Grenze International Journal of Engineering and Technology, Jan Issue

Best Practice for Integrated Urban Water Management-IUWM in Urban Cities

Mr. Kakhandaki Sadanand P[1] and Dr. Hareesh K[2]
[1]Research scholar, Department of CS & E, Government Engineering College Ramanagara, Karnataka, India
sadapk05@gmail.com
[2]Associate Professor, Department of CS & E, Government Engineering College K.R Pet, Karnataka, India
hareeshk.gec@gmail.com

***Abstract*—The water is scares resource for existence of mankind in this universe. Due to exponential growth of population all the water bodies are polluted in Urban Cities. The major urban services are demanded by Urban Cities with increase of population. The Major urban services are Water Supply in the Urban Cities, Management of wastewater and Storm water, providing potable water to population of urban cities by resolving all the issues with respect to rapid Urbanization. The pollution is increased with modifications of land use pattern. All Utilities of Urban Cities have to adopt the best practice for Integrated Urban water management like fixing of Electromagnetic measurement sensor for all inflow of water to urban cities. Providing Remote Terminal Units of wireless Network capabilities which facilitates the seamless data transfer and integration of Data to the remote server. The applications for centrally monitoring data will be hosted into the central server.**

***Index Terms*—EMF = Electromagnetic Flow Meters, IUWM = Integrated Urban Water Management, FTP= File Transfer Protocol, NGO=Non Governmental Organizations, EN = European Standards, ISO = International Organization For Standardization, JIS = Japanese International Standard, CWSS = Cauvery Water Supply Scheme, HART = Highway Addressable Remote Transducer Protocol, GSM = Global Systems for Mobile Communications, MLD= Million Liters Per Day, ADC = Analog to Digital Converters, HTTP = Hyper Text Transfer Protocol, ISP = Internet Service Provider, IP = Internet Protocol, APP = Application, DB = Database, Q-BR = Quantity on Branch, IP-SAN = Internet Protocol, Storage Area Network. GPRS = General Packet Radio Services, RTU = Remote Transmitter Unit.**

I. INTRODUCTION

Water is an extremely sacred resource for the existence of human beings. From the ancient times, water in the form of major rivers established the prominent world civilizations like Mesopotamia, Egyptian, Chinese and Harappan. In ancient India, it formed the part of five elements of nature that were respected and worshipped by the people. In the present day, the extensive Research has depicted the fact that people are reaching a point where water will be as expensive as mineral oil. It is very much true that we have exploited nature extensively that there is bound to be ‘Water Crisis’ around the globe.

1. One of the major issues that are increasing at an alarming rate is that different water bodies like rivers, oceans, lakes, bays are getting polluted due to the exponential population growth.

Grenze ID: 01.GIJET.7.1.2

2. We are losing the actual amount of potable water that should be present on the planet. Water bodies like the ground water are exploited to the fullest for the vested interests of some people. This will lead to a day when there won’t be any ground water reservoirs left.

II. Future Challenges In Urban Water Management

The Urban Population is continuously increasing; the increase in population is taking place primarily in the developing countries, where the unplanned growth is occurring. The increase in the population of urban cities demands major Urban Services. The demanded major services are (1) Supply of water in the Urban Cities. (2) Management of wastewater and Storm water. (3) The Population growth and the rapid Urbanization are leading to increased demand for Water and Wastewater services, increased pollution & modifications in the land use pattern. The challenges are listed as below:-

1. **Climate Change:** Increased Intensity of Rainfall, Rising temperature, Rising Sea Level, Increased floods and droughts.
2. **Growth of population and Urbanization:** migration from Rural to Urban areas, loss of Green space and peri-urban agriculture.
3. **Governance & Policies**: New Political regimes, Institutional Policies and Global Frameworks.
4. **Damage of Infrastructure Systems:** Pipe Breakage with water losses and wastewater leakage, tremendous operational costs.
5. **Changes in Public Priorities**: Basic economics and versus environmental protection.
6. **Emerging Technologies**: Adopting the IoT technologies, Smart Water Management technologies to achieve Integrated Urban Water Management (IUWM).

Water management utilities shall have complete knowledge of existing and present issues. The team shall also look into the Uncertainty which may arise. The aspects with respect to ambiguity need to be addressed into the phases of planning and Decision making processes. To address the uncertainty, the strategic thinking is required and same shall be adopted and translated into strategic and flexible planning.

III. Importance of Water Management

1. Water management helps in developing efficient irrigation practices for the betterment of agriculture in the country.
2. Proper utilization of water in our homes too can save this precious resource. Water management teaches us to use a limited amount of water whenever required. This keeps every citizen accountable for any wastage that occurs.
3. We need to preserve water resources for future generations. There are different statuary commissions established by the government and NGOs that are working towards sustainable protection of water resources.

A. Latest Water Management Technology

1. Data Analysis & Fusion.
2. Data Management and Display in the form of Dashboard.
3. Data Collection and Communication through latest Technologies.
4. Process Sensing and Control equipments.
5. Usage of Flow and Pressure control Equipments.

B. Characteristics of Measurement Sensors.

1. **Accuracy**-Accuracy is the capacity of a measuring instrument to give **results** close to the Exact Value of the measured quantity.
2. **Discrimination-** Discrimination is the minimal change of the input necessary to produce a detectable change at the output.
3. **Precision-**The capacity of a measuring instrument to give the same reading when repetitively measuring the same quantity under the same prescribed conditions.

IV. Features of Bulk Water Flow Measurement Devices

1. Electromagnetic flow meters (EMF) can measure the volume flow of liquids, slurries, sludges and pastes in almost any industry. The only prerequisite to use an EMF is that the product being measured must have minimum electrical conductivity.
2. EMF devices enable the linear display and totalizing of volume flow in both flow directions. The measurement is virtually unaffected by pressure, density, temperature, viscosity and flow profile.
3. EMFs also feature very high measuring accuracy. Depending on the version, the error under reference conditions can be less than 0.15% of the measured value. Because of the high degree of repeatability a standard deviation of less than 0.03% of the measured value is achieved. Measuring ranges of more than 100: 1 can be achieved with errors of less than 1% of the measured value.
4. The unobstructed tube cross section prevents any additional loss of pressure. Even when the process liquid contains solid particles, the risk of damage through abrasion is limited because with EMFs there are no parts protruding into the tube. When it comes to abrasive or even aggressive products, there is a broad range of materials available for the wetted parts.
5. EMFs do not have any moving mechanical parts, they are virtually maintenance free. Consequently, they are extremely reliable, have a long service life and boost superior long-term stability and availability.
6. The Installation and Commissioning of EMF meters shall be done by following Installation and Process Guidelines.
7. The Damage to the Flow Device shall be prevented with proper Grounding of Device with the help of Grounding Rings and Grounding Electrodes.

V. Components of EMF meters

The bulk flow meters shall have the following Components:

1. **Field coils:** The field coils are protected within the housing of the primary head. They are diametrically fastened to the measuring tube and perpendicular to the electrode axis. The supply that generates the magnetic field comes from the signal converter.
2. **Measuring tube:** The magnetic field generated by the field coils located on the measuring tube must be able to penetrate the process liquid through the wall of the tube. For this reason, the measuring tube may not be made of a ferromagnetic material. Neither may the inner wall of the tube be electrically conducting, so that the signal voltage induced in the process liquid cannot be short-circuited. The measuring tube is thus normally made out of ceramic, plastic or non-ferromagnetic stainless steel with an electrically insulating liner or internal coating. The interior wall of the tube comes in contact with the process liquid and must thus be corrosion-resistant to the process liquid.
3. **Electrodes:** The electrodes are in direct contact with the process liquid and must therefore be corrosion resistant while ensuring good electrical transfer to the process liquid.
4. **Designs**: The primary heads for electromagnetic flow-meters are available in a variety of versions. They include: Flanged version, Sandwich version, Hygienic version.
   Flanged version: This is the most common version for installing the EMF into a process line. The flanges are available in a variety of nominal sizes and pressure ratings according to EN, ISO and JIS.
5. **Signal converter:** One of the tasks of a signal converter is to supply the current required by the primary head field coils to generate the magnetic field.

The signal converter is also responsible for the µP-controlled processing of the flow-proportional signal voltage. This signal voltage U is in the µV to mV range and is subject to noise and interference voltages. The converter's

signal processing converts this voltage into digital values and digitally filters the noise and interference signals out. From this filtered signal, the flow velocity v and the volume flow qV are calculated using scaling of the calibration constant and the nominal size of the primary head.
The signal converter can also provide a variety of diagnostic data including the conductivity of the process liquid, indication of the flow profile, etc. The output of the data measured can then be visually displayed on the local display or in analogue form via the mA current output as well as in binary form by way of frequency, pulse and status outputs. It is not without reason that EMFs are the favourite flow meters in many industries. Electromagnetic flow meters feature advantages that make them indispensable for many applications.
The main advantages are a) The linear measuring principle. b) The high measuring accuracy. c) The unobstructed cross-sectional area of the flow tube. d) No mechanically moving parts. e) Largely independent of the viscosity. f) Density of the process liquid. g) Largely independent of the flow profile. h) Measurement in both directions of water flow.

VI. IMPLEMENTATION OF IOT (INTERNET OF THINGS) FOR MONITORING CUMULATIVE DISCHARGE IN URBAN CITIES: SUB-SYSTEM1

The water to All urban cities in India like Bangalore is being discharged 24x7 and 365 Days continuously through pipeline system. The MS pipelines are laid all along the road side from source to the Entry point of City. There are 'N' Pipelines which are acting as the transmission Channels of water to Urban Cities. The Bangalore water transmission pipes are having the following Pipe Diameter (in mm):-

1. The Water Supply Scheme – CWSS Stage-I-1200 mm Diameter.
2. The Water Supply Scheme – CWSS Stage II-1200 mm Diameter.
3. The Water Supply Scheme –CWSS Stage III-1950 mm Diameter.
4. The Water Supply Scheme – CWSS Stage 4-Phase I- 2200mm Diameter.
5. The Water Supply Scheme –CWSS Stage 4- Phase II- 3000mm Diameter.

These '5' Pipelines are called as the Transmission Pipeline / Feeder Mains, which is installed with EMF / Ultrasonic Bulk flow sensors. The Measurements from these EMF/Ultrasonic Bulk-flow meters are integrated to Centralized server / Remote Monitoring system.The transmissions from Remote field Instrument to remote server are being done through the Communication Protocols like Modbus, HART and 4-20 mAmps etc. The Details of the total "Tataguni Discharge" from the RTU unit is as below. The 29 samples are obtained and analyzed in each CWSS Stage.

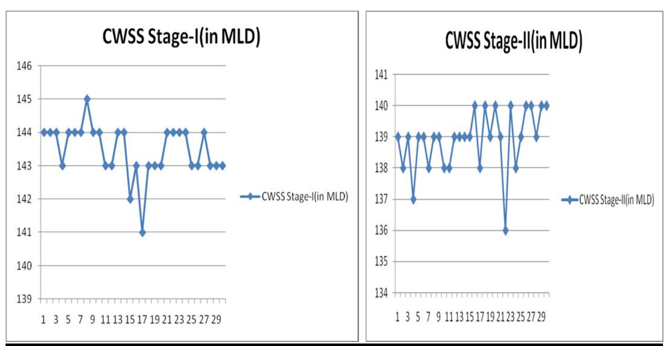
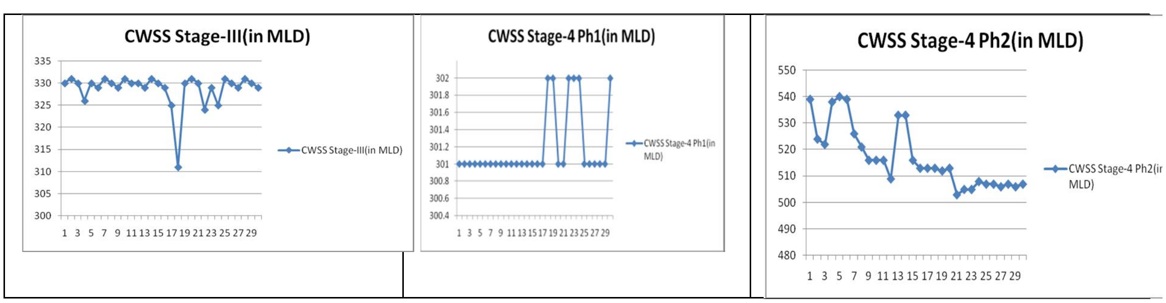


Figure 1 : CWSS-Stage I & CWSS –Stage II



Fgure 2: CWSS- Stage III, CWSS-Stage 4-Ph1 & CWSS-Stage 4Ph2

The Cauvery Water Supply Scheme (CWSS) Stage-I was designed with the Capacity of 145 MLD discharge per Day. The diameter of the pipeline is 1200mm Diameter. The pipelines are fixed with Ultrasonic Bulk flow meter which has the capability of remote transmission. The Wireless network technology is being implemented. The regular intervals Data is transmitted to remote server integrated with File Transfer Protocol (FTP). The above chart shows One month Data which is being recorded and transmitted to remote server.

The Cauvery Water Supply Scheme Stage-II was designed with the capacity of 140MLD discharge per Day. The Data of One Month is observed, the line chart (2) shows the variation Data in different days. The Variation is from 136MLD to 140 MLD. The Cauvery Water Supply Scheme Stage-III was designed with the Capacity of 330 MLD discharge Per Day. The Diameter of the Pipeline is 3000mm Diameter. The Data of one Month is observed as shown in the line Chart (3), there is variation of Discharge in different Days. The Variation is from 310 MLD to 330 MLD.

The Cauvery Water Supply Scheme Stage-4 Phase I was designed with the Capacity of 301 MLD discharge Per Day. The Diameter of the Pipeline is 2000mm Diameter. The Data of one Month is observed as shown in the line Chart (4), there is variation of Discharge in different Days. The Variation is from 301 MLD to 302 MLD. The Cauvery Water Supply Scheme Stage-4 Phase II was designed with the Capacity of 540 MLD discharge Per Day. The Diameter of the Pipeline is 2700mm Diameter. The Data of one Month is observed as shown in the line Chart (5), there is variation of Discharge in different Days. The Variation is from 540 MLD to 501 MLD.

VII. Implementation Of EMF/Ultrasonic Sensors With Wireless Transmission Module On Branches:Subsystem2

The process and Analysis of total quantity of water supplied from main source of water to urban cities is deliberated in the sub-system1. The main transmission system is branched at ‘n’ locations. Each Branch is having different sized (in mm) pipeline. The size can be represented with symbol Φ. The branches of each transmission pipeline can be represented with BR. The total volume of water in each of the Branch shall be measured by fixing EMF (Electromagnetic Flow Meter) or Ultrasonic Electronic sensor. The output from the sensor shall be connected to ADC equipments. The resulting output from ADC is connected to 4-G Wireless transmitter. The public static IP Address of remote server shall be configured in 4G-transmitter to facilitate the remote transmission of Data. The transfer of Data from Branch Point will be through GPRS wireless technology.

The raw Data from Remote branch Location is being communicated to FTP (File transfer Protocol) server or Web server through HTTP.

Total Quantity of Water Discharge to Urban City (T) = ∑(Q-BR1:Q-BRn);

T= Total Quantity of Water.

Q-BR1 = First branch on the transmission Pipeline.

Q-BR2 = Second Branch on the Transmission Pipeline.

.

.

Q-BRn = Nth Branch on the Transmission Pipeline.

The wireless transmission system used in IMPLEMENTATION are as below

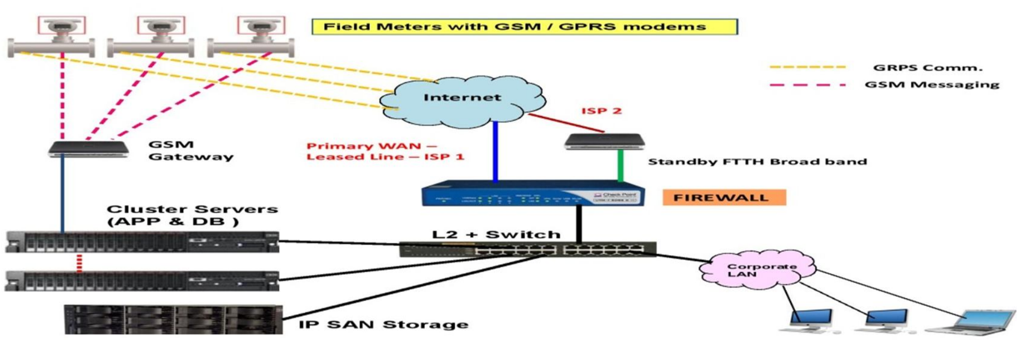


Fig 3: wireless transmission system used in implementation

The Bulk flow meters, the EMF flow sensors are provided at the distribution/transmission network of Urban City. The field Instruments are represented as “Field Meters with GSM/GPRS modems”. The data from the field

Instruments is pushed to GSM Gateway/Internet – ISP1 (Internet Service Providers). The data transmission between field Instruments (meters) to the central server is through wireless Network. The leased line is established in between private service provider gateway and remote server. The data is fed to File Transfer Protocol (FTP) server.

The Data shall be fed to cluster servers (APP + DB), through the L2 switch. The application is hosted into web servers with static public IP Address. The wireless network is used in between the remote field instruments and the remote application hosted in the servers.

VIII. CONCLUSION

The urban cities are facing the threat of Water Scarcity. The water to be supplied to the Urban Cities needs to be properly managed in an integrated approach. The process of urban water supply management is divided into two sub-systems. The subsystem-1 provides an approach and analysis to provide and transfer the Measurements from the Inlets to the urban cities. The subsystem2 provides an idea and approach for providing Electromagnetic flow meter/Ultrasonic flow sensors with remote transmission capability on every Branch point of transmission network and integration. The concept can be used as the Best practice in every urban city.

REFERENCES

[1] Integrated Urban Water Management- By Akiça Bahri

[2] Integrated Urban Water Management (IUWM): Toward Diversification and Sustainability - Global Water

[3] An Approach to Integrated Urban Water Management (IUWM)- First published by Arghyam, Bengaluru, 2012

[4] Key concepts for Integrated Urban Water Management infrastructure planning: Lessons from Melbourne- Utilities Policy, Volume 45, April 2017, Pages 84-96

[5] Adopting Integrated Urban Water Management 12 December 2018 India Pavilion Katowice, Poland

[6] Using Integrated Urban Water Management to Promote Sustainable, Resilient Cities in Africa- World Bank Project.

[7] Integrated urban water management: lessons and recommendations from regional experiences in Latin America, Central Asia, and Africa- 2012 The World Bank, 1818 H Street NW

[8] Integrated Urban Water Resources Management- Petr Hlavinek, Tamara Kukharchyk, Jiri Marsalek, Ivana Mahrikova PAUL JEFFREY Pages 11-18

[9] Applying Integrated Urban Water Management Concepts: A Review of Australian Experience- 37(5):589-605 · June 2006.

[10] Adopting Integrated Urban Water Management in Indian Cities (AdoptIUWM), Newsletter, November 2016.