CODEX ALIMENTARIUS COMMISSION

Food and Agriculture Organization of the United Nations

World Health Organization

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Agenda Item 4 **CX/CF 24/17/4**

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ORIGINAL LANGUAGE ONLY

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON CONTAMINANTS IN FOODS

17th Session
15–19 April 2024

MATTERS OF INTEREST ARISING FROM OTHER INTERNATIONAL ORGANIZATIONS

Part I

International Atomic Energy Agency and the Joint FAO/IAEA Centre

(Prepared by the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture[1])

1. This year will mark the 60th anniversary of the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture (Joint FAO/IAEA Centre), a unique partnership between two international organizations in the United Nations family. Established in October 1964 as a strategic partnership between the Food and Agriculture Organization of the United Nations (FAO) and the International Atomic Energy Agency (IAEA), it has continued to mobilize the capabilities and resources of both organizations to benefit their Member States in the peaceful application of nuclear science and technology. The programme of the Joint FAO/IAEA Centre is demand led and has continually evolved to meet changing needs world-wide. It currently has five subprogrammes related to: land and water management; livestock production; food safety and control; major insect pest control, and; crop improvement for agricultural production. Another unique feature in the UN system is that each subprogramme includes an associated research laboratory. For example, the Food Safety and Control Section provides applied and adaptive research into analytical method development, laboratory support, advice, and training through its Food Safety and Control Laboratory (FSCL), located in Seibersdorf, Austria.

2. Joint FAO/IAEA Centre activities of main interest to the CCCF are those related to the analysis and control of various chemicals and contaminants in food. However, there will also be some interest in food authenticity and provenance; food and phytosanitary irradiation, and food related radiation safety standards. Programmatic activities involve collecting, analysing and disseminating information for the effective transfer of skills and technology related to the nuclear sciences in food and agriculture. These matters and more will be highlighted at the International Symposium on Food Safety and Control, Organized by the FAO and the IAEA through the Joint FAO/IAEA Centre. The Symposium will be hosted by the IAEA at its headquarters in Vienna, from 27–31 May 2024, and participation is at no cost but registration is necessary for in person participation and also online "virtual" attendance as an observer.

Atoms4Food

3. On 18 October 2023, the Directors General of FAO and IAEA issued a joint statement about "Atoms4Food" and the initiative was launched at the 2023 World Food Forum in Rome. It will support countries to use innovative nuclear and related techniques to ensure food safety, enhance agricultural productivity, reduce food losses, improve nutrition, and adapt to the challenges of climate change. There will be a focus on tailor-made responses to the specific needs of countries. For example, through the Atoms4Food initiative the IAEA and FAO can be invited to provide evaluation services, including on food safety and control, to produce individual assessments of a country's laboratory capabilities and ability to conduct surveillance of food hazards. Such country-specific assessments will be used as the basis for the FAO and IAEA to harness partnerships and collaboration with other UN Agencies, the Consultative Group on International Agricultural Research (CGIAR), international financial institutions, development agencies, foundations, industry, national academic centres, research institutions, and other relevant partners, to deliver the long-term outcomes identified.

[1] https://www.iaea.org/topics/food-and-agriculture

Research

4. In 2023, the FSCL developed new methods and protocols for measuring levels of mycotoxins (aflatoxins and fumonisins) in foods such as maize tortillas, millet and maize grains and pistachio nuts. These new methods included rapid electrochemical techniques where screen-printed carbon electrodes were optimised and cross validated as competitive electrochemical immunosensors for the determination of total aflatoxins in pistachio and for the determination of total fumonisins in maize. The immunosensor technologies were confirmed by repeating the experiment using a liquid chromatography coupled with tandem mass spectrometry as an independent assay technique.

5. Also in the past year, eight international coordinated research projects (CRPs) were implemented by the Joint FAO/IAEA Centre in the field of food safety and control. The IAEA uses CRPs as the main mechanism for organizing and delivering international research outputs consistent with the organization's agreed programmatic goals. Each CRP typically involves up to twenty institutions from developed and developing countries that collaborate on research topics of common interest, for a period of five years. In total, 105 institutions received funding through this mechanism for research related to food safety and quality in 2003. The CRPs of most relevance to the CCCF are CRP D52041 on "Integrated Radiometric and Complementary Techniques for Mixed Contaminants and Residues in Foods" and CRP D52044 on "Nuclear techniques to support risk assessment of biotoxins and pathogen detection in food and related matrices".

6. Research activities under CRP D52041 concluded in 2023. The project brought together research and regulatory institutions in Benin, Botswana, China, Colombia, Ecuador, Italy, Netherlands, Nicaragua, North Macedonia, Pakistan, Papua New Guinea, Peru, Spain, South Africa, Uganda, and the USA. Multi-class analytical methods were developed to support systematic programmes for detecting and controlling residues and contaminants. A report is being produced for the IAEA TECDOC series of publications and will be freely available online. The research proved to be successful despite challenges associated with the COVID-19 pandemic. Twenty-five isotopic, nuclear, and related analytical methods were developed and validated; twenty-one standard operating procedures were prepared, and results were published as manuscripts in at least sixteen peer reviewed journals. The participants commented that the activities contributed to improved laboratory performance with analyses of multiple chemical hazards in a single method rather than testing for each analyte using separate approaches. More than three hundred analytes (residues and contaminants) in at least seventeen food types/commodities can be detected by multi-class methods developed due to this collaborative research effort. Some of these methods are already being applied in routine testing and in national monitoring programmes and all are transferrable to laboratories in other countries. The development of human resource capacities should not be overlooked as this initiative contributed to the attainment of twenty-seven academic degrees (10 PhD, 15 MSc and 2 BSc studentships).

7. The second research coordination meeting of CRP D52044 on nuclear techniques to support risk assessment of biotoxins and pathogen detection in food and related matrices was held in October 2023. The opportunity was taken to review and consolidate the achievements gained in the initial phase of this five-year CRP. It has a "One Health" perspective and focuses on nuclear, isotopic, and related techniques, and the generation of data on biotoxins. For example, cyanotoxins in fresh/inland water and associated food matrices along the food chain. It also involves research work on biomarkers of these toxins; several targeted mycotoxins; toxins from pathogens; and pathogens of zoonotic and non-zoonotic nature associated with food sickness outbreaks.

Capacity Building

8. The IAEA's primary mechanism for transferring nuclear and related technology to Member States is its technical cooperation programme. It helps institutions to address key development priorities for their countries in many different areas including food and agriculture. In the area of food safety and control one hundred IAEA technical cooperation projects were supported in 2023 and into 2024 (90 national and 10 regional projects). The Joint FAO/IAEA Centre provides technical support for these projects funded through the IAEA Department for Technical Cooperation. Further details on these capacity building projects can be found online[2], including a full listing and articles on the most recent activities.

9. The Joint FAO/IAEA Centre participates at the Codex Alimentarius Commission, as well as various Codex committees, including the CCCF. It is committed to assisting Member Countries in providing data to Codex and helping develop Codex standards, codes of practices and guidelines. The Joint FAO/IAEA Centre also promotes sustainable networks to foster sharing of laboratory technical knowledge, experiences, and resources, including analytical methods and protocols for testing foods for contaminants as well as the collection of necessary data.

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2 Food Safety and Control Newsletter Vol. 03 No. 1, Jan 2024 https://www.iaea.org/publications/15625/food-safety-and-control-newsletter-vol-03-no-1-january-2024

In total over 200 institutions are involved in these regional networks. They include the African Food Safety Network (AFoSaN)[3], the Latin American and Caribbean Analytical Network (RALACA)[4] and the Food Safety Asia Network[5].

10. In the reporting period, the Joint FAO/IAEA Centre has implemented three training workshops related to food safety and control and other events such as arranging and hosting technical visits and fellowships to assist in the development and transfer of technical expertise. At least 417 people receiving training in total in 2023. The Food Safety and Control Section and its Laboratory produced 42 publications, including nine manuscripts in peer-reviewed journals, two book chapters and eighteen manuals/standard operating procedures for methods of analysis. In addition, the Food Contaminant and Residue Information System (FCRIS)[6] was maintained and updated. It now contains approximately 300 methods. The FCRIS is a free-to-access resource that provides useful and informative data on food contaminants and residues. It includes a database of analytical detection methods for contaminants and residues in foods.

Part II

Radionuclides in Food in Non-Emergency Situations

(Prepared by the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture)

Overview

11. The IAEA's Statute authorizes it to establish or adopt safety standards and requires the Agency to promote international cooperation. These Safety Standards are among the Agency's key publications, they provide fundamental principles, requirements, and recommendations to ensure nuclear and radiation safety. They serve as a global reference for protecting people and the environment and contribute to a harmonized high level of safety worldwide. They cover all aspects of nuclear and radiation safety, and the principal users are often regulatory bodies and national authorities.

12. Radionuclides exist in the environment and are therefore present to some degree in foods. A project related to providing guidance for the implementation of a Safety Requirement contained in the International Basic Safety Standards with respect to managing radionuclides in foods was undertaken as a collaboration between FAO, IAEA, and the World Health Organization (WHO). The aim was to develop practical guidance for assessing and therefore controlling internal radiation exposures that could arise from the ingestion of radionuclides in food in circumstances other than a nuclear or radiological emergency (note that there were and are guidelines for restricting food according to different Safety Requirements that are specific to nuclear or radiological emergencies). Recognizing that careful consideration was necessary regarding any impact on food standards, food safety and trade aspects, representatives from the IAEA and the Joint FAO/IAEA Centre have reported progress to this Committee and invited feedback from Codex members, through the CCCF.

Considerations and Agreements at the 13th and 14th Sessions of the CCCF (2019 and 2021)

13. At CCCF13 in 2019, this Committee established an Electronic Working Group (EWG) on radioactivity in feed and food to produce a discussion paper for consideration at CCCF14. The EWG was chaired by the European Union (EU) and co-chaired by Japan. At CCCF14, the EWG Chair noted that the discussion paper concluded that naturally occurring radionuclides (i.e. mainly ^{40}K, ^{210}Po, ^{210}Pb, ^{228}Ra and ^{226}Ra) are found in many different foods and tend to give radiation doses higher than those provided by artificially produced radionuclides (such as ^{134}Cs, ^{137}Cs, ^{131}I and ^{90}Sr) in situations not affected by a nuclear emergency situation in the past, but no specific safety problem for food, feed or drinking-water due to the presence of naturally occurring radionuclides had been identified. Furthermore, no international trade issues had been identified due to the presence of naturally occurring radionuclides in food, feed and drinking-water. Subsequently, the Committee asked to be kept informed about the FAO, IAEA, WHO project but it agreed that no further work was required to be done by CCCF at that time given that naturally occurring radionuclides in food, feed and water did not seem to be an issue for food safety and trade. The committee also welcomed the offer of IAEA to elaborate, with the collaboration of FAO and WHO, an informative document for the food safety regulators community, providing the state of the art of natural radioactivity in food/feed/water.

14. Making use of the information contained in the EWG discussion document, an "informative document" on natural radioactivity in food, feed and water was subsequently drafted by the representative of the Joint FAO/IAEA Centre in collaboration with representatives from FAO, IAEA and WHO. Input was also provided by the

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3 http://www.africanfoodsafetynetwork.org/
4 http://red-ralaca.net
5 http://www.foodsafetyasia.org
6 https://nucleus.iaea.org/sites/fcris

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). The Codex Alimentarius Commission Secretariat kindly circulated this for comment in February 2023 as CL 2023/17-CF.

15. Thank you to all those who provided feedback and comments in response to CL 2023/17-CF. The responses are reproduced here in Annex 1 and Annex 2. As was suggested by some of the respondents, the re-drafting and production of a revised "informative document" will take place after UNSCEAR has produced and published its current evaluation of public exposure to ionizing radiation (the UNSCEAR public exposure document will include natural radionuclides in food and water, it is an update to Annex B to the UNSCEAR 2008 report, that was an up-date to Annex B to the UNSCEAR 2000 report). The IAEA and the FAO (through the Joint FAO/IAEA Centre) are observers at UNSCEAR. The seventy-first session of UNSCEAR takes place in May this year. It is expected that the UNSCEAR evaluation of public exposure to ionizing radiation will be approved at this meeting. Therefore, the "informative document" on natural radioactivity in food, feed and water can be re-written to address comments received from Codex Members and also the up-coming UNSCEAR report.

Publications of Technical Material and Guidance

16. The FAO, IAEA, WHO project (mentioned in paragraph 12, above) was successful and subsequently the FAO, IAEA and WHO cosponsored the production of two documents, both are now available as IAEA publications:

- Safety Report Series No. 114 entitled 'Exposure due to Radionuclides in Food Other Than During a Nuclear or Radiological Emergency. Part 1: Technical Material' was published in 2023 [7] and is freely available online. It gives information that may be used to support national policies and strategies to control radiation doses from natural and human-made radionuclides present in foods in non-emergency situations. This joint FAO, IAEA and WHO report discusses the sources of radionuclides in foods, reviews the different ways of estimating dietary intakes of radionuclides using food consumption data and different dietary sampling methods, it makes an analysis of dietary radiation exposure studies and pathways by reviewing literature reports and includes sections on radionuclides in natural mineral waters, in aquaculture and in foods collected from the wild. Safety Report Series No. 114 also includes a statistical analysis of reported activity concentrations of natural radionuclides in different foods, with tabulated results giving new data on the observed world-wide distribution of activity concentrations of key radionuclides in various foods.
- IAEA TECDOC-2011 published in 2022 [8], is entitled "Exposure Due to Radionuclides in Food Other Than During a Nuclear or Radiological Emergency Part 2: Considerations in Implementing Requirement 51 of IAEA General Safety Requirements Part 3 (International Basic Safety Standards)". It is also co-sponsored by FAO, IAEA and WHO as is available freely online. It puts forward approaches that can be used by regulatory bodies, policy makers, interested parties and others with responsibilities in relation to the management of food in various circumstances where radionuclides are, or could be, present, excluding any nuclear or radiological emergency. Note that Requirement 51 of the International Basic Safety Standards relates to exposure to ionising radiation due to radionuclides in commodities, see footnote [9].

17. Safety Report Series No. 114 and IAEA-TECDOC-2011 provide a scientific and technical foundation for implementing Requirement 51, as it relates to the management of exposures due to radionuclides in food. The proposed approaches for managing natural and human-made radionuclides in food are consistent with those for managing radionuclides in drinking water in existing exposure situations. The approaches are consistent with the Guidance levels in the WHO Guidelines for Drinking-water Quality[10] and the Guideline Levels for Radionuclides in Foods contained in the Codex General Standard for Contaminants and Toxins in Food and Feed[11].

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7 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION., Exposure due to Radionuclides in Food other than During a Nuclear or Radiological Emergency Part 1: Technical Material, Safety Reports Series No. 114, IAEA, Vienna (2023),

8 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION., Exposure due to Radionuclides in Food other than During a Nuclear or Radiological Emergency Part 2: Considerations in Implementing Requirement 51 of IAEA General Safety Requirements Part 3 (International Basic Safety Standards), IAEA-TECDOC-2011, IAEA, Vienna (2022),

9 www-pub.iaea.org/MTCD/Publications/PDF/Pub1578_web-57265295.pdf

10 WORLD HEALTH ORGANIZATION, Guidelines for Drinking-water Quality — fourth edition incorporating the first and second addenda, WHO, Geneva (2022).

11 JOINT FAO/WHO FOOD STANDARDS PROGRAMME, CODEX ALIMENTARIUS COMMISSION, Codex General Standard for Contaminants in Food and Feed, Radionuclides, CXS 193-1995.

ANNEX 1

COMMENTS IN REPLY TO NATURAL RADIOACTIVITY IN FEED, FOOD AND DRINKING-WATER (CL 2023/17-CF)

Comments of Canada, Chile, Egypt, Norway, Peru, Sierra Leone, USA and International Feed Industry Federation

GENERAL COMMENTS

COMMENT	MEMBER / OBSERVER
There is no double asterisk in Table 1 that this footnote refers to. There is no double asterisk in Table 2 that this footnote refers to.	**Canada**
En cuanto a contenidos de forma, en relación a los cuadros entregados al final del documento, Chile quisiera indicar lo siguiente: - Cuadro 2, página 13, falta un asterisco en el 3,3 - Cuadro 2, página 13, evaluar si es posible considerar agregar al lado de cada valor indicado en la tabla, entre paréntesis el mismo valor ahora expresado en porcentaje respecto del total determinado, con la finalidad de ampliar la información entregada. - Cuadros 3, 4, 5 y 6, evaluar si es posible entregar, además del número de puntos de datos (N) por encima del umbral de detección, el total de datos analizados por alimento en cada caso, con la finalidad de ampliar la información entregada. También es necesario indicar el intervalo de confianza entregado para la media aritmética, ya que se presume es 95% pero no se tiene seguridad. - Cuadro 7, evaluar si es posible entregar el total de datos para cada analito por categoría, con el cual se determinó cada mediana de concentración de actividad, con la finalidad de ampliar la información expuesta.	**Chile**
Egypt appreciates the work which done in the document and suggest the following recommendations : 1- Setting limits for the levels of positive intervention to prevent foods intended for public consumption from being circulated in cases of nuclear and radiological emergencies 2- Setting maximum radionuclides concentration of radionuclides 3- Setting maximum limits for the radioactive concentration of natural radionuclides in materials used as feed 4- Setting maximum limits for the permissible radioactive concentration in drinking water	**Egypt**
We welcome this paper which provides a thorough overview of the issue and we note the content.	**Norway**
El Perú desea agradecer a la Secretaría de la Comisión del Codex Alimentarius, Programa Conjunto FAO/OMS sobre Normas Alimentarias, respecto a la solicitud de observaciones sobre la radiactividad de origen natural en los piensos, los alimentos y el agua potable. i. Observaciones generales: Perú, país en desarrollo, tiene interés en los análisis (medición de niveles de referencia para determinar la situación de contaminación; entre otros, residuos mineros) y normativas sobre radionucleidos naturales: Uranio (U), Torio (Th), radón (RN), Polonio (Po), Radio (Ra), Potasio K), Estroncio (Sr) y Cesio (Cs) que se transfieren del suelo a los cultivos (producción de alimentos de origen vegetal, animal y PIENSOS; agua de consumo humano (agua mineral) y agua para los peces de los ríos, lagos y mares, agua de bebida para animales productores de alimentos de consumo humano); ya que ellos varían según el clima, la geología o composición edáfica y las prácticas agrícolas y pecuarias. Lo anteriormente mencionado, fue considerado prioritario en la importación de leche y productos lácteos de algunos países, luego del accidente de la planta nuclear de Chernóbil y actualmente podría suceder en países es conflicto, quienes por ejemplo podrían producir cereales (trigo), papa, betarraga azucarera y otros alimentos; o también, ciertos países podrían tener centros mineros generadores de contaminación radiactiva y siendo productores y exportadores de fertilizantes hacia nuestro país, afectándonos.	**Peru**

Finalmente, por los antes mencionamos, Perú considera que el enfoque, la estructura y el contenido general del documento está conforme. ii. Observaciones específicas Sobre los párrafos 1–23 del documento presentado en el Apéndice de la CL 2023/17-CF, no se tienen comentarios.	
Sierra Leone approves the document for ratification	**Sierra Leone**
This work may help to present previously issued radionuclide reports in a more digestible form. However, we have the following comments and suggestions. o It may be beneficial to issue this paper after the publication of an updated UNSCEAR report. o Box 3 is confusing because it is unclear who the regulatory body is; information can be better provided as footnotes to the GSR Part 3.	**USA**
We thank you for sharing the proposed background information regarding the source of natural radioactivity in food, feed and drinking water. We recognize the value of the document, for informing the CODEX members on the occurrence of natural radioactivity and its impact through ingestion. However, in certain occasion within the document, the delineation between the natural and human-made radioactivity is not very clear and may lead to misunderstanding. The information provided in the tables is a good basis for supporting that no further actions necessary from the Committee.	**International Feed Industry Federation**

SPECIFIC COMMENTS

INTRODUCTION	
Para 2. Suggest to omit mention of K-40 in this paragraph because it's discussed in later paragraphs and K-40 in the body is not amenable to control. In theory, there is no reason why exposure to external sources of K-40 in commodities could not be controlled in the same way as other natural radionuclides (which seems to be the subject of this sentence). There is no need to control it because of homeostasis, but that is not the same as not being amenable to control. Suggest that last sentence of paragraph 2 could be removed to improve readability. The first sentence essentially repeats a statement made earlier in the same paragraph. The second sentence claims that the definition is broad and then gives only one example, unrelated to natural radionuclides. It's correct but potentially confusing and unnecessary for the purposes of the document. 2. It is normal for air, soil, food, feed and drinking-water to contain low levels of radioactivity caused by the ubiquitous presence of radionuclides in all substances. Radionuclides in food, feed and drinking-water are mostly of natural origin but can also include human-made ~~radionuclides. With~~ radionuclides that have entered the ~~exception of a radioisotope of potassium (~~environment through past accidents, events and historic practices. A^{40}~~K), all~~ ll of the radionuclides in these commodities are amenable to being controlled in some way. In ~~this respect,~~ radiation safety standards ~~use the concept of~~ this is considered an "existing exposure situation"~~; this refers to a situation where an~~ , where exposure to sources of ionising radiation already exists at the time a decision on control is being taken (i.e., in ordinary circumstances that are not emergencies). Existing exposure situations involve exposure to natural sources and human-made sources of ionising radiation. The definition is broad, for example, it includes but is not limited to exposure to residual radioactive material after a nuclear or radiological emergency has been declared to have ended. Since the paragraph is about existing exposure situations, it's important to distinguish between human-made radionuclides that are in commodities because they've effectively become part of background, and those that might be there because of a problem with a regulated source (e.g., major accidents or malicious events, as mentioned in para 3).	**Canada**

INTERNAL RADIATION DOSE BY INGESTION	
BOX 1: At the levels discussed in the document, the focus should be on risk rather than biological effects. Exposure to chest x-rays is a very different radiation protection situation than radionuclides in food – the comparison is potentially confusing. Also, the paragraph immediately beside Box 1 contains several examples of doses expressed in mSv, therefore there may not be a need for an example in the box. Suggested text for BOX 1: "The risk of biological harm is related to the radiation dose which, in turn, is influenced by factors such as the type (alpha, beta, gamma, etc.) and energy of the radiation and the tissues (organs) that it interacts with. The unit of effective radiation dose is the sievert (Sv). Since one sievert is a large quantity, radiation doses normally encountered are expressed in millisievert (mSv) or microsievert (µSv) which are one-thousandth or one millionth of a sievert."	**Canada**
Para 3. Radionuclides are present in the Earth's crust and oceans. People have always been exposed to radiation and this includes radiation emitted by radionuclides in the foods that they eat. Although food and drinking-water can contain ~~radioactive substances~~radionuclides, the levels are in general relatively ~~low,~~ low and of no significant health concern. Levels, are expected to remain ~~at~~ low ~~levels~~ except in extreme circumstances (e.g., major accidents or malicious events that could result in some food becoming contaminated with large amounts of radioactive material). Replace "radioactive substances" with "radionuclides" for consistency of terms used in the document. The addition of text regarding "no significant health concerns" provides context to the 'relatively low' levels that are noted in the text. ~~Although concentrations of radionuclides in food, feed and drinking-water are typically low, the ionizing radiation emitted by ingested radionuclides can make a significant contribution to the overall radiation dose [Box 1] that we receive from the many different sources of radiation to which we are exposed in our everyday lives.~~ The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in its report of 2000 [2] calculated that the world-wide annual ingestion dose from natural sources can typically range from 0.2–0.8 mSv, **with an average of about 0.31 mSv or about 12% of the total worldwide average annual dose from all natural sources of 2.4 mSv (typical range of 1–10 mSv) (Fig. 1). In its later report in 2008 the UNSCEAR reassessed the world-wide annual ingestion dose from natural sources as typically ranging from 0.2–1.0 mSv with an average annual ingestion dose of 0.29 mSv [3].** Suggest to delete this sentence. It does not add any new information. Furthermore, as written, the statement that low concentrations can lead to "significant" doses potentially exaggerates the concern – a significant portion of a very low total background dose is insignificant from the perspective of health effects. Also, the "many different sources of radiation" in our everyday lives should include medical procedures like x-rays unless it's explicitly limited to background. **(BOLD)** Mentions that annual ingestion dose is reported to be 0.31 mSv in UNSCEAR 2000 (e.g. paragraphs 3, 7, 8, footnote 2) and 0.29 in UNSCEAR 2008 (e.g. paragraph 3). Consider reporting dose as 0.3 mSv/a (i.e. one less significant figure, and number is relevant to both UNSCEAR reports). It could also be useful to include an explanation for why two UNSCEAR documents are referenced and the older one (2000) is used as the basis for this document in most cases.	
Para 4. There are five key radionuclides that make significant contributions to the radiation dose from the ingestion of food and drinking-water and these all occur naturally. These radionuclides have been present in the environment since the earth was formed and include a radioisotope of potassium, ^{40}K, plus radioisotopes of lead, polonium and two different isotopes of radium: ^{210}Pb; ^{210}Po; ^{226}Ra, and; ^{228}Ra. A small proportion (0.012%) of all naturally occurring potassium is present as radioactive ^{40}K, whereas the latter four ~~heavy isotopes~~ radionuclides occur during the natural radioactive decay of uranium and thorium.	

'Heavy' replaced with 'radionuclides, as 'heavy' is not the correct term in this context.	
Para 6. **The radionuclides ^{210}Po, ^{210}Pb, ^{228}Ra and ^{226}Ra are together assessed as accounting for almost all of the remaining average annual ingestion dose with all other remaining radionuclides making a minor contribution (<1%).** However, these four (and other) radionuclides are not maintained under homeostatic control. The amount of these radionuclides in the human body and therefore the radiation dose they impart, is related to how much of the radionuclide is ingested. Therefore, ^{210}Pb, ^{210}Po, ^{226}Ra and ^{228}Ra can be detected in different amounts in humans because they are found in varying quantities in food and drinking-water. The levels present in humans reflect the levels found in the diet and variations are ultimately due to the varying concentrations of these radionuclides in different soils and waters of the environments where the foods are produced, or the drinking-water is obtained. **(BOLD)** Statements regarding how much of the annual ingestion dose that is made up by Po-210, Pb-210, Ra-228, and Ra-226 vs. other radionuclides are inconsistent in paragraphs 6, 8, and 11. Suggest reviewing what the correct numbers are adjust relevant text accordingly. Paragraph 6 mentions that remaining radionuclides make up <1% of annual ingestion dose excluding K-40 (and does not provide a reference). Paragraph 8 mentions that remaining radionuclides make up <14% of the annual ingestion dose excluding K-40 (references UNSCEAR 2000). Paragraph 11 mentions that the 4 radionuclides contribute to more than 86% of ingestion dose excluding K-40 (references UNSCEAR 2000).	
Para. 7. At the time of writing, UNSCEAR has established an expert group to update its public exposure assessment from all sources, including food and drinking-water[1]. **The UNSCEAR 2000 report [2] is the most recent report by the committee that presents representative values for nine of the most prevalent naturally occurring radionuclides generally found in food and drinking-water.** The technical data published by UNSCEAR in 2000 on the different concentrations of natural radionuclides in different foods and drinking-waters from different countries and regions were used by the committee to generate single representative values for concentrations of the nine most prevalent radionuclides (^{210}Po, ^{210}Pb, ^{228}Ra, ^{226}Ra, ^{230}Th, ^{232}Th, ^{238}U, ^{228}Th, ^{235}U) in several food categories and drinking-water. These global representative concentrations, together with the dose contribution from ^{40}K were used by UNSCEAR to calculate a worldwide averaged (age-weighted) annual effective dose from the ingestion of natural radionuclides in food and water of 0.31 mSv (typical range of 0.20–0.80 mSv) in their 2000 report. Should this statement clarify that (if true) the UNSCEAR 2000 report [2] is "the most recent" report by the committee to provide the following information? Although UNSCEAR published a later report in 2008 [3], but perhaps it did not include the noted information - this should be made clear in the text.	
Para 8. Suggest that paragraph 8 could be deleted in entirety. It contains almost no new information. In addition, it cites figures about the contributions to ingestion dose that appear to conflict with paragraph 6 (e.g., paragraph 6 says that "other" radionuclides account for less than 1% of the ingestion dose; paragraph 8 says less than 6%). Suggest adding the information about dose from Po, Pb & Ra (0.14 mSv/y) to paragraph 6. If the sentence about monitoring programmes is retained, consider adding that many countries monitor human-made radionuclides in traditional/local foods that may be impacted by nearby power plant operations.	
Para 9. Human-made radionuclides (e.g., from industrial, medical, nuclear and research establishments and other regulated uses of radioactive materials) may enter food, feed and drinking-water supplies. However, the contributions to ingestion dose from these sources of human-made radionuclides in planned exposure situations are limited by regulatory control of the source or practice in the specific discharge authorization. Should such sources of human-made radionuclides be regarded as important, it is normally through such regulatory mechanisms that action is taken to prevent or limit the radionuclide(s) from entering the environment and transferring into food, feed and water. Add "regulated" to differentiate between human-made radionuclides from current practices and those from past events and accidents	
Para 12. Animal feed may contain ~~radionuclides that could present a risk to human health through~~ the ~~ingestion of foods of animal origin. Therefore, in normal circumstances the key~~ the same radionuclides ~~of interest are no different to~~ as those in foods (i.e., ^{210}Po, ^{210}Pb, ^{228}Ra and ^{226}Ra). However,	

some monitoring programmes are established to check levels of specific human-made radionuclides in feeds (e.g., ^{90}Sr, ^{137}Cs and ^{134}Cs), for example, to monitor feeds that originate from areas affected by nuclear or radiological accidents where significant amounts of radionuclides were accidentally released into the environment at some time in the past. Edits suggested to reduce the complexity of the sentence. This is the only paragraph that suggests that low levels of these radionuclides could pose risk to human health, which could seem alarmist and speculative; suggest removing this text.	
Para 13. Suggest paragraph be revised for clarity and correctness. In particular, the word "absorption" is used in different places to refer to different aspects of radionuclide uptake (absorption through skin vs absorption by plants that are then used as feed vs absorption through the alimentary tract after ingestion) but no distinction is made.	
Para 6. The radionuclides ^{210}Po, ^{210}Pb, ^{228}Ra and ^{226}Ra are together assessed as accounting for almost all of the remaining average annual ingestion dose with all other remaining radionuclides making a minor contribution (<1%). However, these four (and other) radionuclides are not maintained under homeostatic control. The amount of these radionuclides in the human body and therefore the radiation dose they impart, is related to how much of the radionuclide is ingested. Therefore, ^{210}Pb, ^{210}Po, ^{226}Ra and ^{228}Ra can be detected in different amounts in humans because they are found in varying quantities in food and drinking-water. The levels present in humans reflect the levels found in the diet and variations are ultimately due to the varying concentrations of these radionuclides in different soils and waters of the environments where the foods are produced, or the drinking-water is ~~obtained~~obtained and individual diets or dietary patterns. Amend to include "and individual diets or dietary patterns" as this would reflect reality. Comment: The levels present in humans reflect the levels found in the diet and variations are ultimately due to the varying concentrations of these radionuclides in different soils and waters of the environments where the foods are produced, or the drinking-water is obtained and individual diets or dietary patterns	**Norway**
Para 3. Restructure Para 3 as follows: ------- typically range from 0.2–0.8 mSv, with an average of about 0.31 mSv. or about 12% of the total worldwide average annual dose from all natural sources of 2.4 mSv (typical range of 1–10 mSv) (Fig. 1). In its later report in 2008 the UNSCEAR reassessed the world-wide annual ingestion dose from natural sources as typically ranging from 0.2–1.0 mSv with an average annual ingestion dose of 0.29 mSv [3]. The average annual ingestion dose was about 12% of the total worldwide average annual dose from all natural sources of 2.4 mSv (typical range of 1–10 mSv) (Fig. 1).	**USA**
Para 4 – 6 focus on 210Po, 210Pb, 228Ra, and 226Ra and do not discuss an additional five radionuclides found in the UNSCEAR data. It may be helpful to mention all nine prevalent radionuclides prior to para 7.	
Para 5. Information in para 5 is repetitive	
What about national dietary studies and assessed ingestion doses? Move the subheading "What about national dietary studies and assessed ingestion doses?" to above para 7.	
RADIONUCLIDE CONCENTRATIONS	
Para. 14. Ingestion dose cannot be measured directly, but it can be calculated from radionuclide activity. Activity can be easily measured and internationally accepted dose conversion factors that are specific to each radionuclide can be used to convert activity (Bq) to dose (Sv). **Although activity is a rate, it can be used as a proxy for the amount of radionuclide [Box 2].** Therefore, surveillance and dose assessments are based on activity concentrations (Bq/kg or Bq/L). As mentioned in the previous section, data published by UNSCEAR in 2000 [2] presented activity concentrations that were considered to be representative values for the most prevalent radionuclides in several different categories of food and in	**Canada**

drinking-water (reproduced in Table 2). Although these data were produced by UNSCEAR to assess public exposure, the representative activity concentration values in Table 2 are also used by laboratories to place their analytical results into context. A document published by the FAO, IAEA and WHO in 2021 [1] also provides data on activity concentrations of key natural radionuclides in different foods and gives data that can be used to place monitoring results into context. Some radionuclides, including Po-210, can be quite difficult to measure in foods, especially if a country does not have well-developed lab facilities. **(BOLD)** Suggest to consider if this information and the level of detail in Box 2 (e.g. "first order process") will be useful to the reader or add unnecessary complexity to this document.	
Para 16. The radionuclides mentioned in the ~~two~~ preceding ~~paragraphs~~ paragraph occur naturally, but radionuclides such as ^{14}C, ^{90}Sr, ^{137}Cs and ^{134}Cs have also been found to contribute to ingestion dose in some instances. For example, although ^{14}C occurs naturally in the environment, it is also produced by the nuclear industry and therefore surveillance monitoring can sometimes detect enhanced ^{14}C levels in some foods. Similarly, concentrations of a few Bq/kg or less of human-made radionuclides such as ^{137}Cs, ^{134}Cs and ^{90}Sr may sometimes be found in foods, for example due to authorized discharges from nuclear facilities or from fallout due to past testing of nuclear weapons. However, in areas affected by a past nuclear accident ^{137}Cs, ^{134}Cs and ^{90}Sr concentrations in some foods could be higher by up to an order of magnitude. Radionuclides are only mentioned in one preceding paragraph.	
Para. 16. The radionuclides mentioned in the two preceding paragraphs occur naturally, but radionuclides such as ^{14}C, ^{90}Sr, ^{137}Cs and ^{134}Cs have also been found to contribute to ingestion dose in some instances. For example, although ^{14}C occurs naturally in the environment, it is also produced by the nuclear industry and therefore surveillance monitoring can sometimes detect enhanced ^{14}C levels in some foods. Similarly, concentrations of a few Bq/kg ~~or less~~ of human-made radionuclides such as ^{137}Cs, ^{134}Cs and ^{90}Sr may sometimes be found in foods, for example due to authorized discharges from nuclear facilities or from fallout due to past testing of nuclear weapons. However, in areas affected by a past nuclear accident ^{137}Cs, ^{134}Cs and ^{90}Sr concentrations in some foods could be ~~higher by up to an order of magnitude~~higher. Delete "higher by up to an order of magnitude" as this may vary and might be higher than "an order of magnitude".	**Norway**
INTERNATIONAL STANDARDS AND GUIDANCE	
Para. 19. **Drinking-water**: International Guidelines for Drinking-water Quality [5] and guidance on the management of radioactivity in drinking-water [6] establish criteria with which to determine the ~~quality and~~ safety of both natural and human-made radionuclide levels in normal circumstances (i.e., planned and existing exposure situations). The approach for managing radionuclides in drinking-water also considers an annual reference level of about 1 mSv from all radionuclides in drinking-water, consistent with international radiation safety standards (Requirement 51 of reference [4]). Part of the approach in these guidelines involves screening levels and guidance levels of activity concentrations expressed as becquerels per litre for different radionuclides in drinking-water. This internationally accepted approach for screening levels and guidance levels is based on an 'individual dose criterion' (IDC) per radionuclide of 0.1 mSv/year. The guidance helps to determine the quality of drinking water, not the quality of radionuclide levels.	**Canada**
Para. 21. More general international guidance [1, 8] has recently been developed to assist national authorities in establishing reference levels for radionuclides in food in non-emergency situations. As a first step, the FAO, IAEA and WHO have produced Safety Report No. 114 [1] with technical information that can be used to assess and manage radionuclides in food in existing exposure situations. In addition, another joint FAO, IAEA, WHO document [8] puts forward an approach for managing radionuclides in food that considers an annual reference level of about 1 mSv from all radionuclides in the food supply, consistent with international radiation safety standards (Requirement 51 of reference [4]). This involves using dietary surveys to ~~monitor~~ estimate the food ingestion dose due to radionuclides in the food supply. Part of the guidance also addresses the issue of	

assessing individual food products using guidance levels of activity concentrations for different radionuclides in food products (rather than the annual food supply as a whole). With some foods where natural levels of ^{210}Po, ^{210}Pb, ^{226}Ra or ^{228}Ra may be ~~enhanced~~relatively high, the approach recommends using guidance levels based on the upper 95th percentile activity concentration values given in reference [1] and reproduced in Tables 3–6. For foods where these four radionuclides are not expected to be naturally ~~enhanced~~high, and for all other radionuclides (except ^{40}K) these guidance level activity concentrations are based on an 'individual dose criterion' (IDC) per radionuclide of 0.1 mSv/year. The technical ~~information is consistent with that~~ criteria are related to those used for drinking-water [5] and also for foods in international trade affected by a nuclear or radiological emergency [7]. Various changes to this paragraph to improve accuracy. -"Enhanced" was changed to "high" to avoid the impression that radionuclide levels are high due to human activity. -"Criteria are related to those used for drinking water…" edited to highlight the important differences in the way the IDC is applied for drinking water compared to the proposal for food (in drinking water, there is a summation formula for comparing the dose from all radionuclides to the IDC, not just individual ones).	
Para. 20 Respecto a lo indicado en el párrafo 20 "Las normas alimentarias internacionales del Codex Alimentarius proporcionan orientaciones para la seguridad radiológica de los alimentos en lo relativo al comercio internacional con zonas que no se hayan visto afectadas directamente por un accidente nuclear", Chile considera que se produce una contradicción con lo indicado en el Codex Stan 193, el cual en su página 68 "Los niveles de referencia se aplican a los radionucleidos presentes en alimentos destinados al consumo humano y que participan en el comercio internacional, que han sido contaminados después de una emergencia nuclear o radiológica".	**Chile**
Para. 20. **Food**: The international food standards of the Codex Alimentarius provide guidance for the radiological safety of food ~~in terms of international trade with areas not directly affected by a nuclear accident~~ [7]. ~~This focuses~~ They focus on human-made radionuclides (i.e., the presence of radionuclides as the result of an accidental or malicious release). Guideline Levels are provided for 20 radionuclides, most important for uptake into the food, in foods destined for human consumption and traded internationally, which have been contaminated following a nuclear or radiological emergency. Suggested edits to Para 20 "The international food standards of the Codex Alimentarius provide guidance for the radiological safety of food [7]. They focus on human-made radionuclides (i.e., the presence of radionuclides as the result of an accidental or malevolent release). Guideline Levels are provided for 20 radionuclides, most important for uptake into the food, and apply to foods destined for human consumption and traded internationally, which have been contaminated following a nuclear or radiological emergency"	**USA**
Para. 21. At the very end of the document, seems to contain the key information (e.g., Reference [8] considers an annual reference level of about 1 mSv from all radionuclides; This involves using dietary surveys to monitor the food ingestion dose due to radionuclides in the food supply). Can this information be presented in a flow chart or graphic? While IAEA's job is not to provide guidance in the information document, a clearer description of how this information would potentially be used by a risk manager would be helpful.	
Para. 23. We suggest deleting paragraph 23. As noted in para 10 of the Background, "CCCF agreed that no further work was required to be done by CCCF at this time given that naturally occurring radionuclides in food, feed and water did not seem to be an issue for food safety and trade." However, paragraph 23 implies a deficit for CCCF or national regulators to fill: "International guidance is not available to assist national authorities in establishing reference levels for radionuclides in feed for food producing animals in non-emergency situations." As another alternative to deleting the whole paragraph, the first sentence can be deleted instead.	

ANNEX 2

Comments of the European Union

EU Comments on CL 2023/17-CF

Natural Radioactivity in Food, Feed and Drinking Water

Mixed Competence
Member States Vote

The European Union and its Member States (EUMS) welcome and appreciate the work done by FAO, IAEA and WHO to prepare the document CL 2023/17-CF related to natural radioactivity in feed, food and drinking water.

The EUMS wish to make the following comments:

General comments on the approach, structure and overall content of the document

(1) The document is foreseen to be an informative document for food safety regulators providing the state of the art of natural radioactivity in food/feed/water thereby also reflecting regional variations and should provide all relevant information related to natural radioactivity in food, feed and drinking water, in a summarized way to increase the understanding of the presence of radioactivity in feed and food (including drinking water) without having the need to consult the more detailed documents referred to in the document.

(2) Furthermore, it is very important that the document contains the information referred to in § 8 of the Background section of CL 2023/17 – CF, i.e. that no specific safety problem and no international trade issues have been identified due to the presence of naturally occurring radionuclides in food, feed or drinking water.

(3) It is important to mention that statistical analysis of measurement data on various foodstuffs does not indicate significant regional variations in activity concentrations, although differences can be distinguished in relation to the radionuclide and the food category/subcategory (in the introduction or in the section on radionuclide concentrations).

(4) The different topics in the section "Internal Radiation Dose By Ingestion" should be reworded as headings instead of questions. For example, "Key radionuclides responsible for radiation dose from ingestion of food and drinking water" instead of "What are the key radionuclides responsible for this dose?"

(5) In the document reference is mainly made to the UNSCEAR 2000 report for the mentioned ingestion doses. It is also mentioned that the UNSCEAR 2000 is the most recent report that presents representative values for nine of the most prevalent naturally occurring radionuclides generally found in food and drinking-water. However, reference is also made to UNSCEAR 2008 and the IAEA report (2021) when referring to ingestion doses and representative values in food and drinking water. It would be appropriate to put clearer upfront in the document the relationship between these reports, the sources of this report and why in, the document mostly reference is made to UNSCEAR 2000 report and not to the more recent UNSCEAR 2008 and IAEA 2021 reports.

(6) In the document reference is made to nine most prevalent radionuclides besides ^{40}K. In these nine most prevalent radionuclides, ^{235}U is mentioned. However, it is not explained in the document why ^{235}U is mentioned as one of the most prevalent radionuclides and not ^{234}U, which is present in food at concentrations higher than ^{235}U.

(7) The concept of reference value (§ 19) should be better explained and be put in context. The International Commission for Radiological Protection (ICRP) recommends setting a reference level between 1 and 20 mSv/year for such exposures, although it might be chosen lower depending on the circumstances. The choice of the reference value of 1 mSv seems cautious as this reference value is fairly close to the typical range of worldwide annual ingestion dose from natural sources of radioactivity in the environment (0.2-0.8 mSv/year according to UNSCEAR 2000, 0.2 – 1.0 mSv/year according to UNSCEAR 2008). Experience shows that despite all precautions taken by ICRP to ensure a proper use of the reference level concept, that it is almost always handled as a health limit which it is not. Consequently, the choice of a reference level as close as possible to the environmental background level may have consequences in particular on the commitment of resources for the management of possible exceedances. In that context, it would be helpful if, besides the reference level also an indication is given from which ingestion dose onwards, possible adverse health effects cannot be excluded.
Finally, it might be considered to increase the coherence to explain the individual dose criterion (IDC) first, followed by an explanation of the reference level.

(8) As this is an informative document for food safety regulators and also in relation with the above comment on putting the concept of reference level into context (and also in relation with the first comment that essential information should be included in the document without having the need to consult the more detailed

documents referred to), it would be appropriate to summarise or explain the methodology/approach for managing exposures to radionuclides in food and drinking water in response to requirement 51 of Part 3 of the GSR regarding the establishment of reference levels as proposed in the summary of the IAEA Technical Guidance Document TECDOC-2011 (point 9 of this publication).

The explanation would clarify that it is not sufficient to simply list the estimated guidance levels for each food-radionuclide combination or to define the dose criteria to be applied. It is necessary to emphasise that the application of these guidance levels and dose criteria must comply with the ICRP principles of justification and optimisation, taking into account the prevailing environmental conditions. For example, in particularly vulnerable areas, either because the radioactive background is higher than average, or because it is enhanced by human practices, or because they have been affected by a nuclear or radiological accident, food control campaigns would be justified and an optimisation plan could be drawn up to reduce activity concentrations exceeding the guidance levels. In other cases, it would probably be sufficient to carry out environmental monitoring campaigns and to estimate the concentration in food from transfer factors to the food chain.

The proposed rewording of the new §23 would address this (see below).

Specific comments on paragraphs 1-23 of the document presented in the Appendix

§1: it would be appropriate to explain in this paragraph the relationship between UNSCEAR 2000, UNSCEAR 2008 and IAEA 2021 reports (see point (5) above).

§4, 7, 15, Table 2 and table 7: see point (6) above: to be verified and explained why ^{235}U is referred to instead of ^{234}U.

§20. The word "not" has to deleted in the following sentence "The international food standards of the CODEX Alimentarius provide guidance for the radiological safety of food in terms of international trade with areas ~~not~~ directly affected by a nuclear accident".

§ 21 and 22 The two paragraphs refer essentially to the same thing and are confusing. It is therefore to reorganise the two paragraphs whereby the information referring to reference [1] is put in a paragraph (§22) separate from the information referring to reference [8] put in §23. In addition, in §23 a summary of the TECDOC 2011 approach is proposed (see point (8) above)

"*§21. More general international guidance [1, 8] has recently been developed to assist national authorities in establishing reference levels for radionuclides in food in non-emergency situations. As a first step, the FAO, IAEA and WHO have produced Safety Report No. 114 [1] with technical information that can be used to assess and manage radionuclides in food in existing exposure situations. Together, these two documents [1, 8] establish a scientific and technical foundation for implementing Requirement 51 of reference [4] as it relates to radionuclides in food.*

§22. Safety Report No. 114 [1] includes information on the observed distributions of concentrations of natural radionuclides in various food products, the use of 'total diet' and other studies to assess ingestion doses from radionuclides in general. It also reviews and analyses studies of radionuclides in aquaculture, food collected from the wild, and natural mineral waters sold as foods. The technical information is consistent with that used for drinking-water [5] and also for foods in international trade affected by a nuclear or radiological emergency [7].

§23. In addition, another joint FAO, IAEA, WHO document [8] puts forward an approach for managing radionuclides in food that considers an annual reference level of about 1 mSv from all radionuclides in the food supply, consistent with international radiation safety standards (Requirement 51 of reference [4]). This involves using dietary surveys to monitor the food ingestion dose due to radionuclides in the food supply. Part of guidance also addresses the issue of assessing individual food products using guidance levels of activity concentrations for different radionuclides in food products (rather than the annual food supply as a whole). With some foods where natural levels of ^{210}Po, ^{210}Pb, ^{226}Ra or ^{228}Ra may be enhanced, the approach recommends using guidance levels based on the upper 95th percentile activity concentration values given in reference [1] and reproduced in Tables 3–6. For foods where these four radionuclides are not expected to be naturally enhanced, and for all other radionuclides (except ^{40}K) these guidance level activity concentrations are based on an 'individual dose criterion' (IDC) per radionuclide of 0.1 mSv/year.

TECDOC-2011 [8] is intended to support regulatory bodies, policy makers and others with responsibilities relating to the management of exposures where radionuclides are, or could be, present in food, but it excludes nuclear or radiological emergencies. In particular, this publication provides a proposed approach for the management of radionuclides in food for consideration in implementing Requirement 51 in GSR Part 3. The publication will be of practical value to all those with roles in food safety or radiation protection. The point 9 of the publication summarise this approach, emphasizing the next: the importance of the application of principles of justification and optimisation to the implementation of monitoring of radionuclides and actions to reduce the dose; to take into account the prevailing circumstances in the environment to apply the reference level , as well as the specific or actual consumption at local, regional or national level, other radionuclides and the different population groups; consider a graded approach, according the prevailing circumstances for the monitoring and actions."