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Intelligent Management of Secondary Water Supply Systems in Downtown Shanghai

Xinyue Liu^a, Shihu Shu^{a,b*}, Kun Yang^a, Tingting Wang^a, Bing Geng^a

a. National Engineering Research Center of Urban Water Resources, Shanghai, 200082, CHINA

*b. College of Environmental Science and Engineering, Donghua University, Shanghai, 201620, CHINA**

Abstract

Secondary water supply, as the final component of the urban water supply system, is critical for ensuring the safety of urban water supply, and is directly related to customers' water use. However, water stored in secondary water supply facilities will more likely to lose disinfectants (chlorine residual) which can lead to bacterial regrowth and water quality deterioration. Therefore, it is important to solve problems associated with secondary water supply and manage the system more effectively. In the context of the Internet of Things, the intelligent management model based on information technology has become the growing trend. This paper introduces the application of the secondary water supply intelligent management model in Shanghai.

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1. Introduction

According to the statistics, the number of secondary water supply tanks in Shanghai is more than 200,000 which accounts for more than 20% of the daily water supply. Due to the complex structure of the secondary water supply system, with a huge number of facilities that are scattered across the city, it is difficult for property companies to manage. Therefore, the government has been pushing forward the renovation program to update aging secondary water supply facilities in residential communities, and these facilities will be taken over by water utilities after renovation. It is expected that the renovation work will be completed by the end of 2018, and property rights of the facilities of all secondary waterworks will be transferred to water utilities by 2020. In the present circumstances, how to strengthen the management of secondary water supply and ensure the safety of drinking water quality is worthy of further discussion ^[1].

* Corresponding author.

E-mail address: ssh314@126.com (S. Shu)

2. General Situation of Secondary Water Supply

As a result of intensifying urbanization and population growth, more and more high-rise residential buildings have been built for achieving high density development we have been went through. Secondary water supply facilities like water storage tanks became a “must-have” for those high-rise buildings. However, poor design of water storage facilities, for example, the designed volume of water tank is much larger than water demand, so a dead storage capacity will be generated and fresh water cannot be replenished frequently, resulted in deterioration of water quality. On the other hand, property company might sometimes be irresponsible for their secondary water supply properties, not taking operation and maintenance seriously. Problems of construction and management associated with secondary water supply facilities have aroused great concerns in the government, water utilities and water users. In order to deal with these problems and ensure water safety, it is urgent to regulate and improve the management of secondary water supply [2-3].

3. Development of the Integrated Management Information Platform

The primary objective of the secondary water supply management information platform is to meet the daily management needs, to manage the whole process of secondary water supply in Shanghai more intelligently.

The overall design concept is to integrate various advanced technologies such as GIS, IoT technology, remote communication technology and information science, establishing a secondary water supply management information platform, achieving unified data management, sharing and mining. Several sub-systems with different functions including project management, operation and maintenance, billing system, asset management, customer service, emergency alarming are all combined in one overall monitoring and management system that can provide different kinds of water supply services. The platform assures the effective communication of sub-systems for information exchange, and eventually realizes a society-oriented, leadership-oriented, decision-oriented integrated management system.

Given the information platform, comprehensive and reliable water-related information was available for water utilities to check up regularly in order to ensure stable operation and water safety, providing a strong technical support for scientific scheduling and decision making. Moreover, measures of online monitoring, dynamic data assessment and remote control of secondary water supply facilities in residential communities greatly improved water supply management and services, as well as customers’ satisfaction. Several residential communities were selected to carry out the demonstration projects construction and have achieved ideal effects.



Figure 1. Advantages of the Management Information Platform

4. Water Properties Monitoring

4.1 Online Monitoring System

The main function of the real-time monitoring system for secondary water supply is to achieve the real-time

monitoring of the water information as well as the operation status of secondary water supply facilities. The monitored data include turbidity, residual chlorine concentration, pH value, temperature, water pressure, operation parameters of pumps, etc. The online monitoring system will assist water utilities in ensuring water safety, operation security and stability. Specific functions are as follows:

- (1) Quickly retrieve the information of pumping room in residential areas.
- (2) Real-time monitoring;
- (3) Real-time video surveillance;
- (4) Historical water quality data inquiry;
- (5) 3D rendering and visualization of pump rooms;
- (6) Panoramic technology to view the internal information of the pump room;
- (7) Geographical localization.

Real-time data of each community are collected by installing onsite sensors and communication equipment. Data will be transmitted and stored in the database for record computation and analysis, then be intergrade in the management information platform. Different types of charts and graphs such as GIS map, pipeline map, water quality charts, can be generated for checking whenever needed, improving the overall water supply management.



Figure 2. Online Water Quality Monitoring and Data Transmission

4.2 Mobile APP

A mobile App software was developed for monitoring secondary water supply systems. It is a simple, convenient and practical software for timely communication within enterprises and real-time access to enterprise data. The app consists of two parts, the mobile-end part and the server part. The mobile end is responsible for meeting various residents' needs and providing a good user experience. The server part is responsible for receiving and processing information, and providing different kinds of services.

Residents can download the app through scanning a QR code. Residents can benefit from the app as they can have access to dynamic water-related information such as water pressure, water quality and quantity through the APP or electronic screen. Also, they can report water issues back to water utilities in a timely manner through the APP, and the platform will automatically dispatch the repair team to solve the water issues accordingly. Moreover, once abnormal situation happened, residents will receive warning messages. As a result, the overall customer satisfaction will increase.

5. Demonstration Projects

After the site-selection process, more than 10 residential communities in downtown Shanghai were selected for carrying out demonstration projects. The first thing is to install water quality monitors, pressure gauges and water meters in order to continuously record the water quality and operation status of secondary water supply systems. Collected data will then be transmitted to the online monitoring system for record computation and reporting. Each facility is labeled a unique number as data can be accurately processed and transmitted between multiple systems [5].

In addition, The GIS technology was also introduced for secondary water supply management, so it will become much easier to identify and localize the residential community, and visualize its floor plan and pipeline map in 3D, as well as check the water quality information online. Combined with advanced AR technology, customers can get 360 degree internal detailed information of the pump room.

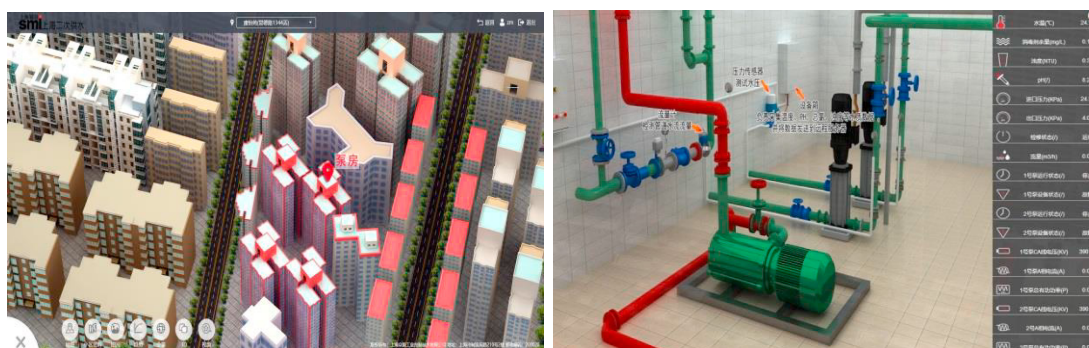


Figure 3. 3D Visualization

Conclusions

The integrated information platform will make up for the inadequacy in secondary water supply management. Water utilities can optimize secondary water supply operation while improving asset management, as well as maintaining a desired level of services in the most cost-effective manner. The government can also benefit from the platform for they can supervise secondary water supply systems more effectively through online monitoring data.

The secondary water supply information management system was developed and put into operation in selected residential communities in downtown Shanghai, achieving desired results. Shanghai creates its unique model of management through measures of on-line monitoring, dynamic assessment and remote communication and control of secondary water supply facilities in residential communities, which can be further developed and promoted throughout the city.

References

1. Chen Gu, Weizhong Shen. Thoughts on Promoting the Management of Secondary Water Supply Facilities in Shanghai Residential Buildings. *Communication & Shipping* 2008;**22**(6):26-28.
2. Yazhen Zhou, Qiyao Shao, Zhengming Gu. Research of Urban Residential Secondary Water Supply Management Model. *Water & Wastewater Engineering* 2012;**38**:23-26.
3. Yi Huang, Wenqi Zhou, Cheng Tao. Elementary Analysis of Water Quality Management Mode for Secondary Water Supply System in Cities. *Water Purification Technology* 2012;**31**:24-26.
4. Yingwu Zhang, Liang Zhao. Discussion on issues of secondary water supply facilities management in residential buildings. *City and Town Water Supply* 2011;**(3)**:83-84.
5. Yue Shen, Yanping Ge, Yuanju Dong, etc. Design and preliminary application of classification and encoding rules based on features of secondary water supply facilities and equipment. *Chinese Journal of Health Inspection* 2017;**24**:318-322.