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Guidelines for the management of assets of water supply and wastewater systems —

Part 1: Drinking water distribution networks

Lignes directrices pour la gestion d'actifs des systèmes d'eaux usées et d'eau potable —
Partie 1: Réseaux de distribution d'eau potable

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Foreword

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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).

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For an explanation on 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.

The committee responsible for this document is Technical Committee ISO/TC 224, *Service activities relating to drinking water supply systems and wastewater systems — Quality criteria of the service and performance indicators*.

A list of all parts in the ISO 24516 series can be found on the ISO website.

Introduction

This document is written within the overall concept of management of assets which is an activity all organizations undertake in some manner and to some degree. It focuses on the details of managing the physical assets at the operational level rather than the organizational (corporate management, structural or process) level.

Drinking water utilities are reliant on their assets to deliver their services to the resident populations in their jurisdictions. The assets (underground pipes, reservoirs, storage tanks, treatment plants, etc.) collectively form the physical infrastructure of the drinking water utilities and are the consequence of the accumulated capital investments and operational expenditures on maintenance and rehabilitation over many years. In many of these utilities, the replacement value of these past investments will amount to many millions (even billions) of US dollars depending on the size of the community served. The infrastructure represents therefore a major societal investment in essential services contributing to public health and the protection of the environment.

In many countries, these assets have been identified as critical infrastructures, and programmes are in place to assure their protection or their sustainability. Like many other organizations having assets, drinking water utilities undertake programmes of activities to manage the assets to ensure they continue to meet the needs of the community for reliable delivery of drinking water. These management activities can be at the strategic, tactical or operational level. The activities can be part of a formal management system, the result of specific legislative requirements, or simply the result of due diligence by the service operators and managers.

This document can serve as a supporting document for utilities operating an asset management system regardless of whether the utilities make use of any management system standard (e.g. ISO 55001).

In many countries, there is a recognized sustainability problem, sometimes referred to as the infrastructure gap, which recognizes that for various reasons, the infrastructure has not been maintained over the years on a truly sustainable basis, i.e. funding and implementation of rehabilitation programmes have been postponed, with a focus instead on short-term repairs or an allowed decrease in the level of service provided.

The condition of water infrastructures greatly influences the adequacy of the water service from aspects of quality, quantity, pressure, safety, reliability, environmental impact, degree of treatment and economic efficiency. System condition-based rehabilitation approaches serve to meet these requirements with a focus on a holistic approach of condition-based, risk-oriented maintenance.

As the installation and development of water assets mature, the optimization of networks will become necessary in many places in order to respond to changing societal and economic conditions. Consequently, networks are subject not only to ageing as well as wear and tear but also to adaptation processes resulting from growth, new legislative requirements, or changing customer service level expectations. This requires drinking water utilities not only to focus on maintenance and rehabilitation but also to keep future requirements and developments in mind. Rehabilitation will thus become essential in management of assets, with ever more stringent requirements on the design and execution of rehabilitation (partial replacement of specific sections of the entire network is also considered as rehabilitation).

In recent years, much effort has been applied to the whole issue of management of assets on two levels:

— What are the principles and structure of an asset management system?

— What are the good practices that can be implemented on a technical level to assess the condition of the assets and help decide when asset interventions (repair, renovation or replacement) take place?

This document describes the information required and how to collect and process reliable inventory, condition, operational and context data about drinking water systems. Condition data for the underground water infrastructure notably include data on failure. These data serve mainly as a basis for systematic maintenance and can also contribute data needed for benchmarking.

Reliable failure statistics and the database description of the condition are of particular significance for establishing investigation, maintenance and rehabilitation priorities.

This document also provides guidance on how to define a strategy on management of assets with regard to the overall performance expected by the drinking water utility and other stakeholders. It includes several aspects of the operation and maintenance, including asset condition assessment and investment strategies (new assets and rehabilitation).

The approaches offered in this document are intended to be universally applicable, regardless of the structure of a given water system.

The usual and expected goal of the effective management of assets is to provide an appropriate service life while fulfilling given requirements in a cost-effective manner.

This document is intended to provide guidance on the assets typically owned or operated by drinking water utilities (networked drinking water systems) that are expected to meet customer needs and expectations over longer (multi-generational) periods.

Additional information on objectives of management of assets is provided in Annex A. Information on the assessment of typical service life and age-based failure rates of pipes is shown in Annex B and risk-based prioritization of pipe rehabilitation in Annex C.

Guidelines for the management of assets of water supply and wastewater systems —

Part 1:
Drinking water distribution networks

1 Scope

This document specifies guidelines for technical aspects, tools and good practices for the management of assets of drinking water networks to maintain value from existing assets.

This document does not apply to the management of assets of waterworks (including catchment and treatment, pumping and storage in the network), which are also physically part of the drinking water system and can influence the management of assets of the pipe network.

NOTE 1 The drinking water network is taken to include both pressurized and non-pressurized (i.e. containing free surface flow) conduits and accessories such as valves and control or metering equipment.

NOTE 2 The management of assets of drinking water pumping stations and storage in the network will be included in another part of the ISO 24516 series.

This document focuses on the assets typically owned or operated by drinking water utilities (networked drinking water systems) that are expected to meet customer needs and expectations over longer (multi-generational) periods.

This document includes examples for good practice approaches on the strategic, tactical and operational levels.

This document is applicable to all types and sizes of organization and/or utilities operating drinking water systems, and all different roles/functions for the management of assets within a utility (e.g. asset owner/responsible body, asset manager/operator, service provider/operator).

NOTE 3 Depending on the size and structure of an organization, the utility can decide to what extent it applies the guidance in this document, but in any case, the philosophy of this document remains applicable to small and medium utilities.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
asset
capital-forming goods used for the provision of the service

Note 1 to entry: Assets can be tangible or intangible. Examples of tangible assets are: land, buildings, pipes, wells, tanks, treatment plants, equipment, hardware. Examples of intangible assets are: software, databases.

Note 2 to entry: Contrary to consumables, assets can be depreciated in accounting systems.

[SOURCE: ISO 24510:2007, 2.4]

3.2
asset management
processes that enable a water utility to direct, control and optimize the provision, maintenance and disposal of infrastructure assets, including the necessary costs for specified performances, over their life-cycle

[SOURCE: ISO 24510:2007, 2.5]

3.3
asset system
set of *assets* (3.1) that interact or are interrelated

[SOURCE: ISO 55000:2014, 3.2.5]

3.4
asset type
grouping of *assets* (3.1) having common characteristics that distinguish those assets as a group or class

Note 1 to entry: Examples of asset types include, but are not limited to, physical assets, information assets, intangible assets, critical assets, enabling assets, linear assets, information and communications technology (ICT) assets, infrastructure assets, moveable assets, etc.

Note 2 to entry: Examples of physical asset types in the water sector are pipes, valves, pumps or filters of the same class, coating, year of manufacture, producer or the ageing process.

[SOURCE: ISO 55000:2014, 3.2.6]

3.5
failure
local inadmissible impairment of the operability of an asset of a drinking water or wastewater system

3.6
failure data
data describing the characteristics of the *failure* (3.5) caused at a certain point in time on a certain asset of a drinking water or wastewater system

3.7
failure rate
number of *failures* (3.5) per unit

Note 1 to entry: In the case of pipelines, expressed per kilometre per year.

Note 2 to entry: For drinking water networks, in the case of connections and valves, expressed per thousand per year.

3.8
inspection
identifying the actual status of an asset or asset system

3.9
investigation
gathering of all information necessary for a decision making process

Note 1 to entry: This includes both qualitative and quantitative information.

[SOURCE: EN 15898:2011, modified]

3.10
level of service
service to users which reflects social and economic goals of the community safety, customer satisfaction, quality, quantity, capacity, reliability, responsiveness, environmental acceptability, cost and availability

Note 1 to entry: A defined level of service can include any combination of the aforementioned parameters deemed important by the asset owner, users or relevant stakeholders.

3.11
life cycle cost
total cost of an *asset* (3.1) throughout its service life, including planning, design, construction, acquisition, operation, maintenance, rehabilitation and disposal costs

3.12
maintenance
combination of all technical, administrative and managerial actions during the life cycle of an asset intended to retain it in, or restore it to, a state in which it can perform the required function

[SOURCE: ISO 24510:2007, 2.19]

3.13
management of assets
operation, maintenance and rehabilitation of assets of water supply and wastewater systems as a functional activity

Note 1 to entry: This encompasses all necessary activities for sustainable operation and maintenance of the assets in drinking water and wastewater systems.

3.14
operation(s)
action(s) taken in the course of normal functioning of drinking water or wastewater systems

EXAMPLE Monitoring and regulation or diversion of drinking water or wastewater.

[SOURCE: EN 752:2015, modified]

3.15
operational plan
documented collection of procedures and information that is developed, compiled and maintained in readiness for the conduct of operations

3.16
performance indicator
metric or measure by which the achievement of an objective can be assessed

[SOURCE: ISO 19440:2007, 3.1.62]

3.17
rehabilitation
measures for restoring or upgrading the performance of existing asset systems, including renovation, repair and replacement

[SOURCE: EN 16323:2014, modified]

3.18
rehabilitation rate
percentage of entire inventory which is rehabilitated or to be rehabilitated on an annual basis

3.19
service
result of a process

Note 1 to entry: Adapted from the definition of "product" in ISO 9000:2005.

Note 2 to entry: Services are one of the four generic categories of products with software, hardware and process materials. Many products comprise elements belonging to different generic product categories. Whether the product is then called "service" depends on the dominant element.

Note 3 to entry: Service is the result of at least one activity necessarily performed at the interface between the provider of the service and, in the first place, its user and, in the second place, a stakeholder. Service is generally intangible. Provision of a service can involve for example the following:

— activity performed on a tangible product supplied by the user, e.g. wastewater,

— activity performed on an intangible product coming from the user, e.g. processing new connection requests,

— delivery of an intangible product, e.g. delivery of information,

— creation of ambience for the user, e.g. reception offices.

Note 4 to entry: The word "service" in common English can also refer to the entity providing the actions related to the subject in question, as is implicit in such phrases as "bus service", "police service", "fire service" and "water or wastewater service". In this context and usage, "service" implies the entity that is delivering the service, e.g. "the public transport of passengers", "the provision of public security", "fire protection and response", and "delivering drinking water or collecting wastewater". If "service" can be understood in this way, "water service" becomes synonymous with "water utility"; hence in this document, in order to avoid confusion, only the definition in 3.19 applies.

[SOURCE: ISO 24510:2007, 2.44]

3.20
service life
period of time after installation during which an asset or an asset system meets or exceeds the technical requirements and functional requirements

[SOURCE: EN 15978:2011, modified]

3.21
strategic plan
plan containing the long-term goals and strategies of an organization

Note 1 to entry: Strategic plans have a strong external focus, cover major portions of the organization and identify major targets, actions and resource allocations relating to the long-term survival, value and adoption to ongoing changes of an organization.

3.22
tactical plan
prioritization in the medium term on the basis of influencing factors/indicators on performance, costs, risk and failure probability and scale of failure, including general determination

EXAMPLE 1 Indicators of damage probability can be age, usage and damage.

EXAMPLE 2 Indicators for the magnitude of failures can be hydraulic importance and vulnerable infrastructures.

EXAMPLE 3 General determinations can be technology of rehabilitation and material.

4 Principles aspects of the management of assets

4.1 Objectives and requirements

4.1.1 Objectives

According to ISO 24510 and ISO 24512, the objectives of drinking water utilities are the following:

— protection of public health;

— meeting users' reasonable needs and expectations;

— providing services under usual and emergency situations;

— promoting the sustainability of the drinking water utility;

— promoting sustainable development of the community;

— protection of the environment.

Drinking water utilities, in undertaking management of asset, should aim to manage their facilities systematically and efficiently in order to sustain their function, through establishment of clear objectives, based on assessment and forecasting of the condition of their often extensive and complex facilities.

The objective of the management of assets is to ensure that the drinking water utility complies with agreed sustainable levels of service, while also meeting economic performance objectives such as attaining the least possible overall life cycle cost.

For further information on objectives of management of assets for drinking water networks, see Annex A.

4.1.2 Functional requirements

In order to achieve the objectives, functional requirements should be established.

Functional requirements cover the drinking water network, together with pumping installations, pressure control devices, reservoirs, waterworks and other components. The functional requirements should be considered in respect of the whole system to ensure that additions or modifications to the system do not result in failure to meet the target.

Functional requirements should be established that, while taking into account sustainable development and whole life costs including indirect costs (e.g. traffic congestion, military aid provided by civil authorities), ensure that drinking water networks do not cause unacceptable environmental nuisance, risk to public health, or risk to personnel working therein.

Each functional requirement can relate to more than one objective. An indication of the relevance of each of the functional requirements in achieving the objectives is shown in Table 1.

Table 1 — Relationship between objectives and functional requirements

Functional requirements	Objectives						
	Protection of public health and safety	Meeting users' reasonable needs and expectations	Occupational health and safety	Providing services under usual and emergency situations	Promoting the sustainability of the drinking water utility	Promoting sustainable development of the community	Protection of the environment
Ensuring the drinking water quality	XXX	XXX	XX	XX	XX	XX	XX
Continuity of supply	XXX	XXX	—	XXX	XXX	XXX	X
Ensuring adequate pressure	XXX	XXX	X	XX	XX	—	X
Maintainability	XX	X	XXX	XX	XX	XX	XX
Providing service under emergency situations	XXX	XXX	X	XXX	XXX	—	XXX
Sustainability of products and materials	—	XX	—	XX	XXX	—	XX
Sustainable use of energy	—	X	—	XX	XXX	—	XX
Long design life of assets	X	XX	X	XX	XXX	—	XXX
Minimizing of leakages	XX	X	X	X	XXX	—	XXX
Prevention of noise	XX	X	X	X	X	—	X
Not endangering adjacent structures and environment	XX	X	XX	X	XX	—	X
NOTE The number of X indicates the relevance of the requirement in achieving the objectives.							

4.1.3 Performance requirements

In order to evaluate the performance of the network and to allow development of design standards, measurable performance requirements should be determined from each functional requirement.

For each functional requirement, there can be legal requirements, public expectations and financial constraints which will influence the performance requirements.

For each aspect of performance, different levels can be required, for example:

a) trigger levels which justify early upgrading action according to priority;

b) target levels to aim for in upgrading, which should be equal to the requirements for new construction, but which sometimes can only be achievable or necessary in the longer term.

Performance requirements should be reviewed periodically and updated, if necessary. The performance requirements for the network should be updated after major extension, maintenance or rehabilitation.

In principle, the performance requirements for a rehabilitated network should be the same as those for a new network.

Performance indicators are an essential tool in understanding a utility's infrastructure conditions and needs and, in parallel, enable indicator-supported infrastructure planning and decision making. Properly implemented, indicators provide information on the condition of the assets and the level of their contribution to the achievement of the utility's objectives.

Performance indicators should be defined at strategic, tactical and operational levels. They should make clear how actions at the operational level contribute to achieve strategic level objectives. Strategic level performance indicators are often called "outcomes". Operational and tactical level performance indicators are called "inputs" and "outputs" respectively.

4.2 General aspects

4.2.1 General

A distinction can be drawn between aspects of the management of assets for the drinking water utility or responsible authority and aspects for the drinking water system to be managed.

Management of assets should take into account

— attention to stakeholders' requirements, needs and expectations,

— sustainability of the asset system and the provided service, and

— the management of risk.

The management (of the organizing authority) of the utility's assets will be directed towards ensuring the utility's objectives are met (see ISO 24510).

4.2.2 Principal aspects — Drinking water utilities

The management of the physical infrastructure of drinking water utilities is recognized globally as a critical activity if user's and other stakeholders' expectations should be realized. Key activities include

— the determination of the utility's current and longer term objectives,

— planning and implementing activities to achieve objectives, and

— the means of measuring the performance of the utility in meeting these objectives.

Additionally, for ensuring long and economical life cycles, they include

— knowledge of the layout of the entire water supply system together with knowledge on costs (planning, constructing, operation, maintenance),

— knowledge on availability and need of resources,

— the selection of appropriate materials and components,

— the choice of installation technology and corresponding contractors,

— quality control of materials used and of installation,

— maintenance of assets and asset systems including routine and incident-related inspection and investigation, and

— monitoring of operating conditions.