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Current Tampering Techniques on Prepaid Domestic Meters in Uganda

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Abstract*: Energy theft is a common activity in our country today according to reports and it is causing utility companies to lose money, making it a major source of concern. Consumers have been caught tampering with their energy meters, causing them to stop, under register, or even circumvent the meter, effectively utilizing electricity without paying for it. The resulting losses cause power utilities to raise electricity prices in order to recoup distribution and operation costs which affect new entrepreneurs thus hindering economic growth. In this paper, we discuss the two common tampering techniques identified during our survey, this will help the stakeholders in the utility distribution company to mitigate or further reduce on the losses incurred during meter tampering.*

Keywords—Tampering, Prepaid Meter, Theft, distribution, losses, Consumers, Utility

1. OVERVIEW

The BEC44(09) meter is a single-phase Standard Transfer Specifications pre-payment electricity meter with a Dual In line rail mounting and is ideal for residential applications [1]. The solution comprises two elements, a measurement control unit (MCU), more commonly known as the meter and a user interface unit (UIU) which is the consumer's keypad interface. The installation is termed "split" or "split metering", as the metering device is separated from the consumer's interface. The meter is housed outside the consumer's premises, for example in a street kiosk or pole top box, which enables easy access for the utility [2]. The User Interface Unit (UIU) is installed in the consumer's premises for easy user access. The UIU is used by consumers to enter their electricity tokens, to view information regarding their consumption and other functional abilities. The BEC44(09) solution provides a number of innovations, where the device can operate as a smart pre-payment meter or post-payment meter. The device has over 50 programmable functions, to provide a high level of customization for each utility.

The BEC44(09) meter has optional tamper protection, that is configured in production. If the tamper feature is enabled, any attempt to tamper with the meter can result in the consumer's supply being disconnected, if so configured [3]. The supply is only reconnected when a Standard Transfer Specifications (STS) clear tamper token is entered into the meter. The STS tamper token is meter specific. When enabled, tamper is only active once the meter is commissioned. The meter is shipped in a decommissioned state to facilitate installation. In this mode, the tamper feature is disabled to allow the installer to fit and remove the terminal cover, without the unit going into tamper. Currently, electric theft is becoming common and there are several ways in the which the prepaid domestic meters are tampered with i.e. breaking the seals on the meter and the terminal cover opening either to bypass the meter at the terminal or tamper with the meter circuitry.

In this paper we review some of the common current techniques of prepaid meter tampering in Uganda.

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2. TAMPERING TECHNIQUES

Reduction of the amount of current entering the meter.

In partially earth condition one of the loads is connected to earth and other is returned back to neutral of the meter. In fully earth condition the total load is earthed. In both the cases the current in the neutral wire I_N, is less than that in the Phase wire (I_P). To detect this condition, the meter monitors the currents in both energy wires - Phase and Neutral with the Measuring current transformer and compares them. If they differ significantly, the meter uses the larger of the two currents to determine energy. The missing neutral tampering condition occurs when the neutral is disconnected from the meter. In this condition, there is no voltage input and thus no output would be generated by the power supply. However, when the load is applied, there would be a valid input signal on current circuit, hence power will be consumed. Since the voltage on Neutral is zero, Power P = V x I = 0. This condition is also known as single wire operation. During our study the amount of current entering the metering control unit was reduced by placing a resistor on the signal wire feeding the Meter control unit which reduced power consumption in Kilowatts on the side of the consumer, thus translating into an energy loss to the Electricity distributing company. The figure below shows energy theft by insertion of a resistor in the meter circuit which was confiscated during the survey.

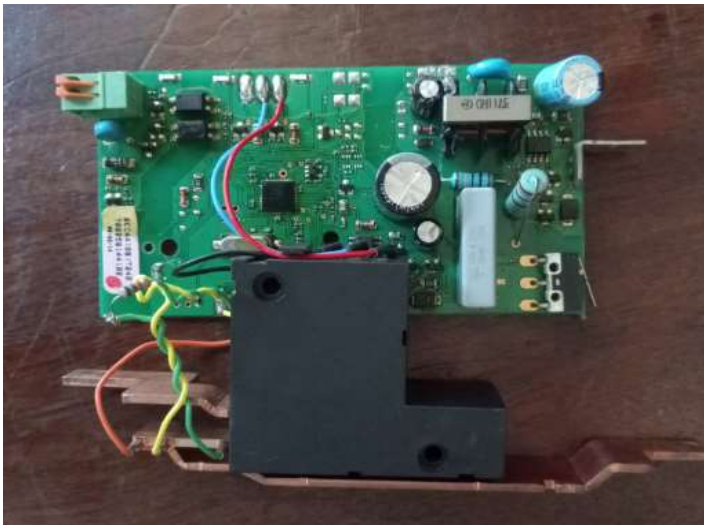

Figure 1: Energy theft by insertion of resistor in the meter circuit

Tampering with the follow of current.

There are many ways to bypass an energy meter. The most common way is by putting a jumper in meter terminal such that connection is bypassed and the energy consumption is not registered. This kind of meter bypass can be easily detected by monitoring the currents in all energy wires – all Phases and Neutral, and compares them. But in this case an external bypass circuit containing a microprocessor that was programmed to open or close a relay connected in series with the meter, bypassing the meter and not recording any energy use when the relay is opened was used thus registering enormous losses by the distribution company.

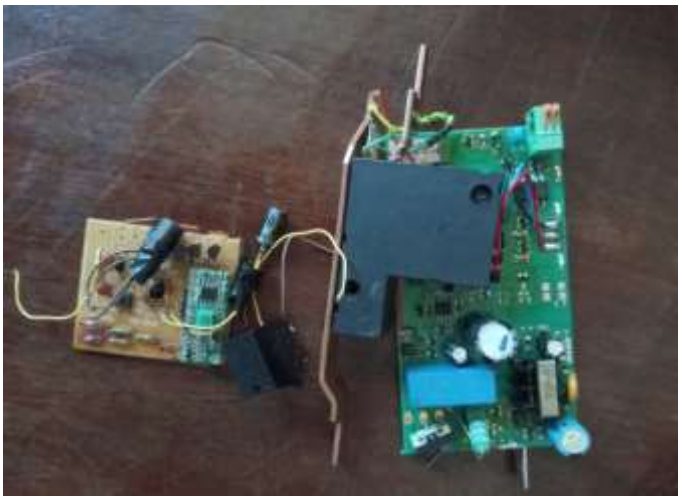

Figure 2: Circuit board with relay for meter bypass.

3. CONCLUSION

As part of a drive to reduce theft losses, Uganda's main power distributor, UMEME limited, implemented prepaid meters, and by the end of 2020, 97 percent of her customers had been connected to prepaid meters [4]. It has reduced losses from around 40% when it first joined as a utility service provider in 2005 to 17.5% by the end of 2020. Despite the fact that this is a great achievement, it is still above the statutory objective of 14%, and more effort needs to be done to further reduce it [5]. The figure below shows the performance road map of UMEME as far as Energy losses are concerned.

Figure 3: UMEME's loss reduction performance

Despite the fact that prepaid meters have made a major contribution to loss reduction, they still face a barrier that, if addressed, might assist further cut losses. The prepaid single-phase meters in use are unable to detect tampering when it occurs during a power outage, giving questionable electricity customers the opportunity to alter the meter for energy theft. The meters also lack the capability to notify tampering in real time, while having tamper detection capabilities. These flaws highlight the importance of finding ways to improve these components of prepayment meters.

References

[1] S. S. Sable, Saurabh Padalkar, Akshay Rathod, Gaurav Tayade, and Vaibhav Bhadmukhe, "Smart Energy Meter," *Int. J. Adv. Res. Sci. Commun. Technol.*, 2022, doi: 10.48175/ijarsct-2888.

[2] W. A. Souza, F. D. Garcia, A. C. Moreira, F. P. Marafao, and L. C. P. Silva, "Automatic Consumption Management for Prepaid Electricity Meter with NILM," *IEEE Lat. Am. Trans.*, vol. 18, no. 6, 2020, doi: 10.1109/TLA.2020.9099748.

[3] Kannan P, A. Devaraj, Esakki Rajavel. S, Nisharni B, Sancta A, and Muthu Lakshmi M, "GSM Based Smart Energy Meter System," 2021. doi: 10.3233/apc210274.

[4] Abubaker Mayemba, "Umeme Loses Billions to Power Theft," *Observer-26 august*, 2016.

[5] J. Mawejje, E. Munyambonera, and L. Bategeka, "Powering Ahead: The Reform of the Electricity Sector in Uganda," *Energy Environ. Res.*, vol. 3, no. 2, 2013, doi: 10.5539/eer.v3n2p126.