HACCP* as a tool for assuring safe drinking water : The Veolia Water experience

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* HACCP : Hazard Analysis Critical Control Points

Summary

- Veolia Water Organization
- Institutional context & place of HACCP implementation within French legislation
- HACCP implementation in Veolia Water - GdE
- Consequences of HACCP implementation to improve Water Quality
- Conclusion

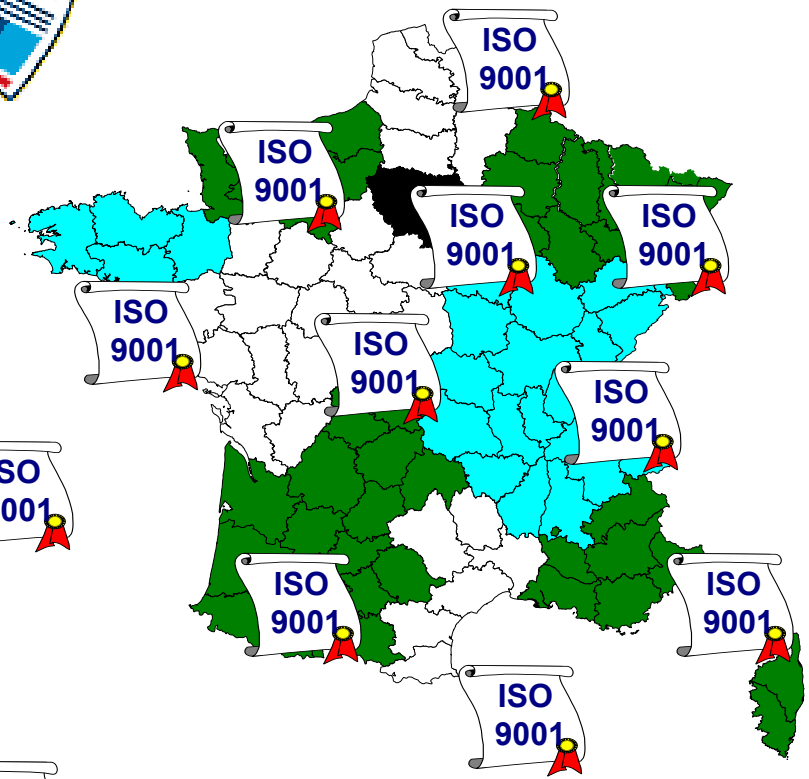
Veolia Water Organization

French Administration

- ≈ **100 French local authorities**
  with health authority officers
  with a representative of the French government (“Préfet”)

VeoliaWater-GdE organization

- **11 “regions” in VW-GdE**
  11 regional Quality Management Systems
- **4 regional accredited laboratories**
- **1 accredited proficiency testing scheme**



Institutional context
Assuring quality and safety of drinking water

→ European legislation (98/83/EC Drinking Water Directive) still based on compliance monitoring

- parametric values
- minimum frequencies for water monitoring

→ Increasing documented waterborne infectious illnesses in industrialized countries

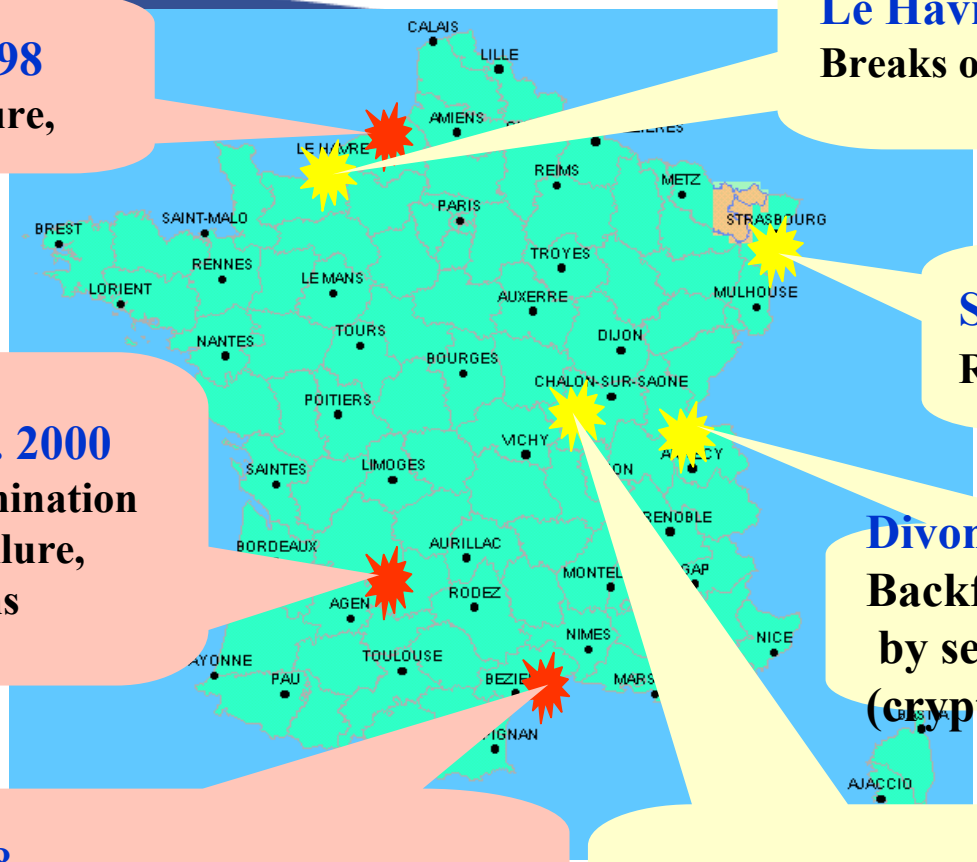
Institutional Context
Infectious illnesses

Resource and treatment problems

Network problems

Fécamp, Sept. 98
Disinfection failure,

Le Havre, Dec. 1997
Breaks of mains + pressure drop



Strasbourg, May 2000
Repairs of main

Gourdon, Aug. 2000
Resource contamination + disinfection failure, several pathogens

Divonne , Aug. 2003
Backflow recontamination by sewage, multi agents (crypto)

Sète, Sept. 98
Resource contamination by surface water
Cryptosporidium

Dracy le Fort, Sept. 2001
Backflow recontamination by sewage,
Cryptosporidium

Compliance monitoring is a reactive management.

A new comprehensive management system is needed ⇒ HACCP

Place of HACCP in the new French regulation for drinking Water

Public Health Code - Art R.1321

- **Operator must - continuously**
  - examine assets (plants, networks…)
  - monitor where risk have been identified
  - keep and record all relevant information
- **Water quality monitoring is carried out by**
  - health authorities
  - operator if
    - risk analysis has been done 

    - control is realised and operating instructions are followed 

    - analyses are done by certified or accredited laboratories 

HACCP implementation in Veolia Water

Chronology

→ 2000-2001 : Pilot Phase

- Annet sur Marne : 100 000 m^3/day, 700 000 inhab.
- Source : Marne River
- Multibarrier treatment : CFD, rapid filtration, ozonation, final chlorination
- Supply network : reservoirs, boosting chlorination stations
- June 2001 : HACCP evaluation by AFAQ (French accredited certification body)

→ 2004 : 45 different systems in Générale des Eaux

- Ground and surface water
- Different size water systems in the different regions
- Most of them from catchment to consumer, representing different treatment lines and evaluated by AFAQ
- Overall : 8.5 M inhabitants

HACCP implementation in Veolia Water

12 Tasks - 5 Preliminary tasks

Task 1. Assemble HACCP team (multidisciplinary)

Local level : Water treatment Manager, Supply Manager, Quality manager (Quality Management system- Water Quality)

Regional level : specialists in water treatment and supply, in QMS

Task 2. Describe product

Final Product : Tap water in compliance with legislation

Entering products : Raw water + chemical reagents and material in contact with water

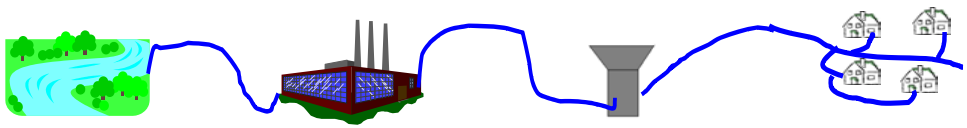
Task 3. Identify intended use

Expected use : normal : food, sanitary, industrial

abnormal : Hot water consumption, stagnation, ice refreezing ...

Specific use : vulnerable groups :dialysis, immunodefficient …

Tasks 4 and 5. Construct flow diagram



From resource to consumer tap

HACCP implementation in Veolia Water

12 tasks - 7 principles

Principle 1 Hazard Analysis

1. List Hazards
2. List Hazards causes
3. Prioritize (3 criteria : gravity, frequency, detectability)
4. List control measures

Principle 2 Determine Critical Control Points (CCP)

Principle 3 Establish critical limits for each CCP

Principle 4 Establish a monitoring system for each CCP

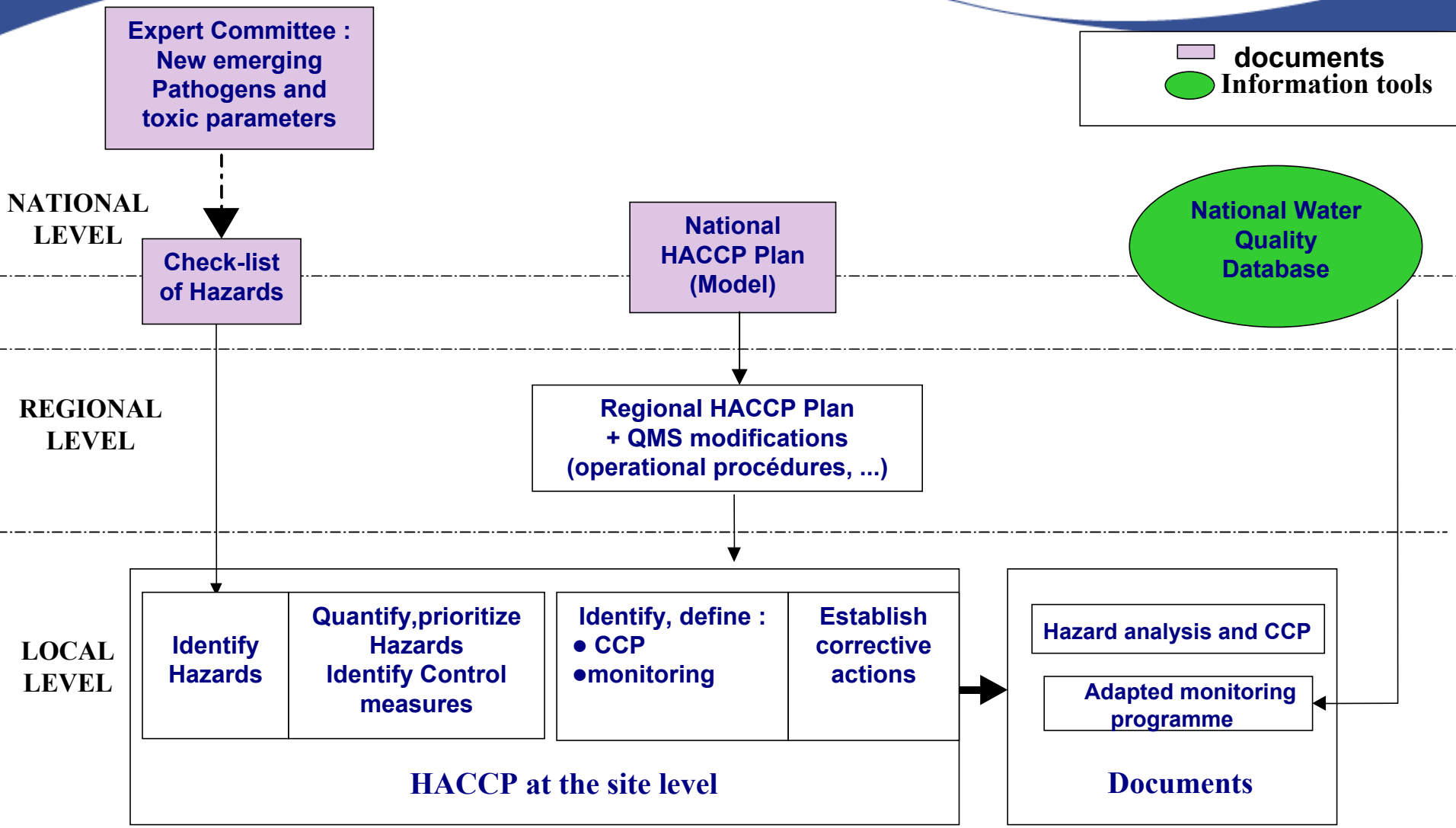
Principle 5 Establish corrective actions

Principle 6 Establish verification procedures

Principle 7 Establish documentation and Record keeping

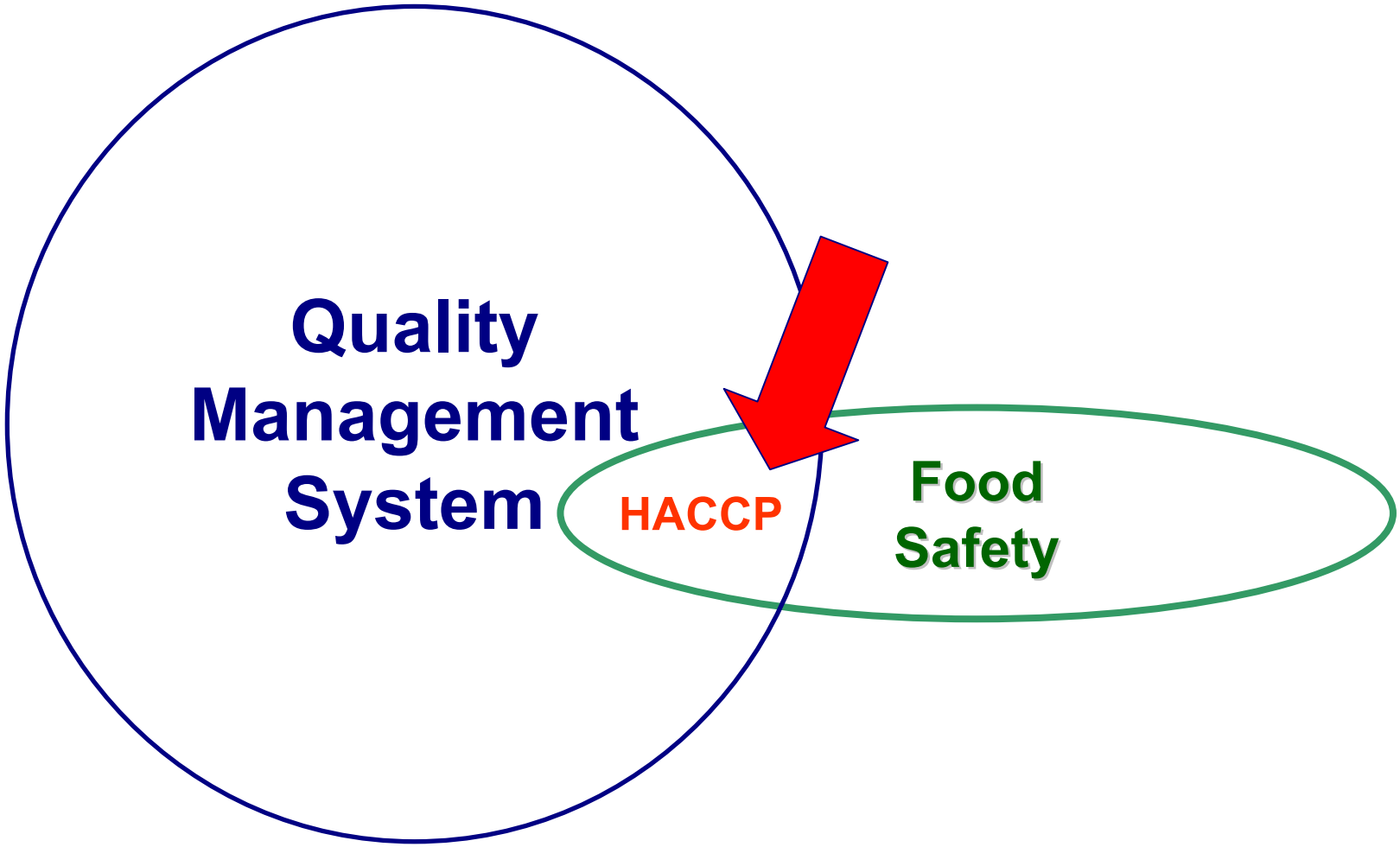
HACCP implementation in Veolia Water

Levels and tools for action



HACCP implementation in Veolia Water

Integration in the QMS



HACCP implementation in Veolia Water

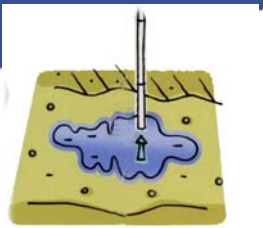
National Check-list of Hazards

→ Include the regulated parameters

- Microbiological parameters
  - Bacteriological parameters, cryptosporidium, giardia
- Chemical Parameters
  - Pesticides, Nitrates, Nitrites, Chlorites, Ammonium, ...
  - Hydrocarbons, 1,2-dichloroethane, Trichloroethylene, THM ...
  - Aluminium, Antimony, Arsenic, lead, Iron, manganese, Zinc ...
- Algae
  - Microcystin
- Radioactivity
  - Tritium, TID

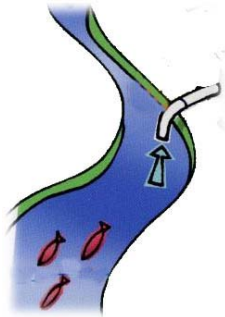
HACCP implementation in Veolia Water

Hazard causes and control measures on the resource



→ Hazard causes

- Cattle breeding and agricultural activities
- Seasonal pollution (storms, pluviometry, …)
- Natural presence
- Human and domestic activities (raw sewage, wastewater treatment plant discharge)
- Industrial activities
- Pest intrusion
- Accidental spills
- Malevolent actions

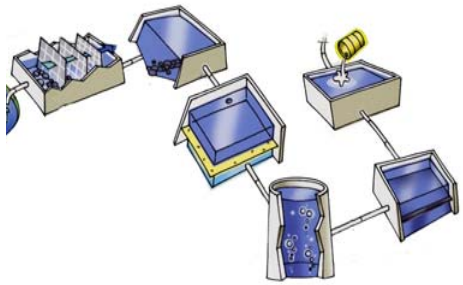


→ Control measures

- Protection zones
- Treatment steps (coagulation/floculation, sedimentation, filtration, chlorination ...)
- Warning Network
- Fences, locked doors, screened windows (ground water)

HACCP implementation in Veolia Water

Hazard causes and control measures on the treatment plant



→ Hazard Causes

- Chemicals use in water treatment
- Treatment byproducts
- Pest intrusions
- Malevolent actions

→ Control measures

- Control of the chemicals
- Control of the treatment steps
- Fences, locked doors

HACCP implementation in Veolia Water

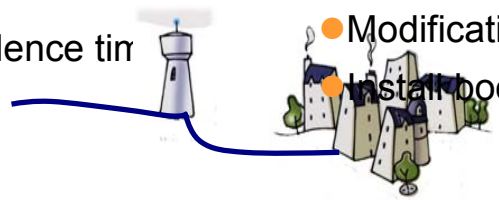
Hazard causes and control measures on the service reservoirs and distribution network

→Hazard causes

- **Accidental, uncontroled events**
  - pipe bursts, leaks,
  - cross-connections and proximity to sewers,
  - infiltration and ingress of contamination from cross-connections, backflow,
  - sabotage, natural disasters.
- **Operational practices**
  - Construction, repair and maintenance,
  - biofilm, sloughing, and resuspension/regrowth,
  - build-up of sediments and slimes,
  - corrosion of pipes and reservoirs.
- **Network structure, third party activities**
  - age and nature of pipe materials
  - flow variability, inadequate pressure
  - short circuit, stagnation zones, residence tin
  - illegal connection services

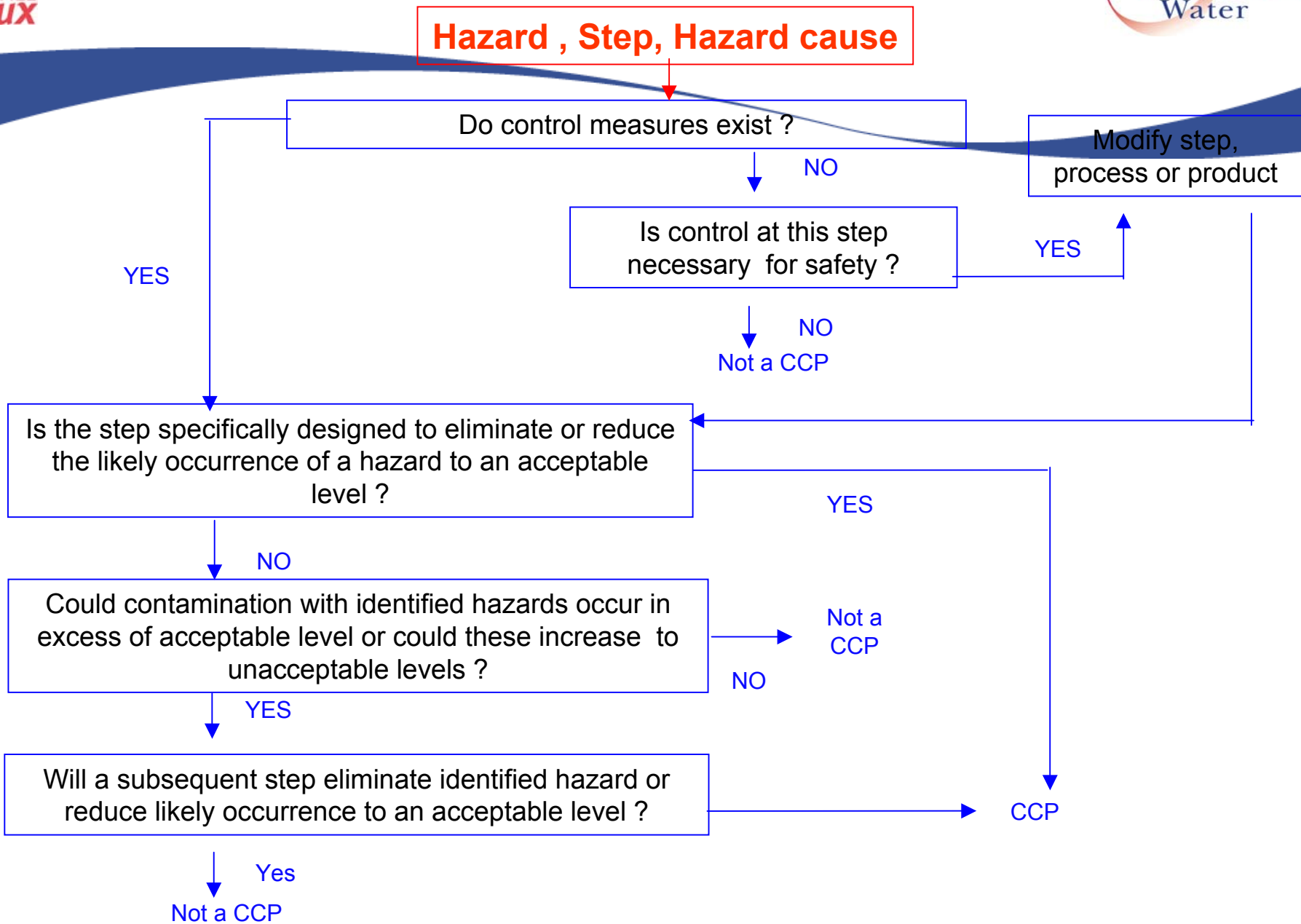
→Control measures

- **Accidental, uncontroled events**
  - Leak research, network knowledge (hydraulic modelization, GIS)
  - Check-valves, diconnectors (generalization), list of clients with specific risks
  - Fences, locked doors, screened windows, stocks of bottled water
- **Operational practices**
  - Operating procedure (disinfection, flushing) for repairs or line construction, training if necessary.
- **Network structure, third part activities**
  - Flushing dead-ends
  - Modification of the network
  - Install boosting rechlorination stations



HACCP implementation in Veolia Water

Determine CCP



HACCP implementation in Veolia Water

Example : CCP for cryptosporidium

For each CCP, establish :

Principle 2: Determine CCP

Principle 3: critical limits

Principle 4: monitoring system

Principle 5: corrective actions

Hazards	Step	Causes of hazard	Critical limits	Monitoring	Documents	Corrective actions
Cryptosporidium	Sand Filtration	Resource contamination	Turbidity in filtered water, head loss filter pressure, filter backwashing frequency. Threshhold values for upstream steps. Drinking water standards.	Turbidity analyses, Measure of head loss filter pressure, filter backwashing frequency	"Crisis Management responses" procedure. "Non compliance response management" procedure.	Specific actions according to the QMS Procedures : early filter backwashing

Principle 6: verification procedures

Principle 7: documentation and record keeping

HACCP implementation in Veolia Water

CCP table : example

Hazards	Steps	Causes of hazards	Critical limits	Monitoring	Documents	Corrective actions
Bacterio	**Chlorination**	raw water contamination	bacteriological drinking water standards residual chlorine	bacteriological analyses residual chlorine (continuous)	Analytical results "Crisis Management responses" procedure remote management	According to "Crisis Management responses" procedure, increase chlorine dose
	Service reservoirs	Vandalism	Warning system, Inspections: gates, doors, screens damaged…	Warning system against intrusion, periodic inspections, traceability of keys for access	Annual inspection report, Cahier de bord "Crisis Management responses" procedure	Specific actions according to the Procedure:Contact with authorities, Advice for limiting water uses Distribution of bottled water, additional monitoring programme...
	Mains, pipes	Back-siphonage (including fire-hydrants,…)	compliance parametric or indicator values (bacterio, turbidity) Odor Taste	check monitoring, consumer complaints	"Crisis Management responses" procedure "Non compliance response management" procedure	According to "Crisis Management responses" procedure flushing, check-valve installation Fire-hydrants: : check-valves-, good practice,…

Consequences of HACCP implementation to improve water quality

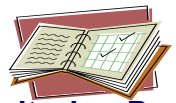
HACCP : Part of an integrated approach

→ Quality Management System

- Certification of QMS
- Laboratories : Accreditation
- Interlaboratory proficiency testing scheme

→ Risk management and monitoring

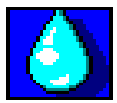
- based on risk assessment



Monitoring Programs

→ Database

- Recording of data: traceability
- Reporting and exchange of data: transparency



→ Reporting on Water quality

→ Communication : on water quality an

risks

Consequences of HACCP implementation to improve water quality

- → **Well structured method**
- → **Existence of the QMS and other tools**
- → **Team meeting : promote technical discussions**
- → **Involvement of operators and subcontractors**
  - Data exchange (water purchase), warning network
- → **Focus on difficulties**
  - Water treatment plant : well known
  - Resource, Network
- → **Implementation Cost :**
  - 30-60 days/Man for a system
  - New Control measures implementation

Consequences of HACCP implementation to improve water quality

Water distribution system specificity

→ **Production/distribution processes : continuous**

- A « permanent » working system : unknown
- Characteristics of the network : wide, open

→ **Operations on the network**

- Suppliers - Subcontractors
- Others : firemen, road maintenance, specific customers (potential polluters), consumers (general population, at risk people) …

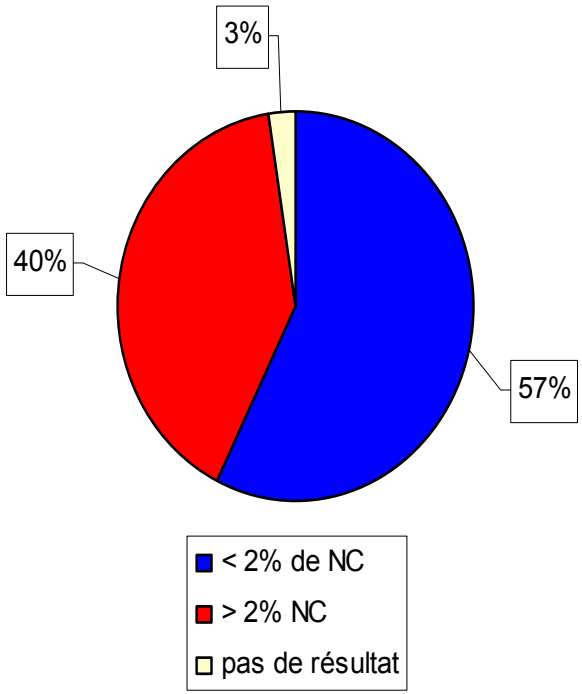
→ **Incomplete knowledge and needs**

- Network characteristics : Network materials (pipes, ...)
- Events on the network : Monitoring Information tools (GIS,…)
- Hydraulic regimes : Hydraulic models, water quality

Consequences of HACCP implementation to improve water quality

➔ Water Quality evaluation

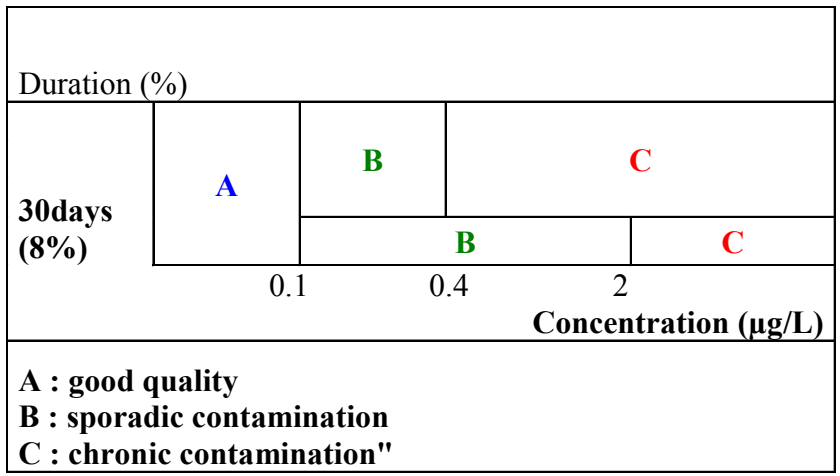
Percentage of non compliance



Quality Class

Example of pesticides

- Duration of non-conformity
- Maximum value recorded



➔ Apply HACCP on vulnerable systems

Conclusion

→ HACCP : a tool to manage food safety for potable water

- global vision of water quality
- systematic evaluation of risks
- optimisation of monitoring plans related to risk
- Integration into Quality Management System
- plan should be reviewed and agreed upon with the health authority