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Water reuse in urban areas — Guidelines for centralized water reuse system —

Part 2: Management of a centralized water reuse system

Réutilisation d'eau dans les zones urbaines — Lignes directrices concernant les systèmes de réutilisation de l'eau —

Partie 2: Gestion d'un système centralisé de réutilisation de l'eau

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 282, *Water reuse*, Subcommittee SC 2, *Water reuse in urban areas*.

A list of all parts in the ISO 20760 series can be found on the ISO website.

Introduction

With economic development, climate change and increases in population and rapid urbanization, water has become a strategic resource especially in arid and semi-arid regions. Water shortages are considered as one of the most serious threats to sustainable development of society. To address these shortages, reclaimed water is increasingly being used to satisfy water demands and this strategy has proven useful in increasing the reliability of long-term water supplies in many water-scarce areas.

The role of water reuse is growing for urban areas in many countries including landscape irrigation, industrial uses, toilet and urinal flushing, firefighting and fire suppression, street cleaning, environmental and recreational uses (ornamental water features, water bodies' replenishment, etc.) and car washing. These centralized water reuse systems have been developed to the degree that they are now considered as an effective component of urban water management and are used in many cities and countries.

The essential components of a centralized water reuse system include wastewater collection systems (sewers and pumping stations), water source, a wastewater treatment facility, reclaimed water storage, a reclaimed water distribution system, and a water quality monitoring system. The management concepts and principles are suggested to be implemented throughout the whole system, from the source water to the end users. Each component should be characterized and managed with appropriate strategies.

This document provides management concepts and principles for centralized water reuse system in urban areas. It considers and addresses the critical issues or factors during management, which will facilitate water authorities and reclaimed water providers to conduct cost-effective approaches for safe and reliable fit-for-purpose water reuse. For details on the design of a centralized water reuse system, see ISO 20760-1.

Water reuse in urban areas — Guidelines for centralized water reuse system —

Part 2:
Management of a centralized water reuse system

1 Scope

This document provides guidelines for the management of centralized water reuse systems and water reuse applications in urban areas.

This document is applicable to practitioners and authorities who intend to implement management concepts, principles and supports on centralized water reuse in a safe, reliable and sustainable manner.

This document addresses centralized water reuse systems in their entirety and is applicable to any water reclamation system component (e.g. source water, treatment, storage, distribution, operation and maintenance and monitoring).

This document provides:

— standard terms and definitions;

— principles and methodology of reclaimed water management;

— management issues in each system component of a centralized water reuse system;

— specific aspects for consideration and emergency response.

Monitoring parameters and regulatory values of a centralized water reuse system are out of the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 20670:—[1)], *Water reuse — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20670 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

1) Under preparation. Stage at the time of publication: ISO/DIS 20670:2017.

3.1
reliability
<asset, process> probability that a device, system, or process will perform its prescribed function without failure for a given time when operated correctly in a specified environment

[SOURCE: ISO 24512:2007, 2.38]

3.2
water reuse in urban areas
beneficial use of reclaimed water for non-potable and/or indirect potable applications in urban areas

EXAMPLE Landscape uses, street cleaning, firefighting, industrial applications, environmental enhancement, recreational applications, flushing and other domestic uses, etc.

4 Overview of management issues of a centralized water reuse system

4.1 General

The system analysis and management of a centralized water reuse system should have an understanding of the entire system, which generally includes several aspects:

a) water supply needs;

b) assessment of the reclaimed water system (e.g. environmental sustainability and health risk);

c) preventive maintenance measures for reclaimed water management;

d) operational procedures and process control;

e) verification of reclaimed water quality to ensure public health protection while providing environmental benefits;

f) social and public aspects on water supply needs and the water quality needs;

g) incident and emergency management.

The management framework can be supplemented with supporting recommendations and should be periodically reviewed and modified. The planning of review periods should take into account the influencing technical and environmental factors. As the wastewater production of an area differs (e.g. seasonal and tourist activities, cultural influence, etc.) the management practices and review periods should be adjusted. Water reuse management should be consistent with the overall water resources management objectives, which can be defined through an integrated planning process, such as the River Basin Management Plans defined under the Water Framework Directive in European Union. The application of an integrated or global water management approach is a means of improving water resource management and reducing waste streams and water reuse can be a key factor in this holistic planning method[11] [12] [13].

For instance, a centralized water reuse management plan can be developed considering the following issues:

a) management principles and objectives;

   — risk and health issues;

   — site conditions and urban planning;

   — demands and expectations of the users and other stakeholders;

   — financial capability and environmental benefits to initiate an urban water reuse system development;

b) management considerations for each system component;

— source water, treatment systems, storage systems, distribution systems, water quality monitoring, etc.;

c) corrective actions:

— deficiencies identified through the planning and operational processes;

— unintended use control such as cross-connections and unintended discharges;

— control and improvement of the quality of the source water (secondary effluents) delivered by the wastewater treatment plant in cooperation with the users and stakeholders;

d) preventive maintenance measures:

— staff responsibility to develop new user agreements, utilities, onsite design and retrofit needs, public education programs, etc.;

e) social and public aspects:

— affordability and acceptance of the service to users;

— public consultation (e.g. a communication plan and a feedback system);

— public awareness on pollution prevention;

— cultural aspects;

— notification signs to make sure the public is aware of reclaimed water use.

4.2 Water demand

The water consumption and the ratio between planned demand and current uptake should be followed and analysed on a regular basis. New demands for reclaimed water should also be assessed including the type and location of potential end users that may be served by reclaimed water and the ability to economically meet their demands. The reclaimed water supply characteristics can include quantity, quality, diurnal and seasonal variations, weather, delivery pressures, water flow rates, existing and potential new customers.

4.3 System components

A centralized water reuse system is generally comprised of five essential components, source, treatment, storage, distribution and monitoring. Effective management should have an understanding of the reclaimed water system from the source to the end user. Each part of the system should be characterized and managed with appropriate strategies. For instance, the strategies should establish goals for treatment process effectiveness and efficiency, storage specificities, distribution system performance, etc. Regular monitoring is suggested to determine compliance with the goals and take appropriate actions if goals are not achieved. However, the detailed needs can depend on the complexity of the system. For example, the storage system(s) can be located before and/or after the distribution system depending on the distribution system hydraulic design and should equalize reclaimed water quantity and system pressures.

4.4 Possible models of the reclaimed water system and use needs

There are different models of a reclaimed water reuse system from a simple usage pattern to more complicated ones for single and/or multiple application purposes. The management of a system should take into account end use needs to maximize reliability to all customers, such as:

— assessment of the suitability of reclaimed water (e.g. quantity, quality and location) to end-user purpose;

— installation of additional equipment (e.g. a booster pumping station to increase system pressures);

— prevention of inappropriate use of reclaimed water.

Specifically, risk assessment and good operation practices should be developed and implemented. In all cases, special considerations can be given to financial, public health, environmental and public awareness issues.

5 Principles and methodology of reclaimed water management

5.1 Principles

When managing the centralized water reuse system, the basic principles include safety, effectiveness, reliability, efficiency and economic viability. In particular, water quality safety and reliability should be analysed in each system component to protect human health and the environment[14]. Specific risk management principles include the following.

— Protection of public and environmental health is of paramount importance and should never be compromised.

— Protection of public and environmental health depends on implementing a preventive risk management approach.

— Application of corrective actions and preventive measures for water quality should be commensurate with the source of reclaimed water and the intended uses.

5.2 Risk management

Depending on the system scale and end use applications, risk management approaches can be considered for certain applications (e.g. car washing, toilet flushing, recreational uses, etc.). For instance, a Hazard Analysis and Critical Control Point (HACCP) plan for monitoring the performance of ultrafiltration (UF) membranes towards the removal of human pathogens may be daily pressure decay tests and/or inline turbidity monitoring. For end uses without direct/close human contact, simplified risk assessment, water safety and/or other methodologies/tools should be considered, see ISO 20761, ISO 20426, ISO 22000 and References [15], [16], [17], [18] and [19]. Corrective actions can be programmed into the system if any of the critical control points (CCPs) are out of range. It is recommended for operators to implement preventive measures and control to ensure the effectiveness and efficiency of the processes, anticipate potential problems and respond before problems become critical.

6 Management of source water

A source water management program is recommended to be carried out by proponents or authorized practitioners[20]. The program should be consistent with facilities management practices to measure and monitor the quality of reclaimed water. For example, an early warning system can be included in the program which can provide timely information to detect sudden changes in source water quality (e.g. heavy rains, flooding or industrial accidents)[21]. Knowledgeable decisions or responses can be made concerning changing treatment and operational methods or closing intakes. Accordingly, a source control program (e.g. wastewater treatment plants may have an agreement with industries to prevent hazards entering the wastewater collection system, see ISO 24511) can be implemented to document contaminant concentrations and diversion alternatives.

In addition, a response and management plan for mitigating reclaimed water shortages can be developed and maintained depending on whether reclaimed water supply is critical to customers. The plan should include provisions of backup water resources for short-term essential services and strategies to allow seasonal or interruptible reclaimed water use, or scheduling deliveries (e.g. defined watering schedule).

7 Management of reclaimed water treatment systems

The management of a reclaimed water treatment system should be undertaken in a manner that optimizes the use of equipment and resources involved, while protecting public health. Treatment operation and management objectives should be clearly defined based on the specific needs, intended uses, financial and environmental concerns and other factors.

A multiple barrier approach together with a monitoring, sampling and testing plan should be developed throughout the treatment processes, reclaimed water applications and additional measures. The multiple barrier approach highlights the use of combined measures to reduce the risks in management wherein each provides a specific level of contaminant reduction consistent with the demanded water quality applicable to intended uses. Funds and a schedule for preventive maintenance should be established at project inception for long term operational sustainability and protection of public health. Corrective actions and preventive maintenance measures can be developed to improve the management of noncompliance of reclaimed water quality. A minimum technological need (e.g. a disinfection program) that sufficiently protects public health and safety should also be implemented and maintained[22]. For example, some jurisdictions specify a treatment process that should contain a minimum of secondary treatment, tertiary filtration and disinfection prior to unrestricted urban reuse for water safety management, see ISO 20468-1. Relevant information regarding the recommended water quality criteria for water reuse applications in several countries can be found in ISO 20761:—[2], Annex C and References [19], [23] and [24]. As another consideration, treatment process by-passing situations should be managed since the wastewater flow around a process stage(s) during emergencies or excess wet weather flow periods for combined sewerage systems can lead to reduced effluent quality. Solutions can be considered, including diversion of untreated or partially treated bypass flows away from the reclaimed water product and/or storage of effluent for reprocessing through the water reclamation facility and/or alternative disposal routes for the treated effluent if quality is not suitable for the intended reuse, etc.

A detailed and reliable management procedure of treatment system performance normally includes:

a) individual evaluation of multiple barriers that mitigate the key contaminants for the intended use(s);

b) principles for setting specific parameter value;

c) risk management;

d) certification of operators;

e) protocols for preventive and corrective actions.

8 Management of reclaimed water storage systems

Reclaimed water storage facilities are essential components in a water reuse system. Sufficient storage should be designed and operated to meet water demands and reduce pressure fluctuations. The management of reclaimed water storage system should consider the following aspects:

a) emergency storage for fire flows, as applicable;

b) operational and seasonal storage;

c) ability to divert reclaimed water that does not meet water quality demands to interim storage for retention, retreatment or disposal;

d) water quality control (e.g. best management practices to maintain reclaimed water quality during storage);

e) system leakage and facility corrosion control;

f) funds, responsibilities and a schedule for preventive maintenance.

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