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PART II

Statutory Notifications (S.R.O.)

In the name of ALLAH the most gracious and the most merciful

PAKISTAN ATOMIC ENERGY COMMISSION

Pakistan Nuclear Safety & Radiation Protection Regulations, 1990

S.R.O. 957(II)/90.— In exercise of the powers conferred by Section 8 of the Pakistan Nuclear Safety and Radiation Protection Ordinance, No. IV of 1984, the Pakistan Atomic Energy Commission is pleased to make and promulgate the following Regulations—

1. **Short title, extent and commencement.**—(1) These regulations may be called the Pakistan Nuclear Safety and Radiation Protection Regulations, 1990.

(2) These regulations extend to the whole of Pakistan.
(3) These regulations shall come into force at once.
(4) These regulations shall also apply to all the establishments of the Commission.

Price: Rs. 03.00

[3827/Ex. Gaz.]

2. **Definitions.**—In these regulations unless there is anything repugnant in the subject or context, the following expressions shall have the meanings hereinafter assigned to them—

(1) "accidental exposure" means an exposure to ionizing radiation arising from a chance occurrence and of an involuntary nature, whereby one or more of the dose limits for workers may be exceeded or individual members of the public may be subjected to abnormal conditions of radiation exposure.

(2) "activity" means an amount of radioactive nuclide in a particular energy state at a given time and is the quotient of dN by dt, where dN is the expectation value of the number of spontaneous nuclear transformations from that energy state in the time interval dt.
The special name for the SI unit (SI Units refer to System International Units). of activity is Becquerel (Bq): 1 Bq = 1 disintegration per second. The special unit of activity, curie (Ci), may be used temporarily—

$$1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq (exactly)}$$

(3) "advisory committee" means a committee or a body appointed by the Commission under section 4(4) of the ordinance for advising or assisting the Commission in the performance of its functions.

(4) "ALARA" (As Low As Reasonably Achievable) means that the design and use of radiation sources and practices associated there-with, should be such as to ensure that exposures are kept as low as reasonably achievable, economic and social factors being taken into account.

(5) "ALI" (Annual Limit on Intake) means secondary limit for occupational internal exposure and is the smaller value of intake of a given radionuclide in a year in a reference man which would result in either a committed effective dose equivalent of 50 mSv or a committed dose equivalent in the lens of the eye of 150 mSv or in any other organ or tissue of 500 mSv.

(6) "approved medical practitioner" means a medical practitioner responsible for the medical surveillance of workers designated as operating in working condition A(regulation 26), and whose capacity to act in this respect is recognized by the Commission.

(7) "by-product materials" mean any radioactive material (except special nuclear materials), yielded in or made radioactive by exposure to any radiation, in the process of producing or utilizing special nuclear material.

(8) "controlled area" means an area subject to special rules for the purposes of protection against ionizing radiation and to which access is controlled.

(9) "conversion" means conversion of uranium oxides to uranium hexaflouride or other chemical compounds of uranium.

(10) "cost/benefit analysis" means a sequential analysis of the incremental changes in costs and benefits arising from alternative actions, and it represents the approach for optimizing radiation protection expenditure and defining "ALARA" for the limitation of radiation exposure.

(11) "critical group" means the group of members of the public whose exposure is reasonably homogeneous and is typical of individuals receiving the highest dose.

(12) "DAC" (Derived Air Concentration) for a given radionuclide means the activity concentration of that radionuclide in air (Bq/cubic meter) which, if breathed by a "Reference Man" for a working year of 2000 hours under conditions of light physical activity (breathing rate 1.2 cubic meters/h), would result in an inhalation of one ALI, or such concentration which for 2000 hours of air immersion would lead to the irradiation of any organ or tissue to the appropriate limit.

(13) "detriment" means the mathematical expectation of harm which is determined by taking into account the severity of an effect and the probability of its occurrence.

(14) "Director" means the officer incharge of the Directorate of Nuclear Safety and Radiation Protection established under Section 4 Clause (2) of the ordinance, howsoever known or designated and includes any other officer, acting, officiating or exercising the powers of the Director.

(15) "Directorate" means the Directorate of Nuclear Safety and Radiation Protection (DNSRP) established under the ordinance.

(16) "dose" means the quantity of radiation energy absorbed by a medium.

(a) "absorbed dose (D)" means the quotient of $d\bar{\varepsilon}$ by dm, where $d\bar{\varepsilon}$ is the mean energy imparted by ionizing radiation to matter of mass dm

$$D = d\bar{\varepsilon}/dm$$

The special name for the SI unit of absorbed dose is gray (Gy);

1 Gy = 1 Joule per Kilogram

The special unit of absorbed dose, rad, may be used temporarily;

1 rad = 0.01 Gy

(b) "dose equivalent (H)" means the product of D, Q and N at the point of interest in tissue, where D is the absorbed dose, Q is the quality factor and N is the product of all other modifying factors, currently a value of unity is assigned to N.

$$H = DQN$$

The SI unit for H is the same as that for D (Joule per Kilogram). The special name for the SI unit of dose equivalent is sievert (Sv):

1 Sv = 1 Joule per Kilogram

The special unit of dose equivalent, rem, may be used temporarily:

1 rem = 0.01 Sv.

(c) "effective dose equivalent (H_E)" means

$$H_E = \sum_T w_T H_T$$

where H_T is the mean dose equivalent in tissue T and w_T is a weighting factor representing the proportion of the detriment from stochastic effects resulting from tissue T to the total detriment from stochastic effects when the body is irradiated uniformly.

(d) "effective dose-equivalent commitment, $H_{E,c}$ from a given decision or practice means the infinite time integral of the per caput effective dose-equivalent rate, $\dot{H}_E(t)$ for a specified population—

$$H_{E,C} = \int_0^\infty \dot{H}_E(t)\,dt$$

(e) "committed effective dose equivalent, $H_{E,50}$" resulting from an intake of radioactive material into the body, means the effective dose equivalent that will be accumulated during the 50 years following the intake.

$$H_{E,50} = \int_{t_0}^{t_0 + 50\ \text{years}} \dot{H}_E(t)\,dt$$

where $\dot{H}_E(t)$ is the relevant effective dose-equivalent rate from the intake and t_0 is the time of intake. Sometimes it may be necessary to extend the integration time beyond 50 years in order to assess the "lifetime dose".

(f) "collective effective dose equivalent, S_E" gives a measure of the total health detriment from a given radiation source and is defined as—

$$S_E = \int_0^\infty H_E P(H_E)\,dH_E$$

where $P(H_E)dH_E$ is the number of individuals receiving an effective dose equivalent between H_E and $H_E + d H_E$ from the given source.

The units of S_E are man-sieverts (man. Sv).

(17) "dose equivalent indices"; For these regulations two dose equivalent indices are defined as under—

(a) "deep dose equivalent index, $H_{I,d}$" at a point is the maximum dose equivalent within the 28 cm diameter core of a 30 cm diameter sphere centred at this point and consisting of material equivalent to soft tissue with a density of one gm per cm^3.

(b) "shallow dose equivalent index, $H_{I,s}$" at a point means the maximum dose equivalent within the spherical shell extending from a depth of 0.07mm to a depth of 1 cm from the surface of a 30 cm diameter sphere centred at this point and consisting of material equivalent to soft tissue with a density of one gm per cm^3.

(18) "emergency exposure" means the exposure which is received during the abnormal conditions in the interest of preventing injury or saving life or property.

(19) "enrichment" In relation to uranium enrichment means enrichment in U-235 isotope composition of uranium.

(20) "exposure" means any exposure of person to ionizing radiation, a distinction is made between:

(a) external exposure, being exposure to sources outside the body;

(b) internal exposure, being exposure to sources inside the body;

(c) total exposure, being the sum of the external and internal exposures.

(21) "management" means the administrative structure and chain of responsibilities involved in operating a nuclear installation or conducting on operation where radioactive material or radiation apparatus are handled and it includes the licencee.

(22) "medical exposure" means the exposure of an individual resulting from medical, surgical, dental examination or treatment involving radiation.

(23) "milling of radioactive ores" means concentrating or processing radioactive ores, and includes the management and disposal of waste resulting from such operations, but does not include in-site leaching carried on in the course of the mining of radioactive ores.

(24) "mine" has the same meaning as given in the Mines Act.

(25) "mining of radioactive ores" means extraction of radioactive ores, including excavation, in-situ leaching removal and storage of radioactive ores and management and disposal of waste resulting from such operations.

(26) "nuclide" means any atomic species characterized by the number of protons and the number of neutrons in its nucleus, and by the energy state of the nucleus.

(27) "natural radiation exposure" means exposure of persons resulting from natural radioactive substances inside the body and from sources of external radiation including cosmic rays and sources of terrestrial origin, *i.e.* radionuclides naturally present in the crust of the earth and in air.

(28) "occupational exposure" means exposure of a worker during a period of work.

(29) "order" means any general or special order, direction or instruction made, given or issued by or under the authority of the Commission.

(30) "ordinance" means the Pakistan Nuclear Safety and Radiation Protection Ordinance, No. IV of 1984.

(31) "owner" In relation to radiation apparatus or thing that has been let out on hire or otherwise, means the person who lets out as well as who takes it on hire or otherwise and in relation to a mine has the same meaning as given in the Mines Act-IV of 1923.

(32) "physical surveillance" means surveying and monitoring of radiation workers, areas of work, the evaluation of protective measures, the assessment of working methods with respect to health and safety, the establishment of radiation areas, the continued assessment of protective measures, the classification of radiation workers according to conditions of work, the provision of advice on decontamination procedures and any other appropriate measures.

(33) "premises" means any land, any building or structure whether fixed or movable, or any part of any land, building or structure.

(34) "qualified expert" means a person having the knowledge and training required by the Commission to give advice on protection regulations, measures and procedures that will ensure effective radiation protection for persons exposed to ionizing radiation.

(35) "quality factor" This factor weighs the absorbed dose in the definition of dose equivalent.

(36) "radiation" means the ionizing radiation as defined in Pakistan Nuclear Safety and Radiation Protection Ordinance IV of 1984.

(37) "radiation protection officer" means a technically qualified person approved by the Commission and designated by management to supervise the application of appropriate radiation protection regulations, measures and procedures.

(38) "radiation source" means substance or apparatus producing or capable of producing ionizing radiation.

(39) "radioactive ore" means any ore or mineral containing more than the prescribed concentrations of any nuclear substance or which spontaneously emits radiation in excess of the levels specified by the Commission.

(40) "sealed radioactive source" means a radioactive substance bonded within metals or sealed in any capsule or other container in such a way as to—

(a) minimize the possibility of escape or dispersion of the radioactive substance,

(b) allow the emission of ionizing radiation for use as and when required.

(41) "unsealed radioactive source" means a radioactive source that is not a sealed radioactive source.

(42) "source material" means any radioactive material which is determined by the Commission to be a source material; including ores containing one or more of these materials, in such concentration as the Commission may determine from time to time.

(43) "special nuclear material" has the same meaning as defined in the Pakistan Atomic Energy Commission Ordinance No. XVII of 1965.

(44) "substance" means any natural or artificial substance, whether in solid or liquid form or in the form of a gas or vapour and any manufactured article or any article which has been subject to any artificial treatment or process.

(45) "stochastic effects" means radiation effects, the severity of which is independent of dose and the probability of which is assumed to be proportional to the dose without threshold at the low doses of interest in radiation protection.

(46) "non-stochastic effects" means radiation effects for which a threshold exists above which the severity of the effects varies with the dose.

3. **Fixation of date.**—(1) The date of notification of these regulations in the Gazette of Pakistan is hereby fixed as the date for the commencement of Licensing under Section 5 of the ordinance provided that the Licensing of X-ray machines shall commence from 1st day of January 1992.

4. **Power to determine nuclear substance.**—(1) The Director shall have the power and authority to determine and declare, from time to time that any substance or material including any substance obtained or obtainable from the soil, water, or from the atmosphere, which may be used for production of or use in atomic energy or for research into matters connected therewith, whether or not otherwise radioactive, is nuclear substance for the purposes of the ordinance and the regulations.

(2) Natural uranium, depleted uranium, enriched uranium, thorium, plutonium, zirconium, heavy water, tritium and beryllium are hereby determined and declared to be substances which are used for production of or use in atomic energy and shall for all intents and purposes be deemed to fall within the expression 'nuclear substance'.

5. **Delegation of powers.**—(1) All the powers and functions of the Commission under the ordinance and these regulations shall be exerciseable by the Director, provided that the power to make regulations shall not be deemed to have been delegated.

(2) The powers to appoint the advisory committees and to lodge the complaints shall be exercised by the Director with the prior approval of the Chairman.

6. **Designation of Inspectors.**—(1) The following officers shall be Inspectors for whole of Pakistan.

(a) Director;

(b) Any other officer designated by the Director to be an Inspector.

(2) An Inspector may be designated for a particular place or area or for specific purpose or the period.

(3) The Inspector shall carry with him a valid identity card of such designation, issued by the Directorate and if so required, he shall show his identity card for identification to any person, in relation to whom he is exercising or proposing to exercise any of his powers.

7. **Powers of the Inspectors.**—An Inspector may—

(a) carry out periodic inspection of the licensed premises/installation or radiation apparatus and submit a report to the Director;

(b) record the statement of any person in the performance of his duties.

8. **Assistance to the Inspectors.**—Every licencee and any other person acting for or under him shall be bound to assist and provide all relevant facilities, data, records, information and full access to the necessary areas to the Inspector in performance of his duties and functions without any obstruction, hindrance or delay.

9. **Loss of radioactive material etc.**—(1) Where, in the opinion of an Inspector—

(a) any loss, theft, or destruction of any radioactive material or radiation apparatus has occured or the same has fallen into the possession of some unauthorised person or is so suspected;

(b) a nuclear incident or radiation accident has taken place and has caused or is likely to cause the increase of normal radiation levels,

(c) a violation of any provision of the ordinance, these regulations or of the terms and conditions of a licence has taken place;

he may direct any person whether holding the appropriate licence or not to submit a report pertaining to the circumstances of such loss, theft, occurrence or violation, as the case may be, alongwith any remedial action taken or proposed to be taken in respect thereof, and direct such other action to be taken as he deems necessary to remedy or to prevent the breach of these regulations or the terms and conditions of the licence or to minimize the consequences, if any, of the loss, theft, destruction, occurrence, violation, nuclear incident or radiation accident.

(2) If in his opinion a violation of the terms and conditions of the licence or breach of these regulations has taken place in any premises or nuclear installation, the Inspector may, with the approval of the Director order work to be stopped or suspended in the said premises or the nuclear installation, unless he is satisfied that the risk to the public, workers or the environment by the operation of the installation is not greater than that when the licence was granted.

(3) A person, who is given any direction or instruction by the Inspector in the execution of his duties, shall comply with such direction or requirement.

10. **Procedure of obtaining a licence.**—(1) Any premises, in which nuclear installation, radiation apparatus or food irradiation facility is to be installed or radioactive material is to be stored shall require registration.

(2) The Director may, upon application in writing, register any premises, in the name of the owner or the operator as the case may be if after—

(a) getting plans, maps, blue prints, and statement of type, capacity, description, quality and quantity of the proposed installation, radiation apparatus or the radioactive material;

(b) checking suitability of the site;

(c) getting the feasibility and preliminary assessment reports;

is satisfied that the premises meets the safety requirements.

11. **Issuance of a licence.** -(1) After registration, any person desirous of obtaining a licence for any purpose for which a licence is required under the Ordinance shall apply in writing to the Director for such licence.

(2) Every application for a licence shall be accompanied with a deposit receipt of the fee specified for such licence in Schedule-I and such information and documentary evidence which may be required by the Director provided that the existing activities mentioned in the application and carried out by a person shall continue as before for a period of six months from the date fixed under regulation 3 and shall be deemed to have been carried out under a licence if such person submits an application for a licence within that aforesaid period.

(3) In the case of an application by an individual every application for a licence shall also be accompanied with—

(a) an attested photocopy of the national identity card of the applicant;

(b) the address, telephone numbers, nationality, occupation, qualifications, and experience of the applicant;

(c) details of any such application if made before.

(4) In the case of an application by a person other than individual as defined in section 2 (n) of the ordinance every application for a licence shall also be accompanied with—

(a) a statement of authorised capital and paid-up capital of the company, the certificate of registration, the nature and principal place of business, the names and nationality of the executives thereof alongwith their qualifications, experience and a copy of the memorandum and articles of association of the company;

(b) a statement whether an application for such licence was submitted by him in the past to the Director and the result thereof;

(c) any other information or further evidence required by the Director.

(5) In case of application for a licence to cause a nuclear-powered vehicle to enter Pakistan,the applicant shall also furnish with his application.

(a) type, make, and capacity of the vehicle and machinery;

(b) type and make of nuclear installation carried on the vehicle;

(c) quantity and quality of fuel stored and used in the vehicle and installation;

(d) origin and destination including the purpose of journey and previous stations where stopped in transit, including periods of stay;

(e) an undertaking that the applicant shall not discharge or dispose-of radioactive waste in the territorial limits of Pakistan;

(f) purpose of stay and period for which a licence is required.

(6) The Director may make such further inquiries, inspections or investigations either himself or through an officer or committee as he may deem necessary and require an applicant to demonstrate by submitting the required information that the purpose for which the licence is required would not be hazardous to the workers, the public and the environment.

(7) If an applicant does not furnish all the information or the evidence required by the Director under these regulations within the time specified in the order and unless that time is further extended by the Director for sufficient reasons shown by the applicant, his application for the grant of such licence shall be deemed to have been rejected.

12. **Disposal of the application.**—(1) After considering the application, the Director may issue a licence to such person for such period, for such purpose and on such terms and conditions as may be specified in that licence, provided that in case of nuclear installations, the licencees shall also abide by the licensing procedures issued by the Directorate.

(2) The Director may reject the application and refund the fee paid by the applicant after deducting 20% as service charges.

13. **Renewal of licence.**—(1) Subject to the licencee carrying out his obligations, the Director may, on application made by the licencee, at least one month prior to the expiry of the period of existing licence, grant the renewal of the licence on year to year basis on the payment of renewal fee as specified in Schedule-I.

(2) Every application for renewal of a licence shall be accompanied with a receipt of deposit of renewal fee as specified in Schedule-I, provided that if the renewal of the licence is rejected by the Director, the renewal fee paid shall be refunded.

14. **Grant of more than one licence to the same person.**—Nothing contained in these regulations shall prevent issuance of more than one licence to the same person for different purposes or for similar purposes at different places.

15. **Transfer/amendment of licence.**—(1) The licence shall not be assigned or transferred to any other person without the prior consent in writing of the Director, provided that the licencee may get the licence amended on the payment of fee as specified in Schedule-I.

(2) No licencee shall change the premises or shift the nuclear installation, or the radioactive material, as licenced without the prior written approval of the Director.

16. **Suspension of licence.**—If at any time, on receiving the information or otherwise the Director is of the opinion that a licencee is violating any provisions of the ordinance or these regulations or any of the terms and conditions of the licence, he may order immediate stoppage of the work or order such other action as may be necessary to stop, minimize or check the increase in the level of radiation, or any nuclear damage, provided that if the licencee fails to comply with such orders the Director may carry out the same at the cost of the licencee.

17. **Revocation/surrender of the licence.**—(1) After giving an opportunity of showing cause, and on being satisfied that the licencee has violated the provisions of the ordinance or of these regulations or the terms and conditions of the licence, the Director may revoke the licence.

(2) The licencee shall have a right to surrender his licence by giving three months prior notice to the Director.

18. **Record of licences.**—The Directorate shall maintain a record of licences in such form as it may deem fit.

19. **Confidential information.**—The information furnished to the Directorate in pursuance of any order, direction or requirement or in an application made in accordance with these regulations, shall be treated as confidential by the Directorate, and shall not be divulged except for purposes of prosecution, or when the Director himself considers it expedient in the interest of nuclear safety or radiation protection.

20. **No Objection Certificate.**—(1) Any person desirous of importing or exporting, radioactive material, or radiation apparatus, shall apply to the Director for No Objection Certificate (NOC).

(2) The Director may require the applicant to produce invoices or other documents which may show the origin, technical specifications and other details as the Director may deem necessary.

(3) The Director may defer the consideration of the application and may require the applicant to do such other acts which he deems necessary under the safety standards laid down in these regulations.

(4) The Director may

(a) issue no objection certificate;

(b) reject the application;

provided that the applicant shall have a right of making representation to the Chairman if his application is rejected by the Director.

(5) Notwithstanding anything contained in Import and Export Control Act 1950, no person shall apply for an import or export licence in respect of radiation apparatus or radioactive material to the Chief Controller of Imports and Exports unless he obtains a no objection certificate (NOC) from the Directorate.

21. **Variation of the orders passed.**—The Chairman may call for the records of any application for a licence, renewal or other proceedings pending or disposed of by the Director or any other officer of the Commission, suo moto or on information received, or representation made to him by an aggrieved applicant/licencee and may—

(a) grant, revoke, suspend, or renew a licence, or change the terms and conditions of any licence;

(b) uphold, reverse or vary any orders passed on that record or may pass any further orders as he may consider appropriate.

22. **Maintenance of records.**—Every licencee shall—

(a) maintain the record showing the nature, form and quantity of radioactive material obtained and used monthly;

(b) keep a record of the names, addresses, designations, qualifications and status of all persons involved in the use or handling or connected with the use or handling of radioactive material, radiation apparatus or nuclear installation;

(c) record full particulars of disposal, decay and loss of radioactive material and intimate the Directorate about such loss and efforts made by him for the recovery thereof;

(d) keep all necessary and up-to-date records of radiation apparatus regarding its maintenance and operation;

(e) not sell, transfer or dispose-of any radiation apparatus or radioactive material, without prior approval of the Director;

(f) keep all necessary and up-to-date records and ledgers to show the monthly dose of ionizing radiation received by each person as a result of the use or handling of radioactive material or radiation apparatus;

(g) chalk out and introduce a system of periodical medical tests and examinations of all the workers whether employed by him directly or indirectly and keep a record thereof;

(h) keep such other records as the Director may direct from time to time;

(i) submit to the Directorate such returns, at such times, in such form and containing such particulars and information relating to nuclear installation, radioactive material, radiation apparatus or relating to workers or other related matters as required by the Director.

23. **Radionuclide contamination levels.**—(1) No person shall import, store, sell or offer for sale any food item in which the radioactive contamination is more than the levels prescribed in Schedule-II.

(2) No person shall apply to Chief Controller of Import & Export for an import licence for any food item unless he produces with his application a certificate from the relevant authority of the country of origin showing that the radionuclide levels in that food are not more than those specified in Schedule-II.

24. **Insurance.**—(1) Every licencee when required by the Director, shall obtain an insurance policy for such amount as may be fixed by the Director for each type of licence in the guidelines to be issued by the Directorate.

(2) Notwithstanding anything contained in any law for the time being in force, no licencee or insurer shall cancel or suspend a policy obtained under the preceding clause without the prior approval of the Director in writing.

25. **Disposal order by the court.**—If a person is convicted of an offence under the ordinance which was committed in respect of radioactive material, nuclear substance, radiation apparatus, or contaminated food and the court passes an order for such radioactive material, nuclear substance, radiation apparatus or contaminated food to be handed over to the Director for safe disposal, the Director shall dispose of the same as prescribed in the guidelines.

26. **Working conditions.**—There shall be two classes of working conditions—

(a) working condition A—where the annual exposures may exceed three-tenths of the dose equivalent limits specified in Schedule-III;

(b) working condition B — where it is most unlikely that the annual exposures will exceed three-tenths of the dose equivalent limits specified in Schedule-III.

27. **Conditions of exposure.**—There shall be two conditions of exposure—

(a) conditions in which the occurrence of exposure shall be foreseen and limited by appropriate control measures, and includes exposure under normal conditions of operation and planned special exposures;

(b) conditions in which the source of exposure is not subject to control and includes exposure during abnormal conditions where it is urgent to prevent injury or to save life and property, to rescue injured or trapped individuals and to prevent a substantial increase in the scale of an accident.

28. **Categories of workers.**—(1) For the purpose of these regulations there shall be two categories of occupational workers—

(a) Radiation workers who are directly engaged in radiation work and to whom the dose limits specified in Schedule-III shall apply;

(b) Non-radiation workers who are not directly engaged in radiation work, but who shall be exposed to ionising radiation or radioactive substances.

(2) Members of the public shall be treated as non-radiation workers.

(3) No person under the age of 18 years shall be employed as a radiation worker.

(4) No worker, student, apprentice or trainee under the age of 18 years shall be directly engaged in radiation work in working condition A.

(5) Workers, students, trainees or apprentices between the age of 16 years and 18 years shall be categorised as directly engaged in radiation work and shall be allowed to work in working condition B.

29. **Classification of radiation workers.**—(1) Radiation workers shall be classified according to their radiation exposure conditions.

(2) The licencee in consultation with Radiation Protection Officer, shall categorise radiation workers as—

(a) radiation worker A.—These are radiation workers working under working condition A;

(b) radiation worker B.—These are radiation workers working under working condition B.

(3) The licencee shall keep a list of all radiation workers according to their classification and shall review it in accordance with changes in working practices.

30. **Classification of areas.**—(1) The licencee shall, in consultation with, Radiation Protection Officer classify all areas of the facility in accordance with the provisions of these regulations and abide by the conditions of the licence.

(2) Areas where workers may receive a dose equivalent or committed dose equivalent exceeding three-tenths of any of the annual dose limits shall be included in controlled areas.

(a) The boundaries of controlled areas shall be determined according to the operational situation and include existing structural boundaries;

(b) No worker shall be allowed to enter the controlled areas unless authorised by the licencee with the concurrence of the Radiation Protection Officer.

(3) Any area where conditions are such that workers are not likely to receive more than three-tenths of any of the dose limits but may receive doses exceeding the limits for non-radiation workers shall be designated as supervised areas.

(a) The boundary of the supervised area shall be chosen so that the sum of annual dose equivalents, outside the supervised areas shall not exceed the dose limits;

(b) Access of radiation workers to supervised areas shall be allowed by the licencee in consultation with the Radiation Protection Officer.

(4) The licencee shall sub-classify controlled areas as under—

(i) radiation area;

(ii) high radiation area;

(iii) very high radiation area;

(iv) airborne radioactivity area; and

(v) storage area for radiation sources and radioactive material.

(5) The licencee shall in consultation with the Radiation Protection Officer—

(a) mark controlled and supervised areas by appropriate radiation warning sign as specified in Schedule-IV;

(b) ensure that appropriate instruments for radiation monitoring are available;

(c) ensure that the working instructions as appropriate to the radiation risk are available and are being adhered to;

(d) ensure that the appropriate radiation monitoring is carried out;

(e) ensure that qualified experts are available to check engineered and control safety features.

31. **Dose limitation system.**—(1) During normal exposure conditions where the occurrence of exposure is foreseen, the doses from sources or practices shall be restricted by the application of the dose limitation system.

(2) No worker shall unnecessarily expose himself or unnecessarily be exposed to ionising radiation.

(3) The design, plan and subsequent use and operation of sources and practices shall be performed in a manner to ensure that exposures are as low as reasonably achievable (ALARA), economic and social factors being taken into account.

(4) The licencee, in consultation with the Radiation Protection Officer, shall optimise and fulfil other operational optimisation requirements in accordance with the guidelines to be issued by the Directorate for the purpose of carrying out differential cost-benefit analysis.

32. **Primary dose equivalent limits for radiation workers.**—(1) The Primary limits for radiation workers shall be dose equivalent, effective dose equivalent, committed dose equivalent or committed effective dose equivalent depending on the exposure circumstances.

(2) The licencee shall limit the occupational doses to workers to those annual dose equivalent limits specified in Schedule-III, except as provided for the planned special exposures.

(3) The licencee shall ensure that—

(a) any necessary exposure received by women workers of reproductive capacity be as uniformly distributed with time as is practicable;

(b) pregnant women workers should work only in Working Condition B (Regulation 26 (b).

33. **Planned special exposure for exceptional situations.**—(1) The dose equivalents or the committed dose equivalents incurred in the course of planned exposures shall not exceed twice the relevant annual limit specified in Schedule-III in any single event, and in a lifetime five times this limit.

(2) The licencee shall authorise in writing a planned special exposure only in an exceptional situation.

(3) The licencee shall inform the workers of the estimated radiation doses and potential occupational hazards during the planned operation.

(4) The worker shall be instructed by the Radiation Protection Officer about the measures to be taken to keep the doses and other risks as low as reasonably achievable.

(5) The licencee shall ensure that planned special exposures are not authorised for workers who have previously received abnormal exposures resulting in dose equivalents in excess of five times the relevant annual limit and workers who are women of reproductive capacity.

(6) The licencee shall inform the worker, the approved medical practitioner and to the Director, the dose equivalents or the committed dose equivalents resulting from planned special exposure.

(7) Planned special exposure for operations involving inhalation risk of radioactive substances, shall be avoided.

(8) Dose equivalents or the committed dose equivalents resulting from planned special exposure shall be recorded with those from normal exposures, but any excess over the limits prescribed in Schedule-III for radiation workers shall not in itself constitute a reason for removing the worker from his occupation.

34. **Secondary limits for radiation workers.**—(1) When the primary dose limits cannot be applied directly, secondary limits shall be dose equivalent indices for external radiation and annual limits on intake (ALI) for internal exposure.

(2) The secondary limits for occupational exposure shall be as specified in Schedule-V

35. **Derived limits for radiation workers.**—The derived limits shall be related to the primary limits by a defined model such that if the derived limits are observed the primary limits shall also be observed as specified in Schedule-VI.

36. **Primary dose equivalent limites for non-radiation workers.**—For non-radiation workers, the dose equivalent, effective dose equivalent and the committed effective dose equivalent limits shall be same as prescribed hereinafter for individual members of the public.

37. **Primary dose equivalent limits for members of the public.**—The limit for the annual effective dose equivalent for individual members of the public shall be 5 mSv per year, provided that the average annual dose equivalent over a life time shall not exceed the limit of 1 mSv per year. The annual dose equivalent limit for both the skin and the lens of the eye shall be 50 mSv.

38. **Authorised and operational limits.**—(1) For particular installations—

(a) the Directorate shall specify various authorised limits for various quantities relating to individuals, sources of radiation or the environment;

(b) such authorised limits shall take precedence over derived limits and shall be specified in the licence;

(c) the authorised limits shall be lower than the primary limits or derived limits.

(2) The licencee shall in consultation with the Radiation Protection Officer, ensure compliance with the authorised limits and lay down operational limits which shall be lower than the authorised limits.

39. **Reference levels.**—(1) Reference levels shall be as follows—

(a) recording level shall be for dose equivalents or effective dose equivalents or intake above which the information is of interest from a radiation protection point of view;

(b) investigation levels shall be for dose equivalents or effective dose equivalents or intakes above which, in the opinion of the Directorate, further investigations are justified;

(c) intervention levels shall be specified in advance for abnormal situations by licencee with the approval of the Director; and

(d) a reference level shall be established by the licencee, with the approval of the Director, for any quantity used in radiation protection where limit for the quantity does not exist.

(2) The level of three-tenths of the dose limits for individual workers aged 18 years and above shall be used as a reference level for administrative classification of conditions of work.

40. **Limitation of radiation exposures (abnormal conditions).**—Radiation emergency plan shall be prepared by the licencee with the approval of the Director which shall include—

(a) a description of the hierarchy of command for dealing with the emergency;

(b) an outline of the lines of communication within the facility and with appropriate national, international authorities and the public;

(c) an outline of the special monitoring needed to assess the situation;

(d) an indication of the various counter-measures available for minimizing exposures and an explanation of the effectiveness and consequences of these measures under different conditions;

(e) a general description of the manpower and material resources including sufficient funds necessary to effect such counter-measures;

(f) the description of intervention levels and derived intervention levels;

(g) provisions for demonstrating the efficiency of the planned counter measures;

(h) provisions for special monitoring and data collection following the accident; and

(i) any other provisions considered necessary by the Director.

41. **Actions to be taken following abnormal exposure.**—(1) Where individual workers are seriously exposed or contaminated as a result of abnormal situations, there shall be taken the following actions, namely—

(a) collecting dosimeters and information that will help in estimating doses and intakes;

(b) obtaining, as appropriate, excreta sample for bio-assay;

(c) initiating medical tests and making subsequent diagnosis;

(d) collecting information about the circumstances of the accident.

(2)(a) causes and consequences of doses or intakes to workers incurred during abnormal events shall be subject to investigations;

(b) an occupationally exposed worker incurring a dose or intake of radioactive material, exceeding twice the annual limit, shall be referred for appropriate medical examination by the approved medical practitioner;

(c) the administrative arrangements to be made following an accident shall include decision for any restriction on the future occupational exposure of those involved in the event. The worker shall still be allowed to continue routine work if there is no objection from the medical standpoint, due account having been taken of previous exposures, health, age, special skills as well as social and economic responsibilities;

(d) all emergency and accidental doses and emergency and accidental intakes shall be recorded together and clearly distinguished from normal exposure.

(3) In case an exposure in excess of the dose limits occurs, or is suspected to have occurred, an investigation shall be made of the circumstances in which the exposure took place, and the results shall be reported by the management to the Director.

42. **Abnormal exposure to members of the public and counter-measures.**—(1) Any accident involving the exposure of the population to abnormal levels of radiation shall be immediately reported by the management of the installation to the Director.

(2) The measures to mitigate the consequences of an accident shall be taken by the management in consultation with the Directorate.

43. **Physical surveillance of radiation workers.**—(1) The licencee shall

establish a system of physical surveillance to ensure compliance with the system of dose limitation.

(2) Records shall be maintained comprising the results of appropriate physical surveillance.

(3) All monitoring instruments shall be tested for satisfactory performance and calibrated at appropriate intervals.

(4) A physical surveillance programme shall include—

(a) correctly established and implemented radiation protection procedures;

(b) correctly performed analysis;

(c) correctly maintained records;

(d) limitation of errors;

(e) maintenance of the measurement accuracy; and

(f) properly trained personnel.

44. **Duties of the physical surveillance service.**—The physical surveillance service shall provide—

(a) facilities located within the site for the de-contamination of personnel, equipment and areas;

(b) all persons who carry out remedial actions, with individual dosimeters, suitable protective clothing and respiratory protective equipment as appropriate to the situation;

(c) sufficient quantities of various protective equipments, readily available to meet at least the minimum requirements foreseen in the emergency plan;

(d) high range radiation monitoring instruments including dose rate instruments with or without a warning signal, battery operated air samplers; and

(e) in selected areas, pre-installation of fixed monitoring instruments with high-level detection capabilities for rapid assessments of an emergency situation.

45. **Duties and functions of the Radiation Protection Officer.**—The Radiation Protection Officer shall—

(a) formulate the necessary radiation protection working procedures, in

respect of the safe handling of radioactive materials or radiation apparatus and practices leading to exposures to ionising radiation;

(b) establish a system of physical surveillance of radiation exposure and radioactive contamination through adequate procedures and practices;

(c) organise the radiation monitoring programme for routine, operational and special monitoring;

(d) impart necessary radiological safety training to workers under his charge;

(e) organise the safe transport, storage and disposal of all radioactive materials including waste containing radioactive materials;

(f) make arrangements for testing and calibrating all monitoring instruments;

(g) make arrangements for record keeping;

(h) ensure that the quality assurance of radiation monitoring programme is maintained; and

(i) carry out as appropriate the relevant tasks and duties as required in emergency situation.

46. **Medical surveillance of radiation workers.**—(1) The licencee shall provide medical surveillance of radiation workers by an approved Medical Practitioner.

(2) Medical surveillance of radiation workers exposed to radiation shall be based on the general principles of occupational health to ensure initial and continuing compatibility between the health of workers and the work.

(3) The medical surveillance for normal conditions of work shall also include health assessment after the termination of assignments.

(4) The medical surveillance for abnormal exposure conditions of work shall include special examinations when—

(a) the results of physical surveillance indicate that the individual has received radiation dose equivalents in excess of twice the prescribed dose limits or twice the relevant annual limits on intake;

(b) an individual is to return, following a radiation accident, to radiation work and any decision based on such special examination shall be communicated either to the person incharge of the installation or the Radiation Protection Officer.

(5) Workers shall have the right to examine their radiation exposure record and the results of medical examinations.

(6) The fitness of the worker for a particular radiation work assignment shall be evaluated by the Radiation Protection Officer.

(7) No worker shall be employed, or continue to be employed, as radiation worker contrary to qualified medical advice.

(8) In case of excessive over exposure, assignment of the radiation worker shall be changed to non-radiation work.

47. **Duties of the medical surveillance services.**—(1) The physician in-charge of the health service shall ensure that in case of radiation accident situations, adequate medical facilities and staff are available for the administration of first aid and for carrying out external de-contamination of the affected persons without any delay.

(2) The adequacy of such facilities shall be regularly reviewed by the management.

(3) The approved Medical Practitioner in collaboration with the licencee shall make necessary arrangements that in case of radiation injuries, affected persons are immediately admitted in suitable hospitals.

48. **Control of radiation exposure of workers.**—The licencee shall make arrangements for restricting occupational exposure through protection at the source of radiation, intrinsic safety features of the workplace and personal protective equipment.

49. **Surveillance for members of public.**—The licencee shall develop long term forecasts of the trends of various contributions to the total collective and individual dose equivalent from various sources of exposure and these forecasts shall be submitted to the Directorate.

50. **Individual-related radiation protection criteria.**—(1) For design and planning purposes, values above the dose equivalent limits shall be avoided but values below the limits shall also be reduced as far as possible.

(2) When several practices are likely to contribute significantly to the exposure of the same exposed population, either simultaneously or successively, the determination of the critical groups shall take account of these separate contributions.

(3) Dose limits applicable to the combined exposure from many practices, shall not be used as operational limits.

51. **Source-related radiation protection criteria.**—Source-related assessments aimed at the estimation of the total radiation detriment from a given source or practice. the methodology shall be determined in accordance with the guidelines issued by the Directorate from time to time.

52. **Control of exposures.**—(1) Control of exposure from a source or practice shall involve the examination and testing of protective arrangements.

(2) All releases of radioactive substances to the environment including the disposal of solid wastes shall be subject to authorisation and control by the Directorate unless specifically exempted.

(3) Direct external exposure from sources used for industrial, medical or scientific purposes shall be restricted.

53. **Monitoring and surveillance programmes.**—(1) Surveillance programme shall—

(a) ensure compliance with authorised limits;

(b) assess dose equivalents of members of the public from the sources under consideration;

(c) evaluate trends of exposure levels in the environment;

(d) monitor the source, environmental pathways and the critical group including the pre-operational studies.

(2) Records of the measurement of external exposure and radioactive contamination and the estimates of doses received by the population shall be properly maintained.

(3) All values of releases of radioactive material to the environment shall be recorded in conformity with the requirements of the Directorate.

54. **Exposure from medical practices.**—(1) Medical exposure shall be subject to the system of dose limitation in such a manner that the use of radiation for medical purposes be avoided unless justified and the protection be optimised so that irradiation of the patients is as low as reasonably achievable and consistent with the desired results.

(2) Dose limits as specified in Schedule-III shall apply to exposures of pesons as a result of research applications of ionizing radiation or radioactive substances when there is no direct benefit to the exposed individual and these limits shall not be applicable to the patients undergoing diagnostic or therapeutic procedures.

(3) Medical examinations involving exposure to ionizing radiation shall only be authorised if necessary information is not already available from previous examinations or by alternative techniques.

(4) The Medical Practitioner using radiation apparatus and radioactive material shall have the training in the field of radiation protection approved by the Director.

(5) Minimisation of exposure to any embryo or foetus shall be ensured by the Medical Practitioner whether the woman is known to be pregnant or not.

55. **Medical research on human beings.**—Any medical research involving human beings shall be in complete conformity with the guidelines issued by the Directorate.

56. **Periodic radiological examination.**—Periodic radiological examinations undertaken without reference to clinical indications in the individual case shall be subject to a justification assessment relative to the information likely to be obtained and the importance of this information for the individual's health.

57. **Examination for occupational purposes.**—Radiological examination carried out for occupational medical purposes shall be justified relative to the health of the individual and individual's fitness for the work.

58. **Storage of radioactive material.**—(1) The licencee shall provide adquate facilities for storage of any radioactive material within his possession in such a manner that—

(a) special containers and secure places approved by the Radiation Protection Officer are used;

(b) it is kept away from inflammable substances;

(c) no person is exposed to radiation resulting in doses in excess of the authorised limits; and

(d) in the event of any breakage or rupture of the container, its entire contents are retained in appropriately designed receptacle.

(2) Every container used for storage of any radioactive material shall have affixed to it in addition to the symbol of ionizing radiation, a label indicating—

(a) nature and activity of the contents;

(b) date of measurement of activity;

(c) name of the person incharge of container; and

(d) special safety instructions.

59. **Record Keeping of Radioactive Material.**—(1) Records of the radioactive materials as stored shall be kept by the licencee in a form and in a manner prescribed by the Directorate.

(2) The storage site shall be adequately protected to be inaccessible to unauthorised personnel.

60. **Radioactive waste disposal.**—(1) The licencee shall follow the guidelines to be issued by the Directorate for management and disposal of radioactive waste.

(2) The licencee shall take such measures to ensure that no authorised limits as laid down in these regulations or in the operating licence are exceeded.

61. **Authorisation for *radioactive* waste disposal.**—The Directorate shall examine and approve the methods proposed by the licencee for waste disposal.

62. **Transport of radioactive material.**—The transport of radioactive material shall be regulated by the guidelines issued by the Directorate.

63. **Additional Requirements.**—During the transport of radioactive materials any other hazardous characteristics of these materials such as explosiveness, inflammability, pyrophoricity, chemical toxicity and corrosiveness shall be taken into account in such a manner as to be in conformity with the regulations already in force for the transport of dangerous goods.

64. **Radiation protection in mining and milling of radioactive ores.**—The licencee shall carry out all activities related to the development, excavation, production, processing and handling of radioactive ores and other prescribed substances in accordance with—

(a) the guidelines issued by the Directorate: and

(b) instructions and supervision of a Radiation Protection Officer.

65. **Exemption from licensing.**—The sources and practices which might give exposures resulting in individual doses not exceeding $10\,\mu S_v$ per annum and a collective dose not exceeding 1 man-Sv shall be exempt from licensing.

66. **Frior approval.**—Unless authorized by the Director in writing, no person shall—

(a) administer radioactive substances to persons for purposes of diagnosis, treatment or research;

(b) use of radioactive substances in toys and import toys containing radioactive substances; and

(c) use screening apparatus for security purposes that involve exposure to X-rays.

67. **Quality factor (Q).**—The values of the quality factor (Q) for various types of radiation specified in Schedule-VII shall be used for calculating dose equivalent limits.

68. **Annual Limits on Intakes (ALIs) and Derived Air Concentrations (DACs) of radionuclides for occupational exposure.**—The values and methodology to be used in

calculating ALI's and DAC's shall be applicable in accordance with the guidelines to be issued by the Directorate.

69. **Weighting Factor (w_T).**—The values of the weighting factor (w_T) for various organs of the body and tissues, given in Schedule-VIII shall be used for calculating effective dose equivalents.

SCHEDULE-I

LICENSING AND RENEWAL FEES

No.	Facility	Licence Fee (Rupees)	Annual Renewal Fee (Rupees)
1.	Full-fledged medical centre which will include: a. Radiotherapy Centre where radiation apparatus such as Linear Accelerator, Betatron, Cobalt-60, Cesium-137, Deep X-ray therapy etc., are installed. b. Nuclear Medical Centre where diagnostic apparatus such as Gamma Camera, Linear Scanner, RIA equipments etc., are installed.	1,50,000	75,000
2.	Radiotherapy Centre or Nuclear Medical Centre or Nuclear Cardiology Centre.	1,00,000	50,000
3.	Laboratory used for Radio-Immunno-Assay (Tests), research, teaching etc.	20,000	10,000
4.	X-ray machine used for diagnosis in clinics, hospitals, nursing homes etc.	5,000	2,500
5.	Industrial Radiography units and other related facilities such as gas mantle manufacturers, oil well logging etc.	25,000	12,500
6.	Nuclear power plants:		
	a. Construction licence.	2,00,00,000	—
	b. Operating licence.	2,50,00,000	20,00,000
7.	Nuclear Research Reactors:		
	a. Construction licence.	7,00,000	—
	b. Operating licence.	11,00,000	1,00,000

8.	Nuclear fuel enrichment & fabrication facilities:		
	a. Construction licence.	80.00.000	
	b. Operating licence.	1.00.00.000	10.00.000
9.	Mining & Milling facilities.		
	Operating licence.	12.00.000	2.00.000
10.	Conversion facility.		
	Operating licence.	20.00.000	5.00.000
11.	Waste Repositories.		
	Operating licence.	60.00.000	2.00.000
12.	Entry into Pakistan and stay, of nuclear powered vehicle.	5.000	—
13.	Food irradiation facility or sterilization of medical products facility.	50.000	25.000
14.	Licence Amendment fee.	Half the amount of the renewal fee of that Licence.	

SCHEDULE-II

RADIONUCLIDE CONTAMINATION LEVELS IN FOOD ITEMS

Radionuclide	Target Organ	Dose Level (mSv)	Limits of radionuclide concentration level per Kg of Food (Bq Kg)
Limits applicable during the first year after a nuclear accident:			
Strontium-90	bone surface (infant)	50	70
Iodine-131	thyroid (infant)	50	400
Cesium-134	whole body (adult)	5	350
Cesium-137	whole body (adult)	5	500
Plutonium-239	bone surface (infant)	50	10

Limits applicable to the years subsequent to the first year of a nuclear accident:

Strontium-90	bone surface (infant)	10	20
Cesium-134	whole body (adult)	1	50
Cesium-137	whole body (adult)	1	100
Plutonium-239	bone surface (infant)	10	2

Exception:

Milk powder shall be treated as being diluted 7 times with water when made ready for use. therefore. the limits of concentration as given above shall be multiplied by a factor of seven (07).

Formula for additivity

This Schedule shall be applicable to any of the above single radionuclide present in the food. When two or more radionuclides are found to be present or are so declared at the time of export or import. the formula applicable in such cases shall be worked according to the following sum (S):

$$S = \frac{\text{Actual level of radionuclide A}}{\text{Limit for radionuclide A}} + \frac{\text{Actual level of radionuclide B}}{\text{Limit for radionuclide B}} + \ldots\ldots \text{etc.} \leqq 1$$

Illustration I

For example. within one year after a nuclear accident. radiometric analysis of one kilogram of certain food sample has shown presence of three radionuclides: (a) Cesium-137 (Cs-137). (b) Cesium-134 (Cs-134) and (c) Strontium-90 (Sr-90) with concentrations of 75 Bq. 25Bq and 10 Bq. respectively. The radionuclide limit shall be determined as given below: -

$$S = \frac{75}{500} + \frac{25}{350} + \frac{10}{70} = 0.364$$

As the calculation has shown that the sum (S) for the sample under reference is less than one, the concentration is therefore, within limits of Schedule-II.

Illustration II

In case of years subsequent to first year of the accident the sum (S) for a certain food sample having the same concentrations of radionuclides as above shall be determined as given below:—

$$S = \frac{75}{100} + \frac{25}{50} + \frac{10}{20} = 1.75$$

The calculation has shown that the sum (S) for the sample under reference is greater than one, and therefore, the food sample shall be considered unfit as it exceeds the limits given in this Schedule.

SCHEDULE-III

ANNUAL DOSE EQUIVALENT LIMITS FOR RADIATION WORKERS (AGED 18 YEARS AND ABOVE)

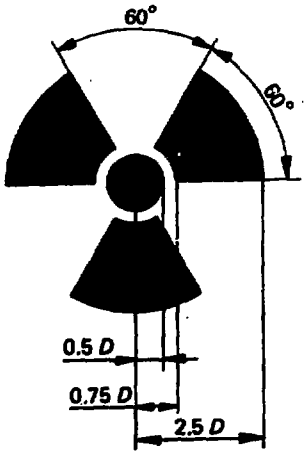
Organ or tissue	Dose quantity	Dose limits	
		(mSv)	(rem)
Whole body	Effective dose equivalent.	50	5
Partial body	Committed effective dose equivalent or effective dose equivalent from partial body exposure.	50	5
Individual organs and tissues except the lens of the eye or the skin.	Dose equivalent or committed dose equivalent.	500	50
The lens of the eye.	Dose equivalent or committed dose equivalent.	150	15
Skin averaged over an area of $100cm^2$*	Dose equivalent or committed dose equivalent.	500	50
Hands, face, arms, feet and ankles.	Dose equivalent.	500	50

*Averaging over an area of 100 cm^2 applies to doses from radioactive contamination, a smaller area shall be used for averaging in case exposure is to radiation beams.

SCHEDULE-IV

SYMBOL FOR IONIZING RADIATION

The basic symbol shown below indicates the potential or actual presence of ionizing radiation. Unless otherwise authorised by the appropriate management level after consultation with the radiation protection officer the symbol shall use colours, such as for example magenta or purple, for the black area with a yellow background.



SCHEDULE-V

SUMMATION OF SECONDARY LIMITS

Where limits are expressed in terms of effective dose equivalents, they shall apply to the sum of the effective dose equivalents resulting from external exposures during one year and the committed effective dose equivalents resulting from the intake of radionuclides during that year. The annual dose limit shall not be exceeded if both the following conditions are met:—

$$\frac{H_{I,s}}{500\ (mSv)} \leq 1$$

$$\frac{H_{I,d}}{50\ (mSv)} + \sum_{j} \frac{I_j}{I_{j,L}} \leq 1,$$

Where $H_{I,s}$ is the shallow dose-equivalent index, $H_{I,d}$ is the deep dose-equivalent index, I_j is the annual intake of radionuclide j, and $I_{j,L}$ is the annual limit on intake for radionuclide j.

SCHEDULE-VI

DERIVED LIMIT FOR AIR CONCENTRATION

The most important derived limit for occupational working conditions is the derived air concentration (DAC). Derived air concentration can be used as appropriate by the licencee as a value to demonstrate that exposure of workers to fractions of derived air concentration assures compliance with the dose limits provided that the following two conditions are satisfied.

$$\frac{H_{I,s}}{500\ (mSv)} \leq 1$$

$$\frac{H_{I,d}}{50\ (mSv)} + \sum_{j} \frac{AC_j \times t}{(DAC)_j \times 2000h} \leq 1.$$

$H_{I,s}$ = the individual shallow dose equivalent index:

$H_{I,d}$ = the individual deep dose equivalent index:

AC_j = average air concentration of radionuclide j over the duration of exposure during the year:

t = the duration of exposure during the year:

$(DAC)_j$ = the derived air concentration for radionuclide j.

SCHEDULE-VII

VALUES FOR QUALITY FACTOR (Q)

Type of Radiation	Q
X-rays, Gamma-rays, and electrons	1.0
Thermal neutrons	2.3
Other neutrons	20.0
Protons and single-charged particles	10.0
Alpha particles and multiple-charged particles	20.0

SCHEDULE-VIII

VALUES OF THE WEIGHTING FACTOR w_T

Tissue	w_T	Tissue	w_T
Gonads	0.25	Thyroid	0.03
Breast	0.15	Bone surfaces	0.03
Red bone marrow	0.12	Remainder	0.30
Lung	0.12		

A value of 0.06 for w_T is applicable to each of the five organs or tissues of the remainder receiving the highest dose equivalents, and the exposure of all other remaining tissues may be neglected. (The following parts of the GI-tract, stomach, small intestine, upper large intestine and lower large intestine are to be treated as four different organs). The dose equivalents in hands and forearms, feet and ankles, the skin and the lens of the eye are not considered in computing the effective dose equivalent. However, to assess the detriment from exposure of population groups, due to a small risk of fatal cancer resulting from exposure of the skin, a value of 0.01 for w_T is assigned.

MOHAMMAD AFZAL
Secretary, PAEC

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