



Overview of standards/guidelines and current practices for vulnerability assessment of drinking water security in the European Union

*ERNCIP Thematic Group
Chemical and Biological
Risks to Drinking Water
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Abstract

The assets associated with the production and supply of drinking water are regarded as critical infrastructure (CI) that must be protected against a wide range of incidents that could compromise its integrity. Of concern are those incidents that occur infrequently and often with little or no prior warning and have the potential to cause major contamination or disrupt the supply of drinking water.

Member States have included the security of water supply in their national security plans and have conducted vulnerability assessments. Organisational responsibility rests with different government departments depending on the country. Several countries reported conducting research at the national level aimed at safeguarding water supply.

Several organisations within the European Commission have implemented action at EU level and Comité Européen de Normalisation (CEN) have several working groups concerned with security and water supplies in particular. In addition, a considerable number of research projects have been funded by the Commission.

The assessment is of a very fragmented structure for critical infrastructure protection (CIP) with the European Union. There appears to be overlapping in responsibility for drinking water security between different organisations, which to a certain extent would be expected because of the wide variety of threats that could potentially compromise the integrity of a water supply system.

This review has not yet covered all Member States, but it is intended to act as an active document that will be periodically revised to take account of new developments. The information will be used to support the ongoing work of the Thematic Group for Chemical and Biological Risks to Drinking Water with the development of its programme of work aimed at managing chemical and microbiological risks.

1. Introduction

The European Reference Network for Critical Infrastructure Protection (ERN-CIP) aims at providing a framework within which experimental facilities and laboratories will share knowledge and expertise in order to harmonise test protocols throughout the EU, leading to better protection of CIs against all types of threats and hazards as well as to the creation of a single market for security solutions. A thematic group for Chemical and Biological Risks to Drinking Water was established to coordinate activities on chemical and biological risks in the water sector. Its focus has been (1) to develop guidelines and potential standards for early warning sensors for contamination and (2) to validate screening methods for the identification of unknown substances.

The European Commission defines CIs as an asset, system or part thereof located in Member States that is essential for the maintenance of vital societal functions such as health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact on a Member State as a result of the failure to maintain those functions (European Union, Council Directive 2008/114/CE).

The infrastructure associated with the production and distribution of drinking water is vulnerable to a wide range of hazards that could have an adverse impact on public health. The production and supply of drinking water requires suppliers to have in place robust procedures to assess and manage a wide variety of risks that could have an adverse impact on public health. Guidelines have been prepared by the World Health Organisation (WHO) and take the form of a drinking water safety plan. One component of the plan is prioritising the risks using, as an example, a matrix that assesses the likelihood of a hazard and its potential consequences (Table 1).

Table 1 Example of definitions for likelihood and consequence/impact categories that could be used in hazard prioritisation (taken from WHO)

Level	Descriptor	Description
Likelihood		
A	Almost certain	Once a day
B	Likely	Once per week
C	Moderate	Once per month
D	Unlikely	Once per year
E	Rare	Once every 5 years
Consequence/impact		
1	Insignificant	No detectable impact
2	Minor	Minor aesthetic impact causing dissatisfaction but not likely to lead to use of alternative less safe sources
3	Moderate	Major aesthetic impact possibly resulting in use of alternative but unsafe water sources
4	Major	Morbidity expected from consuming water
5	Catastrophic	Mortality expected from consuming water

The majority of risks experienced by water suppliers are those that occur frequently but with a variety of consequences. For example, sources of water vulnerable to faecal contamination require continuous water treatment to produce water that is safe to drink. Another example is operational failures such as mains breaks, pump malfunctions and power outages. These are manageable if the provider has a response plan that can be put into action quickly.

This thematic group, however, is concerned with those events that tend to occur infrequently and with little or no warning and have the potential for a major impact on the provision of safe water. The security of supplies, in terms of availability of water, is not within its current scope of interest.

A wide range of events can be considered as being of this type and can be classified into one of four broad categories. These categories with corresponding examples are given in Table 2.

Table 2 Categories of significant events

Natural disasters	Accident	Deliberate acts	Negligence
Weather-related damage caused by storms and floods.	Chemical spillage from road traffic accident.	Destruction of facilities or equipment.	Cross-connections.
Seismic activity and ground motions.	Damage of water mains by street works.	Airborne release of hazardous chemicals stored on-site.	Failure to maintain integrity of an asset.
Release of material from volcanic eruption.		Sabotage of supervisory control and data acquisition (SCADA) and other computer systems.	Proper procedures not followed for disinfecting water mains after maintenance work.
Threat from new and emerging pathogens.		Introduction of chemical, biological or radiological contaminants into the water supply.	

Regardless of the root cause, the consequence of these events is the likelihood of contaminating drinking water with harmful chemicals, pathogenic organisms or dangerous radionuclides.

The objective of this task is to establish the guidance available for vulnerability assessment and state of preparedness of Member States to respond to these types of events.

2. Vulnerability assessment for critical infrastructure

Assessing vulnerability requires 'undertaking a systematic examination of the characteristics of an installation, system, asset, application or its dependencies to identify its vulnerabilities'.

Primarily, attention should focus on measures to prevent an adverse event from damaging the infrastructure or breaching its security. It also requires that systems employ reasonable security measures to protect the raw water intake facilities, water treatment processes, storage facilities, pump-houses and distribution systems from possible damage or intruders.

Where events cannot be managed by preventable measures, systems need to be put in place to provide an early warning that an event is occurring.

3. Activities at national level

3.1. Czech Republic

The Ministry of the Interior of the Czech Republic has formulated a number of policies and strategic and legislative materials aimed at defining the state's security policy and contributing to the effective set-up and operation of the national security system. The key policymaking and strategic document in this area is the *Security strategy of the Czech Republic*, which defines the basic values, interests, approaches and objectives of the Czech Republic in safeguarding its security.

Ministry of the Interior

VF20102014009 — 'Posuzování bezpečnosti prvků kritické infrastruktury a alternativní možnosti zvýšení zabezpečení měst a obcí pitnou vodou při vzniku živelních pohrom a rozsáhlých provozních havárií' (2010-2015, MV0/VF)

[VF20102014009 — 'Considering the security of critical infrastructure elements and alternative options for increasing the security of towns and villages with drinking water in the development of large-scale natural disasters and industrial accidents' (2010-2015, MV0/VF)]

[English text in brackets taken directly from Google translate]

3.2. Estonia

The Ministry of Internal Affairs is responsible for the coordination of arrangements for the sustainability of vital services at the national level. The ministry is to provide an overview on sustainability of vital services two times a year.

A provider of a vital service is responsible for carrying out a risk assessment of the continuous operation of the vital services and for presenting a continuous operation plan. The purpose of such documents is to prevent an interruption of vital services and, in case of interruption, to find measures to recover the provision of such services as quickly as possible. Should an interruption occur in the provision of vital services or a threat of interruption, the service provider is to immediately inform the state authority responsible for organising the services in its field of activity.

The providers of vital services are identified on the grounds of criteria defined in the special laws on critical sectors. The criteria were defined having regard that providers of all services shall be defined as providers of vital services.

<https://www.ria.ee/en/ciip.html>

3.3. France

Security systems of drinking water in France is organised through three major regulations and one security analysis guide:

- the civil security law of 13 August 2004;
- the public health code, especially Article R 1321-23 related to sanitary protection of waters to be used for production and distribution of potable water;
- Decree No 2006 — 212 of 23 February 2006, dealing with security of vital importance to infrastructures, among them drinking water systems, which modifies the defence code, Article 1321-1 and the following ones;
- the technical guide Direction générale de la santé (DGS) - 2007 *Les systèmes d'alimentation en eau potable — Évaluer leur vulnérabilité*, which gives detailed analysis tools to estimate and improve the security of drinking water systems.

Most of the rules are aimed at preventing contaminations and building and training an organisation able to detect and to react quickly and properly in case of problem.

Different rules apply, depending mainly on the size of the population served. For example, a detailed vulnerability study, as described in the technical guide, is mandatory for systems delivering water to more than 10 000 inhabitants.

Specific protection plans for the biggest drinking water systems must be approved by governmental authorities.

All drinking water systems operators must follow permanent security 'Vigipirate' rules, whatever their size.

3.4. Germany

The Federal Office of Civil Protection and Disaster Assistance was established on 1 May 2004 as a central organisation for ensuring civil safety. It is not only a technical authority of the Federal Ministry of the Interior, but it also gives advice and support to the other federal and land authorities.

A specific provision for protection of CI for safety in drinking water supply is covered by the Deutscher Verein des Gas- und Wasserfaches (DVGW) guidelines W 1001 and W 1002.

Safety in drinking water supply — DVGW guidelines W 1001 and W 1002

Plans for normal conditions and crisis events

W 1001 Safe and secure drinking water supply – risk management under normal operating conditions

W 1001 takes the fundamental elements of the WHO WSP approach and integrates them into the DVGW technical rules. It serves as a basis for risk-based and process-oriented management of normal operation aimed at improving the safety of supply by means of continued internal operation monitoring. W 1001 also outlines principles for the development of a continuous improvement process designed to create a 'culture of improvement' within the organisation, and promotes the mutual understanding between, and cooperation of, water suppliers with the local supervisory authorities, such as, for instance, health agencies.

W 1002 Safe and secure drinking water supply – organisation and management in the event of a crisis

W 1002 enables water suppliers to take action in the event of a crisis in order to ensure the continued supply of water to the greatest possible extent and to restore normal operating conditions as quickly as possible. It describes the fundamentals of corporate crisis management, including relevant recommendations for water utilities and offers abundant information about the disaster and crisis management organisation of the local authorities.

3.5. Spain

The national security strategy proposes a number of key initiatives aimed at classifying and prioritising risks posed to CIs. The National Centre for Critical Infrastructure Protection is the organisation responsible for promoting, coordinating and supervising all CIP-related activities for which the Secretary of State for Security is competent at national level.

Under Spanish law (Ley 8/2011), CI is defined as 'those whose operation is indispensable and to which there are no alternatives, for which reason their disruption or destruction would imply a serious impact on essential services'.

The Association for the Protection of Critical Infrastructure is a non-profit entity endowed with legal personality and full legal capacity to fulfil its purposes of analysis and treatment of risks and threats that occur around the activities and facilities of CI.

3.6. Sweden

The responsibility for civil emergency planning (CEP) is managed by three different levels of government — national, regional and local. The Ministry of Justice has overall political responsibility for CEP. In order to assure that the government offices have a coordinated ability to handle cross-sector emergencies when they occur, the Crisis Management Coordination Secretariat at government offices is responsible for everyday management.

Civil Protection Act (2003:778)

The objective of this act is the provision of equal, satisfactory and comprehensive civil protection for the whole country — with consideration given to local conditions — for life, health, property and the environment against all types of incident, accident, emergency, crisis and disaster.

Act on measures to prevent and limit the consequences of major chemical accidents (1999:381)

The aim is clear from the full title of the act; prevent and limit injury to people and damage to the environment.

Emergency management and heightened alert ordinance (2006:942)

The aim of the stipulations of this ordinance is to ensure that government authorities, through their operation, reduce societal vulnerabilities and maintain a good capacity for dealing with their tasks during peacetime and periods of heightened alert.

The Swedish Civil Contingencies Agency is responsible for issues concerning civil protection, public safety, emergency management and civil defence as long as no other authority is. Responsibility refers to measures taken before, during and after an emergency or crisis.

Dricksvatten: Produktion och Distribution Handbok för Egenkontrollprogram med HACCP (Hazard analysis and critical control points)

[Drinking water: production and distribution manual user control with HACCP]

Dricksvattenförsörjning i förändrat klimat Underlagsrapport till Klimat- och sårbarhetsutredningen

[Potable water supply in the changed climate background report to the climate and vulnerability]

Kartläggning av SCADA-säkerhet inom svensk dricksvattenförsörjning

[Mapping of SCADA security in the Swedish drinking water supply]

Acreeo Swedish ICT

Acreeo Swedish ICT manages a large consortium developing a sensor-based, online monitoring solution that will provide safe and resource-efficient water management.

Acreeo Swedish ICT and SICS Swedish ICT, in cooperation with over 20 project partners, are developing an online monitoring solution for safe water management. The solution

uses sensor technology to detect small quantities of microorganisms, metals, surfactants and oil in order to secure water quality from an environmental, economic and health perspective. These sensors are linked to a service and communication platform, including advanced data analysis, for online monitoring of the water quality. The monitoring is online, which means deviations are detected much faster (within 1 to 2 hours) than what is possible with today's methods. Based on the results, appropriate actions can be taken.

<https://www.swedishict.se/safeguarding-water-supply>

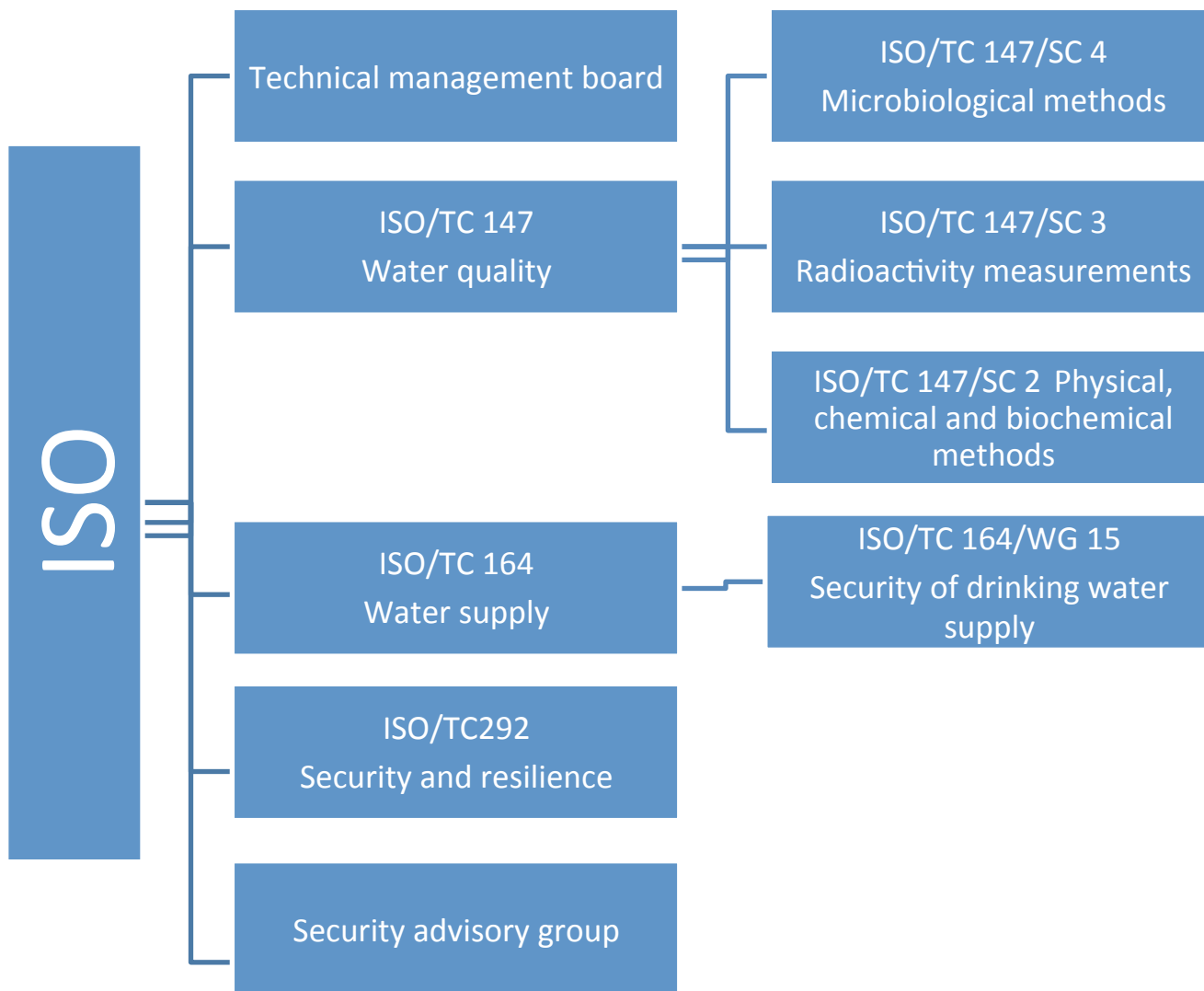
[English text in brackets taken directly from Google translate]

3.7. United Kingdom

<http://www.cpni.gov.uk/advice/physical-security/cbr-attacks/>

4.0. Standards activities

International action through the International Organization for Standardization (ISO) and at EU level by CEN has led to the adoption of a considerable number of initiatives covering security. Figure 1a shows activities within ISO and CEN and those activities specific to CEN are shown in Figure 1b.



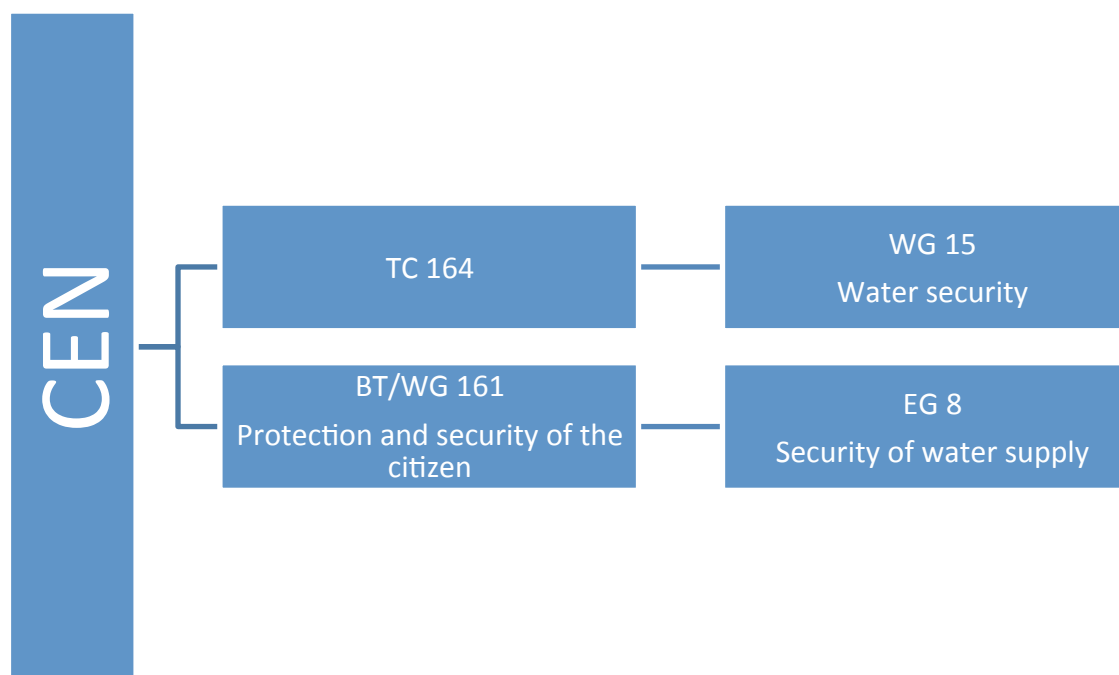


Figure 1 Standards relating to security in general and specifically for drinking water

5.0. European Union activities relevant to drinking water

Several organisations have responsibility for security activities that are directly or indirectly related to protecting the infrastructure supplying drinking water. In addition, the European Commission has funded several projects, some of which are specific for drinking water or have a component related to drinking water.

Table 3 European Union activities relevant to drinking water

Project	Objectives
European Cooperation Network on Critical Infrastructure Protection (EUCONCIP)	<p>The project aims at setting the ground for an EU partnership between CIs' stakeholders to strengthen public-private EU cooperation, training and cross-border/cross-sector knowledge sharing and building as well as the exchange of public available information on CIP.</p> <p>The project will build a network of stakeholders, in the form of a transnational association, which will be able to benefit from a set of joint activities organised by project partners.</p>
EU CBRN-E action plan	<p>The EU chemical, biological, radiological and/or nuclear (CBRN) action plan is aimed at strengthening CBRN security in the European Union. Its overall goal is to reduce the threat and damage from CBRN incidents of accidental, natural and intentional origin.</p> <p>It is broadly based on an all-hazard approach, including terrorist threats, and contributes to the implementation of the EU counter terrorism strategy.</p>
EU CBRN CoE	The European Union CBRN risk mitigation centres of excellence (CoE) initiative
Practice project	The Practice project will improve the preparedness and resilience of EU Member States and associated countries from an attack by a terrorist group using non-conventional weapons, specifically an attack with CBRN materials.

	EU CBRN risk mitigation CoE initiative
AniBioThreat	The focus of the project AniBioThreat is to improve the EU's capacity to counter biological animal bio-threats in terms of awareness, prevention and contingency.
Recipe 2015	<p>The project intends to strengthen the resilience of CIP systems both at national and at EU levels by filling the gaps in the management and protection of CI caused by the observed:</p> <ul style="list-style-type: none"> • scarce and inadequate transfer of knowledge, experiences and best practices among Member States; • lack of mutual support, communication and cooperation between relevant public and private sectors; • lack of quality CIP solutions throughout the EU as assessed per project partner countries; • insufficient and inadequate involvement of the academic community and the resulting lack of scientific and research activity in the field of CI risk management.
Crisalis project	'The Crisalis project aims at providing new means to secure CI environments from targeted attacks carried out by resourceful and motivated individuals. The recent discovery of a malware called Stuxnet show that these threats are already a reality. Their success in infiltrating CI environments is calling attention on the ineffectiveness of standard security mechanisms at detecting them. Stuxnet is believed to have been operating undetected for almost 1 year leveraging multiple vulnerabilities that were previously unknown, and has been discovered only as a consequence to an operational anomaly that triggered the attention of the field operators. This fact clearly shows that our methods to find vulnerabilities and detect ongoing or successful attacks in CI environments are not sufficient.
Assessment of	The objective is to gain a better understanding of potential future

<p>environmental accidents from a security perspective (SECURENV)</p>	<p>threats and based on this develop targeted policy recommendations for EU policymakers and the security community based on the results acquired in the course of the project.</p> <ul style="list-style-type: none"> • Review and analyse past environmental accidents, catastrophes and effects of human actions. Establish databases with relevant information for end users. • Identify novel and emerging threats on the environment as well as the technological opportunities. • Develop an appropriate foresight methodology and potential scenarios involving future environmental risks and use this for investigating policy options. • The project will contribute to define the strategic roadmap for future seventh framework programme (FP7) security research and in planning and designing other future security research programmes and actions. • The project will also give support in developing policies, programmes and initiatives which aim at further enhancing the security of EU citizens. It will provide improved insight and advice for security policymakers, security research programme managers and security researchers concerning contemporary terrorism and in particular for potential future acts perpetrated by intentional adversaries. • The project will provide complementary support to other ongoing activities under the FP7 on security research and national-level research and development that have already started to address security research. • The project will support the objective to determine the long-term threats to EU security and guide the development of both technologies and policies.
<p>SecurEau</p>	<p>The main objective of SecurEau is to launch an appropriate response for rapidly restoring the use of the drinking water network after a deliberate contamination.</p> <ul style="list-style-type: none"> • Design of methodologies to identify new relevant contaminants. • Modelling of the contaminants distribution throughout the network

	<p>and identification of the origin point of the contamination.</p> <ul style="list-style-type: none"> • Adaptation and integration of various sensors in a surveillance system in an optimal configuration. • Development of methods to decontaminate polluted drinking network and installations including the neutralisation of contaminated water and residues.
Multisense chip	<p>The goal of the 'Multisense chip' project is the development of a detection and identification system for biological pathogens in order to build an integrated 'sample in, result out' system. This chip system shall include both a sample preparation function, during which target molecules are directly extracted nucleic acid-based and/or immunological detection as well as identification steps. Disruptive technologies (e.g., advanced sensor technologies like optoelectronic sensors or electrochemical sensors), lab-on-a-chip technology and innovative instrumentation are key to reaching the as yet unrealised goal of identifying multiple pathogens in parallel on the molecular biological level via PCR and immunological means, respectively.</p>
CockpitCI	<p>CockpitCI aims to improve the resilience and dependability of CIs by the automatic detection of cyber-threats and the sharing of real-time information about attacks among CI owners.</p> <p>CockpitCI aims to identify, in real time, the CI functionalities impacted by cyber-attacks and assess the degradation of CI-delivered services.</p> <p>CockpitCI aims to classify the associated risk level, broadcast an alert at different security levels and activate a strategy of containment of the possible consequences of cyber-attacks.</p> <p>CockpitCI aims to leverage the ability of field equipment to counteract cyber-attacks by deploying preservation and shielding strategies able to guarantee the required safety.</p>

6.0. Conclusions

All of the Member States considered so far developed national security plans that recognise the assets associated with the production and distribution of drinking water as CI. However, the extent of vulnerability assessments that have implemented within a country has been difficult to ascertain but does appear to vary between Member States.

A considerable amount of activity, either of direct or indirect relevance, is taking place within the European Union. Some work is of direct relevance to drinking water security whilst it forms one component of a larger project.

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