برنامج قطر الوطني للأمن الغذائي
QATAR NATIONAL FOOD SECURITY PROGRAMME

Emergency preparedness & crisis response in water management

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Introduction

Production and distribution capacities of Gulf water companies can unfortunately be damaged by natural disasters, industrial accidents or criminal actions.

Consequences on water supply systems can potentially prove to be very serious if emergency preparedness plans and technical innovations are not fully in place.

Thanks to to the **Qatar National Food Security Programme's** initiative on water security, launched by H.E. Fahad Al-Attiya, this presentation aims at suggesting improvements from lessons learned by water security experts and from new technologies available to help utility managers to better anticipe and react in case of any major crisis.

Threats scenarios for GCC countries' water systems

Threats	Scenarios	Classification
Pollution		
Maritime pollution : oil spill scenario	**SE1**	**Extreme**
Maritime pollution : red tide scenario	**SE2**	**High**
Contamination		
Nuclear pollution of raw and treated water	**SE3**	**Extreme**
Intentional contamination of treated water	**SE4**	**Extreme**
Power and IT		
Power outage	**SE5**	**High**
Hacking on SCADA systems	**SE6**	**Extreme**

Oil spill contingency

Oil spills can be consequences of pipeline spills, tank vessel spills, operational discharges from cargo washings, coastal facilities spills, sabotage or terrorist actions.

Should such a scenario happen, damage on intake filters, heat exchangers, reserve osmosis membranes would be high, if shut-down orders are not given in time.

Airborne and UAS remote sensing component

According to experts, 90% of the oil volume of the spill are contained in only 10% of the total spill area of coverage. Thus, knowing where the heaviest (thickest) areas of oil are located and having the ability to track these areas and then effectively direct the clean-up efforts to these specific areas is of utmost importance to the overall response effort.

As the Arabian Gulf is a narrow, shallow body of water (with a surface of 260 000 km2), the use of **a tactical UAS (Unmanned Aircraft System) to detect, monitor and track any oil spill** would help emergency response teams.

Airborne and UAS remote sensing component (2)

However **no single sensor available can give an accurate estimate for all the parameters required for oil spill contingency planning**.
Therefore **a multi-sensor system loaded on tactical UAS is needed** for effective oil spill response with radar sensors **(SAR and SLAR), UV/IR, Microwave radiometer (MWR), and laser fluorosensor.**

Nuclear disaster management : lessons from Japan

Japanese utilities have always developed **innovative approach** in order to cope with the permanent threat of earthquakes and tsunamis.

Due to the circumstances following Fukushima, they are also experiencing **practical solutions to face the nuclear contamination of water.** For instance, in order to decontaminate water at the Fukushima plant, the French nuclear engineering company Areva and the French environmental services management company Veolia Water have co-developed in a record-short time (2 months) a system which has reached :

- 80 000 cubic meters of highly radioactive water treated in just three months of operation.
- Radioactivity of the contaminated water reduced 10 000 fold.
- 40 000 to 50 000 cubic meters of contaminated water prevented to enter the ocean.

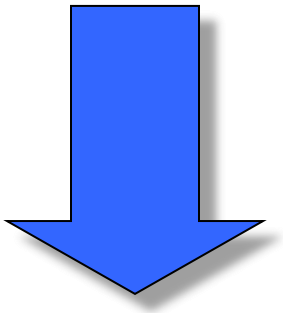
Nuclear disaster management : lessons from Japan (2)

This treatment process was essential to TEPCO's (Tokyo Electric Power Company) plans to reuse water for cooling the reactor, so as to put an end to the emergency and prevent the discharge of radioactive water totaling tens of thousands of cubic meters into the sea.

Moreover Japan water companies, such as the Tokyo water company, have also implemented preliminary recommendations for **water supply systems decontamination**, using chemical decontamination agents such as citric acid. **Radiological monitoring arrangement** for water supply have also been developed following the nuclear accident.

Intentional pollution of water

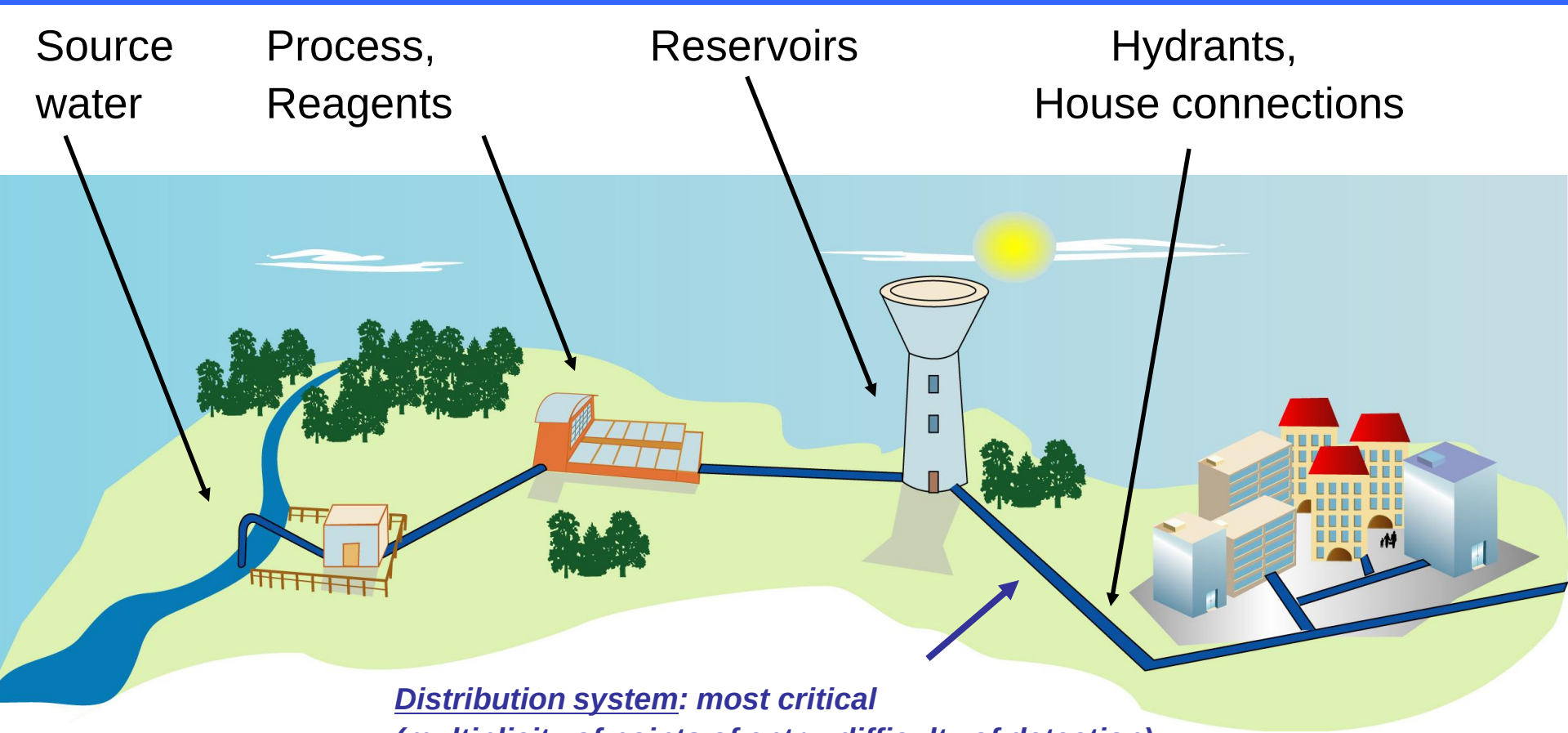
- ✓International terrorists.
- ✓Extreme activists.
- ✓Lone wolves.
- ✓Vandals.



- ✓Chemical contamination (pesticides for instance).
- ✓Biological contamination (chlostridium botulinum, bacillus anthracis, ricine).
- ✓Physical destruction.
- ✓Psychological impact (non lethal contaminants).

- ✓Potentially serious public health damages.
- ✓Disturbance during major sport and cultural events hosted in the country.
- ✓Loss of capacity (power plants, hospitals, …).
- ✓Important economic damage (oil & gas industry).
- ✓Loss of public confidence.
- ✓Political crisis management.

Contamination scenarios



***Distribution system*: most critical**
(multiplicity of points of entry, difficulty of detection)

← ***High potential impact***
Large quantities of contaminant

Low impact
Small quantities of contaminant →

Open sources and website monitoring

- ✓ Dedicated web monitoring by Gulf security services and water companies make it possible to collect and identify intelligence information concerning the possible targeting of water infrastructures.

- ✓ This gives for instance a clear indication of people interests and know-how, from their strategic intentions to target water facilities, to their intelligence gathering, technical capabilities and their actual modus operandi.

- ✓ The results of those web investigations show that some people have unfortunately discussions on : **how to best cause panic over water contamination, the availability of infrastrutures' plans on the web, best recipes for poisoning.**

Protection of reservoirs and underground pipes

In order to better protect visible assets such as pumping stations and reservoirs, Gulf water companies have already decided to invest on intrusion detection systems coupled with CCTVs. But, for visible assets as well as for the most sensitive parts of underground networks, they can also use **underground layer of protection.** This kind of system is installed to monitor events on the pipeline and in its vicinity - on the ground and underneath it.

Using **electro dynamic sensors** placed along the most sensitive part of the pipe (on, around and about the pipelines), the system receives and identifies **seismic sound waves** that are transmitted through the underground.

Protection of reservoirs and underground pipes (2)

The sensors connect to the central control room which is able to detect, classify and monitor :

- digging, excavating, drilling and cutting,
- leakage, explosions,
- human motion : walking, running, crawling vehicle/machine motion.

Early Warning Contamination Systems

In order to better react, detect and analyse very quickly what's going wrong in the water supply network, Gulf water companies can also be more proactive if they decide to use an **Early Water Contamination System,** whose objectives would be to **:**

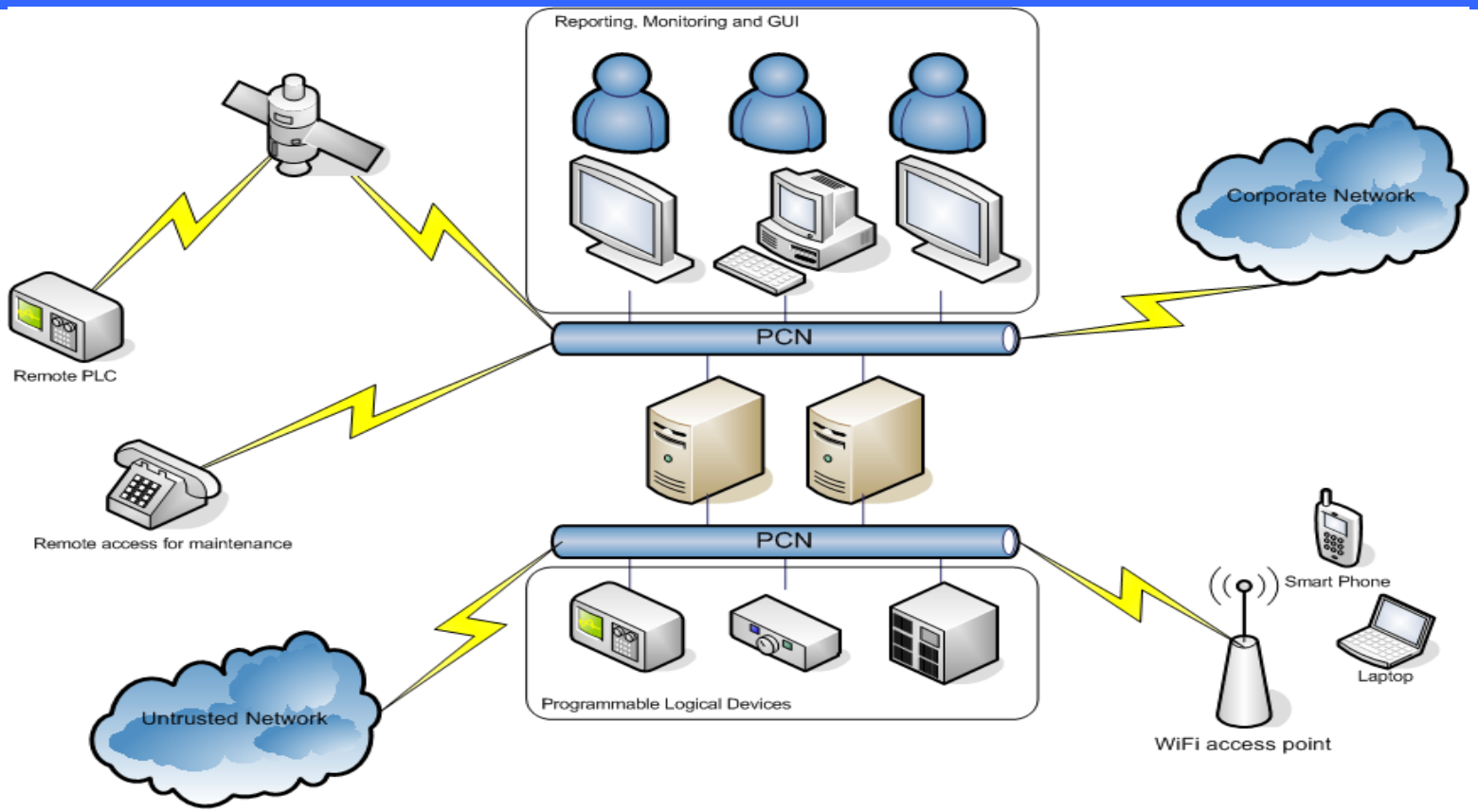
• Collect and integrate information from multiple sources such as water quality monitoring devices, physical security systems (CCTV, intrusion detection, …), SCADA, CRM, GIS, public health, labs, GPS and more.

• Manage public complaint and feedback on water quality and supply with a sophisticated CRM module.

Early Warning Contamination Systems (2)

• Present information from the various systems in a unified, user-friendly interface, including GIS map view, video, event management screen and online water parameters graphs.
• Distribute alerts, tasks and files via a secure network of all types of multimedia messaging (e-mail, fax, SMS, and more), as triggered by device alarms and emergency policy.
• Predict contamination spread and analyzes the contamination source.
• Respond dynamically to non conventional events with the help of **a laboratory quick detection team.**

Power outage and SCADA hacking : a threat for WWTP as well as for water supply systems



So far, official water strategies have not really addressed the risk of a major power outage or a cyber security attack. Things are only beginning to change, because :

Power outage and SCADA hacking : a threat for WWTP as well as for water supply systems (2)

- In **2003**, due to an electricity blackout in the Northeast United States, wastewater treatment plants in Cleveland, Detroit, New York, and other locations that lacked backup generation systems lost power and discharged millions of gallons of untreated sewage during the emergency.

- In **2000**, in Maroochy Shire, Queensland, Australia, an individual released millions of liters of untreated sewage using a wireless laptop, apparently taking revenge against former employer. The laptop found in the criminal's car contained enough messages to prove he sent commands to disrupt various pump stations, combined with proprietary radio equipment and specialized cable.

Crisis Management Training & Education

Training is also essential to keep all emergency plan stakeholders and participants well informed and ready to respond in case of an emergency.

Preparedness exercises, mock scenarios, table top spill drills, and other utility-specific training are indeed key to improve reaction capabilities.

Consequences of climate change on infrastructures

Asset management (CAPEX and OPEX) is under control by Gulf water companies. Redundancy of equipment and network also allow desalination plants and water supply systems to be resilient in case of any major incident on the systems.

However, R&D should now focus efforts **on consequences of climate change on desalination and water supply infrastructures**, taking into account the sea level rise, the evolution of salinity of the sea, more frequent sand storms, and possible periodic flash floods.

Annexes

SCADA Security

A lot has been done by Gulf water companies in terms of cyber security protections for SCADA systems of their national water control centre.

However, the very best is to continue investments on training for prevention and crisis response, and in particular with the objectives to :

- Train operators on security and on escalation procedures in the event of an incident.
- Institute system change control policy.
- Upgrade application to version that supports strong authentication.
- Employ encryption if any over-the-air protocol is unencrypted.
- Use strong authentication for remote control software and dial-in.
- Harden workstation security.
- Deploy system and network intrusion detection software.
- Institute nightly system backups and off-site tape storage.
- Increase backup power/fuel for generators in case of any power major failure at their national water control centre.

Red tide management

1. Like for oil spill, **detection, monotoring and tracking capabilities of red tide** are already effectively implemented at the GCC level, through effective cooperation within States. Lessons learned from past experiences are fregularly shared (see for instance « Expert workshop on red tides and HABs : Impact on desalination plants » organized by the Middle East Research and Desalination Center (MEDRC) on the 7th and 8th of February 2012).

1. Complementary to **Satellite remote analysis**, which already measures the average chlorophylle concentration (µg/l) of algal booms, the use of **airborne sensors for detailed red tide analysis** is a solution to prevent algal bloom from targeting desalination plants. The airborne or UAS (Unmanned Aircraft System) remote sensing component with appropriately installed sensor sub-systems and specialized mission software can indeed provide the real-time information necessary to detect, respond to and mitigate red tide.

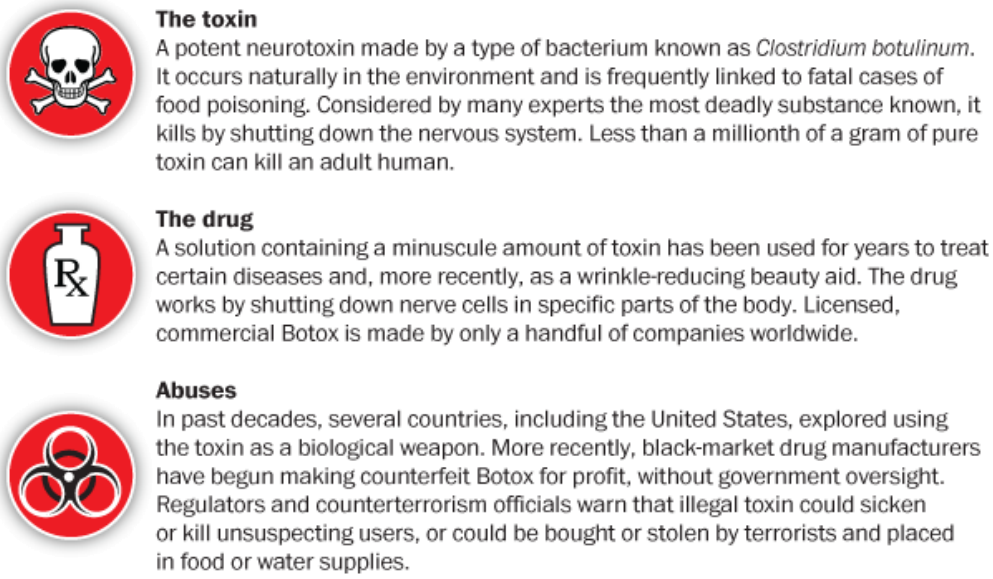
2. The use **Dissolved Air Floatation (DAF) technology,** as primary treatment step for SWRO, are also already helping desalination operators to avoid a complete stop of the plant. This technology is currently spreading in the Gulf countries.

Recipe for poisoning : botulinum toxin

A preparation method of botulinum toxin, « the rotten meat toxin », is for instance given :

« Take a vessel and fill one third of it with grained powder. Place inside it a small piece of meat, 1,5 spoons of dust or animal dropping and fill it with water until it reaches the top. Seal it and store it in a room temperature shaded place for 10 days. You will see that the cover of the vessel got inflated and that there is a small quantity of brown sediment. The sidement is the required toxin ».

Botulinum toxin is a highly toxic protein secreted by the bacteria Clostridium Botulinum, named after the Greek word for sausage, botulus, as it was associated with meat poisoning.



The toxin
A potent neurotoxin made by a type of bacterium known as *Clostridium botulinum*. It occurs naturally in the environment and is frequently linked to fatal cases of food poisoning. Considered by many experts the most deadly substance known, it kills by shutting down the nervous system. Less than a millionth of a gram of pure toxin can kill an adult human.

The drug
A solution containing a minuscule amount of toxin has been used for years to treat certain diseases and, more recently, as a wrinkle-reducing beauty aid. The drug works by shutting down nerve cells in specific parts of the body. Licensed, commercial Botox is made by only a handful of companies worldwide.

Abuses
In past decades, several countries, including the United States, explored using the toxin as a biological weapon. More recently, black-market drug manufacturers have begun making counterfeit Botox for profit, without government oversight. Regulators and counterterrorism officials warn that illegal toxin could sicken or kill unsuspecting users, or could be bought or stolen by terrorists and placed in food or water supplies.