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EXPLORING THE FINANCIAL IMPACT OF NON-TECHNICAL ENERGY LOSSES AND THE EMERGING BEST PRACTICES TO CURB THIS

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INTRODUCTION

Meter equipment tampering and energy theft is a widespread problem. Supply authorities experience losses relating to tampering ranging from 1.25 – 58% of total revenue. The intent of tampering is to reduce the account, without reducing consumption. It is by nature fraudulent. It is an economic and criminal offence. As the cost of energy increases, incidents of tampering and theft will escalate. Energy theft and meter equipment tampering MUST be stopped and perpetrators must be taken to task.

CONCLUSION

No supply authority, on a global scale, is immune to the prevalence of meter tampering and subsequent energy theft. There is a very definite correlation between entities who take a firm stand to reduce their losses by getting the basics right and following four steps:

1. Management commitment to addressing the problem – adopt a zero tolerance policy
2. Implementing a dedicated revenue protection programme with measurable objectives
3. Replacing archaic lead and ferule sealing methods with plastic, tamper indicative, uniquely numbered seals
4. A dedication to community awareness, training, education and responsibility transfer

INTRODUCTION

Meter equipment tampering and energy theft is a widespread problem. Supply authorities experience losses relating to tampering ranging from 1.25 – 58% of total revenue. The intent of tampering is to reduce the account, without reducing consumption. It is by nature fraudulent. It is an economic and criminal offence. As the cost of energy increases, incidents of tampering and theft will escalate. Energy theft and meter equipment tampering MUST be stopped and perpetrators must be taken to task.

Readers of this report may nod their heads in agreement, but why then, are so few doing anything proactive about deterring it? Why is not more emphasis placed on the deterrence of meter tampering and energy theft? Why is there such widespread reluctance to get the basics in place? These questions will hopefully be answered by analyzing field comment extracted through a case study conducted by Integrity Control Systems (ICS). The case study reveals interesting correlations between supply authorities who have disciplined initiatives in place, who use uniquely numbered seals and who have been successful in deterring non-technical losses. The case study also highlights that management commitment precedes the implementation of simple control measures all of which support the success of a dedicated revenue protection program.

PROBLEM DEFINITION

One asks the question: What is at the core of every business? The answer should surely be: Making money to be both profitable and sustainable. Unless supply authorities embrace a zero tolerance attitude towards electricity thieves, energy theft will continue unabated and will keep on eroding the profitability and sustainability of energy distributors. In light of the energy crisis, the active prevention of energy theft has never before demanded such desperate attention.

SITUATIONAL ANALYSIS

There are no *non-criminal* reasons for meter equipment tampering. Someone wants to consume energy but doesn't want to pay for it. And if he gets away with his endeavours, he is guaranteed to do it again, and again. It is devious but it has to be proven before there is any hope of curbing this behaviour. Having no deterrent mechanisms in place or generic ones (like lead seals or ferules) which anybody can manipulate, find, *borrow* or buy, plays right into the hands of the person or parties behind this criminal behaviour because the supply authority simply has no reliable recourse for action.

WHAT ARE THE IMPLICATIONS OF THIS PERPETUATED ENERGY THEFT?

Plunged into a recent energy crisis, it may not be so far fetched to attribute some portion of the energy crisis to the ineffective manner in which energy theft, wasteful usage and non-payment has been handled by policy makers and supply authorities in the past. The implications are far reaching and painful; personally and economically.

I make reference to research recently conducted by Mr Chris Yelland, managing editor of EE Publishers. In an article published in the April 2008 issue of Energize, he recorded his findings, of which I extract the following: "…the impact of lost revenue of the electricity distribution industry due to theft and unpaid electricity of 12 934 GWh per annum is about R5,34-billion per annum." It should be noted that the non-technical losses are equivalent to the Eskom target saving of 3GW. Even when the generation capacity problem is solved, the financial shortfall created by energy theft and non-payment will not miraculously go away, it will simply continue on its perpetuated cycle unless more is done to stop or at least deter meter tampering and associated fraud.

This paper does not profess to uncover the reasons which have led to this mammoth problem situation nor will this paper elaborate on a myriad of solutions to judicial challenges in dealing with energy thieves.

It suffices to say that I have observed reluctance from industry to quantify the scale and monetary value of non-technical losses prevalent in a particular entity, and, perhaps by drawing your attention to the previously mentioned statistics, the matter of meter sealing will deserve a slightly more elevated rank of importance.

WHAT ARE THE OBJECTIVES OF USING UNIQUELY NUMBERED SEALS?

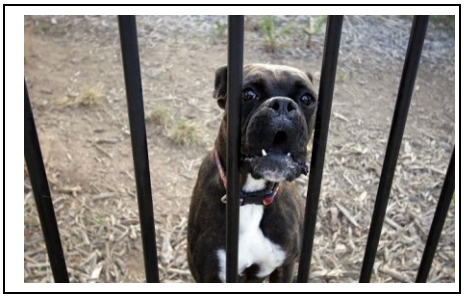
- Restricting access to certain parts of a device (interference, theft, vandalism, safety)
- Deter tampering and to provide reliable proof of tampering
- Identify the point of liability
- A visual checking mechanism to act as an integrity flag: consumer behaviour and equipment status
- The presence of seals validate the quality of a process or work performed
- To validate the calibration of meters to SABS standards
- Ensure the integrity of the initial commissioning
- Ensure process control and traceability from the start of the meter's life cycle
- Create an audit trail of activity associated with that item of metering equipment

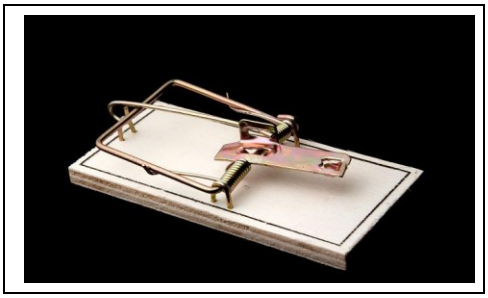
ACADEMIC DEFINITION OF A SEAL:

A security seal is a passive, one time locking device, with **a unique, serial number** / identification / bar-code that is used to provide a reliable indication of tampering (unauthorized removal or attempted removal) or entry. In addition, by virtue of its construction, the security seal provides limited resistance to an intentional, pre-meditated attempt to open it and gain access to the meter or metering equipment that is sealed with the seal. It should not be possible to manipulate and breach a seal without clear visual indication thereof, nor should it be possible to cannibalize a seal to construct another functional seal. Seals require inspection to indicate whether tampering has occurred or entry has been attempted.

A LATERAL VIEWPOINT:

Interestingly enough, many users of seals, Revenue Protection officials and industry players conjure very different associations when asked to define a 'seal', but the following colourful definitions have a common thread – it is a control and warning mechanism which creates an audit trail and when breached, should lead to a secondary action.





'The seal says STOP, don't try to get in there', 'The seal draws the line in the sand, it eliminates the grey area', 'A seal is a deterrent to discourage a devious attempt', 'The seal is a watchdog which triggers secondary actions', 'The seal is the 'finger-point' to say YOU DID IT' 'It is a visual warning: if you are in breach, we'll catch you' 'The seal is like a mouse-trap, if its breached, we have proof and can take action.' 'A seal may not stop the entire problem, but it's the vital step to containing the problem', 'A seal is the irrefutable proof that someone is acting fraudulently and which helps us to prosecute or even to just recover our revenue', 'The seal is a visual indicator of the goings on surrounding that piece of metering equipment'.

FINDINGS FROM A CASE STUDY CONDUCTED BY ICS

ICS embarked on a case study involving 19 utilities and supply authorities in Southern, Eastern and Central Africa. The research was conducted over a period of 4 months and the responses as at 18 July 2008 indicate the following statistics:

100 %	Experience meter equipment tampering and energy theft The reported percentage of annual revenue loss due to energy theft ranges between 1.25 % and 58 % of total revenue
100 %	Reported that consumers are most likely to engage in fraudulent activities, in addition
16 %	Reported that their own staff are most likely to engage in fraudulent activities
16 %	Reported that contractors are also likely to engage in fraudulent activities
84 %	Of utilities & supply authorities have dedicated Revenue Protection programmes
37 %	Have formal sealing policies in place to control the use of uniquely numbered seals
91 %	Of users of lead seals & ferules confirm the ineffectiveness of this sealing method
42 %	Are currently utilizing plastic, uniquely numbered seals
100 %	Of users of uniquely numbered seals feel that tampering is deterred more successfully than when using ferules, lead seals or no seals
58 %	Are using uniquely numbered seals (plastic, metal or self adhesive seals)
29 %	Of users using uniquely numbered seals, have no or inadequate databases in which unique seal numbers and associated information is recorded
100 %	Feel a seal tracking system would be of benefit (either a simple paper based system or web based)
61 %	Feel the current legislation is inadequate in addressing the severity of energy theft
53 %	Place an emphasis on community awareness training and education as part of a successful revenue protection programme

A quantifiable 'before and after' scenario was difficult to document as many of the entities reviewed have only recently begun transition strategies from using no seals, or lead seals or ferules, to uniquely numbered seals. It is estimated that measurable improvements would only really be evident after 2 to 5 years of dedicated, measured strategy.

The primary conclusion one draws from this research is that supply authorities who utilize lead seals or generic ferules are more vulnerable to non-technical losses than those supply authorities who have stringent sealing policies in place, coupled to the use of plastic, uniquely numbered seals.

The secondary conclusion is that strong leadership and focus in management, underpins the success of any revenue protection endeavour.

Thirdly, community awareness training enhances buy-in and co-operation in terms of energy theft prevention and resource conservation.

Fourthly, the old adage of 'what you can't measure, you can't manage' was echoed. If your data is unavailable or inaccurate, this also needs to be a focal point in any attempt to contain non-technical revenue loss.

Integrity Control Systems has been closely involved in co-operative projects with several of the entities researched and have successfully developed appropriate, practical and cost effective solutions to combating the threat of meter tampering and energy theft.

REASONS CITED FOR THE LACK OF METER SEALING & SEAL CONTROL

a) No dedicated Revenue Protection initiative
b) Ignorance of the problems associated with old, ineffective methods of sealing
c) Ignorance of the steps that can be implemented to ensure better management control
d) No budget allocated for quality, uniquely numbered seals
e) Apathy in implementation of the necessary controls
f) Sealing ranks low in importance requiring management focus
g) Apathy in people management
h) Lack of ownership, *who's problem is this any way*?

HAS THERE BEEN ANY PROGRESS?

My observations thus far have been fairly grim, but there is positive feedback, and yes, there is progress. In July 2006, I participated in a panel discussion held at the SARPA convention in Midrand, Johannesburg, entitled: 'What are the benefits of sealing and what are the preferred options." For those of you who did not participate in the discussion and for those who may not recall the outcome, a summary of the outcome is provided. *The general response from the forum confirmed the need for seals on conventional meters as well as pre-payment meters. The advantages of using plastic or paper, uniquely numbered seals, in various colours, seemed widely and favourably acknowledged. Although still in use, the weaknesses of lead seals, ferules and wire, received knowing nods from the forum. The biggest, 2-pronged question raised from this discussion was; will SARPA and a working group, work towards the setting of a sealing standard to benefit the industry and what is being done to help develop a system which will assist users in the control of the above mentioned seals. Responses to this question will follow.*

The positive feedback is that a working group was formed, championed by SARPA and the subsequent result is the publishing of NRS 096 Part 1: The sealing of electricity meters.

A SUMMARY OF NRS 096: SEALING STANDARD FOR ELECTRICITY METERING EQUIPMENT

The purpose of this NRS specification is to establish and promote uniform requirements for application in the South African Electricity Distribution Industry. It identifies available sealing options and sets out guidelines to enhance controls within a revenue protection process. No formalised direction and guidance on the matter of meter equipment sealing, has previously existed which probably contributes to the resulting ignorance about sealing. The standard provides answers to widespread requests for a 'how-to' guideline to manage an effective revenue protection process by implementing simple sealing protocols to create a chain of custody and to ensure its integrity. Subsequent to the request raised at the SARPA convention in 2006, this guideline has been developed and published. NRS 096 supports the NRS 055 – Code of Practice for Revenue Protection.

To summarise the main points of this specification:

- The document sets out the **requirements for sealing** of electricity meters and related ancillary metering equipment

- The document provides **guidelines** on the roles and responsibilities related to the **management of seals**, the process for the management of seals and provides information on the requirements for various types of seals

- The primary objective of sealing any item of metering equipment, is to ensure that **access** to certain sensitive parts of that device is **restricted**. This is especially so where energy meters is concerned, since these form the basis from which **revenue** is **obtained** by the electricity supply utility. It is therefore imperative that **strict sealing standards** are established and that proper control is maintained to ensure that these requirements are adhered to
- A secondary objective of sealing is to provide a mechanism by which the last person to have worked on a specific piece of equipment can be traced – **a reliable audit trail**.
- The document details the steps in implementing an **effective sealing policy**. These include: (1) Authorised management and control of seals; (2) Authorised procurement from a compliant supplier; (3) Receiving of seals; (4) Secure storage; (5) Authorised issuing; (6) Staff training; (7) Auditing of seals; (8) Returned seals; (9) Accurate record keeping and info transfer onto secure database; (10) Seal disposal

- The document explores **various sealing options** available to the industry. A strong rejection of lead seals is voiced and hopefully everybody to whom this paper is directed, is aware of the harmful properties of lead. Metal seals are not recommended due to the corrosion factor and high vulnerability to tampering. The document does make allowance for paper seals, otherwise known as security labels and copper ferules and wire, but strongly promotes the use of uniquely numbered, plastic seals.
- The document proposes a **colour code** for tool-less seals to identify various tasks performed on the metering equipment.

THE OVER SIGHT

Although the creation of the NRS 096 is an extremely positive development which has given the industry a much needed tool to enhance their revenue protection endeavours, it is not mandatory. In light of the staggering statistics highlighted earlier in this paper, it concerns me that this standard cannot be formally imposed on the management of supply authorities who should be directly accountable for the prevention and deterrence of energy theft.

The use of generic, un-numbered ferules is still widespread amongst municipalities and Eskom as a whole. This archaic method of so-called sealing creates a false sense of security and control as there is nothing to audit and monitor, yet, this method of sealing is included in the NRS 096 as an 'acceptable' means of sealing. Comments from the field are frequently received stating that users do indeed have 'uniquely' numbered pliers used to crimp lead seals and ferules. Let us for a moment define the word 'unique' – ***one of its kind***. This may be so for the crimping tool or pliers, with personalized jaws, but as soon as more than one lead seal or ferule is applied to any item of metering equipment, the controls are diluted and one essentially cannot differentiate one sealing activity from another. There is no longer a singular, unique seal, which creates an audit trail - every seal looks the same in that application chain. If a lead seal or ferule is intact on visual inspection, is it *really* intact, or does the possibility exist that it has been breached and simply been replaced by another one, using the same pliers or crimping tool? The same risk applies to the pliers getting into the wrong hands or being lost, there is no subsequent control of this tool which simply does not distinguish one sealing action from another. One cannot realistically expect a deterrence value from something that is easily manipulated and easily available to replace to disguise criminal behaviour. A reluctance to change is clearly evident. Perhaps the numbers that are coming out of the research and case studies will shake up the industry and will advocate the necessity to rule out lead seals and ferules, recognizing them for what they are: outdated, inadequate and simply put, a waste of time, money and resource to apply them. Provision should be made to replace these dinosaurs with uniquely numbered, tool-less seals.

NUMBERING FORMAT: A MATTER THAT REMAINS UNADDRESSED

To re-iterate, NRS 096 has been a very worthwhile basic step in compiling a guide line to the industry on sealing options and the implementation of sealing control protocols. If viewed in isolation as an initial step, it has achieved its objective. However, as a supplier to the industry, it has been noted that the validity and integrity of numbering formats for seals, calls for a little clarity.

This issue was not explored during the development discussions of NRS 096 and may not perturb users too much at this stage, who are still in the transition phase; *no seals or lead seals / ferules to uniquely numbered seals,* but, it could raise complex problems at a later stage. It may be necessary to propose an addendum to the NRS 096 as it currently stands to include a minimum quality and security standard for seals. Discussion needs to focus on a conformance with number sequence formats across multiple suppliers which will ensure the integrity of a supply chain of seals into the field and which will help to deter and detect the presence of 'alien' seals in the industry. Integrity Control Systems has identified these challenges and proposes an application guide to enhance the adoption of these guidelines, should they be formalised and to help convert an academic document to practical and manageable implementation.

It is suggested that a numbering format or number allocation standard is developed. This format needs to cater for multiple suppliers and seal types. The number allocation standard is expected to address the transition challenges as identified and is conceptualised to preserve the integrity of the supply chain in supporting the chain of custody throughout the life-cycle of the seal.

Suggested numbering formats:

Format 'A' (accessories): Stock print on seals + 7 digit human-readable number only. Example: **'SEALED 1234567'**

Format 'B' (bar-code): Supplier ID **(AB)** / User ID **(CD)**+ bar-code representing a 6 digit unique serialized code, (alpha & numeric). Example:

ABCD Z12345

Format 'C' (compact / personalised): Supplier ID **(AB)** / User ID **(CD)**+ 6 or 7 digit unique human-readable number. Example:

ABCD
Z12345

It is suggested that these numbering formats are applied as appropriate to the application. Seal manufacturers could then innovate and cost reduce various seal technologies as different "types" with a clear understanding of the format of the numbering to be applied.

Format 'A' seals would consist of a 7 digit, human readable number only, and would be recommended for accessories and general, less stringently audited applications. **Format 'B'** seals would be recommended for stringently audited applications embracing bar-coding technology. **Format 'C'** would be for primary use, compact seals (ie meter manufacturers). Formats B and C would require that both parties (AB and CD) maintain and retain records of the seals issued. This would help overcome fraudulent and / or inadvertent "loss" of records of the seals issued. Registration as an AB or CD would require proof that adequate capability exists to capture and retain records of the seals issued. A requirement for issue of Format B seals would be an undertaking that CD has understood the field scanning equipment requirements and methods of transferring such information to a secure storage medium. The use of Formats B and C would indicate that the user understands his / her responsibility for having adequate controls in place to support the 'chain-of-custody' surrounding seals.
In practical terms, this numbering format would cater for users who have advanced technological platforms in place but will also offer inclusion to other users who wish to comply with the standards proposed but who are still operating manual processes.

The alpha in the number sequence for Format B and C, allows 26 additional numbering combinations. If the colour of the seal will be varied and this needs to be recorded, it would be acceptable for the colour of Format A and C seals to be captured manually. The barcode on Format B seals could be specified to contain a field that identifies the seal colour, so that it is captured automatically. The barcode definition thus needs to clarified to confirm the order of the fields (eg X for colour, ABCD Z12345)

A COMPARISON BETWEEN THE FINANCIAL IMPACT OF TAMPERING & THEFT VS THE ESTIMATED SOLUTION SPEND

5 supply authorities have been identified to create this scenario analysis.

We reviewed their individual annual revenue, totaled their number of customers, showed the monetary value of their non-technical losses per annum in ZAR and used a unit cost of R 3.50 for a premium quality uniquely numbered plastic seal. We then calculated the total cost of the uniquely numbered plastic seals to cover the customer profile, basing our calculation on two seals per meter. We subsequently calculated the monetary value of the potential savings if 70% of the revenue attributed to non-technical losses and theft was recovered.

Please see attached spreadsheet, annexure 'A'.

Many acknowledge the existence and impact of the problem, but struggle to quantify it and struggle with the challenge of the lack of resource and capability. If a revenue protection team cannot be mobilized internally, I urge you then to develop a loss reduction strategy which involves the services of an outsourced consultancy. Make them accountable for the measurable results. This service comes at a cost but they are invariably better equipped to manage projects like these as Revenue Improvement and Revenue Turnaround strategies are a core competency.

DEPARTURE POINT

The reality and magnitude of the problem has to acknowledged. Management need to take ownership to address the issue of meter tampering. It is recommended that a Revenue Protection Programme is established and NRS 055 provides a comprehensive reference for this. Thereafter a Sealing Policy needs to be formalized, NRS 096 offers guidance in this regard. Hand in hand with these guidelines, a tool kit has been compiled to assist in the practical implementation of an effective seal management strategy.

TOOL KIT

1. Quantify the risk and identify priority areas for seal implementation roll-out
2. Assess risk profile (low / medium / high)
3. Allocate time frame for roll-out
4. Choose appropriate seal (risk, conditions, functionality, industry preference)
5. Obtain specifications from supplier
6. Standardise seals to be used
7. Agree on name, colour /s, numbering format
8. Quantity requirements
9. Procurement process (initial / ongoing)
10. User training
11. Customer awareness and responsibility transfer
12. Web based seal management system or manual control process
13. Manage the strategy internally or appoint suitable consultancy
14. Define measurement indicators
15. Review the benefit of the sealing strategy over a period of time

CONCLUSION

No supply authority, on a global scale, is immune to the prevalence of meter tampering and subsequent energy theft. There is a very definite correlation between entities who take a firm stand to reduce their losses by getting the basics right and following four steps:

5. Management commitment to addressing the problem – adopt a zero tolerance policy
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8. A dedication to community awareness, training, education and responsibility transfer

This is a call for engineering managers and revenue protection officials to take ownership for this seriously debilitating problem, to delegate responsibility to do something about it and to set measurable goals to achieve a percentage of non-technical loss reduction over a certain time frame. It is a mindset change. How much more severe must the energy crisis become before more industry members draw a line in the sand and acknowledge the need to act. Little steps to institute control and to demonstrate zero tolerance, coupled with the implementation of an inexpensive, uniquely numbered 'watchdog' will result in substantial financial recovery and will send out the message that criminal acts will not go undetected and without consequence. The time frame in which these case studies were conducted was short and disappointingly, many entities failed to respond even after agreeing to participate. We look forward to continuing the research and to report back on field progress in a future forum.