WHO's approach to managing radioactivity in drinking water

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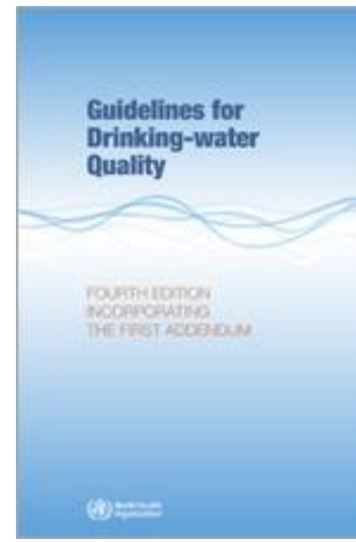
WHO Guidelines for Drinking-water Quality

First edition 1984, before that International Standards for Drinking-water. WHO do not set standards but the Guidelines are the scientific point of departure for developing national standards.



2017

Second addendum prepared.
Fifth edition planning started

Overall approach in the Guidelines

In the context of the Framework for Safe Drinking Water based around a source to tap proactive, preventive approach to safe water.

Key to this is the establishment of supply-specific Water Safety Plans that work on mapping and understanding the system, identifying the hazards, assessing the risks and putting in place appropriate barriers. The operation of the barriers is monitored to ensure that they are working efficiently at all times. Periodic review and modification if new data emerge or something goes wrong.

The risk-based approach is incorporated in the revised drinking water directive.

Radioactivity is one of the possible hazards.

Radioactivity in the WHO Guidelines

Chapter 9 covers radioactivity

Radioactivity is generally not the greatest concern for drinking water. Microbial pathogens and a limited number of chemicals are usually the greatest risk for health. Pathogens are an acute risk but most chemicals are only of concern following long-term exposure, e.g. arsenic, fluoride.

Radioactivity is also only of concern after long-term exposure.

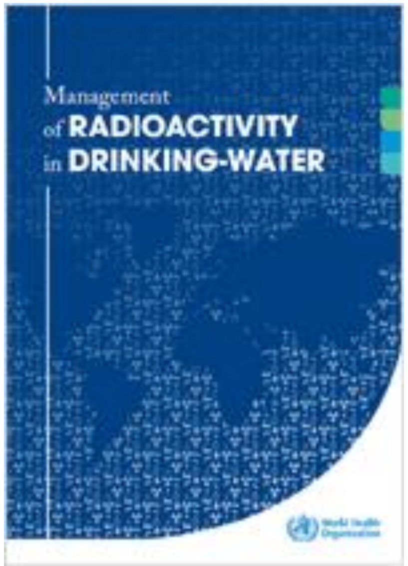
The basis of the Guidelines is screening values for gross alpha and gross beta.

Radon is considered separately.

Supporting Document

Developed to provide supporting information and explanation for non-experts who are responsible for regulation or decisions regarding management of drinking water supplies. Q and A format and tries to keep to plain language.

Consultation meeting held in Amman with experts and non-experts (in radioactivity).



What the Guidelines Say

Screening values: Gross α 0.5Bq/L and Gross β 1.0 Bq/L

These are based on an IDC (Individual Dose Criterion) of 0.1 mSv from 1 year consumption of drinking water at 2 litres per day.

This is deliberately very conservative but provides a practical way of examining drinking water supplies without excessive cost and difficulty since the level of radioactivity is below this for the great majority of supplies.

Very useful approach to screening, and where appropriate, monitoring sources and supplies. They cover natural and man-made radionuclides in non-emergency situations but exclude radon. There is a small number of natural radionuclides that would not be captured by these screening levels. Potassium-40 need not be considered unless the screening value for Gross β is exceeded.

Management needs to be considered in the context of overall exposure from food etc.

What are we interested in?

Naturally occurring radionuclides from elements of the thorium and uranium decay series, e.g. radium-226, radium-228, polonium-210, lead-210 and *radon*. From natural processes or some human activities. Very variable depending on the geology and the water characteristics. Mostly groundwater. Uranium is covered on the basis of chemical toxicity.

Human-made radionuclides, e.g. from accidental or regular discharges from nuclear facilities, discharges of radionuclides produced for and used in medicine or industry, discharges from military activities and global dispersion of nuclear weapons fallout. These are caesium-134, caesium-137, strontium-90, iodine-131, tritium and carbon-14. Levels in drinking-water generally very low and usually not measurable using standard analytical methods.

Need to consider "local" circumstances, geology etc. Some deep groundwater bodies in certain regions can have elevated concentrations that are of concern for health.

What if the screening values are exceeded?

Check the validity of the measurements, repeat samples.

Still exceeded – subtract K-40 following separate determination of K^+

Still exceeded – look at available information on sources of radionuclides and develop a specific analytical strategy to identify what is there.

Check against the Guidance Levels in the GDWQ for specific radionuclides.

If more than one radionuclide present does the sum of the measured activity concentration above the respective limit of detection (LOD) of each radionuclide divided by the guidance level for that radionuclide, calculated using the default assumptions (adult, 2 L d-1)
exceed unity need to consider possible actions to reduce the dose.

Assess whether varies over time, particularly seasonally.

Neither the screening values nor the individual dose criterion (IDC) should be interpreted as a limit above which drinking-water is unsafe for consumption. Drinking-water is a fundamental requirement of life and the risks of not having a drinking-water supply are likely to be much higher than consuming drinking-water that does not meet the IDC.

All clear if not exceeded?

Generally yes but not always. Screening is not good for some elements, particularly lead-210 and radium-228 due to low energy of their beta particles.

May require radionuclide specific analysis where these are the significant contributors to gross beta. Uncommon but possible in certain regions, e.g some deep groundwater in the Middle East and Australia.

Management

Change water sources if this is practical and the new source will not result in other risks.

Controlled blending of supplies to reduce concentrations.

Modify or install treatment – coagulation, sedimentation and filtration on surface sources can be very effective at removing suspended radionuclides **BUT** this will lead to a waste stream that does need to be considered. Treatment on groundwater is usually limited and any treatment needs to consider the waste stream and its disposal.

Some effective point of use devices but again the exhausted material needs to be safely disposed of.

Sampling and analysis

Sampling can normally be at the exit to the treatment works because radionuclides do not change appreciably in distribution.

Sampling should initially determine variation over time (seasonal).

This is followed by risk-based sampling frequencies, i.e related to actual risk of the screening values or the IDC being exceeded. In low risk situations may be one sample every 5 years or longer unless there is evidence of a change.

Radon

Potential issue for some groundwater. Degasses from surface water.

Inhalation rather than drinking

Water treatment or processes that encourage degassing will effectively remove radon from groundwater.

Where there are small supplies with a short gap between source and tap then potentially a problem. Will contribute to indoor air concentrations and will also be consumed.

Often there will be greater contributions from gas leaking into buildings.

Emergencies

There are the IAEA Safety Standards Series on preparedness and response for a nuclear or radiological emergency, which includes General Safety Requirements No. GSR Part 7 (IAEA, 2015) and General Safety Guide No. GSG-2: *Criteria for use in preparedness and response for a nuclear or radiological emergency* (IAEA, 2011). These contain criteria for drinking-water that apply for emergency situations. These standards are co-sponsored by a number of international organizations, including WHO. Usually short term.

The WHO guideline values are sometimes used as a quick first screen. They are used post-emergency for the longer term.

Final Remarks

The WHO Guidelines provide an understandable and pragmatic approach to managing radioactivity in drinking water. The supporting document provides explanation and guidance in plain language.

They apply to normal long-term situations but not emergencies.

They need to be applied with proper consideration and thought.

Most of the time radionuclides are not an issue for drinking water but in certain circumstances they can be and then need to be properly managed just as with other hazards.