EMERGING TRENDS IN QUALITY ASSURANCE OF WATER METERS

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ABSTRACT

Water meters are generally considered as the "cash box" of water utility. Realizing this fact, 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. Merits and demerits of different quality assurance practices adopted in India are discussed. This paper is expected to help the water utilities in their effort to ensure quality of water meters during bulk purchase.

INTRODUCTION

In India, water utilities are undergoing increased pressure for better accountability and improved revenue collection. This has resulted in realizing the importance of water meters, which is referred as "Cash box" of the utility. Non-registering as well as under registering meters are posing a serious challenge to water utilities. In the recent past, several steps were taken to improve this situation. However, the procedure followed by different utilities is found to be quite different and some procedures have resulted in some setbacks. In fact, there is no manual or guideline in India, which suggests the right engineering practice for ensuring the quality of meters. This paper describes merits and demerits of various strategies adopted by various utilities in order to accelerate the evolution of an ideal strategy. Specific reference of the utilities is intentionally avoided.

Realizing the importance of accurate metering, several utilities have initiated programmes to improve this situation in a short span. This has resulted in huge investment towards bulk purchase of water meters of different sizes. It may be noted that accumulation of poor quality meters is resulted mainly due to lack of quality assurance practice in the past. Hence it is high time to review the procedures followed so far and adopt a suitable procedure for procuring and maintaining good quality meters.

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In this context, it is worth mentioning the efforts taken by certain utilities which was found successful resulting in successful metering and thereby improvement in revenue. Realizing this success, other utilities also have come forward to adopt same or similar practice. Fluid Control Research Institute (FCRI) also played an important role as a third-party testing/consulting agency during the past decade. In this paper, the authors are reviewing the practices followed by different utilities and suggesting a suitable procedure for quality assurance of water meters in India.

POLICY

It is important to define the policy and develop procedures before initiating any program. As a service provider, water utilities have to collect revenue from the beneficiaries. Hence the utilities generally follow the policy of ***charging consumers based on the actual quantity of water consumed by each consumer***. In order to implement this policy actual measurement of the quantity of water delivered to each consumer is essential. Proper metering can be technically defined as the measurement of the volume of water passed when flow is within a specified flow rate range with specified accuracy levels at the field conditions.

It may be noted that the size and type of a meter is not mentioned in the above objective. Size of the water meter is decided based on the flow rate likely to pass through the meter. Unlike many industrial flow meters that indicate flow rate, water meters are expected to indicate the volume of water passed through it. Moreover it should be capable of accommodating a wide flow rate range that is expected in the field. The registration should be within a particular accuracy level so that the contribution of this error in the bill is not substantial. A meter is expected to withstand other field conditions like internal pressure, temperature, in addition to adverse weather conditions.

The implementation of metering mentioned above will naturally incur certain cost. Hence minimization of the cost also should be ensured. The cost of the metering involves:

a) cost of meter
b) installation cost
c) maintenance cost including periodic testing
d) expenditure towards meter reading
e) expenditure towards data processing and billing.

Any water utility should try to reduce the total cost for a particular period, which is the sum of all the above cost. It may be noted that the cost of the meter and the installation cost are the initial costs and other costs are recurring in nature. Total cost of metering should be calculated duly considering the time span for comparison between different alternatives. It is incorrect to procure meters merely considering the cost of meter alone without considering the life span. A meter with higher initial cost may become economical if the life span is high.

The life span of the meter plays an important role in the cost of metering. The life span of a meter can be defined as the expected duration of service in the field beyond which maintenance cost becomes exorbitant and replacement becomes economical. Life span depends on the technology and quality of components used in the meter duly considering the field conditions. Long term studies on the field performance of the meters are essential for estimating the life span of each brand under specific field condition. Unfortunately such studies are not reported in India. In the absence of the data, water utilities assume a life span of 5 to 7 years.

STRATEGIES

Pressure for increased revenue collection has forced certain water utilities to increase the minimum charges considerably. Even though it is the easiest solution to increase revenue, it is a step towards un-metered supply and amounts to charging the consumers irrespective of the supply quantity. This is against the policy of charging based on the actual consumption and some consumers have to pay for the water not supplied to them which is highly unjustifiable.

Cost of metering depends upon several factors like technology used, design of meters etc. In order to provide cost effective solutions, necessary feedback from the field with appropriate technology under a single agency is necessary. Hence it will be better if the meter manufacturers take up the responsibility of metering. Attempts in this direction have already initiated in India. This requires necessary changes in the role played by utilities as well as the manufacturers. Like any privatization issue, necessary safe guards to protect the interests of the consumers and the state are inevitable.

At present, the strategies followed by different utilities for proper metering vary widely. Several utilities leave the responsibility of purchase, installation and maintenance to their consumers. It is not correct to leave the responsibility to the consumers who lack technical knowledge or bargaining capacity. It is the duty of the utilities to protect the interest of the consumers by providing proper metering at the lowest cost. This can avoid involvement of middlemen like distributors and dealers.

In some cases, consumers are permitted to buy only certain brands which are approved by water utilities. Certain routine tests are conducted before granting approval of a particular brand. This strategy is not sufficient to ensure the quality of the entire meters manufactured and sold by the manufacturer.

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. The following sections describe the specification and conditions followed for quality assurance of metering.

TENDER DOCUMENT

Basically, tender document should convey the strategy adopted to achieve proper metering objective. The specifications and conditions should be drawn duly considering sufficient availability in the market so as to ensure sufficient competition among bidders. Usually Indian and international standards are followed during the preparation of tender document. ISO 4064-1: 1993, ISO 4064-2:2001, ISO 4064-3:1999 are widely used by utilities even after the revision of these standards in the year 2005. In ISO standards revised in 2005, the critical flow rates are Q1, Q2, Q3 and Q4 compared to Qmin, Qt, Qn and Qmax in the older version. Q3/Q1 ratio of 80 corresponds almost same as class B meters. IS 779: 1994 which is in line with ISO 4064-1: 1993, is also referred in many tenders in India for domestic meters.

It may be noted that the utilities are making the investments for metering on behalf of the consumers and hence it is better to keep their activities as transparent as possible. Unfortunately there is a tendency to add several specifications as well as conditions in tender document, which are not having any practical significance. Sometimes the availability of meters in the market is not considered. Due to this, several utilities are forced to cancel their purchase actions in a later stage. In fact, a utility is expected to evaluate the importance of these specifications and conditions relating to field condition. In general they should try to reduce the additional specifications or conditions in order to get sufficient quotations for attaining good competition among the bidders.

Due to the recent liberalization, several brands from different countries are available in India having wide variation in quality and price. Some meters manufactured in India contain imported materials. Good and poor quality meters are produced in India and abroad. Hence there is no need of making a distinction between Indian and imported meters. It may be understood that a costly meter need not be superior in quality.

SPECIFICATION

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.

Certain utilities have considered the possibility of willful tampering the meter while purchasing the meter. In principle, tampering is an issue, which requires attention of water utilities. However overemphasizing this issue without sufficient field data may sacrifice economical and technological advantages. Hence the decision should be based on the field data. FCRI conducted a study on 15mm water meters brought directly from consumer connections. Out of 955 meters brought from the field, willful tampering was not noticed in any meter.

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.

CONDITIONS

As mentioned earlier, the life of a meter is a major factor directly influencing the metering cost. Due to the insufficient feedback system from the field, neither utilities nor manufacturers are in a position to give a clear picture about the life of any brand at any field condition. Under this circumstance, a few utilities tried to impose long-term maintenance conditions like 5 years after one year warranty period. Manufacturers also came forward to meet this challenge in the case of bulk purchase. Now, several utilities are following this practice of insisting long-term maintenance period. Attempts are made to maintain the water meters by certain utilities keeping the spares and training personnel. However, they were not found successful due to multiple manufacturers and their models. Hence it is better to fix the responsibility of maintenance of meters with the manufacturers who can do it efficiently.

During the maintenance period, a meter is expected to measure the volume of water at the specified accuracy levels. Performance evaluation of meters after installation at site requires dismantling from site, assessment in laboratory and installation at site again. Considering the large number of meters involved, water utilities are finding it difficult to check the performance after installation. As the revenue lost due to under-registration of meters can be significant, it is necessary to assess the condition of installed meters at least on a sample basis.

ENDURANCE TEST AND SELECTION OF SUPPLIER

It is important to select the right meter suitable for the field condition. Endurance tests or “Pattern approval tests” mentioned in the standards are generally considered as the minimum qualifying criteria for selection of the supplier. When the number of meters

Fig.1 Test facility at FCRI

proposed to procure is substantially high, endurance tests can be conducted on the sample meters supplied by the supplier. These tests may be conducted in a reliable accredited laboratory.

It may be noted that the above tests are conducted on the samples provided by the manufacturer at their discretion. Even though these limited tests on these “Golden samples” do not reflect the quality of a particular brand, this procedure is highly suitable for eliminating sub-standard brands. Tests conducted in the past show that many brands available in the market do not conform to the above requirements. It may be noted that this endurance test identify a particular model of the meter in addition to the supplier.

As mentioned earlier, all the above mentioned tests can be conducted during the bulk purchase. Usually smaller size meters, especially 15mm, are purchased in large quantity and bigger size meters are purchased in very few quantity. It may not be feasible to conduct all the tests on the sample meters submitted by the manufacturers. The type of tests should be decided based on the number

Fig.2 Test bench for domestic water meters

of meters planning to be purchased. Nowadays, water utilities prefer to conduct the test on 15mm meters even if their requirement is for 25,000 numbers. In such cases the utilities need to spend 2 to 3% of the cost of meter towards quality assurance procedure. If the requirement is larger, this expense will come down further. For bigger sizes, utilities prefer to accept the models which have passed the model approval program (MAP) of FCRI.

The testing is very important for deciding the supplier. Third party testing labs with adequate facility and manpower may be selected for the purpose. NABL accreditation ensures the capability of a laboratory. For the past two decades, FCRI conducted several tests for different utilities during the bulk purchase. These tests are conducted as transparent as possible and witnessed by representatives by water utilities and sometimes by concerned manufacturer.

ACCEPTANCE TEST

After selecting the supplier, it is necessary to ensure that the meters supplied are having sufficient quality similar to the meters submitted for endurance test during selection of supplier. For this purpose, routine test are usually conducted on sample meters selected at random from the lot supplied. During the supply of each lot of meters, samples may be obtained by random sampling basis. Number of samples depends on the size of lot under supply.

Lot size	First Sample	Acceptance Number	Rejection number	Second Sample	Cumulative acceptance
1-50	5	0	1	-	-
51-150	13	0	2	13	1
151-280	20	0	3	20	3
281-500	32	1	3	32	4
501-1200	50	2	5	50	6
1201-3200	80	3	6	80	9
3201 - 10000	125	5	9	125	12
10001 - 35000	200	7	11	200	18

Table 1 Random sampling and acceptance criteria

The lot size and corresponding sample size, and criteria of acceptance are mentioned in the table below which is given in IS 779:1994.

If the supplier is supplying 10,000 meters as a lot, 125 samples are selected from the lot and routine test is conducted. If the number of failed meters is 5 or less, the lot can be accepted. If the number of meters failed is 9 or more the entire lot must be rejected. If the number of failed meters is between 5 and 9, second sample of 125 meters may be obtained from the lot and tested. The cumulative acceptance number is 12.

The above practice is followed by several utilities for quality assurance of supplied meters. Since the number of meters permitted for failure is quite low compared to the number of meters in a lot, manufacturers need to follow a rigid quality control during the manufacture of the meters.

CONCLUSION

The procedure of selection of supplier and meter model through endurance test is found ideal, during bulk purchase. Routine test on sample meters is also considered acceptable during the acceptance of each lot during the supply. Realizing this success, some other utilities have followed this procedure. Hence it is advisable to follow this procedure until any better procedure is evolved.

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