Technical Report

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Examples of good practice for the management of assets of water supply and wastewater systems —

Part 1:
Water supply

Exemples de bonnes pratiques de la gestion d'actifs de systèmes d'approvisionnement en eau potable et d'assainissement —

Partie 1: Approvisionnement en 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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This document was prepared by Technical Committee ISO/TC 224, *Drinking water, wastewater and stormwater systems and services*.

This first edition of ISO 24589-1, together with ISO 24589-2, cancels and replaces ISO 24589.

A list of all parts in the ISO 24589 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

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

Water services 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 water services and are the consequence of the accumulated capital investments and operational expenditures on maintenance and rehabilitation over many years. In many of these services, the replacement value of these past investments amounts to many millions (even billions) of 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 programs are in place to assure their protection or their sustainability. Like many other organizations having assets, water services undertake programs of activities to manage the assets to ensure they continue to meet the needs of the community for reliable delivery of potable water. These management activities can be at the strategic, tactical or operational level. The activities can be part of a formal management system, or the result of specific legislative requirements, or ultimately just the result of due diligence by the service operators and managers.

This document is expected to serve as a supporting document for utilities operating management of assets in accordance with ISO 24516.

In many countries there is a sustainability problem, sometimes referred to as the infrastructure gap: this recognizes that, for various reasons, the infrastructure has not been maintained over the years on a truly sustainable basis, in other words funding of rehabilitation and replacement programs has 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, specifically its quantity, pressure, quality, safety, reliability, environmental friendliness, degree of purification 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.

Once the installation and development of water assets is almost completed, the optimization of networks will become necessary in many places in order to respond to changing societal and economic conditions. Networks are subject not only to aging and to wear and tear, but also to adaptation processes resulting from growth, new legislative requirements, or changing customer service level expectations. This requires water utilities to focus increasingly on the growing need to rehabilitate existing water networks rather than removal and replacement of the networks. Rehabilitation will thus become essential in asset management, with ever more stringent requirements on the design and execution of rehabilitation.

In recent years, much effort has been applied to the whole issue of asset management on two levels: what are the principles and structure of an asset management system, and 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, rehabilitation or replacement) take place.

This document offers examples of how an asset management strategy is defined with regard to the overall performance expected by the owner. It includes several aspects of the operations and maintenance, including asset condition assessment and investment (new assets, rehabilitation and renewal) strategies.

The focus is on the following selected activities of the management of assets of water supply systems as addressed in ISO 24516-1 and ISO 24516-2.

— Clause 4 covers the principal aspects of the management of assets, including examples of:

  — objectives;

  — strategies;

  - structure of the process.
- Clause 5 covers the tools and methods for investigation, including operational data collection, tools for diagnosis, and other sources of information, such as:
  - non-destructive pipe condition assessment techniques;
  - high density polyethylene (HDPE);
  - hydraulic performance;
  - drinking water storage tanks.
- Clause 6 covers the assessment of the system against its performance expectations for the following aspects:
  - practical tools and methods for structural, functional, hydraulic performance;
  - examples of degradation factors and models of degradation;
  - practical tools and methods for criticality assessment (plants and networks);
  - examples of calculation to assess the likelihood of a failure.
- Clause 7 covers the implementation of sustainable field works, providing examples of what matters from an asset management point of view.
- Clause 8 covers the operation and maintenance by providing examples of leakage management, flushing, energy management, monitoring and control, pressure regulation and maintenance of civil structures.
- Clause 9 covers the prioritization of rehabilitation of assets with examples of how it is done practically.

The examples of good practice for asset management of water supply systems covered in this document are applicable to all types and sizes of organization and utilities operating water systems.

Examples of good practice for the management of assets of water supply and wastewater systems —

Part 1:
Water supply

1 Scope

This document contains selected examples for good practice approaches for the management of assets of drinking water supply systems. This document is intended as a supporting document for ISO 24516-1 and ISO 24516-2, which contain guidelines for the management of assets of drinking water systems. As such, this document can contribute to realize value from existing assets when following the guidelines for the management of assets of drinking water systems approaches in the strategic, tactical, and operational plans given in ISO 24516-1 and ISO 24516-2.

NOTE A recapitulative table of the examples covered in this document is provided in Annex A.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Principal aspects

4.1 Objectives

4.1.1 Water utility with multiple waterworks and distribution networks

Table 1 contains an example of objectives for a water utility with multiple waterworks and distribution networks. This example is obtained from Japan. The good practices highlighted in Table 1 include:

— objectives of a mature water utility facing risks of natural disasters (earthquakes);

— clear break-up of main objectives into sub-objectives and indicators;

— clear baseline and medium/long term targets.

Table 1 — Objectives for multiple waterworks and networks

Macro-objectives	Indexes	Results: financial year 2019 (%)	Planned: financial year 2030 (%)	Calculation method
Stable supply of pure and high-quality water	Duplex improvement rate of water conveyance facilities	81	88	$\frac{\text{Number of duplicated water conveyance facilities}}{\text{Number of water conveyance facilities to be duplicated}}\times 100$
	Improvement rate of water transmission pipe networks	81	93	$\frac{\text{Length of networked transmission pipes}}{\text{Total length of transmission pipes for formation of water network}}\times 100$
	Securing rate of stable water supply	84	89	$\frac{\text{Capacity of service reservoirs in purification plants and water supply stations}}{\text{Planned maximum water supply volume for 12 h of a day}}\times 100$
	Achievement rate of residual chlorine target	87	94	$\frac{\text{Number of 0,1 mg/l to 0,4 mg/l water tap data}}{\text{Total number of water tap data}}\times 100$
Preparation for various disasters	Rate of earth-quake-resistant purification facilities	14	69	$\frac{\text{Capacity of earthquake-resistant purification facilities}}{\text{Total capacity of purification facilities}}\times 100$
	Rate of earth-quake-resistant distribution reservoirs	80	98	$\frac{\text{Capacity of earthquake-resistant service reservoirs}}{\text{Total capacity of service reservoirs}}\times 100$
	Rate of earth-quake-resistant-joint pipes introduction	45	61	$\frac{\text{Length of earthquake-resistant-joint pipes}}{\text{Total length of pipelines}}\times 100$
	Rate of water suspension during earthquake occurrences	29	21	$\frac{\text{Population affected by water suspension}}{\text{Service population}}\times 100$
	Rate of earth-quake-resistant-joint pipes used in supply routes serving important facilities	82	100 (2022)	$\frac{\text{Length of pipelines on supplying routes with earthquake-resistant-joint}}{\text{Total length of pipelines on target supplying routes}}\times 100$
	Resolution rate of pipes difficult to replace (Rate of conversion to ductile iron pipes 100 %)	5	100 (2026)	$\frac{\text{Length of replaced pipes difficult to replace}}{\text{Total length of pipes difficult to replace}}\times 100$

[a] Areas in which water suspension rate is over 50 %.

Table 1 *(continued)*

Macro-objectives	Indexes	Results: financial year 2019 (%)	Planned: financial year 2030 (%)	Calculation method
	Resolution rate of pipe replacement priority areas [a]	67	100 (2028)	$\frac{\text{Number of municipalities that fall below 50 \% of water suspension rate}}{\text{Number of target municipalities}} \times 100$
	Rate of earthquake-resistant-joint pipelines in replacement priority areas	65	100 (2028)	$\frac{\text{Length of earthquake-resistant-joint pipelines}}{\text{Total length of required pipelines with earthquake-resistant-joint in replacement priority areas}} \times 100$
	Rate of earthquake-resistant service pipes installed in private roads	47	67	$\frac{\text{Length of earthquake-resistant service pipes}}{\text{Total length of service pipes in target private roads}} \times 100$
	Securing rate of water supply available during massive power outage	63	92	$\frac{\text{Available water supply volume}}{\text{Estimated required water volume at massive power outage}} \times 100$
	Securing rate of fuel for independent power generation equipment (72 h)	45	83	$\frac{\text{Fuel stock volume}}{\text{Required fuel stock volume for 72 h continuous operation}} \times 100$
	Undergrounding rate of river crossing pipelines	0	18	$\frac{\text{Number of undergrounding places of river crossing pipelines}}{\text{Number of priority undergrounding places of river crossing pipelines}} \times 100$

[a] Areas in which water suspension rate is over 50 %.

4.1.2 Water distribution network

Table 2 contains an example of objectives for a water distribution network in Germany. The good practices highlighted in Table 2 include:

— three main objectives: continuity, quality, quantity;

— good break-up and indicators.

Table 2 — Objectives for network

Indicator	Objective
Failure rate	0,10 failures/(km·year)
Water loss	< 0,10 m^3/(hour·km)
Pressure	> 2,35 bar [a] – houses with first floor > 2,70 bar – houses with second floor and 0,35 bar for each next floor
Water quality	In accordance with national requirements
Minimal risk	Low failure rates, water losses and service interruptions, risk minimization requirement
Duration of service interruptions	< 10 min/year and costumer
[a] 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2	

4.1.3 Waterworks

Table 3 contains an example of objectives for a waterworks in Spain. The good practices highlighted in Table 3 include:

— ISO 55001 certified plant, with renewal objective;

— break-up of actions and indicators.

Table 3 — Plant asset management strategy

Processes/ origin	Owners – responsible – resources	Type of indicator [a]	Indicator	Remarks	Objective value	Goals and actions	Periodicity and dates	Records and documents
Implement an asset management system that consolidates the experience of the plant's management team and ensures optimal asset management.	Plant manager/ external certifying company	Q	Renewal of ISO 55001 certification in May 2019.		Obtaining a certificate	Phase 1 external audit, documentary. Phase 2 external audit implementation.	04/04/2019 08/05/2019	— ISO 55001 certificate — Internal audit plan — Action plan
Endorse the professional ties with the client, through a win-win relationship, complying with and enforcing the contractual and legal framework, in addition to accompanying in the technical challenges.	Plant manager / client	Q	Joint assessment of the condition of assets by the asset condition assessment (ACA) method.		List of evaluated equipment (ACA)	1. Customer training 2. Joint assessment condition assets client – driving equipment 3. Decline of results in asset registry	1. Initial 2. Initial and final contractual period 3. Initial and final contractual period	List of evaluated equipment (ACA)
		AM	Monetized impact of unrealized corrective maintenance (critical and non-critical) that depends on the client. I_{GA7} = sum of the monetized criticality of unrealized corrective maintenance (critical and non-critical) that depends on the customer.				Monthly	— Minutes of meetings — Monthly data by registration
		EE Env AM Q	I_{GE1} = kWh consumed/ m^3 treated water. I_{05} = kg of chemical reagents consumed/m^3 treated water.		Comparison of previous years.		Semi-annual	Indicators and objectives report

[a] Types of indicators: Q = Quality, EE = Energy management, Env = Environment, S = Safety, AM = Asset management

Table 3 *(continued)*

Processes/ origin	Owners – responsible – resources	Type of indicator [a]	Indicator	Remarks	Objective value	Goals and actions	Periodicity and dates	Records and documents
Comply with and enforce in a holistic and optimal way the management systems (OSHAS 18001[7], ISO 14001, ISO 9001, ISO 50001, ISO 55001), ensuring the competence required for the perenniality and sustainability of the process.	Coordinator quality management	Q	Internal and external audits related to asset management. Internal: evaluate the possibility of doing cross-audits with other entities in 2020. External: monitoring by external auditor.		At least one internal audit per year once certification is achieved.	Carry out an annual audit plan.	Annual	— Program annual internal audits — Internal and external audit plan — Internal and external audit report
Ensure the integrity and well-being of staff.	Plant manager	S	Number of accidents with sick leave and without sick leave.	KPI analysed monthly with the plant management. Compliance with the organization's accident target. It is an indicator at the workplace level.	1 accident without sick leave 0 accidents with sick leave		Monthly	Accident plan of the centre
		Q	Perform evaluation of the competencies required for asset management to the personnel involved.	Verify that you have the competencies required for asset management (identify competencies, operating plan, training plan, procedure professional categories, ...).	At least 50 % of the staff involved in the 2019 asset management system and 100 % in 2020			— Action plan — Matrix of competences — Priority training plan — Employment authorization documents (EAD)

[a] Types of indicators: Q = Quality, EE = Energy management, Env = Environment, S = Safety, AM = Asset management

Table 3 *(continued)*

Processes/ origin	Owners – responsible – resources	Type of indicator [a]	Indicator	Remarks	Objective value	Goals and actions	Periodicity and dates	Records and documents
Study the optimization of the total cost of the life cycle (LCC) of the assets.	Plant manager	AM	I_{GA1} = renovation costs/ replacement value of equipment. I_{GA2} = total cost of preventive maintenance/ total cost of the plant. I_{GA3} = total corrective maintenance cost/total plant cost.	— Asset management KPIs. — Preventive maintenance value > corrective maintenance value			Quarterly	The data that feeds these indicators are analysed monthly in the asset management indicators dashboard.
			Investments over € 10 000 with LCC/investments over € 10 000.		1			Make LCC for investments over € 10 000 before the purchase order.
Mobilize the necessary human, material and financial resources in order to implement the strategic asset management plan.	Plant manager	Q	Have the risk assessment, training plan, EAD.		1			Action plan
Promote the continuous improvement of the asset management system.	Plant manager	Q/S/Env/ EE/AM	Report 1 REX file/average year of the contract period.		2		Contract duration	REX tab
		AM	Update of the criticality plan once a year and whenever there is a relevant change.		1			Criticality plan

[a] Types of indicators: Q = Quality, EE = Energy management, Env = Environment, S = Safety, AM = Asset management

Table 3 *(continued)*

Processes/ origin	Owners – responsible – resources	Type of indicator [a]	Indicator	Remarks	Objective value	Goals and actions	Periodicity and dates	Records and documents
		AM	Impact of planned and unrealized maintenance orders (critical and non-critical). I_{GA5} = number of critical equipment orders not performed/number of critical equipment orders planned. I_{GA6} = sum of monetized criticality of critical equipment with planned and unrealized order.		$I_{GA5} = 0$ $I_{GA6} = 0$		Weekly maintenance meetings	Dashboard AM
		AM	I_{GA4} = Planned maintenance orders/maintenance orders made.	Asset management KPIs.	> 90 %		Quarterly	The data that feeds these indicators are analysed quarterly in the asset management indicators dashboard.
Promote close cooperation between all processes involved in asset management.	Plant manager	Q/S/Env/ EE/AM	Perform audit of the 5S.		1		Initial and annual	Audit report
The application of the asset management policy together with the support of the functional teams and integrated management system.	Plant manager	Q	Implementation of the asset management system in the workplace and ensuring compliance with said management system.	— Maintenance ISO 55001 certification — Indicators — Audits — Action plan — Awareness talks — Training/competences	1			— Action plan — Audit plan — Monitoring indicators

[a] Types of indicators: Q = Quality, EE = Energy management, Env = Environment, S = Safety, AM = Asset management