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KENYA STANDARD

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**Discharge of patients undergoing
treatment with radioactive substances —
Code of practice**

PUBLIC DRAFT REVIEW

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Kenya Airways- Non Destructive Testing Department
Kenya Industrial Research and Development Institute- Energy Division
Kenya National Accreditation Service
Kenyatta National Hospital-Radiation Safety Department
Kenya Nuclear Electricity Board
Kenyatta University- Department of Applied Physics
Ministry of Roads and Public Works — Materials Testing and Research Department
National Commission for Science, Technology and Innovation
Non Destructive Testing Society of Kenya
Radiation Protection Board
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Discharge of patients undergoing treatment with radioactive substances — Code of practice

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Foreword

This Kenya Standard was prepared by the Technical Committee on Dosimetry Radiotracer and Non Destructive Testing and it is in accordance with the procedures of the Bureau.

The purpose of this standard is to provide guidance on the requirements and conditions that should be met for the discharge from a hospital or clinic of a patient who is undergoing treatment with a radioactive substance, and the conditions for the treatment of an outpatient. In the context of these recommendations, discharge of the patient means the return of the patient into the community, and applies equally to the patient who has been admitted to a hospital for the treatment and to the patient who has been administered the treatment as an outpatient.

These recommendations are based on the premise that the radiation dose to persons with whom the patient may make contact outside the hospital or clinic should be kept as low as reasonably achievable, taking into account the particular social and economic factors, and does not exceed the relevant dose limit prescribed by regulation.

During the preparation of this standard, the following publications were referred to:

ICRP, 1996. Radiological Protection and Safety in Medicine. ICRP Publication 73. Ann. ICRP 26 (2)

ICRP, 1988. Radiation Dose to Patients from Radiopharmaceuticals. ICRP Publication 53. Ann. ICRP 18 (1-4)

National Council on Radiation Protection and Measurements, Dose limits for individuals who receive exposure from radionuclide therapy patients, NCRP.

The Radiation Protection Act, CAP 243, of the Laws of Kenya, 1985 (revised)

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3

The assistance derived from these sources is hereby acknowledged.

Discharge of patients undergoing treatment with radioactive substances — Code of practice

1 Scope

This standard relates to the treatment of patients with sealed or unsealed forms of a radioactive substance. It takes into account the dose rate external to the patient, the potential for loss of a sealed source from the patient, and the potential for the spread of contamination of an unsealed radioactive substance that is excreted by the patient.

The requirements for the discharge of individual patients should be assessed by a medical specialist who holds an appropriate license, preferably in consultation with an experienced medical physicist, having regard to the prevailing circumstances.

2 Radiation protection criteria for patient discharge

2.1 Dose limits and dose constraints

The effective dose to any member of the general public should not exceed 1 millisievert (mSv) in a year, excluding exposure from natural background radiation and medical procedures. This dose limit applies to adults and children, including the unborn child. In the context of these requirements, the dose limit applies to persons who may make contact with the patient, for example, through work, travel, social or domestic activities.

Adult family members or persons who care for the patient are not necessarily subject to the 1 mSv dose limit for members of the public. The effective dose to an appropriately informed carer who knowingly and willingly provides comfort and support to the patient should not exceed a dose constraint of 5 mSv per treatment episode. This criterion need not be applied rigidly in all cases, as for example when a parent is assisting with the care of a sick child.

2.2 The discharge of patients following treatment

Patients may be discharged from hospital or may leave a clinic following treatment with a radioactive substance when an estimate of the effective dose to family members and to members of the general public has been shown to comply with the dose limits and dose constraints given in 2.1.

Such an estimate should be based on measurements of the external ambient dose equivalent rate from the patient, the physical half-life of the radionuclide, the biological clearance of the radioactive substance from the body, the patient's clinical condition and the proximity to other family members, especially children, and to other persons. The dose estimates, and the measurements on which they are based, should be recorded in the patient's clinical record.

2.3 Maximum external dose rate from an inpatient at the time of discharge from hospital

When patient-specific dose estimates to family members and to members of the general public are not available, it is recommended that, in order to comply with the criteria given in 2.1, the ambient dose equivalent rate at a distance of 1 m from a patient who is undergoing treatment with a radioactive substance should not exceed 40 μ Sv/h at the time of the patient's discharge from hospital. Measurements at distances of 2 m or 3 m may be more appropriate in the clinical setting, thus limiting the radiation exposure to the staff and minimising any effects arising from the non-uniform activity distribution in the patient.

The patient does not represent a point-source of activity, so that the inverse-square law often does not apply until at least 3 m from the patient. The external ambient dose equivalent rate from iodine-131 distributed within a patient may be approximated by an 'inverse 1.5 power' relationship from 1 m to 3 m.

The total external radiation dose to members of the public and to family members will depend not only on the dose rate at the time of discharge but also on the physical decay rate of the radionuclide, the biological clearance rate of the radioactive substance from the patient, and the time spent by the patient in proximity to these persons. The above-recommended level of 40 $\mu\text{Sv/h}$ at 1 m has primarily been derived from considerations of iodine-131 in the treatment of thyroid disorders. It should be equally applicable to other therapeutic uses of iodine-131, and to other therapeutic radionuclides, even though the rates of physical decay and biological clearance may differ. However, the rates of physical decay and biological clearance will determine the period during which radiation safety restrictions will apply, particularly in relation to the exposure of family members, and the time at which the patient may resume normal employment and social activities (see Clause 3, Instructions for patients).

Where the patient's circumstances are such that the dose limits or dose constraints given in 2.1 could be exceeded even though the ambient dose equivalent rate at 1 m from the patient is below 25 $\mu\text{Sv/h}$, the responsible medical specialist should postpone the discharge of the patient until such time that the limits or constraints can be met.

2.4 Treatment of patients with sealed sources

The medical specialist with the appropriate license who is responsible for the treatment of patients with sealed sources of caesium-137 or iridium-192 must ensure the safe keeping of these sources at all times. Consequently, a patient who is undergoing treatment with a sealed source or sources is not to be discharged from a hospital or clinic until these sources have been removed from the patient's body.

Where one or more sealed sources of other radionuclides remain in a patient who is to be discharged from a hospital or clinic, consideration should be given to the possibility that these sources may be dislodged from the patient, and to the need for appropriate action to be taken by the patient or carer in this contingency.

2.5 Treatment of patients with unsealed sources

When a patient is to be discharged from a hospital or a clinic following treatment with an unsealed source of a radionuclide, consideration should be given to the possibility of contamination arising from the escape of body fluids, for example as a result of urinary incontinence or vomiting. After oral administration of an unsealed radionuclide (e.g. iodine-131 for thyroid therapy), the patient should remain at the hospital or clinic until such time as the patient is unlikely to vomit the administered dose.

2.6 Maximum radionuclide activity to be administered to an outpatient

In general, the patient may be treated as an outpatient if the activity of the radionuclide to be administered does not exceed the activity given in Annex A for sealed sources or Annex B for unsealed sources. Where the patient's circumstances are such that the dose limits and dose constraints given in 2.1 could be exceeded even though the activity to be administered complies with that listed in Annex A or Annex B, then the responsible medical specialist should postpone the discharge of the patient until these conditions can be met.

The maximum radionuclide activities given in Annex A and Annex B are recommendations for radionuclide therapies used clinically at the time of the writing of these Recommendations. It is acknowledged that new treatment procedures may be developed in the future which could render these limits unnecessarily restrictive. If it can be shown for a particular treatment that the dose limits and dose constraints given in 2.1 will not be exceeded, then the regulatory authority may grant permission to discharge patients receiving this treatment at activities greater than those given in these requirements, upon application from the responsible medical specialist.

Where the patient is undergoing a novel treatment with a radioactive substance not listed in these Annexes, guidance should be sought from the regulatory authority. Further information on the rationale for the maximum activities at which patients may be discharged from hospital, or treated as an outpatient, is provided in Annex C.

2.7 Postponement of the discharge of a patient from hospital or clinic

A patient should not be discharged from a hospital or clinic if it seems likely that:

- a) a sealed source may be lost;
- b) a spread of contamination may occur as a result of the excretion of an unsealed source; or
- c) the patient may vomit shortly after oral administration of an unsealed source.

2.8 Discharge of a patient to premises other than a private dwelling

If a patient is to be transferred to an institution or place of care other than a private dwelling, for example to a nursing home, appropriate notification of the patient's radioactive status should be sent to that place at the time of the transfer. The notification should include details of the form and activity of the radionuclide, the time and date of administration of the radionuclide to the patient, the relevant radiation characteristics of the radionuclide, and the precautions that should be observed for a specified time by the persons who will care for the patient. The name of the hospital or clinic from which the patient was discharged should also be provided, together with the name and telephone number of the person who may be contacted in order to obtain further information on radiation protection matters or advice in the event of a medical emergency.

2.9 Use of public transport by the patient

The time of travel by public transport for the patient returning home should not exceed one hour when the patient is discharged at a maximum ambient dose equivalent rate of $40\mu\text{Sv/h}$ at 1 m or, for a radionuclide that emits penetrating radiation, at the maximum activity given in Annex A or Annex B. If it is known that the journey would be of longer duration and that the patient intends to use public transport, then the patient should remain either in hospital or in local premises after discharge so that the journey may be deferred until the external ambient dose equivalent rate has fallen to an acceptable level.

Alternatively, after taking into consideration the possible dose to a carer or any other person accompanying the patient, the patient may be advised to travel by means other than public transport. This is of particular importance where the public transport involves confined adjacent seating at distances of considerably less than 1 metre.

3 Instructions for patients

Individualized instructions relevant to the patient's medical and social circumstances should be provided to each patient by the licensed medical specialist responsible for the treatment, in consultation with an experienced medical physicist. The instructions should state the radionuclide, the form of the radionuclide and the activity administered, should be designed to suit the patient's own particular travel and domestic arrangements and should be based on the need to minimize the radiation dose to other persons, taking into account the social and economic costs.

The instructions should be given to the patient orally and in writing. The instructions should include, where appropriate, the need to restrict close proximity to other members of the household, especially children, young persons and pregnant women, the importance of good personal hygiene in order to prevent the spread of contamination, and the date when normal social and employment activities may be resumed. The resumption of normal employment should take into account the duration and distance of interaction with other persons in the workplace. Similarly, social activities which involve close proximity to other persons for extended periods, such as going to the cinema or long journeys by public transport, should be distinguished from activities such as shopping, where there are only brief encounters with other persons.

Instructions should also be given, where appropriate, on the precautions to follow in situations such as medical emergencies requiring hospitalization. On the day of treatment, a written record of the treatment should be provided to the referring doctor and, where appropriate, to the patient and/or carers. This record should include the following information:

- a) the radionuclide administered, the activity administered and date of administration;
- b) name(s) and contact number(s) of the prescribing doctor and/or radiation safety officer or medical physicist, for emergencies or other hospitalization; and
- c) the duration of any pertinent radiation safety restrictions.

The patient should also be provided with a card containing the above information. The card should be carried by the patient at all times until the date specified.

Annex A
(normative)

Maximum activities of radionuclides in sealed forms at which a patient may be discharged*

RADIONUCLIDE	PHYSICAL HALF-LIFE	ACTIVITY IN MBq	Note
Caesium-137	30.1 years	None	1
Gold-198	2.69 days	400	-
Iodine-125	59.4 days	2 000	2, 3
Iridium-192	73.8 days	none	1
Palladium-103	17.0 days	10 000	2, 3

* This Annex should be used in conjunction with 2.2 and 2.6.

NOTE 1 Sources are to be removed before the patient is discharged from hospital.

NOTE 2 Because of the relatively long physical half-life of this radionuclide the patient should be instructed to limit periods spent in close proximity to other persons, particularly children or someone who is pregnant, until the administered radionuclide has decayed to at least one-eighth of the amount listed in this Annex. There would normally be no restrictions on the time spent with a person who is at a distance of 1 metre or more from the patient.

NOTE 3 No activity limit is necessary for shielded iodine-125 or palladium-103 plaques/applicators.

Annex B
(normative)

**Maximum Activities of radionuclides in unsealed forms
which may be administered to Outpatients***

Radionuclide	Physical half-life	Activity in MBq	Note
Indium-111	2.81 days	400	1
Iodine-131	8.02 days	800	2
Phosphorus-32	14.3 days	1 200	1. 4
Rhenium-188	17.0 hours	4 000	1. 4
Samarium-153	1.93 days	4 000	1. 4
Strontium-89	50.5 days	300	2. 4
Yttrium-90	2.67 days	4 000	2. 4

* This Annex should be used in conjunction with 2.2 and 2.6.

The following notes do not apply to radionuclides in radiopharmaceutical forms that are insoluble or are totally retained in the body, e.g. labelled microspheres or colloids.

NOTE 1 An incontinent patient should not be discharged to a private dwelling or other non-controlled premises in the first two days after administration of this radionuclide unless monitoring of the patient or of the excreted activity indicates that an earlier discharge date is appropriate.

NOTE 2 An incontinent patient should not be discharged to a private dwelling or other non-controlled premises in the first week after administration of this radionuclide unless monitoring of the patient or of the excreted activity indicates that an earlier discharge date is appropriate.

NOTE 3 An incontinent patient should not be discharged to a private dwelling or other non-controlled premises in the first two weeks after administration of this radionuclide unless monitoring of the patient or of the excreted activity indicates that an earlier discharge date is appropriate.

NOTE 4 In the case of pharmaceutical forms of the radionuclide where there is rapid renal excretion of activity, the patient should remain in hospital or at the clinic until one, or preferably two, urinary voids have occurred. Monitoring of the patient or of the excreted activity may indicate that an earlier or later discharge time is appropriate. The patient should receive appropriate instructions to minimize the spread of contamination from excreta for at least the next 24 h after discharge from the hospital or clinic.

Annex C (informative)

C.1 Rationale for the recommended maximum activities administered to outpatients and the maximum dose rate for discharge of inpatients from hospital

The purpose of the standard is to provide guidance on the conditions which should be met for the discharge of a patient who is undergoing treatment with a radioactive substance. The principal criterion is that the effective dose to any member of the general public, including children and the unborn child, should not exceed 1 millisievert (mSv) in a year, excluding exposure from natural background radiation and from medical procedures to the recipient.

The 1 mSv dose limit is chosen to be consistent with the ICRP recommendations, which set a public exposure limit of 1 mSv in a year (public exposure covers all exposures arising from practices; that is, all exposures that are neither occupational nor medical). This limit does not necessarily apply to adult family members or carers who are appropriately informed and knowingly and willingly provide comfort and support to the patient.

An effective dose constraint of 5 mSv is recommended for adult family members and carers, but this criterion need not be rigidly applied in all cases, as for example when a parent is assisting with the care of a sick child.

The approach taken in these requirements, in order to achieve the above criteria under normal circumstances is that the ambient dose equivalent rate at a distance of 1 m from the patient undergoing treatment with a radioactive substance should not exceed 40 $\mu\text{Sv/h}$ at the time of discharge from a hospital or clinic. It is recognized that the patient does not represent a point-source of activity, and that as a consequence the inverse-square law does not normally apply until distances of at least 3 m from the patient. It has been shown that, in the case of iodine-131 distributed within a patient, the ambient dose equivalent rate at distances from 1 to 3 m from the patient follows an approximate 'inverse 1.5 power' relationship.

The recommended maximum ambient dose equivalent rate of 40 $\mu\text{Sv/h}$ at 1 m from the patient at the time of discharge has been derived primarily from considerations of iodine-131 in the treatment of thyroid disorders. Experience has shown that the dose limits and constraints for exposure to members of the public, family and carers are unlikely to be exceeded if a patient is treated with up to 800 MBq of iodine-131 as an outpatient or if a patient is discharged from a hospital or clinic when the external ambient dose equivalent rate is less than 40 $\mu\text{Sv/h}$ at 1 m, provided that the patient observes some simple precautions such as restrictions on close proximity to other persons.

In general, the radiation dose to persons other than the patient will depend upon:

- a) the activity and distribution of the radionuclide retained in the patient at the time of discharge;
- b) the specific exposure rate constant of the radionuclide;
- c) the shielding provided by the patient's body;
- d) the physical decay rate and the biological clearance rate of the radioactive substance in the patient's body; and
- e) the time spent by such persons at relevant distances from the patient.

These requirements do not specify a different external ambient dose equivalent rate for each radiopharmaceutical even though the radiation dose received by family members during the course of treatment will depend on the physical decay rate and the biological clearance rate of the radioactive substance in the patient. Rather, it is required that the period during which radiation safety restrictions should be applied should be varied to reflect the different half-lives.

The doses received by persons who may be close to the patient for only short periods of time (for example, during travel by public transport or shopping) will depend on the external dose rate and the time period of the proximity. Thus, it is recommended that the time of travel by public transport of the

discharged patient returning home should not exceed one hour when the patient is discharged at a maximum ambient dose equivalent rate of 40 $\mu\text{Sv/h}$ at 1 m or, for a radionuclide that emits penetrating radiation, at the maximum activity given in Annex 1 or Annex 2. This is of particular importance where the public transport involves confined adjacent seating at distances of considerably less than 1 metre.

C.2 Radionuclides in sealed forms

C.2.1 Caesium-137 and Iridium-192

Caesium-137 and iridium-192 emit penetrating gamma radiation and have significantly long physical half-lives (30.1 years and 73.8 days, respectively). Sealed sources of these radionuclides present a major radiation hazard if dislodged from the patient or otherwise lost. These sources are to be removed from the patient before discharge from hospital.

C.2.2 Gold-198

The recommended maximum discharge activity of 400 MBq for gold-198 corresponds to an ambient dose equivalent rate of approximately 25 $\mu\text{Sv/h}$ at 1 m (calculated from the unshielded gamma dose rate with allowance made for limited shielding by the patient's body).

C.2.3 Iodine-125 and Palladium-103

The 'no limit' maximum discharge activity for iodine-125 (sealed) contained in the 1983 Recommendations is not generally useful. The major factor determining the external dose rate from implanted iodine-125 and palladium-103 is the depth of implantation from the skin surface, which is primarily determined by the patient's weight. Studies have shown that, for the commonly administered activity range of these radionuclides, the ambient dose equivalent rate at a distance of 1 metre is less than 0.3 $\mu\text{Sv/h}$ (Smathers et al. 1999).

The recommended maximum discharge activities of 2000 MBq for iodine-125 and 10 000 MBq for palladium-103 are expected to cover activities administered in current practice. The need for the discharged patient to limit periods spent in close proximity to other persons, including pregnant women, until the administered radionuclide has decayed to at least one-eighth of the recommended maximum discharge activity is emphasized in the Notes listed in Annex 1. This is due to the high dose rate at the skin surface of the patient in the proximity of the implant. No activity limit is necessary for shielded iodine-125 or palladium-103 plaques or applicators.

C.3 Radionuclides in unsealed forms

C.3.1 Indium-111

The ambient dose equivalent rate at 1 metre from a patient containing 400 MBq of indium-111 is approximately 25 $\mu\text{Sv/h}$.

C.3.2 Iodine-131

The maximum activity of iodine-131 in unsealed forms at which a patient may be treated, as an outpatient is 800 MBq in these Recommendations. The main determining factor in this recommendation was the external dose rate, but potential contamination from excreted activity was also considered. A residual patient activity of 800 MBq of iodine-131 results in an ambient dose equivalent rate in the range 25 - 40 $\mu\text{Sv/h}$ at 1 m, taking into account the shielding provided by the patient's body.

C.3.3 Rhenium-188

The ambient dose equivalent rate at 1 metre from a patient containing 4 000 MBq of rhenium-188 is approximately 25 $\mu\text{Sv/h}$ (Fox 2002). In addition, because of the high energy beta emission, the potential contamination from excreted activity needs to be considered. Where excretable forms are administered, the time for discharge of incontinent patients to non-controlled premises should take into account the 17 h physical half-life of this radionuclide.

C.3.4 Samarium-153

The reported ambient dose equivalent rate at 1 metre from patients 1-2 hours after the administration of 3 700 MBq of samarium-153-EDTMP is 20-30 $\mu\text{Sv/h}$ (Eary et al. 1993). This, taken together with the further recommendation that the patient should not be discharged until one, or preferably two, urinary voids have occurred is consistent with a recommended maximum discharge activity of 4 000 MBq.

C.4 Beta emitters (Phosphorus-32, yttrium-90 and strontium-89)

External dose rate limits are not applicable to these radionuclides when they remain within the patient's body. There is minimal external dose rate from the activities normally administered because the beta radiation is absorbed within the patient's body tissue. The small external dose rate that does exist in some cases is chiefly from bremsstrahlung radiation.

The major concern is from the excreted activity. The activity restrictions for discharge in respect of urinary excretion and for incontinent patients have been listed in the Notes in Annex 2. These Notes do not apply to radiopharmaceutical forms that are insoluble or are totally retained in the body. The recommended maximum discharge activity for phosphorus-32 has been retained at 1 200 MBq, but the maximum discharge activity for yttrium-90 has been increased from 1 200 MBq to 4 000 MBq in these Recommendations. It has been shown that the ambient dose equivalent rate at 1 metre from a patient containing 4 400 MBq of yttrium-90, when mostly concentrated in the abdominal organs, is approximately 5 $\mu\text{Sv/h}$ (Smart 2002).

The recommended maximum discharge activity of 300 MBq for strontium-89 is consistent with the relatively long physical and biological half-life of this radionuclide, and should impose no practical restrictions since the administered doses are generally less than this.

Annex D
(informative)

D.1 Health effects of ionizing radiation and standards for control of exposure

It is well known that high doses of ionizing radiation can cause harm, but there is continuing scientific uncertainty about effects at low doses. At levels of dose routinely encountered by members of the public and most present-day radiation workers, there is little or no epidemiological evidence of health effects. Radiation protection standards recognize that it is not possible to eliminate all radiation exposure, but they do provide for a system of control to avoid unnecessary exposure and to keep doses in the low dose range.

Extreme doses of radiation to the whole body (around 10 sievert and above), received in a short period, cause so much damage to internal organs and tissues of the body that vital systems cease to function and death may result within days or weeks. Very high doses (between about 1 sievert and 10 sievert), received in a short period, kill large numbers of cells, which can impair the function of vital organs and systems. Acute health effects, such as nausea, vomiting, skin and deep tissue burns, and impairment of the body's ability to fight infection may result within hours, days or weeks. The extent of the damage increases with dose.

However, 'deterministic' effects such as these are not observed at doses below certain thresholds. By limiting doses to levels below the thresholds, deterministic effects can be prevented entirely. Doses below the thresholds for deterministic effects may cause cellular damage, but this does not necessarily lead to harm to the individual: the effects are probabilistic or 'stochastic' in nature. It is known that doses above about 100 mSv, received in a short period, lead to an increased risk of developing cancer later in life. There is good epidemiological evidence – especially from studies of the survivors of the atomic bombings – that, for several types of cancer, the risk increases roughly linearly with dose, and that the risk factor averaged over all ages and cancer types is about 1 in 100 for every 100 mSv of dose (i.e. 1 in 10 000 per mSv).

At doses below about 100 mSv, the evidence of harm is not clear-cut. While some studies indicate evidence of radiation-induced effects, epidemiological research has been unable to establish unequivocally that there are effects of statistical significance at doses below a few tens of millisieverts. Nevertheless, given that no threshold for stochastic effects has been demonstrated, and in order to be cautious in establishing health standards, the proportionality between risk and dose observed at higher doses is presumed to continue through all lower levels of dose to zero. This is called the linear, no-threshold (LNT) hypothesis and it is made for radiation protection purposes only.

There is evidence that a dose accumulated over a long period carries less risk than the same dose received over a short period. Except for accidents and medical exposures, doses are not normally received over short periods, so that it is appropriate in determining standards for the control of exposure to use a risk factor that takes this into account. While not well quantified, a reduction of the high-dose risk factor by a factor of two has been adopted internationally, so that for radiation protection purposes the risk of radiation-induced fatal cancer (the risk factor) is taken to be about 1 in 20 000 per mSv of dose for the population as a whole.

If the LNT hypothesis is correct, any dose carries some risk. Therefore, measures for control of exposure for stochastic effects seek to avoid all reasonably avoidable risk. This is called optimizing protection. However, risk in this sense may often be assessed in terms of risk to a population, and may not ensure sufficient protection of the individual. Consequently, the optimization approach is underpinned by applying dose limits that restrict the risk to individuals to an acceptable level. The fundamental regulatory philosophy is expressed in three principles, based on the recommendations of the International Commission on Radiological Protection (ICRP), which may be summarized as follows:

D.2 Justification

Human activities that cause exposure to radiation may be permitted only if they do more good than harm.

D.3 Optimization of protection

Exposure to radiation from justified activities should be kept as low as reasonably achievable, social and economic factors being taken into account.

D.4 Limitation of individual dose

Doses must not exceed the prescribed dose limits.

Determining what is an acceptable risk for regulatory purposes is a complex value judgement. The ICRP reviewed a number of factors in developing its recommendations, which have in general been internationally endorsed, including by the World Health Organization, the International Labour Organisation and the International Atomic Energy Agency.

The recommended dose limits are summarized as follows:

D.4.1 Limit on effective dose

To limit individual risk	For occupational Exposure	For members of the public
	20 mSv per year averaged over 5 years	1 mSv in a year

In most situations, the requirements for limiting individual risk ensure that doses are below deterministic thresholds, but for cases where this does not apply, the recommended limits are as follows:

D.4.2 Annual limit on equivalent dose

Commented [u1]: New annual limits from ICRP 103

Dose Limits Recommended by ICRP

Type of Dose Limit	Limit on Dose from Occupational Exposure	Limit on Dose from Public Exposure
Effective Dose	20 mSv per year, averaged over defined periods of 5 years, with no single year exceeding 50 mSv After a worker declares a pregnancy, the dose to the embryo/fetus should not exceed about 1 mSv during the remainder of the pregnancy	1 mSv in a year In special circumstances, a higher value could be allowed in a single year, provided that the average over 5 years does not exceed 1 mSv per year
Equivalent Dose to the Lens of the Eye	20 mSv per year, averaged over defined periods of 5 years, with no single year exceeding 50 mSv	15 mSv in a year
Equivalent Dose to the Skin Averaged over 1 cm ² of skin regardless of the area exposed	500 mSv in a year	50 mSv in a year
Equivalent Dose to the Hands and Feet	500 mSv in a year	

In the case of occupational exposure during pregnancy, the general principle is that the embryo or foetus should be afforded the same level of protection as is required for a member of the public. For medical workers, the

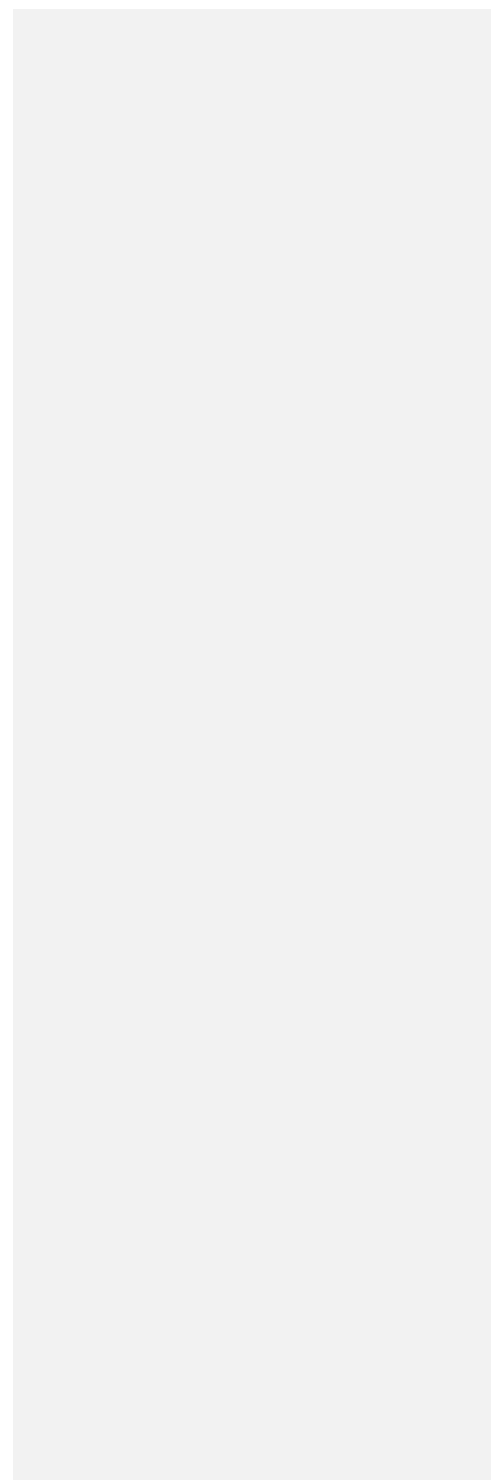
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ICRP recommends that there should be a reasonable assurance that foetal dose can be kept below 1 mGy¹⁾ during the course of the pregnancy. This guidance may be generalised to cover all occupationally exposed pregnant workers by keeping the foetal dose below 1 mSv.

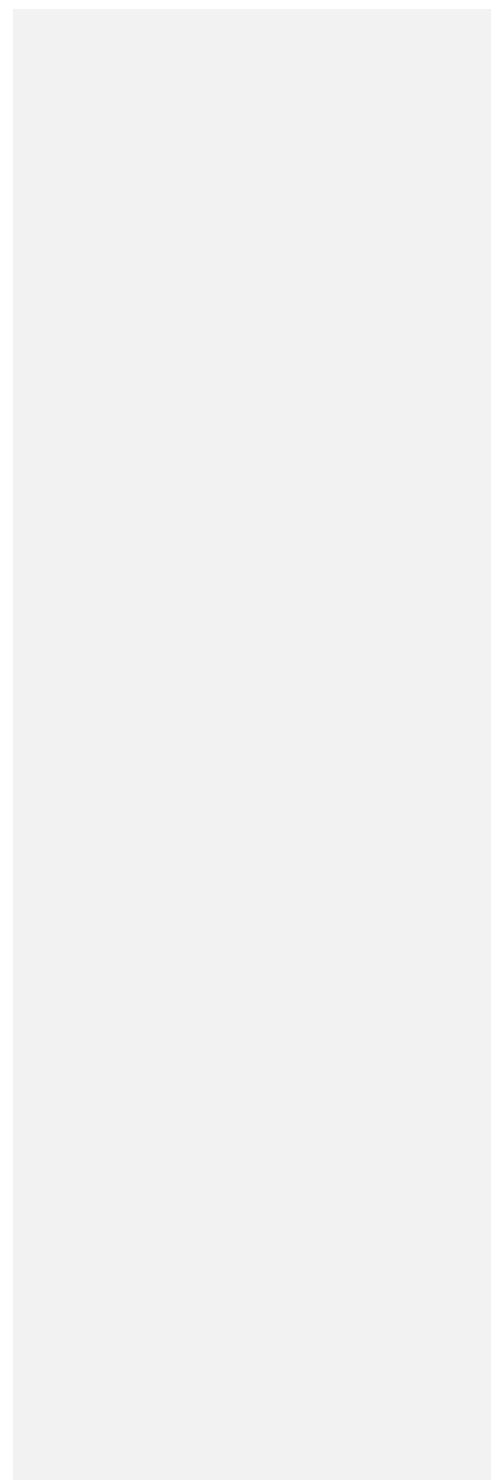
¹⁾ The gray (Gy) is a unit of radiation dose. For X-rays and gamma radiation, it is essentially equivalent to the sievert.

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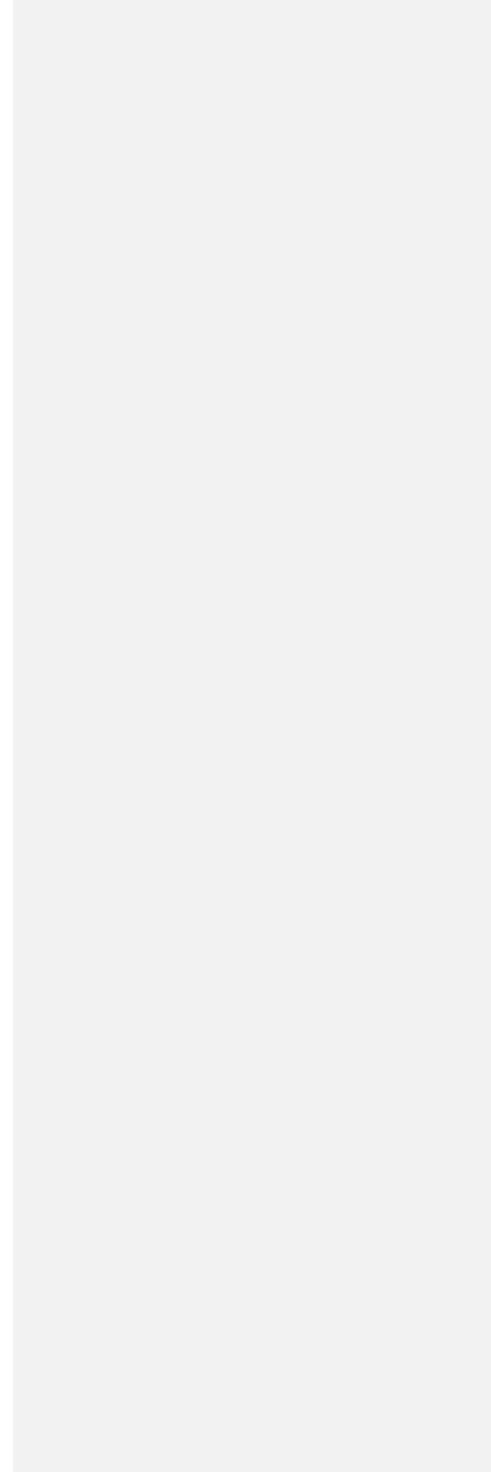
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- Quality System Certification
 - Creating awareness of the standards to all members of staff in an organization from top management to the operators
 - Training in the use and implementation of the Standards
 - Training of internal auditors for continuous assessment of the quality system
 - Development of the necessary documentation (manuals, procedures and work instructions)
 - Assisting the organization through client managers to implement the quality system
- Product Certification (Issuance of the Diamond Mark of Quality)
- Laboratory Testing Service
- Consumer Protection Work
 - Handling of complaints
 - Product certification
- Standards Implementation
- Metrology and Calibration
 - Instrument calibration in the fields of measurement of mass, torque, force, length, dimensional metrology, pressure, time and frequency, electricity, temperature, density and viscosity, volume and flow
- Quality Inspection of Imports at All Ports of Entry
- Training Programmes and Technical Advice
 - Training seminars in the fields of company standardization, industrial quality control, quality management, laboratory testing and metrology
 - Technical advice in standardization and quality assurance
- Documentation and Information Services
 - Standards information
 - WTO (World Trade Organization) enquiry point
 - Sale of Kenya and foreign standards

For further information please contact:

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