Mandatory Water Audit for Urban and Industrial Water Supply

Shri Sanjeev Agarwal, Shri Ravi Shanker, Shri P K Sharma
Central Water Commission
cepd-cwc@nic.in

Shri Sanjeev Agarwal
Planning and Development Organisation, Central Water Commission,New Delhi, India

Shri Ravi Shanker
River Data Directorate, New Delhi, India

Shri Pankaj Kumar Sharma
River Data Directorate, New Delhi, India

Water Audit, Urban and Industrial Area, Water Audit Framework, Central Water Commission, Water Quality
Click here to enter text.

ABSTRACT

Overall water availability is guided by precipitation everywhere. In India, precipitation has uniqueness in form of limited monsoon season. Within monsoon season itself, precipitation is temporally and spatially skewed in its distribution. While continuous growth of population has resulted in dwindling per capita water availability expected to be 1140 m^3 by 2050 with population stabilising at 1.6 billion thus making the country as water stressed. Upliftment of lifestyle of people in general has increased demand of water and power. Further, shift of population towards urban centers requires shifting of water from natural sources to the place of utilisation i.e. in urban areas and industries. Not only the quantity of available water, but quality of water is also an important aspect. Effluents from industrial areas and urban settlements require continuous water quality monitoring so that the natural water body in which it is being disposed, is not polluted beyond limits. Wherever required, suitable processing of effluents has to be done before its disposal.

The water supply to urban areas and industries begins with creation of diversion structures on natural water bodies. Thereafter, energy consuming systems such as pumping, purification, and transmission and distribution system have to be created and maintained. Though the nature gives us water free of cost, some cost is added to it at each step. The water available at the tap end in a house/office and at the door-step of an industry is the costliest one. In the water bills of industrial and urban user, this cost is not reflected due to prevalent water pricing policy based on socio-politico-economic compulsions of governments. As such, the end user is still unaware of the importance of the end water reaching to its premises. Our Draft National Water Policy 2012 requires mandatory water auditing of urban water supply along with waste-water it generates.

In the Industries, a report of TERI indicates that there is a possibility of annual saving of 65.2 million m^3 of water for a coal based thermal power plant of 3000MW capacity. The cost incurred in adopting water-conservative processes can be recovered in less than 3 years. A report of IFP Energies nouvelles indicate that in the refineries 200 liter to 800 liter water is used for each tonne of petroleum products. This is expected to rise further with shift towards “secondary recovery” of petroleum products.

The freshwater is a renewable natural resource but it is a limited one and cannot be increased by human efforts cost-effectively, now it has become necessary that mandatory water audit for urban and industrial water supply is done to reduce wastage of water. This also limits the conflicts among the various water users.

1. INTRODUCTION:

In India, availability of natural resources like land and water are scarce in comparison to the population. Presently, with 2.4 per cent of land and 4 per cent of water resources, India has to support 16 per cent of world's population and 15 per cent of livestock. For Indian Water Resources Sector, Monsoon is the guiding factor with an almost fixed average precipitation of 4000 billion cubic meters (BCM) per annum. Further, distribution of this precipitation is highly skewed in time and space terms. 75% of total average annual precipitation occurs in 4 months of monsoon period. Even during the monsoon months, about 50% of total annual rainfall takes place only in 15 days and in less than 100 hrs. The national average annual rainfall is 1100 mm, which varies from 10900 mm (Meghalaya) to 100 mm (Rajasthan) in terms of spatial distribution.

Central Water Commission has assessed water resource potential of the country basin-wise as 1869.37 BCM. The total utilisable water resources has been assessed as 1123 BCM. Out of which, utilisable Surface Water share is 690.1 BCM and utilisable ground water is 433 BCM. The overall water resource potential has remained constant over the years, while continuous growth in country's population, which is expected to stabilize at 1.6 billion by 2050, is reducing per capita availability of utilizable water. Further, with ever-rising standard of living, all around rapid industrialization and urbanization, demand of fresh water is going up continuously. There is a strong direct relationship between energy consumption and water consumption and standard of living.

Unabated discharge of industrial effluents into water bodies is further aggravating the situation of scarcity of water of acceptable quality. Scarce fresh water resources are continued to be used wastefully. The increase in consumption is rapidly polluting the scarce fresh water resources (river water and ground water) and quality of available water is deteriorating at alarming rate. Central Water Commission has analysed its historical data and published a report on "Hotspots of Rivers of India" in which the reducing water quality of rivers of India has been highlighted.

Till resources are aplenty, terms like audit, accounts and management do not have any meaning. Only when, resources get scarce, these terms assume meaning. The definition of audit is an evaluation of a person, organization, system, process, enterprise, project or product. Another definition is Auditing is a systematic process of objectively obtaining and evaluating evidence regarding assertions about economic actions and events to ascertain the degree of correspondence between those assertions and established criteria and communicating the results to interested users. Some kind of paper trail like accounts, guidelines, norms, standards etc. are essential to begin with audit. Initially, Äudit was associated only with financial activities. The aim of water audits is to identify and inculcate exact steps to be carried out to reduce excess consumption of water and manage wastewater. Water auditing begins from point of ingress to its release to the drain. The audit is meant for identifying and quantifying inexplicable water losses and measures taken for wastewater management.

The water audit should be made mandatory for all uses for proper utilisation of the day-to-day getting scarce water resources and reduce its wastage.

2. URBAN WATER AUDIT:

Consumption in domestic water sector accounts for 6% of the utilizable water. Civic Bodies like Municipalities, Boards and Cantonments are responsible for urban water supply in India and they are increasingly opting for audit exercise particularly in water stressed regions like Rajasthan.

The audit formats basically monitor inlets and outlets. The results help in assessing losses, gaps and wastages.

Table 1: Schema of Water Audit courtesy IWA/AWWA

<table>
<tr><td rowspan="8">Water from own sources (Corrected for known errors)</td><td rowspan="8">System Input Volume[A]</td><td rowspan="2">Water Exported</td><td rowspan="3">Authorized Consumption[B]</td><td rowspan="3">Billed Authorized Consumption</td><td>Billed Water Exported</td><td rowspan="3">Revenue Water[F]</td></tr>
<tr><td>Billed Metered Consumption</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="6">Water Supplied</td><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="6">Non-Revenue Water[G]</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses[C]</td><td rowspan="3">Apparent Losses[D]</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Data-Handling Error</td></tr>
<tr><td rowspan="3">Water Imported</td><td rowspan="3">Real Losses[E]</td><td>Leakage on Transmission and Distribution in Mains</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>

*All data in volume for the period of reference – typically one year.	[D]Unauthorized Consumption, all types of metering inaccuracies, and systematic data-handling errors.
[A]The annual volume input to the water supply system.	[E]The annual volumes lost through all types of leaks, breaks, and overflows on mains, service reservoirs, and service connections, up to the point of customer metering.
[B]The annual volume of metered and/or unmetered water taken by registered customers, the water supplier, and others authorized to do so.	[F]Those components of System Input Volume that are billed and produce revenue
[C]The difference between System Input Volume and Authorized Consumption, consisting of Apparent Losses and Real Losses.	[G]The difference between System Input Volume and Billed Authorized Consumption

Central Water Commission has published a "GENERAL GUIDELINES FOR WATER AUDIT & WATER CONSERVATION" in December, 2005. The document contains basic formats for undertaking water audit exercise by civic bodies. Annex-C of the guideline provides a format for Domestic Water Audit as given below:

Table 2: Sample format for Domestic Water Audit courtesy CWC

Annex- C							
DOMESTIC WATER AUDIT							
Assessment of water requirement for residential Units							
Number of persons / user in the residential unit =							
Measurement of Water Uses per Residential Unit							
Sl. No.	Fixtures	Rate of Discharge (litre/min)	Average Duration of Use (min)	Average Quantity per Use (litre)	No. of Uses (No.)	Total Daily Use (litre)	Per Capita Daily Water Use (litre)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Kitchen faucet						
2	Utility faucet-1						
3	Utility faucet-2						
4	Bathroom faucet-1						
5	Bathroom faucet-2						
6	Bathroom faucet-3						
7	Other faucet-1						
8	Other faucet-2						
9	Shower-1						
10	Shower-2						
11	Shower-3						
12	Toilet-1						
13	Toilet-2						
14	Toilet-3						
15	Washing Machine						
16	Dish washer						
17	Others						
TOTAL							

Such reports should be supplemented with location maps, indicative site drawings, and schematic diagram of water inlets and outlets.

Similarly, office and institutional buildings can also be audited for water. Centre for Science and Environment, New Delhi has completed a similar task for their office located in the Tughlakabad Institutional Area.

Ministry of Water Resources has planned to establish National Bureau for Water Use Efficiency. The NBWUE will work in the area of water footprints, benchmarking and water auditing to improve the overall water use efficiency in the country. NBWUE may establish a rating system for water-efficient devices (like dishwashers, washing machines, coolers etc.) similar to star rating system of BEE for energy efficient devices. Water audit should be made part of school-curriculum and also as an exercise within school premises for creating awareness among children. The tools to assess water requirement of homes/offices should be made easily available on internet for general public. These

tools will help in educating public and will provide them with information before creating water-consuming liabilities.

3. INDUSTRIAL WATER AUDIT

Consumption in Industrial water sector accounts for 9% of the utilizable water. This may rise to 25% as per comparable existing uses of developed nations. Major users are Thermal Power Plants, Oil Refineries, Paper & Pulp Industry, Fertilizer Industry, Textile Industry and Food Processing. Water is used in the industry for cooling, dilution and/or transportation of waste, cleaning, lubrication, processing and often as base material. (i.e. soft drinks)

Industrial sector offer a better opportunity for application of Water Audit principles as it results often in cost-saving, better products and processes.

TERI has carried Water Audit for thermal power plants which produce 66% of the electricity generated in India. It was estimated that for every MW of power produced, Indian thermal power plants consumed about 80 m^3 of water as compared to less than 10 m^3 water consumption in developed nations. This is mainly due to open-water cycle process and lack of reprocessing of waste-water.

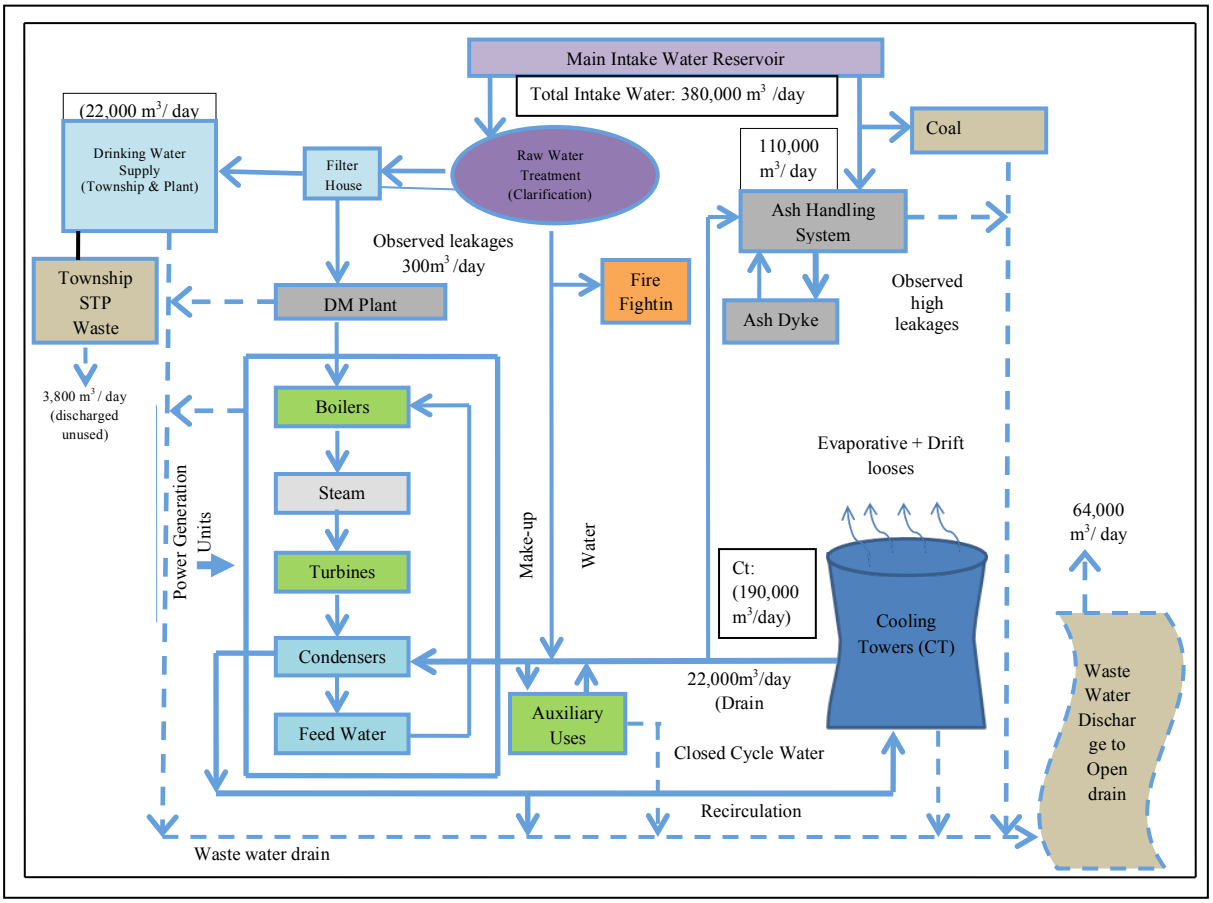

Figure 1: Water Cycle without recycling and waste-regeneration in a typical thermal power plant courtesy TERI

It has been found that by adopting closed-loop water cycle and recycling of waste-water, for a 3000MW coal based thermal power plant has a potential for water saving upto 65.2 million m^3/year and 26.1 crore (INR)/ year. The estimated pay-back period is less than 3 years.

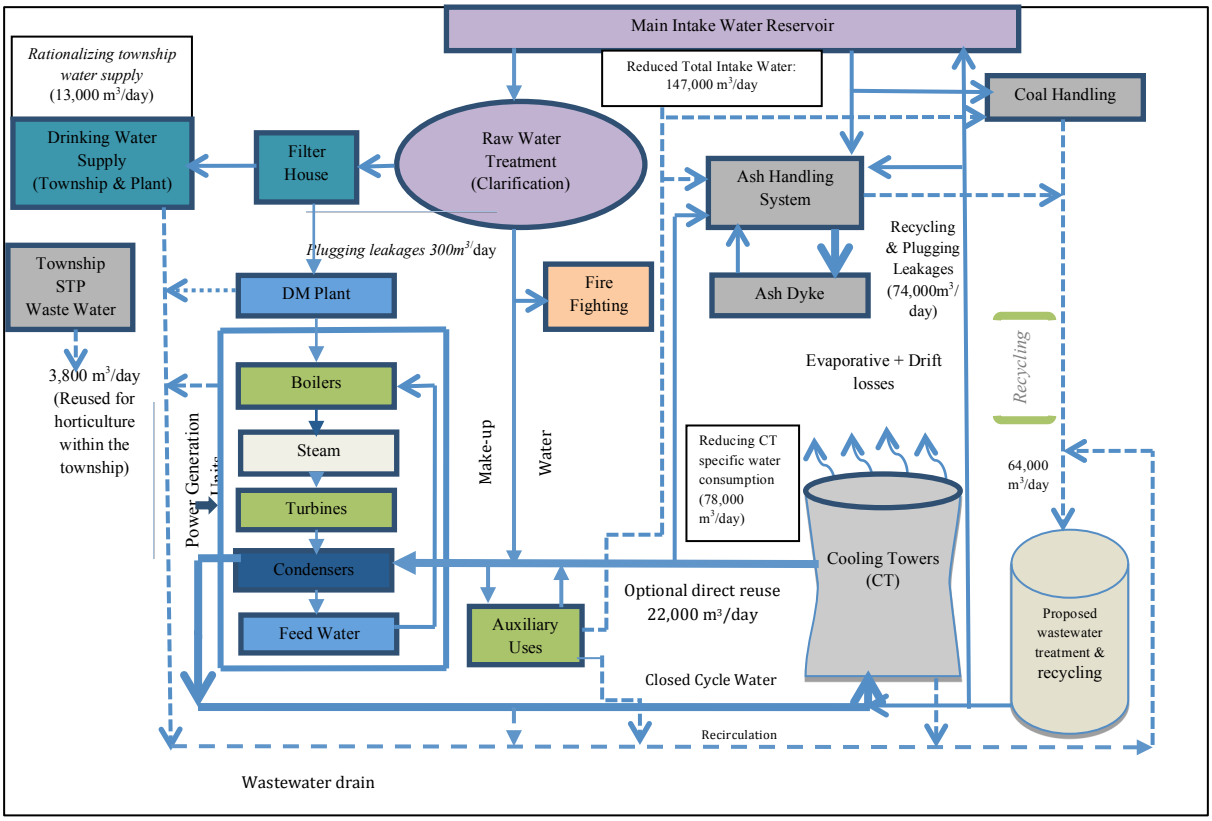

Figure 2: Water Cycle with recycling and waste-regeneration courtesy TERI

In the refineries also, cooling towers are used extensively and as such principles of water auditing can be applied there. In fact, all the industries using water for cooling purpose may benefit from this process conversion. Average water consumption in refinery has considerably improved in comparison to earlier decades, but still the requirement is within the range of 200 liter – 800 liter per tonne. Within a refinery, nowadays water is increasingly used for "secondary recovery". In this process, Water is pumped down the petroleum bearing strata to forcely lift up the lighter petroleum products. Basically, consumption of water increases with consumption of energy of any form. There is linear relationship between energy and water consumption.

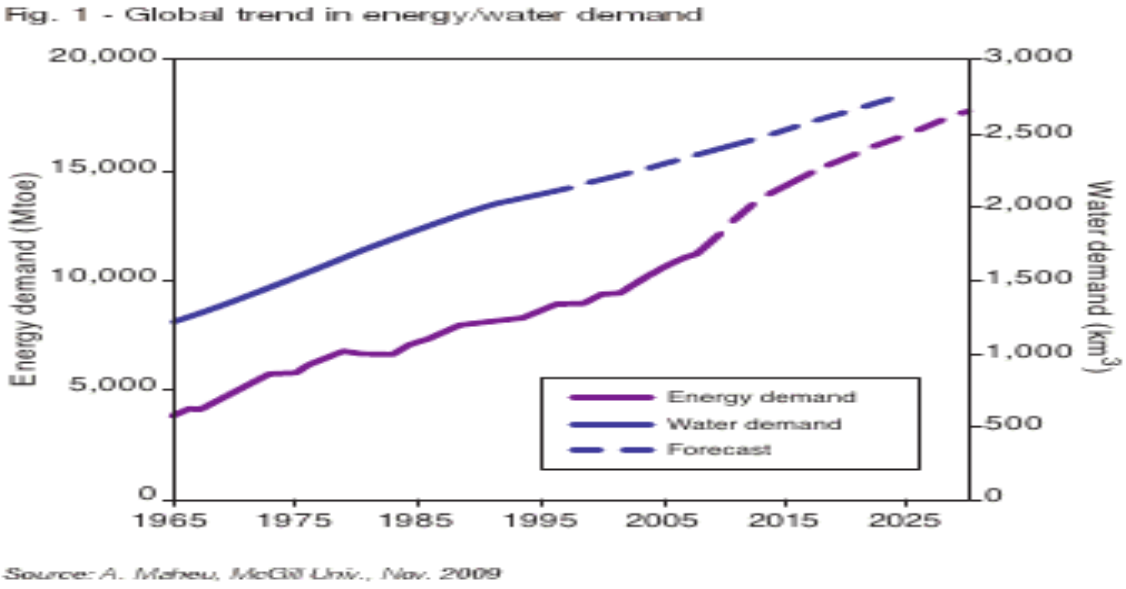

Figure 3: Direct co-relationship between energy and water demand courtesy A Maheu, McGill University

In the refineries, there is ample scope of saving water.

Fig. 11 – Optimising refinery water Circuits, towards zero discharge levels.

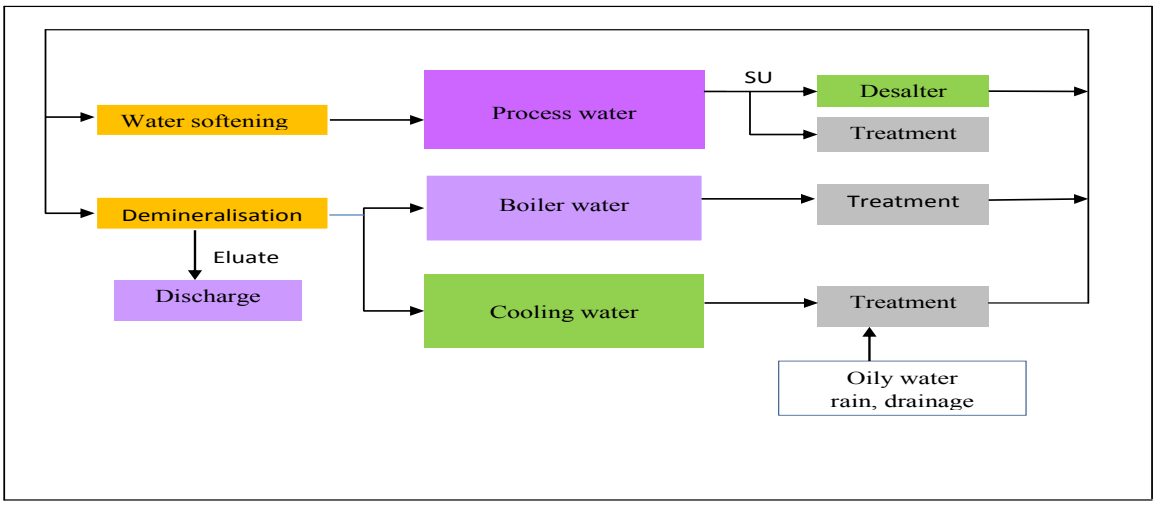

Figure 4: Optimising water use in refineries courtesy IFP Energies Nouvelles

4. MANDATORY WATER AUDIT FRAMEWORK:

All the stakeholders, the urban and industrial water users, policy makers, planners, infrastructure providers should be made to understand the fact that first natural resources like water need to be transported from the point of availability to the point of processing (to ensure desired quality standard) and thereafter again transported to the point of use. Secondly, after its use, the polluted water needs to be transported to a processing facility to bring down the pollutant level to acceptable standards before its discharge into the natural bodies again.The transportation, processing and storage facilities require huge amount of money and skill to create, maintain, and after standard uses, replace them.The audit framework should be based upon this understanding and not merely on the cost charged from users by municipalities.

The National Mandatory Water Audit framework should consist of following parts at its minimum:

Part 1: Identification of all constituents of the water consumption cycle water sources, its temporal and spatial behaviour; Identification of water users, water usage pattern, its temporal and spatial behaviour; Identification of water (including polluted water) transportation, storage, and processing facilities along with associated attributes like water quality , cost , frequency etc.

Part 2: Identification and establishment of initial control points in the entire consumption cycle

Part 3: Development of First model of consumption cycle; thereafter circulation of its result (cost, quantum, time, technology, effluent quality, natural resource quality etc.) among all the stakeholders.

Part 4: Development of alternate models of consumption cycle based upon different scenarios like: fund availability, technology availability, needs assessment, time availability, resource availability etc.

Part 5: Based upon the selected model, redefining the control points and modification of the consumption model.

The audit thus performed would not only evaluate the existing system / process / infrastructure for its efficiency but would also be able to suggest workable models for future.

5. ROLE OF CENTRAL WATER COMMISSION:

Central Water Commission is a premier Technical Organization of India in the field of Water Resources and is presently functioning as an attached office of the Ministry of Water Resources, Government of India. The Commission is entrusted with the general responsibilities of initiating, coordinating and furthering in consultation of the State Governments concerned, schemes for control, conservation and utilization of water resources throughout the country, for purpose of Flood Control, Irrigation, Navigation, Drinking Water Supply and Water Power Development. It also undertakes the investigations, construction and execution of any such schemes as required.

In exercise of the above responsibilities, some of the main functions of CWC are as given under:

- To collect, compile, publish and analyze the hydrological and meteorological data relating to major rivers in the country, consisting of rainfall, runoff and temperature, etc. and to act as the central bureau of information in respect of these matters;
- To collect, maintain and publish statistical data relating to water resources and its utilization including quality of water throughout India and to act as the central bureau of information relating to water resources;
- To promote modern data collection techniques such as remote sensing technology for water resources development, flood forecasting and development of related computer software;

At present, Central Water Commission is maintaining 878 hydro-meteorological stations. Water Quality parameters are observed at 396 stations out of the above. Commission has published a report titled as Water Quality “Hot spots in Rivers of India” in August, 2011. In this report, last ten years of data was analysed. It was found that quality of river water was beyond acceptable limits at several places for different purposes like drinking, irrigation, etc.

Further, Commission has specialized directorates for planning, appraisal and cost accounting of projects. The common knowledge-pool of these offices may be aptly utilized for preparation and execution of National Mandatory Water Audit Framework.

6. CONCLUSION:

It may be concluded that there is ample scope of achieving positive output from application of water audit principle in urban and industrial sector. In the industrial sector, cost incurred in recirculation, waste-regeneration can be recovered easily in limited time. In urban sector, the quality and reliability of water supply can be improved with sensitisation of stakeholders.

7. REFERENCES:

TERI Policy Brief , December 2012 : Enhancing water-use efficiency of thermal power plants in India: need for mandatory water audits.

Lahcen Nabzar – lahcen.nabzar@ifpen.fr : Panorama 2011 : Water in fuel production ,Oil production and refining : IFP Energies Nouvelles

General guidelines for water audit & water conservation : Evaluation of Water Utilisation Directorate, Central Water Commission, December 2005.

Audrey Maheu : Energy Choices And Their Impacts On Demand For Water Resources: An Assessment Of Current And Projected Water Consumption In Global Energy Production : November 2009 :Mcgill University

8. LINKS

http://wateruseitwisely.com/region/arizona/links-and-resources/more-resources.php

http://wateruseitwisely.com/region/arizona/links-and-resources/demonstration-gardens/

http://www.azwater.gov/azdwr/StatewidePlanning/Conservation2/documents/documents/laundry_residential.pdf

http://wateruseitwisely.com/100-ways-to-conserve/home-water-audit.php

http://www.cseindia.org/userfiles/CSE_water_audit_report.pdf

http://www.cwc.nic.in/main/downloads/Water%20Audit%20&%20Water%20Conservation%20Final.pdf

http://www.hindu.com/2011/06/13/stories/2011061358120300.htm

http://in.finance.yahoo.com/news/ministry-moots-water-efficiency-bureau-145801304.html

http://urbanindia.nic.in/programme/lsg/teri_uc_report.pdf

http://mowr.gov.in/writereaddata/linkimages/DraftNWP2012_English9353289094.pdf

http://www.ifpenergiesnouvelles.com/

http://www.ifpenergiesnouvelles.com/content/download/70601/1513892/version/2/file/Panorama2011_11-VA_Eau-Production-Carburants.pdf