8

Management procedures

If monitoring detects that a process is operating outside of the specifications of the critical or operational limits there is a need to act to restore the operation by correcting the deviation. An important component of a water safety is the development of corrective actions which identify the specific operational response required following specific devations from the set limits (operational and/or critical).

8.1 CORRECTIVE ACTIONS AND INCIDENT RESPONSE

The range of corrective actions can be diverse but, in an ideal system, the ability to change temporarily to alternative water sources is one of the most useful. More commonly, the use of backup disinfection plants or spot dosing may be used to correct disinfection system failure within the water supply. By ensuring that a contingency is available and promptly applied in the event of a deviation outside an operational or critical limit, safety and security of supply can be maintained.

> A Corrective Action is defined as the action to be taken when the results of monitoring indicate a deviation from an operational or critical limit.

It is necessary to detect a deviation through monitoring and respond through corrective action to prevent unsafe water being supplied, therefore, timing of response is an important consideration. For some control measures, such as chlorination, the monitoring may need to be on-line and may require instantaneous corrective action in response to a deviation. For others, such as control of animal densities in catchments, monitoring may only need to be annual and deviations may only require a corrective action to be applied over a period of months to years.

A corrective action might be initiated in response to deviations arising from events such as:

- non-compliance with operational monitoring criteria;
- inadequate performance of a sewage treatment plant discharging to source water;
- notification of chance events;
- spillage of a hazardous substance into source water;
- extreme rainfall in a catchment;
- unusual taste, odour or appearance of water.

Corrective actions typically comprise:

- accountabilities and contact details for key personnel;
- clear description of the actions required in the event of a deviation;
- location and identity of the standard operating procedures and required equipment;
- location of backup equipment;
- relevant logistical and technical information.

8.2 MELBOURNE WATER CASE STUDY – CORRECTIVE ACTIONS AND CONTINGENCY MEASURES

The corrective actions and contingency plan for microbial hazards potentially affecting primary disinfection are illustrated for selected control measures in Table 8.1.

Table 8.1: Corrective actions and contingency plan relating to microbial hazards potentially affecting primary distribution

Control measures	Critical limits	Monitoring	Corrective action	Contingency plan
Operating Procedures for operation of treatment plants Chlorine residual must not be outside bandwidth for >45 min (for process correction – not product safety) Duplicate	1) No zero dosing*. Chlorine concentration is not to record zero for > 10 minutes. This allows for plant control loop time. 2) Chlorine residual must not be outside bandwidth for > 24 hours.	On-line, continuous flow and chlorine residual at the plant controls dosing at a constant set-point.	Zero disinfection SOP. Process: Use duplicate facilities or consider plant shutdown Product: Manage flows SOP for spot dosing with chlorine,	*Zero disinfection event*

Control measures	Critical limits	Monitoring	Corrective action	Contingency plan
facilities (e.g. chlorinators, service water pumps, dosing lines, PLC) Backup power generation	(* no power or intensity outages for UV plants)		Notify retail companies (to flush zones, manage consumers)	

8.2 KAMPALA CASE STUDY – CORRECTIVE ACTIONS AND CONTINGENCY MEASURES

The corrective actions and contingency plan for hazards potentially affecting water production and distribution are illustrated for the control measure outlined in Table 8.2 and Table 8.3

Table 8.2: Corrective actions and contingency plan relating to microbial hazards potentially affecting water production

Control measures	Critical limits	Monitoring	Corrective action	Contingency plan
Flow through intake insufficient	3,745 m^3/hr; action when <3,000 m^3/hr (Gaba 1); 3,500 m^3/hr at 2 pumps (Gaba 2)	Pumping rates	Set intake at appropriate depth (Gaba 1), regular cleaning of screens (Gaba 2)	Ensure sufficient flow available during cleaning through on-site storage and timing of cleaning
Filter performance	38.7 m^3/hr at 0.9 bar (Mannesman); <7.7 m/hour filtration rate (Patterson)	Air scouring rates (Mannesman) filtration rate (Patterson)	Replace air scourers and automate filter operation (Mannesman); operational procedures for backwashing followed (Patterson)	Until air scourers replaced, inspected bed after scouring and manually relay bed if needed
Chlorination	Dosing rate 3 kg/hr low level and mix with high level; 0.2-0.5 mg/l residual chlorine <1 NTU pH of 6.5-7	Dosing rates and chlorine residual	Replace buried feeder pipe and install chlorinator on high level line	Back-up for shock chlorination must be place at all times

Table 8.3: Corrective actions and contingency plan relating to microbial hazards potentially affecting water distribution

Control measures	Critical limits	Monitoring	Corrective action	Contingency plan
Ensure sanitary integrity of service reservoirs	All vents and inspection covers maintained according to critical limits	Sanitary inspection, turbidity and chlorine residual testing by operators and water quality control staff	All vents immediately repaired on sign of damage. All operating staff trained to ensure inspection covers replaced	Facilities for shock chlorination at sites where contaminatio n suspected
All major valves are structurally secure and well drained	No signs of damage and adequate drainage, no debris in valve box	Sanitary inspection, turbidity and chlorine residual testing by operators and water quality control staff	Valve boxes are repaired as soon as damage or poor drainage noted, valve box cleaned	Community-utility communicati on network and rapid response team in place to respond to request
Tertiary mains buried and exposed pipes recovered	All pipes buried or with secure protection; exposed pipes indicate action needed	Periodic sanitary inspection by water quality control staff; periodic inspection by community	Pipes re-buried when exposed, community caretakers cover pipes when cover starts to become eroded	
Contaminated water enters at road crossings	Pipes buried, no sign of leaks	Monthly to quarterly sanitary inspection by water quality control staff	Repair leaks, bury pipes and reinforce joints	
Community tanks kept clean	Tanks clean and in good condition; no increase in turbidity or change in appearance; no loss of chlorine residual; no community complaints	Periodic sanitary inspection by community and water quality control staff; turbidity and chlorine residual testing	Community action to clean tanks; advice from NWSC staff on cleaning requirements	Where community tanks persistently insanitary, NWSC and environment al health staff can enforce cleaning by operators or remove licence from owners

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8.3 EMERGENCY MANAGEMENT PROCEDURES

No matter how thorough the water safety plan it is possible that unforeseen events or deviations may arise for which no corrective action is in place. Under such circumstances there is a need to develop corrective actions without warning. Although it is not possible to have specific and detailed corrective actions in place to respond to such scenarios, it is appropriate to have in place a generic emergency response plan for unpredictable events.

An emergency response plan would not have specific definitions of the operational and critical limits that, if deviated from, trigger a corrective action. Rather, the plan would include a protocol for situation assessment and the declaration of situations that require activation of the emergency response plan. This would include personal accountabilities and categorical selection criteria. The selection criteria may include:

- time to effect;
- population affected; and
- nature of the suspected hazard.

The success of emergency response depends on the experience, judgement and skill of the personnel operating and managing the drinking-water supply systems. However, generic activities that are common to many suspected contamination events can be incorporated within the emergency response plan. For example, for piped systems, emergency flushing standard operating procedures can be prepared, and tested, for use in the event that contaminated water needs to be flushed from a piped system. Similarly, standard operating procedures for rapidly changing or by-passing reservoirs can be prepared, tested and incorporated. The development of such a ‘toolkit’ of supporting material limits the likelihood of error and speeds up responses during emergency response situations.

The emergency response plans can be very broad and can include major regional disasters (such as earthquakes, floods, damage to electrical equipment by lightning strikes), accidents (spills in the watershed), damage to treatment plant and distribution system, and human actions (strikes, sabotage). Emergency response plans should clearly specify responsibilities for coordinating measures to be taken, a communication plan to alert and inform users of the supply, and plans for providing and distributing emergency supplies of water.

Emergency response plans should be developed in consultation with relevant regulatory authorities and other key agencies, and should be consistent with national and local emergency response arrangements. Key areas to be addressed in emergency response plans include:

- response actions, including increased monitoring;
- responsibilities and authorities internal and external to the organisation;
- plans for emergency water supplies;
- communication protocols and strategies, including notification procedures (internal, regulatory body, media and public); and
- mechanisms for increased public health surveillance.

During an emergency in which there is evidence of faecal contamination of the supply, it may be necessary either to modify the treatment of existing sources or temporarily to use alternative sources of water. It may be necessary to increase disinfection at source or to rechlorinate during distribution.

If possible, a piped distribution system should be kept under continuous pressure, as failure in this respect will considerably increase the risks of entry of contamination to the pipework and thus the possibility of waterborne disease. If the quality cannot be maintained, consumers should be advised to treat at the point of use (e.g. to boil the water during the emergency).

It is impossible to give general guidance concerning emergencies in which chemicals cause massive contamination of the supply, either caused by accident of deliberate action. The guideline values recommended in the *Guidelines for Drinking-water Quality* relate to a level of exposure that is regarded as tolerable throughout life; acute toxic effects are not normally considered. The length of time during which exposure to a chemical far in excess of the guideline value would be toxicologically detrimental will depend upon factors that vary from contaminant to contaminant. In an emergency situation the public health authorities should be consulted about appropriate action.

Following any emergency, an investigation should be undertaken and all involved staff should be debriefed to discuss performance and address any issues or concerns. The investigation should consider factors such as:

- What was the initiating cause of the problem?
- How was the problem first identified or recognised?
- What were the most essential actions required?
- What communication problems arose and how were they addressed?
- What were the immediate and longer-term consequences?
- How well did the emergency response plan function?

Appropriate documentation and reporting of the emergency should also be established. The organisation should learn as much as possible from the emergency to improve preparedness and planning for future emergencies. Review of the emergency response may indicate necessary amendments to existing protocols.

The preparation of clear procedures, accountabilities and equipment for the sampling and storing water in the event of an emergency can be valuable for follow up epidemiological or other investigations, and the sampling and storage of water from early on during a suspected emergency should be part of the response plan.