NUCLEAR SAFETY AND RADIATION PROTECTION ACT
(1995 No. 19)

Nigerian Radiation Safety in Scanning Regulations, 2007

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DOSE LIMITS FOR OCCUPATIONAL AND PUBLIC EXPOSURE

S. I. of 2006

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(1995 No. 19)

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Commencement:

In exercise of the powers conferred on it by Section 47 of the Nuclear Safety and Radiation Protection Act 1995 and of all other powers enabling it in that behalf, THE NIGERIAN NUCLEAR REGULATORY AUTHORITY, with the approval of the President, hereby makes the following Regulations -

PART I - GENERAL

1. Interpretation

In these regulations, unless the context otherwise requires -

"absorbed dose" means the fundamental dosimetric quantity D, defined as:

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

where $d\varepsilon$ 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. The energy can be averaged over any defined volume, the average dose being equal to the total energy imparted in the volume divided by the mass in the volume. The SI unit of absorbed dose is the joule per kilogram ($J.kg^{-1}$), termed the gray (Gy);

"approved" means approved by Authority;

"authority" means the Nigerian Nuclear Regulatory Authority ;

"authorization" means the granting by Authority of written permission to perform specified activities;

"authorized" means Granted an authorization by Authority;

"dose constraint" means a prospective and source related restriction on the individual dose delivered by the source which serves as a bound in the optimization of protection and safety of the source for –

(a) occupational exposures, dose constraint is a source related value of individual dose used to limit the range of options considered in the process of optimization;

(b) public exposure, the dose constraint is an upper bound on the annual doses that members of the public should receive from the planned operation of any controlled source. The exposure to which the dose constraint applies is the annual dose to any critical group, summed over all exposure pathways, arising from the predicted operation of the controlled source. The dose constraint for each source is intended to ensure that the sum of doses to the critical group from all controlled sources remains within the dose limit;

(c) medical exposure the dose constraint levels should be interpreted as guidance levels, except when used in optimizing the protection of persons exposed for medical research purposes or of persons, other than workers, who assist in the care, support or comfort of exposed patients;

"effective dose" means the quantity E, defined as a summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_T w_T H_T$$

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:

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

where w_R is the radiation weighting factor for radiation R and $D_{T,R}$ the average absorbed dose in the organ or tissue T. The unit of effective dose is $J.kg^{-1}$, special name sievert (Sv);

"employer" means A legal person with recognized responsibility, commitment and duties towards a worker in his or her employment by virtue of a mutually agreed relationship. (A self-employed person is regarded as being both an employer and a worker.);

"excluded" means outside the scope of Nigeria Basic Ionizing Radiation Regulations;

"**external surface**" means the outside surface of the cabinet X-ray system, including the high voltage generator, doors, access panels, handles, control knobs and other permanently mounted hardware and including the plane across any aperture or port.

"health surveillance" means medical supervision intended to ensure the initial and continuous fitness of workers for their intended task;

"legal person" means any organization, corporation, partnership, firm, association, trust, estate, public or private institution, group, political or administrative entity or other persons designated in accordance with national legislation, who or which has responsibility and authority for any action having implications on protection and safety;

"licence" means a legal document issued by the Authority granting authorization to perform specified activities related to a facility or activity;

"licensee" means the holder of a current licence;

"member of the public" means in a general sense, any individual in the population except, for the purposes of Nigerian Basic Ionizing Radiation Regulations, when subject to occupational or medical exposure. For the purpose of verifying compliance with the annual dose limit for public exposure, the representative individual in the relevant critical group;

"normal exposure" means an exposure which is expected to occur under normal operating conditions of a facility or activity, including possible minor mishaps that can be kept under control, i.e. during normal operation and anticipated operation occurrences;

"notification" means a document submitted to Authority by a legal person to notify an intention to carry out a practice or other use of a source;

"occupational exposure" means all exposures of workers incurred in the course of their work with the exception of exposures excluded from Nigerian Basic Ionizing Radiation Regulations and exposures from practices or sources exempted by Nigerian Basic Ionizing Radiation Regulations;

"potential exposure" means exposure that is not expected to be delivered with certainty but that may result from an accident at a source or owing to an event or sequence of events of a probabilistic nature, including equipment failures and operating errors;

"**port**" means any opening in the outside surface of the cabinet which is designed to remain open during generation of X-rays for the purposes of conveying materials to be irradiated into and out of the cabinet.

"practice" means any human activity that introduces additional sources of exposure or exposure pathways, or extends exposure to additional people, or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed;

"protection and safety" means the protection of people against exposure to ionizing radiation or radioactive materials and the safety of radiation sources, including the means for achieving this, and the means for preventing accidents and for mitigating the consequences of accidents should they occur;

"protective action" means an intervention intended to avoid or reduce doses to members of the public in chronic or emergency exposure situations;

"**public exposure**" means exposure incurred by members of the public from radiation sources, excluding any occupational or medical exposure and the normal local natural

background radiation but including exposure from authorized sources and practices and from intervention situations;

"**radiation safety officer**" means an individual technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of the requirements of the Nigeria Basic Ionizing Radiation Regulations;

"registrant" means an applicant who is granted registration of a practice or source and has recognized rights and duties for such a practice or source, particularly in relation to protection and safety;

"**registration**" means a form of authorization for practices of low or moderate risks whereby the legal person responsible for the practice has, as appropriate, prepared and submitted a safety assessment of the facilities and equipment to the regulatory body. The practice or use is authorized with conditions or limitations as appropriate. The requirements for safety assessment and the conditions or limitations applied to the practice should be less severe than those for licensing**;**

"risk" means a multi attribute quantity expressing hazard, danger or chance of harmful or injurious consequences associated with actual or potential exposures. It relates to quantities such as the probability that specific deleterious consequences may arise and the magnitude and character of such consequences;

"safety assessment" means a review of the aspects of design and operation of a source which are relevant to the protection of persons or the safety of the source, including the analysis of the provisions for safety and protection established in the design and operation of the source and the analysis of risks associated with normal conditions and accident situations;

"safety culture" means the assembly of characteristics and attitudes in organizations and individuals, which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance;

"source" means anything that may cause radiation exposure, such as by emitting ionizing radiation or releasing radioactive substances or materials. For example, materials emitting radon are sources in the environment, a sterilization gamma irradiation unit is a source for the practice of radiation preservation of food, an X-ray unit may be a source for the practice of radiodiagnosis, and a nuclear power plant is a source for the practice of generating electricity by nuclear power. A complex or multiple installations situated at one location or site may as appropriate be considered a single source for the purposes of application of Nigerian Basic Ionizing Radiation Regulations;

"standards dosimetry laboratory" means a laboratory designated by the relevant national authority for the purpose of developing, maintaining or improving primary or secondary standards for radiation dosimetry;

"supplier" means any legal person to whom a registrant or Licensee delegates duties, totally or partially, in relation to the design, manufacture, production or construction of a source. (An importer of a source is considered a supplier of the source.);

"worker" means any person who works, whether full-time, part-time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection. (a self-employed person is regarded as having the duties of both an employer and a worker).

2. Objective

The objective of these regulations is to assist licensees in meeting radiation protection requirements in scanning practice for the attainment of adequate radiation protection and safety of workers and the public.

3. Scope

These regulations are applicable to all established uses of ionizing radiation sources employed in the practice of Scanning, to the facilities where the ionizing radiation sources are located and to the individuals involved. The regulations cover occupational, public, potential and emergency exposure situations.

PART II - PRINCIPAL REQUIREMENTS

Administrative Requirements

4. Authorization of practices

(1) Any legal person who intends to utilize radiation sources in scanning (container and baggage scanning) shall notify his intention to the Authority and shall apply for authorization in the form of a licence.

(2) The person applying for an authorization shall refrain from carrying out any of the actions of the practice until licence has been granted to him.

(3) The person shall include in the application for authorization:

(a) the qualifications in radiation protection of the operators who are to be so designated by name in the licence; or

(b) a statement that only operators with the qualifications in radiation protection specified in these regulations or to be specified in the licence will be permitted to scan by means of the authorized radiation source.

(4) The licensee shall comply with radiation safety requirements for the following stages of the scanning practice:

(a) design and construction;

(b) siting;

(c) operation (acceptance, commissioning, operation, maintenance);

(d) modifications; and

(e) decommissioning (partial or total) and return or disposal of radiation emitting equipment.

(5) Modification with possible implications for radiation safety, of the scanning and of procedures, or cessation of the practice, shall require an amendment to the licence.

(6) Application for authorization shall be made on the form issued by the Authority.

5. Renewal of authorization

The authorization shall be renewed periodically as may be determined by the Authority.

6. Non-compliance and suspension or withdrawal of authorization

(1) In the event of a breach of any licence condition, the licensee shall, as appropriate:

(a) investigate the breach and its causes, circumstances and consequences;

(b) take appropriate action to remedy the circumstances that led to the breach and to prevent a recurrence of similar breaches;

(c) communicate to the Authority, and to any other relevant organizations when applicable, on the cause of the breach and on the corrective or preventive actions taken or to be taken; and

(d) take whatever other actions are necessary as required by the Authority.

(2) Failure to take corrective or preventive actions within a reasonable time shall be a ground for modifying, suspending or withdrawing any authorization that had been granted by the Authority.

(3) The Authority will suspend or revoke an authorization when a licensee is in serious breach of the conditions of the licence, Nigeria Basic Ionizing Radiation Regulations or specific requirements of these regulations. In order to be able to resume operation, the licensee shall reapply for authorization in the case of revocation, or apply for reconsideration in case of suspension (Section 32 of the Act)

7. Personnel accreditation

(1) All personnel on whom protection and safety depend shall be appropriately trained and qualified to be able to understand their responsibilities and perform their duties with appropriate judgement according to laid down procedures.

(2) Individuals with key positions, that is, responsibilities for protection and safety and those who could substantially affect protection and safety by virtue of tasks involving manipulation of sources or operation of equipment shall have certificate(s) of education and training in radiation protection. These individuals are:

(a) professionals operating scanners;

(b) radiation safety officer; and

(c) staff performing special tasks (e.g. type testing of equipment, quality control tests).

(3) To obtain personal accreditation, the staff listed in these regulations shall meet the following requirements as applicable:

(a) university degree or academic qualification relevant to the profession, issued by universities, colleges of health technology, polytechnics and colleges of technology and other accredited federal institutions;

(b) accreditation to exercise the profession granted by the relevant competent authorities or other professional or academic bodies recognized by the Authority;

(c) attendance and passing of required examinations on a course on radiation protection for which the contents, the methodology and the teaching institution are accredited by the Authority or by other professional bodies recognized by the Authority. This course may be integrated in the curricula of the professional education under (a) and (b), and;

(d) on-the-job training supervised by professionals with accreditation by the Authority or other appropriate authorities.

(4) Equipment servicing personnel shall have documentary evidence for the individual to perform maintenance of scanners. This documentary evidence shall consist of the following:

(a) certification, ideally by the manufacturer, of having completed a training programme on the type of authorized equipment;

(b) course on radiation protection for which the contents, the methodology and the teaching institution are approved by the Authority.

8. Authorization of other practices related to scanning

Since the activities listed below also require authorization:

(a) import, distribution, sale, commissioning, decommissioning or transfer of X-ray systems;

(b) personal monitoring;

(c) installation and maintenance of scanners,

a licensee of scanning practice shall contract any of these services only to enterprises authorized by the Authority.

9. Inspection

A licensee shall permit the Authority to inspect his facilities and records as required by Section 37 of the Act.

10. Radiation protection requirements

The radiation protection requirements on justification of the practice, dose limitation and optimization of protection and dose constraints as provided in Section 25 of the Act and Regulation of Nigeria Basic Ionizing Radiation Regulations shall be applied to radiology. The dose limits for occupational and public exposure are reproduced in Schedule I.

Managerial Requirements

11. Managerial commitment and policy statement

(1) A safety culture shall be fostered and maintained to encourage a questioning and learning attitude to protection and safety and to discourage complacency. To comply with this requirement, the employer shall be committed to an effective protection and safety policy, particularly at management level and by clear demonstrable support for those persons with direct responsibility for radiation protection.

(2) This commitment shall be expressed in a written policy statement that clearly assigns prime importance to protection and safety in the radiology services, while recognizing that the prime objective is the medical care of the patients. Appropriate resources shall be made available to support this commitment. This action shall be followed by establishing a radiation safety and quality assurance programmes by fostering a safety culture within the organization.

12. Organization and responsibilities

(1) The principal parties having the main responsibilities for the application of the Nigeria Basic Ionizing Radiation Regulations and these regulations shall be licensees and employers.

(2) Other parties shall have subsidiary responsibilities. These parties include, as appropriate, suppliers, workers, radiation protection officers, qualified experts, ethical review committees and any other party to whom a principal party has delegated specific responsibilities.

(3) A licensee shall establish a Radiation Safety Programme and shall provide the necessary resources to comply with the programme. This programme shall relate to all phases of the practice, from design through operation to decommissioning.

(4) The radiation safety and quality assurance programmes shall reflect the management responsibility for radiation protection and safety through the adoption of management structures, policies, procedures and organizational arrangement that are commensurate with the nature and extent of the risks.

(5) A licensee shall assign clear responsibilities to personnel to ensure adequate radiation protection of workers, and the public.

(6) The need for qualified experts shall be determined by their responsibilities and suitable persons appointed on a full-time or part-time basis as required.

(7) A licensee shall appoint a Radiation Safety Officer who shall have sufficient authority and management standing to communicate with and direct personnel regarding regulations and licence provisions.

(8) The licensee shall ensure that, for baggage and container scanning, the imaging and Quality Assurance (including quality control) and optimization of protection shall be carried out with the advice of a qualified expert, as appropriate.

(9) A radiation safety committee shall be formed according to the size of institution and complexity of procedures.

(10) The Radiation Safety Committee shall –

(a) review and audit the entire Radiation Safety Programme systematically to determine whether the activities are conducted in a safe manner and in accordance with the regulations and terms of the authorization; and

(b) meet regularly.

13. Quality assurance

(1) A licensee shall establish a comprehensive quality assurance programme for radiation protection, safety and image quality to ensure that all necessary procedures are developed and implemented to comply with the regulations for radiation protection within the terms and conditions of the authorization(s) of the facility.

(2) The programme shall cover the entire process from the initial decision to adopt a particular procedure through the interpretation and recording of results and shall include ongoing auditing, both internal and external, as a systematic control methodology.

(3) Quality assurance shall cover, as a minimum:

(a) selection of the correct procedure for scanning;

(b) optimization of examination protocol;

(c) record keeping and report writing;

(d) acceptance and commissioning;

(e) quality control of equipment and software;

(f) training and continuing education of staff;

(g) audit; and

(h) general outcome of scanning service.

14. Human factors

A licensee shall make provision for reducing as far as practicable the contribution of human error to accidents and other events that could give rise to exposures.

15. Staffing

(1) A licensee shall appoint a number of professionals, each possessing a recognized form of accreditation, sufficient to ensure that all activities relevant to Quality Assurance, radiation protection and safety are undertaken in accordance with these regulations and Nigeria Basic Ionizing Radiation Regulations.

(2) Human resource requirements shall be reviewed as workload increases or as new techniques and new equipment are incorporated into the facility.

16. Education and training

(1) All staff working with X-ray systems in scanning practice, as specified in these regulations shall have appropriate academic qualifications and relevant practical training

(2) A licensee shall ensure that his staff are aware of:

(a) the conditions of the licence;

(b) use and operation of the equipment;

(c) instructions that should be provided to clients;

(d) institutional radiation protection policies and procedures (including emergency practice drills);

(e) the local Quality Assurance programme and Quality Control procedures;

(f) results of review and analysis of incidents and accidents that have occurred in the institution or elsewhere.

(3) This training shall be completed before commencement of duties.

(4) The training of personnel shall be required whenever significant changes occur in duties, regulations, and the terms of the licence or radiation safety procedures.

(5) The training shall be updated as required.

(6) A licensee shall establish a policy that encourages and provides continuing education and a programme of professional development.

(7) A licensee shall prepare and keep records of the initial and periodic instruction of personnel. These records should be kept for at least five years after the expiration of the corresponding authorization.

PART III - SAFETY OF SOURCES, EQUIPMENT AND FACILITIES

17. Defence-in-depth

A multilayer (defence in depth) system of provisions for protection and 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 accidents that may cause exposure;

(b) mitigating the consequences of any such accident that does occur; and

(c) restoring sources to safe conditions after any such accident.

18. Design

(1) Scanners used in screening of baggage and containers shall be so designed that:

(a) failure of a single component of the system be promptly detectable so that any unplanned exposure of patients or staff be minimized; and

(b) the incidence of human error in the delivery of unplanned screenig be minimized.

(2) A licensee shall:

(a) take into account information provided by suppliers, identify possible equipment failures and human errors that could result in unplanned exposures;

(b) take all reasonable measures to prevent failures and errors, including the selection of suitably qualified personnel, the establishment of adequate procedures for the calibration, Quality Assurance and operation of equipment, and the provision of appropriate training and periodic retraining to personnel in the procedures, including protection and safety aspects;

(c) take all reasonable measures to minimize the consequences of failures and errors that may occur; and

(d) develop appropriate emergency plans for responding to events that may occur, display plans prominently, and periodically conduct practice drills.

19. X-ray systems (tube, generator and ancillary equipment)

(1) A licensee shall only use x-ray equipment in which:

(a) radiation generators and their accessories are designed and manufactured so as to facilitate the keeping of medical exposures as low as reasonably achievable in consistence with obtaining adequate diagnostic information;

(b) operational parameters for radiation generators, such as generating tube potential, filtration, focal spot position, source-image receptor distance, field size indication and either tube current and time or their product, are clearly and accurately indicated;

(c) scanners are provided with devices that automatically terminate the irradiation after a preset time, tube current-time product or dose (automatic exposure control); and

(2) X-ray systems and accessories shall only be purchased from authorised suppliers and be certified in conformity with the standard of International Electrotechnical Commission or its Nigerian equivalent; Standard Organization of Nigeria.

(3) Compliance with International Electrotechnical Commission or its Nigerian equivalent Standard Organization of Nigeria shall be demonstrated and supported by written evidence.

(4) Compliance shall be confirmed for the particular piece of equipment delivered, by including the relevant tests of the International Electrotechnical Commission standards in the acceptance protocol.

(5) The set of tests to be included in the protocol shall be specified in the purchasing conditions.

(6) A licensee shall ensure that operator's manual(s) are made available in English Language which is widely understood by users.

(8) X-ray systems shall be purpose built for the intended imaging tasks. The X-ray systems shall indicate at the control panel all the important technical parameters relevant to image quality.

(9) Additional information about the selection of an automatic exposure device as well as the sensor area selected to terminate the exposure shall be available to the operator at the console.

(10) The X-ray systems shall always have a collimator to restrict the radiation field size to the area of interest and this shall be in the form of adjustable diaphragms or for specific examinations in the form of fixed collimator.

(11) For scanning equipment there shall be a light beam to indicate the position and extent of the radiation beam, visible during normal lighting conditions.

(12) Manual collimation shall be possible in addition to automatic collimation

(13) The licensee shall ensure that Quality Control tools are available in the facility where they are installed.

(20) Written procedures shall be developed as part of the quality assurance programme for purchasing, installation, acceptance, commissioning, use, maintenance and quality control.

20. Facilities design

(1) **Radiation shields**

(a) Except within ports where flexible shields may be used, radiation shields installed to achieve compliance with the external radiation limits specified in NiBIRR shall be fixed and shall be made of lead affixed to material having greater resistance to distortion than lead (e.g. steel or plywood), or of dense materials not readily distorted, such as steel, brass or lead filled rigid plastic or glass.

(b) Reduction of radiation emitted through a port to the level permitted may be achieved by the use of baffles, multiple curtains of durable flexible shielding material, tunnels providing distance protection or other equivalent methods. Where curtains of flexible shielding material are used the presence of an item to be examined displacing any such curtain shall not permit the emission limit to be exceeded.

(2) **External radiation**

(1) The radiation level at any accessible point 5 centimetres from the external surface of the cabinet shall not exceed 5 microgray in one hour when averaged over an area of 100 square centimetres.

(2) Measurements for compliance with this section shall be made with an object in the beam typical of those to be examined and any flexible or moveable screen displaced as would reasonably occur during the operation of the equipment.

(3) Where pulsed X-ray systems are used, compliance with the above requirement shall be determined with the X-ray tube operated at its maximum rating at the maximum kilovoltage to which it can be set by the control for that tube in the busing in which it is installed.

(3) Safety interlocks

A device intended to prevent exposure of any part of the human body to the primary X-ray beam by preventing production of X-rays while any door or access panel leading to the

interior of the cabinet is open shall be provided. Failure of any component of the equipment shall not cause the failure of more than one safety interlock.

(4) Access

(a) Where a door is provided for insertion of items to be examined or tested it shall have a minimum of two safety interlocks, one but not both of which shall be arranged to disconnect the supply of the high voltage transformer when the door is opened.

(b) Where entry ports are provided for insertion of items or materials to be examined or tested the equipment shall be so constructed that:

(1) insertion of any part of the human body into the primary beam is not possible; or

(2) in the case of a conveyor system used to convey the items to be examined into the primary beam, insertion of any part of the human body into the primary beam shall not be readily achieved, and the dose rate shall be so limited that, 20 centimetres above the conveyor, an object shall not receive a dose in excess of 10 microgray in a single pass through the beam when the conveyor is moving at the slowest rate at which it can be operated in normal conditions. When the conveyor is stationary the equipment shall not produce X-rays except by manual control.

(3) Panels provided for maintenance purposes which could permit access to the primary beam shall be so secured that tools or keys are required to open them. Where access is by means of a key the panel shall be provided with at least one safety interlock. Where tools are required for access these shall not be common hand tools, and each panel should be provided with at least one interlock. Any panel which allows access to the X-ray tube and is not protected by an interlock shall be provided with a label warning of the presence of the X-ray tube within.

(5) Controls

(a) Controls referred to in this section are those which initiate and terminate the generation of X-rays other than by functioning of a safety interlock or mains power control.

(b) There shall be a key operated control so connected that X-rays cannot be produced when the key is removed.

(c) There shall be a separate switch for the control of the X-ray beam. This may provide for manual control, in which case the switch shall be of the ‘dead man’ type. Alternatively, the X-ray beam ‘on’ and ‘off’ may be activated by automatic devices (e.g. where the items to be examined may trigger the production of X-rays when the items are transported on a conveyor belt).

(7) Ground fault

An accidental earthing of an electrical conductor shall not result in the production of X-rays.

(8) X-ray indicator lights

(a) The production of X-rays shall be indicated by two independently operated lights that are clearly discernible from each point at which production of X-rays may be initiated. One of these lights shall be so connected that it indicates when voltage is applied to the primary

windings of the X-ray tube high tension transformer. Failure of any single component shall not result in the failure of both indicator lights to operate. These indicator lights shall be labelled 'X-RAYS ON'.

(b) If the period of exposure is intended to be less than one second, all X-ray indicator lights shall be activated for at least one second for each exposure.

(9) Warning sign

(a) A clearly visible sign bearing an ionizing radiation warning symbol (trefoil) and the word 'CAUTION' shall be fixed to the equipment adjacent to the controls. In addition, the following words should be included on the sign: X-RAY APPARATUS

(b) This unit produces radiation when energized. The lettering and symbol shall be in black on a yellow background. The Authority shall be consulted with respect to this requirement.

(10) Equipment for examination of carry-on baggage

The following requirement shall be met by equipment designed primarily for the inspection of carry-on baggage at airline, shipping, bus terminals etc

(a) The equipment shall be so arranged that the operator who initiates the X-ray exposure must be in a position where he can readily observe all ports and doors during generation of X-rays.

(b) In the case of equipment in which the X-ray beam is activated by an automatic device, this requirement will be met by the primary viewing position for the X-ray image permitting all ports and doors to be readily observed during generation of X-rays.

(11). Equipment which allows the admission of human beings to the interior

All the following additional requirements shall be met by equipment which allows the admission of human beings to the interior for purposes associated with the operation of the equipment (e.g. equipment used for the examination of LARGE items of freight):

(a) There shall be a control within the cabinet which can be used to terminate or prevent the production of X-rays. This control shall not be overridden from the outside of the cabinet.

(b) There shall be no other means by which X-ray generation can be controlled from within the cabinet.

(c) There shall be audible and visible signals within the cabinet activated for at least ten seconds prior to the production of X-rays. Failure of any single component of the cabinet X-ray system shall not cause failure of both audible and visible signals.

(d) There shall be a further visible warning signal within the cabinet which shall be activated when X-rays are produced. If the period of exposure is intended to be less than one second, this warning signal shall be activated for a least one second for each exposure.

(e) There shall be clearly visible, legible signs describing the meaning of the warning signals required in this statement. These signs shall be adequately illuminated when the main power control is in the 'on' position.

13. Instructions

Manufacturers and suppliers of X-ray equipment subject to this statement shall provide the purchaser with adequate written instructions on the operation of the equipment and on radiation safety procedures.

21. Maintenance

(1) The licensee shall ensure that adequate maintenance (preventive and corrective) and inspection are performed as necessary to ensure that X-ray systems retain their design specification for image quality, radiation protection and safety for their useful lives.

(2) The licensee shall therefore establish the necessary arrangements and co-ordination with the manufacturer's representative or installer before purchase and initial operation.

(3) All maintenance procedures shall be included in the Quality Assurance Programme at a frequency recommended by the manufacturer of the equipment and the relevant professional body and servicing shall include a report describing the findings, which shall be archived as part of the Quality Assurance Programme.

22. Electrical and mechanical safety

(1) The electrical and mechanical safety aspects of the X-ray systems are an important part of the maintenance programme, and can have direct or indirect effects on radiation safety.

(2) This work shall be performed by authorized persons who are aware of the specification of the X-ray systems.

(3) Electrical and mechanical maintenance shall be included in the quality assurance programme at a frequency recommended by the manufacturer of the X-ray system and servicing shall include a written report describing the findings. These reports shall be archived as part of the Quality Assurance Programme.

23. Acceptance

(1) After the equipment has been installed, acceptance testing shall be conducted in order to verify that the equipment conforms with technical specifications given by the manufacturer and to verify compliance with the standard safety requirements of International Electrotechnical Commission or its Nigerian equivalent; Standard Organization of Nigeria.

(2) The tests to be included in the acceptance protocol shall be specified in the purchasing conditions and contracts shall clearly establish responsibility of suppliers for resolving non-conformity identified during acceptance testing.

24. Commissioning

After acceptance and before starting operation, commissioning shall be performed. During commissioning, the qualified expert in radiological physics shall measure all data required for clinical use.

PART IV - OCCUPATIONAL EXPOSURE

25. Classification of areas

(1) In a scanning facility, all areas in the facility where mobile X-ray units are used shall be controlled areas. All other areas outside scanning shall be designated as supervised areas.

(2) Each room of the facility shall be used for its specified work.

26. Local rules and supervision

(1) Employers and licensees shall**,** in consultation with workers, through their representatives, if appropriate:

(a) establish written local rules and procedures necessary to ensure adequate levels of protection and safety for workers and other persons;

(b) include in the local rules and procedures the values of any relevant investigation level or authorized level, and the procedure to be followed in the event that any such value is exceeded;

(c) make the local rules and procedures, the protective measures and safety provisions known to those workers to whom they apply and to other persons who may be affected by them; and

(d) ensure that any work involving occupational exposure are adequately supervised and take all reasonable steps to ensure that the rules, procedures, protective measures and safety provisions be observed.

(2) These local rules shall include: procedures for wearing, handling, and storing personal dosimeters; actions to minimize radiation exposure during unusual events.

27. Protective equipment and tools

(1) A licensee shall ensure that workers are provided with suitable and adequate personal protective equipment, which meets any relevant regulations or standards; protective equipment includes lead aprons, thyroid protectors, protective eye-wear and gloves.

(2) The need for these protective devices shall be established by the Radiation Safety Officer.

(a)

28. Individual monitoring and exposure assessment

(1) Individual dose monitoring shall be undertaken for workers who are normally exposed to radiation in controlled areas.

(2) Individual dose monitoring shall be undertaken for workers who are normally exposed to radiation in controlled areas, as indicated in these regulations.

(4) Individual external doses shall be determined by using individual monitoring devices approved by the Authority, such as thermoluminescent dosimeters, film badges or other devices. Each monitor shall be used only by the person to whom it is issued.

(5) The monitoring device shall be worn on the front of the upper torso of the body, between the shoulders and the waist.

(6) The monitoring period shall be for one month, and shall not exceed three months.

(7) The exchange of dosimeters and receipt of the dose reports shall be within an interval of 3 months.

(8) If an individual's dosimeter is lost, the Radiation Safety Officer shall perform a dose assessment and record this evaluation of the dose and add it to the worker's dose record.

(9) Individual monitoring devices shall be calibrated and this calibration shall be traceable to a standards dosimetry laboratory.

29. Pregnant worker

(1) A female worker shall, on becoming aware that she is pregnant, notify the employer and licensee in order that her working conditions may be modified if necessary.

(2) The notification of pregnancy shall not be considered a reason to exclude a female worker from work; however, the employer of a female worker who has notified pregnancy shall adapt the working conditions in respect of occupational exposure so as to ensure that the embryo or foetus is afforded the same broad level of protection as required for members of the public

30. Monitoring the workplace

(1) A licensee shall develop programmes for monitoring of the workplace.

(2) All survey meters used for workplace monitoring shall be calibrated and this calibration shall be traceable to a standards dosimetry laboratory.

(3) Initial monitoring shall be conducted immediately after new radiology equipment has been installed and shall include measurements of radiation leakage from equipment, and area monitoring of useable space around radiology rooms.

(4) Annual area surveys shall be performed

(5) All radiation monitors shall be calibrated, and their warning devices and operability shall be checked prior to each day of use.

31. Investigation levels

(1) Employers and licensees shall, in consultation with workers or through their representatives, include in the local rules and procedures the values of any relevant investigation level or authorized level, and the procedure to be followed in the event of any such value being exceeded.

(2) A licensee shall conduct formal investigations, as required by the Authority whenever:

(a) an individual effective dose exceeds investigation levels;

(b) any of the operational parameters related to protection or safety are out of the normal range established for operational conditions;

(c) any equipment failure, severe accident or error takes place, which causes, or has the potential to cause, a dose in excess of annual dose limits; and

(d) any other event or unusual circumstance that causes, or has the potential to cause a dose in excess of the annual dose limits or the operational restrictions imposed on the installation (e.g., the significant change in workload or operating conditions of radiology equipment).

(3) The investigation shall be initiated as soon as possible following discovery of the event, and a written report shall be prepared concerning its cause, including determination or verification of any doses received, corrective actions, and instructions or recommendations to avoid recurrence.

(4) The report shall be submitted to the Authority and other concerned bodies as required, as soon as possible after the investigation.

32. Health surveillance

(1) A licensee shall make arrangements to provide health surveillance to workers as specified by Nigeria Basic Ionizing Radiation Regulations.

(2) The primary purpose of health surveillance is to assess the initial and continuing fitness of employees for their intended tasks.

(3) Counselling shall be provided for women who are or may be pregnant.

33. Records

(1) A licensee shall maintain exposure and medical surveillance records for each worker and the records shall be kept according to the requirements of the Authority.

(2) Employers and licensees shall provide access for workers to information on their own exposure records; and give due care and attention to the maintenance of appropriate confidentiality of records.

SCHEDULE

DOSE LIMITS FOR OCCUPATIONAL AND PUBLIC EXPOSURE

Occupational Exposure

Dose limits

(1) The occupational exposure of any worker shall be so controlled that the following limits be not exceeded an:

(a) effective dose of 20 mSv per year averaged over five consecutive years;

(b) effective dose of 50 mSv in any single year;

(c) equivalent dose to the lens of the eye of 150 mSv in a year; and

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

(2) 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 be not exceeded an:

(a) effective dose of 6 mSv in a year;

(b) equivalent dose to the lens of the eye of 50 mSv in a year; and

(c) equivalent dose to the extremities or the skin of 150 mSv in a year.

Special circumstances

(3) When, in special circumstances, a temporary change in the dose limitation requirements is approved pursuant to Nigeria Basic Ionizing Radiation Regulations:

(a) the dose averaging period mentioned in Para. 1.(1)(a) may exceptionally be up to 10 consecutive years as specified by the Authority, and the effective dose for any worker shall not exceed 20 mSv per year averaged over this period and shall not exceed 50 mSv in any single year, and the circumstances shall be reviewed when the dose accumulated by any worker since the start of the extended averaging period reaches 100 mSv; or

(b) the temporary change in the dose limitation shall be as specified by the Regulatory Authority but shall not exceed 50 mSv in any year and the period of the temporary change shall not exceed 5 years.

Public exposure

Dose limits

(4) The estimated average doses to the relevant critical groups of members of the public that are attributable to practices shall not exceed the following limits:

(a) an effective dose of 1 mSv in a year;

(b) in special circumstances, an effective dose of up to 5 mSv in a single year provided that the average dose over five consecutive years does not exceed 1 mSv per year;

(c) an equivalent dose to the lens of the eye of 15 mSv in a year; and

(d) an equivalent dose to the skin of 50 mSv in a year.

MADE at Abuja this day of 2007

PROFESSOR SHAMSIDEEN BABATUNDE ELEGBA
Director-General/Chief Executive Officer
Nigerian Nuclear Regulatory Authority

EXPLANATORY NOTE

(This note does not form part of the regulations, but it is intended to explain its purport)

1. This set of regulations is a practice-specific elaboration of the Nigeria Basic Ionizing Radiation Regulations, which is derived from, but not a substitute to, the International Basic Safety Standards for Protection against Ionizing Radiation Sources and published as International Atomic Energy Agency Safety Series No. 115 in 1996.

2. The Regulations provide, among other things, for the protection of workers and the public from the harmful effects of exposure to ionizing radiation.