

*WG 4 working document***Secretariat of ISO/TC 224**

Service activities relating to drinking
water supply and sewerage

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PURPOSE

*WG 4 working document “**Management of wastewater systems – Guidelines for the assessment of the service**”*

COMMENTS

This document provided by Karl ROHRHOFER and Heekyung PARK, convenors of WG 4, is the second version of the WG 4 working draft (WG 4 N 37). This document is dated 2003-09-24 and seems to be the result of the Ottawa meeting. It does not take into account the result of the WG 4 meeting in Vienna in December 2003.

ACTION

For discussion at the next WG and TC 224 meeting in Korea

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ISO/TC 224/WG 4
Management of Wastewater Systems

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Final Working Draft [WD] of WG4

(Final Working Draft of WG4 of ISO/TC224, as discussed in the 3rd WG4 meeting in Lisbon, May 26-27, 2003.)

Management of Wastewater Systems

Guidelines for the assessment of the service

Note 1: This Final Working Draft of WG4 is based on the Resolution 1 of ISO/TC224 (27. September 2002), and on the Resolution of WG4 (27 May 2003).

Note 2: The Co-Convenors, Park + Rohrhofer, have prepared this Final Working Draft of WG4, which is now designated as document N37rev1 of WG4 (the text in doc. N37rev1 is unchanged compared with N37; only new cover sheet).

Note 3: The doc. N37rev1 has been sent on 22 July 2003 to the TC224-secretariat, officially requesting a TC-Internal Enquiry: TC224 members will be requested to send their comments, amendments, proposals during this TC-internal enquiry to the TC Secretariat until 12 September 2003.

Note 4: WG4 will deal with these comments in its next meeting, just before the next TC plenary session in Ottawa, Canada.

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- regarding personnel (human) resources;
- regarding financial resources (cost & benefit);
- regarding customer relations management;
- regarding environmental protection & conservation of water resources;
- regarding operation and maintenance (O&M) of wastewater systems.

Annex D: Bibliography

Foreword

This standard addresses wastewater systems in its entirety but it is also applicable to systems at any level of their development (e.g. pit latrines, on-site systems, networks, treatment facilities).

Introduction

The objectives of the standard is to provide guidelines for assessment of the services related to the management of wastewater systems. In addition, the guidelines should aid all the relevant stakeholders including public authorities, regulators, and operators to continuously improve the level of service provided to the user at optimal cost. The standard is of voluntary application, does not include any targets/limits for the suggested performance indicators and can be used by all stakeholders, irrespective of their legal status.

The wastewater systems are built and operated mainly to protect the public health and environment.

1 Scope

This standard is a framework for the definition and measurement of service activities relating to wastewater systems.

Note: Waste water in this standard includes sanitary and industrial wastewater allowed to be discharged into a sewer system outside buildings, as well as sanitary waste in undiluted form and storm water.

This standard includes

- the definition of a language common to different stakeholders,
- definitions of the characteristics of the elements of the service according to the consumer expectations,
- a list of requirements to be fulfilled for the operation and maintenance (management) of a wastewater system,
- a list of service quality criteria and related examples of performance indicators, all without setting any target values or thresholds.

2 Normative References

ISO 9000 series.
See clarification #2

3 3 Terms and definitions

Note 1: Common definitions for ISO/TC 224 are expected to be drafted by ISO/TC224/WG1. Therefore, some definitions are not yet given in the following list.

Note 2: Relevant definitions could also be found e.g. in IWA (Manual), MBP 2003 (see Bibliography, Annex D).

Assets management: An integrative optimization process that enables a utility to determine how to minimize the total life-cycle cost of owning and operating infrastructure assets (e.g., treatment plant components, pipes, pumps, etc.) while continually delivering the service levels customers desire.

Collection System:

Confidence Grade:

Consumer (/User/Beneficiary of the system) :

Criteria:

Effectiveness: Extent to which declared or imposed, objectives, such as levels of service, (specifically and realistically defined) are achieved.

Efficiency: Extent to which the resources of an undertaking are utilised to provide the service.

Maintenance:

On-site system: System, whereby all the waste and wastewater produced is handled locally on site near to point of origin (e.g. by means of septic tanks, soakaways, composting toilets, evaporation beds, reed beds, etc.).

Operator (of the system, could be private or public or public/private):

Performance indicator (PI): figure resulting of a ratio or simple combination of several basic variables of a system; it consists of a value expressed in a certain unit, and a confidence grade which indicates the quality of the data represented by the indicator.

Rehabilitation: all measures in a system to grant intended performance, consisting of repair, renovation and replacement

Service connections :

Service Quality:

Sewer system: Network of pipelines (drains and sewers) and auxiliary structures (e.g. gullies, pumping stations, weirs, stormwater tanks, siphons), excluding treatment systems, which conveys wastewater and/or rainwater from their points of entry to their points of discharge.

Stakeholder:

Undertaker:

Variable: basic parameter of a system which can either be measured from the field or is easily obtainable. It consists of a value (resulting from a measurement or a record) expressed in a certain unit, and a confidence grade which indicates the quality of the data represented by the variable.

4 Components of wastewater systems

4.1 General

A wastewater system consists of components for collection, transport and treatment of wastewater. The systems can be on-site or centralized.

A diagram of the wastewater system and the relation between the various components is shown in the diagram of Annex A (informative).

4.2 Collection and transport of wastewater

Components of the system for collection and transport of wastewater are:

- sewer systems;
- transport systems.

Sewer systems can include:

- storage/collection/service connections;
- sanitary/storm/combined sewers and accessories;
- pumping and storage facilities;
- overflow structures;
- monitoring/sampling/measuring/remote control facilities.

Transport systems can include:

- storage and retention basins;
- gravity sewers;
- pressure sewers.

4.3 Treatment of wastewater

Wastewater treatment can include:

- treatment facility inlet structures;
- monitoring/sampling/measuring/remote control facilities;
- preliminary/primary/secondary/complementary treatment and reuse/disposal facilities;
- residues handling/conditioning facilities;
- residue reuse/disposal facilities.

5 Management of wastewater systems

5.1 General

Management of a wastewater system comprises:

- activities management;
- process management;

- resources management;
- customer relations management (CRM);
- information management;
- asset management.

5.2 Activities Management

Activities should be managed on the various levels in the organization. Activities are:

- policy making;
- strategy formulation;
- internal and external coordination;
- operation and control.

5.3 Process management

Process management of the activities in a wastewater system should be in accordance with ISO 9000 series, related to the management cycles:

- research/investigation and inspection (check);
- assessment (act);
- planning of measures (plan);
- realization of measures (do).

5.4 Resources Management

Resources to be managed are:

- personnel (human resources);
- financial (costs and benefits).

Special consideration must be given to make best use of staff expertise.

Examples of measures regarding personnel (human) resources (see Annex C, informative):

Examples of measures regarding financial resources (cost & benefits; see Annex C, informative):

5.5 Customer relations management (CRM)

Customer relations management includes:

- identification of customer needs and expectations;
- registration and handling of complaints;
- customer service;
- communication, education and information.

Note: WG2 of ISO/TC224 will provide a separate standard on customer relationships.

Special considerations shall be given to achieving customer satisfaction.

Examples of measures regarding customer relations management (see Annex C, informative):

5.6 Information management

Information management includes:

- registration of inventory data of the system;
- data management;
- evaluation of data;
- evaluation and progress reports.

5.7 Asset management

Asset management includes:

- monitoring of the condition components of the system;
- registration of data of the condition of the system;
- optimizing depreciation and reinvestment;
- risk management.

Examples for measures regarding environmental protection and conservation of water resources (see Annex C, informative):

Examples for measures regarding operation and management (O&M) of wastewater systems (see Annex C, informative):

6 Objectives for the Management of Wastewater systems

6.1 General

Management of a wastewater system needs formulation of objectives and performance requirements, targeting the performance requirements by the use of a set of performance indicators and evaluation of the performance by measuring and assessment.

6.2 Objectives

Objectives are generally defined for a certain region.

Objectives need to be expressed in the form of performance requirements.

Objectives for a wastewater system must be established for:

Protection of public health

Protection of the natural/built Environment

Provision of quality of public space

Promotion of sustainable development

Promotion of affordability

~~Flood control??~~

Note: individual services to define specific objectives within the general objectives described in this section/table

- ~~public health;~~
- ~~environmental protection;~~
- ~~quality of public space;~~
- ~~sustainable development.~~
-

7 Requirements for the management of wastewater systems

~~Performance requirements~~

Performance requirements consists of criteria for the assessment of the management and functioning of the systems.

The performance requirements shall be expressed in measurable targets in the form of performance indicators.

Performance requirements shall be made measurable by performance indicators (PIs).

~~Examples of performance requirements are given in~~ Annex B (informative) provides examples of performance indicators related to;

Function ~~Basic requirements~~

Organization ~~requirements~~

Planning and construction ~~requirements~~

Operation and maintenance ~~requirements~~

Support activities ~~requirements~~

8 Service Quality ~~Criteria Assessment and related Performance Indicators (PIs)~~

Service quality criteria provide an assessment of the service received by the user. The necessary service quality criteria must be selected according to the objective and requirements of interest. The service quality criteria are provided in Informative Annex B1, 2, 3.

OR

To asses whether the objectives and performance requirements of a wastewater system have been achieved a set of service quality criteria are used. These are provided in Informative Annex B1,2,3.

9 Performance Indicators

9.1 General

Quality of service results from the operation and assets management activities within the context of regulatory requirements.

Monitoring and assessment of service quality are appraised with respect to optimisation of system management aimed at to user satisfaction and to environmental protection, taking into account also the long term. They depend on the consideration of quality criteria and on their measurement by means of performance indicators (PIs).

Irrespective as to whether it is a private or a public service supplier, any undertaking needs to strive for high degrees of efficiency and effectiveness to achieve its management goals. In addition, other stakeholders, such as regulators or customers, require assurance that the undertaking is performing appropriately.

The overall assessment of an undertaking should be primarily directed to the achievement of objectives and performance requirements identified in clause 5 of this standard. In general, the analysis of more specific thematic areas (e.g. asset management) requires a combination of performance measures of the output (e.g. failures recording) and of the means (e.g. network inspection, network rehabilitation). In any case, a coherent system of Performance Indicators (PIs) should be adopted.

9.2 Performance Indicators and related Components ~~of a PI System~~

A PI system is composed of a set of performance indicators, context information and variables.

The core component of a PI system should be a comprehensive set of performance indicators, defined as measures of the efficiency and effectiveness of the delivery of services by an undertaking. PIs may also be considered as providing information for 'metric' benchmarks – quantitative comparative assessment of performance.

Individual PIs should be unique and collectively appropriate for representing all the relevant aspects of undertaking performance in a true and unbiased way, thus reflecting the managing activity. Each PI should contribute to the expression of the level of actual performance achieved in a certain area and during a given period of time, allowing for a clear comparison with targeted objectives and simplifying an otherwise complex analysis.

Performance Indicators are typically expressed as ratios between variables; these may be commensurate (e.g. %) or non-commensurate (e.g. \$/m³). In the latter case, the denominator shall represent one dimension of the system or of the undertaking (e.g. total sewer length;

population served, annual costs), to allow for comparisons along time (even though the size of the wastewater system evolves), or between systems of different sizes.

A clear processing rule shall be defined for each PI, specifying all the variables required and their algebraic combination. The input data maybe data generated and managed within the undertaking (utility data) or externally (external data).

The interpretation of the performance of an undertaking cannot be carried out without taking into account the context in which it operates, particularly if it is based on comparisons with other cases. Therefore, complementary to the PI's, context information shall consider also the characteristics of the infrastructure and resource systems and the characteristics of the region in which the services are provided (see Figure 1)

The undertaking profile outlines the management environment in which the organisation operates. The system profile focuses mainly on the volumes managed, the physical assets, the technological means used to provide the services and on the demographic aspects of the customers. This profile requires more detail than the other system or region profiles because it also contains the descriptive indicators that are essential for the interpretation of the performance indicators. The region profile will be particularly relevant for comparisons between undertakings, as it provides the information needed to understand the demographic, economic, geographical and environmental context within which each undertaker operates.

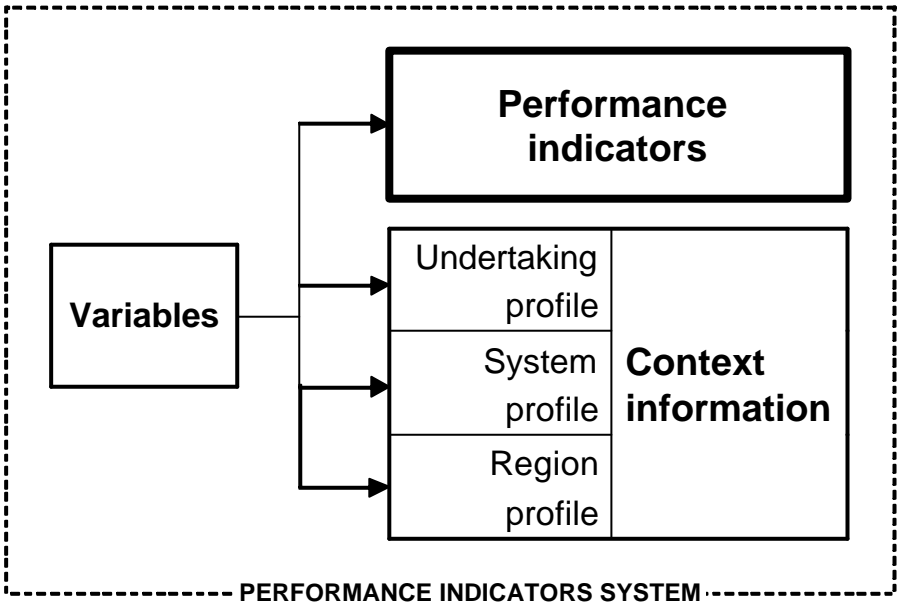


Figure 1 – Performance Indicators, Variables and Context Information

The input data for the undertaking and system profiles are typically utility data, whereas for the region profile there is the need to use external information.

9.3 Requirements of Performance Indicators and Variables

9.3.1 Requirements of PIs

This subclause specifies the basic requirements of PIs and variables.

Individually, each PI should comply with the following requirements:

- be relevant and representative of the performance;
- be clearly defined, with a concise meaning;
- be simple and easy to understand;
- be quantifiable so as to provide an objective measurement of the service, avoiding any personal or subjective appraisal;
- be sensitive and responsive to the implemented actions;
- be reliable and not subject to random changes;
- be reasonably achievable;
- be a ratio (expressed dimensionless or in units) that allows for performance comparisons;
- be auditable;
- referred to a well defined period of time and geographical area / regional characteristics.

Collectively, PIs should comply with the following requirements:

- every PI should provide information significantly different from the other PIs in the system;
- only such PIs should be established which are deemed essential for effective performance evaluation and information for all stakeholders;
- variables to calculate PIs should be easily measurable at a reasonable cost;
- definitions of PIs, variables and context information should be univocal;
- PIs should favour an easy and intuitive interpretation when possible;
- PIs should be accompanied of the necessary context information to aid in its interpretation.

Criteria and PI systems provide assessment of service quality for better user's satisfaction. It is used as tools for communication with users and accountability for management. Necessary PIs can be selected according to the nature of each service activity.

Further selection and addition of criteria and PIs are possible, corresponding to regional characteristics and changes in social situation.

For certain PIs, the following may be assessed by relevant authorities:

- the performance objective;
- measurement frequency and conditions;
- changes over time;
- inacceptability thresholds.

For every location, a set of PIs should be elaborated/selected from available sources, e.g., IWA, World Bank, national associations.

Note: IWA has developed a comprehensive framework of performance indicators for wastewater services provision; when establishing performance indicators for certain services, IWA document is expected to be a good reference. In addition, national performance indicators may be applicable; see examples in Annex D, Bibliography.

9.3.2 Requirements of variables

Each variable should comply with the following requirements:

- fit the definition of the PI they are used for;
- refer to the same geographical area and the same period of time or reference date as the PI they will be used for;

- be as reliable and accurate as the decisions made based on them require.

Some of the variables are external data and mainly informative, and their availability, accuracy, reference dates and limits of the corresponding geographical area are generally out of the control of the undertaking. In this case, variables should also comply with the following requirements:

- Whenever possible, and particularly if to be used to assess PIs, be collected from official survey departments;
- be fundamental for the PI assessment or interpretation;
- collectively, be as few as possible.

9.4 Confidence Grading

A *confidence-grading* is required so that users of the PIs and Context Information are aware of the reliability of the information available. PIs and Context Information could be misleading without their confidence grade. The quality of variables should be therefore assessed in terms of its accuracy and reliability:

- The accuracy accounts for measurement errors in the acquisition of variables.

Note: No measurement device is completely accurate, and some of the data available in the system may have been obtained by less accurate methods.

- The reliability accounts for uncertainties in how reliable the source of the data may be.

Note: Old records may not be reliable in terms of depicting the current situation of the assets.

An example for the confidence grading scheme is referenced in the Bibliography (see Annex D, informative).

9.5 Implementation of PIs

Note: this clause is to be moved to informative annex

The implementation of PIs shall be carefully planned. A possible implementation of PIs is given in figure 2.

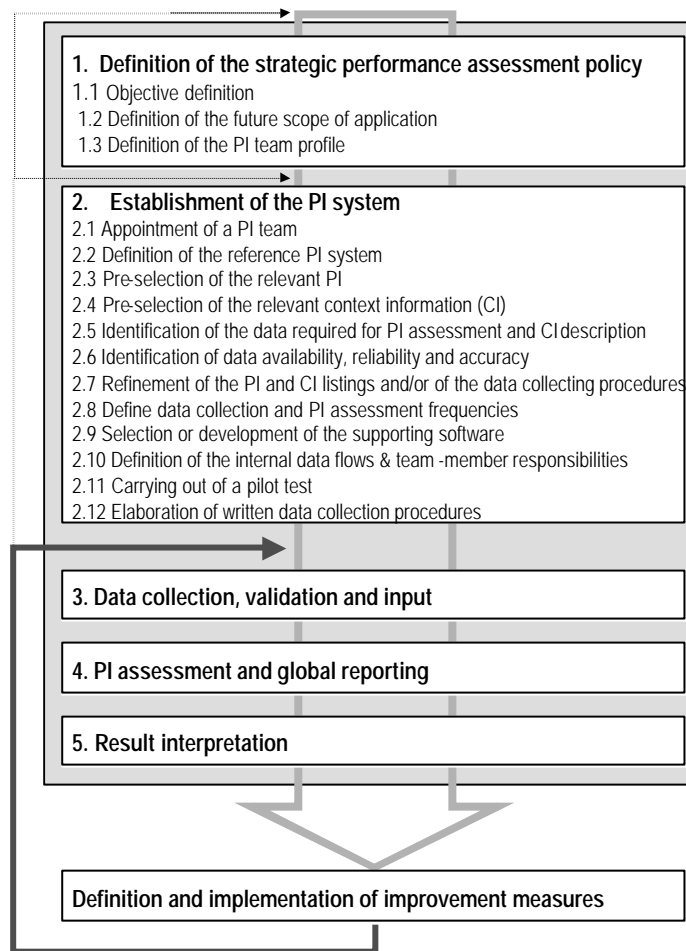


Figure 2 – Example of implementation of PIs

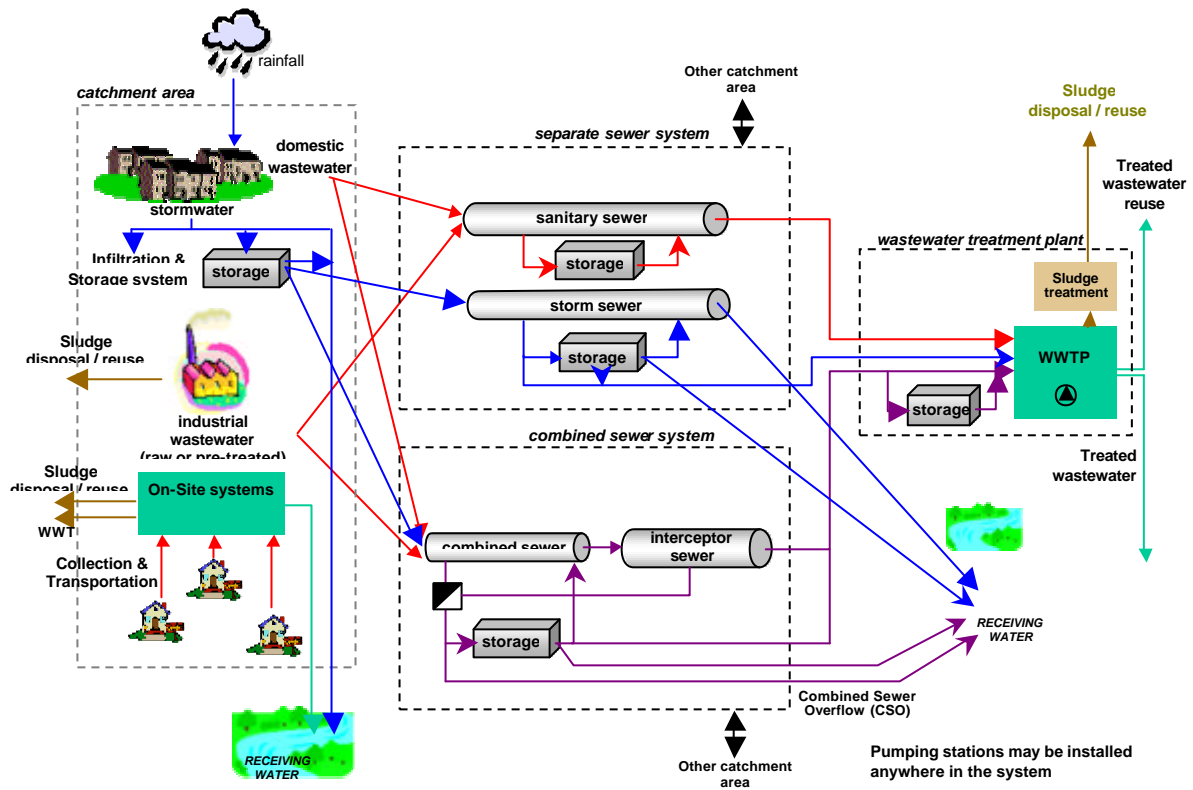
[End of text to go to annex](#)

In Annex B (informative), examples of wastewater service quality criteria and performance indicators are given.

Annex A (Informative)

Scheme of Wastewater System

(Source: IWA Performance Indicators for Wastewater Services, MBP 2003; see Annex D, Bibliography).



Annex B: (Informative)

Examples of wastewater service quality criteria and performance indicators

In the following text examples of criteria and PIs are given with regard to: collection and transport, treatment and disposal/reuse of effluents/ residues:

B.1 Examples for collection and transport

Examples for criteria

- coverage;
- capacity;
- hydraulic capacity;
 - sedimentation;
 - flooding;
 - overflow;
 - condition;
- tightness (e.g., infiltration, exfiltration);
- corrosion;
- structural integrity;
 - operation and Management;
- safety of personnel;
- inspection (including wrong connection);
- inflow control (including quantity and quality, indirect discharge control);
- maintenance;
- disposal of residues;
- reuse;
- man-power;
- odor control;
 - rehabilitation (repair + renovation + replacement);
 - assets Protection;
 - meeting future requirements (e.g., expansion, legal requirements);
 - monitoring;
- discharge consents (input to the sewer system and to the environment/overflows);
- flow and quality monitoring.

Examples of associated performance indicators :

- surcharging (e.g., number of surcharges per sewer length);
- flooding (e.g., number of flooding per time);
- weight of sediment removed per sewer length;
- percentage of sewer system inspected per time;
- percentage of sewer system cleaned per time;
- overflow (e.g., frequency, volume, and contaminant loading);
- system effectiveness.

B.2 Criteria and Performance Indicators for treatment

The service quality criteria to be considered should include:

- coverage;
- quantity of incoming wastewater;
- quality/Concentration of incoming wastewater;
- treatment capacity;
 - hydraulic capacity;
 - pollutant removal capacity;
 - residues treatment capacity;

- condition;
 - structural integrity;
 - equipment redundancy;
 - environmental impact;

- operation and management;
 - safety of personnel;
 - inspection;
 - maintenance;
 - disposal of residues;
 - wastewater reuse;
 - residues reuse;
 - energy savings and reuse;
 - man-power;
 - chemicals;
 - odor control;
 - rehabilitation (repair + renovation + replacement);
 - assets protection;
 - meeting future requirements (e.g., expansion, legal requirements);

- monitoring;
 - discharge consents (into the environment);
 - flow and quality monitoring.

Examples of associated performance indicators:

- percentage of treated wastewater;
- energy consumption for wastewater treatment (e.g., per pe);
- wastewater quality tests carried out in compliance with requirements;
- sludge quality tests carried out in compliance with requirements;
- wastewater treatment utilisation (current loading rate versus design capacity);
- inspection of equipments (e.g., frequency);
- personnel training (e.g., in confined spaces).

B.3 Criteria and Performance Indicators for disposal/reuse of effluent/residues

Effluents and residues from treatment facilities (discharge consents):

- quantity and quality of effluent discharge into the environment or for reuse;
- quantity and quality of residues (sludge utilization or disposal);
- quantity and quality of other environmental emissions (including odours, noise and vibration).

Examples of associated performance indicators:

- number of non-compliant quality test/quantity discharge for effluent;
- number of non-compliant quality test for residues;
- number of non-compliant quality test for other environmental emissions;
- wastewater reuse;
- sludge utilization;
- solid waste from grit and grease separators and screens;
 - sediments from on-site systems (e.g., septic tanks).

Annex C: Informative: Examples for measures

- **regarding personnel (human) resources:**
 - maintain and secure health and safety of personnel;
 - employ appropriate personnel for the appropriate jobs in consideration to their technical capabilities;
 - ensure that personnel complies with laws/bylaws/regulations;
 - train personnel to upgrade their abilities;
 - place qualified personnel in compliance with laws/bylaws/ regulations;
 - instruct personnel to behave in good faith in relation to customers.

- **regarding financial resources (cost & benefit):**
 - develop a clear and fair service charge structure;
 - develop applicable revenue sources to ensure cost recovery and long-term sustainability of wastewater treatment services;
 - develop a service charge structure reasonable to different customers that accounts for local economic considerations and revitalization efforts;
 - ensure long-term soundness of systems while considering cost-effectiveness;
 - conduct asset inventory preparation and update/forecast of new assets;
 - maintain sound finances under long-term management projections;
 - analyze management conditions using appropriate methods while considering regional characteristic;
 - continue cost reduction efforts.

- **regarding customer relations management:**
 - identify and meet customer needs;
 - respond to customer complaints and opinions swiftly and appropriately;
 - provide customers with communication opportunities to express their opinions;
 - give considerations to people in neighboring communities to gain their support;
 - organize events using the wastewater facilities;
 - participate as volunteers in local events;
 - disclose understandable and transparent information for customers.

- **regarding environmental protection & conservation of water resources:**
 - contribute to sustainable Integrated Water Resources Management policies;
 - act as a responsible stakeholder in basin institutions;
 - promote Integrated Water Resources Management in water projects;
 - control and limit pollution in the flows of water returning to nature;
 - protect water quality in public water bodies;
 - protect and conserve water sources for drinking;
 - provide sound water cycle by reuse of treated wastewater;
 - operate wastewater systems with considerations for the global environment;
 - educate customers on environmental management concerns, and also not to discharge substances adversely affecting wastewater systems or the environment;
 - optimize energy efficiency and minimize environmental loads;
 - minimize consumption of electric power in wastewater systems;
 - comply with local rules and regulations and consider customer requirements;
 - ensure customers comply with requirements to connect to wastewater systems, including limitations on:
 - water quantity and quality of final effluent;

- exhaust gas, noise, vibration and odors coming from wastewater systems ;
- disposal and reuse of sludge;
- minimize the impacts of combined sewer overflow (CSO);
- take care of diffused pollutants in rainwater from separate sewer systems;
- maximize utilization of sludge and by-products;
 - use as energy source;
 - recycle as fertilizer for greenery and agricultural lands;
 - recycle as construction materials ;
- organize good practices for sludge disposal, reuse of by-products and waste.

- **regarding operation and maintenance (O&M) of wastewater systems:**
 - conduct systematic operation and preventive maintenance, including repairs, for stable service quality and prevention of accidents;
 - measures against ageing to preserve sound systems ;
 - prevent any subsidence due to pipe collapse;
 - maintain stable water quality of final effluent against fluctuation of water quality and quantity in influent;
 - limit impact of disasters and accidents;
 - provide information to related organizations;
 - establish systems to cope with leakage and inflow of toxic, hazardous or explosive substances;
 - prepare for earthquake;
 - operate and maintain rainwater drainage systems properly for flood control;
 - develop a plan to secure public health based on possible damage from earthquakes;
 - improve service quality by developing and introducing new technology;
 - monitor the processes of wastewater treatments;
 - guide the management of industrial discharge into sewer in accordance to laws/bylaws/regulations;
 - provide monitoring system for inflow of hazardous substances into wastewater systems;
 - maintain backup systems to avoid overflow and to maintain quality level of final effluent when pump and treatment systems are out of order;
 - restore the systems immediately after accidents;
 - reduce infiltration and exfiltration in wastewater systems.

Annex D: Bibliography

National standards related with detailed referring information

- French national standard:
 - NF P 15-900-2, “Local public services – Guidelines for drinking water supply and sewerage service activities – Part 2: Management of a sewerage network”, AFNOR, Paris; 2001;
 - NF P 15-900-3, “Local public services – Guidelines for service activities relating to drinking water supply and sewerage – Part 3: Management of a wastewater treatment system”, AFNOR, Paris; 2001;
- European standard: EN 752-2, “Drain and sewer systems outside buildings – Performance requirements”, CEN, Brussels;
- German standard: ATV-M 801E: Integrated Quality and Environmental Management System for Operators of Wastewater Facilities, ATV-DVWK, Hennef (Germany); 1997;
- Japanese national guideline: “Guideline for Improving O&M of Wastewater Systems”, JSWA No. 472; May 2003;
- Dutch guideline “Leidraad Riolering”, Netherlands;
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