

Code of practice for fluoridation of drinking water supplies

Health (Fluoridation) Act 1973



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Health (Fluoridation) Act 1973

Department of Human Services, Victoria

Amended May 2009

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Foreword

Water fluoridation is the adjustment of fluoride in drinking water to a level that helps protect teeth against dental decay. Tooth decay is a largely preventable disease that affects both children and adults and can cause considerable pain and suffering. Fluoride in drinking water acts like a constant repair kit that neutralises the effect of acids that cause decay and helps to repair damage before it becomes permanent.

Currently 78 per cent of Victorians receive drinking water with naturally occurring or added fluoride. Melbourne and some regional centres have had fluoridated drinking water for more than 30 years. Water fluoridation is the most effective and socially equitable way to give everybody access to the caries-preventive effects of fluoride regardless of age, income or education level.

The *Code of practice for fluoridation of drinking water supplies* supports the implementation of the *Health (Fluoridation) Act 1973* and specifies the requirements for water fluoridation plants to ensure the safe and effective addition of fluoride to drinking water supplies.

This code has resulted from a review of the *Standards for fluoridation of public water supplies: Health (Fluoridation) Act 1973* published by the department in 1993, recognising advances in technology and the risk management framework underpinning Victoria's *Safe Drinking Water Act 2003*.

The underlying philosophy of this code is to provide a forward-looking approach rather than simply reflecting historical trends and, as such, encourages the water industry to strive for continuing improvement in safeguarding the fluoridation of our drinking water supplies. The department acknowledges the important contribution from a wide range of departmental and industry stakeholders who assisted in this process. Central to finalising this code was the valuable contributions from members of the water industry with responsibilities associated with delivering safe drinking water.

This code sets in place design and operational requirements where public water supplies are fluoridated. The Department of Human Services is committed to working with the water industry to ensure the safe and effective addition of fluoride to drinking water supplies.



Fran Thorn
Secretary
Department of Human Services

1 Introduction

The *Health (Fluoridation) Act 1973* ('the Act') regulates the safe and effective addition of fluoride into drinking water supplies in Victoria. The *Code of practice for fluoridation of drinking water supplies* (this code) specifies the requirements for the safe design and effective operation of a fluoridation plant.

Fluoridation of drinking water supplies requires the adoption of a preventive risk management approach in the design and operation of fluoridation plants. Preventive risk management systems are the most effective way to assure the safe and effective addition of fluoride into a drinking water supply. These systems underpin the *Australian drinking water guidelines* and the *Safe Drinking Water Act 2003* (SDWA). This code requires the inclusion of water fluoridation practice into every water supply authority's overall quality management system.

Under the Act, before adding fluoride to any public water supply, a water supply authority (the authority) is required to submit information (the submission) to the Department of Human Services (the department) including plans and specifications for the proposed scheme for fluoridation. The submission relates to the aspects of public health and the ability of the authority to operate the scheme satisfactorily.

This code describes the requirements for compliance with the provisions of the Act, and has been designed to assist the authority in preparing its submission, including plans and specifications for the proposed fluoridation scheme.

Where the authority proposes alternative controls that deviate from those specified in this code, the submission must include evidence to demonstrate an equivalent or greater level of safety.

1.1 Objective

The overall objective of this code is to provide for the safe and effective addition of fluoride into the drinking water supply.

This will be achieved by specifying:

- the optimum fluoride levels for drinking water supplies and the design control limits for fluoridation plants
- the minimum requirements for the safe and effective addition of fluoride chemicals to drinking water supplies, covering the design and operation of a fluoridation plant
- monitoring and reporting requirements for the proposed fluoridation scheme.

1.2 Scope

This code applies to all works undertaken on water fluoridation plants in Victoria after 1 January 2009 and integrates the practice of water fluoridation with the SDWA through:

- the inclusion of water fluoridation into the authority's risk management plan under the SDWA
- integration and compliance with the auditing, notification and reporting requirements of the SDWA.

The authority responsible for a water fluoridation plant existing prior to 1 January 2009 should undertake a gap analysis of the plant against the code and establish a works program to ensure the plant complies with the code prior to 31 December 2015.

This code also describes:

- the regulatory framework including the procedure to fluoridate (section 2)
- safety in design (section 3)
- requirements for the design and control of fluoridation facilities (section 4)
- requirements for plant operation including monitoring, training of personnel, occupational health and safety, security and environmental protection (section 5).

1.3 Terminology

Australian drinking water guidelines: ‘ADWG’

Code of practice for fluoridation of drinking water supplies: ‘this code’

Department of Human Services: ‘the department’

Reference to the Department of Human Services includes the statutory functions of the Secretary as described in the Health (Fluoridation) Act and the SDWA.

Environment Protection Authority: ‘EPA’

Fluoride concentration

The fluoride concentration refers to the total amount of fluoride present regardless of its form and is expressed in milligrams per litre (mg/L).

Fluoridation plant

The building and equipment required for fluoridation of drinking water, including chemical storage areas, dosing and control equipment, safety equipment and other fixtures used for, or associated with, the purpose of fluoridation.

Health (Fluoridation) Act 1973: ‘the Act’

‘Must’ and ‘should’

The word ‘must’ identifies a mandatory requirement for compliance.

The word ‘should’ refers to practices that are advised or recommended but are not mandatory.

Water supply authority: ‘the authority’

Under the Health (Fluoridation) Act a ‘water supply authority’ is:

- (a) *the holder of a water licence, water and sewerage licence or water headworks licence issued under Division 1 of Part 2 of the Water Industry Act 1994; or*
- (b) *an Authority within the meaning of the Water Act 1989 that has a water district; or*
- (c) *a council performing water supply functions under the Local Government Act 1989; or*
- (d) *Melbourne Water Corporation.*

Safe Drinking Water Act 2003: ‘the SDWA’

The SDWA uses the term ‘water supplier’ as equivalent to a ‘water supply authority’ under the Act or, in the case of Melbourne Water Corporation, the term ‘water storage manager’.

‘Drinking water’ and ‘risk management plan’ have the same meanings as per the SDWA.

‘Water sampling locality’ and ‘water sampling point’ have the same meanings as per the *Safe Drinking Water Regulations 2005*.

2 Regulatory framework

2.1 Legislation

This code complements, and must be read in conjunction with, the following legislation governing the fluoridation of drinking water supplies.

2.1.1 *Health (Fluoridation) Act 1973*

The Health (Fluoridation) Act regulates the fluoridation of drinking water supplies in Victoria.

Under the Act, the authority may decide to fluoridate or may be required to fluoridate by the department. In both instances, the authority must receive written consent from the department prior to adding fluoride to a water supply.

The steps required to establish a fluoridated drinking water supply and the subsequent determinations made by the department are specified in section 6 of the Act. The authority is required to submit to the department the proposed scheme for fluoridation including the plans and specifications. The department considers the submission in relation to public health and the ability of the authority to operate the scheme satisfactorily. The procedure to fluoridate is described further in section 2.3. The documentation required for approval is identified in section 6.1.

2.1.2 *Safe Drinking Water Act 2003*

The SDWA and the Safe Drinking Water Regulations regulate the quality of drinking water supplies in Victoria. They set quality standards for drinking water in Victoria, requires water suppliers to prepare and implement risk management plans in relation to drinking water and some types of non-potable water and requires public disclosure of information relating to the quality of drinking water. The risk management plans specifically include risks pertaining to the amount and purity of chemicals added to drinking water and controlling any residue or by-product in the drinking water.

The Act also provides for the risk management plans to be audited and requires reporting to the department under prescribed circumstances. The Safe Drinking Water Regulations also provide for the gazetting of areas supplied with drinking water by water suppliers as water sampling localities.

This code aims to integrate the management of the fluoridation scheme, including operation, notifications, reporting and auditing requirements with the requirements under the SDWA.

2.1.3 Other legislation

Other legislative requirements of relevance to the management of a water fluoridation scheme include:

- *Health Act 1958* (superseded by the *Public Health and Wellbeing Act 2008* as of 1 January 2010)
- *Environment Protection Act 1970*
- *Occupational Health and Safety Act 2004*
- *Dangerous Goods Act 1985*
- *Road Transport (Dangerous Goods) Act 1995*
- *Road Transport Reform (Dangerous Goods) Act 1995*
- *Building Act 1993*
- *Planning and Environment Act 1987*.

2.2 Roles and responsibilities

2.2.1 Department of Human Services

The department is responsible for the implementation and oversight of the Health (Fluoridation) Act and SDWA.

The department may require the authority to add fluoride to any water supply for dental health purposes as specified under section 5(1) of the Act.

Prior to the authority adding fluoride to any water supply, in accordance with section 6(2) of the Act, the department is required to consider the proposed scheme in relation to public health and the ability of the authority to operate the scheme satisfactorily.

The department may direct the authority to cease to use any plant or equipment used for adding fluoride to a drinking water supply.

The net capital costs and expenses incurred by the authority in the installation of the necessary equipment and control measures for an approved system for adding fluoride to a drinking water supply will be paid to the authority out of moneys provided by Parliament (section 8 of the Act).

The net capital costs and expenses specifically include:

- fluoride storage equipment
- dosing system
- instrumentation and control systems
- electrical control system
- safety equipment for material handling and spill management
- testing and commissioning.

2.2.2 Water supply authority

The authority must manage the fluoridation scheme in accordance with this code.

Prior to the construction of a fluoridation plant, the authority must provide the necessary information to demonstrate the safe and effective operation of the plant.

The authority must not introduce fluoride to the drinking water supply until written approval by the Secretary of the department, or their delegate, has been provided.

The authority is responsible for ensuring that the design, installation and operation of the fluoridation plant, and the storage and handling of chemicals, are in accordance with all the relevant legislative requirements. In relation to transport of chemicals, the authority is responsible for engaging contractors who comply with relevant legislative requirements.

The authority must cease to use any plant or equipment used for adding fluoride to a drinking water supply when directed by the department.

The authority must ensure that the water fluoridation scheme is managed in accordance with the provisions of the SDWA. Specifically, the authority must ensure that the water fluoridation scheme is incorporated into the risk management plan for a drinking water supply.

Where the authority supplies or proposes to supply fluoridated drinking water to downstream water suppliers, as defined by the SDWA, then the risk management plan of each entity must be integrated, as required under the SDWA.

2.3 Procedure to fluoridate

Pursuant to section 6 of the Act, the procedure to fluoridate is described below and summarised in Figure 1.

2.3.1 Initial procedure

Having resolved to fluoridate, or having been required to fluoridate by the department, the authority should undertake a feasibility study to determine the appropriate fluoridation system. This provides the basis of the plans and specifications for the fluoride plant. These should include cost estimates for the installation of the necessary equipment and control measures.

The feasibility report should be discussed with the department to ensure the plans and specifications will be consistent with this code.

2.3.2 Documentation

The authority must prepare and submit the plans and specifications for the proposed fluoridation scheme to the department for comment. If the authority or external contractors subsequently amend the plans and specifications, these amendments must be provided to the department.

The submission to the department must include the documentation listed in section 6.1.

2.3.3 Commissioning

The authority, in its submission to the department, must provide a commissioning plan describing the manner in which the plant and equipment will be tested, and the acceptability criteria.

Prior to adding fluoride into the drinking water supply, the authority must provide written confirmation to the department that:

- the fluoride dosing plant has been installed in accordance with the final plans and specifications
- the control system, including critical limit alarms and corrective actions (as identified by the preventive risk management system, Hazard Analysis and Critical Control Point (HACCP)) has been tested and verified.

Any significant modifications resulting from the commissioning process need to be submitted to the department for consideration.

2.3.4 Operation

The authority must ensure that the fluoridation plant is operated in accordance with the approved submission. The authority must also ensure that management of the

plant is incorporated into the risk management plan as required under the SDWA.

Within 12 months of operation, the department will undertake an audit to verify that any recommendations associated with the approval have been implemented.

2.3.5 Department approval

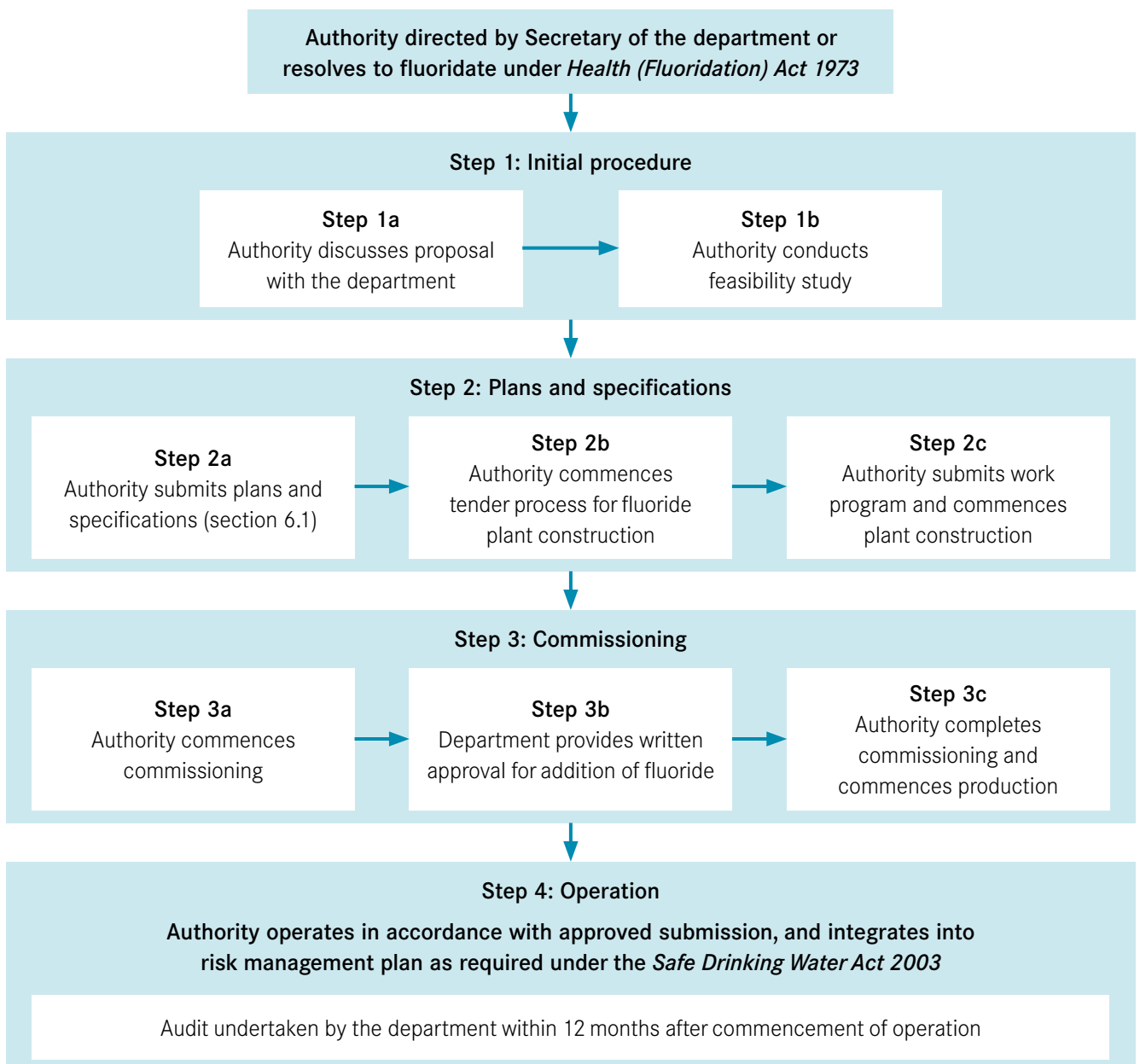
Pursuant to section 6(2) of the Act, the department will consider the submission, including any amendments to

plans and specifications, and based on this will make an assessment whether to approve the addition of fluoride into the drinking water supply. The authority must not introduce fluoride to the drinking water supply until written approval by the Secretary of the department, or their delegates, has been provided.

2.3.6 Audit

An audit will be undertaken by the department within 12 months after fluoride dosing commences.

Figure 1: Procedure to fluoridate



3 Safety in design

3.1 Approach

In the context of water fluoridation, safety in design encompasses:

- drinking water safety
- occupational health and safety
- environmental safety.

The safety in design process is the application of a risk management framework early in the design process to eliminate or minimise the risk to public health and the environment and to ensure occupational health and safety throughout the life of the fluoridation plant being designed. It encompasses all phases of the plant design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout and configuration.

A safe design basis, together with a formal safety management system and safety practices, procedures, and training, is critical for providing the level of confidence required for risk management.

3.2 Risk assessment

The authority must carry out and document a site-specific risk assessment covering all aspects of safety and environmental risk associated with the design and operation of the fluoridation plant. Where risks are identified, appropriate control measures (based on the hierarchy of controls) must be implemented.

Based on the hierarchy of controls, hazards should be eliminated wherever possible, followed by use of engineering controls.

The risk assessment for the fluoridation plant and the effectiveness of implemented control measures should be reviewed on a regular basis. Initial design risk control measures must not be degraded through subsequent modifications of the fluoridation plant and/or the water supply system.

3.2.1 Risk-based systems

Risk-based systems include ISO 9001, ISO 14001, HACCP and local standards such as the Australian and New Zealand *Risk management standard* (AS/NZS 4360). A risk-based system must be used to systematically address and manage risks associated with the fluoridation plant prior to commissioning.

3.2.2 Hazard and operability (HAZOP) studies

The authority must also conduct a hazard and operability (HAZOP) study in accordance with Australian Standard *Hazard and operability studies (HAZOP studies)—Application guide* (AS 61882–2003). The HAZOP must involve the application of a formal systematic critical examination to the process and engineering intentions of the fluoridation plant to assess the hazard potential of mal-operation or malfunction of individual items of equipment and their consequential effects on the water treatment plant as a whole.

The actions arising from the HAZOP study must be incorporated into the design and/or operation of the fluoridation plant.

3.3 Drinking water safety

The performance objective is to ensure the design, construction, installation, operation and maintenance of the fluoridation plant protects public health by:

- maintaining the optimum fluoridation concentration in the drinking water supply
- preventing overdosing of fluoride
- the implementation of quality assurance processes to guarantee the chemical purity of the fluoridating agent.

Controls for managing risks to drinking water safety, as identified through the site-specific risk assessment, must be incorporated in the authority's drinking water risk management plan that is required under the SDWA.

3.4 Occupational health and safety

The design and operation of the fluoridation plant must ensure worker safety. The authority must conduct and document a site-specific safety hazard risk assessment covering all aspects associated with the design and operation of the fluoridation plant.

The authority must ensure risks are assessed and managed in accordance with the relevant occupational health and safety requirements. The Australian Safety and Compensation Council's *Guidance on the principles of safe design for work* provides information and advice on eliminating hazards and controlling risks at the design, construction and operational stage to those involved in the design or modification of products, and processes used for work.

3.5 Environmental safety

The design and operation of the fluoridation plant must not cause environmental harm. The authority must conduct and document a site-specific environmental risk assessment covering all aspects associated with the design and operation of the fluoridation plant, including the delivery, storage and handling of the fluoridating agent.

4 Design of fluoridation plant

4.1 Design criteria

4.1.1 Legislation, regulations, guidelines, standards and codes

The authority must ensure the fluoridation plant complies with the relevant legislative requirements, guidelines, standards and codes in the design, construction and operation of a fluoridation plant. These include, but are not limited to:

- Acts (refer to section 2.1)
- AS1319 *Safety signs for the occupational environment*
- AS 1345 *Identification of the contents of pipes, conduits and ducts*
- AS 3780 *The storage and handling of corrosive substances*
- AS/NZS 1715 *Selection, use and maintenance of respiratory protective devices*
- AS/NZS 4020 *Testing of products for use in contact with drinking water*
- AS/NZS 4360 *Risk management*
- AS/NZS 4452 *The storage and handling of toxic substances*
- AS/NZS 4801 *Occupational health and safety management systems—Specification with guidance for use*
- *Australian code for the transport of dangerous goods by road and rail, 7th Edition, 2007*
- *Australian drinking water guidelines (ADWG) 2004*
- *Building code Australia (BCA)*
- *Dangerous Goods (HCDG) Regulations 2005*

- *Dangerous Goods Storage and Handling (Code of Practice) No. 27, 2000*
- *Dangerous Goods (Storage and Handling) Regulations 2000*
- EPA Victoria Publication 347, *Bunding guidelines*, December 1992
- *Manual handling code of practice*
- *Occupational Health and Safety Regulations 2007*
- *Plumbing Regulations 1998*
- *Road Transport Reform (Dangerous Goods) Regulations 1997*
- *Safe Drinking Water Regulations 2005*
- state environment protection policies.

4.1.2 Chemical selection and approval

Only fluoridating agents approved in the *Australian drinking water guidelines* are permitted to be used to fluoridate a water supply. These fluoridating agents are listed in Table 1.

The authority is responsible for selecting the most suitable fluoridating agent for the drinking water supply. Evidence of the selection process (a risk assessment) must be included in the authority's submission. The selection process must consider material availability and accessibility, whether a quality management system is in place to ensure chemical purity, site constraints and how the authority will comply with regulation 6 (1) (e) of the Safe Drinking Water Regulations. This regulation specifies details of procedures and management systems pertaining to the amount and purity of chemicals added to drinking water and controlling any residue or by-product in drinking water.

Table 1: Fluoridating agents

Common name	Fluoride compound	Formula	CAS no.	Alternative name
Sodium fluorosilicate	Disodium hexafluorosilicate	Na ₂ SiF ₆	39413-34-8	Sodium silicofluoride
Fluorosilicic acid	Dihydrogen hexafluorosilicate	H ₂ SiF ₆	16961-83-4	Hexafluorosilicic acid
Sodium fluoride	Sodium fluoride	NaF	7681-49-4	Sodium monofluoride

The authority must develop and use a specification for purchasing fluoridating agents to ensure consistency in physical characteristics and concentration of fluoride, as well as the chemical specification. The ADWG and the latest American Water Works Association standard specifications for the various fluoridating agents are to be treated as a minimum requirement.

The fluoridating agent must meet appropriate specification limits for contaminants using the Recommended Maximum Impurity Concentration (RMIC) approach as described in chapter 8 of the ADWG.

The authority must undertake a risk assessment to ensure that any material used in the dosing of fluoride, such as soluble bags, do not present a risk to public health.

4.1.3 Concentration of fluoride in water

The purpose of fluoridation is to adjust the natural fluoride content of drinking water to the optimum level to provide a dental health benefit. The optimum fluoride concentration in a water supply is based on water consumption, which has been shown to correlate best with ambient air temperature.

The target concentration of fluoride in treated water is described in Table 2.

The selected dosing concentration and the basis for the selection (including allowance for the fluoride concentration in the raw water) must be included in the final plans and specifications to the department. The authority should maintain a historical record of the fluoride concentration in the raw water to ensure an appropriate allowance for the fluoride concentration and determining the dosing concentration. The fluoride concentration in the raw water should be analysed at an appropriate frequency for the expected variability.

Notwithstanding Table 2, pursuant to section 5(3) of the Act, the authority must not add fluoride to an extent that results in an average optimum concentration in excess of 1 mg/L over any 12-month period in any water sampling locality.

Owing to expected increases in average temperatures, the department will review, as appropriate, the annual average maximum daily air temperature based on data from the Australian Bureau of Meteorology. The department will notify the authority of any changes to the target concentration of fluoride in treated water.

Table 2: Optimum fluoride levels[^]

Annual average of maximum daily air temperatures (°C)*	Recommended total fluoride concentrations [†] (mg/L)
14.7–17.6	1.0
17.7–21.4	0.9
21.5–26.2	0.8
26.3–32.5	0.7

[^] Adapted from American Water Works Association, 2004, *Water fluoridation principles and practice, Manual of water supply practices*, 5th edition.

* Based on temperature data for a minimum of five years.

[†] Division of Oral Health, Centre for Disease Control and Prevention, US Public Health Service, Atlanta, GA.

4.1.4 Design control limits

The design of the fluoridation plant must:

- use a fluoride dosing concentration as determined using section 4.1.3 and approved by the department, and be controlled to the limits specified in Table 3
- at no time allow the fluoride concentration in the drinking water supply to exceed 1.5 mg/L (as specified in the ADWG).

Real-time fluoride monitoring, linked to an appropriate alarm monitoring system and automatic shut-down, is required for all dosing installations and must be available at all times. The fluoride plant control limits in Table 3 apply specifically to the instruments used for real-time fluoride monitoring, namely instruments used for calculating instantaneous water flow and fluoride dose rates, and analyser/s for monitoring the fluoride concentration.

Any delay time associated with the process limits in Table 3 (to account for instantaneous spikes) must be kept to a minimum, justified and specified in the plans and specifications.

Table 3: Fluoride plant control limits and alarms

Parameter	Total fluoride concentration (mg/L)	Response to process limits
Operating target	As determined by section 4.1.3.	-
Operating range	Operating target \pm 0.1 mg/L	-
Lower action process limit	0.6*	Dosing corrected. No shut down required.
Upper action process limit	1.2 [^]	Immediate fluoride plant shut down. (Online monitoring system must be interlocked with the dosing system.)
Emergency process limit	1.5 [†]	Immediate fluoride plant shut down. (Online monitoring system must be interlocked with the dosing system.) The department must be notified immediately.

[^] This action level is based on a slightly lower dose than the maximum level of fluoride permitted in the ADWG, and has been established to ensure that the ADWG level is never exceeded.

[†] NHMRC and NRMMC 2004, *Australian drinking water guidelines*

* NHMRC 2007, *A systematic review of the efficacy and safety of fluoridation*

4.1.5 Functionality of the fluoridation plant

The fluoridation plant must be designed to meet the following requirements:

- (a) The design of the fluoridation plant must provide plant operational staff with all that is required to monitor and control the fluoridation process reliably, accurately and in a timely manner.
- (b) The fluoride concentration in the water supplied for drinking must comply with the requirements set out in section 4.1.3 and 4.1.4.
- (c) The plant must be fully automated and operated by treatment-plant-based control (that is, programmable logic controller).
- (d) The plant must ensure dependable automatic operation with reliable stopping and starting of the system during plant shut-down and start-up.
- (e) The plant must have alarms (including after hours to duty operator) and automatic shut-downs.
- (f) For fluorosilicic acid the fluoride transfer from the bulk tank to the day tank must occur once in a 24-hour period. Refer to section 4.3.3.
- (g) Bulk tanks (fluorosilicic acid) and day tanks (fluorosilicic acid and saturated sodium fluoride) must be equipped with online level indicators and an easily readable graduated volume scale.
- (h) For fluorosilicic acid and saturated sodium fluoride, the day tank must be equipped with online weight measurement.
- (i) Fluoride dosing must be flow-paced based on the measured flow into which the fluoride is being dosed. This will typically be achieved using a suitably placed flow meter and variable speed dosing pumps. A secondary flow-based control device (for example, a flow meter or flow sensing device such as a flow switch) should be provided as backup protection.
- (j) The maximum physical dosing capacity of the fluoridation chemical feeding equipment must be limited by design to a maximum value that is as close as practicable to the operating target dose rate at the maximum water flow rate. This maximum value must not exceed 110 per cent of the operating target dose rate at the maximum plant capacity.

(k) An online fluoride analyser, linked to an appropriate alarm monitoring system and automatic shut down, must be installed downstream of the injection point. The sample point supplying the analyser must be located such that the measurement reflects the real-time dosing performance of the fluoridation plant. To achieve this requirement:

- The sampling point must be located such that adequate mixing has taken place before the sampling point.
- The time taken for the sample to travel from the sampling point to the instrument should be kept to a minimum.
- The sampling point must be before the first draw off for a consumer, and should be located upstream of the clear (or treated) water storage or, if downstream, at such a location that the measurement reflects the real-time dosing performance of the fluoridation plant.

(l) The authority must ensure that upon failure of the control system, treated water exceeding the emergency process limit in Table 3 does not enter the drinking water supply system.

(m) Dosing pumps must be in a duty/standby arrangement.

4.1.6 Other design considerations

(a) Water service off-takes

No drinking water service within the plant or to consumers must be taken directly off the water line to which fluoride is dosed.

(b) Anti-siphonage and back-flow protection

The dosing system must be fitted with back pressure, anti-siphon and pressure-relief valves.

Any water supply used for dissolving the fluoridating agent or as carry water must have a backflow prevention device fitted upstream of where the fluoridating agent is dissolved or diluted (such as mixing tanks), or injected (such as dosing pumps). In some situations this can be achieved simply through using an air gap. Where relevant the device must comply with the current Australian standards.

A shut-off valve (interlocked with the control system) in the dosing line at the fluoride injection point is recommended.

(c) Control equipment

It must be made physically impossible for any component of the fluoridation feeding or control equipment to be manually plugged into standard electrical outlets for continuous operation. Any manual mode (or 'test') switch for the fluoridation chemical feeding equipment must not permit permanent selection (such as spring-loaded switches) and must return to the off position when released to prevent unattended manual operation.

All key components of the fluoride dosing system must be interlocked in the control system to ensure total fluoride dosing system shutdown on the failure of any individual equipment item and to ensure that the dosing system cannot operate unless water is flowing. These key components include, but are not limited to: stop/start/pacing signals; feeders; dosing pumps; solution transfer pumps; solution tank levels; solution tank weight; dilution water pumps; and an online monitoring system.

An assessment of the possible causes of overdosing must be conducted on the plant design and, where appropriate, interlocks and alarms designed into the system.

4.2 Equipment

All equipment used for adding fluoride to a drinking water supply is required to operate in a safe, reliable and precise manner.

The authority must ensure that the equipment and associated controls have safety measures against overdosing and under dosing of chemical through human or operational malfunctions and that the equipment is safe to operate and maintain.

4.3 Chemical delivery, handling and storage

The delivery, handling and storage of chemicals must be in accordance with occupational health and safety and environment protection requirements to ensure the safety of staff, the community, the environment and the drinking water supply.

4.3.1 Chemical delivery and quality assurance

The authority must implement a quality assurance system for the supply and delivery of the fluoridating agent to ensure its chemical purity, safe delivery and use. The quality assurance system must be implemented to manage all the factors associated with the specification, contract management, supply, purity, storage, use and handling of fluoride compounds that could adversely impact upon the health and safety of staff, contractors and consumers. Chapter 8 of the ADWG describes the components that make up an effective quality assurance system for drinking water treatment chemicals. These components must be integrated into the authority's quality assurance system.

The authority must require regular chemical analysis by suppliers in supply contracts. The contractual requirement for chemical delivery must be supported by batch-testing data provided by the supplier from an independent National Association of Testing Authorities (NATA) accredited laboratory, and random testing carried out by the authority. Chemicals must not be accepted for delivery unless a batch Certificate of Analysis has been obtained and checked against the contract specification by the water authority. Refer to section 4.1.2 for further discussion on chemical selection and impurity.

Specifically, the authority must implement procedures and management systems for:

- ensuring that the amount and purity of fluoride chemicals added to the drinking water does not adversely affect the quality of that water or pose a risk to human health
- controlling any residue or chemical by-products imparted to drinking water as a result of the addition of chemicals to water supplied for drinking water purposes
- supervision of deliveries by competent staff for the entire duration of the operation and ensuring that the correct chemical has been delivered by checking the documentation.

The site and plant must be designed to allow for the safe delivery of chemicals in accordance with the legislative requirements for transporting and handling of chemicals.

For fluorosilicic acid, the delivery area and sump must comply with the *Bundling guidelines* (EPA Victoria publication 347). For fluorosilicic acid deliveries the delivery truck must be fully standing on the delivery bund during chemical transfer.

Dry fluoride chemicals must be delivered to and stored in hardstand areas to facilitate easy cleanup in the event of a spill. A delivery bund is not required for dry fluoride chemicals; however, the authority must ensure unloading can be undertaken in a safe and environmentally responsible manner. This includes ensuring that spills of the dry chemical can be cleaned up and disposed of safely.

4.3.2 Bulk chemical storage

The authority must ensure that there is sufficient chemical available and readily accessible to ensure continuity of water fluoridation. The authority should document its storage assessment (taking into consideration availability of the fluoridating agent, transport, procurement strategies and itinerant populations).

Design of the bulk chemical storage must take into consideration:

- (a) material selection (fit for purpose)
- (b) safety in design for access, operation and maintenance ensuring compliance with relevant codes, guidelines and regulations
- (c) that chemicals are stored separately where required as per the *Occupational Health and Safety Act*
- (d) the chemical storage bund requirements for fluorosilicic acid as per the *Bundling guidelines* (EPA Victoria publication 347)
- (e) that dry fluoride chemicals require handling equipment suited to the form and unit size of the delivered chemical
- (f) spill removal and cleanup procedures
- (g) ventilation and dust extraction as appropriate for the selected chemical
- (h) measures to prevent corrosion (such as sealing all connections, water traps)

- (i) weather protection as appropriate
- (j) controls and instrumentation including alarms, and visual display of tank contents
- (k) access authorisation.

4.3.3 Transfer and day tank

All fluorosilicic acid and sodium fluoride saturator fluoridation plants must include the provision of a day tank to guard against the possibility of the entire contents of the bulk storage tank discharging into the water supply. Arrangements for the transfer of the fluoridation chemical from the bulk tank to the day tank must meet the following basic principles:

- (a) Transfer must be by controlled pumping. Gravity transfer must be prevented by appropriate design (for example, an anti-siphon loop).
- (b) All equipment, pumps and day storage should be located within a bunded area and chemical spillage must be captured in a safe manner.
- (c) The day tank must not be filled more than once in any 24-hour period. If a day tank holds less than 24 hours' supply of the chemical, it must not be filled more than once in the number of hours of supply that it does hold.
- (d) The day tank must contain no more than 24 hours' storage volume at maximum flow and target dose rate.

The day tank containing the acid must be vented to the outside atmosphere and all connections must be sealed to prevent corrosion of the equipment in the room, 'clouding' of any windows and damage to any electrical panels.

Corrosion prevention and dust suppression measures must be implemented.

4.3.4 Bag loaders

Where a dry fluoridating agent is used, the design of the plant must minimise airborne dust and the need for manual handling. Where manual handling is necessary, this must be in accordance with the *Occupational Health and Safety Regulations 2007*.

4.4 Chemical mixing and dosing

4.4.1 Mixers

Fluoride solutions must be homogeneous, no matter which method is used to prepare them. Mechanical mixers, if required, are preferred for the preparation of a dilute solution.

4.4.2 Softeners

A softener should be used if the hardness of the water used for sodium fluoride dissolution is likely to cause operational problems due to precipitation, or result in variation in the treated water fluoride concentration.

4.4.3 Dosing pumps

Dosing pumps must be able to accurately deliver the required flow rate, and be sized such that they operate at their maximum output at the maximum flow of the treatment plant. A method for calibrating dose rates must be available and maintained to ensure its reliability.

Any risk of gravity flow or siphoning of the fluoride chemical through the dosing pump must be prevented. Pressure relief and a loading valve on the delivery side of the pump must be provided.

The transfer pump and dosing pumps must be located above the maximum spillage level of the storage tank should they be located within the bunded area.

4.4.4 Dry feeder systems

Dry feeder systems must be able to accurately deliver the required volume or weight of fluoridation chemical for the quantity of water being treated and must be sized for the maximum flow of the treatment plant.

4.4.5 Injection point

The location and detailing of the chemical injection point must be designed to ensure:

- (a) homogenous mixing of the chemical in the treated water (where necessary carry water or mixing devices may be used)
- (b) reducing loss of fluoride by precipitation with other chemicals (such as those containing calcium, aluminium and magnesium) or treatment processes (such as coagulation, filtration and pH correction)
- (c) reducing the possibility of siphonage and overfeeding
- (d) provision of a sampling point and the associated analytical and control equipment for automatic shutdowns
- (e) location upstream of buffer storage of treated water
- (f) no bypass or secondary pipework (or channel) into which the fluoride chemical will not be dosed (except for fire-fighting purposes).

4.5 Process control and instrumentation

Dosing fluoride into drinking water is a continuous process that will involve lifetime exposure to fluoride for most consumers. It is therefore essential that the authority has in place a validated and verified system of accurately controlling fluoride dosing at all times.

For the process control of the fluoridation plant the following instrumentation must be provided:

- (a) online fluoride analyser (refer to section 4.1.5)
- (b) reference fluoride analyser to verify the performance of the online unit
- (c) flow meter (to allow calculation of flow and volume) on the process stream into which fluoride is being dosed
- (d) load cell and flow meter on the vessel supplying fluoride to the dosing pump
- (e) level or pressure indicators on bulk tank, saturator/mixing tank and day tank
- (f) alarm system to notify dosing abnormalities during unsupervised and after-hours periods.

Online instruments must be calibrated against a reference instrument at regular intervals. The frequency must be in accordance with the supplier recommendations and underpinned by a risk assessment.

In any submission to the department, the authority needs to justify its control strategy, including the suitability of analysers and other instrumentation.

4.5.1 Measurement of the fluoride concentration

The authority must measure the total amount of fluoride in the supplied drinking water. The method for measuring the total fluoride concentration must conform to the ion selective method as described in the current edition of *Standard methods for the examination of water and wastewater* 4500-F-C.

The ion selective (lanthanum fluoride crystal) membrane is sensitive to interferences from certain multivalent cations (notably Al^{3+} and Fe^{3+}) and pH. For these reasons, the standard method describes the use of a buffer and a metals complexing agent. Differences in calibration and operating temperatures can also cause inaccuracies and therefore any instrument used must account for such differences.

The authority should carry out method and instrument validation to determine a limit of detection and resolution of their measuring instrument. Accuracy to at least ± 0.15 mg/L should be achieved by a well-maintained instrument in a production environment.

For online measurement and operational control, other methods of fluoride analysis may be employed provided they can be shown to be as accurate as the ion selective method. Measuring techniques that cannot be calibrated against a primary standard are not accepted as definitive evidence of accurate dose control.

If the authority chooses to use a non-ion selective method for operational control, it must consider the risk of interferences in the raw water and the risk of variability in raw water quality. High-risk raw waters will require the use of the ion selective method for online monitoring.

The authority must analyse the treated water downstream of the online analyser on three separate days each week. The samples are to be analysed using a bench top analyser and the results compared to ensure the accuracy of the online analyser.

Irrespective of the online measurement method, the bench top reference unit must be an ion selective electrode (ISE) employing the standard method referenced above. The authority must calibrate the reference unit at appropriate intervals using traceable primary standards.

4.5.2 Flow meters

A flow meter(s) must be provided to measure and integrate the water flow, and to pace the fluoride dosing equipment where the plant design calls for such, over the full water flow rate range approved by the department. The metered flow must be truly representative of the flow into which the fluoride is dosed.

The flow rate signal must be fed back to the fluoride dosing system for adjustment of the fluoride dose rate. The use of electromagnetic flow meters is recommended with an accuracy of ± 1 per cent over the complete range of flow, but must not exceed ± 3 per cent.

If a sodium fluoride saturator is used, a flow meter must be placed in the service water line to monitor and record the dilution water volumes.

4.5.3 Load cells

Load cells must be provided for online measurement of the loss of mass in the day tank, as a check of the average concentration being dosed compared with results for the online fluoride analyser. The accuracy of the load cell measurements must be within ± 1 per cent of the range being measured.

4.5.4 Level and pressure indicators

All fluorosilicic acid storage tanks and saturator/mixing tanks must be equipped with level or pressure indicators to measure, display and alarm the liquid level in the storage tank. Daily changes must be recorded and used as an additional check of the volume of fluoride chemical consumed in the process, as compared with results from the day tank load cell and the online fluoride analyser. The accuracy of the instruments must be within ± 1 per cent over the full range of the instruments.

4.5.5 Control and alarms

The fluoridation plant must alarm and respond to the fluoride action limits as specified in Table 3.

All dosing systems must be configured so as to 'fail safe', that is, failure of a critical component leads to the cessation of dosing and generation of an alarm. Fluoride concentration alarms from the instrument must be transmitted to the duty operator. Loss of water to the online fluoride analyser must also generate an alarm.

After-hours alarms on unattended periods must inform a resource capable of immediate response.

Where dosing is stopped during automatic operation that is outside of the normal operating parameters of the plant (either manually or by shutdown alarms), dosing must not restart automatically without manual on-site intervention.

Where automatic shutdown systems can be manually overridden (such as for maintenance purposes) any override events must be logged and the override facility configured such that the operator is aware that an override is activated (such as by the activation of a local or telemetry alarm).

The operation of shutdown systems must be fully tested at least annually and the outcome of these tests recorded. The testing process must form part of the risk management plan.

4.6 Plant security

The authority must control access to the fluoridation plant in order to prevent unauthorised access and minimise the risk of anyone being injured. Appropriate signage must be provided to indicate the presence of the fluoridating agent, any electrical or OHS hazard and any required personal protective clothing or equipment, and that authorised entry only is permitted.

Access to the fluoridation plant should be restricted through provision of a security locking system.

5 Operation and maintenance

All plant and equipment used for adding fluoride to a drinking water supply must operate in a safe, reliable and precise manner. The authority must only use plant and equipment as specified in the plans and specification and as approved by the department, and must ensure that this plant and equipment is maintained.

5.1 Operational monitoring and verification monitoring

5.1.1 Monitoring of fluoride concentration in the raw water

The fluoride concentration in the raw water should be analysed at an appropriate frequency for the expected variability. The sample must be analysed for fluoride at a NATA-accredited laboratory using the methodology identified in section 4.5.1 above. Any detected variation must be taken into account when designing the control mechanisms for a dosing plant installation.

5.1.2 Quantity of fluoride dosed

Every 24 hours the mass of fluoride consumed by the plant must be calculated and divided by the volume of water that has passed the fluoride dosing point. This is an independent check of the average concentration dosed over each 24-hour period. Any inconsistencies must be investigated and remedial actions taken to bring the actual dose within the operating dose range (refer to section 4.1.4).

5.1.3 Continuous monitoring of fluoride

Continuous fluoride monitoring, linked to an appropriate alarm monitoring system and an automatic plant shut down, is required for all fluoridation plants. The performance of the instrument must be checked against a bench top reference unit (refer to section 4.5.1). These measurements should be compared with the quantity of fluoride dosed.

5.1.4 Monitoring in the distribution system

The authority must arrange to take water samples as follows:

- if a fluoride plant or plants supplies less than five water sampling localities then the authority must take a sample each week from a water sampling point in each water sampling locality supplied from those plants; or
- if a fluoride plant or plants supplies five or more water sampling localities then the authority must take a sample each month from a water sampling point in each water sampling locality supplied from those plants, such that a sample is collected from the distribution system at least once per week.

The sample must be analysed for fluoride using the methodology identified in section 4.5.1.

Notes:

In the event that a water sampling locality receives a blended supply of fluoridated water from two or more fluoridation plants at the same time, only one sample per locality is required.

In the event that a fluoridation plant or plants supplying a water sampling locality is off line for long periods of time advice must be sought from the department in relation to continuity of sampling under 5.1.4.

The sampling program under 5.1.4 must be integrated into the risk management plan under the SDWA for the authority and for any downstream water supplier receiving fluoridated water from the authority.

5.1.5 Monthly quality control sample

One sample per month must be obtained from the fluoridated treated water or the reticulation system and be analysed using the fluoride method routinely used at the treatment plant. The sample must then be forwarded to a laboratory that is NATA accredited for fluoride analysis. The sample must be analysed for fluoride at the NATA-accredited laboratory using the methodology identified in section 4.5.1. The results must be compared to validate the analytical method routinely used.

The authority must have a procedure to rectify discrepancies between samples.

5.2 Quality assurance

The quality assurance system must ensure the fluoridation process is adequately monitored and maintained such that any discrepancy, equipment reliability issue or unacceptable variability in the final fluoride concentration is readily identified and effectively rectified.

The authority must also include the details of the quality assurance (QA) and quality control (QC) framework that will be implemented to verify the accuracy of the results, and the corrective actions and process by which operators

will be informed in the event the fluoride dosing system is either under dosing or over dosing.

The QC framework must comprise activities (checks) designed to ensure: data integrity (consistency and accuracy); use of standardised procedures for sampling, analysis and data interpretation; identification of errors or omissions, and estimation of uncertainties; calibration of equipment; and credible results that relate to the data and analysis.

The authority must ensure that the operation manual is a controlled document with defined procedures/processes for amendment.

5.3 Maintenance and calibration

The authority must carry out weekly plant inspections and record in writing the outcome of these inspections and any resultant actions. Plant inspections will help ensure effective process control, determine whether equipment is operating normally and identify the need for maintenance.

All equipment and instruments considered vital for the process control must be maintained and calibrated regularly according to a maintenance schedule and a calibration schedule documented in the operation manual. The performance of dosing pumps should be calibrated at least monthly by measuring the volume of solution pumped during a measured time interval.

Upon request, the authority must provide the department with evidence of maintenance and calibration of all plant items and equipment.

5.4 Operational personnel

The authority must ensure that operational personnel (employees or contractors) are appropriately skilled and trained in the management and operation of the fluoridation plant. Operational personnel must have an adequate knowledge of the principles of fluoridation, the type of plant or equipment and its operation and maintenance.

Certificate III in Water Operations specialising in water treatment, as described in the Water Training Package NWP07, delivered by a registered training organisation with the Australian Quality Training Framework is recommended. Specifically the unit of competency 'Monitor, operate and report fluoridation systems' from the Water Training Package should be considered as the minimum requirement for operators of fluoridation plants.

Operational personnel must have a sound knowledge base from which to make effective operational decisions. This requires training in the methods and skills required to perform their tasks efficiently and competently. Operational personnel must be aware of the potential consequences of system failures, and of how their decisions can affect the safety of the scheme.

The authority is responsible for developing and implementing standard operating procedures for carrying out routine operational duties within the fluoridation plant. All operators must be competent in carrying out these procedures. The authority must ensure that the operation of the fluoridation plant is supervised and operated by competent personnel (employees and contractors). The authority must ensure that it has a sufficient number of trained people available to enable operation of the fluoridation plant at all times.

5.5 Occupational health and safety

In the area of safety, and the handling and storage of dangerous goods, the *Occupational Health and Safety Act 2004*, the *Dangerous Goods Act 1995* and associated regulations have precedence over this code. If clarification is required in these areas then WorkSafe Victoria will provide the defining interpretation.

The health and safety measures discussed below provide a basis for an authority to assess the control measures it should employ to manage occupational and safety risks associated with fluoridation systems. The control measures listed are not exhaustive and the use of these control measures in no way implies that this is sufficient to comply with the above mentioned Acts and Regulations.

Health and safety measures for consideration in the design and operation of a fluoridation plant include:

- (a) safety in design to ensure a safe working environment and facilitate safe working practices
- (b) effective control measures are applied to mitigate risks as identified by the risk assessment
- (c) adequate training for plant operators as to the hazards associated with the fluoridating agent
- (d) accessibility of the Material Safety Data Sheet (MSDS) for the fluoride chemical by maintaining the MSDS in the operation manual, and providing a copy close to where the substance is used to enable reference to it by operators who handle the substance

- (e) pipework and tanks used for storage and distribution of fluoride chemicals comply with the relevant standards and are appropriately distinguishable (for example, colour coded and labelled) from other plant pipework
- (f) the installation and arrangement of the equipment ensures that the handling and operation of the equipment meet workplace health and safety requirements
- (g) fluoridation equipment to be kept separate from other water treatment plant equipment in a separate building or fluoridation room
- (h) control panels, such as electrical control panels for the fluoridation plant, are protected and located outside the fluoridation room
- (i) the atmosphere of any areas where fluoridating agents are stored or used is safe for workers, and ventilation and dust extraction as appropriate for the selected chemical is provided
- (j) appropriate personal protective equipment is supplied and maintained by the authority for mandatory operator use
- (k) emergency eyewash/showers are available where fluoridating agents are stored and handled.

5.6 Environmental safety

The authority must ensure that the design and operation of the fluoridation plant does not result in environmental harm.

In its management of the fluoridation plant and ancillary equipment and activities, the authority must consider the *Environment Protection Act 1970* and relevant environmental quality guidelines and protection measures as set out in the following state environment protection policies:

- *Waters of Victoria*
- *Groundwaters of Victoria*
- *Prevention and management of contamination of land*
- *Ambient air quality*
- *Air quality management.*

5.6.1 Spills and leaks

The authority must ensure the fluoridation plant and equipment is designed and operated to minimise the risk of fluoridating agent spills or leaks. Any spills or leaks must be contained and must not come into contact with or be stored with incompatible chemicals.

Where fluorosilicic acid is used then appropriate bunding and other measures (such as drip trays) must be provided to contain any spillage. The design of bunding must facilitate the safe removal of any spillage, and be consistent with the *Bunding guidelines* (EPA Victoria publication 347) and relevant Australian standards. In designing the fluoridation plant, the inclusion of all elements containing concentrated fluorosilicic acid (including the feeding equipment) in the storage bund area may be an effective way of reducing environmental risks.

Operating procedures must include measures for managing spills and leaks of the fluoridating agent, including in-built detection devices, surveillance, corrective actions and remedial works, and notification and reporting to the appropriate authorities. Fluoride piping should be visible so that it can be easily inspected for integrity. Where pipes are not visible, leak detection measures must be in place.

5.6.2 Release to the atmosphere

Where dry fluoridating agents are used, measures must be implemented to control dust. This includes designing the plant to prevent the escape of powder into the fluoridation room and atmospheric discharges.

Dry sweeping of dry fluoride chemical should not occur. If powder is spilt then it should be cleaned by vacuuming that is fitted with a HEPA filter to prevent dust. Operators must use personal protective equipment.

5.6.3 Waste disposal

The management of waste containing fluoride must be in accordance with the *Environment Protection (Prescribed Waste) Regulations 1998*. Wastes include fluoride chemical and plant and equipment that have been in direct contact with fluoride chemical.

The authority must document and implement an environmental waste disposal plan for fluoridating agent spills and leaks, contaminated fluoridating agent and fluoridating agent containers.

6 Documentation

6.1 Documentation for approval

Under the Health (Fluoridation) Act, before adding fluoride to any public water supply, the authority is required to submit plans and specifications to the department for the proposed scheme for fluoridation.

In the case of a fluoridation plant upgrade, the department must be consulted in advance and, if required by the department, the authority must submit documentation for approval to fluoridate the water supply.

The authority must submit the following documentation to the department for approval of a fluoridation plant:

- the drinking water supply and the water sampling localities proposed to be supplied
- plans and specifications including:
 - general description of facility and process including an outline of the overall treatment process, description of fluoridation facility, and the design capacity of the plant, expected minimum and maximum flows in normal operations and the expected growth of flows with time
 - a location map, a site plan, and a ‘general arrangement’ showing the fluoridation facility in the context of the overall treatment plant
 - evidence of the chemical selection process, natural fluoride content, optimum fluoride level and the dosage concentration
 - fluoride design control limits, maximum pumping rate, feed rate and dosage calculations
 - functionality of the fluoridation plant including details of intended process control, process and instrumentation (including process and instrumentation design), control philosophy for the proposed facility and integration into overall treatment process
 - risk assessment as per section 3, 4.1.2, and 4.3.1, including the fluoridating agent selection process, quality assurance processes, supply and delivery risks, storage risks and the prevention or control of dosing risks associated with human error, plant malfunction and plant performance

- specification limits developed for contaminants of the selected fluoridating agent
- plans showing the spatial relationship (including levels) between the storage and metering facility and the dosing point, the relationship between the dosing points for fluoride and for any other chemicals added ‘post treatment’, and the pipeline layout from the dosing point downstream to the next component in the plant such as the clear water storage
- measurement of fluoride, monitoring program and quality assurance
- a gap analysis against this code providing justification for any deviations from the requirements of this code and demonstrating an equivalent or greater level of safety
- project plan including timelines
- commissioning plan
- any additional information required by the department.

Documentation pertaining to approved fluoridation plants must be incorporated in the authority’s quality management system. Plant operational staff must be aware of the location of these documents and be familiar with their content once the plant has been commissioned.

6.2 Completion of work

Upon completion of plant construction and commissioning, the authority must maintain the following documentation:

- operation manual including as-constructed drawings and functional description
- emergency management plan
- maintenance and calibration schedules for major equipment items
- commissioning records verifying that the fluoridation plant installation is in accordance with the plans and specifications and its operation is safe and reliable.

6.3 Operation manual

The operation manual must contain adequate provisions and details to assist the operational staff in the operation and maintenance of the facility. The operating manual should be a controlled document and must be integrated into the authority’s quality management system.

6.4 Emergency management plan

The preventive risk management system must include the development of considered and controlled responses to incidents or emergencies that can compromise the safety of fluoridating a drinking water supply, worker safety or the environment.

The authority must develop and implement an emergency management plan to manage incidents and emergencies, including fluoride overdosing, spills entering the environment and operator exposure.

The emergency management plan must address how the system will be managed to prevent fluoride concentrations over 1.5 mg/L reaching consumers.

An emergency management plan must address:

- procedures for shutting down the equipment in the event of overdosing
- the actions required to identify and rectify the problem
- action required to advise and protect the public in the event of a significant overdosing event
- reporting protocols including a clear chain of command and designated responsibility.

The emergency management plan must be integrated into the drinking water risk management plan under the SDWA. This specifically includes details of emergency management arrangements and procedures in accordance with regulation 6 (1) (f) of the Safe Drinking Water Regulations.

6.5 Record keeping

The authority must keep records verifying that the fluoride plant is managed and operated in accordance with this code. The records must be maintained and made available for inspection upon request by the department or by any person authorised by the department. Records include:

- regular chemical analysis of fluoridating agent delivered
- regular analysis of concentration of fluoride in raw water
- plant and equipment calibration and maintenance
- routine testing of critical alarms and corrective actions and outcomes of the system shutdown tests
- surveillance monitoring and audits records
- staff training records.

The authority must also record the following parameters at the frequencies indicated:

(a) continuously

- water flow
- online fluoride concentration
- fluoride solution flow

(b) daily

- the volume of water treated
- the quantity of fluoride added to the water
- the weight of the day tank prior to refilling and following refilling or volume of fluoride solution used
- the stock of fluoride on hand
- the results of fluoride analysis of the samples of water taken from the treated water
- average fluoride concentration over the day on the basis of the online analyser records
- average fluoride concentration over the day on the basis of the loss of volume in the day tank
- a reconciliation of the measured fluoride concentration (based on online analyser records) with the calculated fluoride concentration (based on day tank weight and loss of volume)

(c) weekly

- results from weekly sampling for fluoride in each water sampling locality receiving fluoridated water
- average weekly fluoride concentration using total weekly figures of water treated and fluoride used

(d) monthly

- the fluoride concentration in the reticulation system.

The manner in which this information is recorded (such as via log sheets, SCADA) should be determined by the authority in a manner consistent with the objectives of this code and the Act.

7 Reporting and auditing

7.1 Annual reporting

The SDWA requires water suppliers and water storage managers to provide the department with a report each financial year covering issues relating to the quality of drinking water and management of the water supply system. With regard to fluoride, the authority is required to include information pertaining to fluoridation for every fluoridated supply. The reporting requirements for fluoride will be specified by the department in a guidance note each year and apply to all drinking water supply systems in Victoria. Requirements pertaining to fluoridation may include:

- the annual average, minimum and maximum fluoride concentration at each fluoridation plant
- the annual average, minimum and maximum fluoride concentration from the weekly samples in the water sampling localities, including a summary of any missed samples
- a summary of incidents and emergencies that were reported during the year
- a summary of the fluoridation process and chemicals used at each fluoridation plant (including fluoridation plants operated by an upstream water storage manager).

7.2 Notification requirements

The department's Drinking Water Regulatory section must be notified of emergency and exceptional situations as described in Table 4.

7.3 Auditing

The authority's water fluoridation activities must be integrated into the *Drinking water risk management plan* and incorporated into the scope of the audit requirements of the SDWA.

Table 4: Emergency and exceptional notifications

Emergency and exceptional situation	Method of notification
Fluoride concentration in drinking water supplied in a water sampling locality exceeds or may exceed 1.5 mg/L.	Notification must occur within 24 hours as per the Section 22 notification requirements in the <i>Drinking water regulation guidance note no.7: Notifications required under the SDWA</i> .
Fluoride concentration measured at the fluoridation plant exceeds 1.5 mg/L, however, does not enter the drinking water supply.	An email detailing the issue to be sent to water@dhs.vic.gov.au within 24 hours of the issue occurring.
Fluoride dosing is less than the lower action process limit for a continuous period of >72 hours.	An email detailing the issue to be sent to water@dhs.vic.gov.au within 24 hours of the issue occurring.
If the rolling annual average fluoride concentration of drinking water in a water sampling locality exceeds or is expected to exceed 1.0 mg/L in any 12-month period.	An email detailing the issue to be sent to water@dhs.vic.gov.au within 24 hours of the issue occurring.

8 Bibliography

American Water Works Association, 2006, *Sodium fluoride standard (ANSI/AWWA B701-06)*. AWWA, Denver.

American Water Works Association, 2006, *Sodium fluorosilicate standard (ANSI/AWWA B702-06)*. AWWA, Denver.

American Water Works Association, 2006, *Fluorosilicic acid (ANSI/AWWA B703-06)*. AWWA, Denver.

American Water Works Association, 2004, *Water Fluoridation principles and practices, Manual of water supply practices* (5th edition). AWWA, Denver.

American Public Health Association, American Water Works Association, Water Environment Federation, *Standard methods for the examination of water and wastewater*, 21st edition.

Australian Safety and Compensation Council, 2006, *Guidance on the principles of safe design for work*. ASCC, Canberra.

Department of Health (South Africa), 2000, *Regulations on fluoridating water supplies*, Government Notice.

Drinking Water Inspectorate (England and Wales), 2005, *Code of practice on technical aspects of fluoridation of water supplies 2005*. DWI, London.

Environment Protection Authority Victoria, 1992, *Bunding guidelines*. EPA Victoria, Melbourne.

Irish Expert Body on Fluorides and Health, 2007, *Code of practice on the fluoridation of drinking water*. Irish Expert Body on Fluorides and Health, Dublin.

National Health and Medical Research Council, 2007, *A systematic review of the efficacy and safety of fluoridation*. NHMRC, Canberra.

National Health and Medical Research Council, 2004, *Australian drinking water guidelines*. NHMRC, Canberra.

New South Wales Department of Health (Oral Health Branch), 2002, *Code of practice for the fluoridation of public water supplies, Fluoridation of Public Water Supplies Act 1957*. Department of Health, Sydney.

Queensland Health, 2000, *Code of practice for the fluoridation of public water supplies*. Queensland Health, Brisbane.

Queensland Health, 2008, *Water fluoridation code of practice*. Queensland Health, Brisbane.

9 Further information

Department of Human Services

- Water fluoridation information line:
1800 651 723
- Website:
www.health.vic.gov.au/environment/fluoridation

