Standby Generation Cost Recovery

A practical solution for recovering the costs of standby generation using NES Smart Metering

A White Paper by Power Meter Technics

Meteringonline provides an innovative and cost effective solution to the allocation and recovery of the incremental costs of operating a standby generation system for commercial buildings using NES Smart Meters. The solution operates entirely in the cloud without the requirement for additional infrastructure or control systems and integrates seamlessly with *Meteringonline*'s standard metering data acquisition and billing system.

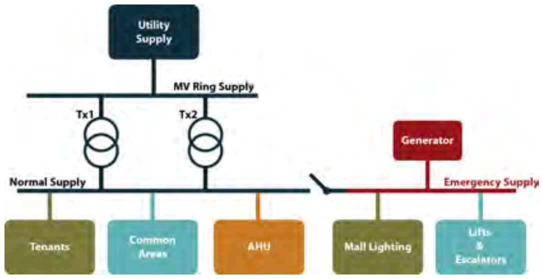

Figure 1: *Simplified reticulation system*

Background

Traditional designs of electrical systems in commercial buildings provides for separate normal and emergency reticulation as shown in Figure 1.

Standby generators are normally sized to only provide sufficient electricity to operate essential services such as some mall lighting, lifts, escalators and so on during a power outage. The anchor tenants in a mall can usually afford to install their own backup generation, but by and large, smaller tenants would be without power and therefore unable to trade effectively during a utility power outage.

This system is adequate in situations where the utility electricity supply is dependable and power outages are rare. Most countries in Africa have constrained electricity supply grids and periods of outages, whether due to generation capacity shortfall or system faults, are common.

To attract good tenants, owners of shopping malls must be able to provide an environment that is favourable for trade over extended trading hours and one of the most important factors is a reliable electricity supply.

The modern trend when designing new shopping malls is to install sufficient local generation capacity to fully supply the mall in the event of a power outage from the utility.

The metering problem

The difficulty with this system is properly accounting for, and recovering, the incremental cost of running large standby diesel generators to ensure an uninterrupted supply since the cost of generating electrical energy from diesel generators is generally significantly higher than the purchase price of electricity from the Utility.

Using conventional metering systems it would be impossible to accurately account for and recover this incremental costs from the tenants without installing a separately metered standby supply to each tenant and major load point in the mall as shown in the simplified example in Figure 2.

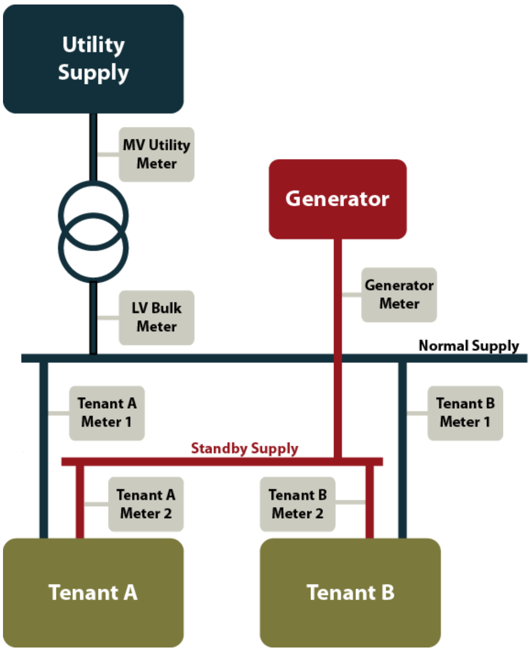

Figure 2: *Separate normal and standby reticulation and metering*

The obvious disadvantage to this approach is that the reticulation would effectively have to be duplicated, with a normal and standby supply interdependently provided to each tenant and each supply would have to be individually metered.

Local signalling and control

One possible solution would be to use meters that have the ability to switch tariffs in response to an external signal on a digital control input. A control signal would be sent to each tenant meter from the generator control system whenever the generator is used and the meters would respond by accumulating energy in a second rate register during this period. The consumption for both rates would then be read either manually or by means of an automated system and different tariffs applied to each rate.

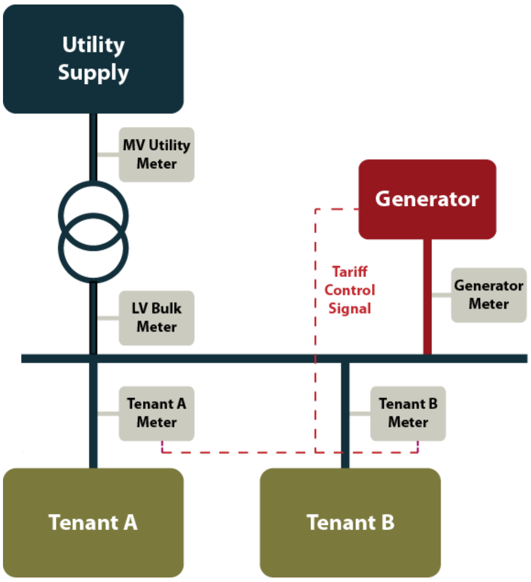

Figure 3: *Local signalling solution*

The main disadvantage of this approach is that the only really reliable and secure method of providing the control signals from the generators to the meters is by means of a hard-wired infrastructure. Several attempts have been made to use wireless control systems based on bidirectional or mesh-network topologies, but these have generally had limited success and the cost of the implementation is usually prohibitive.

A further disadvantage is that the metering system itself is inherently more complex and therefore more difficult and costly to maintain. There is also the problem of a single point of failure since the entire control system would rely on the controller at the generator.

Virtual meters

A *Virtual Meter* is a mathematical construct used to calculate consumption for a logical load point where it is not possible or feasible to have an actual physical meter. Virtual meters are often used in modern MDM systems like *Meteringonline* to provide aggregated data from two or more real meters. An typical example of how virtual meters are used in commercial buildings is to provide aggregated total metering data for the consumption of common-area loads within a building so that these cost may be allocated to tenants on a pro-rated basis.

Virtual meters used for load-aggregation

The most common application for virtual meters to to calculate an aggregated total consumption based on the readings of a number of physical meters.

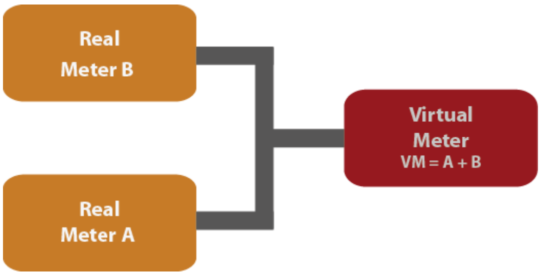

Figure 4: *Virtual meter to aggregate two supply points*

In the example shown in Figure 4, a virtual meter is used to aggregate the active and reactive energy recorded from two real meters. Because the aggregation is performed by means of a vector sum, the correctly diversified maximum demand of the aggregated load is obtained directly from the total active and reactive of the virtual meter.

Conditional virtual meters

Meteringonline takes the concept of aggregate virtual meters further by the implementation of *conditional virtual meters*. In this case a virtual meter is configured to register the consumption from a meter if a certain condition is met. For example, a virtual meter can be constructed to only record demand if the active energy demand recorded by another meter has non-zero interval data - indicating that the generator was producing energy at the time.

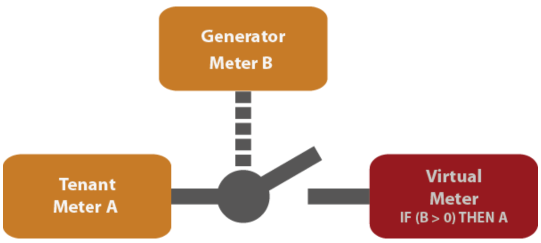

Figure 5: *Virtual meter configured to register when generator is on line*

A second virtual meter is then configured to register consumption fro the tenant meter when the interval data from the generator is zero, in other words when the generator is not operating. The readings from these two virtual meters are then assigned the appropriate tariff - one for the cost of power supplied by the utility and one for the cost of electricity supplied by the generators.

The *Meteringonline* solution

Meteringonline provides an elegant solution to the problem of recovering the cost of locally generated energy using advanced software systems in conjunction with NES Smart Metering technology.

PMT pioneered the use of smart meters in commercial applications where NES power line communication technology (PLC) is used to communicate with smart meters. The NES smart meters are managed by data concentrators, which in turn are connected to the *Meteringonline* servers in Johannesburg using GPRS or 3G cellular data communication. All load points within the building are equipped with smart meters, including supplies to tenants, common area loads, air-handling units, generators and transformers.

This makes it possible to process all data off-line using the *Meteringonline* Meter Data Management (MDM) system and conditional virtual meters as described earlier. The reticulation and metering system is configured exactly as shown in Figure 3, with the exception that no local control is needed.

All meters within the Centre are configured to record active and reactive energy interval data (*depending on local tariffs, this may be either 30 or 15-minute interval data*) and this interval data is read by the cloud-based *Meteringonline* data acquisition server several times per day and stored on the *Meteringonline* meter data store.

Practical example

A practical example of how the system works using data from a shopping mall in Accra, Ghana is shown in Figure 6

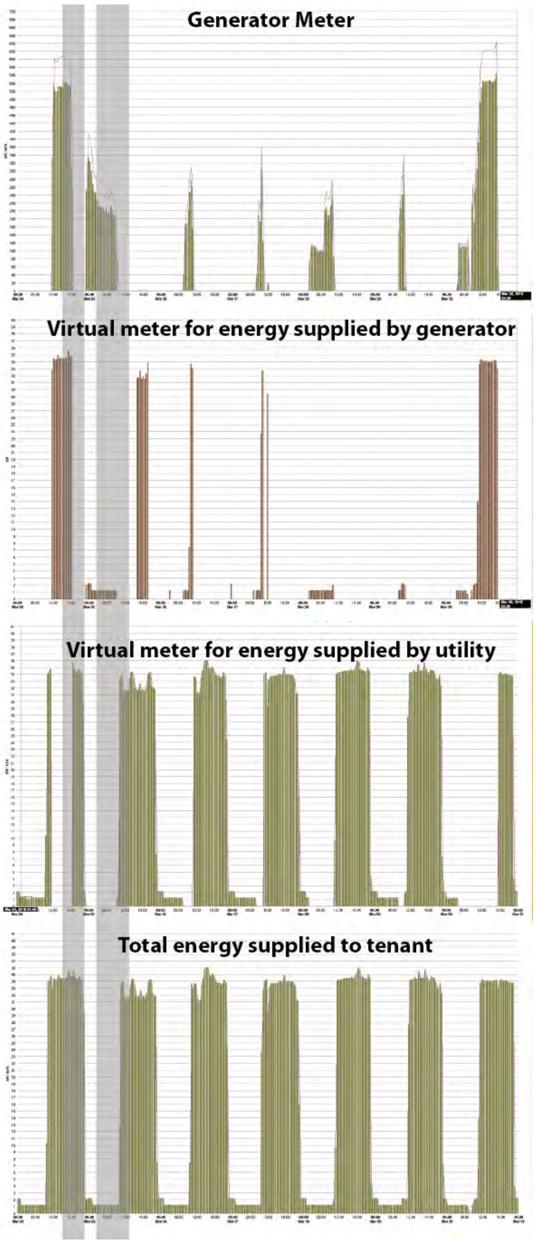

Figure 6: *Energy profile showing conditional virtual metering*

The top profile shows the energy supplied by one of the centre's generators over a seven-day period. The second graph shows the energy consumed by one of the centre's tenants that was supplied from this generator over the same period. The third graph shows the energy consumed by the tenant that was supplied by the electricity utility company and the last graph shows the total energy consumed by the tenant.

Finally, an electricity bill for the tenant is shown in Figure 7. The total cost of electricity supplied by the generator is shown separately from the cost of electricity supplied by the utility and in each case the rate is clearly indicated.

Period 2015-03-01 00:00:00 to 2015-03-31 00:00:00 Run Print Show Help

PROVISIONAL STATEMENT

Site Name	West Hills Mall (Ghana)
Statement Period	2015-03-01 to 2015-03-31
Billing Days	30

Account Name	Shop No.	Building No.	Unit No.
Shop 063	Shop_063	GNAWESBATASH	

Tariff	Description	Unit	Rate	Amount
GENERATOR SUPPLY - Ghana West Hills Mall Generator (1 Line)				
Energy Charge		1,468 kWh	1.300	1908.44
Totals:		1468 kWh		1908.44
UTILITY SUPPLY - Ghana Non-Residential 14/15 (5 Lines)				
Energy	Non-Residential (301-600)	300 kWh	0.630	189.11
Energy	Non-Residential (601+)	733 kWh	0.990	728.74
Energy	Non-Residential (0-300)	300 kWh	0.590	177.72
Service Charge		1 month	6.460	6.46
Distribution Service Charge		1,333 kWh (SU...	0.165	219.32
Totals:		1333 kWh		1321.35

Sub-Total	₵ 3,229.79
GST@0.00%	₵ 0.00
Total	₵ 3,229.79

Figure 7: *Electricity bill showing generator and utility consumption separated*

Conclusion

The *Meteringonline* conditional virtual machine system with NES smart meters makes it possible for commercial properties to accurately allocate and recover the incremental costs of operating a full standby generation system without the requirement of duplicating standby and normal reticulation infrastructure or having complex control systems on site.

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