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GOVERNMENT NOTICE

DEPARTMENT OF MINERALS AND ENERGY

No. 868 **13 June 2003**

The Minister of Minerals and Energy hereby publishes the draft regulations on safety standards and regulatory practices in accordance with the provisions of sections 36 and 47(3) of the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999), for comment.

All interested parties are invited to comment in writing on the said draft regulations and to direct the comments to: The Director-General, Department of Minerals and Energy, Private Bag X59, PRETORIA, 0001, for attention: Dr S de Waal: Director: Nuclear Safety, Fax No. (012) 317 9539 or e-mail: sdw@mepta.pwv.gov.za

The comments must reach the Department of Minerals and Energy within 45 days from the date of this notice.

PHUMZILE MLAMBO-NGCUKA
MINISTER OF MINERALS AND ENERGY

DRAFT REGULATIONS

NATIONAL NUCLEAR REGULATOR ACT, 1999 (ACT NO. 47 OF 1999)

DRAFT REGULATIONS IN TERMS OF SECTION 36, READ WITH SECTION 47 OF THE NATIONAL NUCLEAR REGULATOR ACT, 1999 (ACT NO. 47 OF 1999), ON SAFETY STANDARDS AND REGULATORY PRACTICES

Under section 36, read with section 47 of the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999), I Phumzile Mlambo-Ngcuka, Minister of Minerals and Energy, on the recommendation of the Board of Directors of the National Nuclear Regulator, hereby make the regulations in the Schedule.

PHUMZILE MLAMBO-NGCUKA
MINISTER OF MINERALS AND ENERGY

SCHEDULE

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Section 1
Definitions

1. Terms defined in the Act

In these regulations, any word or expression to which a meaning has been assigned in the Act, shall have the meaning so assigned.

2. Terms not defined in the Act

In these regulations, unless the context indicates otherwise:

(i) "absorbed dose" means the fundamental dosimetric quantity D expressed in the unit Jkg^{-1}, termed the gray (Gy), defined as:

$$D = \frac{d\varepsilon}{dm}$$

where dε is the mean energy imparted by ionising radiation to matter in a volume element and dm is the mass of matter in the volume element;

(ii) "authorised" means permitted in writing by the Regulator;

(iii) "authorised action" means an action authorised in terms of the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) or the Hazardous Substances Act, 1973 (Act No. 15 of 1973);

(iv) "bequerel" (Bq) means the unit of radioactivity in nuclear transformations (or disintegrations) per second;

(v) "clearance" means removal of radioactive materials or radioactive objects within actions authorised by a nuclear installation licence, nuclear vessel licence or certificate of registration from any further control by the Regulator;

(vi) "collective dose" means an expression for the total radiation dose incurred by a population, defined as the product of the number of individuals exposed to a source and their average radiation dose. The collective dose is expressed in person-sievert (person.Sv) (see collective effective dose);

(vii) "collective effective dose" means the total effective dose incurred by a population, being the sum of all the individual effective doses to members of the population.

Mathematically, the total effective dose to a population, S, is calculated as:

$$S = \sum_i E_i \cdot N_i$$

where E_i is the average effective dose in the population subgroup i and N_i is the number of individuals in the subgroup. It can also be defined by the integral:

$$S = \int_0^\infty E \frac{dN}{dE} dE$$

where $\frac{dN}{dE}\ dE$ is the number of individuals receiving an effective dose between E and E+dE.

The collective effective dose S_k committed by an event, a decision or a finite portion of an action k, during a time interval T, is given by:

$S_k = \int_0^T \dot{S}_k(t)dt$ where $\dot{S}_k(t)$ is the collective effective dose rate at time t caused by k.

(viii) "critical group" means a group of members of the public which is reasonably homogeneous with respect to its exposure for a given radiation source and given exposure pathway and is typical of individuals receiving the highest effective dose or equivalent dose (as applicable) by the given exposure pathway from the given source;

(ix) "defence in depth" means the application of more than a single protective measure for a given radiation or nuclear safety objective, so that the objective is achieved even if one of the protective measures fails;

(x) "discharge" means a planned and controlled release of radioactive nuclides to the environment;

(xi) "disposal" means the emplacement of radioactive waste in an approved, specified facility without the intention of retrieval;

(xii) "dose" means the amount of radiation received, where the use of a more specific term such as "effective dose" or "equivalent dose" is not necessary for defining the quantity of interest;

(xiii) "dose constraint" means a prospective and source-related restriction on the individual dose arising from the predicted operation of the authorised action which serves exclusively as a bound on the optimisation of radiation protection and nuclear safety:

(a) to limit the range of options considered in the optimisation process, and
(b) to restrict the doses via all exposure pathways to the average member of the critical group, in order to ensure that the sum of the doses received by that individual from all controlled sources remains within the dose limit, and which, if found retrospectively to have been exceeded, should not be regarded as an infringement of regulatory requirements but rather as a call for the reassessment of the optimisation of radiation protection.

(xiv) "dose limit" means the value of effective dose or equivalent dose to individuals from actions authorised by a nuclear installation licence, nuclear vessel licence or certificate of registration, that must not be exceeded;

(xv) "effective dose" means the quantity E expressed in the unit Jkg^{-1}, termed the sievert (Sv), defined as the summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_T w_T \cdot H_T$$

where H_T is the equivalent dose in tissue T and w_T is the tissue weighting factor for tissue T; from the definition of equivalent dose, it follows that:

$$E = \sum_T w_T \cdot \sum_R w_R \cdot D_{T,R}$$

where w_R is the radiation weighting factor for radiation R and $D_{T,R}$ is the average absorbed dose in the organ or tissue T;

(xvi) "equivalent dose" means the quantity $H_{T,R}$ expressed in the unit Jkg^{-1}, termed the sievert (Sv), defined as:

$$H_{T,R} = D_{T,R} \cdot w_R$$

where $D_{T,R}$ is the absorbed dose delivered by radiation type R averaged over a tissue or organ T and w_R is the radiation weighting factor for radiation type R; when the radiation field is composed of different radiation types with different values of w_R, the equivalent dose is:

$$H_T = \sum_R w_R \cdot D_{T,R}$$

(xvii) "exposure" means the act or condition of being subject to irradiation;

(xviii) "exposure pathway" means a route by which radioactive material can reach or irradiate humans;

(xix) "IAEA" means the International Atomic Energy Agency;

(xx) "institutional control" means control of a waste site (for example, disposal site) by a statutory authority or institution; this control may be active (monitoring, surveillance, remedial work) or passive (land use control) and may be a factor in the design of a nuclear facility (for example, near surface disposal facility);

(xxi) "normal operational exposure" means an exposure which is expected to be received under normal operating conditions, including possible minor mishaps that can be kept under control;

(xxii) "occupational exposure" means exposure of a worker in the course of his or her work in excess of an annual effective dose of 1 mSv in addition to natural background radiation, and "occupationally exposed" has the corresponding meaning;

(xxiii) "prior safety assessment" means a safety assessment undertaken prior to commencement of operations;

(xxiv) "radiation" means ionising radiation;

(xxv) "radiation weighting factor" means a multiplier of absorbed dose used for radiation protection purposes to account for the relative effectiveness of different types of radiation in inducing health effects, the value of which is that specified in the IAEA *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources*;

(xxvi) "radioactive waste" means any material, whatever its physical form, that remains from an action requiring a nuclear installation licence, nuclear vessel licence or certificate of registration and for which no further use is foreseen, and that contains or is contaminated with radioactive material and does not comply with the requirements for clearance in 2.5;

(xxvii) "radon" means the isotope ^{222}Rn of the element of atomic number 86;

(xxviii)"source" means anything that may cause radiation exposure, such as by emitting ionising radiation or releasing radioactive substances or materials; a complex or multiple installation situated at one location or site may, as appropriate, be considered as a single source for the purposes of application of these regulations;

(xxix) "the Act" means the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999);

(xxx) "tissue weighting factor" means a multiplier of the equivalent dose to an organ or tissue used for radiation protection purposes to account for the different sensitivities of different organs and tissues to the induction of stochastic effects of radiation, the value of which is that specified in the IAEA *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources*.

Section 2

Exclusion, exemption, registration, licensing and clearance

2.1 Exclusion

2.1.1 Exclusion of actions

In terms of the provisions of section **2** (2) (*b*) of the Act,

2.1.1.1 the level of radioactivity concentration of each radioactive nuclide in materials below which the provisions do not apply is:
(a) for all radioactive nuclides of uranium and thorium and their progeny except for radon: 0.5 Bq per gram;
(b) for potassium-40: 5 Bq per gram;
(c) for radon-222 in homes: 400 Bq per cubic metre.

2.1.1.2 the level of total radioactivity content below which the provisions of the Act do not apply is 1000 Bq.

2.1.2 Where the provisions of the Act apply to an action but the Regulator is of the opinion that such action is not amenable to regulatory control, the Board must advise the Minister on -
(a) the publication of a notice determining the action as not amenable to regulatory control; and

(b) on appropriate steps which can be taken by the relevant level of Government or any person or body.

2.1.3 The exclusion levels contained in 2.1.1 are not levels for clearance of material in terms of section 2.5.

2.2 Exemption

2.2.1 Criteria

The criteria for the issue of a certificate of exemption as contemplated in section **22** (3) (*b*) (ii) of the Act must be based upon the following principles:

2.2.1.1 the radiation risk to individuals caused by the action concerned must be too low to be of regulatory concern;

2.2.1.2 the collective radiological impact of the action concerned must be too low to warrant regulatory control in the prevailing circumstances; and

2.2.1.3 the action concerned must be inherently safe, with no appreciable likelihood of scenarios that could result in the requirements set out in 2.2.1.1 and 2.2.1.2 being exceeded.

2.2.2 Exemption without further consideration

Actions involving radioactive material may be exempted without further consideration where the following criteria are fulfilled in all feasible situations:

2.2.2.1 the effective dose expected to be incurred by any member of the public due to the exempted action is 10 μSv per annum or less; and the collective effective dose committed by performing the action for one year is no more than 1 person-Sv; or

2.2.2.2 an assessment for the optimisation of protection shows that exemption is the optimum option; or

2.2.2.3 either the radioactivity concentration or the total radioactivity content of each radionuclide in the radioactive material is below the levels specified in Annexure 1 and the quantity possessed or processed in a period of one year is less than one tonne.

2.2.3 Exemption with further consideration

Actions which involve radioactive material which do not qualify for exemption without further consideration as envisaged in section 2.2.2 can be given further consideration subject to a case-by-case evaluation by the Regulator based on the

specific radioactivity, the total radioactivity of discrete radionuclides or on exposure scenarios.

2.3 Registration

Actions other than those that qualify for a certificate of exemption, or which require a nuclear installation licence or a nuclear vessel licence, must be subject to the process of registration as contemplated in sections 22 and 23 of the Act.

2.4 Licensing

Any nuclear installation or nuclear vessel must be subject to the process of licensing as contemplated in sections 21, 23 and 24 of the Act.

2.5 Clearance

Radioactive materials which fall within a Nuclear Installation Licence, Nuclear Vessel Licence or Certificate of Registration may be cleared from further compliance with the requirements of the nuclear authorisation provided that such materials meet the principles for exemption as detailed in 2.2 or that approval has been given by the Regulator on a case-by-case consideration.

Section 3
Principal radiation protection and nuclear safety requirements

The following principal radiation protection and nuclear safety requirements apply to actions authorised by, or seeking authorisation in terms of, a nuclear installation licence, a nuclear vessel licence or a certificate of registration.

3.1 Dose and risk limits

3.1.1 The doses to an individual arising from normal operating conditions must not exceed the limits specified in Annexure 2.

3.1.2 The risk of fatality from any action as defined in the Act must not exceed the limits specified in Annexure 3.

3.2 Optimisation of radiation protection and nuclear safety

The magnitude of doses to individuals, the number of people exposed and the likelihood of incurring exposures must be kept as low as reasonably achievable, economic and social factors being taken into account (ALARA).

3.3 Prior safety assessment

Measures to control the risk of nuclear damage to individuals must be determined on the basis of a prior safety assessment which is suitable and sufficient to identify all significant radiation hazards and to evaluate the nature and expected magnitude of the associated risks, with due regard to the dose and risk limits in Annexures 2 and 3.

3.4 Good engineering practice

Installations, equipment or plant requiring a nuclear installation licence, a nuclear vessel licence or a certificate of registration and having an impact on radiation or nuclear safety must be designed, built and operated in accordance with good engineering practice.

3.5 Safety culture

A safety culture must be fostered and maintained to encourage a questioning and learning attitude to radiation protection and nuclear safety and to discourage complacency.

3.6 Retrospective application of regulations

3.6.1 Subject to 3.6.2, where compliance with the applicable requirements cannot be demonstrated for an action which is restricted in terms of section 20 of the Act and which existed before the coming into force of these regulations, the person engaged in that action must within two months of the coming into force of these regulations or within two months of the issuing of the nuclear authorisation, whichever is the later, submit to the Regulator an action plan to bring the action into compliance.

3.6.2 The requirements specified in 4.5.4 do not apply to bulk mineral residue facilities where deposition was discontinued prior to the date of these regulations or prior to the date of such facilities being authorised by the Regulator, whichever date is the earlier.

3.7 Regulatory approval of radiation protection and nuclear safety measures

3.7.1 The holder of the nuclear authorisation is responsible for radiation protection and nuclear safety, including compliance with applicable requirements such as the preparation of the required safety assessments, programmes and procedures relating to the siting, design, construction, operation and decommissioning of facilities.

3.7.2 Situations where formal approval of radiation protection and nuclear safety measures by the Regulator is necessary should be limited to those where this is appropriate taking into account the nature and extent of the risk and the need for building stakeholder confidence.

3.8 Accident management and emergency planning and preparedness

Where the prior safety assessment has identified the reasonable possibility of a nuclear accident, accident prevention and mitigation measures based on the principle of defence in depth and which address accident management procedures including emergency planning and preparedness must be established, implemented and maintained. The principle of defence in depth must be applied as appropriate.

3.9 Defence in depth

A multilayer (defence in depth) system of provisions for radiation protection and nuclear safety commensurate with the magnitude and likelihood of the potential exposures involved shall be applied to sources such that a failure at one layer is compensated for or corrected by subsequent layers, for the purposes of –

(a) preventing nuclear accidents;
(b) mitigating the consequences of any such accidents; and
(c) restoring sources to safe conditions after any such accident.

3.10 Quality management

A quality management programme must be established, implemented and maintained in order to ensure compliance with the conditions of the nuclear authorisation.

3.11 Application of radiation protection and nuclear safety

The application of the radiation protection and nuclear safety requirements contained in these regulations to any action should be commensurate with the characteristics of the action and with the magnitude and likelihood of the exposure, as determined in the safety assessments. Not all the requirements are relevant to every action.

Section 4
Requirements applicable to regulated actions

Subject to 4.12, the following requirements apply to actions authorised by a nuclear installation licence, nuclear vessel licence or certificate of registration.

4.1 Operational safety assessment

4.1.1 Operational safety assessments must be made and submitted to the Regulator at intervals commensurate with the nature of the operation and the radiation risks involved.

4.1.2 Operational safety assessments must be of sufficient scope and must be conducted and maintained in order to demonstrate ongoing compliance with the dose and risk limits and other relevant conditions of the nuclear authorisation.

4.1.3 The operational safety assessment must establish the basis for all the operational safety-related programmes, limitations and design requirements.

4.2 Controls and limitations on operation

4.2.1 The holder of a nuclear authorisation is restricted to the actions within the specified site and within any limitations imposed in the authorisation.

4.2.2 Technical specifications must be established, implemented and maintained, where applicable, in terms of the prior safety assessment. Such operating technical specifications must provide a link between the safety assessment and the operation and must, as a minimum, include the following:

4.2.2.1 operating safety limitations as imposed by the design or by the safety criteria;

4.2.2.2 surveillance requirements to verify that equipment important to safety is operating satisfactorily or that parameters are within the safety limitations; and

4.2.2.3 limitations on the operation, in the event that equipment important to safety becomes inoperable or in the event that safety limitations are exceeded.

4.2.3 Radioactive waste acceptance criteria in respect of waste disposal facilities must be established.

4.2.4 Operations must be conducted in accordance with formal procedures as required by the conditions of the nuclear authorisation.

4.3 Maintenance and inspection programme

4.3.1 An appropriate maintenance and inspection programme must be established.

4.3.2 The maintenance and inspection programme must be implemented to ensure that the reliability and integrity of installations, equipment and plant having an impact on radiation and nuclear safety are commensurate with the dose limits and risk limits in Annexures 2 and 3.

4.4 Staffing and qualification

4.4.1 An adequate number of competent, qualified and trained staff must be responsible for carrying out the functions associated with radiation protection and nuclear safety and for maintaining an appropriate safety culture.

4.4.2 The relevant staff must be sufficiently independent from production and operational responsibilities to ensure that no conflict of interests will occur which could interfere with the proper execution of their functions.

4.4.3 The appropriate staff must be consulted on all decisions, which may impact on radiation protection and nuclear safety.

4.5 Radiation protection

4.5.1 Optimisation of protection

Measures commensurate with the magnitude and likelihood of exposure must be implemented to ensure that exposures associated with the authorised action are kept as low as reasonably achievable, economic and social factors being taken into account (ALARA).

4.5.2 Dose constraints

4.5.2.1 Where applicable in terms of the prior safety assessment, the optimisation of radiation protection must be subject to dose constraints specific to the authorised action, which must not exceed values that can cause the relevant dose limits to be exceeded and which will ensure as far as practicable that doses are restricted by application of the ALARA principle on a source-specific basis rather than by dose limits.

4.5.2.2 For members of the public, the dose constraint applicable to the average member of the critical group within the exposed population is 0,25 mSv per year unless otherwise agreed by the Regulator on a case-by-case basis, taking into account the dose limit specified in Annexure 2 for exposure of members of the public from all sources.

4.5.3 Annual authorised discharge quantity

The Regulator may, for the purposes of controlling radioactive discharges from a single authorised action, determine a source-specific annual authorised discharge quantity in the nuclear authorisation, which must take into account the source-specific dose constraint.

4.5.4 Radiation dose limitation

The normal operational exposure of individuals must be restricted to ensure that neither the effective dose nor the equivalent dose to relevant organs or tissues,

caused by the possible combination of authorised actions, exceeds any relevant dose limit specified in Annexure 2.

4.5.5 Health register

A health register must be established and maintained. All entries in the health register must be made by an appointed medical practitioner or a person so authorised.

4.5.6 Dose register

A dose register of every occupationally exposed worker must be established and maintained.

4.6 Radioactive waste management

4.6.1 A radioactive waste management programme must be established, implemented and maintained in order to –

4.6.1.1 ensure the identification, quantification, characterisation and classification of any radioactive waste generated;

4.6.1.2 provide for the necessary steps leading to safe clearance, or authorised discharge, disposal, reuse or recycling; and

4.6.1.3 provide for the safe storage of radioactive waste between any waste management processes.

4.6.2 The safety of long-term radioactive waste storage options must be assured for the envisaged period of storage.

4.6.3 Radioactive waste, as well as radioactive or radioactively contaminated material destined for recycling or reuse, may be removed from further compliance with the conditions of the nuclear authorisation if such material is transported to another authorised site or facility or complies with the requirements for –

4.6.3.1 an authorised discharge; or

4.6.3.2 authorised recycling or reuse; or

4.6.3.3 clearance; or

4.6.3.4 waste acceptance criteria,

and is transported directly to an authorised waste storage or disposal facility.

4.7 Environmental monitoring and surveillance

An appropriate environmental monitoring and surveillance programme must be established, implemented and maintained to verify that the storage, disposal or effluent discharge of radioactive waste complies with the conditions of the nuclear authorisation.

4.8 Transport of radioactive material

Transport of radioactive material or of any equipment or objects contaminated with radioactive material off the site or on roads which are accessible to the public must be carried out in terms of the provisions of the IAEA Regulations for The Safe Transport of Radioactive Material, in the revision specified in the nuclear authorisation.

4.9 Physical security

Physical security arrangements must be established, implemented and maintained in order to demonstrate that all necessary measures are taken to prevent, as far as is reasonable, unauthorised access to sites or diversion, theft or removal of radioactive material that does not meet the requirements for clearance in terms of section 2.5.

4.10 Records and reports

4.10.1 A system of record keeping must be established, implemented and maintained.

4.10.2 Operational reports must be submitted to the Regulator at predetermined periods and must contain such information as the Regulator may require on the basis of the safety assessments.

4.10.3 A reporting mechanism must be established, implemented and maintained for nuclear incidents and accidents or any other events that the Regulator may specify in the authorisation.

4.11 Monitoring of workers

4.11.1 In workplaces where workers are liable to receive doses exceeding three tenths of the applicable dose limits in section 1.1.1 of Annexure 2, as identified by the prior safety assessment and confirmed by subsequent operational safety assessments, systematic individual monitoring of doses received by occupationally exposed workers must be implemented.

4.11.2 The individual monitoring must be based on –

(a) individual dose measurements; or

(b) estimates of doses derived from measurements made on other occupationally exposed workers or from the results of workplace monitoring; or

(c) on a combination of the two methods

as may be appropriate, adequate and feasible.

4.11.3 In workplaces where occupationally exposed workers are unlikely to receive doses exceeding three tenths of the applicable dose limits in section 1.1.1 of Annexure 2, workplace exposure conditions must be kept under review to maintain an awareness of any significant changes in conditions and to enable doses to be assigned to occupationally exposed workers on the basis of general workplace exposure conditions.

4.12 Application to radon exposure

For actions where the operational safety assessment contemplated in section 4.1 demonstrates that the occupational exposure to radon does not exceed an action level of 6 mSv/a, the operator shall instead establish a workplace monitoring programme, which must be subject to the requirements of sections 3.10, 4.4, 4.5.6 and 4.10.

Section 5
Decommissioning

The following requirements apply to actions authorised by a nuclear installation licence, nuclear vessel licence or certificate of registration which involves the decommissioning of any installation, plant or equipment having an impact on radiation protection and nuclear safety, or the release of radioactively contaminated land for other uses.

5.1 Establishment of a decommissioning plan

The development of a decommissioning plan must be initiated as part of the prior safety assessment and must proceed throughout the period of operation of the authorised action. The decommissioning plan must be submitted to the Regulator at its various stages of development. The decommissioning plan must specify any institutional controls that are required to maintain radiation safety after termination of the period of responsibility of the holder of the nuclear authorisation and must minimise as far as reasonable the need for such institutional controls.

5.2 Availability of resources

It must be demonstrated to the Regulator that sufficient resources will be available from the time of cessation of the operation to the termination of the period of responsibility.

5.3 Requirements for decommissioning operations

All decommissioning operations must be conducted in compliance with the applicable requirements of section 4.

5.4 Release of radioactively contaminated land

5.4.1 Sites used in the conduct of authorised actions may be released for unrestricted use provided that it is demonstrated that radioactive contamination and radioactive materials which can reasonably be attributed to the regulated action have been removed from the site or, in the case of naturally occurring radioactive nuclides, that the activity concentrations are below the exclusion levels specified in section 2.1.

5.4.2 In the event that it is not feasible to remove all of the radioactive contamination or radioactive materials which can reasonably be attributed to the regulated action, release for use is allowed subject to any restrictions specified by the Regulator, provided that the following can be demonstrated:

5.4.2.1 that the annual effective dose attributable to the residual contamination and received by the average member of the critical group for all feasible future situations will not exceed the dose constraint that was applicable during the operations; and

5.4.2.2 that remedial measures have been taken to achieve an optimal level of safety.

5.5 Obligations under other statutes

Where there are obligations on the holder of the nuclear authorisation under other statutes with respect to decommissioning, the requirements under 5.1 and 5.2 may be integrated into an overall decommissioning strategy and funding mechanism which may serve to satisfy all relevant statutes in accordance with the co-operative governance agreements established in terms of section 6 of the Act.

Section 6
Accidents, incidents and emergencies

The provisions of this section are applicable to emergency exposure situations requiring protective action to reduce or avert temporary exposures.

6.1 Criteria for the definition of a nuclear accident

Any occurrence or succession of occurrences having the same origin and resulting in an unintended/unauthorised release of radioactive material which is capable of giving rise to an effective dose in excess of 1 mSv to the public off-site in a year, or in excess of 50 mSv to a worker on site received essentially at the time of the event, is regarded as a nuclear accident as defined in section 1 (xiii) of the Act.

6.2 Criteria for the definition of a nuclear incident

Any unintended event which is reasonably capable of giving rise to an effective dose equal to or in excess of 0,1 mSv to the public off site received essentially at the time of the event, or the unintended spread of radioactive contamination which could reasonably give rise to an effective dose in excess of 20 mSv to a worker on site received essentially at the time of the event, or significant failure of safety provisions, is regarded as a nuclear incident as defined in section 1 (xvii) of the Act.

6.3 Information to be supplied

The holder of a nuclear authorisation must immediately inform the Regulator when a nuclear accident occurs or an incident has arisen or is expected to occur or arise, as the case may be, and shall provide such information as may be required, including –

6.3.1 the current situation and its evolution;

6.3.2 measures taken to terminate the nuclear accident and to protect workers and members of the public; and

6.3.3 the exposures that have occurred and those expected to be incurred.

6.4 Emergency or remedial measures

Emergency or remedial measures must be considered in the vicinity of a nuclear accident where the potential exists that any member of the public may receive more than an annual effective dose of 1 mSv resulting from the accident.

Section 7
General

7.1 The safety standards referred to in section 1(xiii)*(a)* of the Act are the criteria for a nuclear accident specified in 6.1.

7.2 The exclusion levels provided for in the safety standards referred to in section 2(2)*(b)* of the Act are the exclusion criteria specified in 2.1.

7.3 The exemption criteria specified in the safety standards referred to in section 22(3)*(b)*(ii) of the Act are the exemption criteria specified in 2.2.

7.4 The safety standards with respect to the risk of nuclear damage referred to in section 1(xxii)*(a)*(iii) of the Act are the risk levels corresponding to the release criteria contained in 2.2 and 5.4 for materials and land respectively.

7.5 The safety standard with respect to the risk of nuclear damage referred to in section 37(2)*(b)* of the Act is the potential dose criterion specified in 6.4.

7.6 The safety standards with respect to the risk of nuclear damage referred to in section 39(2) of the Act are the risk levels corresponding to the release criteria contained in 2.5 and 5.4 for materials and land respectively.

7.7 The safety standards referred to in section 41(4)*(e)* of the Act are the release criteria contained in 2.5 and 5.4 for materials and land respectively.

7.8 The exemption criteria provided for in the safety standards referred to in section 41(4)*(f)* of the Act are the exemption criteria specified in 2.2.

7.9 The safety standards referred to in section 41(4)*(g)* of the Act are the release criteria contained in 2.5 and 5.4 for materials and land respectively.

Annexure 1

Exempt radioactivity concentrations and exempt total radioactivity content

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
H-3	1 E+06	1 E+09
Be-7	1 E+03	1 E+07
C-14	1 E+04	1 E+07
O-15	1 E+02	1 E+09
F-18	1 E+01	1 E+06
Na-22	1 E+01	1 E+06
Na-24	1 E+01	1 E+05
Si-31	1 E+03	1 E+06
P-32	1 E+03	1 E+05
P-33	1 E+05	1 E+08
S-35	1 E+05	1 E+08
Cl-36	1 E+04	1 E+06
Cl-38	1 E+01	1 E+05
Ar-37	1 E+06	1 E+08
Ar-41	1 E+02	1 E+09
K-40	1 E+02	1 E+06
K-42	1 E+02	1 E+06
K-43	1 E+01	1 E+06
Ca-45	1 E+04	1 E+07
Ca-47	1 E+01	1 E+06
Sc-46	1 E+01	1 E+06
Sc-47	1 E+02	1 E+06
Sc-48	1 E+01	1 E+05
V-48	1 E+01	1 E+05
Cr-51	1 E+03	1 E+07
Mn-51	1 E+01	1 E+05
Mn-52	1 E+01	1 E+05
Mn-52m	1 E+01	1 E+05
Mn-53	1 E+04	1 E+09
Mn-54	1 E+01	1 E+06
Mn-56	1 E+01	1 E+05
Fe-52	1 E+01	1 E+06
Fe-55	1 E+04	1 E+06
Fe-59	1 E+01	1 E+06
Co-55	1 E+01	1 E+06
Co-56	1 E+01	1 E+05
Co-57	1 E+02	1 E+06
Co-58	1 E+01	1 E+06
Co-58m	1 E+04	1 E+07
Co-60	1 E+01	1 E+05

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
Co-60m	1 E+03	1 E+06
Co-61	1 E+02	1 E+06
Co-62m	1 E+01	1 E+05
Ni-59	1 E+04	1 E+08
Ni-63	1 E+05	1 E+08
Ni-65	1 E+01	1 E+06
Cu-64	1 E+02	1 E+06
Zn-65	1 E+01	1 E+06
Zn-69	1 E+04	1 E+06
Zn-69m	1 E+02	1 E+06
Ga-72	1 E+01	1 E+05
Ge-71	1 E+04	1 E+08
As-73	1 E+03	1 E+07
As-74	1 E+01	1 E+06
As-76	1 E+02	1 E+05
As-77	1 E+03	1 E+06
Se-75	1 E+02	1 E+06
Br-82	1 E+01	1 E+06
Kr-74	1 E+02	1 E+09
Kr-76	1 E+02	1 E+09
Kr-77	1 E+02	1 E+09
Kr-79	1 E+03	1 E+05
Kr-81	1 E+04	1 E+07
Kr-83m	1 E+05	1 E+12
Kr-85	1 E+05	1 E+04
Kr-85m	1 E+03	1 E+10
Kr-87	1 E+02	1 E+09
Kr-88	1 E+02	1 E+09
Rb-86	1 E+02	1 E+05
Sr-85	1 E+02	1 E+06
Sr-85m	1 E+02	1 E+07
Sr-87m	1 E+02	1 E+06
Sr-89	1 E+03	1 E+06
Sr-90*	1 E+02	1 E+04
Sr-91	1 E+01	1 E+05
Sr-92	1 E+01	1 E+06
Y-90	1 E+03	1 E+05
Y-91	1 E+03	1 E+06
Y-91m	1 E+02	1 E+06
Y-92	1 E+02	1 E+05
Y-93	1 E+02	1 E+05
Zr-93*	1 E+03	1 E+07
Zr-95	1 E+01	1 E+06

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
Zr-97*	1 E+01	1 E+05
Nb-93m	1 E+04	1 E+07
Nb-94	1 E+01	1 E+06
Nb-95	1 E+01	1 E+06
Nb-97	1 E+01	1 E+06
Nb-98	1 E+01	1 E+05
Mo-90	1 E+01	1 E+06
Mo-93	1 E+03	1 E+08
Mo-99	1 E+02	1 E+06
Mo-101	1 E+01	1 E+06
Tc-96	1 E+01	1 E+06
Tc-96m	1 E+03	1 E+07
Tc-97	1 E+03	1 E+08
Tc-97m	1 E+03	1 E+07
Tc-99	1 E+04	1 E+07
Tc-99m	1 E+02	1 E+07
Ru-97	1 E+02	1 E+07
Ru-103	1 E+02	1 E+06
Ru-105	1 E+01	1 E+06
Ru-106*	1 E+02	1 E+05
Rh-103m	1 E+04	1 E+08
Rh-105	1 E+02	1 E+07
Pd-103	1 E+03	1 E+08
Pd-109	1 E+03	1 E+06
Ag-105	1 E+02	1 E+06
Ag-110m	1 E+01	1 E+06
Ag-111	1 E+03	1 E+06
Cd-109	1 E+04	1 E+06
Cd-115	1 E+02	1 E+06
Cd-115m	1 E+03	1 E+06
In-111	1 E+02	1 E+06
In-113m	1 E+02	1 E+06
In-114m	1 E+02	1 E+06
In-115m	1 E+02	1 E+06
Sn-113	1 E+03	1 E+07
Sn-125	1 E+02	1 E+05
Sb-122	1 E+02	1 E+04
Sb-124	1 E+01	1 E+06
Sb-125	1 E+02	1 E+06
Te-123m	1 E+02	1 E+07
Te-125m	1 E+03	1 E+07
Te-127	1 E+03	1 E+06
Te-127m	1 E+03	1 E+07

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
Te-129	1 E+02	1 E+06
Te-129m	1 E+03	1 E+06
Te-131	1 E+02	1 E+05
Te-131m	1 E+01	1 E+06
Te-132	1 E+02	1 E+07
Te-133	1 E+01	1 E+05
Te-133m	1 E+01	1 E+05
Te-134	1 E+01	1 E+06
I-123	1 E+02	1 E+07
I-125	1 E+03	1 E+06
I-126	1 E+02	1 E+06
I-129	1 E+02	1 E+05
I-130	1 E+01	1 E+06
I-131	1 E+02	1 E+06
I-132	1 E+01	1 E+05
I-133	1 E+01	1 E+06
I-134	1 E+01	1 E+05
I-135	1 E+01	1 E+06
Xe131m	1 E+04	1 E+04
Xe-133	1 E+03	1 E+04
Xe-135	1 E+03	1 E+10
Cs-129	1 E+02	1 E+05
Cs-131	1 E+03	1 E+06
Cs-132	1 E+01	1 E+05
Cs-134m	1 E+03	1 E+05
Cs-134	1 E+01	1 E+04
Cs-135	1 E+04	1 E+07
Cs-136	1 E+01	1 E+05
Cs-137*	1 E+01	1 E+04
Cs-138	1 E+01	1 E+04
Ba-131	1 E+02	1 E+06
Ba-140*	1 E+01	1 E+05
La-140	1 E+01	1 E+05
Ce-139	1 E+02	1 E+06
Ce-141	1 E+02	1 E+07
Ce-143	1 E+02	1 E+06
Ce-144*	1 E+02	1 E+05
Pr-142	1 E+02	1 E+05
Pr-143	1 E+04	1 E+06
Nd-147	1 E+02	1 E+06
Nd-149	1 E+02	1 E+06
Pm-147	1 E+04	1 E+07
Pm-149	1 E+03	1 E+06

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
Sm-151	1 E+04	1 E+08
Sm-153	1 E+02	1 E+06
Eu-152	1 E+01	1 E+06
Eu-152m	1 E+02	1 E+06
Eu-154	1 E+01	1 E+06
Eu-155	1 E+02	1 E+07
Gd-153	1 E+02	1 E+07
Gd-159	1 E+03	1 E+06
Tb-160	1 E+01	1 E+06
Dy-165	1 E+03	1 E+06
Dy-166	1 E+03	1 E+06
Ho-166	1 E+03	1 E+05
Er-169	1 E+04	1 E+07
Er-171	1 E+02	1 E+06
Tm-170	1 E+03	1 E+06
Tm-171	1 E+04	1 E+08
Yb-175	1 E+03	1 E+07
Lu-177	1 E+03	1 E+07
Hf-181	1 E+01	1 E+06
Ta-182	1 E+01	1 E+04
W-181	1 E+03	1 E+07
W-185	1 E+04	1 E+07
W-187	1 E+02	1 E+06
Re-186	1 E+03	1 E+06
Re-188	1 E+02	1 E+05
Os-185	1 E+01	1 E+06
Os-191	1 E+02	1 E+07
Os-191m	1 E+03	1 E+07
Os-193	1 E+02	1 E+06
Ir-190	1 E+01	1 E+06
Ir-192	1 E+01	1 E+04
Ir-194	1 E+02	1 E+05
Pt-191	1 E+02	1 E+06
Pt-193m	1 E+03	1 E+07
Pt-197	1 E+03	1 E+06
Pt-197m	1 E+02	1 E+06
Au-198	1 E+02	1 E+06
Au-199	1 E+02	1 E+06
Hg-197	1 E+02	1 E+07
Hg197m	1 E+02	1 E+06
Hg-203	1 E+02	1 E+05
Tl-200	1 E+01	1 E+06
Tl-201	1 E+02	1 E+06

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
Tl-202	1 E+02	1 E+06
Tl-204	1 E+04	1 E+04
Pb-203	1 E+02	1 E+06
Pb-210*	1 E+01	1 E+04
Pb-212*	1 E+01	1 E+05
Bi-206	1 E+01	1 E+05
Bi-207	1 E+01	1 E+06
Bi-210	1 E+03	1 E+06
Bi-212*	1 E+01	1 E+05
Po-203	1 E+01	1 E+06
Po-205	1 E+01	1 E+06
Po-207	1 E+01	1 E+06
Po-210	1 E+01	1 E+04
At-211	1 E+03	1 E+07
Rn-220*	1 E+04	1 E+07
Rn-222*	1 E+01	1 E+08
Ra-223*	1 E+02	1 E+05
Ra-224*	1 E+01	1 E+05
Ra-225	1 E+02	1 E+05
Ra-226*	1 E+01	1 E+04
Ra-227	1 E+02	1 E+06
Ra-228*	1 E+01	1 E+05
Ac-228	1 E+01	1 E+06
Th-226*	1 E+03	1 E+07
Th-227	1 E+01	1 E+04
Th-228*	1 E+00	1 E+04
Th-229*	1 E+00	1 E+03
Th-230	1 E+00	1 E+04
Th-231	1 E+03	1 E+07
Th-nat* (incl.Th-232)	1 E+00	1 E+03
Th-234*	1 E+03	1 E+05
Pa-230	1 E+01	1 E+06
Pa-231	1 E+00	1 E+03
Pa-233	1 E+02	1 E+07
U-230*	1 E+01	1 E+05
U-231	1 E+02	1 E+07
U-232*	1 E+00	1 E+03
U-233	1 E+01	1 E+04
U-234	1 E+01	1 E+04
U-235*	1 E+01	1 E+04
U-236	1 E+01	1 E+04
U-237	1 E+02	1 E+06
U-238*	1 E+01	1 E+04

Radionuclide	Radioactivity Concentration (Bq/g)	Total Radioactivity Content (Bq)
U-nat*	1 E+00	1 E+03
U-239	1 E+02	1 E+06
U-240	1 E+03	1 E+07
U-240*	1 E+01	1 E+06
Np-237*	1 E+00	1 E+03
Np-239	1 E+02	1 E+07
Np-240	1 E+01	1 E+06
Pu-234	1 E+02	1 E+07
Pu-235	1 E+02	1 E+07
Pu-236	1 E+01	1 E+04
Pu-237	1 E+03	1 E+07
Pu-238	1 E+00	1 E+04
Pu-239	1 E+00	1 E+04
Pu-240	1 E+00	1 E+03
Pu-241	1 E+02	1 E+05
Pu-242	1 E+00	1 E+04
Pu-243	1 E+03	1 E+07
Pu-244	1 E+00	1 E+04
Am-241	1 E+00	1 E+04
Am-242	1 E+03	1 E+06
Am-242m*	1 E+00	1 E+04
Am-243*	1 E+00	1 E+03
Cm-242	1 E+02	1 E+05
Cm-243	1 E+00	1 E+04
Cm-244	1 E+01	1 E+04
Cm-245	1 E+00	1 E+03
Cm-246	1 E+00	1 E+03
Cm-247	1 E+00	1 E+04
Cm-248	1 E+00	1 E+03
Bk-249	1 E+03	1 E+06
Cf-246	1 E+03	1 E+06
Cf-248	1 E+01	1 E+04
Cf-249	1 E+00	1 E+03
Cf-250	1 E+01	1 E+04
Cf-251	1 E+00	1 E+03
Cf-252	1 E+01	1 E+04
Cf-253	1 E+02	1 E+05
Cf-254	1 E+00	1 E+03
Es-253	1 E+02	1 E+05
Es-254	1 E+01	1 E+04
Es-254m	1 E+02	1 E+06
Fm-254	1 E+04	1 E+07
Fm-255	1 E+03	1 E+06

*Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Cs-137	Ba-137m
Ba-140	La-140
Ce-144	Pr-144
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212(0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

Annexure 2

Dose limits

1. Occupational exposure

1.1 General dose limits

The occupational exposure of any worker shall be so controlled that the following limits are not exceeded:

1.1.1 an (average) effective dose of 20 mSv per year averaged over five consecutive years;[1]

1.1.2 a (maximum) effective dose of 50 mSv in any single year;

1.1.3 an equivalent dose to the lens of the eye of 150 mSv in a year; and

1.1.4 an equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year.

1.2 Apprentices and students

For apprentices of 16 to 18 years of age who are training for employment involving exposure to radiation and for students of age 16 to 18 who are required to use sources in the course of their studies, the occupational exposure shall be so controlled that the following limits are not exceeded:

1.2.1 an effective dose of 6 mSv in a year;

1.2.2 an equivalent dose to the lens of the eye of 50 mSv in a year; and

1.2.3 an equivalent dose to the extremities or the skin of 150 mSv in a year.

1.3 Women

The annual effective dose limit for women of reproductive capacity is the same as that which is generally specified for occupational exposure under 1.1 above. Following declaration of pregnancy, a limit on the equivalent dose to the abdomen of 2 mSv for the remainder of the pregnancy applies.

1.4 Emergencies

[1]The start of the averaging period shall be coincident with the first day of the relevant annual period starting from the date of entry into force of the Regulations, with no retroactive averaging.

In the event of an emergency or when responding to an accident, a worker who undertakes emergency measures may be exposed to a dose in excess of the annual dose limit for persons occupationally exposed as specified in 1.1 –

1.4.1 for the purpose of saving life or preventing serious injury;

1.4.2 if undertaking actions intended to avert a large collective dose; or

1.4.3 if undertaking actions to prevent the development of catastrophic conditions.

Under any of the circumstances referred to in 1.4.2 or 1.4.3 above, all reasonable efforts must be made to keep doses to the worker below twice the maximum annual dose limit. In respect of life-saving interventions as contemplated in 1.4.1 above, every effort shall be made to keep doses below ten times the maximum annual dose limit. In addition, workers undertaking interventions which may result in their doses approaching or exceeding ten times the annual dose limit may only do so when the benefits to others clearly outweigh their own risk.

2. Exposure of visitors and non-occupationally exposed workers at sites

The annual effective dose limit for visitors to the sites and those not deemed to be occupationally exposed is 1 mSv. The annual dose equivalent limit for individual organs and tissues of such persons is 10 mSv.

3. Public exposure

3.1 The annual effective dose limit for members of the public from all authorised actions is 1 mSv.

3.2 No action may be authorised which would give rise to any member of the public receiving a radiation dose from all authorised actions exceeding 1 mSv in a year.

Annexure 3

Probabilistic risk limits

PUBLIC	
Average annual population risk	10^{-8} fatalities per year per site (one fatality per one hundred million per year per site)
Maximum annual individual risk	5×10^{-6} fatalities per year (one fatality per two hundred thousand per year)
WORKERS	
Average annual risk to workers	10^{-5} fatalities per year per site (one fatality per one hundred thousand per year per site)
Maximum annual individual risk to workers	5×10^{-5} fatalities per year per site (one fatality per twenty thousand per year per site)