codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD ADDITIVES AND CONTAMINANTS
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PROPOSED DRAFT REVISED GUIDELINE LEVELS FOR RADIONUCLIDES IN FOODS FOLLOWING ACCIDENTAL NUCLEAR CONTAMINATION FOR USE IN INTERNATIONAL TRADE (CAC/GL 5-1989), INCLUDING GUIDELINE LEVELS FOR LONG-TERM USE

Secretariat Note: Due to time constraints, written comments have not been requested and therefore, document CX/FAC 04/36/35-Add. 1 will not be issued.

INTRODUCTION

The 50th Session of the Executive Committee (June 2002) considered a request of the International Atomic Energy Agency (IAEA) to broaden the Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade (CAC/GL 5-1989) to other radionuclides and to consider the establishment of guideline levels for radionuclides for long-term use as new work.[1] The Executive Committee did not approve the elaboration of guideline levels but referred the issue to the Codex Committee on Food Additives and Contaminants (CCFAC) for consideration along with further input from the IAEA in regard to the scope of the work.[2]

The 35th Session of the CCFAC (March 2003) agreed to request the IAEA, in collaboration with the delegation of Finland, to prepare a revised version of the Codex Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade for circulation, comment and further consideration at its 36th Session.[3] The 26th Session of the Codex Alimentarius Commission (CAC) approved the revision of the Codex Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade (CAC/GL 5-1989), including Guideline Levels for Long-Term Use, as new work for the Committee.[4]

In response to this request, the IAEA convened a consultants meeting at the Agency's Headquarters from 18-22 August 2003 to revise the Codex Guideline Levels for Radionuclides in Foods to other radionuclides and to consider the establishment of guideline levels for long-term use. The consultants meeting was attended by participants from Denmark and Finland as well as representatives of the WHO Department of Protection of the Human Environment and the IAEA Division of Radiation and Waste Safety and the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

1 CX/EXEC 02/50/7, Annex 1
2 ALINORM 03/3A, para. 67 and Appendix III
3 ALINORM 03/12A, paras. 79 and 84.
4 ALINORM 03/41, Appendix VIII.

Subsequently, the IAEA convened a consultants meeting of a high-level group of experts to advise the Agency on radiological criteria for radionuclides in food moving in international trade at IAEA Headquarters from 19-21 January 2004. The high-level group of experts was chaired by the Chairman of the International Commission on Radiological Protection (ICRP) and was attended by the Director of the State Research Centre of the Russian Federation Institute of Biophysics, the Chairman of the Radiation Effects Research Foundation, the Secretary of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), representatives of the European Commission and representatives of the IAEA Division of Radiation and Waste Safety and the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

BACKGROUND

The Codex Alimentarius Commission at its 18th Session (Geneva, 1989) adopted Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade (CAC/GL 5-1989) applicable for six radionuclides (^{90}Sr, ^{131}I, ^{137}Cs, ^{134}Cs, ^{239}Pu and ^{241}Am). The Guideline Levels were designed to be applicable for one year following a nuclear accident. Since that time, the need to establish guideline levels for more than six radionuclides and for a longer time period than one year after a major nuclear or radiological event or due to routine radionuclide discharge to the environment has been recognised. In addition, and as presented in the attached Scientific Justification for Proposed Draft Guideline Levels for Radionuclides in Foods, significant improvements in the assessment of radiation doses resulting from the human intake of radioactive substances have become available.

CURRENT STATUS

The resulting Proposed Draft Revised Guideline Levels for Radionuclides in Foods for Use in International Trade are attached for the consideration of the 36th Session of the Codex Committee on Food Additives and Contaminants.

PROPOSED DRAFT REVISED GUIDELINE LEVELS FOR RADIONUCLIDES IN FOODS FOR USE IN INTERNATIONAL TRADE

TABLE 1: GUIDELINE LEVELS (IN BQ/KG) FOR RADIONUCLIDES IN FOODS

Radionuclides in foods	**Guideline Level (Bq/kg)**
^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am	10
^{90}Sr, ^{106}Ru, ^{129}I, ^{131}I, ^{235}U	100
^{35}S, ^{60}Co, ^{89}Sr, ^{99}Tc, ^{103}Ru, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{192}Ir	1000
^{3}H*, ^{14}C	10.000

* This represents the most conservative value for tritium (organically bound).

Scope: The Guideline Levels apply to radionuclides contained in foods destined for human consumption and traded internationally, which are inherently contained in the food or have been incorporated into the food from any source. These guideline levels apply to food after reconstitution or as prepared for consumption, i.e., not to dried or concentrated foods, and are based on an intervention exemption level of around 1 mSv in a year.

Application: As far as generic radiological protection of food consumers is concerned, when radionuclide levels in food do not exceed the corresponding Guideline Levels, the food should be considered as safe for human consumption. When the Guideline Levels are exceeded, national governments shall decide whether and under what circumstances the food should be distributed within their territory or jurisdiction. National governments may wish to adopt different values for internal use within their own territories where the assumptions concerning food distribution that have been made to derive the Guideline Levels may not apply, e.g., in the case of wide-spread radioactive contamination.

Radionuclides: The Guideline Levels do not include all radionuclides. Radionuclides included are those important for uptake into the food chain; are usually contained in nuclear installations or used as a radiation source in large enough quantities to be significant potential contributors to levels in foods; are routinely discharged or could be accidentally released into the environment from typical installations or used in applications or might conceptually be employed in malevolent actions. Radionuclides of natural origin are generally excluded from consideration in this document.

In Table 1, the radionuclides are grouped according to the guideline levels rounded logarithmically by orders of magnitude. The guideline levels have been checked against age-dependent ingestion dose coefficients defined as committed effective doses per unit intake for each radionuclide, which are taken from the "International Basic Safety Standards" (IAEA, 1996)[5].

Multiple radionuclides in foods: The guideline levels have extensive conservative assumptions built-in and therefore there is no need to add contributions from radionuclides in different groups. Each group should be treated independently. However, the activity concentrations of each radionuclide within the same group should be added together[6].

5 Food and Agriculture Organization of the United Nations, International Atomic Energy Agency, International Labour Office, OECD Nuclear Energy Agency, Pan American Health Organization, World Health Organization (1996) International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, IAEA, Vienna.

6 For example, if ^{134}Cs and ^{137}Cs are contaminants in food, the guideline level of 1000 Bq/kg refers to the summed activity of both these radionuclides.

Small quantity or concentrated foods: Special considerations apply to certain classes of food which are consumed in small quantities (at most a few percent of total diet), such as spices. If such foods represent a small percentage of total diet and hence a small addition to the total dose, the Guideline Levels for these foods may be increased by a factor of 10, in accordance with the internationally agreed basic safety standards (IAEA, 1996).

SCIENTIFIC JUSTIFICATION FOR PROPOSED DRAFT GUIDELINE LEVELS FOR RADIONUCLIDES IN FOODS[7]

The proposed draft Guideline Levels for Radionuclides in Foods and specifically the values presented in Table 1 above are based on the following general radiological considerations and experience of application of the existing international and national standards for control of radionuclides in food.

Infants and adults: As presented in the attached appendices, significant improvements in the assessment of radiation doses resulting from the human intake of radioactive substances have become available since the Guideline Levels were issued by the Codex Alimentarius Commission in 1989 (CAC/GL 5-1989). The levels of human exposure resulting from consumption of foods containing radionuclides listed in Table 1 at the suggested guideline levels have been assessed both for adults and infants and checked for compliance with the appropriate dose criterion. As a result, the present Guideline Levels, in Table 1 are relevant to all kinds of foods destined for human consumption and traded internationally, including infant foods.

In order to assess public exposure and the associated health risks from intake of radionuclides in food, estimates of food consumption rates and ingestion dose coefficients are needed. According to Ref. (WHO, 1988) it is assumed that 550 kg of food is consumed by an adult in a year. The value of infant food and milk consumption during first year of life used for infant dose calculation equal to 200 kg is based on contemporary human habit assessments (F. Luykx, IAEA-SM-306/120, 1990; US DoH, 1998; NRPB-W41, 2003). The most conservative values of the radionuclide-specific and age-specific ingestion dose coefficients, i.e. relevant to the most absorbed from the gastro-intestinal tract chemical forms of radionuclides, are taken from the (IAEA, 1996).

Radiological criterion: The appropriate radiological criterion, which has been used for comparison with the dose assessment data below, is a generic intervention exemption level of around 1 mSv for individual annual dose from radionuclides in major commodities, e.g. food, recommended by the International Commission on Radiological Protection as safe for members of the public (ICRP, 1999)[8].

Naturally occurring radionuclides: Radionuclides of natural origin are ubiquitous and as a consequence are present in all foodstuffs to varying degrees. Radiation doses from the consumption of foodstuffs range from a few tens to a few hundreds of microsieverts in a year. In essence, the doses from these radionuclides when naturally present in the diet are unamenable to control; the resources that would be required to affect exposures would be out of proportion to the benefits achieved for health. Therefore, these radionuclides are excluded from consideration in this document.

One-year exposure assessment: It is conservatively assumed that during the first year after a major environmental radioactive contamination caused by a nuclear or radiological event[9] it might be difficult to replace readily foods imported from contaminated regions with the ones imported from unaffected areas. According to FAO statistical data (see Appendix 1) the mean fraction of major foodstuff quantities imported by all the countries worldwide is 0.1. The values in Table 1 have been derived to ensure that if a country continues to import all the major foods from areas contaminated with radionuclides, the mean annual internal dose of its inhabitants will not exceed around 1 mSv (see Appendix 2). As the assessment has extensive conservative assumptions built-in, the result should be considered as the upper level of the possible dose range.

Long-term exposure assessment: Beyond one year after a major environmental contamination with radionuclides, most of the foods imported from areas with radioactive residues will be replaced with the ones imported from unaffected areas. However, foods contaminated with radionuclides may be still imported occasionally.

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[7] The Codex Alimentarius Commission at its 18th Session (Geneva 1989) adopted Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade (CAC/GL 5-1989) applicable for six radionuclides (^{90}Sr, ^{131}I, ^{137}Cs, ^{134}Cs, ^{239}Pu and ^{241}Am) during one year after the nuclear accident.

[8] International Commission on Radiological Protection (1999). Principles for the Protection of the Public in Situations of Prolonged Exposure. ICRP Publication 82, Annals of the ICRP.

[9] In this document, nuclear or radiological event means nuclear or radiological emergency or terrorist situation involving nuclear facility or major radiation source.

The estimated level of public exposure can be assessed taking account of import/production statistics. Based on FAO statistical data, the worldwide mean value of the import/production factor can be set at 0.0001-0.001 (see Appendix 1). Thus, for a country occasionally importing foods from areas with radioactive residues, the mean annual effective internal dose to its inhabitants is estimated to be less than around 10 µSv (see Appendix 2), which is considered to give trivial health risk to the individual (ICRP, 1991; IAEA, 1988, 1996). As the assessment has extensive conservative assumptions built-in, the result should be considered as the upper level of the possible dose range.

Health risk estimation: Owing to the extremely conservative assumptions adopted, it is most unlikely that the application of the Guideline Levels would result in a committed effective dose from consumption of foods during first year after a major nuclear or radiological event to any individual exceeding a small fraction of 1 mSv. This would add a lifetime risk of death from a radiation-induced cancer of no more than about 10^{-5}.

In the case of a nuclear reactor accident, the release of ^{131}I may present a risk of thyroid cancer. When ^{131}I levels in foods due to short-term accidental release comply with the Guideline Levels, the resulting thyroid dose would not exceed 20 mGy both in infants and in adults. These exposures would add a lifetime risk of radiation-induced thyroid cancer induction for both age groups of no more than about 10^{-4}. The corresponding risk of death from a radiation-induced thyroid cancer is less than 10^{-5}.

The added lifetime risk of death from a radiation induced cancer to individuals consuming foodstuffs imported from areas with radioactive residues that comply with the Guideline Levels in Table 1 will be no more than 10^{-6} from one year of long-term consumption. The corresponding lifetime risks from the consumption of such foodstuffs year by year over a lifetime would be substantially less than 10^{-4}.

APPENDIX 1

ESTIMATION OF THE IMPORT/PRODUCTION FACTOR VALUES BASED ON FAO FOOD STATISTICS

The import/production factor (IPF_{CA}) is defined as the ratio of the amount of foodstuffs imported per year from areas contaminated with radionuclides (I_{CA}), to the total amount produced and imported ($P+I$) annually in the region or country under consideration:

$$IPF_{CA} = I_{CA} / (P+I)$$

Individuals may be considered to consume this proportion of contaminated imported food relative to the total amount of food consumed.

The region-specific or country-specific values of the IPF_{CA} can be determined based on local import and production statistics. In order to numerically estimate the worldwide mean contribution of imported food from areas contaminated with radionuclides, to total food production values needed for the present document, the statistical data on production, import and consumption of major foodstuffs worldwide from the FAOSTAT Food Balance Sheets[10], have been used.

Based on the FAOSTAT data for the recent 5-year period (1997-2001), the mean fraction of major foodstuff quantities (i.e., cereals, starchy roots, vegetables, fruit, meat, milk and fish&seafood) imported by all the countries worldwide (IPF_W), weighted by major foodstuffs consumption, is 0.11 which can be rounded to 0.1. The mean fractions for particular major foodstuffs range between 0.05 for vegetables and up to 0.27 for fish and seafood.

The contribution of food produced in areas affected by a major nuclear accident to the worldwide food import $(I_{CA}/I)_W$ can be assessed based on the experience of the Chernobyl accident which resulted in the radioactive contamination of large agricultural areas. In the three countries mostly affected by the Chernobyl accident (Belarus, Russia and Ukraine), 0.4% to 23% of their territories were significantly contaminated with radionuclides, i.e., above 37 kBq/sq.m (1 Ci/sq.km) of ^{137}Cs. These three countries yield in total about 5%, and their contaminated areas produce less than 0.2%, of major foodstuffs world produce. Taking into account the contribution of other European countries with the Chernobyl contaminated spots, this fraction can be estimated as being 0.3% and accounting for uncertainties ranged between 0.1% and 1% (10^{-3} to 10^{-2}).

As the worldwide mean fraction of imported food comprises about 0.1 of the produced and imported food, the mean fraction of food imported from areas contaminated with radionuclides due to major nuclear or radiological event $IPF_{CA,W}$ can be estimated as 10^{-4} to 10^{-3}.

10 http://apps.fao.org/lim500/wrap.pl?FoodBalanceSheet&Domain=FoodBalanceSheet&Language=english

APPENDIX 2

ASSESSMENT OF HUMAN INTERNAL EXPOSURE WHEN THE GUIDELINE LEVELS ARE APPLIED

For the purpose of assessment of the mean public exposure level in a country caused by the import of food products from foreign areas with residual radioactivity, in implementing the present guideline levels the following data should be used: annual food consumption rates for adults and infants, radionuclide- and age-dependent ingestion dose coefficients and the import/production factors as defined in Appendix 1. When assessing the mean internal dose in infants and general public it is suggested that due to monitoring and inspection the radionuclide concentration in imported foods does not exceed the present guideline levels. Using cautious assessment approach it is considered that all the foodstuffs imported from foreign areas with residual radioactivity are contaminated with radionuclides at the present guideline levels.

Then, the mean internal dose of the public, ***E*** (mSv), due to annual consumption of imported foods containing radionuclides can be estimated using the following formula:

$$E = GL(A) \cdot M(A) \cdot e_{ing}(A) \cdot IPF$$

where:
GL(A) is the age-dependent Guideline Level (Bq/kg)
M(A) is the age-dependent mass of food consumed per year (kg)
e_{ing}**(A)** is the age-dependent ingestion dose coefficient (mSv/Bq)
IPF is the import/production factor as defined in Appendix 1 (dimensionless).
Assessment results presented in Table 2 both for infants and adults demonstrate that for most of twenty radionuclides under consideration, except of ^{14}C, ^{129}I, ^{134}Cs and ^{137}Cs, higher doses might be received by infants than for adults. However, for all the twenty radionuclides doses from consumption of imported foods during 1st year after major radioactive contamination do not exceed around 1 mSv and from annual consumption in the long term (beyond one year) do not exceed around 10 μSv.

For ^{239}Pu as well as for a number of other radionuclides (except of ^{3}H, ^{14}C, ^{35}S, iodine and caesium isotopes) the dose estimate is especially conservative because elevated gastro-intestinal tract absorption factors and associated ingestion dose coefficients are applied for the whole first year of life whereas this is valid mainly during suckling period recently estimated by ICRP to be as average first six months of life (ICRP Committee 2, to be published in 2004). For the subsequent six months of the first year of life the gut absorption factors are much lower.

As an example, dose assessment for the most topical case of ^{137}Cs and for ^{239}Pu in foods are presented below separately for the first year after the area contamination with these nuclides and for long-term exposure.

One-year exposure assessment
For the first year after a major environmental radioactive contamination it is conservatively assumed that it might be difficult to replace readily foods imported from contaminated regions with the ones imported from unaffected areas. Therefore, the mean worldwide value of the import/production factor equal to 0.1 (see Appendix 1) is used for the mean dose estimation.

<u>Cs-137:</u>
For adults: E = 1000 Bq/kg ·550 kg ·1.3·10^{-5} mSv/Bq ·0.1 = 0.7 mSv;
For infants: E = 1000 Bq/kg ·200 kg ·2.1·10^{-5} mSv/Bq ·0.1 = 0.4 mSv

TABLE 2. ASSESSMENT OF A DOSE FOR INFANTS AND ADULTS FROM INGESTION OF IMPORTED FOODS IN A YEAR

Radionuclide	Guideline Level (Bq.kg^{-1})	Annual dose, mSv		
		1st year after major contamination		Long-term Exposure Ranges
		Infants	Adults	
^{238}Pu	10	0.8	0.1	0.0001-0.008
^{239}Pu		0.8	0.1	0.0001-0.008
^{240}Pu		0.8	0.1	0.0001-0.008
^{241}Am		0.7	0.1	0.0001-0.007
^{90}Sr	100	0.5	0.2	0.0002-0.005
^{106}Ru		0.2	0.04	0.00004-0.002
^{129}I		0.4	0.6	0.0004-0.006
^{131}I		0.4	0.1	0.0001-0.004
^{235}U		0.7	0.3	0.0003-0.007
^{35}S	1000	0.2	0.04	0.00004-0.002
^{60}Co		1	0.2	0.0002-0.01
^{89}Sr		0.7	0.1	0.0001-0.007
^{99}Tc		0.2	0.04	0.00004-0.002
^{103}Ru		0.1	0.04	0.00004-0.001
^{134}Cs		0.5	1	0.0005-0.01
^{137}Cs		0.4	0.7	0.0004-0.007
^{144}Ce		1	0.3	0.0003-0.01
^{192}Ir		0.3	0.08	0.00008-0.003
^{3}H*	10.000	0.02	0.02	0.00002-0.0002
^{14}C		0.3	0.3	0.0003-0.003

* This represents the most conservative value for tritium (organically bound).

Pu-239:

For adults: $\boldsymbol{E}$ = 10 Bq/kg ·550 kg ·2.5·10^{-4} mSv/Bq ·0.1 = 0.1 mSv;
For infants: $\boldsymbol{E}$ = 10 Bq/kg ·200 kg ·4.2·10^{-3} mSv/Bq 0.1 = 0.8 mSv

Long-term exposure assessment:
Beyond one year after a major environmental contamination with radionuclides, most of foods imported from areas with radioactive residues will be replaced with the ones imported from unaffected areas. In these conditions, foods contaminated with radionuclides may be still imported occasionally. Therefore, the mean worldwide value of the import/production factor ranging from 0.0001 to 0.001 (see Appendix 1) is used for the mean dose estimation:

Cs-137:

For adults: $\boldsymbol{E}$ = 1000 Bq/kg ·550 kg ·1.3·10^{-5} mSv/Bq ·(0.0001-0.001) = 0.0007 - 0.007 mSv;
For infants: $\boldsymbol{E}$ = 1000 Bq/kg ·200 kg ·2.1·10^{-5} mSv/Bq ·(0.0001-0.001) = 0.0004 - 0.004 mSv.

Pu-239:

For adults: $\boldsymbol{E}$ = 10 Bq/kg ·550 kg ·2.5·10^{-4} mSv/Bq · (0.0001-0.001) = 0.0001 - 0.001 mSv;
For infants: $\boldsymbol{E}$ = 10 Bq/kg · 200 kg ·4.2·10^{-3} mSv/Bq (0.0001 - 0.001) = 0.0008 - 0.008 mSv.