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Service activities relating to drinking water supply systems and wastewater systems — Crisis management — Good practice for technical aspects

Activités relatives aux services de l'eau potable et de l'assainissement — Gestion de crise — Les bonnes pratiques pour les aspects techniques

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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 224, *Service activities relating to drinking water supply systems and wastewater systems — Quality criteria of the service and performance indicators*.

Introduction

Water is the source of life, without which humans, as well as other species, cannot survive. In many countries, there is a lack of knowledge regarding crisis management of drinking water and wastewater services.

Impairment of the drinking water service would change the quality of life of the affected population in the immediate period while in the medium-term it could affect their ability to survive. Therefore, the continuous and orderly supply of clean water is of paramount importance for the population. The collection, treatment and safe disposal of sanitary wastewater are also important if illness and/or inundation are to be prevented and the environment protected. This document describes good practice in the establishment of technical crisis management systems drawn from experience contributed by relevant national authorities.

The approach of a water utility when preparing for any crisis should encompass all pertinent aspects of water supply and the collection, treatment and safe disposal of wastewater. The water utility needs to cooperate with all relevant authorities concerned with the crisis. Effective crisis management should ensure that the actions taken before, during and after the crisis consider the natural environment as well as the impact on the health and wellbeing of the population. Effective communication with the public is necessary to mitigate or prevent panic and to establish trust in the water utility by disclosing important information appropriately in the area affected by a crisis, in neighbouring areas or to any other stakeholders.

This document can be used as a toolkit by water utilities where they wish to review their current capability to prepare for, respond to and recover from a crisis in an effective and efficient manner. It is not intended as a complete guide to crisis management. Water utilities can consult ISO 24518 if they need further guidance.

Service activities relating to drinking water supply systems and wastewater systems — Crisis management — Good practice for technical aspects

1 Scope

This document provides guidance to water utilities on good practice in technical aspects of crisis management.

This document is applicable to all water utilities, of whatever size, whether public or private, that wish to review the effectiveness and efficiency of their service activities relating to preparation for, response to and recovery from a crisis.

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
alternative wastewater service
wastewater (3.40) *service* (3.37) provided to *users* (3.39) by means other than through the normal collection and treatment system

3.2
alternative water supply
water provided to *users* (3.39) by means other than through the normal treatment and distribution system

3.3
analysis
systematic examination in which the biological or technical system is decomposed into its component parts using suitable methods, after which the parts are then organized and evaluated

Note 1 to entry: Analysis also includes water quality sampling operations carried out after sample preparation to determine the amount of concentration of the analyte(s) of interest present in the sample.

3.4
asset
capital-forming goods used for the provision of the *service* (3.37)

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

Note 2 to entry: Contrary to consumables, assets can be depreciated (tangible assets) or amortized (intangible assets) in accounting systems.

3.5
audit
systematic, independent and documented *process* (3.30) for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled

Note 1 to entry: An audit can be an internal audit (first party) or an external audit (second party or third party) and it can be a combined audit (combining two or more disciplines).

Note 2 to entry: "Audit evidence" and "audit criteria" are defined in ISO 19011.

3.6
availability
extent to which the *infrastructure* (3.20), *assets* (3.4), resources and employees of a *water utility* (3.41) enable effective provision of *services* (3.37) to *users* (3.39) according to specified *performances* (3.27)

3.7
capability
quality (3.31) of being able to perform a given activity

3.8
competence
ability to apply knowledge and skills to achieve intended results

Note 1 to entry: Demonstrated competence is sometimes referred to as qualification.

3.9
consequence
outcome of an event affecting *objectives* (3.25)

3.10
continual improvement
recurring activity to enhance *performance* (3.27)

Note 1 to entry: The *process* (3.30) of establishing *objectives* (3.25) and finding opportunities for improvement is a continual process through the use of *audit* (3.5) findings and audit conclusions, *analysis* (3.3) of data, *management* (3.23) reviews or other means and generally leads to corrective action or preventive action.

3.11
crisis
event or situation which affects or is likely to affect the *organization* (3.26) or its provided *services* (3.37) which requires more than the usual means of operation and/or organizational structures to deal with it

3.12
crisis management plan
document specifying which *procedures* (3.29) and associated resources should be applied by whom and where to a particular type of *crisis* (3.11)

3.13
drinking water
DEPRECATED: potable water
water intended for human consumption

Note 1 to entry: *Requirements* (3.34) for drinking water *quality* (3.31) specifications are generally laid down by the national relevant authorities. Guidelines are established by the World Health Organization (WHO).

3.14
effectiveness
extent to which planned activities are realized and planned results are achieved

3.15
efficiency
relationship between the result achieved and the resources used

3.16
environment
surroundings in which an *organization* (3.26) operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation

Note 1 to entry: Surroundings in this context extend from within an organization to the global system.

Note 2 to entry: For the application of this document, environment is considered as a specific *stakeholder* (3.38). The interests of this specific stakeholder can be represented by *relevant authorities* (3.33), by the communities or by other groups, such as non-governmental organizations (NGOs).

3.17
hazard
source of potential harm

Note 1 to entry: Harm in the context of a water utility can include injury to stakeholders; compromising of public health; degradation of the environment; a deterioration in service quality; reputational and/or financial damage; and consequential sanctioning by the relevant authorities.

Note 2 to entry: Capacity for harm can also arise from compromised service provision. In this context a hazard can be considered to be a biological, chemical, physical or radiological agent in, or condition of, water with the potential to cause harm to public health or the *environment* (3.16). This perspective is based on the definition of "hazard" in the WHO Water Safety Plan Manual [expanded to include "condition", which includes quantity (i.e. a shortage or an excess), hence making it applicable also to *wastewater* (3.40) *service* (3.37)].

Note 3 to entry: Other sources of potential harm exist within the water utility's organizational context. These hazards can be internal or external to the *organization* (3.26). Internal hazards could be tangible (e.g. a toxic chemical store; potential energy stored behind a dam perched on a hillside above a town; a chamber potentially containing a hazardous atmosphere) or intangible (e.g. poorly documented procedures; inadequate training; an inappropriate organizational culture). External hazards could be tangible (e.g. earthquake; flooding; forest fire) or intangible (e.g. social unrest; terrorism, cyber threat, corruption; financial instability).

3.18
hazardous event
event that introduces one or more *hazards* (3.17) to, or fails to remove them from, the *drinking water* (3.13) system or the *wastewater* (3.40) system

Note 1 to entry: The equivalent French word for the English expression "hazardous event" is "evenement dangereux". However, the English word "danger" has been removed from this document as it is synonymous with "hazard". Both "hazard" and "danger" convey the concept of a potential *risk* (3.36). When it comes to describing hazard, the English terminology remains consistent, e.g. "fire hazard", but the equivalent French expression "Il y a risque d'incendie" migrates to using the equivalent of the English term "risk". The difficulty is that the meanings of "hazard" and "risk" are subtly different in English. The first conveys the potential exposure (i.e. the impact) while the second additionally conveys the likelihood of that impact's occurrence (risk = impact × likelihood). So a "hazardous event" might be a lightning strike in a wooded area. But if this occurred when the woodland was wet, rather than dry, the risk of a resulting fire would be low rather than high.

3.19
incident
deviation from normal operating conditions

Note 1 to entry: An incident is characterized by its cause, the extent and the *consequences* (3.9) of the deviation.

3.20
infrastructure
system of facilities, equipment and *services* (3.37) needed for the operation of a utility *organization* (3.26)

Note 1 to entry: In a *water utility* (3.41), it is advisable to reserve the term "infrastructure" for physically fixed equipment and installations.

3.21
interruption
situation where the *service* (3.37) is not available

Note 1 to entry: Interruptions can be planned or unplanned.

3.22
maintenance
combination of all technical, administrative and managerial actions during the life cycle of an *asset* (3.4) intended to retain it in, or restore it to, a state in which it can perform the required function

3.23
management
coordinated activities to direct and control a *service* (3.37)

Note 1 to entry: Management can include establishing *policies* (3.28) and *objectives* (3.25), and *processes* (3.30) to achieve these objectives.

Note 2 to entry: The word "management" sometimes refers to people, i.e. a person or group of people with authority and responsibility for the conduct and control of a service. When "management" is used in this sense, it should always be used with some form of qualifier to avoid confusion with the concept "management" as a set of activities defined above. For example, "management should…" is deprecated, whereas "crisis management team should…" is acceptable. Otherwise, different words should be adopted to convey the concept when related to people, e.g. managerial or managers.

Note 3 to entry: The term "management" can be qualified by a specific domain it addresses. Examples are public health management, environmental management, risk management, etc.

3.24
monitoring
determining the status of a system, a *process* (3.30), a product, a *service* (3.37) or an activity

Note 1 to entry: For the determination of the status, there can be a need to check, supervise or critically observe.

Note 2 to entry: Monitoring is generally a determination of the status of an object carried out at different stages or different times.

3.25
objective
result to be achieved

Note 1 to entry: An objective can be strategic, tactical or operational.

Note 2 to entry: Objectives can relate to different disciplines (such as financial, health and safety, and environmental objectives) and can apply at different levels [such as strategic, organization-wide, project, product and *process* (3.30)].

Note 3 to entry: An objective can be expressed in other ways, e.g. as an intended outcome, a purpose, an operational criterion, as a *crisis* (3.11) objective or by the use of other words with similar meaning (e.g. aim, goal or target).

Note 4 to entry: In the context of a crisis management system, crisis objectives are set by the *organization* (3.26), consistent with the crisis management *policy* (3.28), to achieve specific results.

3.26
organization
person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its *objectives* (3.25)

Note 1 to entry: The concept of organization includes, but is not limited to, sole-trader, company, corporation, firm, enterprise, authority, partnership, association, charity or institution, or part or combination thereof, whether incorporated or not, public or private.

Note 2 to entry: For the purposes of this document, the organization will usually be a *water utility* (3.41).

3.27
performance
measurable result

Note 1 to entry: Performance can relate either to quantitative or qualitative findings.

Note 2 to entry: Performance can relate to the *management* (3.23) of activities, *processes* (3.30), products, *services* (3.37), systems or *organizations* (3.26).

3.28
policy
agreed intentions and direction for performing a *service* (3.37) as formally expressed by the technical management board

3.29
procedure
specified way to carry out an activity or a *process* (3.30)

Note 1 to entry: Procedures can be documented or not.

3.30
process
set of interrelated or interacting activities that use inputs to deliver an intended result

3.31
quality
degree to which a set of inherent characteristics fulfils *requirements* (3.34)

Note 1 to entry: There is a clear distinction between quality of the product [*drinking water* (3.13) or treated *wastewater* (3.40)] and quality of the *service* (3.37). This document does not give technical specifications for product quality.

3.32
recovery
provision of *policies* (3.28), *procedures* (3.29) and *process* (3.30) that are necessary to restore operations critical to the resumption of *service* (3.37)

Note 1 to entry: Recovery represents the last stage to be carried out during the *crisis* (3.11) phase and the post-crisis phase prior to the routine operations.

3.33
relevant authority
public body entitled to set general *policies* (3.28), plans or *requirements* (3.34), or to check compliance with these rules, concerning all the *water utilities* (3.41) included in its area of jurisdiction

EXAMPLE National, regional or local governments, public agencies, regulators.

Note 1 to entry: For a given water utility, there can be several relevant authorities, which have jurisdiction in different domains.

3.34
requirement
need or expectation that is stated, generally implied or obligatory

Note 1 to entry: "Generally implied" means that it is custom or common practice for *drinking water* (3.13) or *wastewater* (3.40) utilities, the *users* (3.39) of the *service* (3.37) and other *stakeholders* (3.38), that the need or expectation under consideration is implied.

3.35
restriction
situation where the *service* (3.37) does not meet the *availability* (3.6) conditions specified in the service agreement

Note 1 to entry: Restrictions can be planned or unplanned.

3.36
risk
combination of the likelihood of a *hazardous event* (3.18) and the severity of *consequences* (3.9), if the *hazard* (3.17) occurs in the *drinking water* (3.13) supply or *wastewater* (3.40) system

Note 1 to entry: Risk is often characterized by reference to potential events and consequences or a combination of these.

Note 2 to entry: The English term "likelihood" does not have a direct equivalent in some languages; instead, the equivalent of the term "probability" is often used. However, in English, "probability" is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, "likelihood" is used with the intent that it should have the same broad interpretation as the term "probability" has in many languages other than English.

Note 3 to entry: Risk can also be defined as the effect of uncertainty on *objectives* (3.25), where uncertainty is the state, even partial, of deficiency of information related to understanding or knowledge of an event, its *consequence* (3.9) or likelihood.

3.37
service
result of a *process* (3.30)

Note 1 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* (3.39) and, in the second place, an *stakeholder* (3.38). 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* (3.40);

— 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 2 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 this definition applies.

3.38
stakeholder
interested party
person or *organization* (3.26) that can affect, be affected by or perceive itself to be affected by a decision or activity

EXAMPLE *Users* (3.39) and building owners, *relevant authorities* (3.33), responsible bodies, operators, employees of the operator, external product suppliers and providers of other *services* (3.37), contractors, communities, customers and environmental associations, financial institutions, scientific and technical organizations, laboratories.

Note 1 to entry: Stakeholders will typically have an interest in the *performance* (3.27) or success of an organization.

Note 2 to entry: For the application of this document, *environment* (3.16) is considered as a specific stakeholder.

3.39
user
person, group or *organization* (3.26) that benefits from *drinking water* (3.13) delivery and related *services* (3.37) or from *wastewater* (3.40) service activities

Note 1 to entry: Users are a category of *stakeholder* (3.38).

Note 2 to entry: Users can belong to various economic sectors: domestic users, commerce, industry, tertiary activities, agriculture.

Note 3 to entry: The term "consumer" can also be used, but in most countries the term "user" is more frequent when referring to public services. It is not appropriate for wastewater services.

3.40
wastewater
water arising from any combination of domestic, institutional, commercial or industrial activities, surface runoff and any accidental sewer inflow/infiltration water and which can include collected stormwater, discharged to the e*nvironment* (3.16) or sewer

Note 1 to entry: The definition of wastewater in this document also includes sanitary waste in undiluted form.

Note 2 to entry: Wastewater can flow in separate or combined sewer systems.

3.41
water utility
whole set of *organization* (3.26), *processes* (3.30), activities, means and resources necessary for abstracting, treating, distributing or supplying *drinking water* (3.13) or for collecting, conveying, treating and disposing of *wastewater* (3.40) and for providing the associated *services* (3.37)

Note 1 to entry: Some key features for a water utility are

— its mission, to provide drinking water services or wastewater services, or both,

— its physical area of responsibility and the population within this area,

— its responsible body,

— the general organization with the function of operator being carried out by the responsible body, or by legally distinct operator(s), and

— the type of physical systems used to provide the services with various degrees of centralization.

Note 2 to entry: Drinking water utility addresses a utility dealing only with drinking water; wastewater utility addresses a utility dealing only with wastewater.

Note 3 to entry: When it is not necessary or it is difficult to make a distinction between responsible body and operator, the term "water utility" covers both.

Note 4 to entry: In common English, "water service" can be used as a synonym for "water utility", but this document does not recommend using the term in this way.

4 Concepts and principles

4.1 General

The water utility should establish crisis management plans during normal operations. These plans should be based on risk assessments of the water utility's operations and activities with relevant data being gathered as necessary. These plans should enable the following:

— the early recognition of an actual or impending crisis situation;

— the provision of resources which may be needed in a crisis situation.

See Annex A for more details.

4.2 Crisis management phases

Crisis management is a phased system as described in Figure 1.

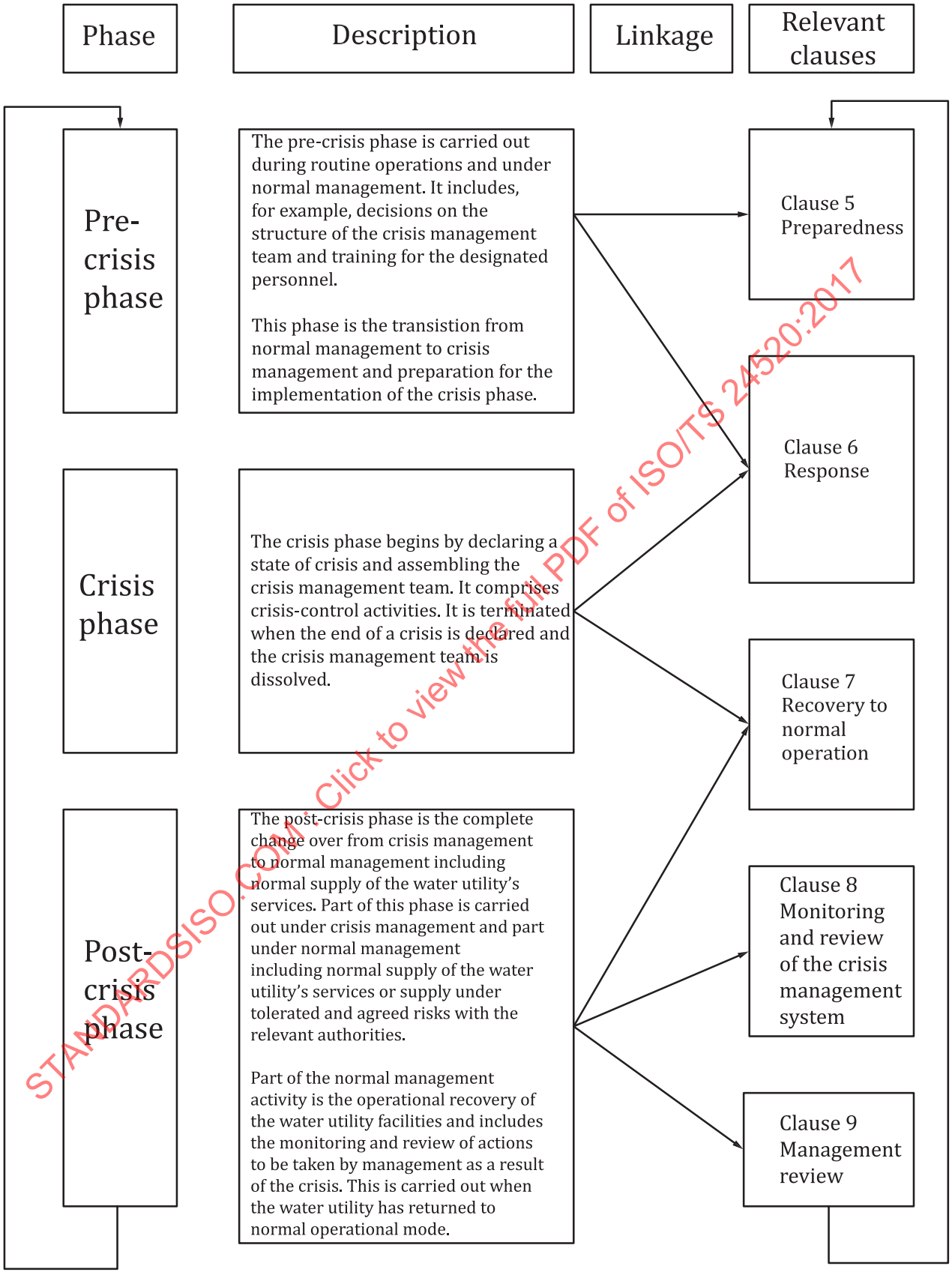
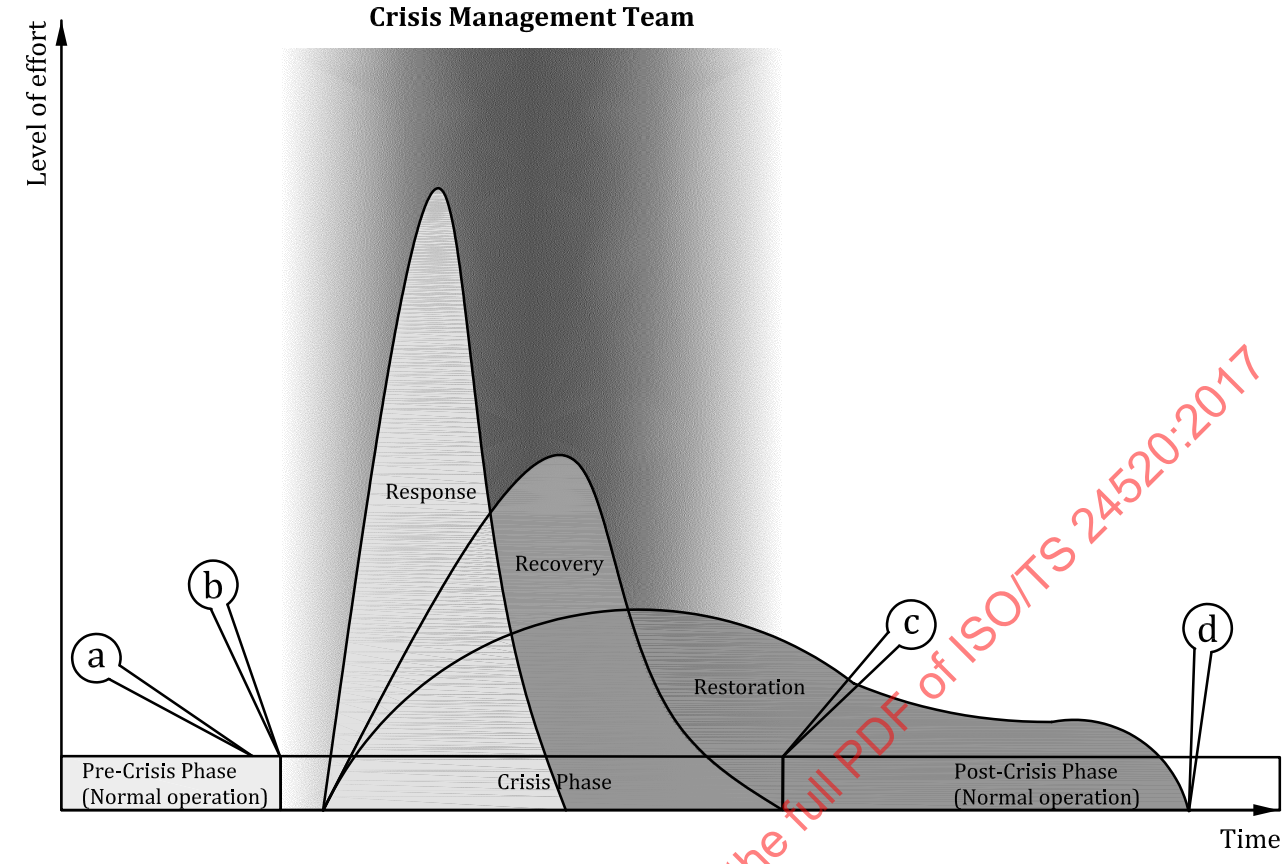


Figure 1 — Sequence of crisis management phases

Figure 2 illustrates the relationships of the sequence, overlap and relative intensity of the response, recovery and restoration activities during the three phases of a crisis.



Key

▬	intensity of activity
a	ascertaining the failure
b	declaring state of crisis
c	declaring the end of crisis
d	changeover to routine operation

Figure 2 — Sequence, overlap and intensity of activities during the phases of a crisis

Figure 2 illustrates an example of a rapid service interruption occurring after the response has been initiated (e.g. due to declaration of a "boil water" notification). However, service interruption may be both rapid and precede the response (e.g. due to a trunk water main burst) or both slow and subsequent to the onset of the response (e.g. due to progressive foul flooding following a pump failure).

Figure 2 illustrates also that the beginning of work on recovery and restoration does not necessarily have to wait for the response to be finished, but may begin in parallel to the response, and as early as practicable in order to mitigate as much of the negative impact of the crisis as possible on users.

5 Preparedness

5.1 General

Systems, processes, procedures and tools should be established in advance under normal operation in order to ensure the identification and effective management of a crisis.

In particular, plans and necessary resources should be determined in advance.

These should include the following:

— establishment of the context, taking in account all legal, environmental, regulatory and economic requirements, as appropriate;

— commitment to establish a crisis management process;

— procedures for assessing risk;

— systems, processes and procedures for planning, responding, repairing, verifying and restoring services;

— structure and organization;

— systems, processes and procedures for the recognition of the beginning of a crisis;

— procedures and tools to determine whether the crisis management team should be activated;

— identification, training and exercise of skilled members of staff to carry out the crisis management plan duties;

— cooperation arrangements between the water utility and other relevant organizations;

— procedures for communication with users, other stakeholders and the public;

— provision of plans and resources;

— documentation;

— monitoring and review.

The water utility should identify the scale of events that could give rise to the need to invoke crisis management plans and the largest scale of incident that it may have to deal with.

The maximum scale of event that a water utility should have crisis management plans in place for should be determined through their risk assessment methodology or relevant authorities.

5.2 Establishing the context

In drawing up its crisis management plans, the water utility should determine all legal, environmental, regulatory and economic requirements to be taken into account, together with any political, sociological, technical and other issues or constraints that may require to be accommodated.

Where appropriate, these should be identified and highlighted in the crisis management plans.

Water utility policy relating to at least the following areas should be considered:

— drinking water quality;

— effluent requirements;

— environmental impact;

— public health;

— response plans to emergency or crisis situations;

— relevant authorities' arrangements relating to emergency management;

— health and safety legislation;

— user service standards.

The water utility should take account of local and national arrangements of the civil authorities (e.g. national and local government, police, health authorities, emergency services, etc.) for dealing with an emergency.

The water utility should be aware of the types and severity of water supply or wastewater incident that would trigger local, regional or national emergency management arrangements and the nature of these arrangements.

The water utility should establish service levels that it aims to achieve when dealing with an emergency. They should be determined during the pre-crisis phase as part of the preparation of the crisis management plans.

Key areas for which service levels should be determined in advance include the following:

— the timescale to restore normal service (this may be aspirational);

— the type, and where applicable, quantity of alternative water supplies (e.g. bottled water, temporary water tanks) and/or alternative wastewater services (e.g. storage tanks, temporary sewers, over-pumping between manholes) and the timescale to establish the means of providing the alternative water supplies or alternative wastewater services;

— the method and timescale for providing information to users;

— the method and timescale for providing information to other stakeholders;

— the specific support to be provided to special categories of user (e.g. hospitals, care homes for the elderly, government and military establishments).

5.3 Commitment

The water utility should establish its commitment in terms of providing resources and time for employees to develop and implement crisis management systems, plans and procedures, including the training and exercising of personnel and the testing of equipment, to meet the service levels it sets out.

The water utility should have arrangements prepared in advance for accessing funding to deal with a crisis. An assessment of funding required should be made based on a probable worst case scenario and the service levels that the water utility will aim to achieve. Arrangements should be established to authorize spending to ensure that funding issues do not unduly delay the response. This could be done through predetermined spending limits for key staff members defined in the roles and responsibilities section of the crisis management plan.

5.4 Risk assessment

Procedures for risk assessment and determining risk control measures should be established in advance to minimize the risks.

Guidance on the risk management procedure, risk assessment procedures and examples of crisis situations are given in Clauses A.7, A.8 and A.9, respectively. Further guidance is given in IEC 31010 and EN 15975-2.

All such procedures should be tested and staff members exercised with the agencies that may be involved in a crisis.

The procedures should take account of local, regional and national arrangements for dealing with crises.

5.5 Procedures and plans, responding, repairing and restoring

The activities of planning, responding, repairing, verifying and restoring of the service and assessing outcomes are essential elements of the normal operational and management activities of the water utility and not necessarily crisis-specific. Depending on the technical development of the water utility,

all this work may be done by the normal operational management and means of the water utility. If applicable, water utilities should improve on current normal operational practice to accommodate lessons learned from crises.

Based on risk assessment, especially risks associated with hazardous events that may lead to a crisis (see Clause A.9), and whenever possible, the water utility should establish procedures and plans for responding, repairing, verifying and restoring the service.

5.6 Structure and organization

The crisis management team should consist of senior staff (e.g. manager, supervisor, etc.) and other members who have knowledge of the construction of, and are experienced in the operating of, water or wastewater systems as appropriate. Their duties should include the following tasks:

— the ascertainment and assessment of the situation;

— decision-making and the implementation of decisions;

— monitoring and control of the implementation of key decisions;

— documenting key decisions and recording the actions taken;

— issue and receipt of internal and external communications;

— the continued supply of adequate resources to deal with the crisis;

— the provision of alternative water supply and alternative wastewater services, if required;

— coordination of response, recovery and restoration actions;

— the provision of guidance on, monitoring compliance with, and challenging departures from the agreed crisis management plans and procedures.

The clear assignment and definition of these tasks should be predetermined.

The structure of the team should be flexible. It may also be advantageous to consider inviting third parties (e.g. contractors) to be part of the team.

For information related to the resources required by the crisis management team, see Clauses A.1, A.3, A.4 and A.5.

5.7 Procedures and tools to identify a crisis and initiate the crisis management team

5.7.1 General

Water utilities should have in place systems, processes, procedures and tools to monitor appropriate parameters that would indicate a potential crisis. They should ensure that, when such parameters approach the threshold of criteria that indicate a crisis, such circumstances are brought to the attention of the responsible person in a timely manner. The responsible person should be authorized to determine whether the crisis management team should be activated.

5.7.2 Recognition of the beginning of a crisis

Systems, processes, procedures and tools to monitor appropriate parameters should be established to enable the recognition of the beginning of a crisis as early as possible and continuous monitoring of the crisis level.

In particular, readings or combinations of readings that call for special attention should be identified. The areas to be monitored can include, but are not limited to, the following:

— routine and online sample analysis (e.g. raw and treated water, influent and effluent wastewater quality, wastewater sludge);

— telemetry alarms (e.g. quality, flows, pressures, plant operation, intrusion alarms);

— user complaints (e.g. widespread taste or odour, widespread discolouration, significant sewage flooding);

— health authority reports (e.g. cases of illness/death suspected to be attributable to the water supply);

— reports of environmental pollution (e.g. significant fish kill, significant debris and odour complaints);

— routine inspection of assets (e.g. significant intentional damage, significant unintended structural change, interference with wastewater microbiological processes);

— operational events (e.g. plant/network failures);

— catchment events (e.g. exceptional rainfall, farming activity, road accidents);

— security events (receipt of verbal or written threats, evidence of intentional contamination);

— activity/displacements in geologically unstable environments (e.g. slope slippage, seismic events).

Procedures should be established, and periodic training given to staff at all levels, to recognize the way in which a crisis may escalate.

In order to protect public health and the environment, the water utility may establish cooperative procedures with the health authorities. These procedures enable the early and rapid detection, reporting, investigation and treatment of the causes of illness that could be related to the water supplied or to wastewater pollution incidents.

5.7.3 Criteria for activation of the crisis management team

The water utility should determine the type and escalating scale of events that could trigger the invocation of its crisis management plans. This may require establishing escalating levels of crisis management structure and authority. These levels of structure and authority should be determined and documented in advance as part of the pre-crisis phase.

Systems, processes, procedures and tools should be established to ensure that any relevant reports are brought to the attention of the responsible person, authorized to determine whether the crisis management team should be activated.

The systems, processes, procedures and tools that should be prepared include the following:

— the establishment of criteria that determine the events, data, reports and/or results to be brought to the attention of a decision maker;

— training staff at all levels to recognize the criteria for escalation;

— a procedure for conveying the information to staff that can make the decisions to initiate the water utility's crisis management plans;

— procedures for establishing the head of the crisis management team and his/her team;

— a procedure to initiate the assembly of the crisis management team.

These arrangements should be active at all times.

5.7.4 Crisis triggers and levels

The water utility should define its crisis trigger levels according to its particular situation and practices.

Factors affecting the scale of events triggering a crisis could include the impact on the water utility itself, the users and communities it serves, neighbouring water utilities and other key stakeholders affected. The sensitivity of the users and of the environment affected should be considered.

Factors that may trigger a crisis should be identified. The factors that should be considered when deciding if an event should be categorized as a crisis may include the following:

— normal levels of failures in service (frequency and extent);

— potential impact on service, public health or the environment;

— potential impact on society and the risk to the public;

— infringement of laws, regulations, contractual duties or informal agreements;

— requirement to mobilize above normal levels of resources;

— requirement to manage significant numbers of personnel (e.g. repair teams, teams for providing alternative supplies);

— complexity of the event for the managing personnel who carry out a large number of distinct activities;

— complexity and volume of communications required with users, the public and stakeholders;

— potential impact on the water utility's reputation;

— requirement to manage the interface and coordinate the response with other agencies (e.g. health authorities, environment agencies, the police).

NOTE It is a common practice to define the different crisis trigger levels by the use of colours or numbers.

Examples of the determination of crisis trigger levels according to expected impact are provided in Clause A.10.

5.7.5 List of critical components/processes

A current list of critical components/processes and their priority for recovery should be prepared to aid prioritization of the crisis management team response.

5.8 Training and exercise

During the pre-crisis phase, the water utility should identify staff (from among its employees or contractors) who are capable of carrying out the roles identified and defined in the water utility. These staff should be periodically trained to carry out the roles as defined.

There should be sufficient people involved in this group to allow working in shifts, if necessary, and to allow also for sufficient rest periods during the crisis phase, which involves the most activity (see Figure 2).

Staff members identified should be trained on the following:

a) the overall structure and functions of the crisis management system;

b) the communication protocol to be used within the crisis management team.

Staff members identified should be exercised in

— their specific role or roles,

— their understanding of the context of their tasks and their relationship with the whole of the crisis management system, and

— the communications and reporting duties they are expected to undertake.

5.9 Crisis management team

The head of the team should have designated responsibilities and authorities, for example to

— approve reports and communications,

— activate necessary resources,

— decide and order response and remedial actions, and

— make decisions (see 6.4).

5.10 Communication and cooperation

5.10.1 Crisis management team communications with users and other stakeholders

5.10.1.1 Communication strategy and identification of stakeholders

A communication infrastructure, including a backup communication system, during a crisis is a key element of crisis management and should be addressed in the pre-crisis phase.

In a crisis situation, communications with significant groups become of crucial importance. Four such groups can be identified:

— the crisis management team;

— users;

— other stakeholders;

— the general public.

The water utility should have a clear policy and procedures for maintaining accurate, timely and effective communications with all these groups. Having a good communication infrastructure, including a backup, is of great importance especially in formulating the crisis management plans.

Users and the public may include residents, foreign citizens and visitors who are non-native speakers for whom special communications provision should be considered.

Procedures for communication with stakeholders, users and the public should be established. An information strategy, including supporting systems and materials, should be developed for ensuring that users and other stakeholders are kept informed during a crisis. Timely, accurate and clear communication constitutes one of the most important elements of crisis management.

In order to establish trust in the water utility and mitigate panic, either in the affected area or elsewhere, and in order to give the inhabitants of the affected area important information, the water utility should identify the following:

— different types of users and other stakeholders, including the public;

— information to be communicated to these groups;

— methods of communication to be used for these groups.

Refraining from disclosing important information may lead to the water utility's failure to establish the trust of its users and other stakeholders.

When devising a strategy for communication, the following should be considered: national, regional or local communication arrangements and practices used for communicating health and environmental messages.

There are a number of communication options available to a water utility for conveying its message, for example, telephones, press releases, loudspeakers, internet, radio, TV and social media. It is recommended that the water utility develops a multimedia approach, utilizing multiple device methods.

5.10.1.2 Crisis communication within the water utility

The purpose of this "internal" communication should be to pass, in both directions, factual information between those in the field (the task force) and management. This type of communication should be private and secure.

NOTE The task force can include the water utility's support service team members (e.g. laboratory, procurement and control room employees) and third parties' employees (e.g. contractors and consultants).

The water utility should put arrangements in place to ensure the following:

— all crisis relevant information and messages from inside and outside of the water utility are forwarded as directly as possible to the crisis management team;

— orders issued by the crisis management team will reach the task force and other relevant collaborators as quickly as possible;

— appropriate communications and telecommunications infrastructure and systems are in place, as well as rules governing their use.

The water utility should consider the best use, and resilience, of all communication means at its disposal (e.g. landline, cellular or satellite telephony, fax, e-mail and other Internet-based applications).

5.10.1.3 Communications with users affected by the crisis

The most important group is the water utility's users in the affected area. They should be kept informed not only on the general state of the crisis, but also get clear instructions on what to do and how to behave, particularly in order to manage risks to their health.

Clear rules regarding communication during a crisis with the public and the media should be prepared, including the following aspects:

— a communications strategy (what should be reported to whom and in how much detail);

— an official spokesperson (who is exclusively authorized to issue public statements).

The water utility should prepare in advance the wording of important statements related to particular types of crisis events and their foreseeable consequences. These could require only little modification before reaching their target groups.

5.10.1.4 Communications with users not affected by the crisis

The water utility crisis management plan's communication strategy should take account of the need to communicate with those not affected immediately by the crisis. Although the initial impact of the crisis would not affect this group, events can escalate to the point of having an impact on the water or wastewater systems of these users.

In some cases, particularly those that involve water conservation efforts, the actions by users outside of the affected area could delay the recovery of the crisis or even increase the area affected by the incident.

The timely communication of accurate information to those outside the affected area should avoid panic and help maintain a positive public perception of the ability of the water utility to handle the existing crisis.

5.10.2 Cooperation and communications between the water utility and the relevant authorities in the event of a crisis

5.10.2.1 General

The water utility should establish systems, processes and procedures to ensure effective cooperation and communications with those external organizations identified in its crisis management plans. These may include, but are not limited to, the following:

— local, regional and national authorities;

— government departments;

— the police and fire services;

— the environmental protection authorities;

— other water utilities;

— other authorities outside the water sector;

— the health authorities;

— volunteer groups;

— the military (under military aid to the civil community type protocols).

These organizations need timely, specific information about the development of the crisis in case they need to contribute to the response and/or recovery. Specific procedures should be established for this type of communication, for example, that messages are initiated only by the crisis management team.

The water utility should take account of how the water utility and the relevant authorities' leadership organization(s) cooperate at local, regional or national level.

The water utility and the relevant authorities should agree normal communication and cooperative arrangements until a crisis situation is declared by the relevant authorities. This should take account of situations where the water utility has itself already declared a crisis and activated its own crisis management plan.

The water utility and the relevant authority in question should agree on the arrangements to coordinate activities in the event of a crisis. Procedures for reliable communication should be established in order to achieve this integration.

Arrangements for the integration of water utility crisis management team members or technical consultants into the relevant authorities' crisis management system, and vice versa, should be incorporated into the water utility's crisis management procedures.

Such an arrangement aims to

— exchange necessary information during normal conditions, without pressure from a crisis,

— build mutual recognition and trust between the parties before these relationships are tested by the pressures of a crisis,

— provide the relevant authorities with subject matter expertise, and

— enable the water utility to have input into decisions and measures for averting hazards in acute situations.

Procedures for the issuing of information to users and the general public by the relevant authorities concerning the water utility's services and activities should be agreed in advance.

NOTE Figure A.1 illustrates possible cooperation activities.

5.10.2.2 Cooperation arrangements between the water utility and other utilities or competent organizations

Cooperation arrangements between the water utility and other utilities or competent organizations in the event of a crisis should be established. A crisis management system may also be organized jointly with another water utility. Multi-segment organizations may outsource it to a suitable unit of the organization, always unambiguously assigning relevant responsibilities. It is recommended that very small local water utilities rely on the support of neighbouring or larger organizations in the event of a crisis.

Regardless of cooperation with other authorities, the water utility should be the one solely empowered to direct crisis-related actions within their organization. This is to ensure the necessary compliance with all drinking water and wastewater requirements.

It is recommended that the following items should be addressed when drafting a cooperation agreement:

— the establishment of communication between the water utility and other utilities;

— how requests for physical support and supply of the materials will be addressed;

— expectations of what the other utilities might do and what support the water utility could offer them in return should the situation be reversed;

— arrangements for controlling the supporting utilities' resources during the successive phases and overlapping activities of the crisis;

— agreeing in advance the basis for the reimbursement of costs likely to be incurred that will be paid directly by:

  — the supporting organizations without expectation of repayment,

  — the supporting organizations but which can be expected, ultimately, to be repaid by the water utility, and

  — the water utility.

5.10.2.3 Cooperation arrangements between the water utility and the relevant authorities

Cooperation arrangements between the water utility and the relevant authorities in the event of a crisis should be established. The water utility's crisis management system should be both consistent and integrated with national arrangements of the civil authorities (local, regional and national government, police and emergency services, and the health, environmental and other relevant authorities) for dealing with a crisis.

The water utility should work with the local, regional and national authorities to develop procedures that

— identify the nature and extent of water utility crises that could activate local, regional or national civil authority emergency response procedures,

— identify the nature and extent of non-water utility crises that could require the participation of the water utility,

— set out the procedure for the different scenarios and define the role and responsibility of the water utility in each scenario, and

— identify roles or staff members that would interface with local, regional and national authorities.

The water utility should work with the local, regional and national authorities as appropriate to identify opportunities to participate in exercises of the highest priority scenarios and modify the cooperation procedures based on agreed lessons learned.

5.10.2.4 Cooperation across river basins and drainage areas

Cooperation arrangements should be established between water utilities and other stakeholders that share exposure to the consequences of pollution of river basins, lakes, aquifers or drainage areas. For example, a problem caused by a third party affecting one water utility's drainage and wastewater treatment systems can have an adverse effect on another water utility's water supply system (e.g. industrial acid spill into drainage system kills microbial life in wastewater treatment process leading to pollution plume affecting another water utility's water supply intake).

5.11 Provisions of plans and resources

5.11.1 Emergency physical facilities

Physical facilities should be provided from which to manage the response, including back-up facilities, should the main one not be available. See Clause A.1.

5.11.2 Water utility personnel safety measures

Water utility personnel safety measures, including evacuation and shelter planning, off-site protective actions, first aid and emergency medical treatment, should be provided. See Clause A.2.

5.11.3 Sampling and analysis capability and capacity

Sampling and analysis capability and capacity should be provided to establish and monitor the nature and extent of the crisis. This capability may also be used for the recovery phase. See Clause A.3.

5.11.4 Alternative water supply

Plans and resources to provide the quantity and quality of alternative water supplies and alternative wastewater services should be determined. See Clause A.4.

5.11.5 Resource availability

Arrangements to ensure the availability of resources should be established. The water utility should make sure that the resources identified as necessary for dealing with the crises that the water utility plans for are available. See Clause A.5.

5.12 Monitoring and review

The water utility should establish and maintain procedures to monitor and measure performance on a regular basis.

The procedures for monitoring, measurement, analysis or assessment should indicate when they are to be performed within the crisis cycle (before, during or after the crisis). These procedures should indicate the methods, either qualitative or quantitative, to be used in order to guarantee valid and comparable results.

5.13 Documentation

All procedures for dealing with a crisis, nominations to the crisis management team, collaboration agreements with organizations relating to the water utility, lists of equipment and their location, special arrangements, etc., should be documented to an extent that is accurate and complete but remains easy to understand.

The documents, which may be either in electronic or paper format or both, should be stored in safe, but accessible places, including off-site locations, so that they can be retrieved quickly when the need arises, and should not be vulnerable to total loss in a single event.

It is recommended that, where practicable, a common format is agreed upon in advance with the relevant authorities and other water utilities possibly affected, to enable better interoperability of the documents in cooperative activities.

Procedures and plans should at least detail how each of the elements identified during the pre-crisis phase should be implemented in the event of a crisis.

In addition, the following documentation is recommended:

— internal and external contact lists (e.g. operational managers, water quality experts, contractors and suppliers of materials and equipment);

— geographic information (e.g. maps of supply zones, sewer catchments, water tank locations);

— crisis management procedures;

— pre-prepared forms to record information during a crisis in a way that helps decision making;

— pre-prepared notices and communications to the public;

— all risk assessments and response scenarios' documentation prepared during the pre-crisis phase;

— liaison arrangements with the relevant authorities.

6 Response

6.1 General

Once the authorized person has decided that the crisis management team should be activated (see 5.7.1 and 5.7.3), then the crisis management team should be convened. The following steps should be organized in such a way as to enable the crisis management team to take action as soon as possible.

6.2 Situation ascertainment

The crisis management team should first ascertain the crisis situation as precisely as possible to create the basis for its further work. Therefore the crisis management team should collect the existing available information such as messages, sample testing results and professional findings. As the available information can be incomplete, ambiguous, or incorrect this can require on-going effort to maintain the best current understanding of the situation.

6.3 Situation assessment

The crisis management team should assess the crisis situation from the interpretation of the findings from the situational ascertainment. The assessment process should include the findings from results of risk analyses' interpretation and could be comprised of the following aspects:

— hazard and damage situation;

— information availability and its reliability;

— assessment of resources (organization, sub-organizations, etc.) and capacity to mobilize external resources;

— prioritization of ways to cope with or de-escalate the situation;

— decisions that are external to the crisis management team and need to be taken into account, such as decisions by relevant authorities.

Each crisis management team member should assess the situation from the point of view of the duties assigned to them and report to the responsible individual (in general, the head of the crisis management team) describing the specific problems caused by the crisis situation and the solutions recommended. In this context, it is important also for them to point out solution alternatives that exceed the normal decision-making authority of each member of the crisis management team.

6.4 Decision making

The head of the crisis management team with the input of his/her team should

— make timely decisions based on the best information available,

— be proactive rather than reactive,

— ensure an adequate depth of resources (e.g. extra staff members working shifts as necessary),

— optimize the currently available resources for the management of the crisis (while seeking better alternatives if their availability is possible),

— consider the communications aspects required for each decision, and

— consider direction given by relevant authorities.

6.5 Implementation of decisions and issuing of orders

The head of the crisis management team should issue the necessary orders on the basis of the decisions taken. Orders should

— set clear and concise objectives to be achieved within defined time frames,

— define tasks to be achieved, and by whom,

— define parameters within which to operate,

— be structured understandably,

— confirm the method of communication (written, verbal, etc.) and the acknowledgement required by the person to whom the task is assigned,

— be of such a nature that they are capable of being carried out, and

— clearly indicate whether they are mandatory or whether discretion is allowed in their interpretation.

6.6 Supervision and control

The crisis management team should supervise and control the proper implementation of the decisions. Therefore, the crisis management team should establish procedures for obtaining continuous feedback.

6.7 Process for risk assessment during a crisis

The crisis management plans should incorporate a procedure and tools for assessing the risks of not restoring service to an acceptable level. In particular, an assessment of the risks to achieving the following key outcomes should be made to enable better decision making and, where necessary, controls put in place to reduce the risks to an acceptable level:

— restoration of service in the agreed/required timescale;

— avoidance of a significant impact on reputation.

The risk assessment and controls should anticipate potential challenges, such as

— recurrence of the event that caused the crisis (e.g. aftershocks following an earthquake), and

— adverse weather impacting on the response.

This process should be repeated at regular intervals throughout the period of the crisis.

6.8 Communications feedback

The crisis management team should establish procedures for obtaining continuous feedback on the effectiveness of the communication strategy. The strategy should be adapted or changed accordingly.

7 Recovery to normal operation

7.1 General

Once the criteria for recovery to normal operation are established, the head of the crisis management team should determine, in collaboration with the relevant water utility representatives, a priority plan for recovery including details of who is required to undertake specific residual actions arising from the crisis.

Key elements of the priority plan for recovery should include the following:

— the technical recovery measures to be undertaken;

— a prioritization of the proposed recovery measures.

Other elements of the priority plan for recovery should include the following:

— a survey of the damage for restoration purposes;

— restoration objectives (short and long term; see Clause B.1); and

— restoration alternatives.

The priority plan for recovery should primarily be developed by the crisis management team during the response phase taking 5.7.5 into account.

The activities of planning, responding, repairing, verifying and restoring the service and assessing outcomes are essential elements of the normal operational and management activities of the water utility and not necessarily crisis-specific. Depending on the technical development of the water utility, all this work may be done by the normal operational management and means of the water utility. If applicable, water utilities should improve on current normal operational practice to accommodate lessons learned from crises.

Recovery actions can be capable of implementation simultaneously in several parts of the water supply and wastewater system affected by the crisis. Other stages of the crisis management plan can also be capable of concurrent implementation by the crisis management team in the same sections of the system.

After the deactivation of the crisis management team (end of the crisis is declared), the recovery plan continues to be implemented if required within the normal operations of the water utility (even if it implies an unusual volume of activity).

7.2 Survey for restoration purposes

The survey should proceed as follows.

— Determine the extent and boundary of the area affected (e.g. contaminated area, area where the water supply or wastewater service has been stopped or diminished).

— Determine the impact of the interruption of water or wastewater service to the affected area including a survey of possible consequences for high-risk populations such as elderly people, hospitals, schools and for environmentally sensitive areas.

— Find out the type, concentrations and characteristics of any pollutant (e.g. risks to public health, stability in water, aesthetic characteristics, treatment possibilities and threats to treatment processes).

— Determine the components of the water supply or wastewater system affected (e.g. pipes, wells, pumping stations, tanks, treatment plants, sludge digesters).

7.3 Restoration alternatives

Based on the objectives defined, the water utility should identify the alternatives for the restoration of the water supply or wastewater system, with emphasis on the following:

— minimizing risk to public health;

— damage to the existing infrastructure;

— the time required for recovery works;

— the environmental impact.

The water utility should give priority to restoration of service to the areas in which restoration will bring the maximum benefit to the users in terms of the size of population served and reduction in the severity of the impact of the crisis.

The analysis of the alternatives should take into consideration the type and concentration of any pollutant and the associated treatment requirements and the different needs and priorities in the different areas affected by the crisis.

7.4 Priorities in recovery

The crisis management team should identify the key elements within the recovery plan and record them in a priority plan for recovery during the response stage.

This priority plan for recovery should be based on clear criteria for determining the order of priorities in the recovery process. These criteria should include the following:

— risk to public health and safety and to the environment due to contamination or risk of service disruption;

— risk to health and safety of responders dealing with related aspects of the crisis;

— risk of disruption to other infrastructure and other recovery activities;

— a possible public reaction (e.g. panic), resulting from the crisis;

— provision of alternative water supplies and alternative wastewater services;

— the most critical users or areas as identified in the priority plan for recovery;

— the time estimated for restoration;

— primary and secondary restoration objectives;

— available resources.

The priority plan for recovery should include a determination of the nature and scale of the interruption to service (contamination, loss of supply, damage to infrastructure, pollution, etc.). These characteristics

should be obtained by means of a survey that determines in detail the extent and location of the different parts of the water supply and/or wastewater system affected by the crisis.

The priority plan for recovery should be based on a risk assessment of the critical recovery areas. It should also determine the recovery objectives as follows.

— Define the main objectives and timetable for achievement of the recovery plan including intermediate objectives, if necessary (see Clause B.1).

— Identify where the weaknesses in the system are and set up a programme to strengthen them, if possible.

— Minimize the length of time that operations would be seriously disrupted (if necessary using the water utility's resources plus external resources that have been arranged beforehand or following liaison during the crisis).

— Restore the interrupted service as soon as possible.

— Coordinate all the recovery tasks.

— Make the recovery effort as uncomplicated as possible.

Where an alternative water supplies or alternative wastewater services agreement is provided, the water utility should establish the service levels and water quality levels to be achieved at each stage of the recovery in cooperation with the relevant authorities for each stage.

Priority plans for recovery should be drawn for the various stages of the recovery process: short, intermediate and long term.

7.5 Planning the deployment of recovery measures

The planning of deployment of recovery measures should start during the response stage.

After deciding on recovery and/or restoration alternatives, the water utility should establish and implement the most suitable plan for the specific crisis situation. This plan could include working instructions for the different task teams (repair teams, sampling teams, laboratories, alternative water supply teams, etc.), including the clear definition of procedures to follow and sequence of activities (e.g. in order to keep a clean water front when cleaning the system).

This plan can require the cooperation of a technical team led by an appropriately qualified person. This technical team could be a part of the crisis management team or be working in parallel and in coordination with the rest of the crisis management team.

A plan for restoring service should be established and put into action which should take into consideration the total resources and staff members that the water utility can allocate and should include priorities and timetables for the restoration of the different parts of the system.

Depending on the technical development of the water utility, the planning may be done by the normal operational management and means of the water utility.

If there are gaps in knowledge and/or a shortage of equipment, it can be necessary to plan for providing for them during the recovery stage, by using assistance from the relevant authorities, neighbouring water utilities and/or by small-scale field experiments using treatment technologies that may not have been applied by the water utility before.

7.6 Repairing the damage

In order to address the damage to the system, the water utility should activate repair teams to restore the damaged water and wastewater systems according to the recovery priorities plan and use external resources as necessary to meet the planned targets.

All the recovery actions such as draining, cleaning and disinfecting, main and sewer repairs, water and wastewater treatment plants' operation, maintenance operations and other recovery action procedures should be carried out by trained working teams and in accordance with a plan that is designed to achieve the restoration of services to the most critical users/areas as identified in the priority plan for recovery in the shortest possible time. For further information, see Clause B.2.

7.7 Verification

7.7.1 General

The water utility should verify that the quality of the water to be supplied or wastewater services to be provided meet the requirements of the relevant authorities before restoring partial or normal operation of the parts of the water supply and/or the wastewater system affected by the crisis. To the greatest extent possible, user expectations of water quality that may exceed regulatory requirements should be addressed, noting that it may not be possible to meet all expectations in the short-term.

7.7.2 Verification of quality in the drinking water supply system

In order to verify the quality of the water in the supply system, the water utility should activate and operate sampling procedures, sampling teams and laboratories that have been established and exercised during the pre-crisis phase.

The water utility should put the sampling teams and laboratories into operation on a 24-h basis, if necessary (depending on the severity of the crisis), in order to shorten the period of recovery as much as possible.

The water utility should establish and implement a programme for water sampling in the supply system and for the services of the laboratories with the necessary analytical capabilities. Such a programme should be dynamic and change according to the results of the water quality tests carried out.

It should be ensured that communications between the crisis management team, the sampling teams and the laboratories are clear, quick and efficient, since the water quality results clear the way for going back to normal operation mode.

7.7.3 Verification of quality in the wastewater system

Before, during and after the crisis, the water utility should verify the water quality of the receiving waters, plant and collection system influent and plant effluent. The testing should meet the requirements and specific approval of the relevant authorities. The water quality of the receiving waters during the crisis may be verified by the relevant authorities, should the crisis level exceed the capacity of the water utility to sample and test.

The water utility should normally strive to continue to provide wastewater services during a crisis while considering issues of public health and environmental protection. The water utility may make attempts to keep certain waste material out of the collection system and/or make attempts to store certain waste at the plant or in the collection system. The water utility should be aware that when the water supply is turned off, the water load is reduced on the wastewater treatment plant and the failure of the wastewater system may only be apparent after the water supply service resumes.

In order to monitor plant operations and evaluate environmental water quality, the water utility should activate and operate sampling procedures, sampling teams and laboratories that were established and exercised during the pre-crisis phase. The water utility should put the sampling teams and laboratories into operation on a continuous basis, if necessary (depending on the severity of the crisis), in order to shorten the recovery period. The water utility should establish and implement a programme for sampling in the collection system, at the wastewater treatment plant and in the environment. Such a programme should be dynamic and change according to the results of the tests carried out.

It is important to ensure that communications between the crisis management team, the sampling teams and the laboratories are clear, timely and efficient, since the influent and effluent quality results indicate where the system and the environment have changed to levels approaching normal conditions.

7.8 Restoring the service

7.8.1 General

After verification has been carried out and the relevant permits granted, if required, the water utility should begin restoring its service.

Additional verification can be required through the restoration process.

7.8.2 Restoration of drinking water service

The water utility should resume water supply only after the relevant authorities grant the permits or approvals for the resumption of water supply to the users.

As an intermediate stage during the recovery phase, water that does not comply with drinking water standards may be supplied to users for limited uses such as toilet flushing, irrigation, washing (body contact without drinking), drinking only after the water has been boiled, etc.

Supply of the water for these limited uses should only be implemented after the authorities responsible for water quality and public health have approved this action and issued the required permits, and only after appropriate notice has been given to the users, to the satisfaction of the relevant authorities. Even after all regulatory quality levels have been reached, it can be important to keep users informed of significant deviations from pre-crisis water quality parameters. For example, in some cases, increased hardness levels are not a public health concern but could have severe impacts on some industrial processes.

7.8.3 Restoration of wastewater service

The water utility should allow industrial discharges to resume only after the relevant authorities grant the necessary approvals. One of the drivers for frequent communication with stakeholders during the crisis is to minimize the risk to the environment and to members of the public from any stakeholders who are interested in resuming discharges before approval has been granted.

7.9 Assessments for recovery stage

The crisis management team should conduct a separate periodic situation assessment in order to evaluate the situation during the recovery and a final assessment to evaluate the situation when the recovery from a crisis situation has been completed.

These assessments can be based on the assumption that for a short period of time the water utility can tolerate a higher level of risk exposure in accordance with the requirements and approval of the relevant authorities.

8 Monitoring and review of the crisis management system

8.1 Performance measurement and monitoring

Proactive monitoring should be used to check the conformity and effectiveness of the crisis management system, while reactive monitoring should be used to investigate, analyse and record system failures, events and disruptions including those narrowly avoided.

These procedures should provide for the following:

— both qualitative and quantitative measures, appropriate to the needs of the water utility and the results of risks evaluation;

— ascertaining the extent to which the water utility's crisis management objectives have been met, taking into account the corresponding assessment criteria;

— proactive measures of performance that monitors conformity with the crisis management plans, operational criteria, applicable legislation and regulatory requirements;

— reactive measures for performance to monitor events and disruptions, including those narrowly avoided, and other evidence of deficient crisis management performance;

— recording of data and results of the monitoring and measurement activities, sufficient to facilitate analysis for subsequent improvement and corrective action;

— recording of new issues or events in order to implement subsequent improvement to the crisis management plans' processes and procedures.

8.2 Issues to address when monitoring the performance of a training procedure

A procedure designed to monitor and measure a water utility's performance in the area of training of the crisis management team members could be based on, but not limited to, the following processes:

— determining what team members have learned using questionnaires and interviews;

— assessing the need for refresher training of team members at regular intervals;

— measuring the competence of team members using tools such as skills matrices;

— undertaking table top exercises during and/or after training.

Exercises should facilitate the following:

— verification that the crisis management plans incorporate the organizational critical activities and their interdependencies and priorities;

— establishing whether those charged with the responsibility for the crisis management system are oriented with their roles and responsibilities;

— testing the efficiency of the convening procedure (how fast the crisis management team members are made available);

— testing of the technical, logistical, administrative, procedural and other operational systems of the crisis management system such as activating cooperation agreements, opening communication channels and communicating the desired location for staff members joining the crisis response;

— testing of the crisis management organization and infrastructure (including control centres and work areas);

— continual improvement of the crisis management system.

The results of the exercises should be considered for continual improvement of the crisis management system.

8.3 Crisis management system maintenance process

The crisis management system maintenance programme should periodically

— review and verify any assumptions made in the risk assessment,

— verify that the training and exercising of all the key people who are to implement the crisis management plans are current, and

— distribute updated, amended or changed crisis management policy, strategies, solutions, processes and plans to key personnel using a formal document control process.

The results of the crisis management system maintenance process should include the following:

— documented evidence of the proactive management and governance of the water utility's crisis management plans;

— verification that effective version control processes or procedures are in place;

— immediate training of new or replacement people in key positions in the crisis management process;

— verification that key people who are to implement the crisis management system and plans remain in place;

— identification and documentation of the crisis management maintenance schedule;

— verification of the monitoring and control of the crisis management risks faced by the water utility.

8.4 Crisis management system assessment

Assessment of the water utility's crisis management system should incorporate verification that

— the critical activities and their interdependencies have been identified and included in the water utility's crisis management strategy,

— the water utility's crisis management policy, strategies, framework and plans continue to accurately reflect its priorities and requirements,

— the water utility's crisis management competence and capability are effective and adequate in order to enable management, command, control and coordination of a crisis,

— the water utility's crisis management solutions are effective, up-to-date, adequate and appropriate for the level of risk faced by the water utility,

— the water utility's crisis management system maintenance and exercising programme have been effectively implemented,

— crisis management strategies and plans incorporate lessons learned from both exercises and actual incidents, as contained in post-exercise and post-incident reports, and amendments arising from the maintenance programme, and

— change and control processes are in place and operate effectively.

9 Management review

The water utility should periodically contribute to the management review process to drive the maintenance and continual improvement of organizational effectiveness. The outputs from the crisis management review should drive the continual improvement of the management system.

Input to management reviews should include, but not be limited to, the following:

— the results of audits and assessments of compliance with legal requirements and with other requirements to which the water utility subscribes;

— communication(s) from external stakeholders, including complaints;

— adequacy of the processes and procedures in place;

— crisis management performance of the water utility;

— the extent to which organizational objectives have been met;

— the status of corrective and preventive actions;

— follow-up actions from previous management reviews;

— changing hazards, risks, threats and circumstances, including developments in legal and other requirements related to such hazards, risks and threats;

— recommendations for improvement.

Output from management reviews should include, but not be limited to, the following:

— actions to address in order to improve the crisis management processes and procedures;

— needs for additional resources.

Annex A
(informative)

Preparedness

A.1 Emergency physical facilities

Physical facilities should be provided from which to manage the response, including back-up facilities, should the main ones not be available. This includes amenities for personnel, such as food, refreshments, a place to rest and sanitary facilities. The water utility should identify facilities from which the crisis management team can operate effectively. The main requirements of these facilities include the following:

— having a location that allows reasonably fast access for all key personnel;

— being protected from events that may affect the water utility;

— having sufficient space to allow effective operation, including any sub-teams or groups that are part of the crisis management team;

— having communication facilities including access to telephones, tele-conferencing, fax and e-mail. These facilities should be sufficient to communicate with staff of the water utility, as well as external organizations, contractors, suppliers, etc., as identified in the crisis management plans;

— having considerations for alternative communications methods (e.g. satellite phones), where loss of communications is identified as a potential risk;

— having a back-up power supply (e.g. diesel generator) available if loss of power is identified as a potential risk;

— risk mitigation measures that could be employed to reduce the impact of a risk to the facilities that has materialized;

— having access to all plans, procedures and documentation required for the effective operation of the crisis management team. Where these are held electronically, hard copies should be in place in the event of an IT failure;

— having provisions for printing documents and maps as may be required;

— having provision for handling visual imagery (e.g. wallboards, whiteboards, projection facilities, geographical information system displays: live-video feeds, tele-conferencing, etc.).

Such facilities should be available at all times and their operation should be planned assuming that they could be used continuously over a prolonged period of time. The facilities can be maintained on a permanent basis or alternatively it should be possible to activate them at short notice.

Consideration should be given to having a back-up facility, particularly where the main one may be disabled through an emergency event. The operational readiness of any back-up equipment and facility should be confirmed at regular intervals to ensure an effective and efficient response to a crisis in which the main facility is disabled.

A.2 Water utility personnel safety measures

Water utility personnel safety measures, including evacuation and shelter planning, off-site protective actions, first aid and emergency medical treatment, should be provided.

Such provisions need to consider the following:

— water utility policy regarding occupational health and safety;

— potential differences between the occupational health and safety (H&S) policy of the water utility and other organization's H&S policies where personnel are jointly engaged in activities under one organization's control;

— occupational health and safety issues arising from relevant hazard risk assessments;

— chemical release or toxic waste release control and countermeasures procedures, including chemical data sheets;

— detailed information regarding known hazards on the site of the crisis.

The water utility should

— identify potential hazardous events and the procedures for dealing with them,

— provide guidance to the staff members in dealing with such hazards,

— consult with emergency services (police, fire and rescue services, paramedics, ambulance service) on the management of hazards particularly where they can be spread off-site (e.g. chlorine gas leak),

— have procedures to evaluate the situation including the nature of the hazards that the situation poses to staff members taking into account factors such as weather conditions, etc.,

— establish facilities to communicate with staff members involved in the crisis response and emergency services, and

— establish evacuation and shelter procedures.

A.3 Sampling and analysis capability and capacity

Sampling and analysis capability and capacity should be provided to establish and monitor the nature and extent of the crisis. This capability may also be used for the recovery.

In a crisis event affecting the quality of water supplied or wastewater treated, the requirement for sampling and analysis can become significant and can put existing sampling and analytical capability under strain. This might happen especially during the recovery.

An assessment of the sampling and laboratory requirements for the largest scale of event planned for should be undertaken. This may require the following:

— adopting different working patterns for existing facilities;

— working with the relevant authorities to forecast possible numbers and types of tests to be conducted;

— reaching agreements with other water utilities, public or independent laboratories to utilize their facilities;

— looking into the possibility of getting services from more than one laboratory during a crisis.

In addition, it may be possible to utilize field analysis to provide the required information, such as on-site water quality monitors or manual on-site analytical kits. It is possible, however, that field analysis techniques produce only approximate results; therefore, confirmation by a qualified laboratory could be needed.

Procedures should be developed to allow the collection, analysis and handling of potentially hazardous samples.

A.4 Alternative water supplies and alternative wastewater services

Plans and resources to provide the quantity and quality of alternative water supplies and alternative wastewater services should be determined.

Alternative water supplies are usually provided via bottled water, emergency tanks and tankers, temporary overland pipework or stand-pipes erected in an adjacent non-affected area. Alternative wastewater services are usually provided via latrines and/or collection by tankers or temporary pumped services.

The water utility should determine the following:

— the circumstances under which alternative water supplies or alternative wastewater services are to be provided, depending on the type of crisis and its timescale;

— the quantities of alternative water supplies and alternative wastewater services to be made available under various circumstances;

— the methods for providing the alternative supplies and/or services.

The water utility should take into account the relevant regulatory requirements under the given circumstances and the quantity, quality and means of providing alternative water supplies and alternative wastewater services. Sometimes the standards employed by the water utility for supplied water are higher than those required by the relevant authorities. In such cases, the water utility should determine its policy concerning alternative water supply; does it strive to keep its own higher standards or should it keep to the relevant authorities' requirements in the event of a crisis.

The water utility should hold and maintain stocks of equipment and supplies or have arrangements in place with suppliers or other agreements to provide the necessary quantity and quality of alternative water supplies and alternative wastewater services.

The plans, maps and supporting information, including contact details of suppliers and contractors, should be readily available and kept up to date.

A.5 Resources availability

Arrangements to ensure the availability of resources should be established. The water utility should make sure that the resources identified as necessary for dealing with the crises that the water utility plans for are both available and suitably maintained for prompt deployment. The following is a partial list for water utilities to consider. Resources may need to be added or deleted depending on the water utility's ability to access the following:

— equipment for providing alternative supplies (emergency tanks, tankers, bottled water, etc.);

— back-up emergency generators;

— pumps (for water and wastewater);

— temporary treatment plant;

— vehicles for transporting all equipment and supplies from storage to place of use;

— sampling and analysis equipment;

— resources to mobilize and deploy equipment and supplies;

— chemicals;

— repair equipment and materials;

— communication facilities to ensure the effective communication within the crisis management team (e.g. phones, e-mail, faxes, radios, etc.);

— communication resources to ensure effective communication with the public in the crisis area (e.g. loudspeakers, pre-printed leaflets, pre-recorded messages on water utility's telephone number, water utility's website, social media, etc.);

— human resources, e.g. spokeperson;

— safety equipment;

— welfare provision for personnel (food, refreshment, etc.);

— critical records (hardcopy and electronic);

— operating and procedure manuals;

— IT technical recovery plan and procedures;

— telecommunications and IT support;

— other utilities (e.g. water, electricity, gas, telephony).

These resources may be procured from

— within the utility,

— contractors and suppliers,

— mutual arrangements with other utilities or organizations, and

— local, regional and national authorities.

The water utility should develop procedures to mobilize and transport the required resources to the location required at short notice. These procedures should be available on a continuous basis and exercised on a regular basis.

Care should be taken to ensure adequate control of the risk arising from the handling, transport and storage of resources for wastewater purposes (deployed currently or previously) cross-contaminating resources intended for water supply purposes.

A.6 Possible cooperation structure of the crisis organizations of a water utility and the relevant authorities

Figure A.1 illustrates a possible cooperation structure of the crisis organizations of a water utility and the relevant authorities.