GUIDANCE ON THE IMPLEMENTATION OF THE WATER SUPPLY (WATER QUALITY) REGULATIONS 2016 IN ENGLAND AND THE WATER SUPPLY (WATER QUALITY) REGULATIONS 2010 (as amended) IN WALES

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PART 4 – MONITORING OF WATER SUPPLIES

Regulation 5 – Interpretation and Application of Part 4

5.1 Regulation 5 sets out the difference between audit monitoring and check monitoring.

5.2 Audit monitoring is the mandatory monitoring required to demonstrate that water supplies comply with regulation 4 – wholesomeness, and with the standards specified in Schedules 1 and 2 of the Regulations, which cover the Directive's requirements, national requirements and indicator parameters.

5.3 The purpose of check monitoring is twofold:

i. to ensure that parameters which give an indication of the effectiveness of treatment (in particular disinfection) and the acceptability of water to consumers (for example taste, odour and discolouration parameters) are monitored at an appropriate frequency and

ii. To ensure that indicator parameters comply with the specifications set out in Schedule 2 of the Regulations.

5.4 Check monitoring for aluminium and iron is required where these metals may be present in the water by virtue of the coagulant chemical used in the water treatment process.

5.5 Check monitoring for iron and aluminium is also required, along with manganese and *Clostridium perfringens*, if the water supply is derived from surface water, or is influenced by surface water.

5.6 Regulation 5(5) [5(4)] specifies that regulations 6 to 10 [5 to 9] apply where a combined licensee[1] introduces water into an undertaker's supply system. The undertaker receiving a combined licensee's supply retains responsibility for carrying out the monitoring of its own supply system. If the point at which the combined licensee's supply enters the undertaker's system is designated as a supply point for monitoring purposes, the undertaker is responsible for carrying out that monitoring. In these circumstances the combined licensee and the undertaker are jointly responsible for managing any risks to quality and sufficiency, and should have documented agreements in place covering management of drinking water quality, sufficiency and emergency procedures. Combined licensees are responsible for monitoring any consumers' premises supplied directly which are not within an undertaker's supply system, and also their own treated waters (regulation 13) and service reservoir outlets (regulation 14) – see Part 5 Section 1.

[1] Since all combined licenses were revoked on 1 April 2017, this regulation no longer applies. Revised regulations will be published in 2017, which will take account of changes to the licensing regime introduced by the 2014 Act – i.e. water supply license (wholesale and supplementary) authorisations. It is expected that this regulation will be amended to refer to holders of water supply authorisations where the requirement currently applies to combined licensees.

Regulation 6 – Monitoring: general provisions

6.1 Regulation 6 specifies that the minimum number of samples water companies must take in each of their water supply zones for compliance purposes must be in accordance with Schedule 3 of the Regulations.

6.2 It is recognised that water companies take additional samples for operational purposes that are over and above those taken to demonstrate compliance with the Regulations. Water companies may carry out sampling for both compliance and operational purposes on the same sampling occasion provided that the samples taken are identified by separate unique sample numbers or other auditable process (with the appropriate sample reason).

6.3 Companies may take more compliance samples than the minimum specified, but it is not good practice to programme significantly above the numbers specified for selected parameters in order to influence compliance statistics.

6.4 Parameters for which check monitoring is required are listed in Table 1 of Schedule 3. As explained in 5.4 and 5.5 above, some of the parameters have conditions specified. If the conditions for those parameters are met then check monitoring must be carried out for that parameter. Otherwise the audit monitoring frequency applies.

6.5 Other parameters listed in Table 1 of Schedule 3 which do not have conditions specified must be monitored at the annual check monitoring frequency (depending on population of the supply zone) as specified in Table 2 of Schedule 3.

6.6 Minimum annual sampling frequencies for audit monitoring, where check monitoring is not a requirement, are also given in Table 2 of Schedule 3. Parameters included in check monitoring do not need additional audit samples, because the check monitoring frequencies specified cover both purposes.

6.7 **Regulation 6(5) [6(6)] – Monitoring for copper, lead and nickel**: Sampling is required at consumers' taps for copper, lead and nickel at the audit frequency specified in Table 2 of Schedule 3. The sampling point should be selected from the random consumer tap (supply zone) sampling programme and the sample should be the first one litre of water drawn from the tap without flushing.

6.8 Monitoring for Pesticides

6.8.1 Pesticides and related products are defined as any organic insecticide, herbicide, fungicide, nematocide, acaricide, algicide, rodenticide, slimicide, molluscicide and any product related to any of these including any growth regulator, and their relevant metabolites, degradation and reaction products. "Relevant" should be taken to mean any metabolites, degradation and reaction products that have similar pesticidal properties to their parent pesticides.

6.8.2 The standard for pesticides applies to each individual pesticide, excluding aldrin, dieldrin, heptachlor and heptachlor epoxide which each have their own standard of 0.03μg/l. The Total Pesticides parameter relates to the sum of all detected concentrations of the individual pesticides (including aldrin, dieldrin, heptachlor and heptachlor epoxide) detected and quantified in the samples taken on a particular sampling occasion from a sampling point. It is recognised that more than sample container may be filled on a particular sampling occasion to enable all the pesticides of interest to be determined for a given sampling point.

6.8.3 It is not practical or necessary to monitor for compliance purposes every pesticide that is used within the catchment of a water source. Water companies should develop pesticide monitoring strategies based on risk, and include pesticides likely to be detected as a result of their properties and usage in the raw water catchment for any given treatment works. On the basis of that strategy, the treated water leaving each treatment works should be monitored at the frequency specified in Table 3 of Schedule 3 of the Regulations. The treatment works sampling point should be designated as the supply point for the zones supplied.

6.8.4 Any relevant metabolites, degradation and reaction products which may be active pesticides and/or a risk to health should be included in companies' monitoring strategies, based on risk assessment.

6.8.5 The majority of pesticide monitoring should take place in the raw water to inform companies' risk assessments and to assess the need for treated water pesticide monitoring.

6.8.6 Companies should monitor treated drinking water for any pesticide which is identified as a residual inadequately controlled risk, for example where there is no treatment capable of removing the pesticide. Where there is treatment such as granular activated carbon (GAC) in place to remove pesticides, or blending is in place to achieve compliance, then the treated or blended water monitoring should include individual pesticides that are likely to be present in the raw water in concentrations greater than 0.1μg/l.

6.8.7 Companies should keep their monitoring strategies for pesticides under continual review, particularly for any new and emerging pesticides and related products, and ensure that they are current and relevant. The European Chemicals Agency website (http://echa.europa.eu/) maintains a current list of registered biocidal products.

6.9 **Radioactive parameters**:

General provisions

6.9.1 Regulation 6 [6A], paragraphs 7 to 15 and Schedule 4 [1 to 8 and Schedules 3A & 5] cover the monitoring requirements for the Schedule 2 (indicator) radioactivity parameters Indicative Dose (ID), radon and tritium (radioactivity monitoring).

6.9.2 Radioactivity monitoring should be initially informed by companies' catchment risk assessments, taking into account the geology and any artificial sources that could lead to an increase in natural background levels of radioactivity. There are a variety of reference sources available to facilitate this, but the most comprehensive source of monitoring data is a joint publication issued annually by the Environment Agency (EA), the Food Standards Agency (FSA), the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA) called the *Radioactivity in Food and the Environment* (RIFE) report, available on the FSA website. Additional information can be found in the EA's Radionuclides Handbook and the DWI-commissioned report on radon (DWI 70/2/301 Understanding the implication of the EC's proposals relating to Radon in drinking water for the UK). A table of common radioactive isotopes and their sources is included in Appendix 6.1 – Radioactivity Monitoring.

6.9.3 If radioactivity has not been detected in a water supply source, and the catchment risk assessment confirms that it is unlikely to be detected, then monitoring for ID, tritium and radon is not required. This is allowed under regulation 6(12) [6A3] – see paragraph 6.9.8 below for further guidance.

6.9.4 The Inspectorate considers that it is good practice to monitor radioactivity at treatment works, on the basis that levels should not deteriorate (i.e. become worse) in distribution. For the purposes of reporting data to the Inspectorate, each treatment works sampling point should be designated as the supply point for the zones it supplies. The zones supplied should also be recorded in applications for notices issued under regulations 6(7)(d) [6A(7)] and 6(12) [6A3].

Indicative Dose

6.9.5 Regulation 6(7) [Schedule 3A(3)] covers the monitoring requirements for **Indicative Dose (ID),** which has a specified value of 0.1mSv:

6.9.5.1 Monitoring for ID is not required if it is unlikely to exceed 0.1mSv. ID is normally monitored by proxy through measurement of gross alpha and gross beta activity. Gross alpha activity has a recommended screening value of 0.1Bq/l, whilst gross beta activity has a recommended screening value of 1.0Bq/l.

6.9.5.2 Where there is no historic data to confirm ID, or where there is no regulation 6(12) [6A3] notice in place (see under 6.9.8 below), monitoring for gross alpha and gross beta activity must be carried out, at the treatment works at the audit monitoring frequency specified in Table 3 of the Regulations. The treatment works must be designated as a supply point for the zones supplied. The ID should be reassessed at appropriate intervals, based on risk. If the radioactivity is naturally derived, and the levels of gross alpha and gross beta activity are reasonably stable, then a minimum interval of 5 years is suggested as good practice. The supply may qualify for a regulation 6(7)(d) [6A(7)] notice (see under 6.9.5.10 below).

6.9.5.3 If it can be demonstrated that detected gross alpha and/or gross beta activities are attributable to a specific radionuclide, the water company may monitor for this radionuclide instead, at the treatment works at the audit monitoring frequency specified in Table 3 of Schedule 3.

6.9.5.4 Some low energy emitters, for example carbon (^{14}C), sulphur (^{35}S) and plutonium (^{241}Pu) will not be detected by screening for gross beta activity. A risk assessment is therefore critical to determine whether there are any likely sources of radioactivity that may not be detected through routine screening. Monitoring for individual radionuclides should therefore be conducted, based on risk assessment.

6.9.5.5 If the level of radioactivity appears to be increasing and/or new information becomes available which indicates that the risk is increasing, ID should be reassessed.

6.9.5.6 If gross alpha and/or gross beta activity is detected above its screening value, and/or risk assessment indicates that ID could exceed 0.1mSv, monitoring must be carried out. Following an initial exceedance, investigatory samples should be collected every few days, at least once per week, for a minimum period of one month, to confirm the level of activity.

6.9.5.7 Gross alpha and gross beta activity (with regard to the point made in 6.9.5.4 above) should then be monitored at the appropriate audit monitoring frequency for the supply point. ID should be determined in accordance with Schedule 4 of the Regulations, based on the derived concentrations (previously known as reference levels) given for the radionuclides listed. Companies should use all relevant information about likely sources of radioactivity when deciding which radionuclides to monitor. In accordance with the requirements of Euratom the

Inspectorate may, if necessary and based on advice from Public Health England (PHE), vary the radionuclides and/or derived concentrations of radionuclides required for the calculation of ID. Companies will be consulted on any changes to the requirements and Guidance will be updated accordingly.

6.9.5.8 If the calculated ID exceeds 0.1mSv, or if the concentration of any radionuclide detected is greater than 20% of the derived concentration, then further monitoring for radionuclides should be undertaken to confirm the ID.

6.9.5.9 If at any time the ID is found to exceed 0.1mSv, then this should be reported to the Inspectorate as an event, as required by regulation 35(6), and the source of the radioactivity identified. If action is required to protect public health, the Inspectorate may decide to issue a regulation 20(4) notice.

6.9.5.10 Where it can be demonstrated that the source of the radioactivity is naturally derived and the monitoring shows that the concentration of the radionuclides is stable (i.e. the levels of gross alpha and gross beta activity are stable and are representative of a stable ID), an application for a regulation 6(7)(d) [6A(7)] notice can be made. The Inspectorate will prescribe the minimum monitoring frequency required through a 6(7)(d) [6A(7)] notice.

6.9.5.11 If the source of the radioactivity is suspected to be an artificial source, then companies should carry out a risk assessment and monitor for radionuclides most likely to be present, based on the risk assessment. ID should then be calculated. Companies may need to seek professional advice to assist with radioactivity risk assessments.

6.9.5.12 Schedule 4 paragraph 3(4) [Schedule 5, paragraph 7]]includes a provision for the Secretary of State/Welsh Ministers to set alternative screening values for gross alpha activity and gross beta activity where it can be demonstrated that the alternative values are in compliance with an ID of 0.1mSv. Further guidance will be provided to companies about this at a future date.

Radon

6.9.6 Regulations 6(8) and (9) [Schedule 3A(1)] cover the monitoring requirements for **Radon,** which has a specified value of 100Bq/l**:**

6.9.6.1 Regulation 6(8) [Schedule 3A(1)(a)] requires that water companies must ensure that a representative survey is carried out to determine the likelihood of radon exceeding the specified value. The report referred to in paragraph 6.9.2 above, *DWI 70/2/301 Understanding the implication of the EC's proposals relating to Radon in drinking water for the UK* is the report on a national representative survey undertaken to fulfil this requirement. In this report, areas of England and Wales have been mapped and delineated based on whether the geology, existing sample result data and radon-in-air hazards are indicative of a high, moderate or low risk of radon being present as a drinking water quality hazard.

6.9.6.2 Companies should use the data provided in this report to inform their catchment risk assessments. Guidance on monitoring requirements is given in Information Letter 05/2015 Publication of Research: Understanding the Implications of the European Requirements relating to Radon in Drinking Water, summarised in 6.9.6.3 below:

6.9.6.3 Companies should complete a risk assessment for every source catchment and determine an appropriate monitoring strategy for radon, based on the risk of radon being present in treated water, as follows:

i. Surface waters do not require monitoring for radon.

ii. Groundwaters in low hazard areas do not require monitoring for radon.

iii. Groundwater supplies in high and moderate hazard areas should, from 1st January 2016, be monitored at the treatment works, at the audit frequency specified Schedule 3, Table 3 until the end of 2016; after which a further review should be carried out to assess whether any further regulatory monitoring is required. Under regulation 6(12) [6A(3)], see under 6.9.8 below, companies may then apply to the Inspectorate for a notice granting an exemption from monitoring, supported with appropriate evidence.

6.9.6.4 Companies should carry out catchment risk assessments to confirm that sources geographically located in the low hazard areas identified in the report referred to above (in 6.9.6.1) are not at risk of exceeding the specified value for radon. Companies wishing to extend beyond 2016 the exemption from monitoring for surface supplies and groundwaters identified as low risk, should apply to the Inspectorate for a regulation 6(12) [6A(3)] notice, accompanied with documentary evidence of risk assessment.

6.9.6.5 The specified value for radon of 100Bq/l applies at consumers' taps. Available evidence indicates it is unlikely that any public supplies will exceed this level, even where radon activity exceeds 100Bq/l at the treatment works, because radon gas is readily released into the atmosphere. In the event of an exceedance of the specified value for radon at a treatment works, further investigatory samples should be collected from the works every few days, at least once per week, for a minimum period of one month, to confirm the level of activity.

6.9.6.6 If radon is detected at greater than 100Bq/l in water supplied from a treatment works, investigatory monitoring should also be undertaken at consumers' taps to assess the impact on public health. Properties in high risk areas may be at risk of elevated levels of atmospheric radon, which could be exacerbated by radon present in the tap water. Advice should be sought from PHE or Public Health Wales (PHW) if there is any concern.

6.9.6.7 The Regulations specify an upper maximum limit for radon of 1,000Bq/l. If this level is exceeded, remedial action is required without consideration. It must be reported immediately to the Inspectorate as an event, as required by regulation 35(6). Companies should also consider, as a matter of good practice, reporting any detections of radon at levels exceeding 100Bq/l to the Inspectorate as an event, because this will allow the Inspectorate to be involved with discussions about any actions required to protect public health, which will add to the overall knowledge base for radon in drinking water supplies and inform future guidance published by the Inspectorate.

6.9.6.8 In Wales, companies may apply for a [6A3(3)] (reduced monitoring) notice if radioactivity due to radon is naturally derived and stable.

Tritium

6.9.7 Regulation 6(10) [Schedule 3A(2)] covers the monitoring requirements for **Tritium,** which has a specified value of 100Bq/l:

6.9.7.1 Monitoring for tritium must be carried out where there is an anthropogenic (man-made, or artificial) source of tritium in the catchment and the data indicates that the level of radioactivity due to tritium exceeds, or is likely to exceed, the specified value. Monitoring should be carried out at the treatment works, at the audit monitoring frequency specified in Table 3 of Schedule 3. The treatment works must be designated as a supply point for the zones supplied.

6.9.7.2 Where tritium is detected above 100Bq/l and it can be demonstrated that the source is naturally-derived, then a regulation 6(12) [6A(3)] notice may be applied for. This situation is unlikely to arise, however, since the presence of tritium in water would invariably be associated with an anthropogenic source.

6.9.7.3 In the event of an exceedance of the specified value for tritium, further investigatory samples should be collected from the treatment works every few days, at least once per week, for a minimum period of one month, to confirm the level of activity

6.9.7.4 If the level of tritium activity detected exceeds 100Bq/l, then companies should carry out further investigations to identify the source, and undertake monitoring for additional radionuclides – see section covering regulation 19 in paragraph 19.9. If at any time tritium is found to exceed 100Bq/l, then this should be reported to the Inspectorate as an event, as required by regulation 35(6). If action is required to protect public health, the Inspectorate may decide to issue a regulation 20(4) notice.

Exemption from Monitoring

6.9.8 Regulations 6(12) to (15) [6A(3) to 6A(6)] cover **allowable exemptions** from radioactivity monitoring:

6.9.8.1 Under regulation 6(12) [6A(3)] the Inspectorate may issue notices to water companies granting exemption from undertaking monitoring for ID, radon and/or tritium. Companies should provide evidence from their catchment risk assessments and monitoring data (whether compliance or operational monitoring) to support any application for a notice. In each case the evidence must demonstrate that water supplied from the treatment works is not likely to exceed the relevant specified value in Schedule 2 of the Regulations. The Inspectorate will determine the period of the exemption.

6.9.9 Regulation 6(13) [6A(5)] requires the Inspectorate to communicate to the European Commission (EC) the grounds for authorising any exemption from monitoring granted under regulation 6(12) [6A(3)], and provide the EC with all the documentary evidence used to support the authorisation. Regulations 6(14) and (15) [6A(6)] cover the circumstances where the Inspectorate must revoke a regulation 6(12) [6A(3)] notice, and water companies' duties to reinstate monitoring for the relevant parameter.

6.9.10 If, through companies' radioactivity monitoring, any isotopes of uranium are detected, the company should analyse samples for uranium concentration (as μg/l) to ensure that the concentrations of uranium found do not present a risk to wholesomeness by virtue of the element's chemical toxicity. The WHO guideline value (GV) for uranium is 30μg/l. If uranium is detected at a concentration exceeding the GV, then it should be reported to the Inspectorate as an event, as

required by regulation 35(6). PHE/PHW should be consulted to determine whether any action is needed to protect human health.

6.9.11 Further guidance on radioactivity sampling and analysis is given in **Appendix 6.1: Radioactivity Sampling and Analysis**. The Appendix includes flow charts illustrating the decision-making process for ID, a more detailed flow chart to aid investigation of ID, a table of commonly-found radioactive isotopes and their sources, information and reference sources for analytical methods and some guidance on the importance of understanding decay pathways.

6.10 Monitoring water supplied from tankers

6.10.1 Regulation 6 paragraphs 16, 17 and 18 [6(3) and 6(4)] specify the requirements for monitoring water supplied from tankers (transportable bowsers and static tanks) where they are used during emergencies to provide an alternative to the piped public supply. Water from every individual tank or bowser must be sampled 48 hours after the start of its use for *E.coli* and conductivity [*E.coli*, hydrogen ion and conductivity in Wales]; and every 48 hours thereafter for these two and all other Schedule 1 parameters. Only wholesome water should be used to fill bowsers. It is good practice for companies to keep records of bowers and tanks deployed, the time filled and the time taken out of use, in order to be able to demonstrate compliance with these regulations.

6.10.2 Guidance on cleaning and disinfecting bowsers before use, and maintaining wholesomeness whilst in use, is given in The Principles of Water Supply Hygiene published by Water UK (October 2015). Manufacturers' instructions for use should also be followed.

6.10.3 These regulations do not apply to vehicle tankers when used to introduce drinking water into the distribution network either directly or to fill service reservoirs. The point of compliance remains at consumers' taps. Monitoring of reservoir outlets should remain as specified in regulation 14. The Inspectorate considers that it is good practice to carry out additional operational monitoring of water supplied from the reservoirs, and water as it is discharged from tankers, to confirm that the water supplied is wholesome.

6.10.4 In carrying out vehicle tankering operations companies should follow manufacturers' instructions for use and guidance in *The Principles of Water Supply Hygiene* when cleaning and preparing tankers, and for maintaining wholesomeness of the water during transport and discharge into the public supply system. Tankers used to supply drinking water should not be used for any other purpose, unless during exceptional emergency situations a lack of available water-only tankers requires the procurement of additional tankers. Tankers that have been used to transport food and drink products for human consumption may be used, provided they have been thoroughly cleaned, disinfected and sampled for microbiological parameters before use.

6.10.5 Where vehicle tankers are used to inject water directly into the distribution network, it is considered good practice to sample water in the tanker after it has been filled or as it is discharged, as a minimum for microbiological parameters and turbidity, and also from suitable points downstream in the network to verify that flow changes and disturbance of deposits have not caused a deterioration in quality.

7. Regulation 7 – Sampling points

7.1 Regulation 7 requires all sampling points in water supply zones to be selected at random. Water companies are expected to maintain a sampling programme that selects sample points at random from a comprehensive list of all its consumers, including commercial premises and buildings where the water supply is made available to members of the public. The list of consumers should also include non-household customers who have switched supplier, because wholesalers retain responsibility for the regulatory sampling and other duties imposed by the Regulations. Sampling points must be representative of the water supply zone as a whole.

8. Regulation 8 – Authorisation of supply points

8.1 Regulation 8 permits the use of monitoring at designated supply points, in place of monitoring in water supply zones, for certain parameters (known as conservative parameters) provided it can be demonstrated that there is no material difference in the data for the parameter between the supply point and the consumers' taps in the zone. Under regulation 8(2) the Inspectorate automatically authorises the use of designated supply points for the parameters numbered 7 to 17 and 19 to 28 [7 to 15 and 17 to 25] in Table 3 of Schedule 3 of the Regulations. Table 3 specifies the annual sampling frequency required for each parameter.

8.2 Nitrite is listed in Table 3 because audit monitoring of nitrite is required at treatment works (under Regulation 13(1)(c)). If chloramination is practised then the check monitoring frequency applies, at the works. If chloramination is not practised then the audit monitoring frequency applies at the works. It is not classed as a conservative parameter, and therefore monitoring at consumers' taps is also required (as specified in Table 2 of Schedule 3).

8.3 A supply point can be a treatment works outlet, a service reservoir outlet or a blending point, and may supply more than one zone. Treatment works and service reservoir sampling points used as supply points must be coded as supply points in companies' monthly data returns for the applicable parameters and zones supplied.

8.4 Under regulation 8(4) [8(3)] the Inspectorate has discretion to authorise supply points for other parameters, subject to certain criteria:

i. Antimony, arsenic, cadmium and selenium may be monitored at supply points where the water company can demonstrate for the zones supplied that these metals have not been detected at significant concentrations in samples taken from consumers' taps for at least two years.

ii. Trihalomethanes may be monitored at supply points where the water supply zones are supplied with water that originates solely from groundwater and the water company can demonstrate that the concentrations at consumers' taps have been an average (mean) of 30µg/l or less for at least two years and not exceeded 50 µg/l in that time.

iii. Where a supply point authorisation is granted for any of the above parameters, companies should adopt the same audit sampling frequency as specified for other parameters listed in Table 3 of Schedule 3.

iv. Regulation 8(4) [8(3)] also specifies that the granting of an authorisation under regulation 8(4) requires a written application from the water company. Regulations

8(6) to 8(10) [8(4) to 8(7)] require that companies must inform the Inspectorate as soon as they become aware that use of a supply point is no longer appropriate for a parameter granted authorisation under regulation 8(4)[8(3)], and the Inspectorate will revoke the authorisation. Furthermore, the Inspectorate has a duty to revoke a Regulation 8(4)[8(3)] authorisation as soon as it becomes apparent, whether the company has informed the Inspectorate or not, that the authorisation is no longer appropriate.

8.5 Fluoride is one of the parameters that may be monitored at a supply point. Where supplies are artificially fluoridated at the request of the local authority, to achieve a target concentration in water supplied to consumers, fluoride should not be monitored at a supply point if the downstream fluoride concentration is likely to decrease through blending with water containing a lower concentration of fluoride. This would constitute "*adverse change*", as specified in the Directive's criteria for use of supply points.

8.6 As explained previously in paragraph 6.8.3, it is good practice that pesticides are, as far as practicable, monitored at treatment works outlets. Where this is carried out the treatment works sampling point should be designated as a supply point for the zones supplied, and all pesticide monitoring undertaken at the supply point. The same applies to radioactivity parameters.

8.7 *Clostridium perfringens* is the only microbiological parameter which may be monitored at supply points. Check monitoring is required for *C.perfringens* in surface water supplies and supplies influenced by surface water. The primary reason for monitoring for *C.perfringens* is because of this organism's properties as an indicator of remote or historic faecal contamination, and its usefulness as an indicator of the effectiveness of treatment processes, in particular processes designed to remove particles. Monitoring of *C.perfringens* at consumers' taps is not consistent with this primary role, therefore companies are advised not to routinely include this parameter in water supply zone compliance monitoring.

8.8 The specified check sampling frequency for *C.perfringens* required for large treatment works can be as high as 2,190 samples per year, which would necessitate taking multiple samples each day from large works. The Inspectorate considers that this is neither practical nor desirable and, therefore, where the required sampling frequency exceeds 365 samples per year it is good practice to take at least 365 samples from the treatment works, and take the remaining samples to meet the minimum frequency from other supply points such as service reservoir outlets. Where no practical alternative exists, the additional samples should be taken in water supply zones.

8.9 In respect of the following parameters, it is unlikely that authorisation to sample from supply points will be given because the results may differ in a material respect:

i. *E.coli*, coliform bacteria and colony counts, because these are likely to change in concentration through the distribution system;

ii. Lead, copper, nickel and chromium because these metals can be present from contact of the water with plumbing materials;

iii. Iron, manganese and aluminium because these metals can be present in water leaving treatment works and picked up from deposits in the distribution system;

iv. polycyclic aromatic hydrocarbons and benzo(a)pyrene because these substances are associated with coal tar pitch linings in distribution systems;

v. Colour, taste, odour and turbidity because these characteristics of the water supply can be affected by the condition of the distribution system and consumers' plumbing systems;

vi. Hydrogen ion (pH) because this can change as the water passes through the distribution system and by treatment equipment within consumers' premises;

vii. Sodium because this can increase when sodium hypochlorite is added during distribution and when treatment equipment is used within consumers' premises;

viii. Ammonium and nitrite because these concentrations are likely to change as the water passes through the distribution system due to microbiological reactions and when chloramination is practised;

ix. Nitrate because it should be sampled at the same time and place as nitrite in order to calculate the nitrate / nitrite formula; and

x. Trihalomethanes when the water supply originates from or is influenced by surface water because the concentrations leaving the treatment works are likely to vary significantly as the water passes through the distribution system.

8.10 Regulation 8(3) [8(2)] prohibits the use of supply points where a combined licensee introduces water into the supply zone unless the water quality within the supply zone remains approximately uniform.

8.11 The Regulations make no reference to the provision of a bulk supply of water from one water supplier to another, though this is common practice. For the parameters specified, and subject to the Inspectorate's approval, companies receiving a bulk import may use data gathered by the supplying company from its supply point in place of supply zone data, provided that the zone receiving the bulk import receives water only from the supplier's supply point.

9. Regulation 9 – Numbers of samples

9.1 Regulation 9 requires companies to take the standard number of samples from its water supply zones (consumers' taps) or, where appropriate, supply points, for analysis for the parameters listed in Tables 2 and 3 of Schedule 3. As explained previously in paragraph 6.6, parameters included in check monitoring do not need additional audit samples, because the specified check monitoring frequencies cover both purposes.

9.2 Sampling frequencies for zones are based on the resident population of the zone, and for supply points the daily volume of water supplied, in cubic metres per day (written as m^3/day).

9.3 Paragraph 2 of regulation 9 allows a reduced sampling frequency for parameters subject to check monitoring. The specified minimum reduced frequencies for water supply zones are shown in column 3 of Table 2, and for supply points in column 4 of Table 3.

9.4 Regulation 9(3)(a) [9(2)(a)] requires that reduced frequency may only be adopted where the water company can demonstrate that the quality of water in relation to that parameter is not likely to deteriorate. The risk assessments carried out under the requirements of regulation 27 should form the basis for making this judgement.

9.5 Regulation 9(3)(b) [9(2)(b)] specifies a second condition, which is that previous results for the parameter over the preceding two years demonstrate that the normal concentration is significantly lower than the PCV or specification for indicator parameters, and that there has been no significant variation in the concentration. For hydrogen ion concentration (pH) the results must all be within the range of 6.5 to 9.5,

and results for colony counts (heterotrophic plate counts at 22°C and 37°C) should show no abnormal change.

9.6 The Inspectorate accepts the following criteria as evidence that reduced frequency may be applied. In each case the sampling data set should be regulatory compliance samples reported to the Inspectorate over the two years prior to the commencement of reduced sampling. If, during that two-year period, fewer than 12 samples have been taken, then results from the last 12 compliance samples should be used:

9.6.1 For aluminium, ammonium, colour, conductivity, iron, manganese, nitrate, nitrite and turbidity: The arithmetic mean must be no more than 20% of the PCV or specified value; and, no result in the same data set should exceed 50% of the PCV or specified value.

9.6.2 For taste and odour all the results must be less than a dilution number of 1, and there has been no significant increase in the number of consumer complaints in the water supply zone.

9.6.3 For *Clostridium perfringens*, the organism has not been detected in any of the samples.

9.6.4 For colony counts, all the results obtained are within plus or minus one order of magnitude of the mean for that zone. In cases where the mean value is less than 2/ml, individual results up to 20/ml can be taken as indicating no significant variation and no abnormal change.

9.6.5 For the hydrogen ion parameter, all the results for pH are within a spread of 1 pH unit, and all the results in the same data set are within the range 6.5 to 9.5.

9.6.6 For all parameters, there must be no risk requiring additional controls identified in the company's risk assessment or outstanding corrective actions (e.g. arising from events) for the supply system that could cause the parameter to exceed the PCV or specified value.

9.7 Where reduced frequency is in place, companies must revert to standard frequency immediately on a pro rata basis for the remainder of that year and the two following calendar years, once it is established that any of the above conditions are no longer applicable, and inform the Inspectorate accordingly.

9.8 Regulation 9(4) [9(3)] requires that samples are taken at regular intervals throughout the year. Companies should ensure that they have sufficient sampling manpower resource and analytical capability to ensure that this requirement is complied with throughout the year. Clustering of samples to compensate for an earlier shortfall, incurred for example during a period of high workload, or staff holidays, constitutes a failure to comply with this regulation.

9.9 If a supply point has been operational for part of a year, the number of samples taken (whether at reduced or standard frequency) should be in the same proportion as the number of days in the year (midnight to midnight) that the supply point was in use.

9.10 If a water company fails to take or analyse a prescheduled compliance sample, for example because of a broken sample bottle or analytical quality control (AQC) breach, it should reschedule a further sample as soon as possible, to be taken well in advance of the next programmed sample, as far as is practicable. Since the Regulations require the frequencies to be met on an annual basis rescheduling does not constitute a

shortfall. Provided the resampling is prompt, occasional occurrences of this type will not be regarded as a failure to meet the regularity requirement.

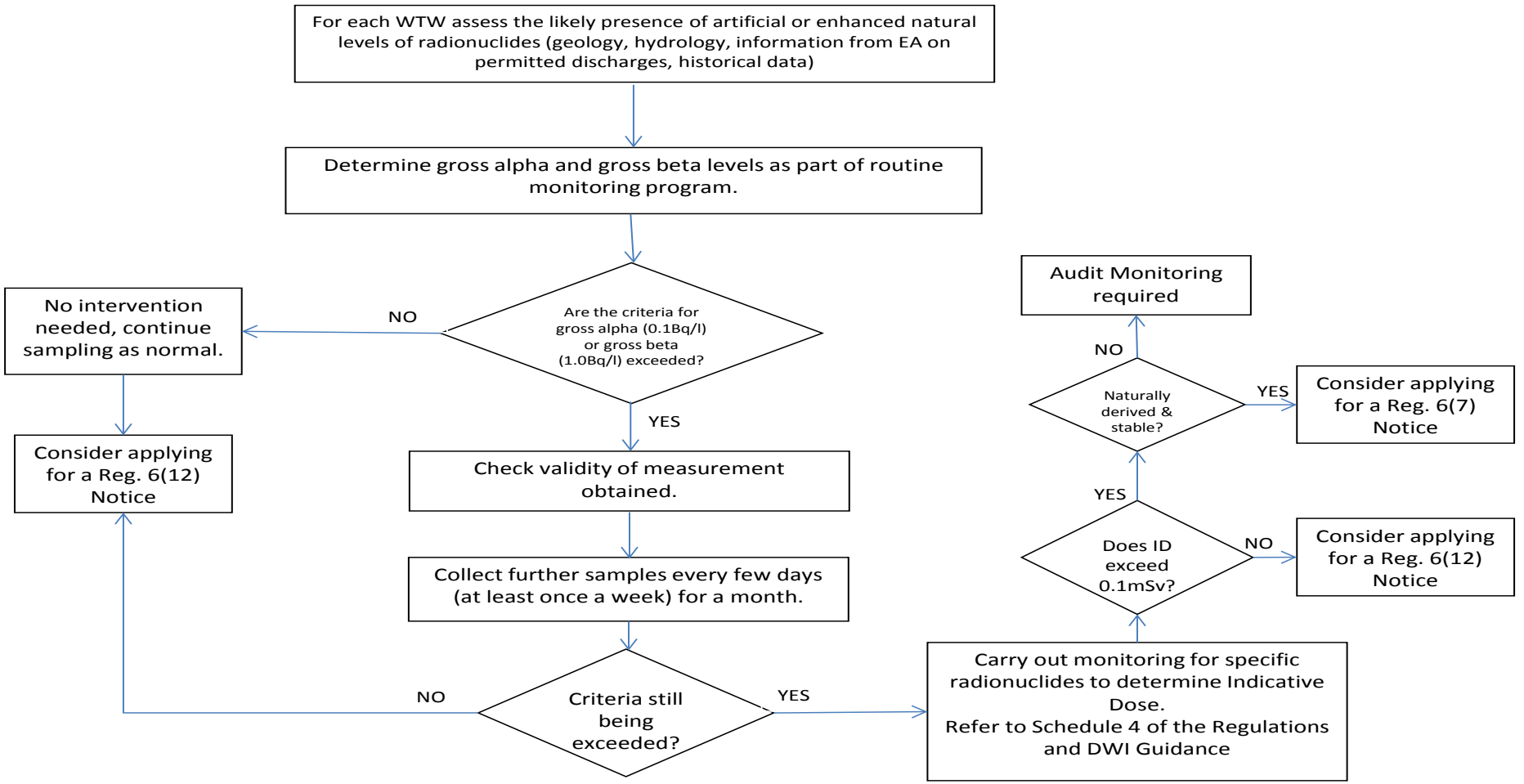
10. Regulation 10 – Sampling: further provisions

10.1 Regulation 10 requires companies to take samples for any element, organism or substance that may cause the water to be unwholesome, where there are reasonable grounds to do so. For example the company's risk assessment has identified that a treated water is at risk of being unwholesome because of the presence of *Cryptosporidium*, which is not a parameter. The company must take a sufficient number of samples, at an appropriate frequency, in order to assess and quantify the risk, and to determine any necessary remedial actions required to ensure that the water supply is wholesome at all times. This should take into account any expected seasonal variation.

APPENDIX 6.1: RADIOACTIVITY SAMPLING AND ANALYSIS

1. Decision Tree for Indicative Dose Monitoring (equivalent Welsh Regulation numbers are not shown)

(refer also to Regulation 6 and Regulation 19 guidance)



2. Common isotopes and sources – an aid to risk assessment

Origin	Nuclide	Derived concentration (Bq/l)[2]	Half life	µg/l	Uses	Emits	WHO guideline value (µg/l as the element)
Natural	U-238	3.0	4.468×10^{9}y	241.2		alpha and gamma	30
Natural	U-234	2.8	2.455×10^{5}y	0.0121		alpha and gamma	30
Natural	Ra-226	0.5	1600y	1.37×10^{-5}	Formerly used in self-luminous paints for watches, nuclear panels, aircraft switches, clocks, and instrument dials. Used as a radiation source in some industrial radiography devices to check for flawed metallic parts.	alpha and gamma	
Natural	Ra-228	0.2	5.75y	1.98×10^{-8}		beta	
Natural	Pb-210	0.2	22.23y	7.06×10^{-8}	Used as a tracer for the behaviour of heavy metals in the soil-stream-estuary system.	alpha, beta and gamma	10
Natural	Po-210	0.1	138.38d	3.53×10^{-8}	Used in anti-static applications	alpha and gamma	
Artificial	C-14	240	5700y	1.45×10^{-3}		beta	
Artificial	Sr-90	4.9	28.80y	9.59×10^{-7}	In industry as a radioactive source for thickness gauges. Heat source for electric power. Radiotherapy	beta	
Artificial	Pu239/Pu-240	0.6	2.41×10^{4}y/6561y	2.61×10^{-4} 7.14×10^{-5}	Power and heat source	alpha and gamma	
Artificial	Am-241	0.7	432.6y	5.52×10^{-6}	Commonly used in smoke detectors	alpha and gamma	

[2]These precise values are calculations for a dose of 0.1mSv as an annual intake of 730 litres and taken from Euratom dose coefficients from Annex III, Table A of Directive 96/29/Euratom. Derived concentrations for other radionuclides can be calculated using this basis and, additionally, derived concentrations based on more up to date information may be used to calculate ID. The Inspectorate will, if required, update this Guidance in response to new information.

Origin	Nuclide	Derived concentration (Bq/l)[2]	Half life	µg/l	Uses	Emits	WHO guideline value (µg/l as the element)
Artificial	Co-60	40	5.27y	$9.55x10^{-7}$	Radiotherapy Industrial radiography Food irradiation	beta and gamma	
Artificial	Cs-134	7.2	2.064y	$1.50x10^{-7}$		beta and gamma	
Artificial	Cs-137	11	30.05y	$3.42x10^{-6}$	Medical radiation therapy devices for treating cancer. Industrial gauges	beta and gamma	
Artificial	I-131	6.2	8.023d	$1.34x10^{-9}$	Medical radiotherapy	beta and gamma	

This is not an exhaustive list, but represents the most common isotopes associated to radioactivity sources.

3. Analytical requirements

These are taken directly from Schedule 4 of the Regulations and collated into a single table. In the absence of accreditation to DWTS for radioactivity parameters, the analytical method should be covered by ISO 11929.

Parameter	Limit of Detection (Bq/l)	PCV (Bq/l)	Action (Bq/l)
Tritium	10	100	
Radon	10	100	1000
alpha	0.04	0.1	0.5*
beta	0.4	1.0	
U-238	0.02		
U-234	0.02		
Ra-226	0.04		
Ra-228	0.02		
Pb-210	0.02		
Po-210	0.01		
C-14	20		
Sr-90	0.4		
Pu-239/Pu-240	0.04		
Am-241	0.06		
Co-60	0.5		
Cs-134	0.5		
Cs-137	0.5		
I-131	0.5		

*This is WHO Guideline Value (GV), which may be set as the limit (screening level), if required, through the notice procedure where ID is shown to be below 0.1mSv, authorised by the Inspectorate. In order operate with this screening level, the company will be required to provide radionuclide identification as evidence to support a relaxation of the gross alpha screening level.

4. Methods of analysis

Below are the published methods of analysis for radioactive parameters. This list is not exhaustive, but these methods provide starting points for in-house methods and are under constant review through either the Standing Committee of Analysts (SCA) or British Standards Institute (BSI). Analytical methods for radionuclides fall under the general DWTS requirements for analysis and accreditation.

Blue book methods of analysis (current 21/12/15)

1. Measurement of alpha and beta activity of water and sludge samples. The determination of Radon-222 and Radium-226. The determination of Uranium (including general X-ray fluorescent spectrometric analysis) 1985-1986 (94).
2. Determination of radioactivity in water by Multinuclide Gamma Ray Spectrometry 1989 (132).
3. The determination of tritium (tritiated water) activity concentration by alkaline distillation and liquid scintillation counting 1999 (173).
4. Guidance on the measurement of tritium in environmental samples 2005 (198).

British Standards (current 21/12/15)

1. BS EN ISO 9698:2015 Water quality. Determination of tritium activity concentration. Liquid scintillation counting method

2. BS EN ISO 10703:2015 Water quality. Determination of the activity concentration of radionuclides. Method by high resolution gamma-ray spectrometry

3. BS EN ISO 13161:2015 Water quality. Measurement of polonium 210 activity concentration in water by alpha spectrometry

4. BS ISO 11704:2015 Water quality. Measurement of gross alpha and beta activity concentration in non-saline water. Liquid scintillation counting method

5. BS ISO 13167:2015 Water quality. Plutonium, americium, curium and neptunium. Test method using alpha spectrometry

6. BS ISO 10704:2015 Water quality. Measurement of gross alpha and gross beta activity in non-saline water. Thin source deposit method

7. BS ISO 9698:2015 Water quality. Determination of tritium activity concentration. Liquid scintillation counting method

8. BS ISO 9696:2007 Water quality. Measurement of gross alpha activity in non-saline water. Thick source method

9. BS ISO 9697:2015 Water quality. Gross beta activity in non-saline water. Test method using thick source

10. BS EN ISO 13160:2015 Water quality. Strontium 90 and strontium 89. Test methods using liquid scintillation counting or proportional counting

11. BS ISO 13163:2013 Water quality. Lead-210. Test method using liquid scintillation counting

12. BS ISO 13164-1:2013 Water quality. Radon-222. General principles

13. BS ISO 13164-4:2015 Water quality. Radon-222. Test method using two-phase liquid scintillation counting

14. BS ISO 13165-2:2014 Water quality. Radium-226. Test method using emanometry

15. BS ISO 13168:2015 Water quality. Simultaneous determination of tritium and carbon 14 activities. Test method using liquid scintillation counting

16. BS ISO 13165-3 Water quality - Radium-226 - Part 3 Test method using coprecipitation and gamma-spectrometry Shortcut

17. BS EN ISO17294-2 Water quality — Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 2 Determination of selected elements including uranium isotopes

5. Decay Pathways

Decay pathways provide useful information to assist water companies in the process of identifying sources, or risks from radionuclides. It is advised that water companies review the radionuclide and its decay pathway to inform the risk assessment and to provide vital information regarding the stability of the radionuclide(s), to ensure that analysis is carried out without degradation to the sample and is representative of the water supplied. 30 day stability is not an absolute and some radionuclides have a considerably shorter half-life than 30 days. The chart below is an example of a decay pathway, in this case naturally occurring uranium, which includes radon.