

## **CURBING NON-TECHNICAL ELECTRICITY LOSSES IN A DOMESTIC PREPAYMENT ENVIRONMENT.**

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**This paper proposes a solution to a worldwide tendency, that of increasing non-technical electricity losses, especially amongst Residential Customers. The primary objective is to prove beyond any doubt that electricity was consumed, doing so with factual evidence, without identifying the manner in which tampering took place, with no photos, no videos or guilty parties and no testifying as to the identity of the actual transgressor or instigator, and finally, to have the proven right to render an account for that consumption.**

### **1. INTRODUCTION**

Throughout the electrical industry, ways and means have been established to curb non-technical losses, to substantiate and prove beyond any reasonable doubt, if taken to court, an assertion that electricity has been consumed without payment (in laymen's terms, stolen) and in accordance with promulgated bylaws, to charge the individual transgressor, in this case the owner / tenant with whom the utility has a signed agreement, a transgression fee and an amount in respect of electricity consumed over the period in question.

### **2. THE DILEMMA**

Prepayment meter technology, which requires a Customer to purchase electricity before consuming it, was thought to be a solution for all utilities selling electricity to a residential consumer base as it required no deposits, obviated the necessity for monthly meter readings and gave each Customer the facility to manage the purchase of electricity according to personal financial means. This should have been the ultimate revenue solution to a serious financial problem. Credit metered Customers effectively consumed electricity and paid for it a month and half to two months after the last reading, depending partly on efficiency of processing and partly on the necessity to render an account well in advance of its due date. If a Customer did not have the financial means to pay, the account fell into arrears and after 14 days electricity supply was disconnected. If the situation persisted, the Customer was served with legal papers or in the worst case, was declared indigent and the amount was written off.

The non-technical electricity losses arising from the act of tampering with electricity supplies, such as bypassing meters, and from illegal connections, have reached alarming levels in South Africa and worldwide. During 2003 over R1.5 billion was recorded as the monetary value lost.

The traditional practice aimed at detecting tampering with electricity supply comprises one or a combination of the following:

- § Conducting physical audits at all connection points to search for illegal connections or wiring that bypasses meters.
- § Auditing and testing electricity meters and metering installations to detect bridging-out of meters and current transformers or to detect isolation of phase voltages.
- § Relying on informants to "blow the whistle" regarding intermittent tampering, which is otherwise extremely difficult to detect.
- § Using abnormal variation in purchase patterns as reported by prepayment meter vending software programs that compare statistics of monthly purchase patterns by Customer with pre-set average levels (minimum and maximum), highlighting an abnormal variation in the purchase pattern as a "suspected tamper".

All the above approaches are very expensive, require specialised technical skills, are of a temporary nature and enjoy limited success, as in most cases, the physical evidence is removed, thus leaving assumptions and little evidence as proof. Customers who resort to tampering are increasingly becoming more and more entrepreneurial and innovative in their quest to achieve success without being detected, and some even pay for "specialised services", be it as bribes to officials or to third parties.

The deviation of the purchase patterns between the minimum and maximum parameters, lends itself to assisting the conscientious "buyer" to purchase just enough not to be detected, in other words, leaving no proof that a proportion of the consumption, perhaps as much as 60%, is not paid for. At the same time, erratic but valid purchases might easily lead to erroneous suspicion of tampering.

### **3. THE SOLUTION: CHECK METER PRINCIPLE**

Conventional credit meters, registering normal electricity consumption or base-mounted prepayment meters, which allow prepaid electricity to be consumed, will always create an environment conducive to tampering, as they are single meters installed inline with the main electricity supplying households.

It is in the combination of the two, that evidence may be found to aid in curbing non-technical losses. The conventional credit meter is installed outside the property

on the road reserve inside a secure metering cubicle / kiosk and inline with the base-mounted prepayment meter situated in the house in close proximity to the main electricity distribution board. Alternatively, a split prepayment, meter and keypad are installed somewhere outside the house and in the house, respectively.

The total consumption of electricity as registered by the credit meter must equal that registered by the prepayment meter over the same period. The credit meter is read periodically (on a 3-monthly basis) at a minimal cost. These readings are processed and the consumption compared to that recorded by the prepayment meter. The accepted deviation or discrepancy between the two manufactured meters, can only be the combined effect of their individual accuracy Class types. Since these meters are of Class 2 type, representing 2% accuracy for each, the combined accuracy can only be deemed to be 4%.

#### 4. REVENUE PROTECTION: ADMINISTRATION

Given periodic readings for every service, the bulk of the auditing (75% to 90%) is done electronically in the office and the remainder by way of physical visits to selected properties to confirm relevant technical detail by recording it on audit sheets / forms. Information available allows a property to be scrutinized by an official with minimum effort, but with excellent results.

Monitoring of properties is an ongoing process and allows hundreds to be processed in a relatively short space of time. Capturing of relevant information is crucial and must be kept up to date. The system is designed to police itself. Every 24 hours,

- any available new readings are captured,
- purchases as well as Consumer and new service data are imported from the Vending System by a facility provided for the purpose, and
- discrepancy lists are revised.

Any property identified in this manner, initiates a physical audit / investigation.

There is no need to audit every household and thereby frustrate the law-abiding citizen, who is paying for his services. This induces a positive attitude on the part of the Customer toward Council.

The following illustrates the essence of the principle:



Figure 1.Proven: Tampered Property Identified



Figure 2.Proven: Consumption Confirmed

It is apparent that Customers, whose electricity supplies are identified as having been subject to tampering, will forthwith, remove all illegal wiring and or other evidence.

A Customer's efforts to present as the innocent "victim", will bring forth all manner of objection, explanation and inconceivable delay tactic, for example:

- § No knowledge of electricity, therefore unable to tamper
- § Request investigation and proof of how it was done
- § Both meters are inaccurate and to be tested
- § Neighbours tapped from the supply
- § If physical evidence is found, previous owner or tenant was responsible
- § Bridging off of electricity supplies to outbuildings, prior to installation of prepayment meter.
- § Utility Contractors involvement
- § Utility officials involved – bribery or own "initiative" of creating additional income
- § The Check meter principle was not advertised or made known so amnesty must be applied
- § An unfair practice – Utility out to make money
- § Deceased person accountable as per the signed agreement, not the current family members
- § No purchases were made for months because meter was faulty and this was reported – no evidence to be found of such report

On the other hand, investigations reveal various techniques aimed at effecting and or concealing the tampering, for example:

- § Bridging off of electricity supplies to outbuildings, prior to installation of prepayment meter.
- § Utility Contractors were involved
- § Utility officials were involved – bribed or used own "initiative" to supplement inadequate income

The list is endless, however, to substantiate findings and prove that tampering indeed took place, purchase history (or consumption) relating to the prepayment meter and consumption registered by the check meter are combined in a graphical representation, as follows:

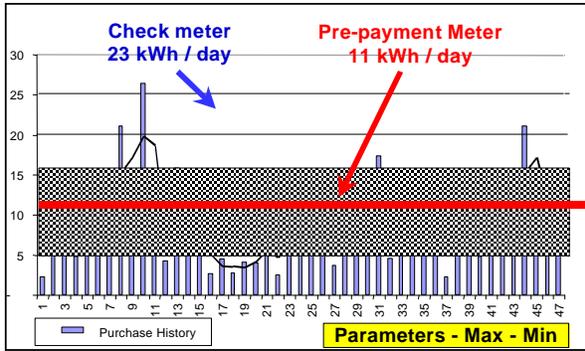


Figure 3. Purchase Pattern versus Check Meter Consumption

Historical evidence verifies tamper removal:

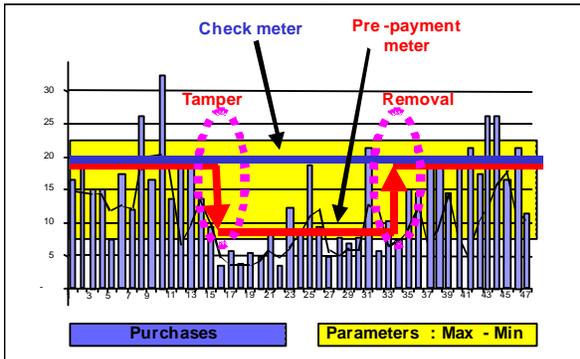


Figure 4. Removal of Tamper (Illegal wiring)

This illustrates that the Customer has corrected the delinquent behaviour and become part of the paying customer base once more.

Evidence as depicted, confirms that the message will not go unnoticed: "TAMPERING WILL BE IDENTIFIED!"

With the above Check Meter Principle as the solution to an ongoing revenue loss problem, where does one start looking into one's own environment.

Install bulk electricity meters at all the bulk intake supply points in all the different areas under your jurisdiction. Should one take monthly meter readings and compare the bulk meter consumption (Energy – MWh's) to Prepayment meter purchases (and credit consumption, if any) for the same area, it will become evident which areas suffer the most serious losses and will be possible to concentrate initial application of the aforementioned principle on the identified areas.

Individual check meters are installed or old credit meters retained as check meters, wherever prepayment meters are or have been installed. When new electricity supply connections are made, Customers pay for prepayment meters and the Utility installs check meters at own cost.

This is a process with long-term results. One cannot expect to achieve results within a short space of time. It requires Customers to make a paradigm shift from non-paying Customers to paying Customers.

The essence of this project was to instil in the community a sense of ownership that goes along with the responsibility to pay for services rendered. Those who do not adhere to the above, have to face the consequences.

## 5. HISTORICAL AUDIT SWEEPS

Unfortunately, this is still generally the only manner in which audits are conducted. Sadly, the effort is usually very expensive and the outcome is the following: The "bush telegraph" is present and cannot be ignored. As the sweep is initiated, a simultaneous message "transcends" the sweep into the identified area, houses are locked, customers "disappear", some hide within and no entry is gained to a large proportion of the premises.

During a sweep of a 1,000 households the following was experienced:

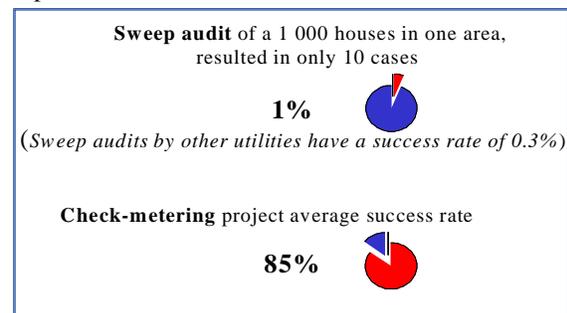


Figure 5. Sweep versus Check Meter results

## 6. PROOF THAT THE PRINCIPLE IS SOUND AND EFFECTIVE

The City of uMhlathuze identified an area in the year 2000 and action plans were initiated to curb losses in this specific area, which losses were close to 30% during the late 90's. Audits commenced in extreme earnest in 1999, but positive benefit followed the introduction of the Check Meter Principle:

- Ø Contractors were appointed to read all the existing credit meters (old billing meters) on a 3-monthly basis.
- Ø Areas were identified and check meters were installed inline with prepayment meters. This is now standard practice.
- Ø Financial implications are in the order of R395 per conventional meter, including installation costs.
- Ø New software was developed to produce thorough checks and balances between all the relevant data captured from the audit sheets, in order to summarize said information by producing a list of discrepancies identifying "tamper" properties.

The above measures were successfully implemented and the results were excellent. To date over 4,500 properties have been identified, an amount of over R10m has been charged and R8.5m has been recouped. The return on the capital investment for this project, can clearly be seen by these figures.

The following graph confirms the results between Purchases, Sales and Electricity Losses:



Figure 6. Purchases, Sales & Non-Technical Losses.

It is essential that all processes be adhered to strictly, for if the occupier of any identified property contests the results, the proof must stand up to close scrutiny. Legal action requires documentation and the results or their proof will be contested in a Court of Law.

Currently as per the Electricity Act, Electricity Supply Authorities are only allowed to disconnect an electricity supply to a property due to:

- ✓ Non-payment of a rendered account after 14 days.
- ✓ A publicly unsafe electrical condition with immediate effect.

A physical tamper is treated as an unsafe condition, and the electricity supply is immediately disconnected with a letter, duly signed by the officials as well as the owner / tenant.

In the case of the Check Meter Principle, where tampering has been proven, an account is rendered with a 14-day notice period within which the Customer is to pay or make due arrangements as per Council's Credit Policy. The right to purchase electricity is immediately revoked by being blocked in the Prepayment Vending System.

In the case of no payment or arrangements as stipulated, a Final Notice is delivered, allowing an additional 7 days grace, after expiry of which, the electricity supply is disconnected.

## 7. TECHNICAL CONTROLS

All meters (Prepayment & Credit) are sealed with uniquely numbered seals belonging to the City of uMhlathuze. These are registered when issued to the technical staff and recorded as such. A special project was launched to remove all old seals still in use in order to conform to the new seal standard. Previous "misuse" of seals was eradicated in this manner.



Figure 7. Seals

Strict meter procedures must be in place. No unauthorised meters should or must be made available to a any "corrupt" person out there, for the difference between an honest person and a transgressor is but a thin line.

An audit process must consist of at least two officials per audit team to assist the utility with the proven evidence, audit sheet / form data, signed by both and co-signed by the supervisor.

During the installation process of Check Meters, labelling, property versus meter, must be correct as this ensures that the crux of check metering is adhered to. Check meter and Prepayment meter must correspond by registering electricity consumed in or at the same property / household.

## 8. EDUCATE THE CUSTOMER

This project was and is no secret. It was and still is advertised to all the residents of the City of uMhlathuze. A special video has been made and is daily shown on a circuit video system at all the Vending Stations in order to sensitise all the Customers against electricity tampering. Special drive with informative sessions, were held prior to the launching of the project. The main drive is about changing a culture of non-payment.

Many informers are assisting Council to identify new or unknown transgressions. These properties must not correspond to any pre-identified tampered properties, in the pipeline to be processed. Informers will receive a monetary value only if the percentage result exceeds 50%. No lottery scheme is accepted whereby random properties are listed to be processed. Consecutive tampered properties will be addressed on merit if they form part of an informer's list.

## 9. ACCOLADES AND ACKNOWLEDGEMENTS

This project has proven itself worthy of the effort and dedication of all the parties involved. Eskom has a national eTa award system, whereby any project / process that has proven to be successful is measured amongst those in the same category. The Check Meter Principle won the esteemed eTa Award during 2003 for the Residential Category.

International recognition was given to the City of uMhlathuze, when the ex-City Electrical Engineer, Mr Danie van Wyk [1], presented a paper as requested, on the subject in Australia during October 2004.

The Association of Municipal Undertakings (AMEU) and the South African Revenue Protection Association (SARPA) has been used many a time as a platform to inform other utilities of the success of this project.

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**REFERENCE**

- [1] van Wyk, DJ., (Pr Eng): Ex City Electrical Engineer, City of uMhlathuze. (Initiator of Check Meter Principle).