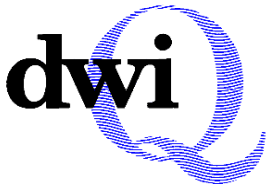

guardians of drinking water quality

Code of Practice on

Technical Aspects of Fluoridation of

Water Supplies 2016

Drinking Water Inspectorate
January 2016

Code of Practice on Technical Aspects of Fluoridation of Water Supplies 2016

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1. Introduction

The purpose of this Code of Practice on Technical Aspects of Fluoridation of Water Supplies 2016, (the Code of Practice) is to outline the principles to be followed by water undertakers and licensed suppliers[1] operating fluoridation schemes in England and Wales. The Code sets out the principles underpinning the safe design and operation of fluoridation installations which are intended to assist water suppliers in:

a) ensuring that fluoride concentrations in water supplies do not exceed the prescribed concentration specified in the Water Supply (Water Quality) Regulations 2000[2] of 1.5mgF/l;
b) avoiding over-dosing of fluoridation chemicals; and
c) maintaining, as far as is reasonably practicable, fluoride concentrations in drinking water within the operational criteria specified in the Company's agreement with Public Health England (PHE)[3]

The Drinking Water Inspectorate (DWI) expects water undertakers to meet the minimum requirements specified in the Code of Practice. However, it is anticipated that water undertakers' own policies and procedures may, where appropriate exceed these requirements.

The Code of Practice applies to all installations where fluoridation chemicals are dosed into public water supplies.

2. Legal framework

The following narrative summarises some key features of the legislation but should not be taken as a description of the entire content of that legislation. Water undertakers involved in fluoridation arrangements, or proposed arrangements, must ensure that they fully understand and comply with their obligations under that legislation.

Legislation concerning the fluoridation of community water supplies is contained within the Water Industry Act 1991 (Sections 87 to 91) ("the Act"), with amendments to the original legislation made by the Water Act 2003 and the Health and Social Care Act 2012. Secondary legislation for England is contained within The Water Supply (Fluoridation Indemnities) (England) Regulations 2005 and The Water Fluoridation (Proposals and Consultation) (England) Regulations 2013. Currently (at 2015) there are no corresponding regulations for Wales, the legislation not having been commenced in that jurisdiction.

Two key changes were introduced by the 2012 amendments to the Act. Firstly, responsibility for proposing new schemes, modifying existing schemes and terminating schemes transferred with effect from 1st April 2013 from the NHS to local government. Local authorities are defined for this purpose as county councils and, where there is no county council, district councils, together with, in London, borough councils and the Common Council of the City of London.

[1] Where reference is made in the Code of Practice to a "water undertaker" this shall equally apply to a licensed water supplier.

[2] Water Supply (Water Quality) Regulations 2001 in Wales

[3] For the purposes of this document, references to PHE equally refer to the Welsh Government in relation to Wales.

Second, responsibility for entering into and maintaining legal agreements for fluoridation schemes with water undertakers transferred, again effective from 1st April 2013, from the NHS to the Secretary of State for Health (SoS). (S)He can only do so if (s)he is so requested by local authorities which have undertaken the procedures prescribed in the Act and 2013 Regulations which include public consultation and consultation with all other affected local authorities (where applicable). For Wales, such requests to fluoridate would come from the National Assembly. Therefore, from 1 April 2013, all fluoridation agreements with water undertakers in England, including all agreements already established at that date, are held by SoS. In practice, many of the responsibilities of SoS are discharged on his/her behalf by Public Health England (PHE) (see below). Of particular note is that PHE is now responsible for initially meeting the costs of fluoridation but may recover such costs from local authorities.

The revised legislation incorporates a number of other modifications to previous statutory requirements and procedures which are consequential on those two key changes.

2.1 The role of Public Health England

Public Health England (PHE) is an executive agency of the Department of Health in England, established in April 2013. As such, it exercises on behalf of the Secretary of State for Health (SoS), many of the fluoridation responsibilities, powers and duties which, under the revised fluoridation legislation, now fall to SoS in England. Key elements of those duties and powers are described at section 2.1 above and, in practice, are largely delegated to PHE albeit that in some circumstances PHE may need to seek specific authorisation for particular actions.

PHE will, on request, provide local authorities and water undertakers with advice on the benefits and safety of water fluoridation. On behalf of SoS, PHE works with water undertakers to ensure the delivery of service under fluoridation agreements including performance of undertakers in delivering target concentration and makes payment for that service. As part of that process PHE requires regular performance data from each water undertaker operating fluoridation arrangements. Core data requirements are specified in an annex to this Code of Practice. PHE, under fluoridation legislation, re-charges local authorities for the operating costs of fluoridation arrangements.

In order to ensure that SoS is able to make informed judgements about the efficiency and operability of proposed new fluoridation arrangements, PHE is closely involved with local authorities and water undertakers in assessing the feasibility and costs of those proposed arrangements.

New fluoridation schemes require capital investment, as does the refurbishment upgrading or replacement of the fluoridation works in existing schemes. All such capital schemes have to be pre-agreed with PHE both in terms of content and cost through business processes which are periodically advised to water undertakers by PHE. Capital funding for agreed schemes of works is provided to water undertakers by PHE, which with the approval of SoS may elect to pass such costs on to those local authorities which are recipients of that fluoridation service.

PHE has a small national fluoridation team which is the main point of contact between PHE and each water undertaker. That central team holds regular meetings with each water undertaker, drawing in local PHE and local authority staff as appropriate.

PHE works closely with the Drinking Water Inspectorate on relevant fluoridation matters and as necessary with Water UK as the national body representing water undertakers.

2.2 Role of the Drinking Water Inspectorate

The Drinking Water Inspectorate (DWI) acts for and on behalf of the Secretary of State (for the Environment, Food and Rural Affairs) and the National Assembly for Wales in regulating the quality of public water supplies in England and Wales. DWI is responsible for assessing the quality of the water supplied, taking enforcement action if standards are not being met, and instituting proceedings when water unfit for human consumption is supplied.

Regardless of whether or not the concentration of fluoride in public drinking water supplies has been raised via an authorised fluoridation scheme, the concentration of fluoride in drinking water must not exceed the maximum concentration of 1.5mgF/l specified in the Water Supply (Water Quality) Regulations 2000.

Where the concentration of fluoride in public drinking water supplies is raised via an authorised fluoridation scheme, DWI will also:

a) expect water undertakers to comply with the requirements of this Code of Practice; and
b) audit water undertaker's arrangements for the fluoridation of water supplies as part of its on-going programme of technical audits.

3. Fluoridation chemicals

3.1 Chemical standards

Section 87C(2) of the Water Act 2003 permits the use of two chemical compounds to increase the fluoride content of water within an area subject to a fluoridation agreement. These compounds are:

- Disodium hexafluorosilicate (Na_2SiF_6); and
- Hexafluorosilicic acid (H_2SiF_6).

European standards for disodium hexafluorosilicate (Na_2SiF_6) and hexafluorosilicic acid (H_2SiF_6) have been published. The BS:EN Standards specify the physical properties and purity criteria required of the compounds, together with test methods for sampling and analysis of the compounds; labelling; transportation; and storage instructions. Companies are reminded that the BS:EN standard does not include reference to the silicate content, which has been associated with storage or dosing issues.

In order to be used in drinking water, these compounds must conform to either BS:EN 12174:2013 Sodium hexafluorosilicate or BS:EN 12175:2013 Hexafluorosilicic acid. Copies of these standards can be obtained from BSi Customer Services, (Tel: +44 020 8996 9000), or ordered from the BSi website: www.bsi-global.com.

Water treatment chemicals which conform to a European Standard may only be used where the national conditions of use are observed. National conditions of use, where applicable, are detailed in the List of Approved Products for use in Public Water Supply in the United Kingdom published by DWI. Water undertakers in England and Wales shall refer to the most recent version of the List which is available on the DWI website: http://dwi.defra.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf for current information on national conditions of use.

Water undertakers are expected to be aware of the contents of the relevant BS:EN standard for any fluoridation chemical used and must also ensure that adequate account has been taken of any additional guidance provided by the DWI.
Section 88 of the WIA91 confers powers on the Secretary of State to make an order to add, or to remove, a compound to the list of permitted fluoridation chemicals.

3.2 Health and Safety considerations

The use of chemicals in the water treatment process, including fluoridation chemicals must be adequately controlled to safeguard the health and safety of employees and the public. The safe use of these chemicals is covered by a range of significant legislation including:

- The Health and Safety at Work etc Act 1974 (HSWA) which places general duties on an employer to conduct their work in such a way that their employees will not be exposed to health and safety risks, and to provide information to other persons about their work place which might affect their health and safety. The legislation also extends these duties on employers to people other than their own employees.

- The Management of Health and Safety at Work Regulations 1999 require employers to make an assessment of the risks to the health and safety of themselves, employees, and persons not in their employment arising out of, or in connection with, the conduct of their business - and to make appropriate arrangements for protecting those people's health and safety.

- The Control of Substances Hazardous to Health Regulations 2002 (COSHH) impose duties on employers to assess the risks to health arising from exposure to hazardous substances, and to ensure that exposure to these substances is prevented or, where this is not reasonably practicable, adequately controlled.

Other relevant Regulations, Codes of Practice and Guidance (including Material Safety Data Sheets) shall be considered by water undertakers when developing written risk assessments, safe working policies, procedures and other suitable precautions. These precautions must be monitored and reviewed regularly. The provision of suitable instruction and training for staff shall be included.

3.3 Principles of Chemical Supply Resilience

Companies are expected to ensure that robust measures are in place to ensure the continued supply of fluoride chemicals. As with all treatment chemicals business continuity plans which cover poor quality product or insufficient supply must be documented.

4. Principles of fluoride dosing installations

In consideration of a suitable dosing (and monitoring) point, good practice shall be employed to ensure that the risk of supplying overdosed water is prevented where practicable (e.g. upstream of contact tanks). Depending on the target area to receive fluoridated water, and in consideration of the distribution network, fluoridation chemicals may be dosed within the treatment process of a water treatment works (WTW), on the outlet of a WTW, or (where practical and reasonable) at the inlet of a treated water storage point or at a fixed point within the distribution system. These latter options may be highly desirable to local authorities in providing the most precise targeting of fluoridation to local communities with the poorest dental health, but their practicality in each

physical situation must be risk-assessed. Always, health and safety; control of dosing; and access prevention measures will be paramount.

The target fluoride concentration for a fluoridation dosing scheme will normally be 1.0mgF/l. However, in each case the written agreement between the PHE and the water undertaker will specify the actual target concentration and the agreed operational criteria.

It is expected that water undertakers will have their own policies and procedures in place to support the implementation of this Code of Practice, which may, where appropriate, exceed the requirements of the Code of Practice. Site specific requirements will need to be agreed with the relevant PHE when establishing the fluoridation agreement. However, in all cases, fluoride dosing installations shall follow the principles described below in order to ensure suitable controls are in place to safeguard drinking water quality.

As noted at 3.1 above, two chemicals are permitted for use in water fluoridation schemes. In designing a particular dosing installation, a water undertaker will select the chemical it considers most suitable for that situation. Evidence of the selection process for that chemical, including a risk assessment, must be included in the water undertaker's proposal to PHE for a capital scheme of works. The selection process and documentation provided to PHE must include consideration of:

- the availability and resilience of supply of the selected chemical;
- site constraints and safety;
- control of dosing; and
- quality control processes are in place throughout the supply chain to ensure the supplied chemical is fit for purpose.

4.1 Hexafluorosilicic acid dosing installations

4.1.1 Chemical delivery, storage & transfer arrangements

Water undertakers must have in place suitable arrangements for the delivery and storage of fluoridation chemicals to prevent accidental spillage. These arrangements shall meet the following basic principles:

Chemical delivery

- Chemical delivery points shall allow appropriate safe access for the mechanism of delivery to the site (e.g. by tanker for hexafluorosilicic acid);

- Delivery locations shall be sited such that any spillage of fluoridation chemical is restricted to drainage facilities which allow spill containment and subsequent removal;

- Any bunding shall be coated with suitable protection

- Where the spill containment measures consist of an interceptor or containment tank, this tank shall be fitted with an audio-visual high level alarm;

- Arrangements shall be in place to contain and dispose of any spillage of fluoridation chemical (in line with advice provided by the supplier);

- Chemical delivery points shall be appropriately labelled, and permanently locked (except when a delivery is taking place) with a suitable key control regime in place;

- All chemical deliveries shall be supervised by a competent member of the water undertaker's staff for the duration of the chemical transfer process; and

- Where undertakers transfer chemicals from bulk storage to remote sites, they shall ensure they comply with the relevant legal requirements applicable to the chemical concerned and the method of transportation e.g. The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (CDG) for tanker transfers, or the Chemicals (Hazard Information and Packaging) Regulations for drums or other containers.

Bulk Chemical storage

- All tanks shall be of an appropriate chemically resistant material[4] and located within a bunded area of not less than 110% of the tank volume;

- Chemical storage areas shall be secure and access restricted to authorised personnel only;

- Chemical transfer pipework shall be arranged such that any spillage of fluoridation chemical during transfer is adequately and safely contained;

- Forced air ventilation or extraction shall be provided as appropriate to the chemical stored;

- Any external vent to a storage tank shall be secure and suitably protected against the weather;

- Indoor overflows from acid storage tanks shall incorporate a fume trap (incorporating suitable frost protection where necessary) located within the storage tank bund;

- All storage tanks shall be equipped with a calibrated level monitoring instrument. The instrument(s) shall include local visual display of tank contents and operate alarms on the detection of a high tank level;

- High tank level and bund flood alarms shall initiate a local audio-visual alarm in addition to any remote alarm signals; and

- All isolation valves shall remain operable in the event of a bund flood (by the use of extension spindles or other appropriate provision).

Chemical transfer arrangements (bulk tank to day tank)

Where dosing is practised, the installation shall include the provision of a day tank to maintain dosing within acceptable limits. Arrangements for the transfer of fluoridation chemicals from the bulk tank to the day tank shall meet the following basic principles:

- Transfers of chemical from the bulk storage tank to the day tank shall be by pumping not gravity transfer;

[4] Advice on the suitability of construction materials shall be sought from the chemical supplier

- Transfer pump(s) shall be located within a bunded area;

- Any risk of gravity flow through the pump from the bulk storage tank shall be prevented by appropriate hydraulic design.

- Chemical transfer shall be initiated and stopped in response to level indicators in the day tank;

- The day tank must not be filled more than once in any 24 hour period. Where a “day tank” holds less than 24 hours supply of acid, it must not be filled more than once in an appropriate shorter period;

- Arrangements shall be in place to determine the number of times that the day tank fills within a given time period;

- A local emergency stop button shall be provided to enable immediate cessation of chemical transfer in the event of a problem occurring; and

- The use of a filter immediately upstream of the chemical transfer pumps is recommended.

Day tank

- A day tank must meet the requirements of section Bulk Chemical storage above; and

- A day tank must be sized such that it can contain no more than 24 hours supply of fluoridation chemical, when dosed at the maximum usage rate (i.e. the volume required to attain the target concentration at the maximum flow rate of the site);

- The recommended minimum size is a “half-day tank” i.e. containing 12 hours supply of acid.

4.1.2 Dosing arrangements

Injection point

- Hexafluorosilicic acid shall normally be dosed at a point where all water to be treated passes. However, where the acid is dosed at a point where not all water passes (e.g. into a motive water stream), the monitoring point controlling the automatic shutdown facility must be located downstream of any blending point;

- Where possible the injection point shall be a point that is under constant positive pressure; where this is not possible particular attention shall be paid to the provision of anti-siphon protection on the dosing pipework;

- Water undertakers shall be mindful of any possible interaction between the fluoridation chemical used and other processes or chemicals dosed during the treatment process. The injection point shall be located accordingly; and

- The design of the injection point shall ensure that adequate mixing occurs.

Dosing

- Dosing shall be flow proportional[5] This will typically be achieved using a suitably placed flowmeter and variable speed dosing pumps;

- Water undertakers may wish to trim the chemical dose based on a feedback signal from an on-line instrument indicating fluoride residual (typically by automatically adjusting pump stroke);

- Flow meters and variable speed/stroke pumps used to control chemical dose shall be regularly maintained and calibrated (as per manufacturers' recommendations); and

- When considering dosing arrangements water undertakers shall be mindful of the need to maintain fluoride concentrations within the operational criteria specified by PHE and not exceed the regulatory maximum concentration of 1.5mgF/l.

Dosing pumps

- Dosing pumps shall be specified such that they are able to accurately deliver the required volume of fluoridation chemical for the quantity of water being treated;

- Positive displacement piston-diaphragm metering pumps are typically used, however water undertakers may use any appropriate pump;

- Any risk of gravity flow or siphoning of acid through the dosing pump must be prevented;

- Dosing pumps shall be sized such that they operate at their maximum output at the maximum flow of the site;

- Where duty & auxiliary dosing pumps are used, the combined maximum output must not exceed the maximum dose required at the maximum flow of the site; and

- The performance of a dosing pump shall be calibrated at least monthly by measuring the volume of solution pumped during a measured time interval. This can be adequately tested by performing a drop test.

Dosing Lines

- Shall be 'secondary contained'

- Shall be kept as short as possible

Provision of anti-siphon devices (in dosing lines)

- Any risk of gravity flow or siphoning of acid from the dosing lines into the water supply must be prevented;

[5] Where the output of a site varies by < +/-10% then fixed speed dosing may be considered. However, undertakers should consider trim-dosing based on residual fluoride concentrations and remain mindful of the need to monitor raw and treated fluoride levels and to cease dosing on high residual alarm.

- Where fitted, anti-siphon devices shall be inspected for wear annually and replaced as directed by the manufacturer; and

- Manually (or remote automatically) operated valves shall be located at the injection end of the dosing line. These valves shall be closed, thereby physically isolating the dosing system, whenever a planned shutdown of the fluoridation plant is carried out.

Backflow protection

- Suitable backflow protection must be provided for all water supplies feeding the fluoridation chemical storage and dosing equipment. This shall be in the form of either an air gap or a vacuum breaker.

Water undertakers shall consider the provision of pressure monitors for burst indication and/or chemical flow meters within the dosing lines. Where present, chemical flow meters shall be fitted with high flow alarms appropriate to the sizing of the installation.

Where site flows are such that the operational requirements for dosing agreed with PHE cannot be met by directly injecting acid, water undertakers may need to consider the use of acid dilution systems.

Water undertakers shall also consider manually calculating fluoridation chemical usage and the consequent calculated fluoride dose as a non-routine additional check.

4.2 Disodium Hexafluorosilicate dosing installations

4.2.1 Chemical delivery storage and transfer arrangements

Water undertakers must have in place suitable arrangements for the delivery and storage of fluoridation chemicals to prevent accidental spillage. These arrangements shall meet the following basic principles:

Chemical Delivery

- Chemical delivery points shall allow appropriate safe access for the mechanism of delivery to the site;

- Delivery locations shall be sited such that any spill of fluoridation chemical is restricted to drainage facilities which allow spill containment and subsequent removal;

- Water undertakers must ensure that they have the necessary equipment to collect and remove any powder spillages;

- Arrangements shall be in place to contain and dispose of any spillage of fluoridation chemical (in line with advice provided by supplier); and

- All chemical deliveries shall be supervised by a competent member of the water undertaker's staff for the duration of the chemical transfer process.

Chemical storage

- Chemical storage areas shall be secure and access restricted to authorised personnel only;
- Ventilation shall be provided as appropriate to the chemical stored. Free circulation of air around bags is required to prevent caking; and
- Any external vent to a storage building shall be secure and suitably protected against the weather.

Chemical storage buildings

- Chemical storage buildings for powder plants shall be regularly cleaned and any collected powder shall be disposed of (in line with advice provided by supplier); and
- Packaging shall be handled and disposed of safely (in line with advice provided by supplier).

Chemical transfer (bags to hoppers)

- The transfer of chemical from storage to dosing area shall be completed in a 'controlled environment' to avoid spillages, for example using a bag handling unit.

4.2.2 Dosing arrangements

Injection Points

- The fluoridation chemical shall normally be dosed at a point where all water to be treated passes. However, where the acid is dosed at a point where not all water passes (e.g. into a motive water stream), the monitoring point controlling the automatic shutdown facility must be located downstream of any blending point;
- Where possible the injection point shall be a point that is under constant positive pressure. Where this is not possible particular attention shall be paid to the provision of anti siphon protection on the dosing pipe work;
- The design of the injection point shall ensure that adequate mixing occurs; and
- Water undertakers shall be mindful of any possible interaction between the fluoridation chemical used and other processes or chemicals dosed during the treatment process. The injection point shall be located accordingly.

Dosing

- Dosing shall be flow proportional;
- Water undertakers may wish to trim the chemical dose based on a feedback signal from an online instrument indicating the fluoride residual;

- Flow meters and variable dry-feeder systems used to control chemical dose shall be regularly maintained and calibrated (as per manufacturers recommendations);

- Disodium hexafluorosilicate in coarse powdered or granular form shall be used in saturators as very fine disodium hexafluorosilicate can cause clogging in the saturator;

- Saturator make-up water shall be softened when the total hardness of the water supply (as CaCO3) exceeds 75mg/l; and

- Saturator reliability may be compromised if operated to its design capacity limit for any length of time. When a saturator's capacity is approached, then an alternative method of fluoridation (i.e. acid dosing) shall be considered.

Dry feeder systems

- Dry feeder systems shall be specified such that they accurately deliver the required volume of fluoridation chemical for the quantity of water being treated;

- Dry feeder systems shall be sized such that they operate at their maximum output at the maximum flow of the site; and

- The performance of the dry feeder system shall be calibrated at least monthly by measuring the volume of powder delivered during a measured time interval. Where this is not possible water undertakers shall manually calculate the fluoridation chemical usage and consequent calculated fluoride dose.

4.3 Monitoring of fluoride in drinking water

4.3.1 Monitoring of fluoride concentration in the raw water

Water undertakers shall establish any variation in the natural fluoride concentration of the raw water. Any variation so detected must be taken into account when designing the control mechanisms (such as dose trimming) for a fluoride dosing plant installation.

Where variations in raw water fluoride concentration are not compensated for by trimming the dose on fluoride residual readings, regular sampling of the raw water is recommended. Sampling shall be at an appropriate frequency for the expected variations in raw water fluoride level.

4.3.2 On-line monitoring at the fluoridation plant

Continuous fluoride monitoring, linked to an appropriate alarm monitoring system and automatic plant shut down, is required for all dosing installations. The instrument must meet the following criteria:

i. The sample point supplying the instrument shall be located such that adequate mixing has taken place before the sampling point. The sampling point must be before the first draw off for a consumer is reached. The time taken for the sample to travel from the sampling point to the instrument shall be kept to a minimum;

ii. The performance of the on-line instrument as installed, maintained and operated shall meet the following criteria:

a. **accuracy** or **trueness** not exceeding 10% of the result or 0.15mgF/l (whichever is the greater), at the 95% confidence level;
b. **precision** or **total standard deviation** (under repeatability conditions) not exceeding 10% of the result or 0.15mgF/l (whichever is the greater);
c. **limit of detection**[6] not greater than 0.20mgF/l;

iii. The instrument shall be subject to an automatic standardisation at least once in every 24 hour period. Standardisation must be at two concentrations spanning the target dose (normally 1.0 mgF/l) and within the range 0.5 to 1.5mgF/l. Where the instrument is used to control (or trim) the amount of chemical dosed, the lower concentration of the standardisation shall be close to the target dose;

iv. Where standardisation results in the adjustment of the instrument's response slope, any adjustment outside of the manufacturers' recommended response range shall result in appropriate remedial action being taken. Where monitors do not record such adjustments, the response slope shall be checked in line with the manufacturers recommendations;

v. The instrument shall allow the manual initiation of a standardisation;

vi. The instrument shall be calibrated, at a frequency in accordance with the manufacturers' instructions, including the verification of the value and alarms displayed in the manned control room;

vii. The instrument shall register a low level alarm at 80% of the target concentration and a high level alarm at 120% of the target concentration, provided that this higher value does not exceed 1.4mgF/l;

viii. The instrument shall register a high-high alarm at 1.4mgF/l;

ix. An alarm shall be generated on failure of the instrument;

x. An alarm shall be generated on loss of water sample to the instrument;

xi. Failure of the instrument or loss of water sample to the instrument shall result in the cessation of fluoride dosing;

xii. Where instrument alarms can be manually overridden (for maintenance purposes) any override events shall be logged and the facility configured such the operator is aware that the override is activated;

xiii. Fluoride concentration alarms from the instrument shall be transmitted to a permanently manned control room;

xiv. Instrument performance shall be compared to the results from the laboratory analysis of samples at a frequency not less than monthly; and

xv. Instrument readings shall be logged and kept for a minimum period of five years.

4.3.3 Manual checks of fluoride residual at dosing sites

Water undertakers may also manually test (using a portable test kit) the fluoride concentration in the dosed water as an additional independent verification of monitor readings. Where such tests are carried out, undertakers should have in place guidance to staff on the permitted variance of

[6] Where 'limit of detection' is defined as the smallest amount reliably detected as giving a response greater than a blank at the 95% confidence level.

manual test results from the on-line monitor readings and instructions as to the action(s) to be taken on exceedances of this permitted variance.

4.3.4 Monitoring at customer taps / authorised supply points

Water supplies must be sampled and analysed for fluoride content at the frequencies specified in Tables 2 and 3 of Schedule 3 to the Water Supply (Water Quality) Regulations 2000[1] (as amended).

Water undertakers are referred to the current guidance on the Regulations available on the DWI website for further information.

4.4 Automatic shutdown systems

As a minimum requirement, fluoride dosing at a site must cease on activation of any one of the following alarms:

Storage alarms	- bund flood alarm
	- day tank high level alarm
	- day tank overfill
	- day tank failed to fill
Dosing system alarms	- dosing pump failure
	- bund flood alarm
	- delivery pressure low
Instrument alarms	- high fluoride residual (target concentration +20%, delay not to exceed 15 minutes)
	- high-high fluoride residual (1.4mgF/l, delay not to exceed 1 minute)
	- instrument failure alarm
	- loss of instrument sample alarm

All dosing systems shall be configured so as to 'fail safe', i.e. failure of a critical component leads to the cessation of dosing.

Where dosing is stopped during automatic operation which is outside of the normal operating parameters of the site (be it manually, or by shutdown alarms), dosing shall not restart automatically without manual on-site intervention.

Where automatic shutdown systems can be manually overridden (e.g. for maintenance purposes) any override events shall be logged and the override facility configured such that the operator is aware that an override is activated (e.g. by the activation of a local or telemetry alarm), and that the override is time limited to 30 minutes.

The full operation of all shutdown systems must be fully tested at least once every six months, and the outcome of these tests recorded.

4.5 Commissioning (and re-commissioning) of fluoride dosing plants

Water undertakers shall agree acceptability criteria for the acceptance of new or refurbished fluoride dosing plants with the relevant PHE. This will typically entail a test using undosed water (for new plants) followed by a surveillance period of at least 14 days during which daily water samples are submitted to an appropriate laboratory for verification.

Where a significant component of the dosing system has been replaced (e.g. a monitor) or dosing has ceased for more than 30 consecutive days, the water undertaker shall prepare an appropriate re-commissioning plan.

Consideration shall be given as to the possibility of re-use of equipment for new or existing plants.

4.6 Decommissioning of fluoride dosing plants and equipment

The decommissioning and removal of fluoride dosing plant and equipment shall take into consideration all relevant legal requirements, including those relating to Health & Safety, construction / demolition and waste disposal.

Any decommissioning activity shall include the preparation of a site specific assessment of the activities to be undertaken. This shall be agreed by both the water undertaker and relevant PHE.

All redundant material and equipment which has been subject to long term exposure to the fluoridation chemical shall be removed and disposed of in an appropriate manner.

The equipment to be removed and disposed of shall be agreed on a site-by-site basis between the water undertaker and Public Health England.

Consideration shall also be given to the future use of any buildings and land areas specifically associated with the fluoridation installation.

4.6.1 Interaction with existing treatment processes / operations on site

Any decommissioning of fluoridation plant and equipment shall include a documented assessment of the likely impact on continuing operational activities at the site concerned. This assessment shall also include detail of the actions to be taken to safeguard the quality of treated water leaving the site during and after the decommissioning process.

This assessment shall consider (but not be limited to):

- The impact of the cessation (temporary or permanent) on water quality, e.g. a reduction in the amount of pH depression as a result of stopping acid dosing;
- The impact of the cessation (temporary or permanent) on treatment processes employed at / near to the site, e.g. variation of other treatment processes, such as coagulation, pH correction;
- The impact on control loops, in particular where flow measurements are also used in the control of other dosing or control systems;
- The impact of changing carrier water flows and/or characteristics;
- The impact of changes to telemetry, alarms and electrical systems resulting from the isolation and/or removal of the fluoridation equipment.

5. Training

Water undertakers' employees involved in the operation and maintenance of fluoride dosing installations shall receive specific training in fluoridation issues.

As a minimum this shall include instruction and the demonstration of competence in the following areas:

- maximum permitted level of fluoride in drinking water;
- permitted fluoridation chemicals and their safe handling;
- knowledge of the contents of this Code of Practice;
- operational checks on fluoridation chemical dosing installations;
- familiarity with the specific operation and/or maintenance of each installation they are required to work on.
- reporting requirements of dosing records; and
- actions to be taken in the event of an incident (e.g. spillage or overdose).

Water undertakers shall maintain records of training and competence assessment of those employees operating fluoride dosing installations.

6. Consumer information

Under regulation 35 of the Water Supply (Water Quality) Regulations 2000[1] (as amended), water undertakers are required to make available to the public information relating to drinking water quality in their area of supply. Included in this are results from samples taken in accordance with the Regulations and will therefore include information on fluoride concentrations in drinking water.

Water undertakers shall also prepare general information for consumers describing the extent of artificial fluoridation within their supply area.

7. Reporting requirements

The fluoridation agreement between the water undertaker and PHE will normally specify the reporting requirements for a given fluoride dosing scheme. In addition, Appendices 1 and 2 shall be completed for all Sites. Companies are reminded of the importance of appraising PHE of any unexpected but significant situation that develops outside of the monthly reporting requirement.

8. Sources of additional information

Further information on aspects of this Code of Practice can be obtained from:

Drinking Water Inspectorate
Area 7E, 9 Millbank
c/o Nobel House
17 Smith Square
London
SW1 3JR
Tel: +44 (0) 300 068 6400
Email: dwi.enquiries@defra.gsi.gov.uk
Internet: www.dwi.gov.uk

Further advice on Health & Safety aspects of fluoridation chemicals and chemical handling can be obtained from the chemical suppliers and/or:

Health & Safety Executive
Caerphilly Business Park
Caerphilly
CF83 3GG
(or the HSE Chemical Hazards and Installations Division, based at Bootle, Merseyside).
Infoline: 08701 545500
Email: hseinformationservices@natbrit.com

Enquiries relating to current policy on the fluoridation of drinking water supplies or queries regarding the impact of fluoridation on health shall be directed to:

Public Health England Enquiries
5th Floor South Wing
Public Health England
Wellington House
133-155 Waterloo Road
London
SE1 8UG

Tel: 020 7654 8000
Email: enquiries@phe.gov.uk

Glossary of Technical Terms

Acid: A substance that dissolves in water with the formation of hydrogen ions, contains hydrogen which may be replaced by metals to form salt, and/or is corrosive.

Accuracy: Closeness of a reading or indication of a measurement device to the actual value of the quantity being measured.

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.

Anti-siphonage valve: a device that prevents back flow.

Audit: a systematic and independent examination to determine whether activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Bund: A retention facility (including walls and base) built around an area where potentially polluting substances are handled, processed or stored, for the purposes of containing any unintended escape of material from that area until such time as remedial action can be taken.

Calibration: process of comparing an instrument's accuracy to known standards.

Certificate of Analysis: a document certifying results of analysis that was carried out.

Cessation: A stopping.

Coagulation: In water treatment, the use of chemicals to make suspended solids gather or group together into small flocs. The clumping together of solids so they can more easily be settled out or filtered out of water.

Colorimetric testing: a common method for testing how much of a substance is in the water is to run a colorimetric test. A colorimetric test is a test which forms a colour. The amount of the colour is then measured. In most tests the more colour formed, the more of the test substance there is in the water.

Combustible: a substance that is capable of igniting and burning.

Conduit: A conduit is a hollow tube, duct or pipe used for containing and protecting wires or pipes.

Corrosive: A liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact or is highly corrosive to steel.

Fluoridation: A water treatment involving the addition of fluoride to drinking water to help prevent dental caries.

Fluoride: A mineral that is effective in preventing and reversing the early signs of dental caries. Fluoride occurs naturally and contains the element fluorine.

HACCP: Hazard Analysis Critical Control Points. A system for risk management of a process, in wide scale use in the food industry.

Hazardous Waste: Waste which, because of its quantity, concentration or characteristics, poses a present or potential hazard to human health or the environment when improperly treated, stored, transported, dispersed of or otherwise managed.

HSE: Health Service Executive

Hydrofluosilicic acid H2SiF6 (also known as hydrofluorosilicic acid; fluorosilicic acid; fluosilicic acid; hexafluorosilicic acid, HFSA): a chemical substance containing fluoride, used for fluoridation of drinking water.

Indelible: cannot be removed, washed away or erased.

Inert: Having little or no tendency to react chemically.

Interlock: An interlock is a safety device used to help prevent a machine from harming its operator or damaging itself by stopping the machine when tripped.

Material Safety Data Sheet: Printed material concerning a hazardous chemical, or Extremely Hazardous Substance, including its physical properties, hazards to personnel, fire and explosion potential, safe handling recommendations, health effects, firefighting techniques, reactivity, and proper disposal. It is prepared by chemical manufacturers, importers and employers for hazardous chemicals.

Methodology: A documented approach for performing activities in a coherent, consistent, accountable, and repeatable manner.

mg/l: milligrams per litre. It is the concentration of a substance expressed as its weight in a specified volume of liquid e.g. milligrams of fluoride per litre of water. It is equivalent to parts per million.

mg/m3: milligrams per cubic metre. It is the concentration of a substance expressed as its weight in a specified volume of a gas e.g. milligrams of fluoride per cubic metre of air.

Natural Background Fluoride Levels: The concentration of fluoride (mg/L) that is present in the water source from naturally occurring fluoride sources.

Occupational Exposure Limit: Measurement of personal exposure and effectiveness of control measures, using the appropriate measurement technique and standards.

pH: The pH of water is a scientific measurement that describes how acidic or alkaline (basic) a substance , e.g. water with a pH of 7 is neutral. . It is expressed on a scale from 0 to 14. pH of less than 7 is acid and greater than 7 is alkaline.

Precipitation: Precipitation is the condensation of a solid from a solution during a chemical reaction. This occurs when the solution is supersaturated, whereupon the solid forms from the solute phase, and usually sinks to the bottom of the solution.

Precision: Is the closeness of agreement between the results obtained applying the method several times under prescribed conditions. The precision depends only on the distribution of random errors.

Public Piped Water Supplies: A system that provides piped water to the public for human consumption.

Pungent: A sharp or stinging sensation of an odour.

SCADA: Supervisory Control And Data Acquisition.

Soda Ash: The common name for sodium carbonate. It is a white powder that is used to increase the pH of acidic (below pH 7.0) water.

Sodium Bicarbonate: also known as baking soda and bicarbonate of soda. It is a white powder used to balance pH level and alkalinity.

Source Water: Untreated water (i.e., raw water) used to produce drinking water.

Standard Operating Procedure: Standard operating procedures are written documents that describe in detail, step-by-step, how a procedure shall be done.

Telemetry Installation: An electronic device which transmits specific data (measurements) to a remote site.

Threshold Limit Value: An exposure level under which most people can work consistently for 8 hours a day, day after day, with no harmful effects.

Toxic: Toxic means able to cause harmful health effects. Toxicity is the ability of a substance to cause harmful health effects. Descriptions of toxicity (e.g. low, moderate, severe, etc.) depend on the amount needed to cause an effect or the severity of the effect.

Turbulence: Irregular motion or swirling agitation of water, air, gas, etc.

Volumetric: Of or relating to measurement by volume; "volumetric testing".

Watercourse: A definite channel with bed and banks within which concentrated water flows continuously, frequently or infrequently.

Water treatment plant: A plant where water is treated to make it fit for potable use.

Appendix 1 Fluoridation Asset Register

Water company

Plant name:	Asset identification number (if appropriate)	Date installed	Expected asset life (years)	Year asset life expires	Asset risk level	Notes / observations
Delivery point and bund					N/A	
Bulk Tank(s)					1	
Day Tank (s)					2	
Monitor (s)					3	
Uninterruptible Power Supply (UPS)					4	
Programmable Logic Controller (PLC)					5	
Plant name:					N/A	
Delivery point and bund					N/A	
Bulk Tank(s)					N/A	
Day Tank (s)					N/A	
Monitor (s)					N/A	
Uninterruptable Power Supply (UPS)					N/A	
Programmable Logic Controller (PLC)					N/A	
Plant name:					2	
Delivery point and bund					2	
Bulk tank(s)					4	
Day tank (s)					2	
Monitor (s)					5	
Uninterruptable Power Supply (UPS)					2	
Programmable Logic Controller (PLC)					3	

Note - the purpose of this register is to capture the more expensive and longer-lived items that might need significant public investment and a forward-looking programme. For that reason items such as transfer / dosing pumps and dosing lines haven't been included as their life seems considerably shorter and they are relatively low cost items

N/A	Not Applicable
1	New, or Expected Asset life 10 + years, Risk level Very low.
2	Good Condition, or Expected Asset life 5 + years, Risk level Low.
3	Average Condition, or Expected Asset life 2 to 5 years, Risk level Medium.
4	Poor Condition, or Expected Asset life less than 2 years, Risk level Significant.
5	Very Poor Condition, or Immediate risk of failure, Risk level Serious.

Appendix 2 Monthly model fluoridation plant performance report

Distribution

Distribution of water from plants to local authorities

Headings	LA 1	LA 2	LA 3	LA 4	LA 5	LA 6	LA 7	LA 8	LA 9	LA 10
Plant 1	X							X	X	X
Plant 2	X					X	X			
Plant 3	X	X	X							
Plant 4	X	X	X		X					
Plant 5					X					
Plant 6					X					
Plant 7				X						
Plant 8				X						
Plant 9						X	X			
Plant 10						X	X			

Summary sheet

Water company

Summary of performance across month

WTW/Plant	Average daily water production (Ml)	Monitor average (mg/l)	Lab result average (mg/l)	No. of Site lab results	% of time plant dosing within range 0.80-1.20 mg/l	Comments
Plant 1	6.24	0.83	0.86	4	84%	Availability < 90% due to dosing plant shutdown for part of month for site remedial works
Plant 2	11.86	0.83	0.78	4	84%	Availability < 90% due to dosing plant shutdown for part of month for site remedial works
Plant 3	4.51	0.96	0.94	4	100%	
Plant 4	6.71	1.05	0.96	4	100%	
Plant 5	7.27	0.98	0.99	4	100%	
Plant 6	15.39	0.97	1.00	4	100%	
Plant 7	8.75	0.99	1.00	4	100%	
Plant 8	0.00					Out of supply
Plant 9	30.00	0.95	0.98	3	99%	
Plant 10	30.00	0.95	0.98	3	96%	
Plant 11	5.50	1.00	1.02	4	100%	
Plant 12	2.19	0.89	0.96	4	92%	
Plant 13	6.57	0.91	0.98	3	95%	
Plant 14	3.66	0.95	1.02	3	95%	
Plant 15	8.93	1.02	1.01	4	100%	
Plant 16	10.76	0.97	0.99	4	100%	
Plant 17	2.43	0.95	1.00	2	100%	
Plant 18	19.56	0.94	0.88	4	97%	
Plant 19	0.00					Out of supply
Plant 20	0.00					Out of supply
Plant 21	22.00	0.86	0.99	4	85%	Availability < 90% due to dosing plant shutdown caused by dosing software fault
Plant 22	18.00	0.84	0.96	4	78%	Availability < 90% due to dosing plant shutdown caused by dosing software fault
Plant 23	0.00					Out of supply
Plant 24	0.00					Out of supply
Plant 25	0.00					Out of supply
Total/Average	**220.33**	**0.94**	**0.96**	**70**	**95%**	

Water Treatment Works

XX WTW fluoride monthly doses and results

YEAR	
MONTH	

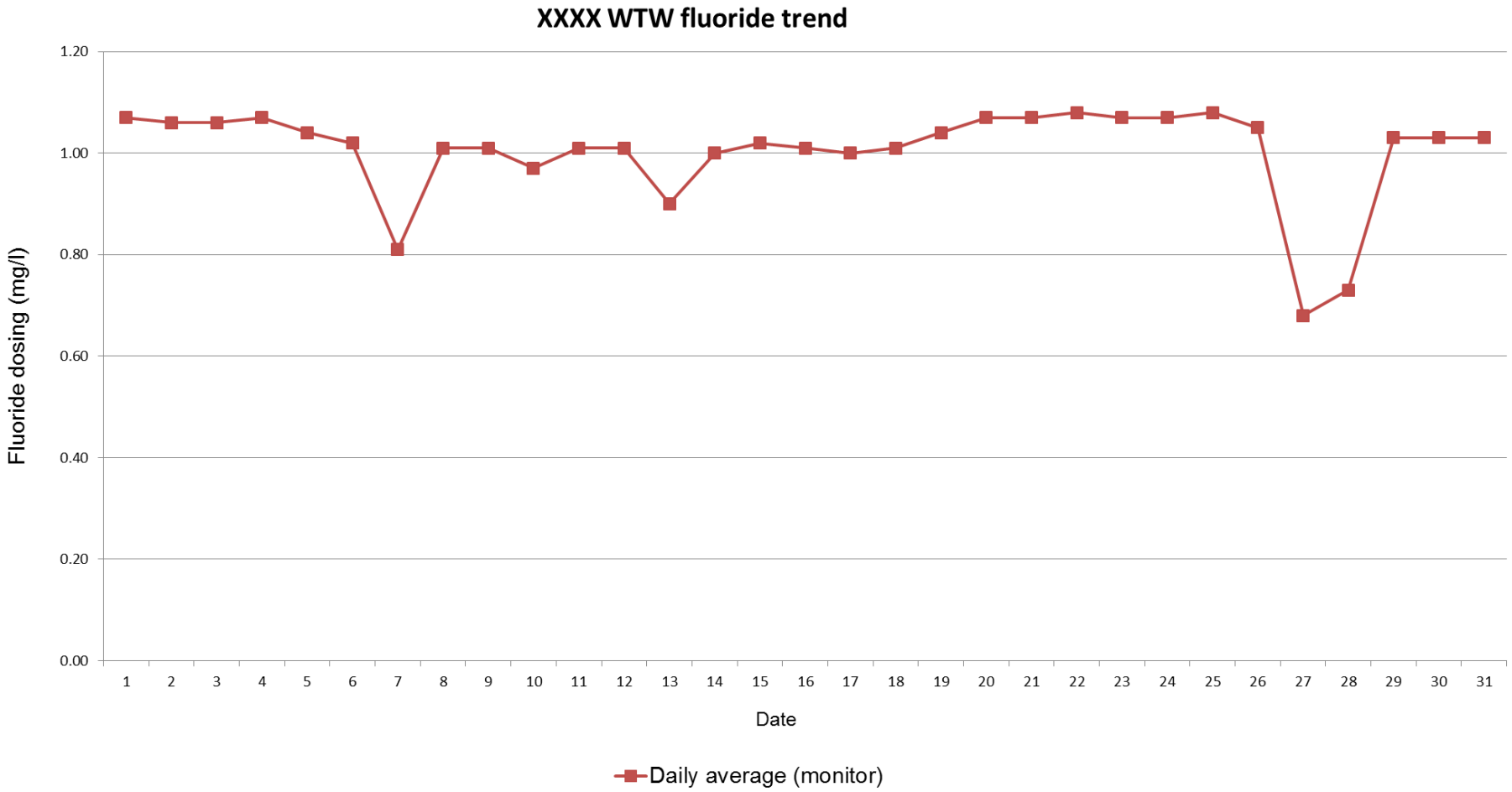
Essential							Optional
Day of week	**Day of month**	**Water flow (Ml/d)**	**Mean fluoride monitor reading**	**Comments (particularly where daily average <0.80 or >1.20)**	**Onsite lab results (where available)**	**Zone sample result[1] (where available)**	**Supplementary calculation of average dose[2]**
Friday	1	19.77	1.07		1.09		
Saturday	2	19.19	1.06				
Sunday	3	16.87	1.06				
Monday	4	17.31	1.07				
Tuesday	5	17.59	1.04	Trip - 10:05 (High pH (Duty Pump Changeover)). Reset - 10:06	0.96		
Wednesday	6	18.66	1.02				
Thursday	7	18.95	0.81	Trip - 02:52 (Caustic Pump Trip). Reset - 04:17. Stop - 04:44 (Plant Maintenance). Restart - 04:59. Trip - 05:08 (Caustic Pump Trip). Reset - 05:18. Stop - 05:20 (Plant Maintenance). Restart - 08:38. Stop - 14:16 (Failsafe Test). Restart - 14:21.		1.05	
Friday	8	19.27	1.01				
Saturday	9	16.90	1.01				
Sunday	10	17.18	0.97	Trip - 22:11 (Caustic Pump Trip). Reset - 23:02.			
Monday	11	17.56	1.01		0.98		
Tuesday	12	18.61	1.01				
Wednesday	13	19.07	0.90	Stop - 11:03 (Plant Maintenance). Restart - 13:39. Stop - 15:57 (SR Outlet Flow Low). Restart - 16:12.		0.97	
Thursday	14	19.25	1.00				

Essential							Optional
Friday	15	19.22	1.02		1.05		
Saturday	16	18.76	1.01				
Sunday	17	17.85	1.00				
Monday	18	16.99	1.01		1.04		
Tuesday	19	17.98	1.04				
Wednesday	20	19.82	1.07				
Thursday	21	19.86	1.07				
Friday	22	17.06	1.08				
Saturday	23	14.68	1.07				
Sunday	24	14.13	1.07				
Monday	25	14.08	1.08				
Tuesday	26	15.01	1.05		0.99	1.05	
Wednesday	27	10.12	0.68	Stop - 15:21 (Plant Maintenance).			
Thursday	28	13.79	0.73	Restart - 07:08.			
Friday	29	16.41	1.03		0.98		
Saturday	30	15.08	1.03				
Sunday	31	14.98	1.03				

Notes:

1. Not relevant if zone/ zones served by more than one plant
2. e.g. from change in bulk tank level, chemical flow meter etc.

Trend


XXXX WTW fluoride trend
Fluoride dosing (mg/l)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Date
Daily average (monitor)