WATER SAFETY PLAN IMPLEMENTATION IN THE PORTUGUESE ÁGUAS DO CÁVADO WATER COMPANY

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ABSTRACT

Water safety plan (WSP) is a concept for risk assessment and risk management throughout the water cycle from the catchments to the point of consumption. It includes the identification of the hazards and introduction of control points that serve to minimize these potential hazards, providing for more effective control of drinking-water quality. This work outlines the way in which Águas do Cávado S.A. has developed and implemented a WSP in the multi-municipal water supply system for the Metropolitan Area of Oporto – Portugal. WSP began to be prepared in 2003 with external consultancy by the University of Minho, being a pioneer experience on applying the methodology in Portugal. By June 2004 the plan was established; the preliminary results will be available in late 2005.

STUDY AREA

The multi-municipal water supply system produces 180000 m^3/day from the river Cávado and delivers to 600,000 inhabitants. After treated in Areias de Vilar Water Treatment Plant, drinking water is supplied to eight northern Portuguese towns (Barcelos, Esposende, Maia, Póvoa de Varzim, Santo Tirso, Trofa, Vila do Conde e Vila Nova de Famalicão) who own and operate the reticulation systems (Figure 1).

The infra-structural system constitutes a multiple barrier for water quality protection. Abstracted surface water is stored in a raw water reservoir with a 24 h detention time. The treatment chain comprises pre-ozonation, remineralisation, rapid mixing, flocculation, sedimentation, rapid sand filtration, chlorination, and pH correction. The water is distributed to 56 service reservoirs through a global extension of 237 km cast iron pipes of 1400 and 200 mm diameter. The hydraulic circuit includes 15 pumping stations, valves, and other complementary appurtenances.

Figure 1 - Survey of the multi-municipal metropolitan area of Oporto water supply system

METHODOLOGY AND RESULTS

WSP was structured in three parts: Part I – Fundamentals, corresponding to the development phase, in which the basic aspects needed for risk assessment and risk management are described; Part II – Operational Aspects, where, for each element of the water supply step, a synthesis of risk management, control measures and corrective actions in critical control points are established; and Part III – WSP Practical Application, where the *modus faciendi* for operational monitoring and reporting is stated.

The critical control point (CCPs) were identified, critical limits (CL) were established according to Águas do Cávado internal standards, operating procedures, and performance targets of the Quality Management System. Some of the CLs were taken on the safety side of legal standards parameters, in order to guarantee the overall water quality of the system. The compliance of CLs is verified through a wide range of parameters that are monitored with on-line sensors and on-site determinations. A sampling and laboratory analysis program at different points of the system has also been included. It is expected that the control measures and monitoring activities are effective enough to smoothly control the routine functioning of the system. However, if and when a CL violation is detected, corrective actions must be considered. Figure 2 shows the CCP's of whole water supply system, Figure 3 presents an example of CCP management, and Figure 4 depicts an example of turbidity behaviour.

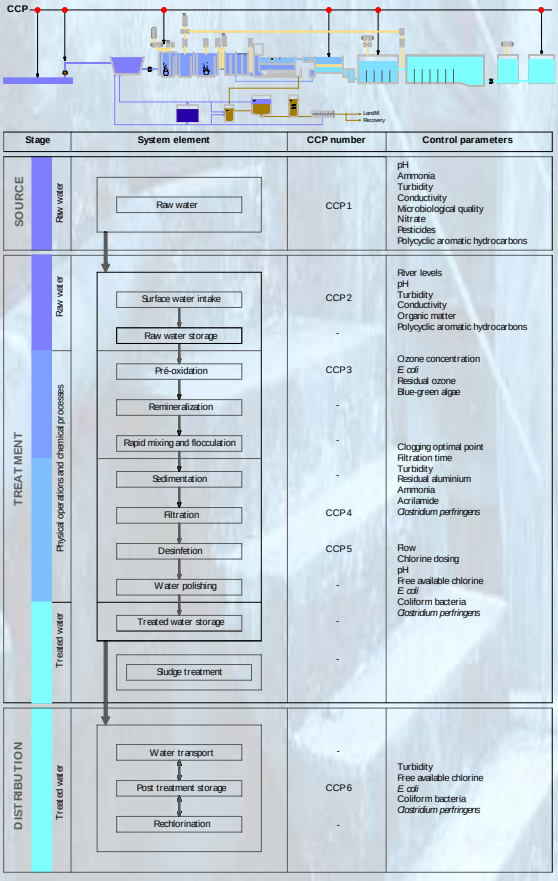

Figure 2 – Critical control point's description in Águas do Cávado water company

HAZARDOUS EVENTS				
T7.1.1 Filter bed supernatant water out of control T7.1.2 Poor control of filter run T7.1.4 Malfunction operation of on-line analysers				
HAZARDS				
Organic matter and turbidity				
CONTROL MEASURES				
Apply the filter maintenance plan Apply the equipment calibration procedure Adjust the number of filters according to the flow rate to treat				
OPERATIONAL MONITORING				
What?	**Critical limit**	**When?**	**Who?**	**Corrective actions**
Clogging optimal point	[2000;2700] mm	Whenever a criterium is reached	DOP	Adjust previous steps in order to optimise filtration efficiency Higher disinfectant dosing
Filtration time	[24;80] hour			
Turbidity	0.50 NTU	On-line		
Residual aluminium	0.20 mg/L Al	Daily	SLB	
Ammonia-N	0.60 mg/L NH_4			
Acrilamide	0.10 μg/L	Monthly		
Clostridium perfringens	0 /100 mL			

Figure 3 – Management of CCP's. Example for rapid sand filtration

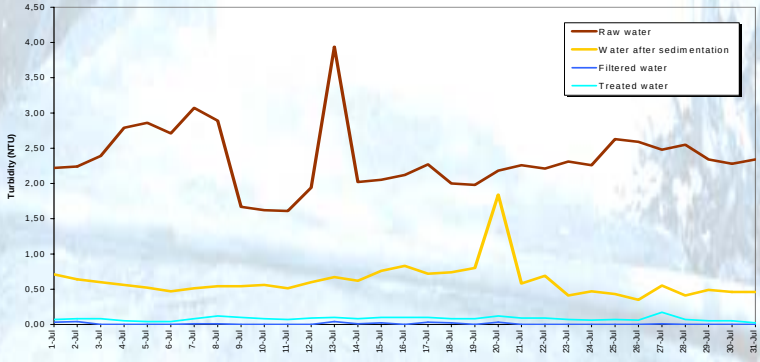

Figure 4 – Turbidity throughout the treatment process

CONCLUSIONS

Development and implementation of a WSP in Águas do Cávado S.A. have demonstrated that water suppliers can successfully adopt methodologies for risk assessment and risk management in drinking-water systems. The systematic operational controls introduced by the WSP have allowed better understandings of negative and positive performances, which appear to be very interesting for internal inspections and maintenance services.