Umeme will be able to achieve the desired loss reduction target if the following recommendations are addressed through appropriate interventions as charted out below: -



An analysis of the current situation indicates that Umeme needs to address all the above areas of Meter Reading & Metering, Billing Process, Theft and Collection Process Deficiencies to bring down its non-technical losses. Summary of audit findings and prioritized recommendations are charted below.

Current Level of Billing Errors: The audit results indicate that there is scope for improvement and reduction in billing errors. Human errors are involved in the meter reading stage as well as in the data entry stage.

Currently, a few meter readers are provided with hand-held devices to take readings in some areas in Kampala and field-reading sheets for other areas and upcountry locations. Further, meter readings are written twice (first in notebooks and then in route sheets), which increases the probability of human errors.

In addressing the above issues Umeme should consider the fact that domestic customers account for 26% of their revenue but total 347,433 of their 378,000 customers (December 2010).

Their efforts should therefore focus on the high gain customers.

Again, the energy audits suggested in Section 7.7 will allow Umeme to identify feeders with high loss and also, after District staff intervention they will be able to break down these losses by cause (meter tampering, billing error, theft etc). This will allow Umeme to focus their efforts on solutions giving the best “return” in terms of loss reduction.

Recommendations:

A) Low Investment Interventions:

- a) Creation of “Check Meter Reading Teams” to perform random audit and mitigate exceptional reading cases.

- b) Relook at the exception logics and ensure that all cases identified as exceptions are mandatorily revisited from the field and this needs to be ensured without enhancing the meter reading cycle time.
- c) Rotation of meter readers across districts to prevent connivance with consumer.
- d) Depute adequate number of meter readers as well as data entry supervisors in the district offices to control billing errors.
- e) Umeme should consider the introduction of longer meter reading cycles for their domestic customers. Few utilities in South Africa, and indeed internationally, read domestic meters on a monthly cycle. Extending the domestic meter reading cycle to 3 months with estimated reading in the interim months would greatly relieve the billing and meter reading activities at District level. Eskom in South Africa currently read domestic meters every three months and in the UK most energy companies read meters only once a year.
- f) Outsourcing of the meter reading function. Very few utilities use “own staff” to read meters. The outsourcing of this activity has been a huge success wherever it has occurred around utilities. Umeme could consider facilitating the formation of specialist meter reading companies by their existing meter reading staff. This would relieve Umeme of the issue of staff redundancies caused by outsourcing.

B) Medium Investment Intervention

- a) Extend handheld meter reading devices across all districts.
- b) These devices should have inbuilt checks to ensure that readings are taken correctly at the first instance itself.
- c) Creation of backup rooms in district offices where handheld devices (HHDs) can be charged and data can be directly uploaded into the system without human intervention.

C) High Investment Intervention

- a) Deployment of Automated Meter Reading (AMR) in the High Revenue Base consumer segment. Umeme are planning the introduction of AMR to their top 200 customers and this is discussed further in Section 7.4.

Current Level of Energy Theft: It was observed that in 2010, not only domestic customers but also key customers like Oasis Shopping Mall, Kampala International University, Crane Bank, etc., indulged in electricity theft. Umeme has already taken initiatives like disconnection of electricity of customers indulging in electricity theft, physical audit, identification of illegal connections and regularisation of same, etc.

Recommendations:

A) Low Investment Interventions:

- b) Umeme should carry out the audit of large customers on a regular basis, and the government should join hands with Umeme and fight against electricity theft.
- c) The investigation officers at Umeme could be given monthly targets for reporting and booking of theft cases.
- d) Creation of Centralized Special Enforcement Group to detect thefts on regular basis.
- e) Educating the public on nuances of power theft through specialized Mass Awareness Programs.

B) Medium Investment Interventions:

- a) **Energy Auditing and Accounting:** This would help Umeme in accurately identifying the areas of losses and then prioritize its efforts accordingly. This is also addressed in Section 7.7.

C) High Investment interventions:

- a) As suggested above, AMR deployment can help identify meter tampering and bypass cases with respect to High End Consumers which can then be booked by Enforcement Group through site visits in accordance with the enforcement procedure at Umeme.
- b) Use of tamper proof metering technologies with tamper recording capabilities.
- c) Usage of AMR based pole mounted group meters with display at consumer premises.
- d) Use of “Prepaid Meters” for those consumers who engage in theft of electricity (Compulsory).

Number of Customers Billed based on Estimated Consumption: This may be a well-defined practice for some distribution companies in developing countries, where for specific customer classes, for example, meters are read every second month and bills are estimated for the in-between months. In other cases, bills are estimated because the meters readers were unable to gain access to the meter during their site visit. If this becomes a common practice and is not rectified where meter access is chronically unavailable, this becomes a serious problem. Umeme should achieve 95% efficiency for meter readers by ensuring that monthly actual readings are taken for at least 95% of all meters listed for reading.

Recommendations

A) Low investment intervention

- a) Bring Existing Meters outside premises.
 - This will help in reducing the meter not read cases.
 - This will also help to de-motivate consumers to tamper meter through easily visible techniques like magnet, shunt wire etc.

- b) Creation of Backup Check Meter Reading Team to take readings in all such cases. This team must verify the meter readings entered in the selected route sheet by visiting the customer premises.
- c) Call up the consumers from outbound call centres whose premises have been found locked, to fix an appointment for meter reading. This significantly brings down the number of “Not Read Cases”.

Collection Process Deficiencies: It is noted that Umeme are facing an acute problems with regards to non delivery of bills as well as payment default by Consumers both of which are affecting its final loss levels. During the interaction with the customers, it was found that there were some cases wherein the electric supply of customers was disconnected without them having received their bills.

Recommendations:

A) Low investment interventions

- a) Upload information on website regarding Bill Amount, Bill Payment Date.
- b) SMS can be sent to High Revenue Base Consumers.
- c) It is usually observed that despite receiving bills on time, consumers complain that they have not received the bills. Options to address this include
 - Delivery of bills with proper acknowledgement and phone no. of premise where the bill was received.
 - Random outbound calls by Call Centre to confirm bill delivery on daily basis as per the report submitted by Outsourced Bill Despatch Agency.
 - Levy of suitable penalty on the Bill distribution agency based on genuine consumer complaints.

B) Medium Investment Interventions

- a) Drop Boxes at Various locations.
- b) Collection Vans for areas located remotely.
- c) Electronic Clearing Service (ECS) options including Website payment option.

C) High Investment Intervention

- a) Installation of Any Time Bill Payment Machines.

Providing multiple options for payments of Energy Bills: Umeme can implement other modes of payment for energy bills like through website (if available), Collection Vans, Drop Boxes, Any Time Payment Machines. These shall help in increasing consumer convenience and result in enhancing the collection efficiency of the utility. Umeme can also consider the “**Spot Billing**” option. This option is extremely useful in reducing the reading to collection cycle to one day. Under this option the Meter Reader is connected online to the Billing System and has the ability to generate bills on the spot.

Customers can also make payment to the reader based on the bills received and this takes care of the total transaction.

At the Workshop held to present the findings of this study held on 7th June 2011 requests were made for the Consultant to prioritise their recommendations for Umeme's loss reduction efforts as well as to provide a capital; expenditure forecast for these initiatives.

Umeme were requested to provide their forecast savings, expenditure requirements and cost benefit analysis for their various loss reduction efforts. This information was not provided by Umeme who have indicated that they have recently appointed a consultant to determine this information.

Without this information it is impossible for the Consultant to prioritise the loss reduction efforts or to provide an expenditure plan.

With the considerable expenditure committed by Umeme on their AMR project it could be assumed that this effort has some priority.

Umeme's "Feeder Loss Reduction Initiative" at the Districts should indicate the major sources of losses but Umeme did not provide any indications that this information was available.

11 AN ALTERNATIVE APPROACH TO INCENTIVISE LOSS REDUCTION

11.1 General

Umeme have indicated that they would prefer to operate under an output based incentive scheme whereby they are encouraged to exceed loss and collection targets in return for a “share” in the savings. The model adopted in Turkey illustrates a possible option for ERA to consider.

Non-technical losses in 20 Turkish regions were between 6% and 64% supplying some 29m customers.

Initiatives to improve the situation commenced in 1996 but attempts to “privatise” the problem have stalled repeatedly for legal and political reasons. In addition, although the non technical losses are due to all of the “conventional” reasons, including untidy low voltage networks, unsupportive legal systems, meter tampering, poor billing systems etc little progress has been achieved in reducing NTL’s due to a lack of institutional strength and poor management of the state owned utilities.

The Republic of Turkey’s Privatization Administration (“PA”) initiated the privatization of Turkey’s electricity distribution utility, Turkiye Elektrik Dagitim Anonim Sirketi (“TEDAS”) in 2003. TEDAS is a Turkish State-owned joint-stock company engaged in the distribution and retail sale of electricity and provision of retail services to final customers. With approximately 29.5 million customers, 126 billion kWh of electricity sales and 98% market share in electricity distribution across Turkey in 2007, TEDAS and its distribution companies together form one of the largest organizations in the country.

11.2 The TSS Model

Privatization of distribution companies will be executed using a Transfer of Operating Rights (“TOR”) backed by a Share Sale model (“TSS model”). According to this model, the investor will be the sole owner of the shares of the distribution company and will be the unique licensee for the distribution of electricity in the designated region without retaining the ownership of distribution network assets and other items that are essential for the operation of distribution assets. The ownership of these distribution assets will remain with TEDAS. The investor, through its shares in the distribution company, however, will be granted the right to operate the distribution assets by a Transfer of Operating Rights Agreement (“TOR Agreement”) with TEDAS.

Under the envisaged market structure, privatized electricity distribution companies will operate as regional monopolies with distribution licenses granted by Energy Markets Regulatory Authority (“EMRA”). As part of ongoing liberalization efforts in the energy sector, Turkey’s distribution network was divided into 21 distribution regions based on geographical proximity, managerial structure, energy demand and other technical/financial factors. After the inclusion of TEDAS in the privatization program, a separate distribution company was established by the PA in each one of the 20 distribution regions owned by TEDAS.

According to the general principles as stated in the Electricity Market Strategy Paper¹, the Turkish Electricity Market has gone through a process of vast restructuring in core

activities ranging from generation to distribution. Accordingly, a new tariff structure has been developed in line with the new structural requirements.

11.3 Tariffs

The main purpose of the market liberalization is to achieve lower tariffs by increasing overall system efficiency. Accordingly, the tariffs are calculated as “cost-reflective” based on pre-determined operating and loss/theft improvement targets.

The first tariff implementation period (or transition period) has been set as the period from 2006 to 2010 to serve as the transitory period to fully cost based tariff structure after 2010. EMRA has already approved the end user tariffs and revenue requirements of each distribution company for the transition period. Revenue requirements cover the projected expenses for providing distribution and retail services and provide an allowance for the target level of technical and non-technical losses. The end-user tariffs for the period after 2010 will be determined by the distribution companies in accordance with the Electricity Market Tariffs Communiqué and the related regulations again in a cost-reflective fashion and will be subject to the Regulator’s approval.

The first implementation period is designed to have a smooth and gradual transition from existing tariff structure to a lean and simple tariff structure. As of 2010, most customer groups will have cost based tariffs in place and the tariff groups will be simplified to five only, namely residential, industrial, commercial, agricultural irrigation and lighting.

According to the Electricity Market Law, the Electricity Market Tariffs Communiqué and other related regulation, the four tariff components; (a) retail sales, (b) distribution, (c) retail services and (d) transmission; are governed in an unbundled fashion. Retail sales tariff has a “price cap” which is set as the basket price of the energy purchased by the distribution company. Distribution and retail services have “revenue caps” which cover operating expenses and investment requirements related to distribution and retail services. Transmission tariff is a complete pass-through of transmission costs as charged by the national transmission company.

The existing “national tariff” scheme will be maintained for the first tariff implementation period, rather than implementing “regional tariffs” so that sudden price fluctuations can be avoided (currently, regional cost based tariffs vary significantly due to wide variation of loss/theft levels and other parameters across the regions). Implementation of national tariffs, however, will result in revenue imbalances since the distribution company revenues will differ from their envisaged revenue caps. In order to remove such imbalances, EMRA will put in place a tariff equalization scheme to transfer revenues across the regions.

11.4 Investments

One of the primary objectives of privatization is to finance required distribution system and network improvements and expansions through private sector investments, thereby removing the burden of such investments away from the state budget. Investments are of great importance in ensuring continuity and quality of service in electricity distribution.

The annual expansion, replacement and improvement investments that are required in each of the 20 distribution regions during the first tariff implementation period (2006–

2010) have been determined during the preparation of the end-user tariffs. For TEDAS as a whole, the investment requirement for the transition period is a total of YTL 2.8 billion (\$2.3 billion), distributed equally to each year of the transition period. These investments have been embedded into the first implementation period tariffs approved by EMRA; hence, they will be recouped by the distribution companies over time.

Investment requirements can be updated by EMRA through the revision mechanisms.

After 2010, distribution companies will prepare annual investment plans each year by making projections on consumption growth, analysing network expansion requirements and other technical parameters. They will then present these investment plans to EMRA for approval. After receiving EMRA approval, distribution companies are obliged to implement the approved plans. Implementation of these investments (i.e. investment amount and form) will be monitored through investment control and quality measurement mechanisms set up by EMRA in collaboration with the distribution companies.

EMRA approved tariffs do incorporate an allowed level of regulated return on the investments and services to be carried out as part of the electricity sales & distribution activities. In addition to this allowed level of return, the distribution company can create substantial value by beating the preapproved loss/theft and operational efficiency targets.

The TOR process was initiated by a call for tenders for the acquisition of the TOR and the tenders were evaluated based on the highest loss reduction figures offered by the tender.

Appendix A

UMEME COMMENTS AND RESPONSES TO THE DRAFT REPORT'S FINDINGS AND RECOMMENDATIONS

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
1	Loss Reduction and Collection Path	<p>Distribution Losses</p> <p>The Report proposes a trajectory for Umeme.s technical and non technical losses of 27% in 2011 reducing to 13.25% in 2018, based on what Umeme has achieved to date in respect of their loss reduction efforts and expenditure and taking into account of the Consultant's recommendations for further work: -</p> <p>Collection Rates</p> <p>The Report proposes a trajectory for Umeme's Collection Rates of 94.5% in 2011 increasing to 98.5% in 2018</p>	<p><i>Umeme expresses its strong reservations to the suggested trajectory on the grounds that the proposal (a) does not take into account the current level of distribution system losses, currently at an average of 30% (b) is not based on quantified investments required to achieve the level of loss reductions suggested (c) does not provide concrete measures that would allow such reductions (e) ignores related operational and maintenance costs, especially in view of the fact that Umeme's DOMC is currently fixed until a new schedule is agreed during the 7th year negotiations with the Government and ERA. (d) does not provide any incentives for the utility to allow such loss reductions proposed.</i></p> <p>ERA Comment - I do not understand why distribution losses should be deteriorating compared to levels achieved in the period to end 2010. The measures to be followed to reduce losses should be the work of the utility. Certainly a new schedule of DOMC will be negotiated based on the outturn over the past 6 years. I agree that the required level of investments should be quantified in respect of technical loss reduction. We need to recognize that distribution companies in the region which are not yet privatized have achieved low levels of loss and high levels of collection. KPLC is a good case. I would like to understand the difference between Kenya and Uganda that would stop Umeme from achieving the same trend of loss reduction.</p> <p><i>Umeme proposes that the trajectory be revised and instead a more realistic loss reduction proposal be provided, with quantified required investment and an output based incentive be proposed to allow a significant reduction in losses to 20% in the shortest possible period</i></p> <p>PB Comment – We understand that the basis of the Concession and tariff methodology was to provide an incentive for Umeme to reduce losses. We have included in the Revised Report an alternative incentive based approach based on the Turkish model.</p>
2	Umeme's performance in reducing losses : 2005 to 2009	<p>The PB Report states that Umeme's performance in reducing the levels of losses (losses at 33% in 2005 and 35% in 2009) did not achieve the results required. However, the report noted that the stakeholders initially underestimated the poor condition of the</p>	<p><i>Umeme agrees with the report that stakeholders initially underestimated the poor condition of the network and also underestimated the resilience of the Ugandan customer to resist paying for electricity.</i></p> <p><i>However, Umeme would like to clarify that at takeover distribution losses were between 38% -40% and had reduced to around 30% at the end of December</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
		<p>network and also underestimated the resilience of the Ugandan customer to resist paying for electricity</p>	<p>2010.</p> <p>ERA Comment - I do not think I agree with the 38-40% losses at takeover. Otherwise, UEDCL would have financially collapsed.</p> <p><i>Umeme further clarifies that, whilst the actual losses were above 38% at take over, the losses allowed in the tariff were 33% reducing by 0.83% pa, However, in 2007, the Concession Agreements were amended, introducing the "Special Provisions Period, (SPP) that provided for a new basis for computing and factoring losses and collections in the tariff</i></p> <p>PB Comment – Our starting point for Umeme's loss levels are based on Umeme's measured losses in 2005.</p>
3	<p>Support from Government</p>	<p>The PB Report acknowledged that Umeme have submitted several letters to both the ERA and to the Minister of Energy and Mineral Development regarding the theft of electricity and asking for assistance in both supporting their drive to educate customers as well as support in prosecuting offenders.</p> <p>The PB Report also acknowledged Umeme's comments that GoU has not been fully supportive of their efforts and this is an area where PB believes that the ERA should participate in discussions between Umeme and the respective Ministries of the GoU.</p> <p>Capital investment and financing</p> <p>The PB Report recommends that Umeme undertakes two studies and use the results of the studies in the discussions with GoU on the required financing of the capital investment</p> <ul style="list-style-type: none"> • A technical losses study - to determine the current levels of losses by feeder by substation. This would 	<p><i>Umeme concurs with the comments made in the report, with regards to the support and assistance required from Government entities in its efforts to address power thefts. In addition, Umeme requests an equitable Regulatory Framework that properly recognizes the activities and challenges involved in combating power thefts and takes appropriate actions that can enable the utility to achieve set loss reduction and collection rate targets. Such actions should provide incentives to the utility to consolidate and sustain the loss reductions and collection targets achieved, rather than a disincentive to implement the required actions.</i></p> <p><i>Umeme notes the recommendations to undertake the two studies. However, it was Umeme's understanding and expectation that the study commissioned by the ERA , would cover the issues contained in the recommendation.</i></p> <p><i>The above notwithstanding, Umeme believes that it is important to carry out the exercise to determine the required investment. Consequently, Umeme requests that the costs associated with the two proposed studies, be allowed to the company as additional DOMC in the Q3 2011 tariff review.</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
		<p>provide a very good idea of the capital expenditure requirements required to bring the level of technical losses within acceptable limits, and</p> <ul style="list-style-type: none"> • A Cost of losses Study to determine the actual cost of losses and hence the effect that losses are having on inflating the tariff. <p>PB believes that it would be possible for Umeme to justify to the GoU an accelerated capital expenditure programme for refurbishment on the basis of a lower tariff increase in the short term. In order to achieve this, however, Umeme will require assistance in financing the loan.</p> <p>Power theft</p> <p>The PB Report acknowledged Umemes's comments that the "Millers" account for 15% of the energy consumed and a considerable part of the Miller's consumption remains unbilled due to theft</p> <p>PB noted that Umeme have tried several initiatives in their attempts to resolve this but the issue is not fully resolved. PB believes that this is an area where GoU intervention is essential.</p> <p>PB also noted the comments by the World Bank in their Aide Memoire of 22 November 2010 that there had been no progress on discussions between MEMD and Umeme on developing a framework which outlines roles and responsibilities of the GoU and Umeme with regard to actions targeting power theft.</p>	<p>ERA Comment - Umeme should have an incentive to carry out these studies.</p> <p>PB Comment – The scope of this assignment did not include such studies.</p> <p><i>Umeme concurs with the report's observations and welcomes the Consultant's recommendations that GoU's support and intervention is required to combat power thefts by Grain Millers.</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
		<p>PB further noted that a Power Loss Reduction Forum was held on 18 July 2008 and attended by Members of Natural resources Committee of Parliament, Resident DC, LC Chairmen and Mayors from areas with major load centres, various ministries, ERA, UMEME, UEDCL, UEDGL, UEDCL etc. Certain actions were agreed upon of which some were actions on Umeme.</p> <p><i>The PB report observed that whilst Umeme have addressed these actions in their Loss Reduction activities but it was not confirmed that the respective GoU agencies had addressed the actions assigned to them, supporting again Umeme.s statement that GoU support to their loss reduction efforts was lacking in substance.</i></p>	
4	<p>Effectiveness of Umeme's Loss Reduction Measures</p>	<p>The PB Report recognized the Umeme Loss Reduction Programmes implemented to date and stated that these initiatives plus the focused restructuring of the organisation are showing results which can be seen in the losses achieved in 2010 which averaged 30% at the end of the year, with Collection rates improving to 94% at the end of December 2010.</p> <p>However, the Report notes that Umeme has not submitted its Loss Reduction Strategy 2011 to the ERA.</p>	<p><i>Umeme appreciates the Report's observations on the achievements made in 2010 in reducing losses to 30% by end of December 2010, and reiterates its commitment to reduce the losses to an average of 28% by the end of 2011</i></p> <p><i>Umeme acknowledges that there has been a delay in the Umeme Board approving the Company's 2011 Loss Reduction Strategy. The delay has been due to the fact that the Electricity Regulatory Authority made two decisions namely (a) losses and collection targets set for 2011 (b) directive on customer security deposits that have negatively impacted on the Umeme capital and revenue budgets for 2011 and the loss reduction action plans for 2011. As a consequence revised budgets had to be submitted to the Umeme Board.</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
			<p><i>Umeme formally objected to the ERA for the inconsistent application of the tariff methodology, in selectively applying the loss and collection factors, and on the security deposit directive that have resulted in Umeme's cash flow being worse off versus its budget to the tune of around US\$ 9 million.</i></p> <p>ERA Comment - I do not understand how these two decisions affected Umeme's investment plan. Customer security deposits are not expected to be part of the investment funds for Umeme. The loss and non-collection rate targets are incentive based targets based on the performance of the company and its difficult to understand how the decisions of the Authority would affect investment plan unless Umeme was planning to raise investment funds through the tariff alone. Umeme's profit is expected to come from its return on investment which has not been affected in any way.</p>
5	Separation between Technical and Non-technical Losses	<p>PB report stated that the Consultants were unable to separate non technical losses. However, they used the Umeme Cost of Service Study, Phase 2 (January 2009) carried out by PPA Energy which estimated total Technical Losses at around 15.1% and non technical (commercial) losses are around 14.9% for 2010.</p> <p><i>PB recommended that Umeme should implement a comprehensive system study to repeat the exercise undertaken in 2008/9 by the Cost of Service Study, Phase 2. The new study will be based on much more accurate network data and should be undertaken by feeder by substation for the entire network..</i></p>	<p><i>Umeme notes the recommendations to undertake a comprehensive study to repeat the exercise undertaken in 2008/2009 by PPA..</i></p> <p><i>However, it was Umeme's understanding and expectation that the study commissioned by the ERA , would cover the issues contained in the recommendation</i></p> <p><i>The above notwithstanding, Umeme believes that it is important to carry out the exercise to determine a more scientific separation of losses. Consequently, Umeme requests that the costs associated with the study, be allowed to the company, as additional DOMC in the Q3 2011 tariff review.</i></p> <p>ERA Comment - Once again, it is the obligation of the utility to provide the separation in these costs.</p>
6	Umeme Capital Investments	<p>Investments –Technical Losses</p> <p>PB commented on the main cause of high technical losses as due to transformer imbalance, small conductors, mix of conductors, long sections with small conductors and high loss steel conductors</p>	<p><i>Umeme notes the comments in the PB Report and concurs with the observation that with the current level of Umeme capital investment, it will take long to achieve significant reductions in technical and non technical losses.</i></p> <p><i>As indicated before, Umeme believes that the technical loss reduction trajectory proposed in the report was not based on a comprehensive study to ascertain the required investments to achieve accelerated loss reduction levels.</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
		<p>PB acknowledged that Umeme Capex focus has been to address the above achieving perhaps a reduction of 1% per year, <i>but commented that at this rate it will take years to achieve reasonable levels of technical losses</i></p> <p>investments –Non Technical Losses PB commented on the main causes of high non technical losses and stated that Umeme's capital expenditure to date, in relation to non technical losses, was appropriate and that future expenditure is necessary on the following: (a) Remote Reading Meters & AMR – top 200 customers (b) GIS & Billing & Customer Data Linked (c) SCADA & CMS (</p>	<p><i>Umeme notes the PB Report's observations and is actually implementing the projects indicated in the report.</i></p>
7	Meter reading, billing, customers and cash collection	<p>Billing</p> <p>Report states that they were unable to audit the level of accuracy of the monthly performance statistics submitted by Umeme to ERA as the requested data was not made available. It is noted that the data used to produce the monthly statistical data did not align with the Umeme Annual Report data for 2009.</p>	<p><i>Umeme has detailed billing data, generated by the billing system, that analyses billing statistics by Districts. The system generated billing data is used to compile monthly performance statistics which we submit to the ERA on a monthly basis.</i></p> <p><i>The system generated billing data, analysed by districts, is used to compile monthly management accounts and also used to prepare annual statutory accounts which are audited by the company's external auditors, Ernst & Young.</i></p> <p><i>The relevant billing data is readily available within Umeme for the Consultant's review. Arrangements are being made to have this information availed to the Consultant as soon as possible.</i></p> <p>ERA Comment - Has this been done?</p> <p>PB Comment – The data has now been received and the audit results are included in the Report</p> <p><i>Umeme notes the Report's recommendation to introduce longer meter reading</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
		<p><i>Meter Reading</i> Between 10% and 20% of the meter readings are estimated</p> <p>Commented that relatively a high number of data entry errors occurred when the Route Sheet meter readings were input into the system and that this may account for around a 5% error in the billing</p> <p>The report recommends introduction of longer meter reading cycles for domestic customers (to relieve district staff from pressure and reduce data input errors)</p> <p>Customers Acknowledged the customer verification exercise although further data clean up work is still being undertaken</p> <p>Collections noted that Collections improved from 87% in January to 94% in December 2010 but further improvements are required in relation to bill delivery</p>	<p><i>cycles. However, Umeme believes that it is still necessary to take actual readings on a monthly basis until domestic customer accounts have a good track record of actual readings to allow good estimations during periods when meters are not read.</i></p> <p>ERA Comment - Agree with Umeme.</p> <p>PB Comment – The District initiative to track losses should provide the basis for focused energy audits and this will provide information on meter tampering. With the high number of estimated meter readings (20%) we still believe that a longer interval between meter reading will relieve District staff and allow a more focused approach to loss reduction in the “bad” areas.</p> <p><i>Umeme notes the observations and concurs with the recommendation</i></p> <p><i>Umeme notes the observations and concurs with the recommendation</i></p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
8	New Customer Care and Billing System (OICS)	Commented that whilst Umeme encountered some teething problems initially but the New Billing and Customer data system is now showing results and noted that Industry standard system with comprehensive procedures	<i>Umeme appreciates the Report's observation on the New Billing System</i>
9	Impact of the Rural Electrification Program	<p>The PB Report recognized the fact that Rural Electrification Agency projects will have an impact on the level of Umeme losses.</p> <p>The PB Report noted that Umeme commissioned PPA Energy to undertake a study to estimate the impact on the Umeme system of the connection of rural electrification schemes. The results of the studies carried out in the Bombo District indicate a low level of technical losses on the 8 transformer feeders studied due to the relatively low level of customers connected and low levels of energy demand.</p> <p><i>PB noted that Umeme was to proceed with a further study in order to inform their discussions with the ERA. PB recommended that Umeme needs to become more involved in the "new" rural areas at an early stage in order to introduce the need for payment and to make known the penalties for theft of energy.</i></p>	<p><i>Umeme notes the Report's observation and would like to proceed with a further study in order to inform their discussions with the ERA on REA losses</i></p> <p><i>Consequently, Umeme requests that the costs associated with the study, be allowed to the company, as additional DOMC in the Q3 2011 tariff review.</i></p>
10	Statistical and Boundary Metering	The Report commented that installation of the statistical and boundary metering is critical to Umeme.s initiative at District level to monitor feeder performance and the issue of missing or defective meters needs to be addressed.	<p><i>Umeme agrees that statistical metering at, feeder level, is key to the company's loss reduction efforts. The consultant has asked to avail Umeme details if statistical meters that were found with anomalies</i></p> <p>ERA Comment - This was a critical finding that needs to be addressed by Umeme and UETCL urgently.</p>

Uganda Loss Reduction Report

	CATEGORY	FINDINGS AND RECOMMENDATION	UMEME'S OBSERVATIONS AND COMMENTS and ERA AND PB COMMENTS
			<p>PB Comment – Details of our statistical metering audit have been provided to Umeme</p>
11	<p>Organisational Initiatives</p>	<p>PB acknowledged that in September 2009 the Umeme Board approved the formation of the Customer Service and Energy Loss Reduction Committee as a committee of the Board.</p> <p>PB Report states that key to the loss reduction initiative was the restructuring exercise initiated in June 2009 that saw the appointment of Area Managers as well as District Managers, with clear KPI.s.</p> <p>The report notes that the effectiveness of this restructuring and decentralization can clearly be seen in the improved loss statistics achieved by Umeme in 2010.</p>	<p><i>Umeme appreciates the Report's observation on the decentralized new organization structure implemented in July 2009.</i></p> <p><i>However, the new structure introduced (as part of the loss reduction and customer service improvements initiatives) has led to increased DOMC costs. Given the increased costs Umeme applied to the ERA for additional DOMC in respect of these loss reduction related costs. Unfortunately, Umeme's application was not approved on grounds that this had to wait for the 7 year review. This decision has curtailed Umeme's loss reduction efforts.</i></p>
12	<p>Objectives of the Study</p>	<p>The Report states that the objectives for the study of the Distribution Losses and the Collection Rates were to achieve the following, among others:</p> <ul style="list-style-type: none"> • Establish the level of technical losses, and identify the required investments to reduce the technical losses to optimal levels for such a network. • Establish the level of non-technical losses and identify measures to eliminate them. • Establish the required inputs to achieve the desired levels of commercial losses. 	<p><i>Umeme observes that, whilst the assignment required a study of the distribution losses, the exercise was in the main an "audit" of the Umeme loss reduction strategies and action plans.</i></p> <p><i>Umeme further observes that the study did not include a comprehensive review and quantification of the required investments to reduce technical and non technical loss to the levels proposed in the report</i></p> <p><i>Umeme noted the comments in the report that It was difficult for the Consultant to conclusively establish the exact level of non-technical losses in the network.</i></p>

APPENDIX B

MINUTES OF WORKSHOP TO PRESENT FINDINGS OF THE STUDY TO STAKEHOLDERS



ERA Consultancy Services (Study of Distribution System Losses and Collectable Rates by UMEME Ltd)

Minutes of Workshop to Disseminate Findings from the Study held at the Imperial Royale Hotel on 7th June 2011

ATTENDEES As per attached list

AGENDA ITEM	ACTION
<p>1. WELCOME AND INTRODUCTION ERA Chairman Mr Richard Apire opened the meeting, welcomed all attendees and introduced the Board Member present.</p> <p>The purpose of the meeting was to present the findings of the Study to the Stakeholders and to ensure that the study results and recommendations are such that the ERA and the GoU can use them productively in their future management of the industry.</p>	
<p>2. APOLOGIES There were no apologies.</p>	
<p>3. PRESENTATION OF THE FINDINGS OF THE CONSULTANTS REPORT The Consultant (PB) presented the Final Report.</p> <p>The presentation reviewed the findings of the audit and summarised the recommendations contained in the Report.</p> <p>Umeme comments to the Report are included in Appendix A to the Final Report.</p> <p>A copy of the presentation will be included in the circulation of the minutes.</p>	
<p>4. COMMENTS AND DISCUSSION ON THE FINAL REPORT</p> <p>MEMD</p> <p>4.1 Umeme efforts with respect to Loss Reduction were to be commended.</p> <p>4.2 The Report should indicate a breakdown of losses to indicate the magnitude of the losses by cause to enable a targeted approach to be adopted in the</p>	



AGENDA ITEM	ACTION
loss reduction efforts.	
4.3 The Consultant should discuss the causes of losses directly with District Staff as they were more aware of the causes.	
4.4 The Report should identify the investment required to reduce losses from, for example, 27% to 24% as shown in the trajectory. The savings achieved by the investment required to reduce losses should also be provided.	
4.5 All of the recommendations arising out of the Power Loss Reduction Forum should be included in the Report, including those for action by stakeholders other than Umeme.	
4.6 Umeme should focus their efforts on audits of large customers in order to obtain maximum benefits from their loss reduction efforts.	
UEDCL	
4.7 The Report should show losses by customer category and the value of those losses.	
4.8 Losses due to poor collection rates would be reduced by the introduction of prepayment metering systems.	
4.9 Rural electrification projects had little impact on commercial losses.	
4.10 Believed that further studies as proposed in the Report were unnecessary. Believed that studies should be conducted by Umeme if they were necessary.	
4.11 The Study did not address the effectiveness of the maintenance carried out by Umeme.	
4.12 Strongly supported the implementation of prepayment metering systems as a means of reducing losses. In particular collection rate losses would be reduced.	
4.13 It was accepted that for various reasons high loss transformers had been installed in the past.	
4.14 Load balancing was difficult to manage due to changing system circumstances and customer connections.	
4.15 Believed that Umeme made greater efforts in the urban centres than in the rural areas and the quality of work in the rural areas was not good.	
Umeme	
4.16 Confirmed that they made full use of the intimate local knowledge of their District staff in their loss reduction efforts.	
4.17 Noted that collection rates had improved from 75% to 95% with a consequent saving of around USD40m.	
4.18 Umeme would welcome support from all stakeholders including GoU but they would not rely on that in their loss reduction efforts due to their previous experiences. They had found little support from the political areas.	
4.19 Umeme currently target the connection of 80,000 new customers a year.	
4.20 Umeme could easily reduce losses to 14% but the methods that they would have to use to achieve that would be unacceptable.	
4.21 Umeme believe that in order to achieve realistic loss targets they need to	

AGENDA ITEM	ACTION
<p>operate in a strong and stable regulatory and political environment and they need to be given prepayment meter targets, new customer targets and loss and collection targets.</p>	
<p>4.22 The Report refers to a mismatch between audited statistics and the monthly reported statistics and Umeme would like to provide the Consultant with information to correct this.</p>	
<p>4.23 Umeme stated that their 2011 Loss Reduction Strategy had been approved by their Board subject to certain funding conditions.</p>	
<p>4.24 Some analysis is required to be done in order to align a loss reduction path and the corresponding expenditure requirements.</p>	
<p>4.25 Umeme agree that the studies recommended in the Report are required but considered that additional funding for these is required. They pointed out that their Distribution Operations and Maintenance Costs (DOMC) was fixed for 7 years and they had exceed this by some USD8m in order to focus on loss reduction efforts.</p>	
<p>4.26 Umeme confirmed that their focus was on their high consumption customers and this is part of their district Feeder Loss Analysis. They would provide the Consultant with a breakdown of non technical losses by cause and area resulting from their Feeder Loss Analysis results.</p>	
<p>4.27 Umeme experience is that non technical losses increase considerably due to illegal connections and direct theft with the connection of new areas as a result of the REA projects.</p>	
<p>4.28 Umeme agreed that the Report should prioritise loss reductions efforts in terms of value for money and agreed to work with the Consultant on this.</p>	
<p>4.29 Umeme agreed that prepayment systems had considerable benefits but they were expensive. Umeme considered that their AMR project would realise better savings in losses and collection rates.</p>	
<p>ERA</p>	
<p>4.30 ERA confirmed that they had not received Umeme's 2011 Loss Reduction Strategy.</p>	
<p>4.31 With respect to accelerated expenditure to reduce losses to acceptable levels the GoU urgently require the investment plans in order to achieve this. They need to see a prioritisation of loss reduction efforts and cost benefit analyses to support these.</p>	
<p>4.32 ERA acknowledge that Umeme are targeting 10,000 customers for prepayment metering and would like to see the impact of the introduction prepayment metering systems on losses.</p>	
<p>4.33 ERA explained that a Planning Forum for the sector is to be introduced and requested that all organisations provide participants losses as soon as the targeted pilot connections are completed and energy usage has been analysed.</p>	
<p>4.34 In order to address the recommendations arising out of the Power Loss Reduction Forum discussions need to take place between Umeme and other stakeholders on a regular basis.</p>	
<p>4.35 Agreed that loss reduction efforts should be prioritised and cost benefit studies done in order to target interventions.</p>	

AGENDA ITEM	ACTION
<p>MEMD</p> <p>4.36 Suggested that a committee be formed to monitor loss reduction efforts on a regular basis.</p> <p>4.37 Suggested that the Area and District Managers should be allowed to see the Report.</p> <p>UETCL</p> <p>4.38 UETCL were concerned about the comment that delayed projects were causing increased system losses to Umeme in some areas. UETCL said that they are looking for money and ways of improving their transmission capability and that if everything is completed as planned they believed that Umeme will not be able to distribute the power UETCL will make available.</p> <p>PB Power</p> <p>4.39 Confirmed that the Report was based on the information provided by Umeme and if information was not provided then this could not be used to inform their recommendations.</p> <p>4.40 The Consultant requested the breakdown on losses on feeder, substation and district levels by customer category, by type from Umeme.</p> <p>4.41 A forecast of expenditure with corresponding savings will be discussed with Umeme.</p> <p>4.42 The prioritisation of loss reduction efforts will be discussed with Umeme and included in the Report.</p> <p>4.43 Considered that the only way to properly identify the costs required in order to reduce technical losses to acceptable levels and to identify the real costs of the current losses is to undertake the studies recommended in the Report.</p> <p>4.44 Explained that the additional losses caused by UETCL project delays was because Umeme were forced to supply customers before network reinforcements were made resulting in higher technical losses on the overloaded networks.</p>	
<p>5. THE WAY FORWARD</p> <ul style="list-style-type: none"> • Additional information is required from Umeme and the Consultant will contact Umeme in this regard. • The Consultant should amend the Report to include comments received at the Workshop. • The Consultant agreed to submit the minutes of the Workshop at the end of the week and the final Report within 2 weeks, subject to receiving data from Umeme. 	<p>PB</p> <p>PB</p> <p>PB</p>

Signed



For PB

Signed

For ERA

APPENDIX C

UMEME COMMENTS TO WORKSHOP AND THE CONSULTANTS REPLY

UMEME COMMENTS TO WORKSHOP AND THE CONSULTANTS REPLY

From: Sam Zimbe [mailto:sam.zimbe@umeme.co.ug]

Sent: Saturday, July 02, 2011 7:11 PM

To: 'Millard, Ron'

Cc: david opio okello; 'Benon'; 'Fourie, Leon'; 'Sidharth'; simbiso chimbima; 'J P K Sembeguya'; 'n.semitala@era.or.ug'; Charles Chapman; Selestino Babungi; Zach Human

Subject: RE: FW: Addition data as per Workshop discussions

Ron

During discussions at the workshop (held on 7th June 2011) on the Consultant's final report on the "Study on Distribution Losses and Collection Rates" Umeme informed the participants that the company holds monthly KPI meetings at which distribution losses, *by feeder and by area*, are extensively discussed by the Senior Management Team and all Area Managers.

It was noted that the Consultant's draft report had implied that Umeme did not have a breakdown of losses by feeder and districts. Umeme refuted this and pledged to avail the Consultant with a schedule providing a breakdown of losses by feeder and district. The schedule was submitted on 16th June 2011.

It would be recalled that at the workshop, the Consultant was asked to include in his report, further information (to be provided by the Consultant as part his analysis and in accordance with the terms of reference of the study) covering:

- *Breakdown of losses* – terms of reference required the consultant to establish the level of technical and non technical losses
- *Prioritisation of loss reduction efforts in terms of best value for effort*- At the workshop the consultant was requested to prioritise the recommendations and align the expected reductions in losses to the proposed Losses Reduction trajectory
- *Impact on DOMC of loss reduction efforts* – At the Workshop, Umeme expressed its strong concerns that a loss reduction and collection trajectory was proposed for the period 2012 to 2018, with no indication as to how this trajectory will impact on the Umeme's DOMC. Umeme restated that the company's DOMC is the tariff was fixed for 7 years to March 2012, and any proposals on a schedule of loss reduction cannot be delinked with discussions on DOMC.

Umeme believes that since the Consultant has provided a losses reduction trajectory, he should accompany this with an assessment of the potential impact on DOMC. It should be noted that the issue of DOMC was raised in the Umeme detailed written comments on the Consultant's draft report

- *Capital expenditure forecasts for technical loss reduction with potential reduction in losses for the expenditure*. Again, at the workshop, Umeme and other participants expressed concern that the proposed losses reduction and collection trajectory was not aligned to the required capital investment. Umeme understands that the terms of reference required the consultant to "identify the required investments to reduce technical losses to optimal levels " Umeme believes that the report on study of losses should provide indicative levels of capital investments to support the proposed losses reduction trajectory.

We hope the above provides further clarity on Umeme's comments on the draft final report.

Regards

Sam Zimbe

The Consultants Response to the above: -

Benon,

We appreciate Umeme's comments and will include them in the Final Report.

As discussed in our Report we have based our trajectory on the current and historic levels of effort and expenditure, acknowledging, of course, that several of Umeme's initiatives are only now showing results. Umeme have provided no indication of their projected expenditure and the loss reductions associated with their proposed expenditure. We are unable to do this independently. Umeme appear not to have a breakdown of losses by type of loss, nor have they provided any indication of the costs associated with each specific loss type. Despite requests by ourselves and you Umeme have not provided cost benefit analysis of any of their loss reduction efforts, past or planned. It is therefore impossible for us to prioritise any loss reduction efforts in terms of best benefit. Umeme appear not to have this information either although we understood that the focus of their District efforts was in order to determine the source of losses in order to inform their loss reduction initiatives.

It seems clear that we will receive no further information from Umeme.

We acknowledge that Umeme's loss reduction efforts will influence their operations and maintenance costs. A study of these is outside of the scope of this assignment. Furthermore, if Umeme are reluctant to share their loss reduction DOMC forecast costs in the same way that they have been reluctant to share their capital expenditure forecasts then we would see this as a fruitless exercise anyway.

We propose to finalise the Report and will include the information received from Umeme on the breakdown of losses by feeder and district. We will revise the Report where we can in accordance with the suggestions made at the Workshop. The Minutes of the Workshop, together with Umeme's comments below will be included as Appendices.

Please confirm that we may proceed as such.

Kind regards

Ron Millard

Senior Consultant

Parsons Brinckerhoff (PTY) Ltd