IJournals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 4 Issue 2 February, 2016

A Review - Water Audit

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Abstract

Water audit is an effective management tool for minimizing losses, optimizing various uses and thus enabling considerable conservation of water not in irrigation sector alone but in other sectors of water use such as domestic, power and industrial as well. A water audit determines the amount of water lost from a water supply system and the cost of this loss to the utility.
It will quantify Unaccounted for Water (UFW) and Non- Revenue Water (NRW). Water audits balance the amount produced with the amount billed and account for the remaining water (loss). Comprehensive audits can give the utility a detailed profile of the water supply system and water users, allowing easier management of resources and improved reliability. It is an important step towards water conservation and, if linked with a leak detection plan, can save the utility a significant amount of money and time.

Key words: Unaccounted for Water (UFW); Non-Revenue Water (NRW), Water Audit

1. Introduction

Growing population and rising standard of living of people are pushing up demand for quality industrial products at phenomenal pace. Thus the industrial requirement for water is increasing day by day. As one of the large users of this precious resource, industry has an important responsibility to practice water audit. Industries can realize many benefits from the practice of water audit. By reducing consumption of water, industries will only have saving of water but also will protect the environment.
Water audit is an important management tool for effective conservation of water. Broadly water audit should be conducted categorically in two systems, resource audit or supply side audit and the other one as consumption audit on demand side. All efforts should be made for improvement of not only water use efficiency and distribution system, but also on the efficient development and management of the source of water.
Water audits typically require an accounting of the following quantities:

- Total water supply
- Total water consumption (metered and un-metered)
- Total unaccounted for water, water losses (apparent and real), leaks, etc.
- Percentage of unaccounted for water
- Metering statistics, such as brand and model, beginning and ending readings, etc.
- Meter accuracy
- Corrections for meter inaccuracy
- Operational efficiency
- Financial indicators (total revenue and costs, revenue lost, etc.)
- Other, depending on individual state requirements

2. Review on Past Work Done

Amol A. Kulkarni et al.(2014)water audit was conducted in ahmedpur. Gross demand of AMC area considering other demands and 15% losses in transmission & distribution network was worked out to be 4.04 MLD. Considering the losses in the distribution network from comprehensive water audit program i.e. 54%, total water demand from source was worked out to be 7.48 MLD. The sanction quota of raw water at Limboti Dam / Mannar Reservoir for AMC is approved by WRD. During Water Audit Study, They observed that Air Valves on Raw Water Rising Mains were leaking continuously leading to major water loss in stretch from Source to WTP Storages such as sump/ESR are overflows frequently and leads to losses Distribution network was serving the town for a long period. Most of distribution pipeline are of AC/PVC/GI material which are leaking. Water was supplied to consumer without metering and hence control usage is not envisaged. Water tariff was based on fixed flat rate basis for residential and commercial consumers. Revenue collection from consumer for water supply bills is average 50 % of demand. Average 50 % deficit in revenue considering revenue collected and expenditure on water supply works. and they nine task study was done The real losses are accounted to 42% and NRW components accounted to 65%.

K. S. Renukumar et al. (2014) In this case study, water audit was conducted for the distribution network for a single District Metered Area in south Bangalore In Distribution network to overcome shortage, leakage and losses of water. A water audit was determines where and how much the water ends up at different locations. All water systems lose some amount of water for a variety of reasons, which was not always easy to measure. Water loss costs money, paid by the authorities and customers. Some water loss was unavoidable, and for the utilities, it was not cost effective to try to eliminate the loss of every drop of water from the system. However, majority of the losses that occurs in water systems can be better managed by using a water audit. Through water audit physical losses due to pipe leakage and other losses due to metering errors, un-authorized connections and any free water given etc can be measured across the distribution system

C.G. Shruthi et al.(2013) the present study water auditing was conducted for Chikmagalur water supply scheme source of water supply was reservoir Yagachi The main objective of the present study was to draft a water balance chart based on AWWA for Chikmagalur water supply scheme and the specific objectives of the present study were Identifying the water sources for the Yagachi reservoir, assessment of the water loss incurred at the dam site and at the distribution line to Chikmagalur, to obtain a comparison between existing water tariff rate and proposed water tariff rate. From the water tariff consideration and calculations, the proposed rate was around Rs 270/- but in actual municipal authorities has fixed a flat rate of Rs.90/-, which seems to be very less. An ultrasonic leak detecting method was adopted in the study, about 13 joints were tested in the water supply pipe lines, among which 2 joints were found to be having a fusion defect. From the data collected and standard formulation the performance indicator ILI value calculated is 0.6, The greater the amount by which the ILI exceeds 2.0, the greater the potential opportunity for further management of real losses by infrastructure management and maintenance, more intensive active leakage control, or speed and quality of repairs. Here the value of ILI is less than 1 which indicates that the system is well maintained

Kenneth Bedu-Addo et al. (2013) water audit for an brewery industry in Ghana. The methodology for the study was derived from the cleaner production (CP) manual from the United Nations Environmental Programme (UNEP), titled: Environmental Management in the Brewing Industry. A three phase approach involving a Pre-Audit, an Audit and Post Audit stages was used. The pre-audit stage of the audit was done to minimize the time spent on the premises of brewery X and also to maximize the productivity of the audit team. During the audit stage, environmental records, certificates of compliance and discharge consents were inspected to verify the brewery's compliance with local and national standards/laws. The company's policies, plans and programmes concerning water conservation, wastewater reuse and recycling were also examined

to assess the soundness of the brewery's internal control of water usage. Waste water samples were collected into sterilized bottles and transported under dark conditions to a water quality laboratory, for the determination of effluent parameters. The post audit stage involved evaluation and documentation of the audit findings on compliance, water consumption, wastewater generation and programmes for water conservation and surface water pollution abatement. Total fresh water consumed and wastewater generated amounted to 532,693m3 and 449,835m3 respectively with water to beer ratio of 7hl/1hl

3. Benefits of Water Audit

Water audit improves the knowledge and documentation of the distribution system, problem and risk areas and a better understanding of what is happening to the water after it leaves the source point. Leak detection programs help in minimizing leakages and tackling small problems before they become major ones. These programs lead to (a) reduced water losses, (b) improved financial performance, (c) improved reliability of supply system, (d) enhanced knowledge of the distribution system,(e) efficient use of existing supplies, (f) better safeguard to public health and property, (g) improved public relations, (h) reduced legal liability, and (i) reduced disruption, thereby improving level of service to customers.

4. Steps of Water Audit

4.1 Water Supply and Usage Study

Water audit comprises of preparation of layout of water sources, distribution network, service/delivery points to water users and return flow of waste or excess water. The layout should include locations and capacities of flow measurement devices installed at key points,
dimensions of pipes and fittings in the water supply system, locations and particulars of flow control devices and history sheets of all measuring and control devices including pipes and fittings.
A study of the availability of water sources and past consumption patterns for various sectors is necessary to understand the present water utilization and projecting future requirement. Data on
development of sustainable source of water through rainwater harvesting and effluent recycling should also be taken into consideration

4.2 Process Study

Flow measurement devices may be installed at all strategic points so that water losses from various components such as raw water source, conveyance system from raw water source to treatment plant, from treatment plant to treated water storage system, treated water storage
system to distribution networks, individual users, etc. could be assessed at regular intervals. Such studies will also prove useful for future extension, renovation and modernization of the system.
Water quality of the distribution system needs to be monitored regularly at strategic points to find out the level and nature of contaminants present in the supplied water. Depending on the types of application and degree of purity needed, the treatment system can be designed and developed. The water distribution system, leakage assessment etc. will form an integral part of this study.

4.3 System Audit

The current water usages and systems for water use under various sectors such as irrigation, industry and commerce, hydropower, domestic water supply, thermal power and others need to be studied to check their operational efficiency and level of maintenance. The scope for any
modification or up-gradation will depend on the status of existing systems. Measurement methodology from the intake point of the system through various sub-systems to the ultimate user points needs to be verified periodically for its suitability, efficiency and accuracy. Bulk
metering should be done at the source for zones, districts etc. and revenue metering for consumers. This will help in identifying the reaches of undue wastewater generation.

4.4 Discharge Analysis

The domestic wastewater, return flows from irrigation, and effluents from the industries need to be

studied for conformity to environment standards, possibility of recovery of valuable by-products and the opportunity for recycling of waste water.

4.5 Water Audit Report

Adequate planning and standard procedures are necessary prior to undertaking the water audit of a system. A water audit can be accomplished on the basis of water allotted for a service and water actually utilized for that service. After assessing the loss of water and the efficiency of the system, steps needed for utilization of recoverable water loss may be listed. A cost-benefit study for optimum recovery of water loss may be performed. A water audit report may, invariably, contain:

(a) amount of water earmarked/made available to the service.
(b) amount of water utilized, both through metered and unmetered
supplies.
(c) water loss and efficiency of the system along with reasons for such
water losses.
(d) Suggested measures to check water loss and improve efficiency.

An effective water audit report may be purposeful in detection of leak in distribution system, taking timely action for plugging such leaks and thereby reducing conveyance losses of water and improving efficiency of the system. Water audit of the system should be undertaken at regular interval of time, at least on an annual basis

5. The International Water Balance

<table>
<tr><td rowspan="8">System Input Volume</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="6">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td rowspan="2">Commercial Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Metering Inaccuracies and Data handling errors</td></tr>
<tr><td rowspan="3">Physical Losses</td><td>Leakage on Transmission and/or Distribution errors</td></tr>
<tr><td>Leakage and Overflows at Utility’s Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer Metering</td></tr>
</table>

6. Conclusion

Water audit is an important management tool for effective conservation of water. Broadly water audit should be conducted categorically in two systems, resource audit or supply side audit and the other one as consumption audit on demand side. All efforts should be made for improvement of not only water use efficiency and distribution system, but also on the efficient development and management of the source of water.

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