Proposals for a guidance related to a Water Security Plan to protect Drinking Water

ERNCIP Thematic Group
Chemical and Biological (CB) Risks to Drinking Water

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Contents

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Abstract

This document, prepared by the ERNCIP Thematic Group on "Chemical and biological risks to drinking water" summarises the key findings from a number of recent reviews undertaken to assess the current situation regarding water security planning with the European Union. A large number of initiatives were found to exist at International, European Union and Member State level. Although a limited response obtained to a survey of water utilities and sensor manufacturers, recommendations for the basis of a Water Security Plan were suggested.

The Water Safety and Security Conference organised in Brussels on the occasion of the 10th anniversary of the Groundwater Directive gave the opportunity to present such recommendations for validation.

The Water Security Plan concept was positively received by the stakeholders (including policy makers and other actors of the EU regulatory framework). The key outcomes show that: (i) security being primarily a matter for Member States, the concept of a Water Security Plan as part of Water Safety Plans is validated/recommended; (ii) preference for guidance rather than further legislation emerged from the discussions; (iii) the concept of a demonstration project captured the audience's interest and various issues related to online monitoring were addressed.

To conclude, the visibility of the ERNCIP TG-Water is strengthened and its recommendations for a Water Security Plan as part of a Water Safety Plan were validated, as well as the need for efficient and integrated online monitoring. Implementation of such a concept will now be clarified in ERNCIP TG-Water's work programme for the next two years.

1. Background

The ERNCIP network has been established to improve the protection of critical infrastructures in the EU. ERNCIP therefore works in close cooperation with all types of CIP stakeholders, focusing particularly on the technical protective security solutions.

The purpose of the ERNCIP Thematic Group on "Chemical and biological risks to drinking water" (TG Water) is to support utilities in the development of an effective response to a wide range of hazards, typically those considered to have a low probability of occurrence but with a potential high impact (e.g. malicious acts), that could compromise the supply of safe drinking water.

In 2015, the Thematic Group produced three state-of-the-art reports that reviewed the current status of protection in relation to security of drinking water. Our assessment has shown that the situation is fragmented with different organisations having responsibility at EU and national level with little coordination of activities. Without a consistent and consensus approach, those ultimately responsible for protecting drinking water are facing problems to implement a robust and reliable framework for risk assessment and risk management including security against malicious contamination.

In 2016, ERNCIP's TG Water canvassed stakeholders across the EU to identify the implementation of current approaches regarding the control of water quality. Thus, water utilities, sensor manufacturers and national authorities have had the opportunity to contribute their views on the topic.

2. Introduction

The ERNCIP TG Water proposes the development of guidance to enable water utilities to prepare a specific Water Security Plan (WSecP), devoted to improving the control of water security and which would form a component of the already existing Water Safety Plan approach. The guidance aims to focus, initially, on the application of on-line monitoring together with event detection software for the detection of chemical and biological contaminations as close to real-time as possible.

The primary focus of the Water Security Plan is responding to deliberate acts of contamination, although the plan would also help to protect against the effects of natural disasters or accidents, keeping in mind the integration into daily operation. It is a complementary approach to existing water safety plan concepts that deal with events that are more familiar to water providers. In particular, this paper reviews the application of innovative online monitoring technologies as part of a water security strategy, depending on the individual vulnerability of utilities.

This paper recommends an approach towards a water security plan in a broader view.

The "Water Safety and Security" Workshop held on the 11-12th December 2016 in Brussels aimed to improve coordination among science, policy-making and management/operation actors. The activity and recommendations from the ERNCIP thematic group of experts on "Chemical and Biological Risks to Drinking Water" was presented to workshop attendees, including representatives of the National Authorities and to the CIP stakeholder community, for validation in a dedicated session of the workshop. This paper presents the results of this validation exercise.

3. Overview of standards, guidelines and current practices for vulnerability assessment (Pitchers, 2016)

There is widespread recognition that the assets, associated with the production and supply of drinking water, are regarded as critical infrastructure that must be protected. Many Member States have included the security of water supply in their national security plans but the nature and extent of their vulnerability assessments was not clear.

Several organisations within the European Commission have been involved with developing emergency response plans and making preparations in the event of an incident. The European standards organisation, CEN, has several working groups involved with security and for water supplies in particular. In addition, a number of research projects have been funded by the Commission but their outcomes tend to have a restricted distribution, the same for those water utilities from big cities already working on it. Several countries have indicated undertaking their own research aimed at developing good practice for safeguarding their water supply infrastructure.

The assessment has revealed a very fragmented structure for vulnerability assessments with several different organisations active in the area of drinking water security. It is not helped by the understandably sensitive nature of the topic which makes access to knowledge and expertise difficult and appears to have resulted in duplication of effort by Member States in their response planning which has resulted in varying extent of implementation.

4. Existing legislation, guidelines, standards, organizations and projects related to drinking water safety and monitoring (Tanchou, 2016)

Although security of the water supply infrastructure is a concern for working groups at the European level, no specific guidelines dealing with biological and chemical monitoring in terms of security have been established up to now. Nevertheless, European directives such as the Drinking Water Directive (DWD) and the Water Framework Directive (WFD) determine regular monitoring to ensure the quality of water. National initiatives (eg. NFX52-120, France) exist but are not easily accessible. Outside Europe, guidelines and directives are available either at the international (WHO, IWA) or national (Canada, US, Australia) levels and include reference scientific information.

In parallel, various European partnerships and organisations exist to tackle water quality and safety (JPI-Water, EIP-Water, EurEau, WISE) and security (M/487). All these networks group the major stakeholders in the water sector (institutions, private companies, operators, governmental agencies, regulators…). They are actively involved in driving strategy, policy, and scientific approaches.

Alternatively, European projects and initiatives enable research and technological innovation developments. For this reason, particular attention has to be paid to FP7 and new H2020 projects as they define future monitoring technologies and establish efficient European networks. However, online monitoring of contaminations due to biological pathogens is challenging and still requires more R&D.

5. Water Security Plan and its elements (Raich & Weingartner, 2016)

A Water Security Plan (WSecP) has different elements compared to Water Safety Plans, although these proposals are being aligned with them, and with the Drinking Water Directive. The new and emerging WSecP is devoted to integration into the operational framework of on-line monitoring of the drinking water supplied from the drinking water treatment plant (DWTP) to the tap of the consumer. By monitoring as close to real-time as possible, the aim is to make sure that any contamination occurring in the network is detected within the shortest possible time and mitigated. In addition, the fulfilment of this WSecP would help a water utility to better understand its vulnerabilities and improve the day to day drinking water operational management. Additionally, emergency response plans would be readily available in case contamination is detected, enabling immediate action and communication with stakeholders.

The proposed elements of a Water Security Plan are:

1. Decision of water utility to establish a Water Security Plan
    a. Every water utility — independent of size, since the number of accidents happening in small towns is higher than in big cities — should be encouraged to go through an evaluation process.
2. Water utilities to conduct a vulnerability assessment
    a. This is a key element. Factors to be looked at include size (population supplied), age and quality of infrastructure, threats, accessibility and exposedness (e.g. number of open channels, tanks, hydrants), potential contamination sources, special land use, poorly-maintained infrastructure in the catchment, history of events, and existing protective resources and safety plans or similar that have already been implemented. The extent of the investigation should correlate with anticipated risks. Some guidance in the form of best practices to give orientation (aspects to look at, depth of analysis, frequency, etc.) would be valuable. The outcome would ideally be quantitative, using tables, and visualised through maps in order to increase acceptance by utilities' management. Although a vulnerability assessment needs to consider physical security, cyber security and the insider threat of all assets, proposals in this report don't cover any of these aspects, as they require a different specialism to advise. The proposals are only concerned with the vulnerability of the drinking water itself.
3. Define protection level
    a. The target protection level will be an individual decision to be taken by the water utilities and should be established in proportion to other known hazards, other forms of vulnerability (i.e. physical, cyber, and insider) as well as other health risk-related guidelines. The standardisation of protection levels has not been identified as a

long-term target; however, criteria to help establish target protection levels will be made available.

4. Determine the protection level that can be achieved by use of existing resources
    a. As a first and most cost-efficient step to increase security and protection levels, the resources that already exist should be analysed and activated for protection purposes. Examples are existing water infrastructure's physical, cyber and insider protections, monitoring systems, data communication systems, available and skilled staff, strengthening of good practice, training and simulation exercises and the extension of processes that have already been implemented. This would allow water utilities to know what protection level they possess and also to consider if the protection level could be improved by a better use of the assets/software that are already part of the water utility. Resources, time and the budget for reaching the protection level target should be also taken into account.
5. Undertake a gap analysis
    a. Considering the existing protection level on the one hand, and the target protection level on the other hand, the vulnerability gap can be described, missing resources to close the gap be defined and a proposal/ plan be formulated.
6. Design of event detection and protection system
    a. Define parameters/data for the event detection system
    b. Analysis of tools for event detection: online and real-time sensors, software and communication tools
    c. Scenarios, selection, positioning and integration of sensors, simulation tools, visualisation, software and related infrastructure
    d. Automated data collection, validation, reporting and escalation program
    e. Automated data analysis, information and alarm program
    f. Integration into daily operation and existing communication systems
    g. Reach sustainability (training, recurring checks, audits)

The finding of other European projects (e.g. UPSIDE DOWN, SecurEau, SAFEWATER, ISIS…) will be taken into consideration.

7. Additional use of Water Security system to support general operation
    a. Security systems need to be integrated into daily operation to provide additional information related to water quality and thus be used for the improvement of general water quality management and daily operations
8. Prepare an emergency response plan

a. Such plans often exist, but need to be adapted according to the special characteristics of water security (events), especially in terms of necessary speed of response and communication management, possible high impact from contamination and alternatives to supplying drinking water from the distribution network. Clear logistics are important to enable fast action when such a plan needs to be executed.

6. Survey of national authorities

Legislation and Organisation

- Drinking water supply is considered a critical infrastructure by nearly all respondents, with one however reporting that drinking water supply was not a critical infrastructure.
- Most Member States reported that Health Ministries have primary responsibility for governing the quality of drinking water although responsibility is shared between other departments.
- Implementation of the provisions of legislation is often devolved to regional authorities.
- Legislation primarily governs water quality although some Member States have additional requirements for security of drinking water but in separate legislation.

Risk Assessment

- The security of drinking water is included in the national risk assessment in all responses.
- Several Member States restricted the requirement for a risk assessment to water treatment works exceeding a specified volume of production or population served. One national authority reported that surface water was viewed as more of a critical infrastructure compared to ground water
- Specifically, reference was made to Drinking Water Safety Plans (World Health Organization) or Hazard Analysis Critical Control Point concept (HACCP) as the vehicle for conducting a risk assessment or preparing an emergency response plan. In one instance, reference was made to a CEN Standard (EN 15975-2) on risk and crisis management. Implementation of measures by water utilities was undertaken either on a voluntary basis or through legislation depending on the national authority and tended to focus on the larger suppliers.
- One Member State reported that it was preparing guidance and factsheets with a software tool and considers sufficient information available to develop an effective response.

Drinking Water Security

- Most Member States reported that measures for protecting the security of drinking water took the form of an emergency response.

  The questionnaire did not seek to establish the components of the emergency response plan. It was not possible, therefore, to establish, the extent to which it covered provisions to maintain a supply in the event of a major disruption or to detect an act of deliberate or natural

contamination or measures in place to restore the safety of the drinking water supply.

- One member state reported that analysis of its national risk assessment has identified a number of areas requiring improvement and has established a national group to continually review the situation.

Support at the EU level

- A limited number of Member States reported that security could be considered within the framework of the Drinking Water Directive, although several other Member States reported their reluctance for additional legislation.
- Many Member States reported that they would benefit from guidance at EU level and could take the form of sharing best practice and practical tools.

7. Water quality monitoring strategies

The availability and suitability of online monitoring techniques to detect variations in water quality caused by intentional and unintentional contamination of drinking water distribution networks has been investigated. Two surveys, both based on a questionnaire, were conducted this year by the thematic group. The first survey was distributed to hundreds of European water utilities while the second one was globally distributed to over 260 sensor manufacturers.

Observations from the surveys are summarised in the following points:

- The response rate to both surveys was very low, 13 water utilities and 10 sensor manufacturers
- The majority of sensor manufacturers who responded, fulfil a niche market in water quality monitoring
- Filling gaps in terms of water quality parameters
- Operational expenses seem to be higher than presented by manufacturers
- On average, 55% of the responding water utilities use online sensors and monitors for both operational- and event monitoring
- Water utilities and sensor manufacturers are agreed on the most important user-related issue(s) with instrument operation and maintenance. These issues are:
    - Lack of available personnel;
    - Lack of skilled personnel;
    - Lack of IT (Information Technology) expertise or resources to develop or support information systems for collecting and acting on monitoring data;
    - Lack of integration options into plant / network operations (software, data processing, communications protocols);
- Benefit of the use of sensors and monitors is not always clear to operators

It is not clear why the response rate was low. Two possible explanations are:

- Reluctance to provide sensitive information. Water utilities are anxious about providing information on the measures they have taken to secure drinking water delivery.
- Overload of information and work, there is no motivation for water utilities to respond to this kind of survey.

To overcome these barriers employees of water utilities could be approached in person in the future to collect information needed. The drawback of such an approach is the effort needed (time and financial) to collect the information.

Beside the use of sensors and monitors for operational purposes water utilities are aware that the same data can be used for both compliance and security

monitoring. Within the "Real-time Water Quality Monitoring" Action Group (RTWQM-AG) of the European Innovation Partnership Water (EIP-Water, 2015) new monitoring strategies are under investigation. On request of the Commission the RTWQM-AG is involved as stakeholder for the revision of the following water related Directives:

- Drinking Water Directive (DWD)
- Water Framework Directive (WFD)
- Urban Wastewater Treatment Directive (UWTD)
- Water Reuse Directive (WRD)

As a result, the RTWQM AG produced two white papers reflecting possible ways to implement online monitoring for compliance water quality monitoring. The legislative bodies present at the stakeholder meetings supported the ideas presented and discussion took place on how the Directives could be adapted to allow online monitoring for compliance monitoring. In principle online monitoring is already allowed within the DWD. A barrier, however, is the way of reporting via the Water Information System Europe (WISE).

Drinking water data are not reported individually in the WISE system. However, when limit values are exceeded, this non-compliance must be reported. In the case of monthly sampling frequencies, an exceedance of a limit value for a certain parameter is quite clear. But when online monitoring data is collected, this may not be as straightforward as it might seem. Is each measurement which exceeds the threshold value in the DWD an exceedance and thus to be classified as non-compliance? If not, how many consecutive measurements above the limit value constitute a non-compliance? And what if a time series of online measurements shows ten measurements above the limit value, followed by five measurements below and then another ten above? Does this count as one non-compliance or as two?

There is a trend among water utilities to move from conventional laboratory analysis to online monitoring of more and more parameters. This means that for certain parameters, analysis results will be generated once every hour or even every minute instead of once a week or once a month. It is important to agree on an approach as to how to aggregate online monitoring data, so that the results to be reported to the national authorities (and in the end the European Commission) are meaningful and reflect the actual status of these parameters. A new definition of (non-)compliance might be necessary for online parameters. This currently hampers the use of online monitoring for legislative purposes under the DWD.

Important for adapting online monitoring for compliance issues is the need for validation of online monitoring equipment and strategies. The RTWQM-AG initiated this subject at the Environmental Monitoring Strategy Team which provides advice to the Strategic Advisory Body on Environment (SABE) of CEN. The following topics are under investigation at the moment:

- What should the performance requirements be for the measuring devices (MD)
- How to facilitate data collection, aggregation and structuring for interpretation and decision making
- What are the performance criteria for installation, Quality Assurance/Quality Control (QA/QC) (Commission Directive 2009/90/EC) of commissioning, calibration and on-going control of MDs to ensure reliable data.

The CEN/TC230 "Water analysis" group will perform a gap analysis on the existing standards (prEN 16479-2 (Uc+field test), EN ISO 15839, EN ISO/IEC 17025 and ISO/FDIS 14034) and will present a report on work to be done to cover these gaps early 2017.

The use of online monitoring for security purposes depends strongly on the implementation of online monitoring for operational and compliance purposes. Many actions have been initiated during this year as presented previously. No legislative actions are needed at this point in time for security matters. In fact there is a strong advice from the Member States (MS) to develop guidelines on how online monitoring can contribute to security issues, rather than legislation.

In summary, the monitoring strategies needed for operational, compliance, safety and/or security matters do not conflict. Actually, in principle these strategies look similar and even strengthen each other. The need to develop these strategies in parallel with a high crossover of information exchange is important to avoid legislative and operational conflicts in the future.

8. Conclusions and Recommendations regarding Water Security Plans

There are widespread and heterogeneous approaches for security of drinking water supply in the MS. Consequently, ERNCIP TG-Water recommends establishment of the Water Security Plan concept, building on best practices. The fulfilment of this Water Security Plan would inform the water utility about its vulnerabilities and improve operational management of drinking water safety on a daily basis. Finally, emergency response plans would be already available in case any contamination is detected and immediate action is needed. MS authorities support the production of guidance at the EU level to all water utilities to specifically consider its security risks, rather than establishing new legislation.

Online monitoring and event detection can be one of the measures to alert an operator at an early stage of contamination. However, online systems need to be integrated into daily operation so that systems intended for security control contribute to ensuring the safety of drinking water. In principle, online monitoring is already allowed within the DWD and would be undertaken regardless for operational monitoring. However, a barrier is the way of reporting via the Water Information System Europe (WISE) that is not in line with the data collected from online monitoring. Additionally, the reliability of data obtained from on-line sensors has to be ensured. This hampers the use of online monitoring for legislative purposes within the DWD.

The following areas are currently under investigation and would facilitate the operation of online systems.

- Performance requirements for measuring devices
- Quality Assurance/Quality Control (QA/QC) of commissioning, calibration and control of measuring devices to ensure reliability
- Harmonization of standards related to equipment and operation

Repeated low feedback rates of surveys suggest reluctance of stakeholders to communicate about security measures. Improved approaches in e.g. personal communications could contribute to supplement fragmentary information.

It is relevant to be in close contact with key organisations. Their expertise and global insight over the drinking water sector is central, especially to deal with security.

Presently, data formats are not compatible and harmonized protocols and data standards would establish proper communication between instruments. The process of treatment of data into information to support decision making has to be looked at.

As introduced in the concept of Water Security Plan, detection of events has to be seen in a broader context to identify the type and nature of contamination (by high end analytical procedures) and to take measures to ameliorate the situation.

9. Recommended next steps

It is recommended that:

1. Although some discussions suggest legislation may be a vehicle to transpose security measures, but national authorities seem to prefer guidance at the EU level rather than establishing new legislation. Guidance by means of a dedicated Water Security Plan would integrate security aspects in drinking water supply taking into account individual risks and capabilities of suppliers. Further specification is to be prepared by the ERNCIP TG-Water in 2017+.

2. Online monitoring is part of the WSecP consideration and takes into account event detection. At the same time, online monitoring can contribute to water quality control if integrated into daily operation.

3. For the same reason, there is a need for performance requirements for measuring devices, Quality Assurance/Quality Control (QA/QC)[5] of commissioning, calibration and control of measuring devices to ensure reliability. These need to be identified by the ERNCIP TG-Water in 2017 in order to produce a proposal.

4. The suggested Water Security Plan could be tested in few water utilities of different sizes, as a reference, in the frame of a European Demonstration Project.

5. Dialogue with end users and other stakeholders should be improved by means of encouraging direct contacts, discussion fora or by developing additional communication channels.

During the Water Safety and Security workshop in Brussels, the main conclusions reported in this paper were presented and the recommendations were discussed to validate the approach of a Water Security Plan. The key questions were:

1- Is guidance in form of a Water Security Plan aiming at addressing security of water utilities in an individual approach supported by the workshop?

2- Is it supported that online monitoring is a powerful tool to detect events, but needs to be integrated into daily operation to deploy its full potential to protect the water distribution? If so, is it supported that WISE needs to be compatible for online monitoring data acceptance?

3- Is it supported that ERNCIP should act as platform to take advantage of expertise gained in relevant EU projects and to initiate demonstration of the power of WSecP in practice?

10. Conclusions from the workshop

The presentation of the ERNCIP TG-Water activities on the Water Security Plan concept (see Annex I) was positively received by the stakeholders (including policy makers and other actors of the EU regulatory framework). Key outcomes are:

- It has to be taken into account that legislation on security is primarily a matter for Member States and not the Commission. However, the concept that a Water Security Plan is part of a Water Safety Plan will facilitate the implementation of the common aspects and the Commission could recommend to the Member States the adoption of the security measures within the Water Safety Plans already included in the DWD. Afterwards, utilities could be put under obligation by their national regulators to have a Water Security Plan.

- Sufficient attention should be given to the feasibility that the guideline is developed within the holistic framework of the anticipated refit of the Drinking Water Directive (DWD). It is suggested reconsider whether the issue of drinking water security should be properly evaluated for this refit.

- Relevance of guideline instead of legislation was discussed. Operators are clearly in favour of guidelines and EurEau, as the European association of water suppliers, has indicated that it will oppose any additional legislative initiative.

- EurEau are ready to collaborate with the TG-Water. The recent involvement of EurEau in a NATO initiative about Drinking Water Security was mentioned. ERNCIP is invited to take part to the next executive committee (2-3 February 2017, Lausanne).

- It is relevant to make a reference to the Commission Directive 2009/90/EC (related to Water Framework Directive 2000/60/EC). This Directive lays down technical specifications for chemical analysis and (online)-monitoring of water status. It establishes minimum performance criteria for methods of analysis to be applied by Member States. Moreover, the Commission adopted the Commission Directive (EU) 2015/1787 amending Annexes II and III to the Drinking Water Directive. These amendments allow a better and more problem-oriented monitoring and include online monitoring.
  In addition, international standards such as EN 15975 part 1 (crisis management) and 2 (risk management) should be taken into consideration

- It was mentioned that water security is in cascade with other sectors such as energy since a major malicious attack may affect several sectors simultaneously. A common approach for a Security Plan might be considered.

- The Water Information System for Europe (WISE) gateway comprises a wide range of data and information collected by EU institutions. However this network may not be suitable as it does only concern exceedance of limit values for the parameter mentioned in the Drinking Water Directive.

- The concept of a demonstration project captured the audience's interest. The objectives must be more precisely defined to test the proposed technologies within a Water Security Plan. Some needs were expressed and might be taken into account:
  (i) the implementation of event detection system to monitor remotely the drinking water quality in water systems should be easy to put into practical use (but not in term of technology). Simple, low-cost, sustainable and maintenance-friendly solutions are still missing
  (ii) the assessment of the performance and reliability of sensors (especially for quantitative analysis) as well as the improvement of low-energy sensors
  (iii) the assessment of procedures for approval of alternative measuring techniques (such as online monitoring). Currently, EU procedures for approval by MS are quite elaborate, time consuming and costly.
  (iv) the validation of natural events as well as malicious acts in parallel for rural and urban areas (since risks and access to water assets are not the same)
  (v) the assessment of software dedicated to sensors location optimisation and false-alarm management
  (vi) the compatibility between the proposed Water Security Plan and existing standards related to risk and crisis management (CEN and ISO)

  However, the ERNCIP may not be the appropriate platform to run such a project.
- NEN (Nederlands Normalisatie-instituut) reminded that they can (i) be consulted as often as necessary with all issues related to European standardization and (ii) attend TG-Water meetings (in Brussels) when specific standardisation skill is required.

- Stronger participation of all stakeholders (end-users, manufacturers, citizen …) at early stage of actions was raised. It was reminded that ERNCIP is a trustworthy network to communicate.

- More Workshops like this one would be valuable to clarify water security issues (especially in terms of research) in order to inform the European Commission about the needs.

- To conclude, the visibility of the ERNCIP TG-Water was strengthened and its recommendations for a Water Security Plan as part of a Water Safety Plan were validated, as well as the need for efficient and integrated online monitoring. Implementation of such a concept has now to be clarified through concrete actions to be included in the work programme for the next two years, relying on the stakeholders' concerns reported above.

11. References

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12. Abbreviations

CEN: European Committee for Standardization

CIP: Critical Infrastructure protection

DWD: Drinking Water Directive

DWTP: Drinking Water Treatment Plant

ERNCIP: European Reference Network for Critical Infrastructure Protection

EC: European Commission

EU: European Union

ISO: International Organization for Standardization

JPI-Water: Joint Programming Initiative on Water

JRC: Joint Research Centre

MS: Member State

NATO: North Atlantic Treaty Organization

RTWQM-AG: Real-time Water Quality Monitoring Action Group

TG-Water: Thematic Group on Chemical and Biological risks to drinking water

WFD: Water Framework Directive

WHO: World Health Organisation

WISE: Water Information System Europe

WSecP: Water Security Plan

13. Annex I


The European Commission's science and knowledge service
Joint Research Centre
Water Safety and Security
Brussels, 11th-12th December 2016
European Reference Network for Critical Infrastructure Protection
Thematic Group on Chemical and Biological Risks to Drinking Water
Philipp HOHENBLUM
Environment Agency – Austria
Thematic Group Coordinator
erncip
European Commission


TG Water
active since April 2012
Environment Agency Austria (coordination)
CEA SBTN Marcoule, Bagnols-sur-Cèze (FR)
University de Lorraine - Nancy (FR)
Fraunhofer-IOSB and IGB (DE)
Robert Koch Institute (DE)
Water Research Centre plc (UK)
Benten Water Ltd. (NL)
ICRA Catalunya (ES)
Austrian Agency for Health and Food Safety
Lyonnaise des Eaux (FR)
Aguas do Algarve (PT)
CETAQUA (ES)
Aigües de Barcelona (ES)
S:CAN (AT, ES)
ADASA Sistemas (ES)
Voluntary membership with signed agreements
TG Chemical and Biological (CB) Risks to Drinking Water
2
erncip
European Commission

1

Incidents

Baia Mare (Romania, 2000)
- Tons of cyanide spilled into Tisza River and Danube
- High and immediate impact
- Availability of huge amounts of toxic materials?

Hochsauerland (Germany, 2006)
- Contaminated agricultural area
- PFOS in drinking water

Nokia (Finland, 2007)
- Accidental waste water discharge into drinking water network
- Stealth contamination
- Human factor? Recognition of problem?

Extreme weather, Availability toxic material

Control ?

Human factor

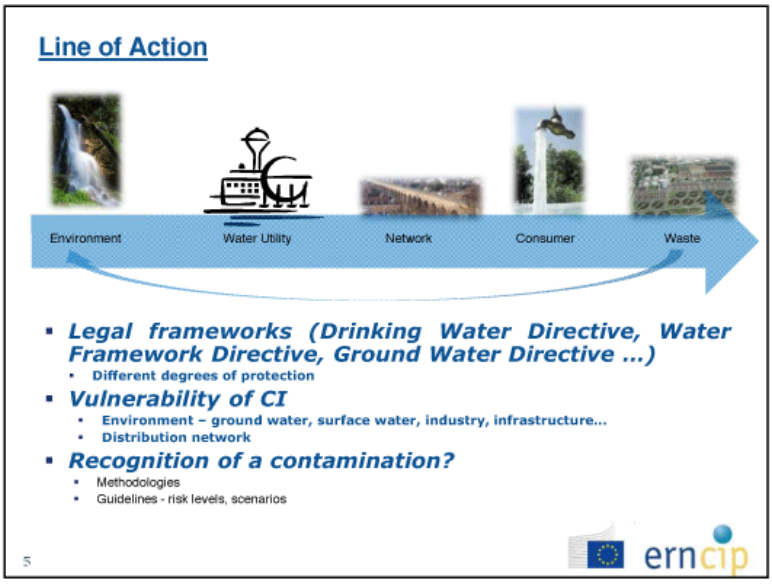
3 erncip European Commission

Purpose of TG Work

- Addressing **chemical and biological risks** rather than physical protection of the infrastructure
- Hazards of **low probability, but very high impact**
- devoted to **improving the control of water security**

4 erncip European Commission

2


Line of Action
Environment
Water Utility
Network
Consumer
Waste
Legal frameworks (Drinking Water Directive, Water Framework Directive, Ground Water Directive ...)
Different degrees of protection
Vulnerability of CI
Environment – ground water, surface water, industry, infrastructure...
Distribution network
Recognition of a contamination?
Methodologies
Guidelines - risk levels, scenarios
5
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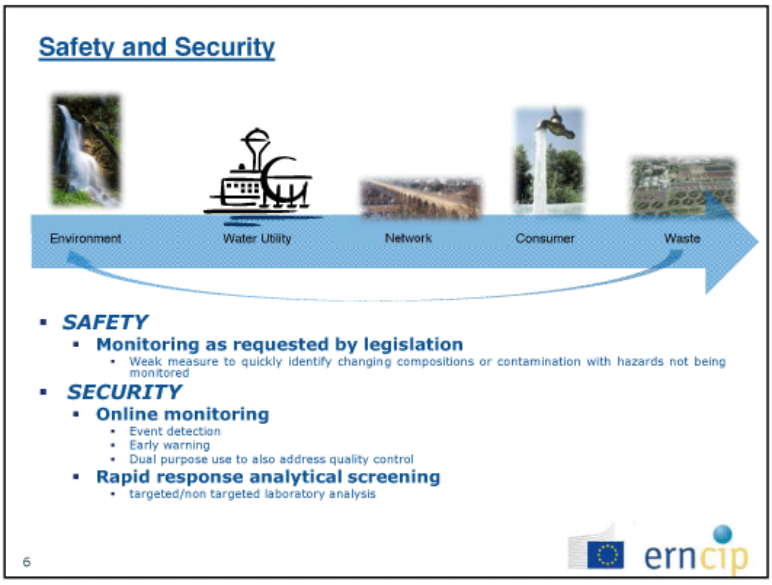
Safety and Security
Environment
Water Utility
Network
Consumer
Waste
SAFETY
Monitoring as requested by legislation
Weak measure to quickly identify changing compositions or contamination with hazards not being monitored
SECURITY
Online monitoring
Event detection
Early warning
Dual purpose use to also address quality control
Rapid response analytical screening
targeted/non targeted laboratory analysis
6
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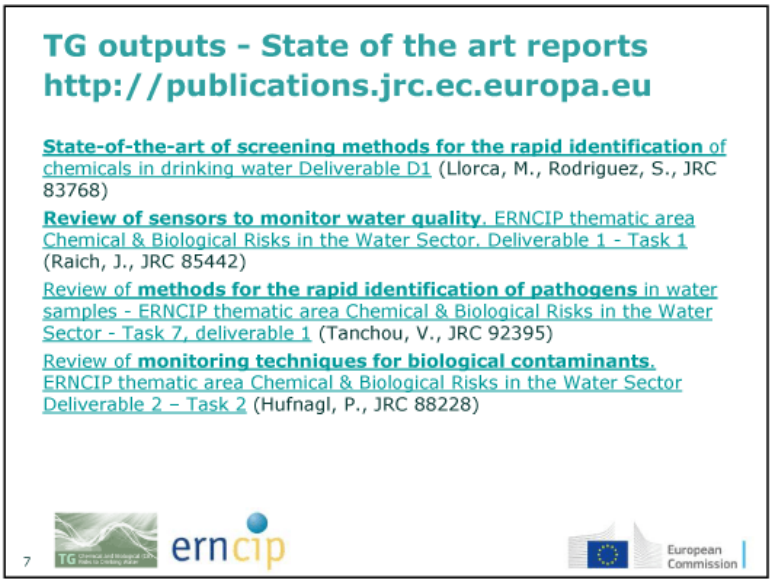
TG outputs - State of the art reports
http://publications.jrc.ec.europa.eu
State-of-the-art of screening methods for the rapid identification of chemicals in drinking water Deliverable D1 (Llorca, M., Rodriguez, S., JRC 83768)
Review of sensors to monitor water quality. ERNCIP thematic area Chemical & Biological Risks in the Water Sector. Deliverable 1 - Task 1 (Raich, J., JRC 85442)
Review of methods for the rapid identification of pathogens in water samples - ERNCIP thematic area Chemical & Biological Risks in the Water Sector - Task 7, deliverable 1 (Tanchou, V., JRC 92395)
Review of monitoring techniques for biological contaminants. ERNCIP thematic area Chemical & Biological Risks in the Water Sector Deliverable 2 – Task 2 (Hufnagl, P., JRC 88228)
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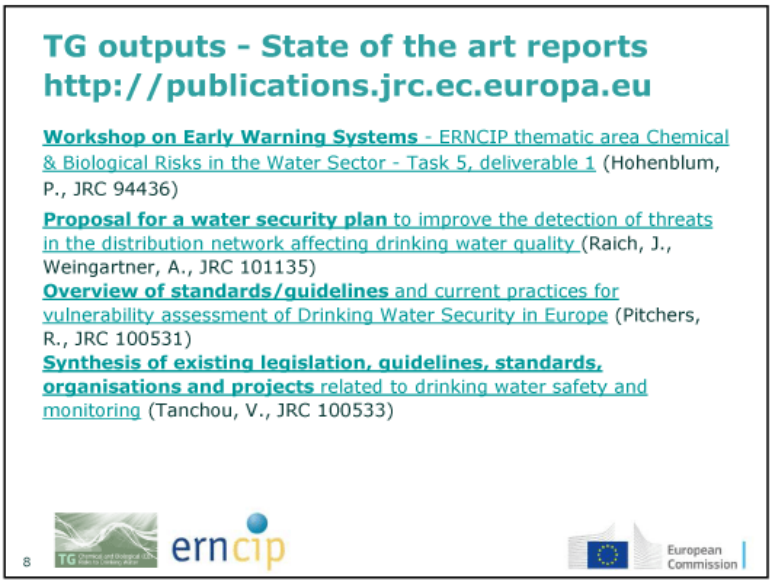
TG outputs - State of the art reports
http://publications.jrc.ec.europa.eu
Workshop on Early Warning Systems - ERNCIP thematic area Chemical & Biological Risks in the Water Sector - Task 5, deliverable 1 (Hohenblum, P., JRC 94436)
Proposal for a water security plan to improve the detection of threats in the distribution network affecting drinking water quality (Raich, J., Weingartner, A., JRC 101135)
Overview of standards/guidelines and current practices for vulnerability assessment of Drinking Water Security in Europe (Pitchers, R., JRC 100531)
Synthesis of existing legislation, guidelines, standards, organisations and projects related to drinking water safety and monitoring (Tanchou, V., JRC 100533)
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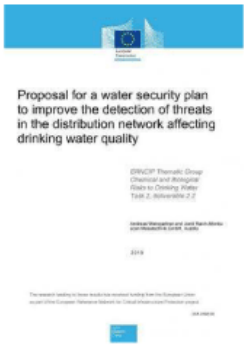
Water Security Plan

Key recommendation

- **Development of guidance to prepare a Water Security Plan**
- **devoted to improving the control of water security**
- **responding to deliberate acts of contamination**
- **whilst helping to protect against the effects of natural disasters or accidents**
- **Integration into daily business**
- **Complementary approach to existing water safety plans**



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TG approach

Technical surveys addressing

- **Sensor manufacturers and water utilities**
- **Water quality monitoring strategy as part of a security plan**
- Presentation by Bram van der GAAG

- **National authorities responsible for control of drinking water quality and critical infrastructure protection**
- Presentation by Robert PITCHERS

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TG approach
Desk Studies
Overview of standards, guidelines and current practices for vulnerability assessment
Presentation by Valérie TANCHOU
Recommendations regarding water security plans
Water Security Plan
Presentation by Andreas Weingartner
Recommendations
Presentation by Philipp Hohenblum
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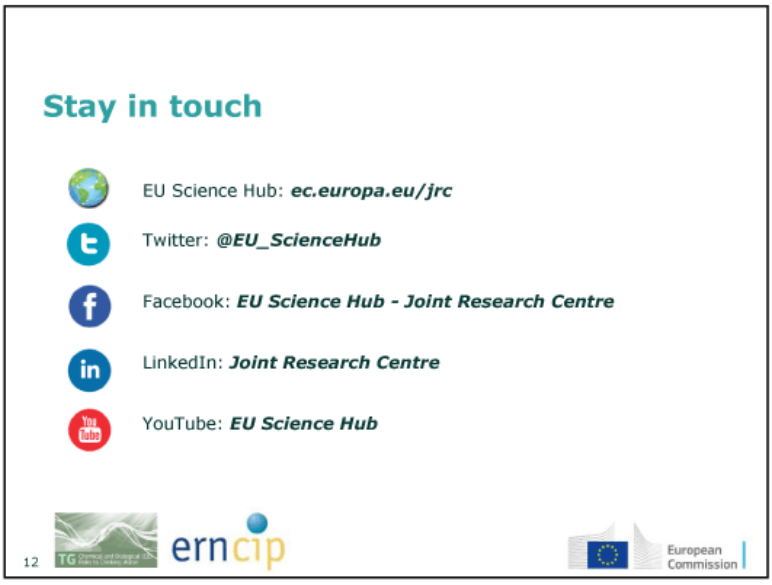
Stay in touch
EU Science Hub: ec.europa.eu/jrc
Twitter: @EU_ScienceHub
Facebook: EU Science Hub - Joint Research Centre
LinkedIn: Joint Research Centre
YouTube: EU Science Hub
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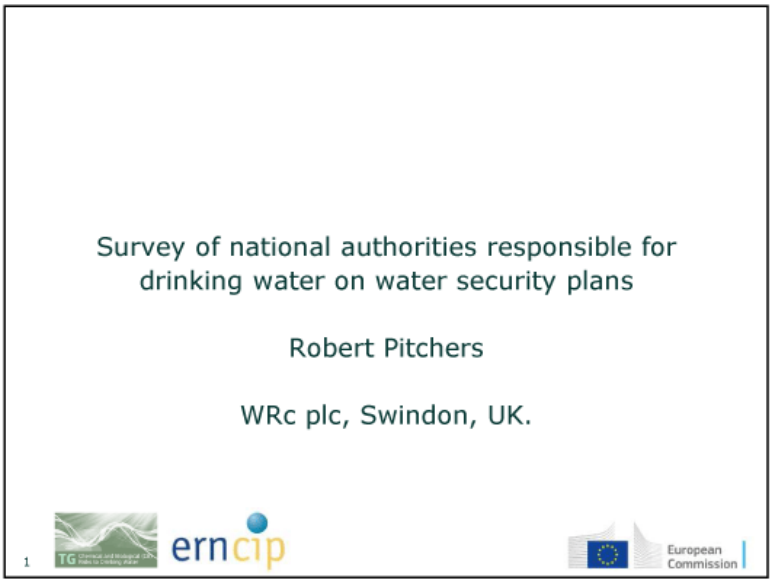
Survey of national authorities responsible for drinking water on water security plans
Robert Pitchers
WRc plc, Swindon, UK.
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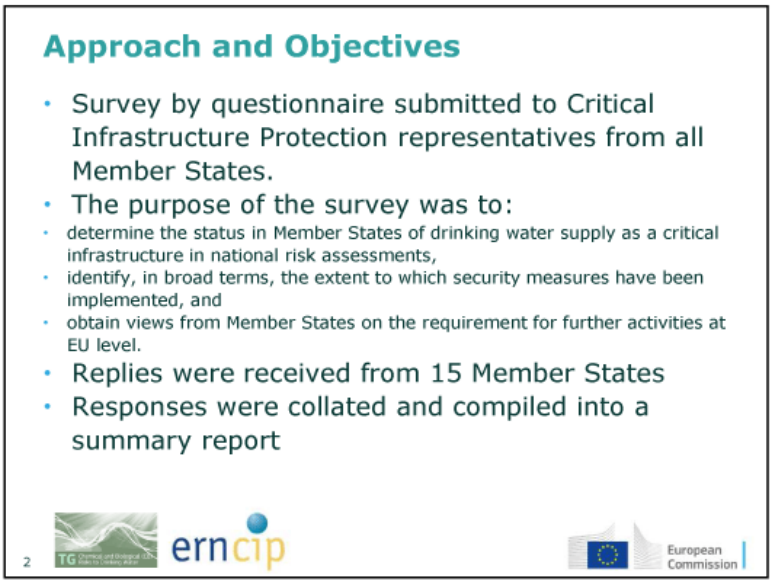
Approach and Objectives
Survey by questionnaire submitted to Critical Infrastructure Protection representatives from all Member States.
The purpose of the survey was to:
determine the status in Member States of drinking water supply as a critical infrastructure in national risk assessments,
identify, in broad terms, the extent to which security measures have been implemented, and
obtain views from Member States on the requirement for further activities at EU level.
Replies were received from 15 Member States
Responses were collated and compiled into a summary report
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Legislation and Organisation
• Drinking water is considered a critical infrastructure by nearly all respondents.
• Most Member States reported that Health Ministries have primary responsibility for governing the quality of drinking water although responsibility is sometimes shared between other departments.
• Implementation of the provisions of legislation is often devolved to regional authorities.
• Legislation primarily governs water quality although some Member States have additional requirements for security of drinking water but in separate legislation.
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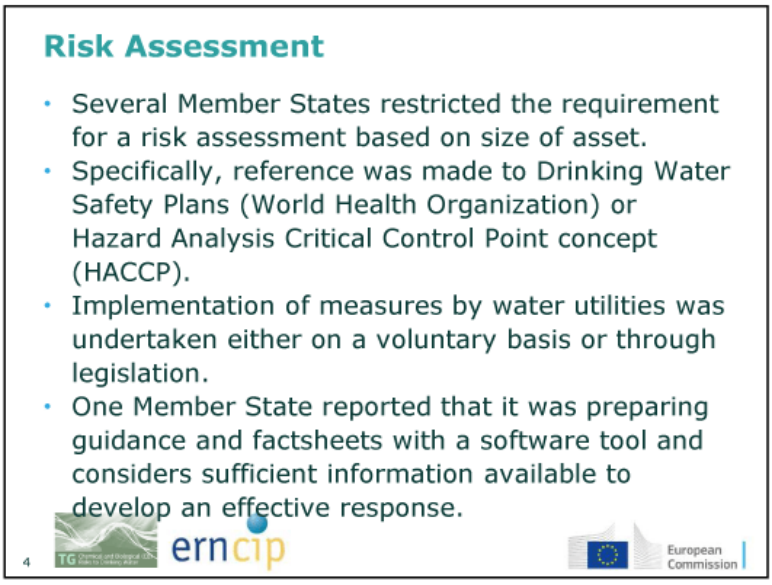
Risk Assessment
• Several Member States restricted the requirement for a risk assessment based on size of asset.
• Specifically, reference was made to Drinking Water Safety Plans (World Health Organization) or Hazard Analysis Critical Control Point concept (HACCP).
• Implementation of measures by water utilities was undertaken either on a voluntary basis or through legislation.
• One Member State reported that it was preparing guidance and factsheets with a software tool and considers sufficient information available to develop an effective response.
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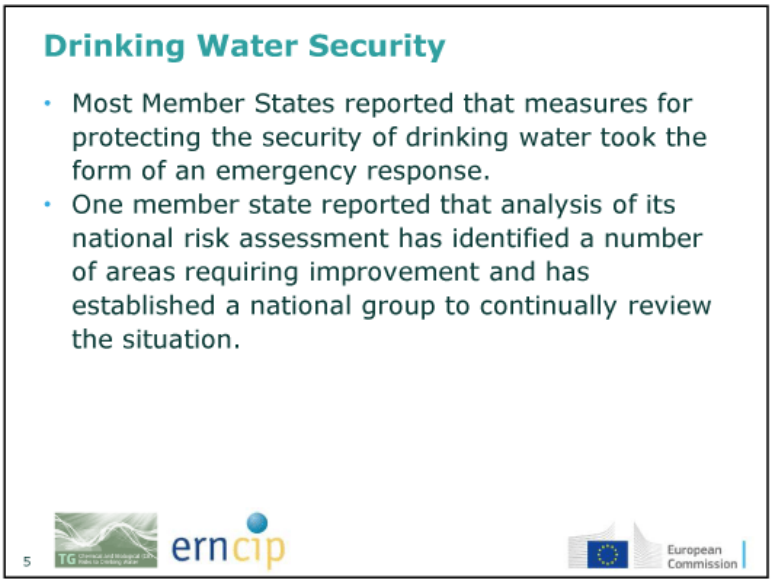
Drinking Water Security
Most Member States reported that measures for protecting the security of drinking water took the form of an emergency response.
One member state reported that analysis of its national risk assessment has identified a number of areas requiring improvement and has established a national group to continually review the situation.
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Support at the EU level
A limited number of Member States reported that security could be considered within the framework of the Drinking Water Directive, although other Member States reported their reluctance for additional legislation.
Many Member States reported that they would benefit from guidance at EU level and could take the form of sharing best practice and practical tools.
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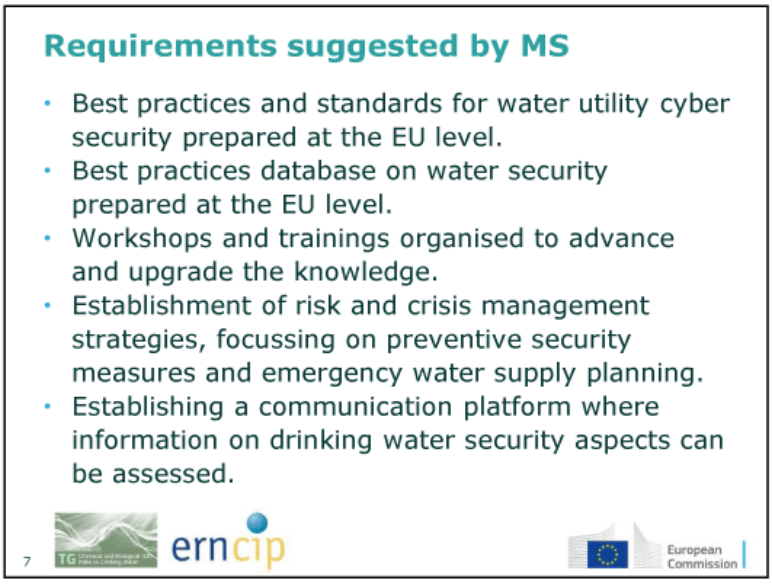
Requirements suggested by MS
Best practices and standards for water utility cyber security prepared at the EU level.
Best practices database on water security prepared at the EU level.
Workshops and trainings organised to advance and upgrade the knowledge.
Establishment of risk and crisis management strategies, focussing on preventive security measures and emergency water supply planning.
Establishing a communication platform where information on drinking water security aspects can be assessed.
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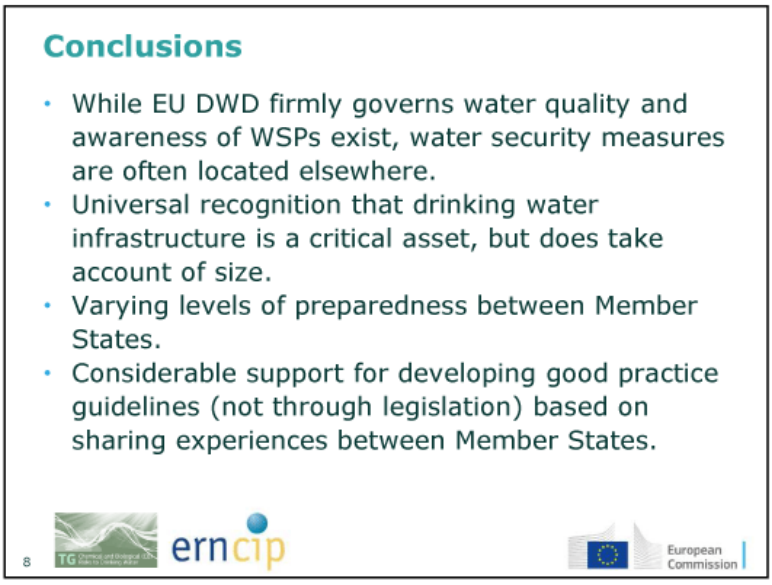
Conclusions
While EU DWD firmly governs water quality and awareness of WSPs exist, water security measures are often located elsewhere.
Universal recognition that drinking water infrastructure is a critical asset, but does take account of size.
Varying levels of preparedness between Member States.
Considerable support for developing good practice guidelines (not through legislation) based on sharing experiences between Member States.
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The European Commission's science and knowledge service
Joint Research Centre
Water Safety and Security
Brussels, 11th-12th December 2016
"SYNTHESIS OF EXISTING LEGISLATION AND CURRENT ACTIVITIES RELATED TO DRINKING WATER SAFETY AND MONITORING"
Valérie TANCHOU
CEA – France
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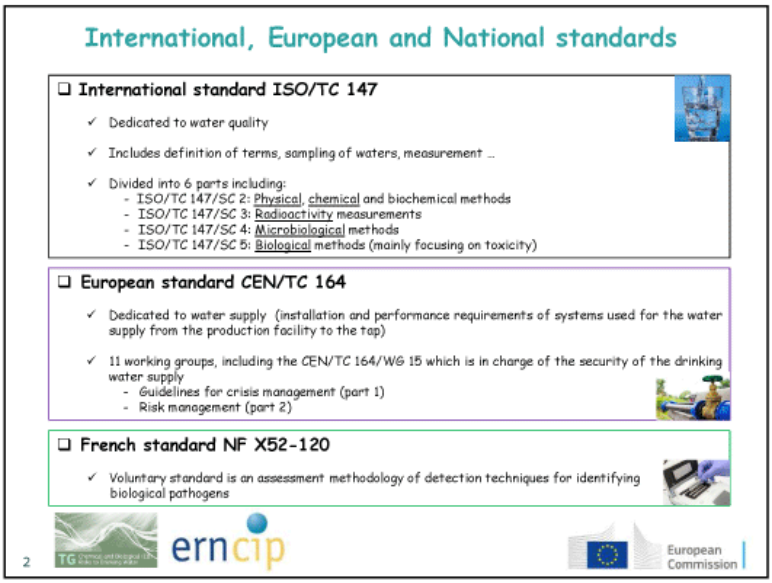
International, European and National standards
International standard ISO/TC 147
Dedicated to water quality
Includes definition of terms, sampling of waters, measurement ...
Divided into 6 parts including:
- ISO/TC 147/SC 2: Physical, chemical and biochemical methods
- ISO/TC 147/SC 3: Radioactivity measurements
- ISO/TC 147/SC 4: Microbiological methods
- ISO/TC 147/SC 5: Biological methods (mainly focusing on toxicity)
European standard CEN/TC 164
Dedicated to water supply (installation and performance requirements of systems used for the water supply from the production facility to the tap)
11 working groups, including the CEN/TC 164/WG 15 which is in charge of the security of the drinking water supply
- Guidelines for crisis management (part 1)
- Risk management (part 2)
French standard NF X52-120
Voluntary standard is an assessment methodology of detection techniques for identifying biological pathogens
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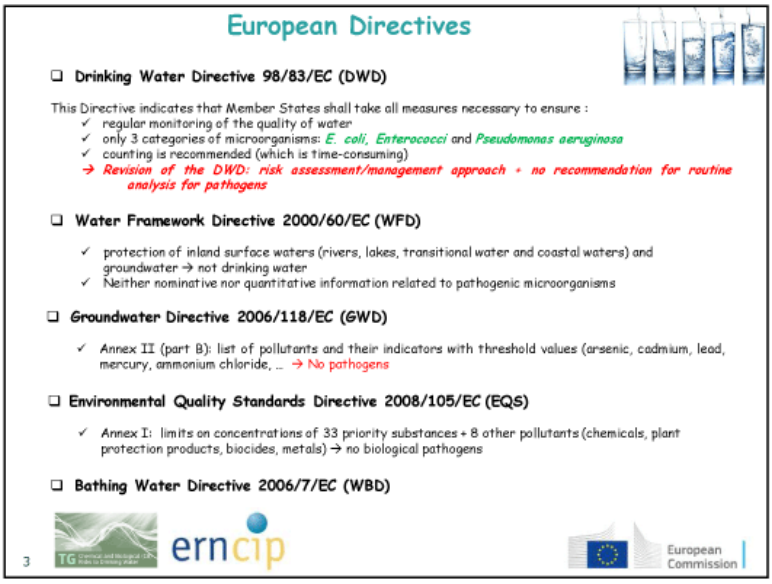
European Directives
Drinking Water Directive 98/83/EC (DWD)
This Directive indicates that Member States shall take all measures necessary to ensure :
regular monitoring of the quality of water
only 3 categories of microorganisms: E. coli, Enterococci and Pseudomonas aeruginosa
counting is recommended (which is time-consuming)
→ Revision of the DWD: risk assessment/management approach + no recommendation for routine analysis for pathogens
Water Framework Directive 2000/60/EC (WFD)
protection of inland surface waters (rivers, lakes, transitional water and coastal waters) and groundwater → not drinking water
Neither nominative nor quantitative information related to pathogenic microorganisms
Groundwater Directive 2006/118/EC (GWD)
Annex II (part B): list of pollutants and their indicators with threshold values (arsenic, cadmium, lead, mercury, ammonium chloride, … → No pathogens
Environmental Quality Standards Directive 2008/105/EC (EQS)
Annex I: limits on concentrations of 33 priority substances + 8 other pollutants (chemicals, plant protection products, biocides, metals) → no biological pathogens
Bathing Water Directive 2006/7/EC (WBD)
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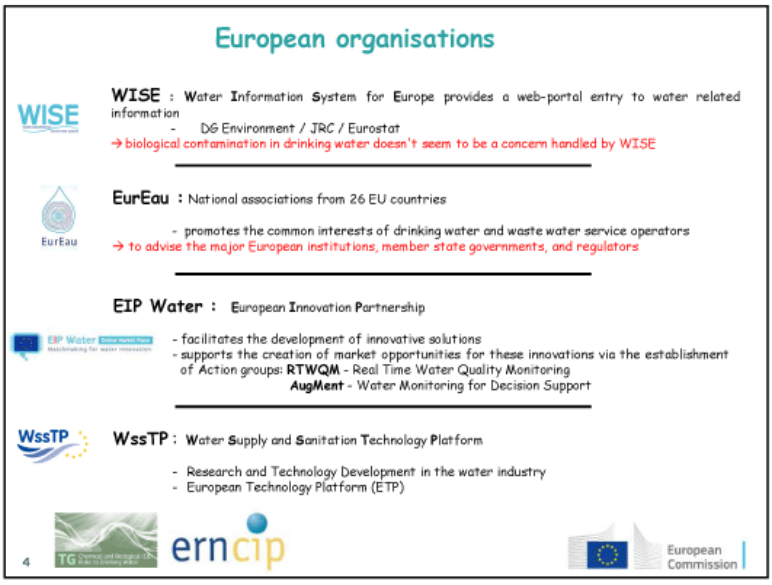
European organisations
WISE
WISE : Water Information System for Europe provides a web-portal entry to water related information
- DG Environment / JRC / Eurostat
→ biological contamination in drinking water doesn't seem to be a concern handled by WISE
EurEau
EurEau : National associations from 26 EU countries
- promotes the common interests of drinking water and waste water service operators
→ to advise the major European institutions, member state governments, and regulators
EIP Water : European Innovation Partnership
- facilitates the development of innovative solutions
- supports the creation of market opportunities for these innovations via the establishment of Action groups: RTWQM - Real Time Water Quality Monitoring
AugMent - Water Monitoring for Decision Support
WssTP
WssTP : Water Supply and Sanitation Technology Platform
- Research and Technology Development in the water industry
- European Technology Platform (ETP)
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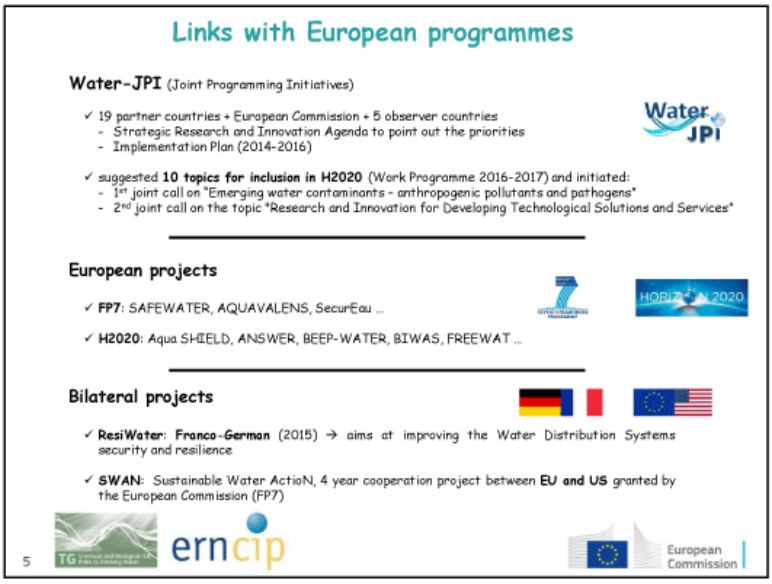
Links with European programmes
Water-JPI (Joint Programming Initiatives)
✓ 19 partner countries + European Commission + 5 observer countries
- Strategic Research and Innovation Agenda to point out the priorities
- Implementation Plan (2014-2016)
✓ suggested 10 topics for inclusion in H2020 (Work Programme 2016-2017) and initiated:
- 1st joint call on "Emerging water contaminants – anthropogenic pollutants and pathogens"
- 2nd joint call on the topic "Research and Innovation for Developing Technological Solutions and Services"
European projects
✓ FP7: SAFEWATER, AQUAVALENS, SecurEau ...
✓ H2020: Aqua SHIELD, ANSWER, BEEP-WATER, BIWAS, FREEWAT ...
Bilateral projects
✓ ResiWater: Franco-German (2015) → aims at improving the Water Distribution Systems security and resilience
✓ SWAN: Sustainable Water ActioN, 4 year cooperation project between EU and US granted by the European Commission (FP7)
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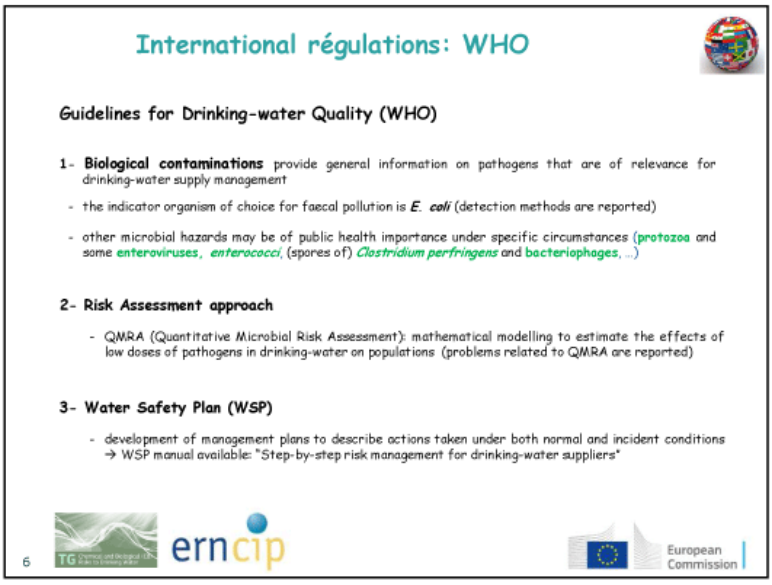
International régulations: WHO
Guidelines for Drinking-water Quality (WHO)
1- Biological contaminations provide general information on pathogens that are of relevance for drinking-water supply management
- the indicator organism of choice for faecal pollution is E. coli (detection methods are reported)
- other microbial hazards may be of public health importance under specific circumstances (protozoa and some enteroviruses, enterococci, (spores of) Clostridium perfringens and bacteriophages, ...)
2- Risk Assessment approach
- QMRA (Quantitative Microbial Risk Assessment): mathematical modelling to estimate the effects of low doses of pathogens in drinking-water on populations (problems related to QMRA are reported)
3- Water Safety Plan (WSP)
- development of management plans to describe actions taken under both normal and incident conditions
→ WSP manual available: "Step-by-step risk management for drinking-water suppliers"
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International regulations: US (SDWA)

SDWA: Safe Drinking Water Act

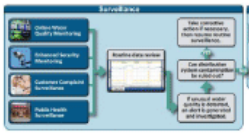
EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers for implementation

✓ **Analytical method procedures**

✓ **Science and technology**

- **Contaminants of Emerging Concern**
- **Monitoring and Assessing Water Quality**: Water quality data are stored and used to characterize waters in US
- **Research** (Microbial (and chemical) risk research) → Newsletter
- **Risk assessment**: development of a software to assist utilities owners and operators in understanding and assessing potential climate change (CREAT, Climate Resilience Evaluation and Awareness Tool)

✓ **Homeland Security: water and wastewater**



- to conduct a risk assessment
- to develop emergency response plans -> Water and Wastewater Agency Response Network (WARN)
- to develop a Water Utility Training and Exercise Plan
- to implement a Surveillance and Response Systems (SRS) for Distribution System Monitoring and Management

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International regulations: Australia

Australian Drinking Water Guidelines (ADWG)

✓ very complete guidelines and fact sheets (more than 1300 pages) based on:

- 12 elements such as operational procedures and process control, management of incidents and emergencies, research and development ...
- risk assessment and preventive measures
- a National Plan For Water Security (modernising irrigation, upgrading water information)

Waterborne pathogens reported - example for bacteria:

- excreted pathogens: *Salmonella spp, Shigella spp, enterovirulent E. coli, Vibrio cholera, Yersinia enterocolitica, Campylobacter jejuni* and *E. coli*,
- pathogens growing in water supplies: *Pseudomonas aeruginosa*, species of *Klebsiella* and *Aeromonas*, and certain slow-growing mycobacteria
- *Legionella pneumophila* (inducing serious illness resulting from inhalation of water)

→ Very detailed fact sheets are available (one per microorganism) BUT only the monitoring for *E. coli* within the distribution system is indicated (*no E. coli* in a minimum of 100 mL)

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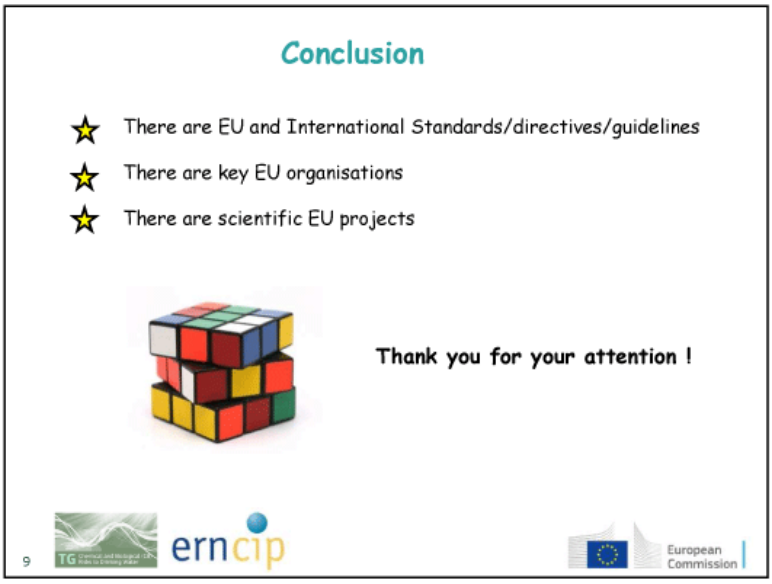
Conclusion
There are EU and International Standards/directives/guidelines
There are key EU organisations
There are scientific EU projects
Thank you for your attention !
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5


The European Commission's science and knowledge service
Joint Research Centre
Water Safety and Security
Brussels, 11th-12th December 2016
European Reference Network for Critical Infrastructure Protection
Thematic Group on Chemical and Biological Risks to Drinking Water
Philipp HOHENBLUM
Environment Agency – Austria
Thematic Group Coordinator
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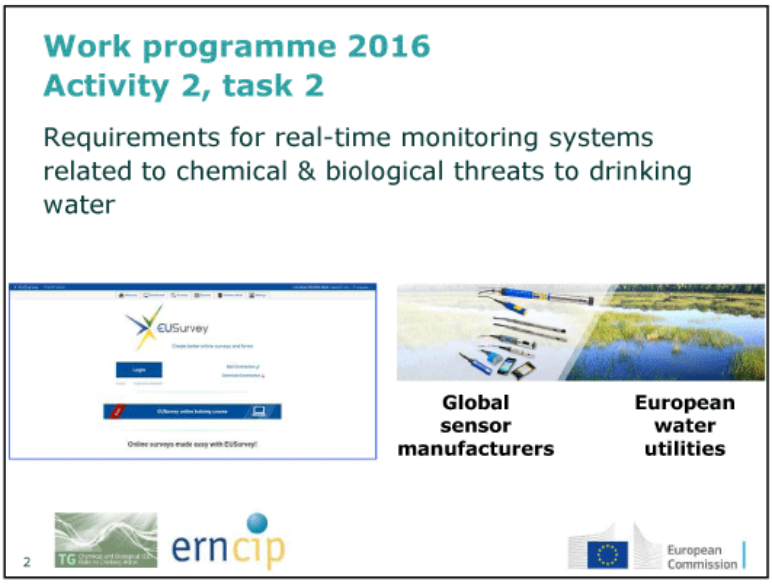
Work programme 2016
Activity 2, task 2
Requirements for real-time monitoring systems related to chemical & biological threats to drinking water
EUSurvey
Global sensor manufacturers
European water utilities
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Questionnaire

- The first question was: If your company uses/produces online sensors or monitoring equipment(s) as part of an early warning system, please tick the boxes of the parameters involved as an indicator of either a microbial or chemical contamination (49 parameters and possibility to add other)
- The second set of questions investigated maintenance features of the early warning system
- The third set of questions investigated which products or services a sensor manufacturer delivers or supports according to the Water Utilities and the Sensor Manufacturers themselves. (23 products and services in total)

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Distribution

- Sensor manufacturers
  - Over 260 international sensor manufacturers;
- Water Utilities
  - EIP-Water- and the "Real Time Water Quality Monitoring" Action Group (RTWQM-AG) website;
  - Members of the RTWQM-AG distributed the invitation to their personal contacts
    - FP7 and H2020 projects;
  - Members of the TG-Water of ERNCIP distributed the invitation to their personal contacts;
  - The invitation was sent to DG-Environment and DG-Home for distribution
  - SWIG in the UK distributed the invitation to their members;
  - The Austrian Association for Gas and Water distributed the invitation to their members;
  - The invitation was send to the EUREAU-network
  - German Technical and Scientific Association for Gas and Water (DVGW);
  - The WIPAC LinkedIn page (Water Industry Process Automation & Control).

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Observations (1)

- The response rate to both surveys was very low, 14 water utilities and 9 sensor manufacturers
- Majority of sensor manufacturers reacted fulfil a niche market
  - They fill gaps in terms of parameters
- Generally, operational expenses seem to be higher than presented by manufacturers
- Those that responded tend to be active to use online sensors and monitors for both operational- and event monitoring, (55% of the responding water utilities)

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Observations (2)

- Water utilities and sensor manufacturers agreed on the most important user-related issue(s) with instrument operation and maintenance. These issues are:
  - Lack of available personnel;
  - Lack of skilled personnel;
  - Lack of IT (Information technology) expertise or resources to develop or support information systems for collecting and acting on monitoring data;
  - Lack of integration options into plant / network operations (software, data processing, communications protocols);
- Benefit of the use of sensors and monitors is not always clear to operators

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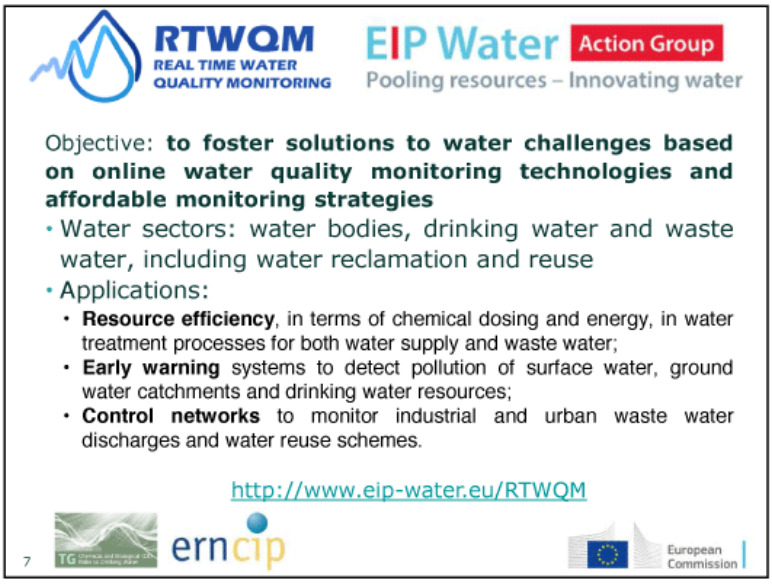
RTWQM
REAL TIME WATER QUALITY MONITORING
EIP Water
Action Group
Pooling resources – Innovating water
Objective: to foster solutions to water challenges based on online water quality monitoring technologies and affordable monitoring strategies
• Water sectors: water bodies, drinking water and waste water, including water reclamation and reuse
• Applications:
• Resource efficiency, in terms of chemical dosing and energy, in water treatment processes for both water supply and waste water;
• Early warning systems to detect pollution of surface water, ground water catchments and drinking water resources;
• Control networks to monitor industrial and urban waste water discharges and water reuse schemes.
http://www.eip-water.eu/RTWQM
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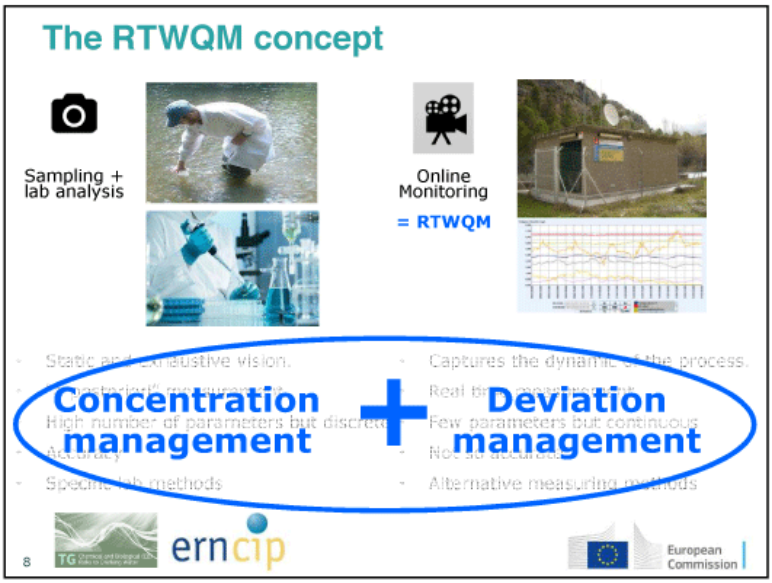
The RTWQM concept
Sampling + lab analysis
Online Monitoring
= RTWQM
Concentration management
+
Deviation management
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Drinking Water Directive consultation

How can European water legislation be formulated in such a way that it does not hamper or block the use of innovative (online) monitoring technologies which can contribute significantly to achieving the directives' goals?

Water Safety Plans as proposed by WHO

Location	Purpose	Examples of parameters/technologies
Catchment	WSP monitoring	Risk assessment on the basis of upstream industrial/agricultural activities or intentional contamination
	Early warning	Online biomonitoring for the detection of pesticides; online alpha or beta radiation detection
Treatment	WSP monitoring Process optimisation	Risk assessment of treatment process Colour, DOC
Distribution	WSP monitoring	Microbiological aftergrowth in network; risk assessment of intentional contamination
	Early warning	Refractive index, conductivity, pH; online alpha or beta radiation detection
Tap	Compliance monitoring	*E. coli*, pesticides, nitrate

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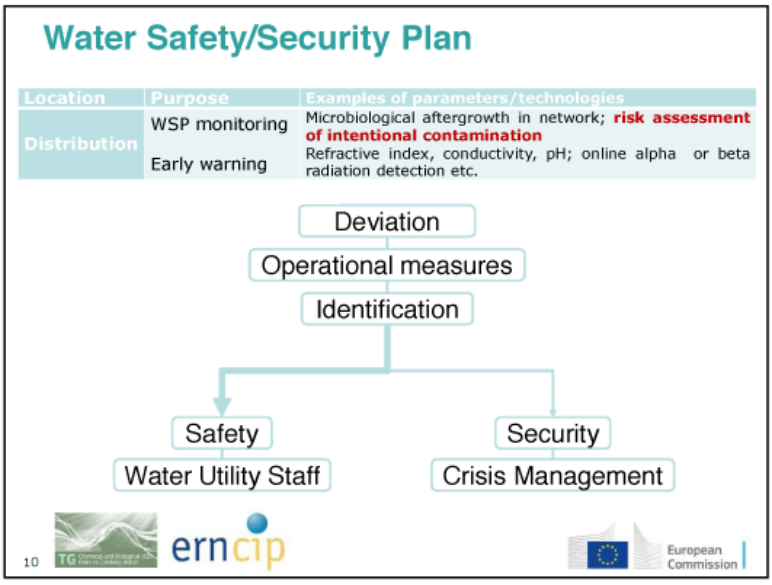

Water Safety/Security Plan

Location	Purpose	Examples of parameters/technologies
Distribution	WSP monitoring	Microbiological aftergrowth in network; **risk assessment of intentional contamination**
	Early warning	Refractive index, conductivity, pH; online alpha or beta radiation detection etc.

Deviation
Operational measures
Identification
Safety
Water Utility Staff
Security
Crisis Management

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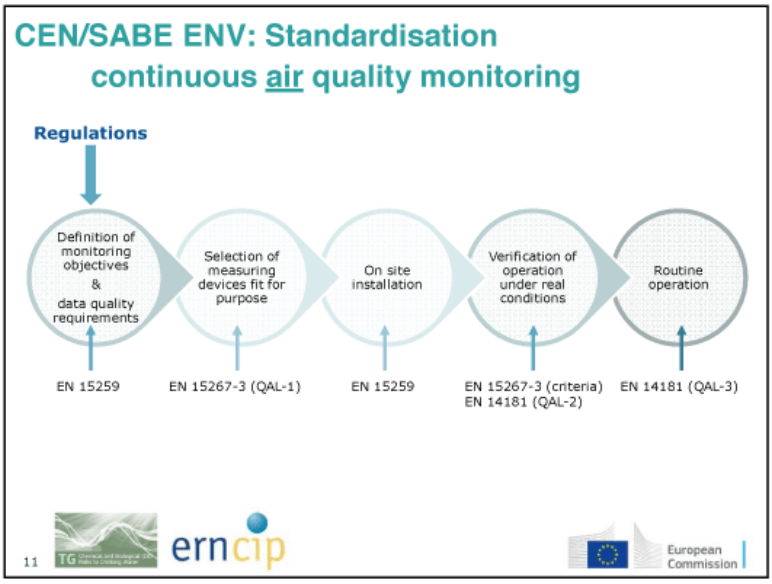
CEN/SABE ENV: Standardisation
continuous air quality monitoring
Regulations
Definition of monitoring objectives & data quality requirements
Selection of measuring devices fit for purpose
On site installation
Verification of operation under real conditions
Routine operation
EN 15259
EN 15267-3 (QAL-1)
EN 15259
EN 15267-3 (criteria)
EN 14181 (QAL-2)
EN 14181 (QAL-3)
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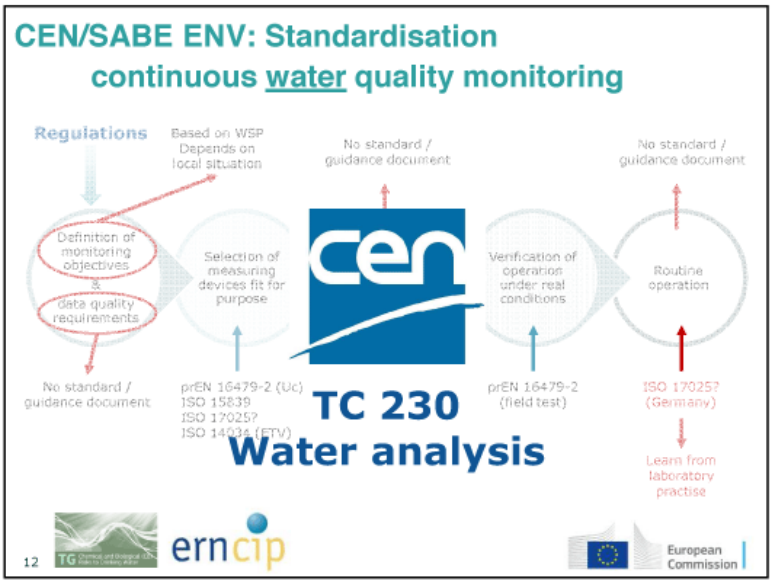
CEN/SABE ENV: Standardisation
continuous water quality monitoring
Regulations
Based on WSP
Depends on local situation
No standard / guidance document
No standard / guidance document
Definition of monitoring objectives & data quality requirements
Selection of measuring devices fit for purpose
Verification of operation under real conditions
Routine operation
No standard / guidance document
prEN 16479-2 (Uc)
ISO 15839
ISO 17025?
ISO 14034 (ETV)
prEN 16479-2 (field test)
ISO 17025? (Germany)
Learn from laboratory practise
TC 230
Water analysis
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THANK YOU
FOR YOUR ATTENTION
Any questions or remarks?
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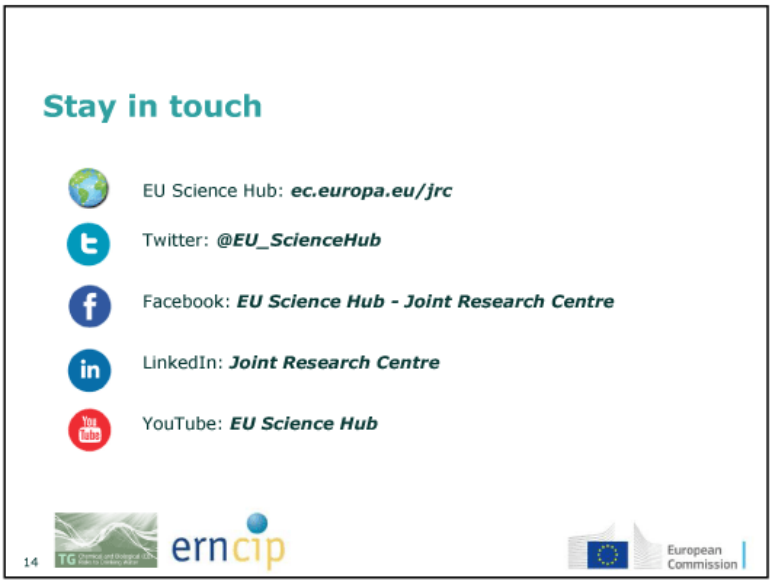
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Twitter: @EU_ScienceHub
Facebook: EU Science Hub - Joint Research Centre
LinkedIn: Joint Research Centre
YouTube: EU Science Hub
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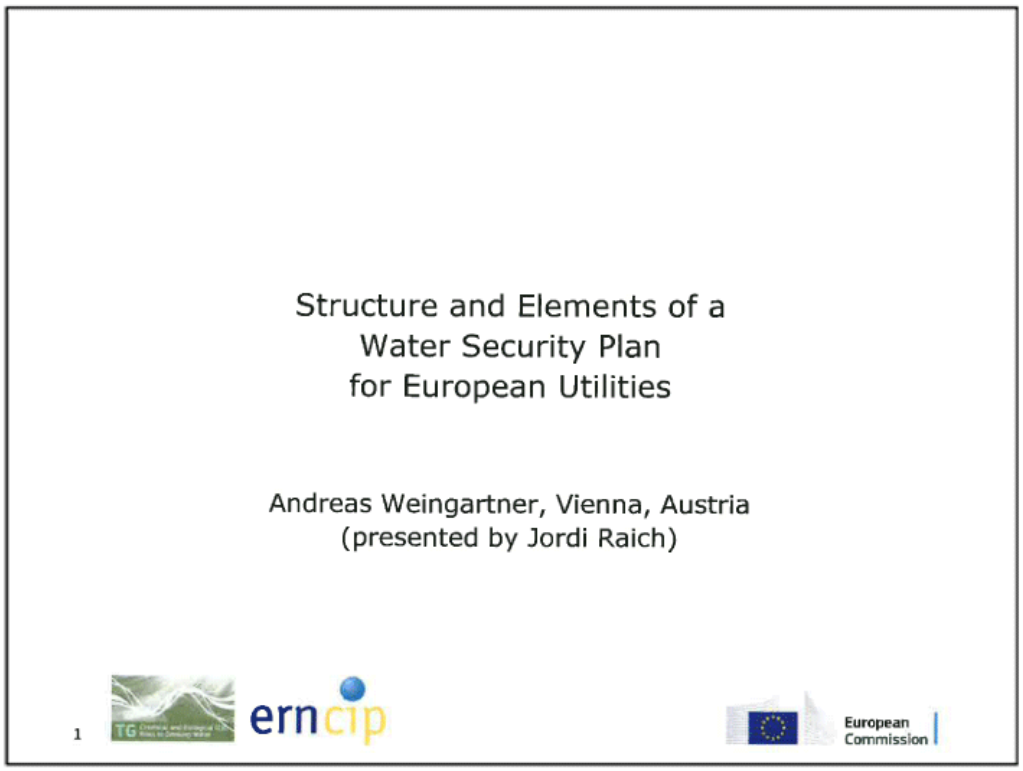
Structure and Elements of a
Water Security Plan
for European Utilities
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(presented by Jordi Raich)
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Allocation of a Water Security Plan
The Water Security Plan targets at prevention, preparation, real-time detection and fast response to anthropogenic contamination events.
To be established as a separate but well synchronized plan, additional to conventional consumer protection by good practice (SOPs), European directives, national standards, and eventually established Water Safety Plans.
To be integrated into the existing operational framework from source water over drinking water treatment to the consumer's tap.
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Principles of a Water Security Plan

- **Sustainability**
- **Adaptability** and **flexibility,** also for small utilities
- **Synchronicity** to existing operations
- Economical **efficiency**
- Operator **acceptability**

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What is a Water Security Event ?

- Accidental or intentional, but typically anthropogenic source of contamination.
- Low probability, high impact, acutely toxic.
- Fast rise of dosage and concentration -> fast (real-time) detection and response mandatory.
- "No time to lose."

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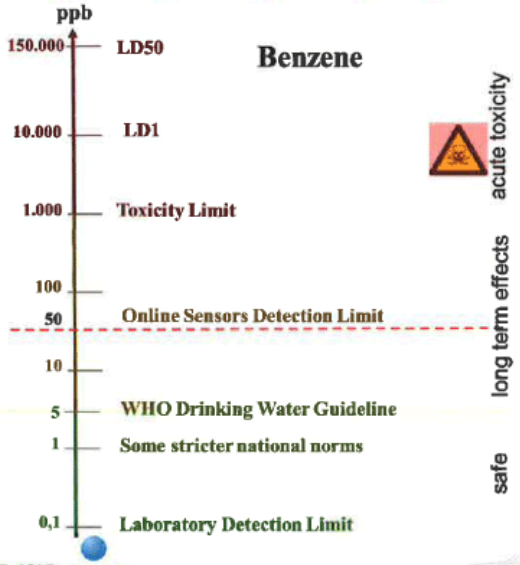
What is a Water Security Event ?



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Elements of a Water Security Plan

1. Decision (of water utility) to establish a Water Security Plan
2. Vulnerability assessment
3. Define wanted protection level
4. Protection level to be activated by use of existing capacity
5. Gap Analysis
6. Design of Event Detection and Protection System
7. Use of Water Security System to support daily operation
8. (Dock to) Emergency response plan

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Elements of a Water Security Plan

1. Decision to establish a Water Security Plan

- Every water utility, independent of size, should be encouraged to go through an evaluation process.
- The process and its elements should be standardized on a European level, considering the size of the utility and assumed hazards.
- The resulting plan should from the beginning dock onto other existing plans, like water safety plan, emergency response plans, and/or other risk assessment plans.

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Elements of a Water Security Plan

2. Vulnerability Assessment

- To define, describe and quantify hazards
- Factors to be looked at are size, age and quality of infrastructure, accessibility and exposedness (e.g. number of open channels, tanks, hydrants), potential contamination sources, special land use, dangerous infrastructure, history of events, existing protective resources, etc.
- The extent and depth of investigation should co-relate to size of utility and anticipated hazards.
- European standards for aspects to look at, depth of analysis, frequency etc., would be valuable.
- Outcome would ideally be quantitative in tables, and visualized in maps in order to increase acceptance.

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Elements of a Water Security Plan

3. Define Wanted Protection Level

- The target protection level will be an individual political decision and should be set into proportion to other known hazards, and to other health risk related guidelines.
- One basic idea would be that drinking a glass of water in a small town should not pose a higher risk - from a security perspective - than in a large city.
- The standardization of protection levels might be a long term target; reference can be found in other existing health / risk related guidelines.
  - -> The water-related **Criteria** should be standardized.
  - -> Acceptable **Levels / Numbers** could be defined by experience accumulating over time.

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Elements of a Water Security Plan

4. Protection to be activated by use of existing capacity

First, fast, and cost efficient step to increase security- and protection level = Analyze and activate the existing capacity in terms of protection purposes:

- Existing water infrastructure /protection
- Existing monitoring systems
- Data communication and analysis systems
- Available staff / training, re-focusing
- Good practice / re-focusing
- Extension of existing processes / SOPs

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Elements of a Water Security Plan

5. Gap Analysis

Compare

Activated protection level ⇔ Target protection level

- Describe the vulnerability gap
- Define missing resources & capacity to close the gap
- Design a proposal / plan to fill the gap

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Elements of a Water Security Plan

6. Design of Event Detection and Protection System

- Analysis of tools for event detection: sensors, software, and communication tools
- Selection, positioning and integration of (additional) sensors, software and related infrastructure
- Automated data collection, validation, reporting and escalation program
- Automated data analysis and alarming program

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Elements of a Water Security Plan

7. Use of Water Security Plan to support daily operation

Experience (mainly in the USA) shows that Security Plans need to be fully integrated into daily operation, to provide additional information related to water quality, to be used for improvement of general water quality management and operation; otherwise it will not be maintained in a sustainable manner.

- Integration into daily operation and existing communication systems
- Reach sustainability (training, recurring checks, audits)

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Elements of a Water Security Plan

8. Emergency Response Plan

- Often exists except in very small utilities
- needs to be adapted according to the special characteristics of water security (events)
- especially in terms of necessary speed of response and communication management,
- possible high impact from contamination,
- and alternatives to supplying drinking water from the distribution network.
- Clear logistics are important to enable fast action when such a plan needs to be executed.

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Keys to sustainability

Lessons learned /in the USA:

- Only Multi–purpose systems work: Use water security infrastructure for daily operation, so there is a visible pay back.
- Use the equipment every day so it is well maintained, and it will be working also in the case of a real security event.
- Water security can not be 100% addressed by existing capacity. Additional water security assets can only be maintained by additional capacity.
- Resulting costs can be covered by 1) savings from operations due to better efficiency, 2) savings from reduced costs of event recovery due to early detection of eventual events, 3) funding, 4) increase water prices.
- Cities using (partly) their own money were more motivated and more sustainable in the USA.

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Conclusions, Recommendations

- Adapt technologies to the "normal" operators: Make existing technologies stable, simple, easy to use, friendly to the user:
- Turn sensors and software into every-day tools - integrate the collected data into daily operations.
- Introduce minimum regulating framework, just to move the topic over the awareness level especially of the smaller utilities. But we do need regulation / motivation, otherwise Security will be considered an extra effort that will not be invested before something really happens.
- Even if Water Security is only partly redundant with the domain of Water safety, it might not be wise to open a new, totally separate field but suggest an extension to existing plans.
- At the same time, carrier projects will be important references from the top to the bottom.
- Involve and convince the water utility associations especially in the German speaking countries.

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