The ACE9000 InfoPOD is a radio frequency (RF) communication device designed to assist with revenue protection (i.e. tamper detection) and to remove operational difficulties in the management of prepayment electricity meters.

The device can be retrofitted in any existing STS compliant prepayment meter that supports an SCSSCAAA9 (MC171) compliant data port. Currently this means that it can be fitted to more than 4,5-million prepayment meters in South Africa alone.

The system set-up of the device is as follows: The RF device is connected into the back of the prepayment meter data port (MC171 port). With a handheld unit (HHU) having an RF master transceiver unit (RF master Unit), communication between the meter and HHU is established. This makes it possible to read the meter registers and to send tokens to the meter from a remote point. The information can be transferred to a central operational workstation or management system.

The InfoPOD provides the ability to audit an STS compliant meter without having physical access to the premises. It assists with tamper detection and provides energy consumption (kWh) information per prepaid consumer (as opposed to purchase information). This is a first in the prepayment industry for one-way STS compliant prepayment meters, and opens the way for enhanced remote vending system. Such sophisticated tampering is very difficult or impossible to detect without a detailed audit of the prepayment meter installation by an inspector.

The prepayment meters are also prone to functional failure and they may fail in a mode where free electricity is delivered to the customer, or the metering function may fail to accurately record the delivery, in which case electricity may be delivered at an effectively reduced price. This may lead to the consumer purchasing tokens less frequently or not at all. There also exists a sophisticated form of tampering where the consumer causes the meter to slow down or to cause it to stop measuring, but the consumer then still continues to purchase tokens at a reduced frequency in order to evade detection by the management system. Such sophisticated tampering is very difficult or impossible to detect without a detailed audit of the prepayment meter installation by an inspector.

The technology, via centrally located wide-area network concentrators, also paves the way for enhanced remote vending capabilities, remote meter reading and customer management functions such as remote disconnections.

The InfoPOD is a proven device that functions with, and is retrofit-able to, all current STS prepayment meters (Lands & Gyr, Conlog, CBI and Actaris). The device is furthermore affordable for deployment in large quantities, with an independently calculated payback period of 1 to 3 years. (Reference: Eskom Distribution Technology).

Ultimately the benefit of the device is destined to provide to the industry is significantly reduced non-technical losses, combined with decreased operations cost, more accurate consumption information and less consumer-intrusive methods of curtailing tampering.

Quantifying the benefit based on losses (15%) to the industry alone equates to more than R750-million annually.

Background

In poorer communities in South Africa it has become common practice to install prepayment electricity meters at the point of delivery of electricity to domestic dwellings.

The consumer has to purchase a predetermined amount of electricity in advance, which he transfers to the prepayment meter by means of a token. As the household consumes electricity, the credit thus transferred is reduced until it is all used up, at which point the electricity supply is automatically interrupted by means of a load switch. The consumer then has to purchase a further amount of electricity to enable him the connection to the supply network to be restored for further consumption.

There are two types of prepayment meters in use. The one type that carries information only from the management system to the meter is known as a one-way token metering system. The other type that carries information from the management system to the meter as well as from the meter to the management system is known as a two-way token metering system. The one-way token metering system is simpler and generally has a significant cost advantage over the two-way type, and it is preferred in electrification projects where the average consumption rates are very low and the consumers are generally poor.

The prepayment meter is normally installed inside the dwelling of the consumer, and is then not accessible to an inspector when the occupants are not at home. In these poor communities it is frequently found that the occupants tamper with the prepayment meter in order to get free electricity and will lock the doors and not open up for an inspector or they will simply not be at home during the day.

In the one-way token metering system, the management system only has information regarding the purchase pattern of the consumer and not of the actual consumption. Much sophisticated effort is put into analysis of this information regarding normacy and deviations in order to detect possible suspected tampering situations. In instances where the management system indicates a suspected tampering situation, an inspector is normally sent to investigate and to visibly inspect the prepayment meter.

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The problem is further complicated by the fact that the prepayment meter is normally sealed and certified after installation in such a way that an inspector would have to dismantle the meter installation with a fair amount of effort in order to find a bypass wire conductor that may have been installed. It is also the case that the original installation personnel are sometimes dishonest and will install and certify the POD+ prepayment meter installation as being correct, but having installed a bypass wire himself and then taking a bribe from the consumer.

These are conditions giving rise to the necessity and need for being able to gain access to a prepayment meter in order to perform an inspection and audit.

The new InfoPOD device overcomes these difficulties by providing a means whereby...
an inspector is able to gain information regarding the correct functioning of a prepayment meter without having to obtain direct physical access to the installation or having to enter the premises of the consumer where the prepayment meter is installed. Information thus gained can then be fed back to the management system in order to improve on the operational performance of a particular prepayment meter, and of the system as a whole.

Other existing solutions take the form of automatic meter reading (AMR) systems where an installed meter may communicate readings back to a central station or to a mobile station by means of a power line carrier modem, radio modem or telephone network modem. These solutions are costly and also do not provide for the full suite of functions enabled by the new device.

Benefits

Associated problems that the InfoPOD helps to solve:

- Meter failure goes undetected or cannot be confirmed by inspection
- Remaining credit cannot be easily extracted from failed prepayment meters to be transferred to the replacement meter
- Failed meters are replaced without the management system database being notified or updated
- Details of newly installed meters are incorrectly reported to the management system database
- Consumer tampering with POD + prepayment meter installation goes undetected or cannot be confirmed by inspection
- Inspector cannot get access to the prepayment meter (no one at home or dogs)
- No feedback status from the meter back to the management system

- Sophisticated tampering is difficult to detect without feedback
- Cannot easily locate a POD or meter in informal housing complex
- Cannot identify a POD or meter without visual contact
- Multiple dwellings on a single erf sharing the same physical address
- Meter serial number is sometimes the only formal identification means for the prepayment meter
- Existing prepayment meters do not have a real time clock
- Existing prepayment meters do not provide for a tariff to be applied in the meter at the time of use
- Existing prepayment meters do not keep historical delivery profile records
- Only the purchase history is known to the management system and not the actual delivery history
- Accurate energy balance is not possible without actual delivery records
- Meters are by-passed by the installation personnel
- Inspection reports are inaccurate due to inaccurate data capture methods

Other solutions offered in the market place

Another solution that exists is the installation of “split” prepayment meters that comprise of two parts. One part is installed inside the home and the other part (containing the measurement functions) is installed outside the home in a locked box, which is only accessible by an inspector. The two parts communicate by means of a wire connection or on the power line by means of a suitable modern coupling. The one part in the home is able to read a token and then transmit it further along the communications medium to the other part where it is further processed. The capital cost plus the labour cost for such an installation is considerably higher than that of a single meter. It also does not address the existing installed base of prepayment meters.

The principle functions embodied in the InfoPOD

The device is installed within a prepayment meter, mainly (but not exclusively) where the prepayment meter is not readily accessible for inspection on demand by maintenance personnel. It has a processor, memory and power supply to support it's functions, even in the event of loss of mains power for a while.

The device has a means for direct connection to the prepayment meter, and a large number of existing prepayment meters already support this direct connection without needing modifications to be done to them.

A wireless radio modem link enables two-way data transfer to an intermediate handheld data transfer unit (HHU) that may in turn be connected to a management system. The two-way communication thus provided allows data to be read from or written to the meter, and the HHU acts as a link between the meter InfoPOD and the management system.

The device records various configuration parameters and events associated with the InfoPOD itself, the connected meter, the HHU and/or the management system, and/or associated with the behavior of the consumer and operational personnel.

The InfoPOD also has a means for analyzing the data of recorded events in order to detect patterns of behavior, and can compare analyzed information to a reference set of data in order to detect deviations from expected norms. The reference set of data may be initially installed via the HHU, which may in turn have obtained the data from the management system. It may also self-learn from actual behavioural patterns, and may adjust the reference information in such a way as to adapt to changing norms.

The device has real-time clock for date and time stamping of recorded events and for use for tariff processing.

The tariff processing capability allows for stored tariff rates to be used directly by the connected prepayment meter for application in the accounting process of the meter. It may alternatively provide a tariff processing service to the connected meter by calculating the electricity cost for further use by the meter or management system accounting process.

A particular InfoPOD may have one or more tariff profiles defined, with an associated date of activation, and the associated tariff rates and taxes. Additionally, the tariff, rates and taxation profiles may each have a complex function associated with the season, month, day and time, and optionally also the rate of electricity consumption.

Deployments

Current deployments of the new device include pilot site implementations in May 2004 at the Eskom controlled townships of Diepsloot, Ivory Park and Mankwane; Ladysmith (October 2004); Stellenbosch (November 2004); and Midvaal (April 2005). Further planned deployments in 2005 include Kimberley (May 2005); Diepsloot (entire township), and additional areas countrywide as identified by Eskom revenue protection managers.

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