A case for electronic electricity meters in India

AMONG THE MANY problems electricity utilities face in distributing electric energy fairly and collecting, in return, a fair economic price for it, the problem of metering could seem to be insignificant, given the capital outlay on it. In fact, it is not so. A typical ''all-electric home'' or AEH (one wired for a connected load of 3 or more kW, permitting the use of heavy appliances such as water heaters and electric stoves, as against the simple ''lights-and-fans'' or LF connections) in Bangalore may consume about 200 kWh of electricity and pay at current (domestic) tariffs Rs. 240 (US$ 6.50) every month. The standard rotating disk single-phase electromagnetic meter used for such an installation may cost more than about two months' consumption at these tariffs. An order-of-magnitude calculation shows this to be not more than $4 per kW of connected load.

With present investment costs on generation alone above $1,000 per kW, investment on metering is small in comparison with total investment, but at least for domestic consumers, large in comparison with collections. (We may add that large numbers of domestic consumers, being only in the LF category, use even less electricity.) Is it worthwhile to invest on improving metering technology?

The answer is yes, for a variety of reasons. The simple electromagnetic meter suffers from several problems. For one thing, it can easily collect dust which will cause friction and slow down its rotation. This may make a material difference to its recording, a difference that may persist unnoticed for several years until the slowing down is sufficient to yield absurdly low readings or cause a complete stoppage. Secondly, the electromagnetic meter records the actual consumption only when the power factor is one, i.e., when current and voltage are in phase. If the power factor is different from one, there are heat losses in motors and induction coils as well as reactive power losses which it does not record. Thus, for example, the true power consumed by rheostat-controlled domestic fans and fluorescent lights equipped with electromagnetic chokes is hidden. These factors alone would point to the advantages of reasonably-priced electronic meters, even if they are somewhat costlier than electromagnetic meters. One can add that the case does not even need to be argued for high demand installations, including both small industries and commercial establishments. They generally pay higher tariffs besides consuming much more energy for a single meter.

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These arguments have been expounded at greater length by S.H. Miller [1993], an electrical engineer who was then Deputy Chief Engineer of the Bombay Electric Supply and Transport Undertaking (BEST), the electrical distribution utility covering the southern part of Bombay city. Miller mentions several other advantages of electronic meters, including the low expected life of electromagnetic meters and the practice, widespread among industrial and commercial consumers, of tampering with them. He briefly touches upon the then on-going experiments being conducted by BEST with tamper-proof electronic meters, which are equipped to record consumption data of true power (kVAh) and reactive power (RkVAh). He also mentions that since they can also be equipped to store hour-by-hour consumption data, they can be used to support a differential pricing system for peak hours (''time-of-day'' or TOD metering).

It would seem that electronic metering could be phased in, at first for large consumers and then even at the domestic level. The initial gain with more accurate metering and recording of what is lost through low power factor could justify the change, and as the political will is found, TOD metering could be introduced to obtain a fair return on the high peak load capacity creation that goes idle for much of the day.

Various electronic energy meters, indigenously manufactured, are or could be available in the Indian market. Miller mentions one make which BEST was testing out at that time (1993). By 1994, the Central Power Research Institute in Bangalore had developed a single-phase model for which the technology had been transferred to an entrepreneur in Hyderabad. A senior scientist connected with the development told this author at that time that the price was expected to be around Rs. 1,000. (Compare this with the price of $100, around Rs. 3,500, for pre-payment electricity meters in South Africa [Thorne, 1995]. It must be noted, of course, that the pre-payment meter has the facility of automatic cut-off when the pre-payment is exhausted.) He mentioned accuracy, correction for power factor, reactive energy recording and TOD capability among its advantages. The manufacturer was apparently concentrating on export marketing, presumably because Indian utilities (other than BEST, perhaps) are not convinced that the product is worth the money or find the scheme politically sensitive.

Another entrepreneur, Signion Systems, also of Hyderabad, has recently developed an inexpensive single-phase electronic energy meter. Its EM1230 model (rated for 20A, extendable to 60A, which works out to over 4 kW at 230V) measures active energy, active apparent power, power factor, and supply frequency. Energy is calculated by integrating power measurements (thus enabling TOD metering). The cost of the meter is put at about Rs. 500, which should mean that it could be marketed at not more than twice that figure.

Signion Systems has incidentally designed and fabricated a solar PV-based 5 kW uninterruptible power supply system for its R&D unit near Hyderabad. The PV panels on the sloping roof of the facility supply power directly and also store the surplus in a battery bank, which takes over via an invertor during the evening and during low insolation periods (cloudy weather, near sunrise and sunset, etc.). Although at Rs. 700,000 (about $20,000) the UPS is expensive, it represents a successful advance in integrating the emerging technology of photovoltaics with the growing need for quality uninterruptible power for high-technology industries. ■

References

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