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INTERAGENCY MEETING ON
DERIVED INTERVENTION LEVELS
FOR RADIONUCLIDE CONTAMINATION

WHO Headquarters Geneva, 20 November 1986

CONTENTS

1. Introduction

The accident at Chernobyl, with its transboundary dissemination of contamination, brought about the realisation that much more needed to be done by governments and international organisations alike, not only to prevent such accidents but also to better deal with them in the future. As a result, the relevant international organisations are expanding their radiation protection activities to address the problems highlighted by the accident. A number of meetings have already been held to discuss the planning and implementation of such activities. A major issue being considered concerns the types of control measures which should be taken at different levels of contamination. These measures need to be based, one way or another, on intervention levels and derived intervention levels. Several organisations have interests and activities in this area of radiation protection. Before proceeding with the development of health-based guideline values for derived intervention levels, an interagency meeting on the subject of intervention levels was convened by WHO to ensure the requisite coordination of activities.

Mr G. Ozolins, Manager, Prevention of Environmental Pollution, welcomed the participants on behalf of WHO (list of participants attached). He briefly reviewed the activities of WHO following the accident. While WHO, as well as other organizations, had played an active and instrumental role in advising Member States following Chernobyl, it was evident that improvements in our capability to do so were needed.

WHO's primary responsibility was to safeguard human health and Member States looked to it to provide guidance on health issues. This mandate was of fundamental importance in determining WHO's role in activities undertaken as a result of the Chernobyl accident. These are largely directed toward the improvement of capabilities, both nationally and internationally, for dealing with radiation emergencies in the future should they occur and include:

(i) provision of more specific guidance on intervention levels;
(ii) measurement of radioactivity in the human environment and the rapid collection, compilation and exchange of data in case of future accidents;
(iii) medical emergency assistance and planning;
(iv) strengthening national radiation protection services (primarily through WHO Regional Offices);
(v) the follow-up to the Chernobyl accident (primarily by the WHO Regional Office for Europe).

In developing guideline values for derived intervention levels, WHO had three objectives in mind: to illustrate the practical application of methodology, to provide guidance in an emergency to Member States which have not yet developed their own action plans and promote the harmonisation of derived intervention levels and emergency plans among countries. It was clear that the lack of international guidance had in part resulted in the introduction of control measures at disparate levels of contamination, and an attempt should be made to rectify this.

The objectives of the meeting were:

1. to inform the other agencies of WHO's plans concerning derived intervention levels;
2. to ensure that these plans are responsive to the needs and integrate with the activities of the other organisations;
3. to obtain the support of the other agencies.

2. Review of the Activities of the Organizations

2.1 WHO

As previously mentioned, WHO's prime interest is one of health and its activities in derived intervention levels reflect this interest. WHO intends to produce guideline values for derived intervention levels, below which the introduction of control measures cannot be justified on the grounds of preventing adverse health effects. It was recognised that

control measures could be introduced for other reasons, as health considerations are not the sole criteria for decision making. The proposed WHO guideline value will represent levels above which control measures should be considered but not necessarily introduced.

These guideline values would be of particular use primarily by those Member States which do not have a nuclear power programme and consequently were unlikely to have developed expertise in this area, although they would also serve as a foundation upon which Member States possessing the expertise would build their structure of derived intervention levels.

The WHO guideline values would concentrate on the radionuclides most likely to be encountered in a nuclear accident. It is felt that during the early phase in the accident vicinity the doses are likely to be higher and the guideline values would be of little use. They would be of more utility at some distance from the accident where contamination of foodstuffs and the environment had occurred at a level where it was debatable whether the introduction of control measures was justified.

The dose to an individual not only depends on the amount of a radionuclide contaminating a food or water but also the quantity of food and water ingested by that individual. Thus accurate food consumption data are ideally necessary, but often unavailable for some countries. WHO will produce average dietary intakes for six or seven regions so that, countries which do not have their own accurate food intake data can fall back on the most appropriate regional diet to arrive at a best estimate of the derived intervention level.

In addition to the average regional diet, WHO would need to produce a list of dose per unit intake of a particular radionuclide. These two endeavours were recognised as potential problems but ones which were not insurmountable.

Within the European region, as reflected in the resolution of the WHO Regional Committee for Europe, as well as follow-up epidemiological studies, guidelines for public health authorities on contingency planning for nuclear accidents, additional efforts will be made to harmonise the levels at which specific control measures would be introduced in the event of another accident.

2.2 IAEA

The IAEA has had and continues to pursue an active role in the development of guidance for actions to be taken in radiation emergencies. In 1985, a document was published on the Principles for Establishing Intervention Levels (Safety Series No.72). In it, guidelines are provided on dose levels at which intervention actions should be considered but not on specific derived intervention levels. Work has now been completed on a document setting out principles and methodology for calculating derived intervention levels, together with illustrative examples and a range of tabulated data for application in their evaluation. Appropriate caveats are included in the text and tables to guide the user on the application and limitation of the numerical data provided. The document will be published as IAEA Safety Series No.81 in December 1986. It reflects the experience gained as a result of the Chernobyl accident and should assist those having responsibility for emergency response planning at the national, regional and nuclear facility levels in assessing derived intervention levels for a variety of control measures, such as sheltering, stable iodine administration, evacuation, and food controls.

A clause in the "Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency" places a requirement on the Agency to collect and disseminate information, methodologies and techniques relating to responding to nuclear accidents or radiological emergencies, to develop appropriate radiation monitoring procedures and standards, and to establish and maintain liaison with relevant international organizations, for the purposes of obtaining and exchanging relevant information and data. In response to the recommendations of the International Nuclear Safety Advisory Group following the Post-Accident Review Meeting in August 1986, the Agency's Expanded Nuclear Safety Activities Programme included a requirement to develop (in collaboration with other relevant international organizations) additional guidance on intervention levels of dose and corresponding derived levels appropriate to reducing the stochastic risk and collective dose equivalent (commitment), especially at long distances from the accident release point. An

Agency Advisory Group will meet in February 1987 to review the existing Agency guidance on primary levels of dose, and determine what additional guidance, if any, is required on the primary and derived intervention levels. This Advisory Group will take the work of the other agencies into account and will rely on WHO to provide input on health aspects. The Advisory Group will take into consideration the concern of Member States regarding the potential transboundary consequences of an accidental radionuclide release, and the desire to seek international harmonization on the levels of radioactive contaminants, particularly for foodstuffs, above which protective measures may need to be introduced. This work, including any relevant publication, is scheduled for completion before the end of 1987.

2.3 FAO

Chernobyl had a serious impact on agricultural production and it was quite clear that there was insufficient guidance available on actions to be taken following radiation contamination of agricultural products and food. FAO is seeking to improve its ability to advise the agricultural and fisheries communities especially on methods of avoiding or reducing contamination of their products. These preventive measures would be aimed at minimizing the economic burden on the food producers. FAO's interest in derived intervention levels stems from the fact that these levels determine what action is taken at the food production level. It recognises that close collaboration between FAO, IAEA, WHO, ICRP, etc. will be essential to both development and application of internationally acceptable lower-tier derived intervention levels. FAO needed to be kept abreast of the course of an accident so that its advice to producers could be timely and appropriate. FAO will convene a meeting from 1-5 December 1986 to discuss the application of derived intervention levels to food products and their implications for producers.

2.4 OECD/NEA

The OECD countries were interested in all aspects of radiation accidents and it was felt that the NEA could channel the input of its Member States to the IAEA and WHO. As far as intervention levels were concerned, the NEA had been specifically requested by Switzerland to cooperate with WHO in achieving some harmonisation of control actions.

The Committee for Radiation Protection and Public Health (CRPPH) of the NEA set up a Group of Experts which met in mid-November 1986. This Expert Group decided to elaborate a report to the CRPPH which would be more pragmatic than theoretical and focus upon:

1. A critical review of the existing recommendations on intervention levels included in ICRP 40 and other documents.

2. Consideration of the stochastic risk i.e. to limit consideration to distant contamination problems and not consider the non-stochastic local effects.

3. Consideration of what recommendations should be made to cover the prolonged intermediate phase and transboundary implications.

4. Examination of the misapplication of control measures with a view to recommending how this might be avoided.

This report would then be offered to WHO and IAEA as an input to their work.

2.5 CEC

In 1958, when the Euratom Treaty came into force, very little nuclear radiation protection expertise was available and competence was concentrated. Over time, expertise in radiation protection has evolved in Member States which have assumed more and more responsibility for national actions.

A number of bilateral agreements involving EC Member States have been established for nuclear emergencies and the Commission has published Working Group reports on:

- Radiological Protection Criteria for Controlling Doses to the Public in the Event of Accidental Release of Radioactive Material" (Doc. V/5290/82 - dealing mainly with sheltering, evacuation and iodine tablets);

- Aims and Practices of Transfrontier Emergency Planning within the EC Countries in case of an Accident in a Nuclear Installation" (Doc. V/2138/86 - a guide for use in bilateral agreements).

However, the Member States were not prepared for an accident having such a widespread impact as in the case of Chernobyl.

In the first week of May the Member States rapidly agreed on limits for iodine-131 contamination of foodstuffs but no subsequent agreement was reached on caesium limits. Advice was, therefore, sought from the Group of Experts established under Article 31 of the Euratom Treaty to advise the European Commission on radiological protection. A preliminary limit of 1000 Bq/kg for all foodstuffs was rapidly recommended on a conservative basis and a Working Party set up to examine the problems of foodstuffs contamination limits in general. For various reasons the Council of Ministers adopted at the end of May limits of 370 Bq/kg for caesium in milk, milk products and infant dietary products and 600 Bq/kg in all other foodstuffs pending the detailed examination.

The Article 31 Group considered its Working Party's report at the beginning of September and reported to the Commission. While details are not yet available it is known that a permanent emergency response system is being considered involving a simplification of the foodbasket and the grouping of nuclides to yield easily applicable levels of temporary application in the event of an accident pending examination of the particular circumstances by experts.

3. Summary and Discussion

3.1 Coordination of Activities

The activities of WHO and the other organisations on intervention levels can readily complement each other and are interdependent.

The work of IAEA on the methodology of derived intervention levels which embrace all the control measures likely to be introduced following an accident, will need to be carefully considered by WHO in the development of their health-based guideline values. It is essential that a consensus methodology be adopted to ensure international consistency.

IAEA's and OECD/NEA's review of the primary intervention dose levels is timely but it is not felt likely that this review will have a radical impact on WHO's health-based guideline values. However, it is important that the results of these discussions be taken into consideration by WHO in developing its guidelines.

So that sufficient time is allowed for NEA to produce their preliminary report to the CRPPH (March 1987) and to provide input to the initial WHO Expert Group meeting on Derived Intervention Levels, it was suggested that the small WHO expert group meeting be postponed until the week of 6 April 1987.

FAO is moving ahead with the application of derived intervention levels to food production and the control of contamination in agricultural products. WHO guideline values will provide the health basis for guidance on the implementation of such controls. In addition, WHO will need to call upon FAO for expertise and data in food consumption and close collaboration will be necessary.

The Expert Group set up by NEA/OECD will also contribute to WHO's activities by providing an assessment of control measures undertaken in OECD countries.

Regional bodies such as CEC, OECD and also WHO Regional Offices are being called upon to develop specific guidelines and, as in the case of the CEC, directives, to foster harmonisation of criteria and levels for protective actions which are essential to avoid confusion in the future. WHO guideline value should provide a cornerstone upon which regional organisations can base their advice in the event of an accident.

3.2 WHO's Project on Derived Intervention Levels

The intention of WHO to produce guideline values below which intervention was not justified on the basis of avoiding adverse health effects was discussed at length. It was concluded that the approach to produce "non-intervention" levels was reasonable and the availability of such values would be of extreme importance in the development of derived intervention levels.

In the discussion it was felt that derived "non-intervention" levels for air and drinking water should also be developed. It was the general view that this would certainly be possible for drinking water but that air would be extremely difficult as it has to be expressed as concentration of the radionuclide per unit time. Certainly the Expert Group would have to discuss this problem.

So that harmonisation might be achieved, an international agreement on the values for dose per unit intake of a radionuclide had to be reached. It was felt that the current values do not vary more than about 40% which is, in effect, relatively good concurrence. The sources of these data have been compiled at the National Radiological Protection Board (U.K.), Oak Ridge National Laboratory (USA) and Institut für Strahlenhygiene (FRG). ICRP Committee 2 will be reviewing these data and a consensus view should be close by September 1987.

As has been mentioned, the quantity of food consumed as well as its level of contamination determines the dose to the individual. The type of food and the quantity consumed varies widely from country to country and region to region. As an example, a higher level of contamination of rice can be tolerated in a European country than in Japan, because less rice is eaten in Europe. For this reason it would be ideal to tailor the derived intervention levels to accurate food consumption data where these are available. However, where such data are not readily available, it will be necessary for WHO in collaboration with FAO to develop perhaps 6 or 7 average regional diets to be used in the derived intervention level calculations.

The sources of dietary intake data were discussed at length. The most reliable food consumption data are those based on national surveys of food intake. The next, in terms of reliability is the food intake data based on income and expenditure on food. The least reliable, but still better than nothing, was average intake based on production plus imports less wastage, spoilage, animal feed and exports.

The Nutrition and Food Safety Units of WHO could provide information on data sources such as the FAO dietary surveys, the OECD surveys, about 50 national surveys and the data of the International Food Analysis Group. The spread of average food consumption was usually encompassed by a factor of 2 for all foods and a factor of 3 for specific foods. WHO agreed to provide a summary of the available food intake data.

3.3 Interagency brochure

It was recommended that consideration be given to the publication of an interagency brochure for the general public which would explain intervention levels in a non-technical way. In this respect it was noted that OECD/NEA was planning to organise a workshop on the problems of communication with the public on radiation protection concepts and terminology in nuclear emergencies. This initiative, to which other Agencies might join, could supply an input to the preparation of the abovementioned brochure.

INTERAGENCY MEETING ON DERIVED INTERVENTION LEVELS

Thursday, 20 November 1986

WHO, Geneva

List of Participants

Agencies

Mr B. Emmerson, IAEA

Mr G. Frazer, CEC

Dr O. Ilari, NEA/OECD

Dr F. P. W. Winteringham, FAO Consultant

WHO Temporary Advisers

Dr R. Clarke, WHO Temporary Adviser

Dr N. Rosdahl, WHO/EURO Temporary Adviser

WHO Secretariat

Mr G. Ozolins, Prevention of Environmental Pollution

Dr I. Risboukhine, Prevention of Environmental Pollution

Dr P. J. Waight, Prevention of Environmental Pollution

Other WHO Units

Dr H. Galal-Gorchev, Food Safety

Dr A. Pradilla, Nutrition

Mr L. L. Zegers-Febres, Nutrition

Annex II

INTERAGENCY MEETING ON DERIVED INTERVENTION LEVELS

Thursday, 20 November 1986

WHO, Geneva

Agenda

1. Opening of meeting

2. WHO activities in the development of Derived Emergency Reference Levels:

   (a) Document - Dr R.H. Clarke

   (b) Timetable - Dr P.J. Waight

3. Activities of other organizations in this area and how mutual support may be effected.

4. Technical review

5. Other Business

6. Close of meeting

Annex III

DERIVED INTERVENTION LEVELS

1. Introduction

When an accidental release of radioactivity to the environment occurs, public health and other authorities need to know what action to take and when.

The basis for taking action to protect the public, in the event of an accidental release from a nuclear installation, has been developed by WHO (Nuclear Power: Accidental Releases - Principles of Public Health Action, Regional Office for Europe, 1984), ICRP (Protection of the Public in the Event of Major Radiation Accidents: Principles for Planning, 1984), and by the IAEA (Principles for Establishing Intervention Levels for the Protection of the Public in the Event of a Nuclear Accident or Radiological Emergency, 1985).

In many countries with nuclear power programmes, emergency plans have been adopted which include monitoring environmental contamination, forecasting the spread of contaminants, and instituting control measures to limit or avoid excessive public exposure.

However, many other countries without nuclear power programmes have not necessarily adopted contingency plans and may well be unable to assess adequately the health implications of radionuclide contamination. In the past, such countries have looked to WHO for guidance on the levels of contamination of the environment at which action should be taken.

The guidance given has been in the form of dose levels. However, many countries experienced difficulty in translating these dose levels into corresponding levels of activity especially in food. For many reasons, it is extremely difficult, if not impossible, to derive a universal level of radioactive contamination at which a specific control measure should be introduced. However, it should be possible for WHO to provide guidance on levels below which there is no justification for action to be taken on health grounds, i.e. a level of accidental radioactive contamination at which the health risk should not give rise to concern.

Once this level is exceeded, the actions taken will depend on the local conditions and no hard and fast rule can be laid down. While the principles which will assist in reaching a decision will be discussed, no values will be developed for the introduction of specific control measures.

2. Philosophy

The underlying philosophy developed by the expert groups of the international organizations (see 1) is that it is not possible to set firm dose limits for dealing with emergency situations because of the very nature of an emergency. It is, however, useful to establish reference levels below which action would not be justified and above which it is almost certainly justified on radiological protection grounds. It is envisaged that responsible national authorities will, by analysis of the consequences of accident sequences predicted for any nuclear plant, plan emergency actions based on the guideline doses outlined in the above documents.

It is felt that the proposed WHO Guideline Values on Derived Emergency Reference Levels should principally provide levels of environmental contamination, (drinking water, food, ground deposition), below which action is not warranted on radiological protection grounds, particularly for the intermediate phase of an accident. It is assumed that in the early phase the most appropriate actions to protect members of the public close to the site will have been initiated by the responsible authorities. It is then in the intermediate phase that controls on foodstuffs and other environmental materials will need to be considered and people in areas outside those immediately affected will need to be assured of their protection.

While measurements of food, water and deposited radioactivity are felt to be important, air monitoring will not be considered as its main benefits are to provide an early warning of potential deposition and to indicate a need or lack of need for environmental monitoring.

The aim of this document is to translate into levels of activity concentration ($Bqkg^{-1}$) that can be easily measured, levels of dose below which there is no need, on grounds of risk to health, to introduce control measures. As stated previously there will be no attempt to address the levels where action should be taken, since that requires a balancing of risks from the introduction of a countermeasure with those from the radiation dose averted. This is considered to be a task for the responsible authorities in the country operating the nuclear plant since they will have an emergency plan and will have considered in advance actions necessary. However, for those outside the immediately affected area, it should be sufficient to have guidance on levels of activity for which there need be no concern to take action.

As recommended by ICRP and accepted by previous WHO expert groups (see 1), the level of committed effective dose equivalent below which there is no radiological justification for action is 5mSv in the first year after the accident has occurred from external exposure plus that from intakes of radionuclides. Some thought will have to be given as to whether guidance is required for doses in subsequent years from long-lived nuclides which may recycle in environmental materials (e.g. ^{90}Sr or ^{137}Cs which may return by root uptake into growing crops in later years).

3. Methodology

3.1 Nuclides to be considered

There is a wide range of radionuclides that may be released to the environment following an accident at a nuclear installation. That range includes short and long-lived fission products and actinides, their relative proportions depending on the actual accident sequence and type of installation involved (e.g. operating reactors, reprocessing and fuel fabrication plants). As this document will be most applicable at some distance from the site of the accident and of most benefit to those countries without existing expertise, the selection of radionuclides will be restricted to those with longer half lives which are likely to be of concern in food and water. The figures will apply not only to foods produced in a country which has received deposited activity but also to those imported from a country so affected.

The likely range of nuclides may be

^{90}Sr, ^{106}Ru, ^{132}Te, ^{131}I, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{239}Pu

3.2 Dose per unit intake for members of the public

Before any reference levels can be established, it is necessary to agree the doses per unit intake (Sv/Bq) that will be applied. ICRP Publication 30 has used reference man to derive dosimetric calculations for adult workers, but there are at present no internationally agreed data for members of the public - which includes children and infants.

ICRP Committee 2 has recently invited the Main Commission to establish a Task Group on this topic and a Working Party has already outlined a programme of work to develop these data on a timescale of 12-18 months. It is therefore proposed to utilize these numbers which are likely to be based on dosimetric models and calculations developed at ORNL, the Institut für Strahlenhygiene Neuherberg and NRPB.

3.3 Dietary Intakes

It will be necessary to agree on intakes of principal foodstuffs for different age groups - infants, children, adults - for various global regions: Africa, Europe, Asia. It is not clear what data already exist but other agencies such as FAO may be able to provide this data.

A basic layout could be:-

Dairy products,* meat, vegetables, fruit, cereals, drinking water.

For each foodstuff the quantities consumed per year at different ages would need to be agreed before activity could be specified per unit mass of each.

3.4 Radionuclide Intake Data

There will be a need to derive the qualities of each radionuclide (Bq) that can be taken in at each age that give rise to the dose level below which action is not justified. These figures together with dietary intakes give the reference concentrations in foodstuffs.

3.5 Multiple Pathways and Mixtures of Radionuclides

The estimation of reference levels in environmental materials, below which action is unnecessary, poses substantial problems because different nuclides can be present in any foodchain depending on the nature of the accident and because various components of the diet are obtained from different areas. Also the variation in diet between areas will have an effect so that the calculation of the level of activity of a single nuclide in one foodchain is complex.

In principle each foodstuff should have a different reference level for each nuclide and that calculation will have to be done after the accident has occurred when the measured values of activity of each nuclide in all food pathways are available. This may be possible in the most affected area closest to the nuclear installation, but is not feasible for general WHO guidance.

It is proposed, therefore, to develop reference levels in the major components of diet that can be used without reference to other dietary components. Account may still need to be taken of the contributions of the mix of nuclides in that single pathway, but generally only 1 or 2 nuclides are expected to contribute in one accident. The aim is simplicity with conservative assumptions on intake (i.e. overestimating doses) so that each pathway can be considered separately.

Some judgement will be necessary on what fraction of an individual's diet is to be assumed contaminated by the accident. Each foodstuff reaching the consumer, e.g. grain, is composed of elements from different areas and it is unrealistic to assume that the measured contamination of a specific batch is necessarily representative of the overall contamination of the diet.

4. Worked examples

It is intended to illustrate the calculation of a reference level using the tabulated data. Annexes will contain the basic information.

5. Simplified Groupings

As a result of the calculations, there should be a possibility of producing a simplified set of reference levels, by grouping foodchains and radionuclides to give rounded values.

*Includes milk, butter, cheese, etc., from cows, sheep or goats, etc.

TIMETABLE FOR DERIVED INTERVENTION LEVELS

(i) Interagency meeting ..... November 1986

(ii) Meeting of experts and Agencies ..... April 1987*

(iii) Working Document circulated by ..... June 1987*

(iv) Expert group (large) to finalise document ..... end September 1987
(ICRP Committees September 6-12. Main Commission 14-18)

(v) Editorial group ..... October 1987

(vi) Submit for publication ..... November 1987

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*as modified following the Interagency meeting