

Automated Meter Reading for Industrial Water Supply

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KEYWORDS

Automated Meter Reading, AMR, Water meter, Metering, Industrial water supply

ABSTRACT:

Improving water management practices that reduce or enhance the beneficial use of water is a strategy for water conservation. Metering plays a vital role in accounting water distribution and usage. Different types of water meters have evolved in the market which serves the water utilities and consumers in many ways. The trend has reached from traditional mechanical meters to smart meters as water has become more and more precious. Many water utilities across the world are recognizing the global need for adopting new technologies to monitor and conserve water. Timely and accurate metering is essential for better accountability and thus improved revenue collection. Traditional monthly visit for meter reading, for billing, may not help in improving monitoring and water consumption control system. A prerequisite for such system is the monitoring of water consumption in sufficiently short intervals in real time. Automated Meter Reading (AMR) is one of the new technology introduced for accurate measurement and ease the task of meter reading, especially in industrial water supply. Different forms of communication links are used as communication medium in AMR systems. Based on the budget and service territory one can choose the technology they need for AMR system. The time and expense of periodic trips to the meter location for meter reading is saved by the use of AMR. This paper provides information on Automated Meter Reading technologies, its merits and demerits, cost implication and feasibility for Indian Industrial water supply system.

1. INTRODUCTION

Industrial water demand is increasing with the growing economy. With growing demand and resource scarcity, challenges in water industry is also growing day by day. Now the time has come to improve the operational efficiency, data accuracy, integrity of distribution system and of course, conservation. Apart from data accuracy, timeliness also has become very important for close monitoring of water distribution. Water utilities uses methods that were developed several decades ago to take meter reading for billing purposes. Most of the utilities are employing manual meter reading which is time consuming and also more prone to human error. Many water meters are installed in locations that require the utility to schedule an appointment with the user in order to obtain access to the meter. Manual meter reading being more person dependant, it is becoming expensive and also time consuming. One of the primary drivers for the automation of meter reading is not only to reduce labour costs, but also to obtain frequent data that is difficult to obtain.

Automated meter reading is the method of automatically collecting consumption, diagnostic, and status data from water meter and transferring that data to a central database for billing, troubleshooting, and analysis. The timely information coupled with analysis can help both utility providers and customers a better control on water consumption. AMR systems uses various technologies like low power radio signals, Network and/or GPRS based loggers and hardwired meters for different types of consumer locations.

2. WATER DISTRIBUTION SYSTEM IN INDIA.

In India, majority of the water supply system has been managed by water utilities under the government. State Water Supply and Sewerage Boards were formed to improve the efficiency and to attract investment in this sector. After irrigation, industries are the next largest water consumers in the country. The Second Irrigation Commission has recommended a provision of 50 BCM water for industrial purpose. But the expected requirement of water for industrial use by 2025 is approximately 120 BCM.

Most of the water utilities in India have made several attempts to ensure quality of water meters in

addition to cost reduction during the last two decades. This has resulted in the availability of several quality water meters at reasonable cost. Focus is shifted from cost of the meter to total cost of metering. Procurement of large quantity of meters requires comprehensive knowledge of water meters available. This includes technology, standards, types, tests, selection etc. and the buyers should adopt a proper quality assurance procedure. There is no standard or guideline available in India for quality assurance of water meters. Due to this reason several utilities have developed and tried different strategies. Some strategies have resulted in good results while some others failed miserably. Emerging technologies in metering can be adopted in suitable areas for improving the efficiency of water supply system and for conservation of water resource.

3. AUTOMATED WATER METERING SYSTEMS

Automated meter reading (AMR) and Advanced Metering Infrastructure (AMI) are the latest technologies which can be tried in Indian industrial water supply system for leakage detection, close monitoring of water usage, improved customer service by providing detailed billing and altogether conservation of water. Periodic reading of meters are essential for consumption based water rates. Except in remote or automated meter reading these readings are usually done by meter readers.

Typically, AMR systems are drive-by systems in which meters are read using laptops or handhelds capable of receiving a radio signal. AMI systems, on the other hand, tend to be fixed base systems where meters can be read centrally from the utility office.

Automated Meter Reading (AMR)

AMR is a method in which metering data are automatically collected and transmitted to a central database for analysis and billing purposes. By using AMR, detailed water usage data can be obtained continuously at regular intervals and can be sent to the water utility's central management and billing system. Automated Meter Reading is one of the new technologies introduced for accurate measurement and ease the task of meter reading, especially in industrial water supply. Different forms of communication links are used as communication medium in AMR systems. Based on the budget and service territory one can choose the technology they need for AMR system. Linking of a real time wireless communication network to digital water meters with a centralized management system is also available in AMR systems. Monitoring of hundreds of meters frequently or continuously and also leak detection and spot the location of leak is possible with this real time network system.

Various methods, ranging from a simple drive-by meter using a hand held unit to automatic communications with the water utility is available in AMR. The AMR Systems include information transmitted via GSM, RF (radio frequency) and/or GPRS and also M-BUS to stand alone computer system and/or hand held terminal.

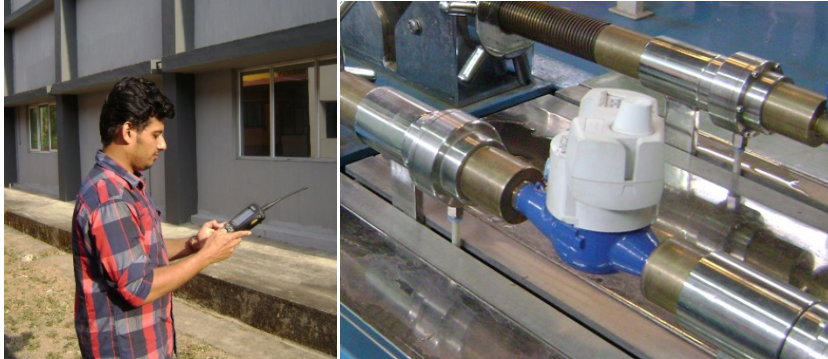


Hand held unit and water meter equipped with AMR technology

Walk/drive By System

The Walk/Drive By System uses radio frequency transmitters that are attached to each metering device that requires monitoring. The transmitter operates like a mini data-logger. The radio frequency transmitters continuously send information until the client walks or drives by the devices and collects the data. Mobile or "drive-by" meter reading is where a reading device is installed in a vehicle. The meter reader drives the vehicle while the reading device automatically collects the meter readings. Often for mobile meter reading the reading equipment includes navigational and mapping features

provided by GPS and mapping software. With mobile meter reading, the reader does not normally have to read the meters in any particular route order, but just drives the service area until all meters are read. As there is no need to site and install fixed network infrastructure devices such as repeaters or data concentrators, once deployed the system requires no maintenance. The benefits of walk by system are cost effective, no special skills required to install, allows for full submersion of meters.



Meter reading using Hand held terminal

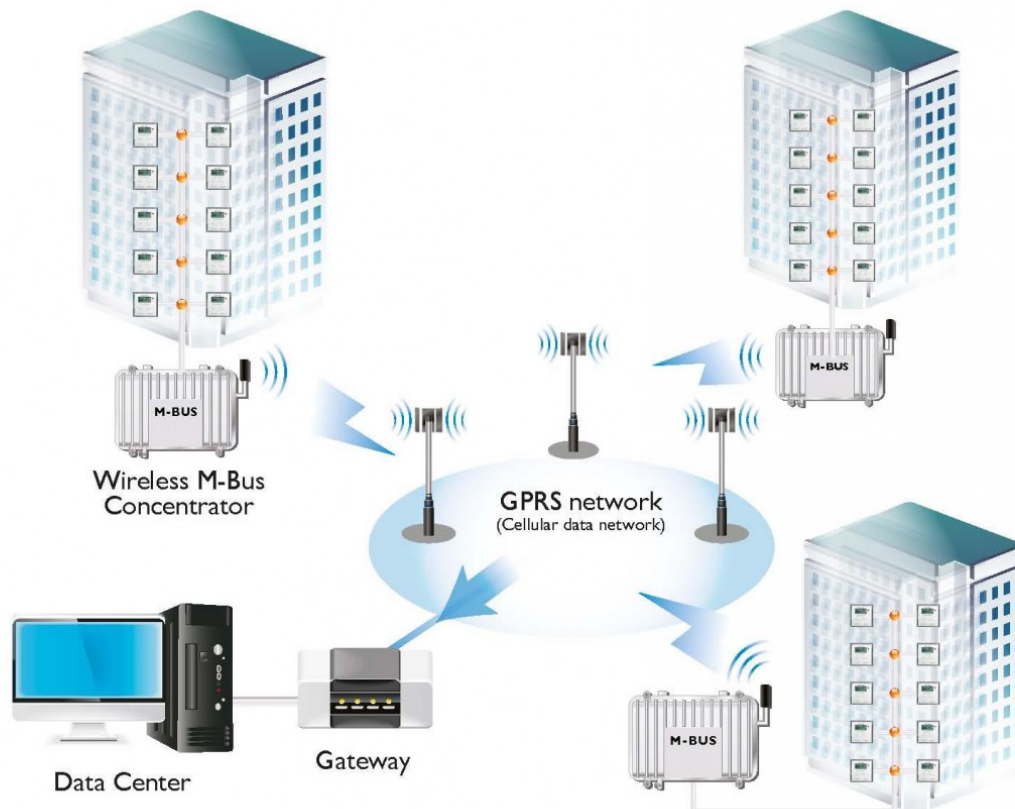
Fixed Network AMR

From an operational point of view, Fixed Network AMR can provide a true insight into a networks performance highlighting leakage, tampering, flow rate variations and backflow detection. In this a transmitter is installed in the water meter and this transmitter intelligently monitor, profile and log consumption and flow data of the consumer. Data is transmitted to the utility in periodic intervals, via various methods like Wi5, RF (Radio Frequency) and GPRS, for processing. GSM & GPRS transmitters are used to monitor the readings of a water meters with pulse output facility. The transmitter is connected to the pulse output of the water meter and readings can be obtained on pre programmed intervals. The water meter readings can be monitor via GSM to the mobile or GPRS to the computer.

Automatic meter reading provides increased performance in the data collection, eliminates reading errors and missing meter readings. Avoiding manual data entry or manual data transfer, a potential source of error, is eliminated. Constant access to real-time data and have meter readings available on request helps handling customer complaints. Costs for meter reading will be reduced and thereby total costs of operation. Reduced cost over the life time of the AMR system. With automatic meter reading utility bills can be made based on actual consumption and estimated bills are no longer necessary. With accurate utility invoices there is no need for estimates or adjusted billing. Demand reads can be done as part of the customer service and action can be taken quickly in abnormal situations and monitor demand and consumption closely.

Advanced Metering Infrastructure (AMI)

Two-way communication between the meter and utility and between the meter and consumer is the main advantage of AMI over AMR technology. This means that in addition to providing readings, the meter can also receive instructions sent from the utility or consumer. Advanced metering infrastructure includes new communications networks and database systems that will modernize the supply system and provide important benefits to utilities and consumers. Two-way communications with "smart" meters allows companies to respond more quickly to potential problems and to communicate real-time prices. These price signals provide consumers with financial incentives to reduce their water usage. The benefits of AMI are reduced meter reading costs and associated management and administrative support, increased meter reading accuracy, improved utility asset management, easier theft/tampering detection, and easier outage management. Customer benefits of AMI includes early detection of meter failures, billing accuracy improvements, faster service restoration, flexible billing cycles and creating customer usage profiles for targeting Efficiency / Demand Response programs.



AMR/AMI system network (www.spiremt.com/data-management/spirecapture-amrami.html)

4. METER SPECIFICATION

In the recent past, many utilities have taken some constructive efforts to achieve proper metering at lowest cost. Usually, procurement of meters is carried out through tendering process and it is reflected in tender document.

Size and the number of meters are generally decided at the initial stages itself. There is a tendency to select the size of the meter same as the size of the adjoining pipeline. This is a highly incorrect practice. A water meter should be selected based on the flow rate expected through the meter under regular use. Even though a meter is expected to measure volume of flow in a wide range of flow rate, it is better to select the meter corresponding to the nominal flow rate of the meter. As per ISO 4064, the nominal flow rate should be marked on the meter. As per Indian standards, there is a defined nominal flow rate corresponding to each size of the water meter.

Limitation of funds becomes a major constraint when deciding about the number of meters. However, the available funds can be effectively utilized by installing meters where increase in revenue compared to the amount required to invest is maximum. The investment also can be made in stages or in a particular area so that action to reduce unaccounted-for water can be initiated.

Usually, the maximum number of meters required for a given period is considered for procurement. This is based on the belief that the increase in number can result in reduction in cost of meter. This need not be always true. When the quantity of procurement is beyond the production capacity of some manufacturers, the number of bidders becomes less and the competition among bidders cannot be ensured. Hence it is better to accept the bids with lesser quantity than the total quantity required.

There are different types of water meters. In addition to mechanical water meters, meters based on electromagnetic, ultrasonic and fluidic oscillation principles are also available. In India, water meters up to 50mm are called Domestic type and meters above 50mm are called Bulk type. Based on the

measuring mechanism, meters are generally classified as volumetric and velocity type. Volumetric type is not produced or used for water supply applications in India. However no adverse remarks are reported so far against volumetric type meters. Velocity type, which are also called as inferential type meters are further classified as single-jet and multi-jet in domestic type, and Woltmann type in bulk type. Single jet and multi-jet meters consist of a turbine rotor rotating about the axis perpendicular to the flow whereas Woltmann type meters consist of helical blade rotating about the axis of flow. In single-jet water meters water jet impinges at a single place on the periphery of the rotor and in multi-jet meters, water impinges at several points simultaneously. Due to this difference multi-jet meters are preferred at custody-transfer locations in many developed countries. However, many water utilities have selected single jet meters and achieved satisfactory performance in India.

Irrespective of the above classifications, water meters are classified based on the flow rates of operation. Indian standards mention Class A and B only. Class O specified earlier in Indian standard has been removed in August 1999. Class C and Class D meters are also mentioned in international standard. However, they are not used in India. Successive letters indicate the capability of measuring lower flow rates. Class of water meter required by water utilities should be specified in the tender document. A study for assessing the amount of water passing to consumers at very low flow rate and its impact on revenue considering the water tariff and metering cost is essential for deciding a particular class.

5. SELECTION OF TECHNOLOGY

Various options are available for the utilities to improve their performance. While going for advanced technology, the cost involved in its implementation increases. In Indian scenario cost implication is an important factor that has to be evaluated. Of course, the advantages of smart meters, AMR and AMI, discussed above is beneficial for the utilities in way of reduced metering cost, leak detection, improved billing etc., but the returns from the implementation and the cost of maintenance also need to be reviewed before selection of a new system. There are various categories of consumers like domestic, commercial, government authorities, partly commercial and bulk consumers. Even though the frequency of billing governs the cash flow of the water billing system, the quantity of water consumed is the important factor contributes to the revenue. The frequency of billing depends mainly on the type of system used. For non-metered system the billing could be quarterly and for the metered system the billing could be bi-monthly. But in both cases all non-domestic, industrial, bulk consumers must be billed monthly.

Now the situation has come in which the cost of producing potable water has increased drastically so that it has become difficult to supply sufficient quantity of water even for domestic use. In most of the domestic water supply system in India, the water supply is intermittent. There are a few pilot projects of continuous supply, known as 24x7, in Karnataka and Maharashtra. For establishing this, a total rework of water supply lines need to be carried out. The water supply pipes must be repaired to reduce leakages and good meters have to be installed to control water loss. Repairing and increasing the capacity of water distribution system infrastructure to switch to continuous supply is very expensive and likely out of reach for many utilities in the short term. In India continuous supply is the long-term vision for most utilities, intermittent supply is the reality of water access for millions of people around the world that has been in existence for decades and will continue to be for many more. Some researchers suggest that increasing scarcity of water from climate change and increasing demand may in fact make intermittent supply more common (Vairavamorthy et al, 2008).

Theft and tampering of water meter is a major issue faced by many water utilities. Instances of even recently installed automated digital meters being stolen from housing societies have been reported in one of the metropolitan city of India. The cost of installation of these meters is approximately Rs 12,000 per meter, which is very high. The rise in meter thefts has been blamed on the rise in prices of material used for the construction of water meter. There are several cases where societies themselves had deliberately removed the water meter to hide actual water consumption. In such a situation, the cost implication for installation and maintenance of smart meter has become an over burden for the utilities. The financial and other benefits expected out of implementing AMR/AMI in such environment needs to be reviewed by comparing with the cost involved in such systems.

While going for a new technology like AMR, its feasibility for the utility and the revenue collecting from

the users also need to be considered. In India the numbers of domestic water connections are very much higher than the industrial connections. However the revenue coming from the domestic users is very less compared to that of industrial users. Thus it is not wise to make a huge investment in domestic connections rather than in industrial connections. As mentioned above, in most of the domestic connections the water supply is intermittent and thus continuous monitoring of water usage in such a connection by using smart meters is not worthy. There are water utilities in India which had gone back to cheap meters from AMR meters due to the difficulty in maintaining such meters in certain areas.

Industries are the second largest consumers of water in India, agriculture being the first. In a rapidly booming economy, we expect the contribution of the industrial sector to increase very much, and the industrial water demand also to increase accordingly. Significant difference between industrial and domestic connection is that, in industrial connections water consumption at each consumer point is very high compared to domestic connection. In industrial connection more number of bulk meters are used since the flow is high. The chances of loss due to leakage are high in such connections. One of the places where maximum leakage occurs is in the distribution system. Pinpointing the location of leak, tampering detection, frequent meter reading or real time monitoring of water consumption is essential in preventing loss. The various advantages of AMR/AMI discussed above can be helpful in improving the efficiency of industrial water supply system. AMR can be used in the bulk meters of supply mains of domestic water supply also. A close monitoring of water supply in the supply mains can help the utility in better accountability of supply and consumption.

6. CONCLUSION

Several developed countries use automated meter reading system along with the meter, for speedy and error-free reading of meters. In India, automated meter reading is getting popular and more and more water utilities are adopting it, at least to a limited extent. These meters provide tremendous amount of valuable information about the consumer supply in addition to the reading for the billing purpose. Utilities are expected to understand the advantages against the cost for same before adopting AMR technology. An analysis will reveal that it may not be worth investing in AMR for domestic meters purely for monthly billing purpose.

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