Regulation

REGULATION FOR RADIATION DOSE LIMITS AND OPTIMISATION OF RADIATION PROTECTION FOR NUCLEAR FACILITIES

(FANR-REG-04)

Version 1

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Contents

Definitions

Article (1)

For the purpose of this regulation, the following terms shall have the meanings set forth below. Other capitalised terms used but not defined herein shall have the meanings ascribed to them in Article 1 of the Federal Law by Decree No. 6 of 2009 Concerning the Peaceful Uses of Nuclear Energy (the Law):

Absorbed Dose	The fundamental dosimetric quantity D, defined as $D = \frac{d\bar{E}}{dm}$ Where $d\bar{E}$ is the mean energy imparted by Ionizing Radiation to matter in a volume element and *dm* is the mass of matter in the volume element.
Accident Conditions	Deviations from Normal Operation more severe than Anticipated Operational Occurrences, including DBAs and Severe Accidents.
Anticipated Operational Occurrence	An operational process deviating from Normal Operation that is expected to occur at least once during the operating lifetime of a Nuclear Facility but in view of appropriate design provisions does not cause any significant damage to items important to Safety or lead to Accident Conditions.
Controlled Area	A defined area in a Nuclear Facility in which specific Radiation Protection measures and Safety provisions are or could be required for: (a) controlling normal Exposures; (b) preventing the spread of contamination in normal working conditions; or (c) preventing or limiting the extent of potential Exposures.
Design Basis Accident (DBA)	Accident Conditions against which a Nuclear Facility is designed according to established Design criteria, and for which the damage to the Nuclear Fuel and the release of Radioactive Material are kept within authorized limits.
Dose Constraint	A prospective and source of radiation related restriction on the individual Dose from a source of radiation, which provides a basic level of Radiation Protection for the most highly exposed individuals to Ionizing Radiation from a source of radiation, and serves as an upper bound on the Dose in Optimisation of

	Radiation Protection for that source of radiation. For Occupational Exposures, the Dose Constraint is a value of individual Dose used to limit the range of options considered in the process of Optimisation. For Public Exposure, the Dose Constraint is an upper bound on the annual Doses that members of the public may receive from the planned Operation of any controlled source of radiation.
Dose Limit	The value of the Effective Dose or the Equivalent Dose to individuals from Planned Exposure Situations that shall not be exceeded.
Effective Dose	The quantity E defined as a summation of the tissue Equivalent Doses, which is each multiplied by the appropriate Tissue Weighting Factor where H_T is the Equivalent Dose in tissue T and w_T is the Tissue Weighting Factor for tissue T . $E = \sum_T w_T . H_T$ From the definition of Equivalent Dose, it follows that where w_R is the Radiation Weighting Factor for radiation type R and $D_{T,R}$ is the average Absorbed Dose in the organ or tissue. $E = \sum_T w_T \sum_R w_R . D_{T,R}$
Equivalent Dose	The quantity $H_{T,R}$, defined as 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: $H_{T,R} = w_R . D_{T,R}$ When the radiation field is composed of different radiation types with different values of w_R the Equivalent Dose is: $H_T = \sum_R w_R . D_{T,R}$
Exposure	Occupational Exposure(s) and/ or Public Exposure(s).
High-LET Radiation	Radiation with high Linear Energy Transfer, normally assumed to comprise protons, neutrons and alpha particles (or other particles of similar or greater mass).
ICRP	International Commission on Radiological Protection

Internal Exposure	Exposure to Ionizing Radiation from a source of radiation within the body of an individual.
Linear Energy Transfer (LET)	The average linear rate of energy loss of charged particle radiation in a medium, i.e., the radiation energy lost per unit length of path through a material. That is, the quotient of dE by dl where dE is the mean energy lost by a charged particle owing to collisions with electrons in traversing a distance dl in matter. $L = \frac{dE}{dl}$ The unit of LET is $J.m^{-1}$ often given in $keV.\mu m^{-1}$
Low-LET Radiation	Radiation with low Linear Energy Transfer, normally assumed to comprise photons (including X rays and gamma radiation), electrons, positrons and muons.
Normal Operation	Operation within specified operational limits and conditions. For a Nuclear Facility this includes start-up, Operation, shutting down, Maintenance, testing and refuelling.
Optimisation	The process of determining levels of Radiation Protection and Safety that make Exposures and the probability and magnitude of potential Exposures “as low as reasonably achievable (ALARA) economic and social factors being taken into account” as required by the International Commission on Radiological Protection System of Radiological Protection. Optimise, Optimised and Optimising shall be construed accordingly.
Planned Exposure Situation	A situation of Exposure to Ionizing Radiation that arises from the planned Operation of sources of radiation or from planned activity of Nuclear Facility including rehabilitation of the previously occupied land. Practices in Operation are Planned Exposure Situations.
Radiation Weighting Factor	A dimensionless factor by which the organ or tissue Absorbed Dose is multiplied to reflect the higher biological effectiveness of high-LET radiations compared with low-LET radiations. It is used to derive the Equivalent Dose from the Absorbed Dose averaged over a tissue or organ.

Representative Person	An individual receiving a Dose that represents the Doses of the more highly-exposed individuals in the public.
Severe Accidents	Accident Conditions more severe than a DBA and involving significant core degradation
Tissue Weighting Factor	The multiplier of the Equivalent Dose to a tissue or organ used for Radiation Protection purposes to account for the different sensitivities of different organs and tissues to the induction of the stochastic effects of Ionizing Radiation.
Worker(s)	Any Person who works full-time, part-time or on a temporary basis for a Licensee and who has recognised rights and duties in relation to occupational Radiation Protection.

Objective and Scope

Article (2)

This regulation establishes Dose Limits and the requirements for Optimisation of Radiation Protection that are relevant to a Nuclear Facility in the phases of Design, Construction, Commissioning, Normal Operation, including Anticipated Operational Occurrences, and Decommissioning.

Dose Limits for Occupational Exposure

Article (3)

1. Through measures taken in the Design and Construction, in the management of the Commissioning, Normal Operation, including Anticipated Operational Occurrences, and in the Decommissioning of a Nuclear Facility, the Licensee shall ensure that the Occupational Exposure of Workers during the Commissioning, Operation and Decommissioning of the Nuclear Facility does not exceed the Dose Limits established in Articles 3.2 through 3.5 and 3.10 below, and as summarised in Annex 1 of this regulation.

2. The Effective Dose Limit to a Worker who is subjected to Occupational Exposure(s) during the Commissioning, Normal Operation, including Anticipated Operational Occurrences and Decommissioning, of a Nuclear Facility is an average of 20 millisieverts (mSv) per year over a period of five years (100 mSv in 5 years) with no single year exceeding 50 mSv.

3. The Equivalent Dose Limit for the lens of the eye of a Worker is an average of 20 mSv per year over a period of 5 years (100 mSv in 5 years) with no single year exceeding 50 mSv.

4. The Equivalent Dose Limit for the extremities (i.e. hands, feet and forearms) of a Worker in a Nuclear Facility is 500 mSv per year.

5. The Equivalent Dose Limit for the skin (i.e. the average dose over 1 cm^2 of the most highly irradiated area at any point of the skin) of a Worker in a Nuclear Facility is 500 mSv per year.

6. If a female Worker who is subjected to Occupational Exposure(s) during Commissioning, Normal Operation and Decommissioning and has announced her pregnancy, the Licensee shall arrange her work so that the Equivalent Dose to the foetus is Optimised and shall not exceed 1 mSv for the remainder of the pregnancy.

7. If a female Worker has informed the Licensee that she is breastfeeding an infant, the Licensee shall ensure that the said female Worker is not employed in work involving risk of Internal Exposure.

8. The Licensee shall ensure that no Person under the age of 16 years is subjected to Occupational Exposure.

9. The Licensee shall ensure that no Person of age 16 to 18 years is allowed to work in a Controlled Area unless under supervision and only for the purpose of training for employment involving Occupational Exposure to Ionizing Radiation.

10. The Dose Limits for Persons of age 16 to 18 years who are being trained for employment involving Occupational Exposure to Ionizing Radiation is as follows:

    a. The Effective Dose Limit is 6 mSv per year;

    b. The Equivalent Dose Limit for the lens of the eye is 20 mSv per year;

    c. The Equivalent Dose Limit for the extremities and to the skin is 150 mSv per year.

11. In order to demonstrate compliance with the Dose Limits for Occupational Exposure defined in this regulation, the Licensee shall apply the methodology and Dose coefficients set out in the most recent ICRP publications on Occupational Exposures, internal and external, that shall be effective in the State at the beginning of the year following the issuance of such ICRP publications.

Dose Limits for Public Exposure

Article (4)

1. Through measures taken in the Design, Construction and in managing the Commissioning, Normal Operation, including Anticipated Operational Occurrences, and Decommissioning of a Nuclear Facility, the Licensee shall ensure that the Public Exposure during the

Commissioning, Operation and Decommissioning of the Nuclear Facility does not exceed the limits on the estimated Doses to the Representative Person established in Articles 4.2, 4.3 and 4.4 below and as summarised in Annex 2 of this regulation.

2. The Effective Dose Limit to a member of the public is 1 mSv per year.

3. The Equivalent Dose Limit to the lens of the eye of a member of the public is 15 mSv per year.

4. The Equivalent Dose Limit for the skin (i.e. the average dose over 1 cm^2 of the most highly irradiated area at any point of the skin) of a member of the public is 50 mSv per year.

5. In order to demonstrate compliance with Dose Limits for Public Exposure, the Licensee shall apply the methodology and Dose coefficients set out in the most recent ICRP publications that shall be effective in the State at the beginning of the year following the issuance of such ICRP publications.

Optimisation of Radiation Protection for Workers

Article (5)

1. The Licensee shall ensure an Optimised level of Radiation Protection for Workers during the Commissioning, Normal Operation, including Anticipated Operational Occurrences, and Decommissioning of the Nuclear Facility so that the number of Workers exposed and the magnitude of the individual Doses are Optimised. This Optimised level of Radiation Protection shall be realised through the Design measures, control of Construction, and the management of Commissioning, Normal Operation, including Anticipated Operational Occurrences, and Decommissioning of the Nuclear Facility.

2. The Licensee shall determine a Dose Constraint for the Occupational Exposure of Workers in line with international good practice in similar Nuclear Facilities and shall Optimise Radiation Protection below that determined Dose Constraint, which shall serve as a target for Design, Commissioning, Operation and Decommissioning of the Nuclear Facility.

3. The Dose Constraint for Occupational Exposure determined in accordance with Article 5.2 shall be subject to the agreement of the Authority.

Optimisation of Radiation Protection for the Public

Article (6)

1. The Licensee shall ensure an Optimised level of Radiation Protection for the Representative Person of the public during the Commissioning, Normal Operation, including Anticipated Operational Occurrences, and Decommissioning of the Nuclear Facility so that the magnitude of the individual Doses is Optimised. This level of Radiation

Protection shall be realised through the Design measures, control of Construction and the management of Commissioning, Normal Operation, including Anticipated Operational Occurrences, and Decommissioning of the Nuclear Facility.

2. The Licensee shall determine a Dose Constraint for the Public Exposure of the Representative Person of the public in line with international good practice in similar Nuclear Facilities, and shall ensure an optimal level of Radiation Protection below that determined Dose Constraint, which shall serve as a target for Design, Commissioning, Operation and Decommissioning of the Nuclear Facility.

3. The Dose Constraint for Public Exposure determined in accordance with Article 6.2 shall be subject to the agreement of the Authority.

ANNEX 1 - Dose Limits for Occupational Exposure

Effective Dose Limits

Person	Period	Effective Dose Limit
Worker	One year (average)	Average 20 mSv over a period of 5 years
	Five years	100 mSv
	One year (maximum)	50 mSv
Person between 16 and 18 years of age	One year	6 mSv

Equivalent Dose Limits

Organ or Tissue	Person	Period	Equivalent Dose Limit
Lens of the eye	Worker	One year	Average-20 mSv over a period of 5 years
		Five years	100 mSv
		One year	Less or equal 50 mSv
	Person between 16 and 18 years of age	One year	20 mSv
Any point of the skin	Worker	One year	500 mSv
	Person between 16 and 18 years of age	One year	150 mSv
Extremities (hands, feet and forearms)	Worker	One year	500 mSv
	Person between 16 and 18 years	One year	150 mSv
Foetus	Pregnant Worker	Remainder of the pregnancy	1 mSv

ANNEX 2 - Dose Limits for Public Exposure

Effective Dose Limits

Person	Period	Effective Dose Limit
Member of the public	One year	1 mSv

Equivalent Dose Limits

Organ or Tissue	Period	Equivalent Dose Limit
Lens of the eye	One year	15 mSv
Any point of the Skin	One year	50 mSv