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A Case Study on Audit of Water Distribution Network in Nagpur Areas

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Abstract - In water-distribution systems, a large percentage of the water is lost in transit from treatment plants to consumers. Water loss can be attributed to several causes, including leakage, metering errors, public usage such as fire-fighting and pipe flushing. Leakage is usually the major cause. Water audits determine the amount of water loss in the distribution system. They can be performed on a network-wide basis or district by district. Network-wide audits provide an overall picture of water losses in the distribution system as a whole. These audits require detailed accounting of water flow into and out of the distribution system, usually based on past meter records and flow meter accuracy checks.

Key Words: Distribution System, Water Losses, Water Audit etc.

1. INTRODUCTION

Water is a daily necessary resource for life, health, economic development and the ecosystem all over the world. As water is precious to everyone, its availability and quality are essential. Climate change, droughts, water shortages and population growth are increasing the strain on existing water resources, thereby increasing the necessity to preserve and avoid water wastage through effective management and reduction of water losses. A significant amount of water is lost in the water supply system. Water leakages have been a major problem for many regions around the world. In some countries water loss due to water leakages in the supply network exceeds 40% of the water in the supply system Reduction of water leakages is an important goal for many countries in the world, as it will mean a reduction in the amount of money and energy required on producing and pumping water and also satisfaction of consumer needs through improved reliability of the system.

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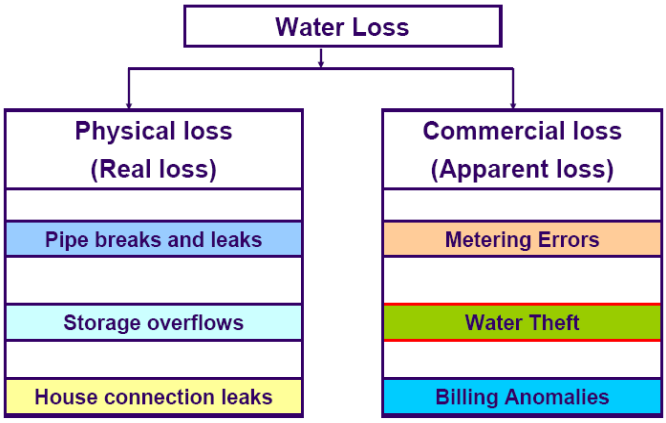
2. UNDERSTANDING THE METHODOLOGY

- System Input Volume
- Master meter accuracy
- Corrected input volume
- Authorized consumption
- Revenue water
  - Billed Metered
  - Water exported
- Non-Revenue Water
  - Unbilled Metered
  - Unbilled Unmetered



Detection of leakage: Acoustic Equipment:

1) Random or regular sounding surveys;
2) Acoustic loggers as a survey tool and
3) Leak noise correlates

. This technique is time consuming and not very efficient in terms of focusing on areas with potential leaks.

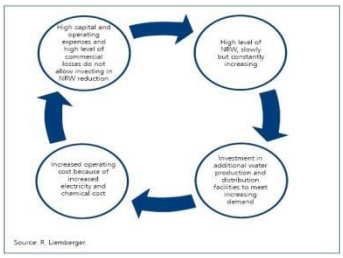
Non-Acoustic Equipment:

1) Tracer gas technique:
2) Thermograph:
3) Ground-penetrating radar:

All these methods require advanced equipments, skilled manpower; and the process involved is time-consuming and very costly.

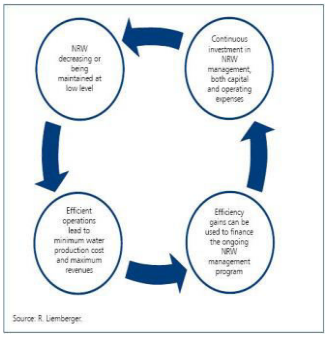
NON REVENUE WATER: - "Non-Revenue Water" (NRW)—defined as the difference between the amount of

water put into the distribution system and the amount of water billed to consumers—averages 35% in the region's cities and can reach much higher levels. One of the major challenges facing water utilities is the high level of water loss in distribution networks. If a large proportion of water that is supplied is lost, meeting consumer demands is much more difficult. Since this water yields no revenue, heavy losses also make it harder to keep water tariffs at a reasonable and affordable level. NRW is a good indicator for water utility performance; high levels of NRW typically indicate a poorly managed water utility. In addition, published NRW data are often problematic, suspicious, inaccurate, or provide only partial information. Some utilities invent "creative" definitions of NRW, use wrong or misleading performance indicators, and fail to quote important information, such as average pressure and supply time



No business can survive for long if it loses a significant portion of its marketable product, but that is exactly what is happening with many water utilities

Reducing physical losses will not only help postpone capital investments for developing new water sources, it will also help reduce a utility's electricity bill.



WATER BALANCE SHEET FOR NAGPUR CITY

AWWA WLCC Free Water Audit Software: Water Balance
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Water Audit Report For:	Report Yr:
Nagpur City	2011

Water Exported 0.000	Billed Water Exported				
Own Sources (Adjusted for known errors) 196,008.650	Authorized Consumption 133,348.700	Billed Authorized Consumption 113,675.600	Billed Metered Consumption (inc. water exported) 104,543.300	Revenue Water 113,675.600	
			Billed Unmetered Consumption 9,132.300		
		Unbilled Authorized Consumption 19,673.100	Unbilled Metered Consumption 6,493.150	Non-Revenue Water (NRW) 82,333.050	
			Unbilled Unmetered Consumption 13,179.950		
Water Supplied 196,008.650	Water Losses 62,659.950	Apparent Losses 7,490.407	Unauthorized Consumption 7,379.259		
			Customer Metering Inaccuracies 111.148		
			Systematic Data Handling Errors 0.000		
Water Imported 0.000		Real Losses 55,169.543	Leakage on Transmission and/or Distribution Mains Not broken down		
			Leakage and Overflows at Utility's Storage Tanks Not broken down		
			Leakage on Service Connections Not broken down		

EVALUATION OF THE SYSTEM: - In accounting terms, an audit is defined as confirming and compiling information gathered on the entity as a whole. A water use audit determines where the water ends up and how much of it go there. The level of detail in the water use audit will vary based on the information of system is available. Water use auditing is an ongoing process that is refined over times. Utilities cannot reduce their water loss to zero. Some water loss is unavoidable, and it is not worth the expense to try to eliminate every drop escaping your system. However, most of the loss that occurs in water systems can be better managed by using a water use audit.

Water loss costs money, paid by your system and your customers. Managing a water utility is similar to managing any other business. Water is the goods that you sell to the public. Losing water is like having a hole in the floor of your store. Inaccurate water metering or billing is like a cash register that rings up all of your sales fifteen percent under the actual price.

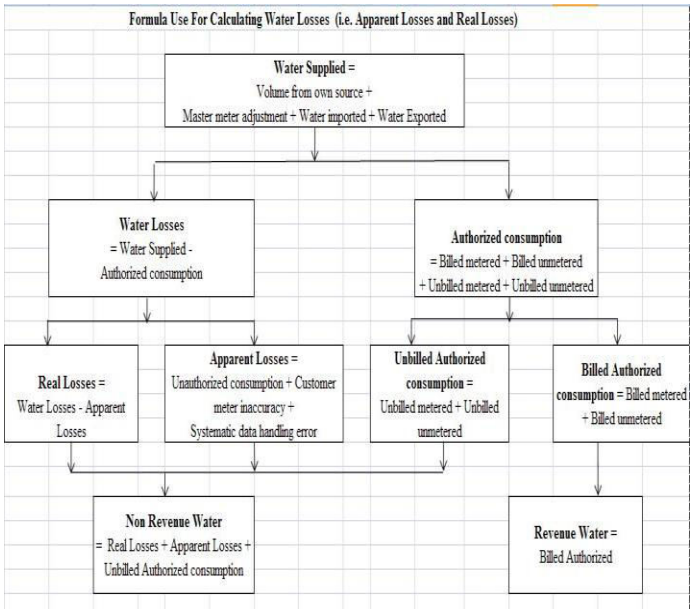
The standard water balance is the framework for categorizing and quantifying all water uses in the water use audit. It is called a balance because when it is completed all uses of water in the system equal the amount of water input by the source starting with the System Input category. It is important to understand that the vertical height of each category represents a proportional amount of water. Thus, the height of the System Input category represents all water pimped by the system in a given time period. This amount of water can be broken down into two additional categories. Authorized use and Water Losses.

Therefore, Authorized Use + Water Losses = System Input. This vertical height water measurement holds true across the entire standard water balance. equal vertical measurements of categories means an equal quantity of water. This holds true even for categories that are not right next to each other, For example:

Water losses = Apparent losses + Real losses

Non-revenue water = water losses + Unbilled authorized use

Apparent losses = Metering inaccuracies + Unauthorized use



CALCULATION OF PERFORMANCE INDICATOR
(For Real Losses And Non-Revenue Water)

NAGPUR CITY:-

1	System Input =	537.01	MLD
2	Non Revenue Water =	225.57	MLD
3	Apparent losses =	20.52	MLD
4	Real Losses =	151.15	MLD
5	Unbilled Authorized Consumption =	60.00	MLD
6	Service Connections =	226669.00	Nos.
7	Pressure Head =	8.00	M
8	Operation & Maint. Cost =	79.07	Crores
9	Tarriff cost/Revenue Water Cost =	6.82	Rs/1000Lit
10	Production cost =	4.03	Rs/1000Lit

I	**Financial NRW by volume**	Volume of NRW [% of system input volume]	=	NRW / System Input	x 100
			=	42.00 %	
II	**Operational Apparent losses**	M^3/service connections /Year	=	Apperent Losses x 10^{-3} x 365 / Service Connections	
			=	33.05 M^3/service connections/Year	
III	**Operational Real losses**	Lit/service connections /Day	=	Real Losses / Service Connections	
			=	666.83 Lit/service connections/Day	
IV	**Operational Real losses**	Lit/service connections /Day/m	=	Real Losses / Service Connections x Head	
			=	83.35 Lit/service connections/Day/	
V	**Financial Real losses Cost in terms of % of OMR cost**	= {(Real losses*production cost + Apparent losses* Tarrif cost) + (Operation, maintenance and repairs cost) }×100			
				34.58 %	
VI	**Financial NRW Cost in terms of % of OMR cost**	= {(Real losses*production cost + Apparent losses* Tarrif cost + Unbilled authorised * production cost) ÷ (Operation, maintenance and repairs cost) }×100			
			=	45.74 %	

3. RESULT

Zone/Area	System Input volume MLD	Non Revenue water MLD	Real Losses MLD	Perfomance Indicators		
				Apparent losses Lit. per service connections per day	Real losses Lit. per service connections per day	Real losses Lit. per service connection per day per pressure head
NAGPUR CITY	537.01	225.57	151.17	90.44	666.93	83.87
LAXMI NAGAR	61.20	4.03	7.05	6.96	236.24	29.53
DHARAMPETH	97.00	42.27	32.04	209.01	1376.42	172.05
HANUMAN NAGAR	29.97	2.90	0.08	2.22	3.09	0.39
DHANTOLI	24.00	11.01	6.52	90.60	451.41	56.43
NEHARU NAGAR	35.00	11.59	5.27	77.23	182.89	22.86
GANDHIBAGH	50.00	32.13	18.21	180.41	1381.50	172.69
SATARANJIPURA	69.53	57.22	42.94	114.44	2476.29	309.54
LAKADGANJ	30.42	5.61	0.37	87.59	14.61	1.81
ASHINAGAR	31.00	10.04	3.80	67.59	126.44	15.80
MANGALWARI	65.00	30.17	22.29	171.10	1192.69	149.09

ZONE NO.	Zone/Area	Financial NRW by Volume	Oprational Apparent losses/Cu. Meter/ service connection/Year	Oprational Real losses/Liter /service connection /Day	Opratio nal Real losses/L iter/serv ice connect ion/Day/ Meter	Financial NRW Cost %	Infrastruct ural leakage Index
1	NAGPUR	42	33.01	666.93	83.37	45.74	548.12
2	LAXMI NAGAR	6.58	2.54	236.24	29.53	16.61	27.01
3	DHARAMPETH	43.58	76.29	1376.42	172.05	47	1107.99
4	HANUMAN NAGAI	9.68	0.81	3.09	0.39	9.8	2.69
5	DHANTOLI	45.88	33.07	451.41	56.43	49.6	356.72
6	NEHARU NAGAR	33.11	28.19	182.89	22.86	37.48	151.81
7	GANDHIBAGH	64.27	65.85	1381.5	172.69	67.49	1176.45
8	SATARANGI PURA	82.3	41.77	2476.29	309.54	84.19	1995.62
9	LAKADGANJ	18.43	31.97	14.46	1.81	23.53	12.82
10	ASHINAGAR	32.39	24.67	126.44	15.8	36.88	103.83
11	MANGALWARI	46.42	62.45	1192.69	149.09	49.77	949.42

4. CONCLUSIONS

Water loss is not “rocket science” however; the utility should carefully examine that one really needs to ponder every aspect of a utility to identify the main areas of water loss. The study on water audit which we perform clearly shows that NRW or UFW of whole Nagpur city is comes out to be 44 % of Total System Input. – Alarming!! For minimizing the losses following measures shall pay dividends. Fixing of Benchmarking and Performance indicators through Water audit, Energy audit & Financial reforms.UFW/NRW reduction program with investment plan.

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