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

**NIGERIAN RADIATION SAFETY IN NUCLEAR WELL
LOGGING REGULATIONS**



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S. I. 20 of 2008

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

**NIGERIAN RADIATION SAFETY IN NUCLEAR WELL
LOGGING REGULATIONS**

[12th November, 2008]

Commence-
ment.

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. In these Regulations—

Interpretation.

“*Abandonment*” means any act of permanent burial of a sealed source(s) in a well logging hole considered irretrievable after reasonable efforts at recovery have been expended. It also means preventive measures against inadvertent intrusion on the source ;

“*absorbed dose*” means the quotient $\frac{dE}{dm}$ (in Gy) where dE 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 ;

“*activity*” means the quotient $\frac{dN}{dt}$ (in Bq or Ci) where dN is the expectation value of the number of spontaneous nuclear transformations from the given energy state in the time interval dt ;

“*applicant*” means any legal person who applies to the Nigerian Nuclear Regulatory Authority for authorization to undertake any of the actions covered by the scope of the Regulations ;

“*approved*” means approval by the Authority ;

“*Authority*” means the Nigerian Nuclear Regulatory Authority established under Section 1 of Act 19 of 1995 ;

“*authorization*” means permission granted in a document by the Authority to a legal person who has submitted an application to carry out a practice within the scope of the Regulations. The authorization can take the form of a registration or a licence ;

“*chronic exposure*” means exposure persisting in time ;

"*collective dose*" means an expression for the total radiation dose incurred by a population, defined as the product of the number of individuals exposed to a source and their average radiation dose (man.Sv) ;

"*consignee*" means any person, organization or government which receives a consignment ;

"*consignment*" means any package or load of radioactive material presented by a consignor for transport ;

"*consignor*" means any person, organization or government which prepares a consignment for transport, and is named as consignor in the transportation documents ;

"*disused source*" means a radioactive source no longer intended to be used for its original purpose ;

"*decontamination*" means the removal or reduction of contamination by a physical or chemical process ;

"*dose limit*" means the value of the effective dose or the equivalent dose to individuals from controlled practices that shall not be exceeded ;

"*dosimeter*" means an instrument used for measuring the absorbed dose of radiation ;

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

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

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

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

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 $J.kg^{-1}$, termed the sievert (Sv).

"*employer*" means a 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 ;

"*health professional*" means an individual who has been accredited through appropriate national procedures to practice a profession related to health (e.g. medicine, dentistry, chiropractic, pediatrics, nursing, medical

physics, radiation and nuclear medical technology, radio-pharmacy, occupational health) ;

"Ionizing radiation" means radiation capable of producing ion pairs in biological materials ;

"Licence" means an authorization granted by the Authority on the basis of a safety assessment and accompanied by specific requirements and conditions to be complied with by the Licensee ;

"Licensee" means the holder of a current licence granted for a practice or source who has recognized rights and duties for the practice or source, particularly in relation to protection and safety ;

"limit" means the value of a quantity used in certain specified activities or circumstances that must not be exceeded ;

"local rules" means rules and instructions made and set down in writing as are appropriate to the radiation risk and nature of operations undertaken in that area.

"management" means all activities, administrative or operational, that are involved in the manufacture, supply, receipt, storage, use, transfer, import, export, transport, maintenance or disposal of radioactive sources ;

"monitoring" means the measurement of dose or contamination for reasons related to the assessment or control of exposure to radiation or radioactive substances, and the interpretation of the results ;

"notification" means a document submitted to the Authority by a legal person to notify an intention to carry out a practice or any other action within the scope of the regulations ;

"occupational exposure" means all exposures of workers incurred in the course of their work, with the exception of exposures from practices or sources exempted by the scope of the Regulations ;

"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 ;

"practicable" means social, technical, economic factors taken into consideration ;

"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 ;

"qualified expert" means an individual who, by virtue of certification by appropriate boards, societies, professional licensees, academic qualifications and experience, duly recognized as having expertise in any specialized field e.g. medical physics, radiation protection, occupational health, fire safety, quality assurance or any relevant engineering or safety specialty :

"radiation generator" means a device capable of generating radiation, such as X-rays, neutrons, electrons or other charged particles, which may be used for practices within the scope of the Regulation ;

"radiation safety officer" means an individual technically competent in radiation protection and safety 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 Regulations ;

"radiation source" means anything that may cause radiation exposure, such as by emitting ionizing radiation or releasing radioactive substances or materials. 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 the regulations ;

"radioactive waste" means a material, whatever its physical form, remaining from practices or interventions and for which no further use is foreseen—

(i) that contains or is contaminated with radioactive substances and has an activity or activity concentration higher than the level from regulatory requirements, and

(ii) exposure to which is not excluded from the regulations ;

"regulatory control" means any form of control applied to facilities or activities by the Authority for reasons related to radiation protection, safety and security of radioactive sources ;

"registrant" means a Licensee or Registrant in respect of a premises where radioactive sources are store, handle and/or use.

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

"safety" means any measures intended to minimize the likelihood of accidents with radiation sources and, should such an accident occur, to mitigate its consequences ;

"sealed source" means a radioactive material that is—

(a) permanently sealed in a capsule or

(b) closely bounded and in a solid form. The capsule or material of a sealed source shall be strong enough to maintain leak tightness under the condition of use and wear for which the source was designed, and also for under foreseeable mishaps ;

"supervised area" means any area not designated as a controlled area but for which occupational exposure conditions are kept under review even though specific protective measures and safety provisions are not normally needed ;

"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 ;

"unsealed source" means a source that does not meet the definition of a sealed source ;

"well-owner" means an employer who engages an independent contractor with technical expertise in the handling or use of radioactive sources in well logging operations. (It also means owner of drilling sites, or who does not handle or transport radioactive sources) ;

"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.

PART I—OBJECTIVE, SCOPE AND APPLICATION

2. The objective of these Regulations is to set up the basic technical and organizational requirements to be complied with by all operators of nuclear well logging operations in Nigeria, in order to ensure the protection of human health and the environment from the hazards associated with ionizing radiation within and beyond the national borders of Nigeria.

Objective.

3. These Regulations shall specify the minimum requirements for radiation protection and safety for all users of ionizing radiation in nuclear well logging operations and specify the radiation safety requirements for persons using licensed materials in these operations.

Scope.

4. These Regulations shall apply to—

Application.

(a) all existing ionizing radiation and nuclear Regulations, such as radioactive waste management Regulations, radioactive material transport Regulations etc in force at the commencement of these Regulations ;

- (b) all sources of ionizing radiation used for the above purposes, with possible exemption prior to authorization by the authority ;
- (c) facilities where sources of ionizing radiation are installed, used or stored ;
- (d) the operation of sources of ionizing radiation ;
- (e) the duties and responsibilities of the users, their internal safety organization and working procedures related to radiation protection ;
- (f) the monitoring of persons occupationally exposed (external, internal dosimeter) and of work places ;
- (g) medical examinations of persons occupationally exposed ;
- (h) radioactive sources or materials in storage or in transit ;
- (i) handling of wastes and radioactive release from the above uses ;
- (j) handling of radiological emergencies or accidents ;
- (k) preparedness in cases of release of radioactive materials to the environment ;
- (l) import or export requirements ;
- (m) quality control of equipment and calibration of instruments, etc ;
- (n) programmes for education, training and development ; and
- (o) the handling of radiation injuries and medical preparedness.

PART II—GENERAL REQUIREMENTS

Radiation
Safety
Requirements.

5. The principal radiation safety requirements related to justification of the practice, dose limitation, optimization of protection, and dose constraints, as specified in the Nigeria Basic Ionizing Radiation Regulations shall applied to nuclear well logging operations.

Authorization
of the
Practice.

6.—(1) A person intending to carry out nuclear well logging or any of the following associated activities shall notify the Authority of his intention and obtain an authorization for the—

- (a) importation, purchase, sale, hire, manufacture, repair or modification of radiation generators and sealed sources used for nuclear well logging including ancillary equipment which incorporates radioactive materials such as depleted uranium source containers etc ;
- (b) transportation, storage and use of radiation generators and sealed sources for nuclear well logging including ancillary equipment which incorporates radioactive materials ;
- (c) construction of facilities for nuclear well logging and any temporary or permanent decommissioning of these facilities ;
- (d) disposal of any sealed sources including ancillary equipment, which incorporates radioactive materials ; and

(e) transfer of ownership of any radiation generator or sealed source including ancillary equipment which incorporates radioactive materials or any facility used for nuclear well logging.

(2) A person shall when applying for a license, provide the Authority with documentary evidence demonstrating that an adequate level of Radiation Safety was provided and maintained.

7.—(1) A Licensee may perform well logging with a sealed source only after the Licensee has a written agreement with the employing well owner or operator and the written agreement shall meet the following requirements—

Agreement
between Well
Owner and
Operator.

(a) where a sealed source becomes lodged in the well, reasonable effort in line with best practice in the industry will be made to recover it ;

(b) recovery of a sealed source in a manner which, in the Licensee's opinion, could result in its rupture or could lead to danger to health, safety and the environment shall not be attempted ;

(c) the radiation monitoring shall be performed from the commencement of logging operation till the end of logging operation or the end of abandonment ;

(d) where the environment, any equipment or personnel are contaminated with licensed material, they must be decontaminated before release from the site or release for unrestricted use ; and

(e) where the sealed source is classified as irretrievable after reasonable efforts at recovery have been expended, the following shall be implemented within 30 days—

(i) each irretrievable well logging source shall be immobilized and sealed in place with a cement plug ;

(ii) a means to prevent inadvertent intrusion on the source unless the source is not accessible to any subsequent drilling operations ; and

(iii) a permanent identification plaque, constructed of long lasting material such as stainless steel, brass, bronze or monel must be mounted at the surface of the well, unless the mounting of the plaque is not practical and the size of the plaque must be at least 17 cm [7 inches] square and 3 mm [$\frac{1}{8}$ -inch] thick ;

(f) the plaque in regulation 7 (1) (e) (iii) shall contain—

(i) the word "CAUTION" ;

(ii) the radiation symbol ;

(iii) the date the source was abandoned ;

(iv) the name of the well owner or well operator, as appropriate ;

(v) the well name and well identification number(s) or other designation ;

(vi) an identification of the sealed source(s) by radionuclide and quantity ;

- (vii) the depth of the source and depth to the top of the plug ; and
- (viii) an appropriate warning, such as, "DO NOT RE-ENTER THE WELLBORE TO THE SOURCE POSITION."

(2) A Licensee shall retain a copy of the written agreement for 3 years after the completion of the well logging operation.

(3) A Well-Owner or Operator shall apply on a case-by-case basis, for authorization to abandon an irretrievable well logging source.

(4) A written agreement between a Licensee and a well owner or operator is not required if the Licensee and the well owner or operators are part of the same corporate structure or otherwise similarly affiliated.

Requirement
for
Authorization.

8. A person shall, when applying for authorization, provide all relevant information to the Authority including the—

- (a) design and construction of facilities, equipment and radiation sources ;
- (b) system for managing radiation safety, radiation safety programme, results of safety assessments, quality assurance procedures ; and
- (c) procedures for the safe operation of radiation sources including local rules and record-keeping.

Duration of
Authorization.

9.—(1) Authorization granted by the Authority shall be for a period as may be determined by the Authority and shall be renewable.

(2) The Authority may suspend or revoke the authorization where a Licensee or Registrant is in breach of these Regulations.

(3) In case of suspension, a Licensee or Registrant shall reapply for authorization where his license is revoked in order to be able to resume operation.

Responsibilities
of a
Licensee or
Registrant.

10.—(1) A Licensee or Registrant shall be responsible for setting up and implementing the technical and organizational measures that are needed for ensuring the protection and safety of sources for which they are authorized.

(2) A Licensee or Registrant shall—

- (a) notify the Authority of all the activities stated in these regulations ;
- (b) notify the Authority of any intentions to introduce modifications to any practice or source for which they are authorized ;
- (c) prepare and implement an operational radiation protection and safety programme which includes the establishment of policies, procedures and standards for the safe keeping and use of radiation sources and the protection of workers and other persons ;
- (d) appoint one or more well logging supervisors who shall serve as the

Radiation Safety Officers to oversee the implementation of the radiation safety programme and provide such Radiation Safety Officers with appropriate authority and adequate resources ;

(e) consult and appoint Radiation Safety Advisers where necessary ;

(f) perform the required Safety Assessments as contained in these regulations ;

(g) ensure that workers are adequately trained in—

(i) radiation protection and safety, and

(ii) the operating procedures, local rules and emergency plans appropriate to the specific types of equipment used within the organization ;

(h) provide workers with personal dosimeter and appropriate health surveillance ;

(i) ensure that all equipment used for the practice is suitable for its intended and actual uses and is properly maintained ;

(j) provide workers with appropriate survey meters that are maintained in good working order and tested regularly ;

(k) ensure that adequate radiation monitoring is carried out and that records are kept ;

(l) provide contingency plans for all reasonably foreseeable radiation accidents and incidents ;

(m) make provisions for the safe disposal or return to the supplier of existing radioactive sources that are no longer required ;

(n) when applying for a new authorization for the importation, use or storage of any radioactive source including ancillary equipment that incorporates depleted uranium shielding, provide for a program for the safe disposal or return of sources to the supplier when they are no longer required ; and

(o) ensure that any provider of radiation protection and safety related services for example dosimeter laboratories are authorized or approved by the Authority.

11.—(1) A Licensee shall—

(a) provide the human and material resources necessary to ensure safe working conditions and compliance with Licence conditions ;

(b) develop and promote a safety culture to encourage a questioning and learning attitude to protection, safety and to discourage complacency ;

(c) establish and maintain a radiation safety programme which objectives shall include the following elements—

Management
and
organizational
requirements.

(i) taking all practicable steps to ensure that the exposure of all persons is kept as low as reasonably achievable and below the dose limits set out in Schedule 1 of these Regulations,

(ii) taking all necessary steps to ensure the physical safety and security of radiation sources to minimize risk to persons not connected with the practice, and

(iii) complying with these Regulations, License requirements and ensuring that all necessary tests, inspections and records are maintained to enable the operating organization to demonstrate compliance with these requirements ;

(d) the Authority shall be notified of all appointments made pursuant to these Regulations.

Appointment
of Well
Logging
Supervisor
as Radiation
Safety
Officer.

12.—(1) A Licensee shall appoint at least one Well Logging Supervisor as Radiation Safety Officer whose functions and duties shall be clearly defined and documented.

(2) The minimum requirements and qualities for a Well Logging Supervisor as Radiation Safety Officer shall be—

(a) theoretical knowledge and practical training in radiation protection and safety related to well logging operations ;

(b) sufficient management authority within the operating organization to effectively supervise and control the well logging activity to ensure that the licence conditions are met ; and

(c) the Radiation Safety Officers shall have the authority to stop any work that is not being undertaken in a safe manner.

Responsibilities
of the Well
Logging
Supervisor
as Radiation
Safety
Officer.

13.—(1) The responsibility of the Well Logging Supervisor as Radiation Safety Officer shall include—

(a) supervising the work to the extent necessary to ensure that procedures including local rules and all licence terms and conditions are complied with ;

(b) preparing and reviewing written administrative procedures that define the means of complying with regulatory or licence requirements ;

(c) preparing and reviewing operational procedures including local rules to ensure that exposures to radiation are kept as low as reasonably achievable ;

(d) ensuring that operational manuals for the well logging equipment are provided and are understood by the workers ;

(e) ensuring that safety assessments and emergency plans are prepared ;

(f) ensuring that engineering controls and other equipment designed to

protect persons against ionizing radiation are maintained ;

(g) identifying designated areas and establishing necessary safeguards for controlling access to such areas ;

(h) arranging for and supervising the use of personnel dosimeter and ensuring that appropriate dose records are maintained ;

(i) ensuring that there is adequate monitoring of workplaces in order to prevent unnecessary exposure and to demonstrate compliance with these Regulations and Licence conditions ;

(j) investigation of accidents including abnormal high exposures in routine work and overexposures, proposing, implementing remedial actions and accident preventive measures ;

(k) to determining the additional requirements for protection of any female staff engaged in the work with ionizing radiation who may be pregnant ;

(l) carrying out a prior examination from a radiation safety standpoint of any plans for new well logging facilities or modifications to existing ones ;

(m) maintaining inventories of radioactive sources ;

(n) performing regular safety inspections of all well logging activity ; and

(o) identifying situations where a Radiation Safety Adviser should be consulted.

(2) Where more Radiation Safety Officers are appointed, in case of multiple job sites, the reporting structure and individual duties of each Well Logging Supervisor or Radiation Safety Officer shall be well defined, with one Well Logging Supervisor or Radiation Safety Officer having general oversight.

14.—(1) A Licensee shall appoint an authorized Radiation Safety Adviser to advise in many areas, such as design of new facilities, maintenance of safety systems etc. to ensure compliance with regulatory and Licence requirements.

Responsibilities
of the
Radiation
Safety
Adviser.

(2) The scope of advice and the services provided by an authorized Radiation Safety Adviser shall be agreed with the Licensee and clearly documented.

(3) A Licensee shall provide the Radiation Safety Adviser with appropriate information and access to facilities in order for the Adviser to carry out the agreed services.

15.—(1) A Licensee shall ensure that only qualified persons carry out well logging activities.

Training
and
Education.

(2) Formal training of Radiation Safety Officers and other personnel shall be carried out in a systematic manner and shall involve accreditation to a

recognized local, national or international standard and periodical training is essential to maintain the required level of competence.

(3) A Licensee shall employ only qualified Radiation Safety Officers who have received formal training which include—

- (a) sufficient educational background ;
- (b) specialized formal training in radiation protection and safety ;
- (c) familiarity with the organization's local rules and License requirements; and
- (d) practical training in techniques and radiation protection and safety requirements including emergency procedures specific to the equipment used within the organization.

Obligations
of the
Licensee.

16. A Licensee shall ensure that Radiation Safety Officers and all workers know and understand the—

- (a) conditions and limitations of the Licence held by the Licensee ;
- (b) organization's radiation protection and safety programme ;
- (c) operation and maintenance of the equipment used by the Licensee ;
- (d) hazards identified by the Safety Assessment ;
- (e) local rules and other operating procedures ; and
- (f) detailed procedures to be followed in the event of emergencies, the training for which shall include training exercises carried under realistic condition.

Record of
Training.

17.—(1) A Licensee shall prepare and maintain a record of training of all the personnel involved in well logging and these records shall include the following information—

- (a) name of the person who received the instruction or training ;
- (b) name of the institution or person who delivered the training ;
- (c) dates and duration of the instruction or training ;
- (d) a summary or list of the topics addressed ;
- (e) copy of any training certificates ; and
- (f) the result of any professional examination taken.

(2) A Licensee shall provide copies of the training records to individual workers especially if they change their employers.

Safety
Assessments.

18.—(1) A Licensee shall ensure that a safety assessment is carried out at the following stages—

- (a) when applying for a new Licence or for modification to an existing Licence ;

- (b) at the design stage, prior to the operation of well logging ;
- (c) when making significant changes to working practices or modifications to well logging facilities ; and
- (d) when operating experience, or other information about accidents, failures, errors or other events that could lead to potential exposures indicates that the current assessment might be invalid.

(2) A Licensee shall ensure that the safety assessment is fully documented and is prepared in consultation with the Radiation Safety Officers and Radiation Safety Adviser.

(3) The safety assessment shall include a systematic and critical review of the—

- (a) nature and magnitude of potential exposures and the likelihood of their occurrence ;
- (b) limits and technical conditions for operation of radiation sources ;
- (c) ways in which structures, systems, components and procedures related to radiation protection or safety might fail, singly or in combination, or otherwise lead to potential exposures and the consequences of such failures ; and
- (d) factors which could give rise to the unintended operation of any radiation source and the measures available to prevent, identify and control such occurrences ;

(4) Where the safety assessment shows there is a risk of a radiation accident, a Licensee shall take all practicable steps to—

- (a) prevent such accident ;
- (b) limit the consequences of such accident, should the accident occur ;
- and
- (c) provide workers with training in emergency procedures.

19. A Licensee shall carry out regular audits of normal well logging operations to ensure that a satisfactory standard of radiation safety is being maintained.

Verification
of Safety.

- 20.—(1)** A Licensee shall develop a policy statement that specifies the—
- (a) person responsible for organizing and carrying out the safety audits ;
 - (b) time interval between audits ;
 - (c) person responsible for preparing the audit report and making recommendations ;
 - (d) person to whom the audit report is to be sent ; and
 - (e) person responsible for implementing any corrective measures that are identified during the audit.

Policy
Statement.

(2) Each audit shall be done according to a structured plan and the time scale set for implementing corrective measures shall ensure that any deficiencies which present a significant radiological hazard are dealt with promptly and the agreed corrective measures shall be followed-up to ensure that the audit process is completed.

PART III—INDIVIDUAL MONITORING OF WORKERS

Statutory
Dosimeters
and Dose
Records.

21.—(1) A Licensee shall assess the occupational exposure of all persons who may regularly work in controlled areas or may receive significant occupational exposure and shall provide such persons with appropriate individual dosimeters to assess their cumulative occupational radiation exposure.

(2) The dosimeters coverage is subject to the following—

(a) the dosimeter shall be Optically Stimulated Luminescent (OSL) badges or a thermo-luminescent dosimeter or as appropriate ;

(b) the supplying laboratory shall be subject to the approval of the Authority ;

(c) the period for the use of a dosimeter shall be for a maximum period of 3 months ;

(d) the statutory personal dosimeter shall only be used by the person to whom it is assigned ;

(e) a Licensee shall maintain a dose record for each individual in the manner specified in these Regulations ;

(f) before a well logging supervisor or well logging or radiation worker starts work, a Licensee shall obtain a copy of the workers' dose record from previous occupational exposure ; and

(g) a Licensee shall draw up procedure to describe the way individual dosimeters are administered and this shall include persons who—

(i) order and receive the dosimeters from the dosimeter laboratory ;

(ii) distribute them to the Radiation Safety Officers and other radiation workers ;

(iii) collect and dispatch them to the dosimeter processing laboratory; and

(iv) review and maintain the dose records.

Radiation
Surveys and
Records.

22.—(1) Radiation surveys and personnel exposure calculations shall be made and recorded for each area where radioactive materials are stored.

(2) Radiation surveys and personnel exposure calculations shall be made and recorded for the radiation levels in occupied positions and on the exterior

of each vehicle used to transport radioactive material and such surveys and calculations shall include each source of radiation or combination of sources to be transported in the vehicle.

(3) After removal of the sealed source from the logging tool and before departing the jobsite, a survey meter shall be used to ensure that the logging tool is free of contamination.

(4) Radiation surveys shall be made and recorded at the jobsite or well-head for each tracer operation, except those using tritium, carbon 14 and sulfur 35 and these surveys shall include measurements of radiation levels before and after the operation and where radiation levels, post operation, exceed twice background, the area shall be decontaminated or restricted until radiation levels reach twice background.

(5) Records required pursuant to this regulation shall include the dates, identification of individuals making the survey, identification of survey instruments used and exact description of the location of the survey and the records of these surveys shall be maintained for inspection by the Authority for 2 years after completion of the survey.

23. In order to ensure the protection of the personnel dosimeters, a Licensee shall—

Protection of
Personnel
Dosimeters
during Use.

- (a) take good care of dosimeter and protect it from loss, theft or damage ;
- (b) return the dosimeter at the end of every specified period of usage ;
- and

(c) inform the Radiation Safety Officer without delay, if dosimeter is missing, damaged or if it has been accidentally exposed to radiation when not in use.

24. To ensure accurate reading of the dosimeters when not in use, the storage of individual dosimeters shall include the following elements—

Storage of
Personnel
Dosimeters.

(a) dosimeters shall be stored in a suitable environmental condition which shall not damage or affect the properties of the dosimeter ; and

(b) individual dosimeters shall not be stored in source stores, near exposure containers, near radioactive luminous items or in any other area where there are raised dose rates.

25.—(1) A Licensee shall take all reasonable steps to recover the loss of any dosimeter.

Loss of
Personnel
Dosimeters.

(2) Where the dosimeter cannot be located, the Licensee shall carry out an investigation and prepare a report which includes an estimate of the dose received by the worker for the relevant period.

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Investigation of Doses.

26.—(1) Results of personal dosimeters shall be reported to the well logging supervisor who shall inspect them to determine whether—

- (a) any unexpectedly high dose has been received ; and
- (b) individuals doses are kept within the dose limits.

(2) The well logging supervisor shall in addition to sub-regulation (1) of this regulation, set investigation levels of doses above which a formal investigation and written report shall be prepared.

Reading of Dosimeter.

27.—(1) Direct reading dosimeters e.g. quartz fibre electrosopes shall be used to supplement the Optically Stimulated Luminescent (OSL) badges whenever it is important to have an immediate indication of exposure, for example during well logging or during emergency recovery of a source.

(2) The uses in regulation 26 (1) of this regulation shall be subject to the following conditions—

(a) direct reading dosimeters shall be read or reset at the start of each work shift and there after read at regular intervals with accurate records kept;

(b) where the direct reading dosimeter exceeds a level set by the Radiation Safety Officer, the radiographer shall stop work and discuss the situation with the Radiation Safety Officer to establish how procedures might be improved ; and

(c) a Licensee shall ensure that direct reading dosimeters and personal alarm monitors are kept in good working condition and subject to regular operational checks.

Personnel Monitoring.

28. No Licensee shall permit any individual to act as a Radiation Safety Officer or to assist in the use of sources of radiation unless such individual wears a dosimeter such as an Optically Stimulated Luminescent Device (OSLD) or a Thermoluminescent Dosimeter (TLD) and each dosimeter shall be assigned to and worn by only one individual.

PART IV—WORKPLACE MONITORING

Maintenance of Workplace Monitoring.

29. A Licensee shall develop and maintain a programme for workplace monitoring in order to—

- (a) evaluate radiological conditions ;
- (b) assess exposures in controlled and supervised areas ; and
- (c) review the classification of controlled and supervised areas.

Survey Meters.

30.—(1) A Licensee shall ensure that a sufficient number of suitable radiation survey meters are available for the Radiation Safety Officer and other personnel.

(2) A survey meter shall be used at all times during storage, handling, use and transportation of well logging sources to ensure that the sources are in their assigned position or location and for it to be suitable for the working environment, radiation survey meters shall satisfy the following conditions—

(a) they shall be robust, waterproof if likely to be used in the rain and have an illuminated display if likely to be used in the dark ;

(b) functional batteries shall be readily available ;

(c) they shall be scaled in the appropriate units and shall be able to indicate radiation levels from about 1 mSv h^{-1} up to about 10 mSv h^{-1} ; and

(d) a Licensee shall ensure that equipment obtained for this purpose is of a type approved by the Authority and that it comes with an operating manual and with an initial certificate of testing by the manufacturer or supplier.

31.—(1) A Licensee shall inspect the operation of the radiation survey meter at the start of each working shift.

Maintenance
and
Calibration.

(2) The inspection shall include—

(a) battery condition ;

(b) any other instrument checks (e.g. high voltage setting) ;

(c) that the background radiation level is as expected ; and

(d) the response against a gamma or neutron source is as appropriate or other suitable check source.

(3) Every radiation survey meter used during nuclear well logging shall be checked regularly by—

(a) normal tests as in regulation 30(2) ;

(b) any specific inspection of instrument specified by the manufacturer ;

(c) inspection of indicated gamma or neutron dose rate versus actual dose rate at a range of dose rates to establish linearity of response ; and

(d) inspection of indicated dose rate versus actual dose rate at a range of dose rates to establish linearity of response.

32.—(1) Radiation survey meters shall be used to evaluate the radiological conditions in all workplaces and in particular at the following locations around—

Use of
Radiation
Survey
Meters.

(a) controlled and supervised areas to review area classification and assess exposures ;

(b) a transport container when a new gamma or neutron source is received ;

(c) a gamma or neutron source container when collecting it from a store ;

(d) a gamma or neutron source container when returning it to a store to confirm the source is present and is fully shielded ; and

(e) a gamma or neutron source container when loading and offloading it into a vehicle used for transport.

(2) Radiation survey meters shall also be used to evaluate the Radiological condition in all work places—

(a) after every use and handling of gamma or neutron source to confirm that the source is in its fully shielded position or assigned location ;

(b) to check the dose rates at the controlled area barriers during site nuclear well logging ;

(c) when transferring radioactive sources between containers ; and

(d) when dealing with emergencies involving gamma or neutron sources.

(3) Records of radiation surveys shall include the following details—

(a) location ;

(b) date ;

(c) name of person performing survey ;

(d) survey meter type and serial number ;

(e) radiation source details, e.g. type of source, activity, etc ;

(f) locations of measuring points ; and

(g) dose rate in $\mu\text{Sv h}^{-1}$ and other appropriate units.

(4) A Licensee shall ensure that records of radiation surveys are kept in a manner specified in any License conditions or these Regulations.

PART V—SECURITY AND STORAGE OF RADIOACTIVE SOURCES

Security and
Control of
Radiation
Sources.

33.—(1) The Licensee in whose custody the sources are at any material time shall establish physical controls and administrative procedures to prevent damage, theft, loss or unauthorized removal of radioactive sources.

(2) In order to ensure Security and Control of Radiation Sources, a Licensee shall take into consideration the following—

(a) control and procedures to prevent entry by unauthorized persons into radioactive source stores and controlled areas during site well logging procedures ;

(b) control of source is not relinquished without prior notification of the Authority ;

(c) a radioactive source shall not be transferred, unless the receiver possesses a valid authorization ;

(d) that all workers shall be informed of the need and importance of radioactive source security ;

(e) permanent and purpose designed radioactive source stores are to be made available ;

(f) temporary stores are established where necessary at sites where well logging procedures are undertaken ;

(g) identification of the potential ways in which sources can be lost or stolen, in particular the risks of theft during temporary storage and transporting radioactive sources ;

(h) an effective system for accounting radioactive sources shall be implemented and shall be fully complied with by all workers and the system shall be capable of detecting losses quickly ; and

(i) during each logging or tracer application, the logging supervisor or other designated employee shall maintain direct surveillance of the operation to protect against unauthorized or unnecessary entry into a restricted area.

34. Sealed sources used in well logging activity shall be stored in secured exposure containers or source changers and these in turn shall be kept in suitable stores that shall meet the following minimum requirement—

Storage of
Nuclear
Well
Logging
Sources.

(a) it shall be designated as a controlled area ;

(b) it shall be properly secured, to prevent removal or tampering with the radioactive sources ;

(c) the keys shall be made available to the well logging supervisor only and key holding shall be properly documented ;

(d) it shall protect the equipment from damage and harsh environmental conditions ;

(e) it shall provide protection against fire and shall not contain or be located in proximity to flammable, corrosive, oxidizing materials, or explosives ;

(f) the entrance door to the store shall be labeled clearly and durably with a radiation trefoil symbol with the words "*Danger Radioactive Material*" in an understandable language ; and

(g) if the store is located at a place not on the Licensee's site, the name, address and telephone number of the Licensee shall be displayed so that he can be contacted in an emergency situation.

35.—(1) A Licensee shall ensure that the location of his sources is known at all times and a formal accountability system shall be established that records the location of the following radioactive sources—

Accounting
for
Radioactive
Sources.

(a) sealed sources used in well logging ;

(b) other sources such as those used to test radiation survey instruments and calibration ; and

(c) transport containers or source shield incorporating depleted uranium shielding, even when these containers do not contain a gamma or neutron source.

(2) The accountancy procedures shall be documented and consist of a number of elements which together provide defence in depth to ensure that records are complete and accurate.

36.—(1) A Licensee shall maintain a central and definitive record of all his radioactive sources and this record shall be established for each source as soon as it is delivered to the organization.

(2) The record in regulation 35(1) shall be established for each source as soon as it is delivered to the organization and shall contain the following documents and details—

- (a) details of the source supplier ;
- (b) date of receipt into the operating organization ;
- (c) manufacturers' serial number ;
- (d) radionuclide and activity on a stated date ;
- (e) normal storage location ;
- (f) type and serial number of the exposure container in which source is located ;
- (g) local identifier ;
- (h) original manufacturers' leak test certificate ;
- (i) copy of any subsequent leak test certificate ;
- (j) original suppliers' special form certificate if one is issued and any updated certificates ; and
- (k) date, method and destination for final disposal or transfer to another party as authorized by the Authority.

(3) The documents and details in sub-regulation (2)(a) to (j) of this regulation, shall be updated when the sources are moved between storage locations or exposure containers for each sealed source.

(4) For each source container incorporating depleted uranium—

- (a) details of the container supplier ;
- (b) date of receipt by the Licensee ;
- (c) manufacturers' serial number ;
- (d) container type or model number or other descriptor ;

- (e) transport code (e.g. Type A, Type B, etc) ;
 - (f) maximum activity of source allowed to be used in the container ;
 - (g) the quantity of depleted uranium in kg if used as shielding material ;
- and
- (h) date, method and destination for final disposal or transfer to another party as authorized by the Authority.

(5) The records shall be securely kept by the Licensee and copies of the records shall be transported with each source in a suitable file or other document holder so that they can be readily inspected by the Authority.

(6) When sources or exposure containers are finally disposed of, the central records for each source or container shall be stored in a secured place for such period as may be specified in the Licence conditions or these Regulations.

37.—(1) Source movement records shall be maintained for every radioactive source and source containers that incorporate depleted uranium and the records shall be recorded as follows—

Source
Movement
Records.

- (a) an identifier that is sufficient to allow the source container to be related to the central records which also contain the records of the sealed source inside the container ;
- (b) the radionuclide e.g. Cs-137, Ba-133 ;
- (c) date and time the source is removed from the store ;
- (d) name and signature of the Radiation Safety Officer removing the source ;
- (e) the place where it will be taken ;
- (f) date and time it shall be returned to the source store ; and
- (g) name and signature of the Radiation Safety Officer returning the source.

(2) The source movement shall be recorded every time the source is moved and the Radiation Safety Officer shall regularly inspect them, to ensure that these records are accurately completed and the Licensee shall retain the source movement records for a period specified by the Authority.

38.—(1) A Licensee shall ensure that monthly audit are made of the source account and movement records.

Radioactive
Source
Audit.

(2) The physical location of each source and any incorporating depleted uranium shall be verified.

(3) The audit shall include the following—

- (a) identification from the central record of which sources are currently held by the Licensee ;
- (b) preparation of a checklist of these sources ;
- (c) confirmation by physical inspection that every source and depleted uranium source container is accounted for using a radiation survey meter if there is any doubt whether the source is present ;
- (d) confirmation that source movement records are accurately completed ; and
- (e) a written record that the audit results are satisfactorily which shall take the form of the signature of the Radiation Safety Officer in the record or a separate record sheet retained by the Radiation Safety Officer.

PART VI—REQUIREMENTS FOR NUCLEAR WELL LOGGING EQUIPMENT

General
Require-
ments.

39. Equipment used for well logging shall be subject to the following general requirements—

- (a) any modification of a sealed source, or any ancillary equipment used in well logging activity shall be undertaken only by a qualified expert who is satisfied that the modification does not adversely effect the safety of the equipment. and significant modifications shall only be carried out following authorization from the Authority ; and
- (b) well logging equipment shall not be used in conditions or environments for which it was not designed and such equipment shall be stored in a suitable manner.

Shielding of
Nuclear Well
Logging
Equipment.

40. In order to ensure adequate protection of persons during well logging the sealed source shall be housed in a shielded container except when in downhole.

Require-
ments for
Sealed
Sources.

41.—(1) Sealed sources used for well logging shall be designed, manufactured and tested to meet the requirements of the International Standard Organization or Standard Organization of Nigeria.

(2) In addition to the requirement of regulation 40(1) of these Regulations—

- (a) they shall be certified as meeting the requirements of 'special form' radioactive material according to the International Atomic Energy Agency transport regulations, TS-R-1 ;
- (b) each radioactive source shall have demonstrated its integrity by completion of a satisfactory leak test in accordance with the international standard organization ;
- (c) any new source shall be supplied with a leak test certificates to ensure the ongoing integrity of the source capsule ;

(d) leak tests shall be carried out at intervals prescribed by the Authority or Licence conditions or the regulations ;

(e) operating organizations shall require that source suppliers provide certification with all new sources ;

(f) source assemblies shall be designed, fabricated and tested to meet the requirements of the International Standard Organization (ISO) ;

(g) source assemblies shall be compatible with the, ancillary equipment and any source changer ;

(h) source assemblies shall be marked with the radiation trefoil sign and a legend "*radioactive*" ; and

(i) they shall also be durably marked with the manufacturer's serial number.

42.—(1) A Licensee shall have a good understanding of the type and safe use of the source or transport containers or any other container authorized by the Authority which shall be used.

Require-
ments for
Source or
transport
containers.

(2) Containers that incorporate depleted uranium shall be treated as radioactive sources even when empty and they shall be properly stored, accounted for and disposed of only in a manner authorized by the Authority.

(3) A Licensee shall have knowledge of which of the containers incorporate depleted uranium and check that the containers are durably marked to identify this.

(4) Any type of source or transport container used, shall meet the minimum requirements of the International Standard Organization or equivalent to the requirements of the Standard Organization of Nigeria.

(5) Any source or transport container shall bear a durable and clear label with the following details—

(a) the ionizing radiation trefoil symbol ;

(b) a cautionary warning e.g. "DANGER – RADIOACTIVE MATERIALS" ;

(c) chemical and mass number of radionuclide (e.g. "Am-241Be", "Cs-137") ;

(d) maximum source activity permitted for the container ;

(e) model and serial number of the container ;

(f) Licensee's name and address ;

(6) The container shall be supplied with an operational and maintenance manual.

(7) A Licensee shall request that suppliers of source or transport containers

and ancillary equipment to provide these manuals in an appropriate language.

Maintenance
Programme.

43. A Licensee shall ensure that the—

(a) radiation generators, ancillary equipment and safety systems are regularly inspected and maintained and this shall require a formal programme of inspection and maintenance that shall take into account the recommendations of the equipment manufacturer and supplier ; and

(b) programme shall incorporate—

(i) routine checks to be carried out at the beginning of each well logging operation and in which all logging supervisors are trained ;

(ii) periodic inspection and servicing of equipment that can be done by a Licensee ;

(iii) periodic inspection and servicing of equipment that shall only be done by a qualified expert either from the equipment supplier or agents approved by the equipment supplier ;

(iv) any service arrangements made between the operating organization and the equipment supplier or approved agent shall be specified in writing and the

(v) operating organization shall monitor these arrangements to ensure that the agreed work is actually carried out ; and

(vi) that any equipment found to be defective shall be marked unserviceable and cannot be used until repaired and any such defect shall be promptly notified to the Radiation Safety Officer.

PART VIII—REQUIREMENTS FOR NUCLEAR WELL LOGGING

Preparation
for Nuclear
Well
Logging.

44. A Licensee shall—

(a) obtain a Licence as required by the Authority ;

(b) carry out a site-specific safety assessment ;

(c) provide a secure store for sealed sources and radiation generators ;

(d) ensure that a suitable, tested and functioning radiation monitor is available at the site ; and

(e) exchange necessary information and co-operate with the site operator as is necessary to ensure the safety of all persons on the site in respect of the nuclear well logging.

Documents
and Records
Required at
Field
Stations.

45. A Licensee or registrant shall maintain, for inspection by the Authority, the following documents and records for the specific devices and sources used at the field station—

(a) appropriate Licence or certificate of registration ;

- (b) operating and emergency procedures ;
- (c) a copy of these regulations ;
- (d) records of the latest survey instrument calibrations ;
- (e) records of the latest leak test results pursuant to Licence conditions ;
- (f) quarterly inventories ;
- (g) utilization records ;
- (h) records of inspection and maintenance and
- (i) survey records.

46.—(1) A Licensee shall ensure that the sealed source except those containing radioactive material in gaseous form, used in downhole operations shall be certified at the time of manufacture to—

Design,
Performance
and
Certification
Criteria for
Sealed
Sources
used in
Downhole
Operations.

- (a) be of double encapsulated construction ;
- (b) contain radioactive material whose chemical and physical forms are as insoluble and non-dispersible as practical ; and
- (c) have individually passed external pressure testing to at least 24,656 pounds per square inch absolute (170 MN per m²).

(2) Sealed sources, except those containing radioactive material in gaseous form of a certificate from a transferor certifying that an individual sealed source meets the requirements of sub-regulation (1) (a) and (b) of this regulation, shall not be put into use until such determinations and testing according to sub-regulation (1) (6) of this regulation have been performed.

(3) Certification documents shall be maintained for inspection by the Authority for a period of 2 years after source disposal and where the source is abandoned downhole, the certification documents shall be maintained for 100 years.

47. A Licensee using radioactive materials shall maintain utilization records which shall be kept available for inspection by the Authority for 2 years from the date of the recorded event, showing the following information for each source of radiation—

Utilization
Records.

- (a) make, model number and a serial number or a description of each source of radiation used ;
- (b) the identity of the well logging supervisor or field unit to whom it is assigned ;
- (c) locations where used and dates of use ; and

(d) in case of tracer materials and radioactive markers, the utilization record shall indicate the radionuclide and activity used in a particular well.

PART IX—PRECAUTIONARY PROCEDURES IN LOGGING AND SUBSURFACE TRACER OPERATIONS

Security. **48.** A well logging supervisor or other designated employee shall maintain direct surveillance of the operation to protect against unauthorized or unnecessary entry into a restricted area during each logging or tracer application.

Handling Tools. **49.** A Licensee shall provide and require the use of tools that will assure remote handling of sealed sources except for low-activity calibration sources that result in a gamma exposure rate at contact of less than 100 milliroentgens (2.58×10^{-5} uC per kg) per hour.

Subsurface Tracer Studies. **50.—(1)** All personnel handling radioactive material shall use protective gloves and other appropriate protective clothing and equipment and precautions shall be taken to avoid ingestion or inhalation of radioactive material.

(2) A Licensee shall not intentionally inject radioactive material into any fresh water aquifers unless the Authority determines that such injection will not endanger the public health, safety and welfare.

(3) A Licensee shall not inject radioactive material into any well unless it can be demonstrated to the Authority that the procedure will not result in any liquid or gases distributed to the public.

Designation of a Controlled Area. **51.—(1)** A controlled area shall be designated without exception during well logging.

(2) In order to determine the extent of the controlled area, a Licensee shall take account of the nature and frequency of well logging at a specific site as well as the occupancy.

(3) The boundary of the controlled area shall be physically demarcated at all positions where access is possible.

Radiation Survey Instruments. **52.—(1)** A Licensee shall maintain sufficient calibrated and operable radiation survey instruments at each field station and temporary jobsite to make physical radiation surveys and instrumentation shall be capable of measuring 0.1 milliroentgen (0.001 mSv) per hour through at least 50 milliroentgens (0.5 mSv) per hour.

(2) Radiation survey instruments used to establish dose rates shall be calibrated—

(a) at energies and geometries appropriate for use ;

(b) at intervals not exceeding 12 months and after each instrument servicing ;

(c) so that accuracy within plus or minus 20 per cent can be demonstrated ; and

(d) for linear scale instruments, at two points located approximately 1/3 and 2/3 of full-scale on each scale; for logarithmic scale instruments, at midrange of each decade and at two points of at least one decade and for digital instruments, at appropriate points.

(3) Records of survey instrument calibrations shall be maintained for 3 years after the calibration date for inspection by the Authority.

53.—(1) A Licensee using sealed sources containing radioactive material shall have the sources tested for leakage and records of leak test results shall be kept in an appropriate SI Unit Hundreds of Bq (KBq) and maintained for inspection by the Authority for 3 years after the leak test is performed or until transfer or disposal of the sealed source.

Leak Testing
of Sealed
Sources.

(2) A Licensee shall ensure that tests for leakage shall be performed only by persons specifically authorized to perform such tests by the Authority.

(3) A Licensee shall ensure that the test sample be taken from the surface of the source, source holders or from the surface of the device in which the source is stored or mounted and on which contamination might be expected to accumulate and analyzed for radioactive contamination and the analysis shall be capable of detecting the presence of 0.005 microcurie (185 Bq) of radioactive material on the test sample.

54. Each sealed source containing radioactive material shall be tested at intervals not exceeding 6 months. In the absence of a certificate from a transferor indicating that a test has been made prior to the transfer, the sealed source shall not be put into use until tested. If, for any reason, it is suspected that a sealed source may be leaking, it shall be removed from service immediately and tested for leakage as soon as practicable.

Interval of
testing.

55. A Licensee shall immediately withdraw the source from use where the test reveals the presence of 0.005 microcurie (185 Bq) or more of leakage or contamination and shall—

Leaking or
Contami-
nated
Sources.

(a) cause it to be decontaminated, repaired or disposed of in accordance with these Regulations ;

(b) check the equipment associated with the leaking source for radioactive contamination and if contaminated ; have it decontaminated or disposed of in accordance with these Regulations ; and

(c) make available to the Authority within 5 days of receiving the test results a report describing the equipment involved, the test results, any contamination which resulted from the leaking source and correctives action taken.

Exemptions.

56. The following sources are exempted from the periodic leak test—

- (a) hydrogen 3 sources ;
- (b) sources containing radioactive material with a half-life of 30 days or less ;
- (c) sealed sources containing radioactive material in gaseous form ;
- (d) sources of beta-emitting or gamma-emitting radioactive material with an activity of 100 microcuries (3.7 MBq) or less ; and
- (e) sources of alpha-emitting radioactive material with an activity of 10 microcuries (0.370 MBq) or less.

Defence-In-Depth
during
Nuclear Well
Logging.

57. During well logging, a Licensee shall ensure that defence in depth is achieved by providing multiple layers of safety that include—

- (a) carrying out a prior site-specific safety assessment ;
- (b) establishment and demarcation of a controlled area ;
- (c) restriction of access to the controlled area ;
- (d) use of survey meters before and after every exposure ;
- (e) use of personal alarming dosimeters ;
- (f) use of warning signals before and after the exposure ; and
- (g) properly and well implemented operating procedures.

Boundary of
Controlled
Area.

58.—(1) A controlled area shall be designated, without exception, during all well logging procedures and the contour demarcating the area of safe dose shall be set at a value ensuring that outside the controlled area the annual dose limits for the public is not exceeded.

(2) The controlled area shall include the complete periphery of the contour and where necessary demarcate areas above and below the working level.

Temporary
jobsites.

59.—(1) A Licensee or Registrant conducting operations at a temporary jobsite, which is a location to which radioactive materials have been dispatched to perform wireline service operations or subsurface tracer studies, shall have the following documents and records available at that site for inspection by the Authority—

- (a) operating and emergency procedures ;
- (b) survey records for the period of operation at the site ;

(c) evidence of current calibration for the radiation survey instruments in use at the site ; and

(d) when operating, a copy of the appropriate Licence, certificate of registration or equivalent documents.

(2) A Radiation Safety Officer must be physically present at a temporary jobsite whenever licensed materials are being handled or are not stored and locked in a vehicle or storage place, however, the Radiation Safety Officer may leave the jobsite in order to obtain assistance if a source becomes lodged in a well.

(3) The Radiation Safety Officer or other individual designated by the logging supervisor shall maintain direct surveillance of the operation to prevent unauthorized entry into a restricted area during well logging, except when radiation sources are below ground or in shipping or storage containers.

60.—(1) Warning notices shall be displayed around the controlled area boundary at suitable positions, and shall bear the international radiation trefoil symbol, warnings and appropriate instructions in English and local language such as Danger Radiation, Controlled Area And Keep Out and the meaning of the warning signals shall be clearly stated.

Warning
Notices and
Warning
Signals.

(2) A notice shall also include a phone number for use in case of emergencies.

61.—(1) Each source, source holder or logging tool containing radioactive material shall bear a durable, legible and clearly visible marking or label, which has, as a minimum, the standard radiation caution symbol with the conventional color requirement and the following wording—

Labeling.

DANGER OR ("CAUTION")
RADIOACTIVE

(2) Each transport container shall have permanently attached to it a durable, legible and clearly visible label which has, as a minimum, the standard radiation caution symbol and the following wording—

DANGER OR ("CAUTION")
RADIOACTIVE.
NOTIFY THE AUTHORITY IF FOUND

62. Before the commencement of any nuclear well logging work—

- (a) the area shall be cleared of all people except authorized personnel ;
- (b) the boundary shall be clearly visible, well illuminated and continuously patrolled to ensure that unauthorized people do not enter the controlled area ;

Patrolling
and
Monitoring
of
Controlled
Area.

(c) prior to carrying out the well logging work, the well logging supervisor shall perform a radiation survey to ensure that dose rates at the boundary do not exceed authorized limits ; and

(d) dose rates at representative points at the boundary shall be checked during operations to ensure that the barriers are correctly positioned, particularly if the position of the equipment or direction of the radiation beam is changed.

De-designating the Controlled Area.

63. On completion of well logging or at the end of a working period if the work is long-term, the controlled area shall be de-designated and the following steps shall be taken—

(a) confirm that all radioactive sources are fully shielded and in their shielding container ;

(b) after all source containers have been removed, a final check shall be made with a survey meter to ensure that no radioactive sources have been inadvertently left behind ; and

(c) check that all warning notices have been removed.

PART X—TRANSPORTATION OF RADIOACTIVE SOURCES

General Requirements.

64. The transportation of sealed sources shall comply with International Atomic Energy Agency for Safe Transport of Radioactive Materials TS-R-1 and the Nigeria Transportation of Radioactive Sources Regulations, 2006 and proper packaging shall be used for all transportation and the manufacturer's instructions followed for proper preparation of exposure containers before transportation.

Receipt of Radioactive Materials.

65.—(1) Prior to each shipment of radioactive sources, a Licensee shall make necessary arrangements with the source supplier to receive all relevant information which shall include the following for each package or container—

(a) the nuclide, number and activity of sources ;

(b) a description of the source construction and performance tests including leakage tests ;

(c) special form approval certificate ;

(d) a description of the package ;

(e) approval certificate for Type B packages, or Statement of compliance with International Atomic Energy Agency (TS-R-1) for other packages ;

(f) details of any special arrangements required, including multilateral approvals, where necessary ; and

(g) a copy of the transportation documents to be sent to the Licensee by fax or e-mail before dispatch if possible.

(2) A Licensee shall not agree to the dispatch of a consignment by the supplier, unless the provisions of sub-regulation (1)(a) to (e) of this Regulation have been complied with and both the supplier and Licensee shall agree on the transportation route and responsibility for each stage of the journey.

(3) Arrangements shall also be made for the following where necessary—

- (a) checking of radiation dose rates from the package or container ;
- (b) checking that the correct transport labels are attached to the package or container and replacing any that is damaged or illegible ;
- (c) ensuring that the package or container is securely attached to the vehicle and that the vehicle is correctly labeled ;
- (d) dealing with border controls ; and
- (e) security of the consignment during transport, particularly during delays or overnight stops.

66.—(1) A Licensee shall return packages or containers to the source supplier after receipt of a consignment of radioactive sources.

Dispatch of
Radioactive
Materials.

(2) All requirements of the Nigeria Transportation of Radioactive Sources Regulations, 2006 and International Atomic Energy Agency (TS-R-1) concerning packaging, labeling, placarding where necessary, consignor responsibilities and all authorizations and approvals must be met before dispatching radioactive sources.

67. A Licensee, while returning unused sources, shall provide the following information to the consignee for each package or container—

Unused
Sources.

- (a) the nuclide, number and activity of sources ;
- (b) a description of the source construction, including leakage tests ;
- (c) special form approval certificate ;
- (d) a description of the packaging in which the source is to be transported ;
- (e) approval certificate for Type B package, or statement of compliance with International Atomic Energy Agency (TS-R-1) for other packages ;
- (f) details of any special arrangements required, including multilateral approvals, where necessary ;
- (g) a copy of the transportation documents to be sent to the consignee by fax or e-mail before dispatch, if possible.

68.—(1) A Licensee and consignee shall agree on the transportation route and the responsibility for each stage of the journey and this shall lie with the Licensee.

Transportation
Routes.

(2) A Licensee shall be responsible from dispatch until the consignment reaches the consignee's premises and other arrangements are satisfactory provided, and an agreement is reached in advance by both parties which is also acceptable to the Authority.

**Details of
Consignment.**

69. In order to prepare the consignment for dispatch, a Licensee shall—

(a) load the sources into the package, verifying the details to be provided to the consignee such as serial numbers and comparable information to be entered on the transport document ;

(b) close it securely and then examine the package or container to ensure that it is in good condition, referring to any procedures provided by the source supplier ;

(c) carry out contamination monitoring of the outside of the package or container to ensure that there is no residual radioactive material present and therefore suitable for transportation ;

(d) carry out dose rate monitoring of the package or container and attach appropriate transport labels ;

(e) refrain from using the transport labels relating to the sources contained in the package or container when received ; and

(f) complete a transportation document.

**Security for
the
Consignment.**

70. A Licensee shall put in place necessary arrangements for the following—

(a) ensures that the package is securely attached to the vehicle and that the vehicle is correctly labeled ; and

(b) provides security for the consignment during transportation particularly during delays or overnight stops.

**Quarterly
Inventory.**

71. A Licensee shall—

(a) conduct a quarterly physical inventory to account for all sources of radiation ; and

(b) maintain records of inventory for 2 years from the date of the inventory for inspection by the Authority and shall include the quantities, kinds of sources of radiation, the location where sources of radiation are assigned, the date of the inventory and the name of the individual conducting the inventory.

PART XI—EMERGENCY PLANNING AND PREPAREDNESS

72. A Licensee shall prepare emergency plans which are designed to secure the protection and safety of anyone who may be affected by such accident, where a safety assessment identifies that an accident is likely to affect workers or members of the public.

Programme
for
Emergency
Planning
and
Preparedness.

73.—(1) A Radiation Safety Adviser shall be consulted when drawing up emergency plans.

Consultation
for
Emergency
Plan.

(2) Emergency planning and preparedness shall be regarded as comprising the following stages—

- (a) identification of potential accidents and other unplanned events during well logging and an evaluation of the risks associated with these ;
- (b) development of emergency plans to deal with the identified hazards ;
- (c) specification and acquisition of emergency equipment ;
- (d) training to implement the emergency plan, including necessary training in the use of the emergency equipment ;
- (e) exercises at appropriate intervals to test the implementation of the emergency plan ; and
- (f) periodic reviews and necessary updates of the emergency plans.

74.—(1) The responsibility for adequately implementing each of the six stages contained under these Regulations lie with the Licensee and the resulting emergency plans and associated arrangements shall form a part of the Licensee's application to the Authority.

Implementation
of
Emergency
Plan.

(2) Implementation of the emergency plan may involve participation by external organizations and specialized consultants and the plan shall clearly address such external participation, ensuring that the participants are fully aware of and accept their various responsibilities.

75. At initial stage, reasonable foreseeable accident and incident situations shall be identified, likely consequences evaluated and potential doses estimated for all persons who may be involved including members of the public where applicable and local circumstances shall be taken into account.

Initial Safety
Assessment.

76. Each of the following events involving sealed sources shall be recognized as constituting a potential event necessitating implementation of an emergency plan—

Sealed
Sources.

- (a) theft or loss of a source, or container ;

(b) damage to a source or a container, such as mechanical or fire damage, including during transport or downhole operations ;

(c) radioactive contamination resulting from a damaged or faulty source ;
and

(d) malfunction or deliberate defeat of the safety and warning system.

Development
of
Emergency
Plans.

77.—(1) A Licensee's operating and emergency procedures shall include appropriate instructions in at least the following—

(a) handling and use of sources of radiation to be employed so that no individual is likely to be exposed to radiation doses in excess of the established standards ;

(b) methods and occasions for conducting radiation surveys ;

(c) methods and occasions for locking and securing sources of radiation ;

(d) personnel monitoring and the use of personnel monitoring equipment ;

(e) where applicable, the transportation of radioactive sources to temporary job sites, field stations, including the packaging and placing of such sources in vehicles, placarding of vehicles and securing the sources during transportation ;

(f) minimizing exposure of individuals in the event of an accident ;

(g) procedure for notifying authorised personnel in the event of an accident ;

(h) maintenance of records ;

(i) where applicable, inspection and maintenance of source holders, logging tools, source handling tools, storage containers, transport containers and injection tools ;

(j) where applicable, procedures to be followed in the event a sealed source is lodged downhole ; and

(k) where applicable, procedures to be used for picking up, receiving and opening packages containing radioactive material.

(2) Emergency plans shall address each of the reasonably foreseeable accident situations identified during safety assessment and shall aim to restrict, as far as is reasonably possible, any exposures that may result from them.

Features of
Emergency
Plan.

78. The emergency plans shall develop the following components—

(a) identification of persons authorized to implement the various stages of the plans ;

(b) identification of persons or organizations that may need be notified at the various stages of the plans, including all necessary telephone, fax, e-mail numbers and addresses ;

(c) advice on when to implement the emergency plans ; and
 (d) procedures specific to each identified emergency situation, to be followed at various stages, as applicable—

- (i) initial stage, to contain the situation ;
- (ii) planning stage, to plan and practice the recovery stage ;
- (iii) recovery stage ;
- (iv) post-accident stage, to return working situation to normal ; and
- (v) preparation of accident report ;
- (e) special procedures to follow in life threatening situations ;
- (f) availability of emergency response equipment ; and
- (g) notification to the Authority.

79. A Licensee shall ensure that all necessary equipment is available to deal with emergency situations and the emergency equipment shall include—

Emergency
Equipment.

- (a) appropriate and functioning survey meters, personal alarming dosimeters and direct reading dosimeters (QFE or electronic) ;
- (b) additional personal dosimeters, thermo luminescent dosimeters or film badges ;
- (c) barrier materials and warning notices ;
- (d) bags of lead shot, spare lead sheet and lead tunnel ;
- (e) suitable tool kit and source recovery equipment, long handling tongs, pliers, screwdrivers, bolt cutters, adjustable spanner, hacksaw and torch light ;
- (f) emergency shielded storage container, spare source container and communication equipment (e.g. mobile phones, walkie-talkies) ;
- (g) spare batteries for survey meters, personal alarms and torch ;
- (h) stationery supplies and incident logbook ; and
- (i) equipment manuals.

80. A Licensee shall carry out regular audits to ensure that all emergency equipments are available and are functioning correctly.

Inspection
and
Maintenance
of
Emergency
Equipment.

Training:
Subjects to
be included
in Training
Courses for
Logging
Supervisors.

81. The following subjects must be included in training courses for logging supervisors—

- (a) fundamentals of radiation safety, including—
 - (i) characteristics of radiation,
 - (ii) units of radiation dose and, if appropriate, quantity of radioactivity,
 - (iii) significance of radiation dose, including, Radiation protection standards and Biological effects of radiation dose,
 - (iv) levels of radiation from sources of radiation, and
 - (v) methods of minimizing radiation dose, including, working time, working distances and Shielding;
- (b) radiation detection instrumentation to be used, include—
 - (i) use of radiation survey instruments, including operation, calibration and limitations,
 - (ii) survey techniques, and
 - (iii) use of personnel monitoring equipment ;
- (c) equipment to be used, include—
 - (i) handling equipment, if appropriate,
 - (ii) sources of radiation,
 - (iii) storage precautions, if appropriate, and control of equipment ; and
 - (iv) operation and control of equipment ;
- (d) training shall also include, the requirements of these Regulations, the Nuclear Safety and Radiation Protection Act, the Nigeria Basic Ionizing Radiation Regulations, the Nigeria Safety and Security of Radioactive Sources Regulations, the Nigeria Transportation of Radioactive Sources Regulations, the Nigeria Radioactive Waste Management Regulations and the Nigeria Radiation Safety in Nuclear Well Logging Regulations ;
- (e) the Licensee's or Registrant's written operating and emergency procedures ; and
- (f) the Licensee's or Registrant's record keeping procedures.

Audit of
Training
Intervals.

82.—(1) All persons nominated to participate in the emergency plans shall be adequately trained to ensure efficient and effective implementation of their roles and this shall include familiarization and understanding of the plans together with training in the use of the emergency equipment.

(2) Training provisions shall be audited at intervals, not exceeding 12 months.

83. Emergency exercises shall be held to test critical components of the emergency plans at intervals and lessons learned shall form part of future reviews of emergency plans.

Emergency Exercises.

84. Formal reviews of emergency plans shall be undertaken annually to ensure—

Periodic Reviews of Emergency Plans.

(a) names of persons, contact details, telephone and fax numbers shall be up to date ; and

(b) emergency equipment is available and maintained.

85.—(1) Notification shall be made of radiation incidents and radioactive sources lost other than downhole logging operations.

Notification of Incidents, Abandonment and Lost Sources.

(2) Whenever a sealed source or device containing radioactive material is lodged downhole, the Licensee shall—

(a) notify the Authority immediately ;

(b) monitor at the surface for the presence of radioactive contamination with a radiation survey instrument or logging tool during logging tool recovery operations ; and

(c) notify the Authority immediately by telephone or e-mail where radioactive contamination is detected at the surface or where the source appears to be damaged.

(3) When it becomes apparent that efforts to recover the radioactive source will not be successful, the Well-Owner shall—

(a) advise the Source-Owner and the Authority of an appropriate method of abandonment, which shall include—

(i) the immobilization and sealing in place of the radioactive source with a cement plug,

(ii) the setting of a whipstock or other deflection device, and

(iii) the mounting of a permanent identification plaque, at the surface of the well, containing the appropriate information required by this section ;

(b) notify the Authority by telephone or e-mail, fax or letter, giving the circumstances of the loss, and request approval of the proposed abandonment procedures.

(4) When efforts to recover the radioactive source are not successful, the Well-Owner shall do the following—

(a) notify the Authority by telephone, e-mail, fax of the circumstances that resulted in the inability to retrieve the radioactive source and obtain the

Authority's approval to implement the abandonment procedures or that the Well-Owner implement abandonment before receiving the Authority's approval because the Well-Owner can demonstrate that there was an immediate threat to public health and safety and nothing can be done further,

(b) file a written report with the Authority within 30 days of the abandonment, setting forth the following information—

(i) date of occurrence and a brief description of attempts to recover the source,

(ii) a description of the radioactive source involved, including radionuclide,

(iii) quantity and chemical and physical form,

(iv) surface location and identification of well,

(v) results of efforts to immobilize and set the source in place,

(vi) depth of the lodged radioactive source,

(vii) depth of the top of the cement plug,

(viii) depth of the well ; and

(ix) information contained on the permanent identification plaque.

(5) Whenever a sealed source containing radioactive material is abandoned downhole, the Well-Owner shall provide a permanent plaque, as described below, for posting the well or well-bore which shall—

(a) be constructed of long-lasting material, such as stainless steel or monel, and

(b) contain the following information engraved on its face—

(i) the word "CAUTION" ;

(ii) the radiation symbol without the conventional color requirement ;

(iii) the date of abandonment ;

(iv) the name of the Well Operator or Well-Owner ;

(v) the well name and well identification numbers or other designation ;

(vi) the sealed sources by radionuclide and quantity of activity ;

(vii) the source depth and the depth to the top of the plug ; and

(viii) an appropriate warning, depending on the specific circumstances of each abandonment which may include—

"DO NOT DRILL BELOW PLUG-BACK DEPTH" ;

"DO NOT ENLARGE CASING" ; or

“DO NOT RE-ENTER THE WELLBORE TO THE SOURCE POSITION”,

followed by the words, “before contacting the Authority”.

(6) The Source-Owner shall immediately notify the Authority by telephone or e-mail, and subsequently by confirming letter, if the Licensee knows or has reason to believe that radioactive material has been lost in or to an underground potable water source. Such notice shall designate the well location, describe the magnitude and extent of loss of radioactive material, assess the consequences of such loss and explain efforts planned or being taken to mitigate these consequences.

(7) In order to learn from the incident situations that have occurred within the organization or elsewhere, and to report back the lessons learned so as to improve equipment, operating procedures and emergency plans, reports of any incident or accidents shall be prepared by the Radiation Safety Officer with the assistance of a Radiation Safety Adviser and the reports shall be submitted to the Authority.

(8) At each stage of the abandonment, the Source-owner shall notify the Authority accordingly.

86. The Incident Report shall include the following—

Details of
the Incident
Report.

(a) a description of the accident, giving as much details as possible concerning the specific equipment involved including model and serial numbers ;

(b) names and designations of all persons affected by the accident ;

(c) environmental conditions at the time of the accident ;

(d) the specific cause of the accident, where known ;

(e) details of actions taken to stabilize the accident situation and restore conditions back to normal ;

(f) evaluation of doses received by all persons affected by the accident ; and

(g) recommendations made with the aim of preventing a similar accident occurring in the future.

PART XII—OFFENCES AND PENALTIES

87.—(1) Any person who contravenes any of the provisions of these Regulations commits an offence.

Offences
and
Penalties.

(2) Any person who commits an offence under these Regulations shall be liable to the penalties as established in the enforcement policy issued by the Authority.

(3) The Authority shall impose penalties such as suspension, revocation of authorization, imposing administrative fine, closure of facility or any combination of these penalties.

(4) Any person or corporate body who, being a holder of authorization under these Regulations, who commits an offence shall be liable to prosecution in a court of law and upon conviction shall be liable to pay fines not exceeding ₦1,000,000.00 (One Million Naira) for an individual and not exceeding ₦10,000, 000.00 (Ten Million Naira) for a corporate body or a jail term not exceeding ten years or both.

Appeal. **88.** A person may appeal to the Board of the Authority if he is not satisfied with the decision made against him pursuant to these Regulations.

Citation. **89.** These Regulations may be cited as the Nigerian Radiation Safety in Nuclear Well Logging Regulations, 2008.

SCHEDULE

DOSE LIMITS

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

- (a) an effective dose of 20 mSv per year averaged over five consecutive years ;
- (b) an effective dose of 50 mSv in any single year ;
- (c) an equivalent dose to the lens of the eye of 150 mSv in a year ; and
- (d) an 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 shall not exceeded :

- (a) an effective dose of 6 mSv in a year ;
- (b) an equivalent dose to the lens of the eye of 50 mSv in a year ; and
- (c) an equivalent dose to the extremities or the skin of 150 mSv in a year.

3. For members of the public, the practice shall be so controlled that the exposure limit of 1 mSv per year is not exceeded.

MADE at Abuja this 11th day of November, 2008.

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).*

These Regulations provide, among other things, for the protection of persons from the harmful effects of exposure to ionizing radiation.



S. I. 21 of 2008

**NUCLEAR SAFETY AND RADIATION PROTECTION ACT
(CAP. N142 LFN, 2004)**

**Nigerian Radiation Safety in Naturally Occurring Radioactive
Materials (NORM) Management Regulations, 2008**

[12th November, 2008] 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. The objective of these Regulations is to establish radiation protection standards for the generation, possession, use, transfer, and disposal of Naturally Occurring Radioactive Materials (herein referred to as "NORM") in order to ensure the protection of human health and environment from the hazards associated with NORM in Nigeria. Objective.

2.—(1) These regulations shall— Scope.

(a) apply to any person who generates, possesses, uses, transfers, or disposes of NORM ;

(b) address the introduction of NORM into products in which neither the NORM nor the radiation emitted from it is considered to be beneficial to the products ;

(c) apply to the manufacture and distribution of products containing NORM in which the NORM or its emitted radiation is considered to be a beneficial attribute ;

(d) not apply to radionuclides defined as source under the Nuclear Safety and Radiation Protection Act of 1995 and is understood that radioactive waste in any concentration regulated by the Nigerian Nuclear Regulatory Authority are not subject to this rule.

3. In these Regulations—

"Authority" means the Nigerian Nuclear Regulatory Authority ;

"beneficial attribute" or "beneficial to the product" means the radioactivity of the product is necessary to the use of the product ;

"consumer products" means appliance or device produced, made, manufactured, refined, or beneficiated in which a small amount of radioactive substance has been deliberately incorporated or induced, and which can be supplied to members of the public ;

Interpretation.

"containment" means methods or physical structures that prevent the dispersion of radionuclides ;

"contamination" means the presence of radioactive substances in or on a material or in the human body or other place where they are undesirable or could be harmful ;

"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 :

$$E = \sum_T W_T \cdot \sum_R W_R \cdot D_{T,R}$$

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 $J \cdot kg^{-1}$, termed the Sievert (Sv).

"exempt waste" means any waste that is released from nuclear regulatory control in accordance with clearance levels because the associated radiological hazard are negligible. The designation should be in terms of activity concentration or total activity and may include a specification of the type, chemical or physical form, mass or volume of waste, and its potential use ;

"external radiation" means, in relation to a person, ionizing radiation coming from outside the body of that person ;

"effluent" means gaseous or liquid radioactive materials which are discharged into the environment ;

"exempt" means a designation for sources of radiation that are not subject to nuclear regulatory control because they present such a low radiological hazard ;

"exposure" means irradiation of people or materials. Exposure can either be external exposure from sources outside the body or internal exposure from sources inside the body ;

"decontamination" means the removal or reduction of radioactive contamination by a physical or chemical process ;

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

"general environment" means the total terrestrial, atmospheric, and aquatic environments outside the site boundary within which any activity, operation, or process authorized by a general or specific license issued under this Part is performed ;

"institutional control" means control of a waste site by the authority or an institution designated under regulations ;

"licence" means an authorization granted by the Authority on the basis of a safety assessment and accompanied by specific requirements and conditions to be complied with by the licensee ;

"monitoring" means the measurement of radiation or radionuclides for reasons related to the assessment or control of exposure and the interpretation of such measurements ;

"Naturally Occurring Radioactive Material (NORM)" means naturally occurring materials not regulated under the Authority whose radionuclide concentrations have been increased by or as a result of human practices and NORM does not include the natural radioactivity of rocks or soils, or background radiation, but instead refers to materials whose radioactivity is enhanced by controllable practices (or by past human practices) ;

"notification" means a document submitted to the regulatory authority by a legal person to notify an intention to carry out a practice or any other action described in the general obligations for practices of the standards ;

"product" means something produced, made, manufactured, refined, or beneficiated ;

"probabilistic analysis" means a statistical method for studying the expected behaviour of a system defined by parameters, events and features whose values are represented by a statistical distribution ;

"quality assurance" means all those planned and systematic actions necessary to provide adequate confidence that an item, process or service will satisfy given requirements for quality, for example, those specified in the license ;

"quality control" means action which provides means to control and measure the characteristics of an item, process, facility or person in accordance with quality assurance requirements ;

"radiation protection" means measures associated with limitation of the harmful effects of ionizing radiation on people, such as limitation of external exposure to such radiation, limitation of incorporation of radionuclides as well as the prophylactic limitation of injury resulting from either of these ;

"*radionuclide*" means a nucleus (of an atom) that possess properties of spontaneous disintegration (radioactivity). Nuclei are distinguished by their mass and atomic number ;

"*requirement*" means a condition defined as necessary to be met by a product, material or process ;

"*safety analysis*" means the evaluation of the potential hazards associated with the implementation of a proposed activity ;

"*safety criteria*" means safety conditions on which a decision or judgment can be based as set by the authority ;

"*shielding*" means a material interposed between a source of radiation and persons, or equipment or other objects, in order to absorb radiation and thereby reduce radiation exposure ;

"*source*" means any physical entity that may cause radiation exposure, for example by emitting ionizing radiation or releasing radioactive material ;

"*storage*" means the placement of waste in a facility where isolation, environmental protection and human control are provided with the intent that the waste will be retrieved for exemption or processing or disposal at a later time ;

"*transport*" means, in relation to *TENORM*, carriage of substance on a road within the meaning of, or through another public place, whether on a conveyance or not, or by rail, inland waterway, sea or air and, in the case of transport on a conveyance *TENORM* shall be deemed as being transported from the time that it is loaded onto the conveyance for the purpose of transporting it until it is unloaded from that conveyance, but *TENORM* shall not be considered as being transported if—

(a) it is transported by means of a pipeline or similar means ; or

(b) it forms an integral part of a conveyance and is used in connection with the operation of that conveyance ;

"*treatment*" means the operations intended to benefit safety and/or economy by changing the characteristics of waste and these three basic treatment objectives are :

(a) volume reduction ;

(b) removal of radionuclides from the waste ;

(c) change of composition,

and after treatment, the waste may or may not be immobilized to achieve an appropriate waste form ;

"unrestricted use" means a designation, by the authority that enables the use of equipment, materials, buildings or the site without radiological restriction.

4.—(1) Persons who generate, receive, own, possess, use, process, transfer, distribute, and dispose of NORM are exempt from the requirements of these Regulations if the materials contain or are contaminated at concentrations less than 1 Bq/kg of uranium or thorium series radionuclides.

Exemptions.

(2) Purposeful dilution to render NORM exempt shall not be allowed.

(3) A person who receives products or materials containing NORM distributed in accordance with a specific license issued by the Authority pursuant to these Regulations is exempted from these Regulations with regard to those products or materials.

5.—(1) A person licensed under regulations 9 or 10 of these Regulations shall not conduct operations, use, or transfer NORM in a manner such that a member of the public will receive an annual Effective Dose in excess of 1 mSv/yr from all licensed sources including NORM ;

Standards
for
Radiation
Protection
for NORM.

(2) A person subject to a license under these Regulations shall comply with radiation protection standards set out in the Nigeria Basic Ionizing Radiation Regulations 2003.

(3) Doses from indoor radon and its progeny shall not be included in Effective Dose calculations.

(4) The use, transfer or disposal of NORM shall be done in such a way as to prevent accumulation of radon in residential structures, schools and other public buildings in concentrations exceeding 0.2 Bq/l and 1.0 Bq/l.

(5) No person shall dispose or release NORM for unrestricted use in such a manner that the reasonably exposed individual will receive an annual Effective Dose in excess of 0.25 mSv/yr excluding natural background.

6. A licensee under these Regulations shall conduct operations in compliance with the standards for radiation protection set out in the Nigeria Basic Ionizing Radiation Regulations 2003 except for the release of radioactivity in effluents, which shall be governed by regulation 8 of these Regulations and other relevant Regulations.

Protection
of Workers
During
Operations.

7.—(1) Each person subject to a license under these Regulations shall—

(a) ensure that facilities and equipments contaminated with NORM in excess of the levels set forth in Appendix A of these Regulations—

Release for
Unrestricted
Use.

(i) shall not be transferred or released for unrestricted use, or

(ii) shall be evaluated prior to release for unrestricted use to ensure that the levels in Appendix A are not exceeded ;

(b) not transfer land for unrestricted use where the concentration of uranium or thorium series radionuclides in soil averaged over any 100 square meters exceeds the background level by more than 1 Bq/g, averaged over top 15 cm layer of soil, unless in compliance with regulation 5(2) to (5) of these Regulations can be proved.

Management
and Transfer
of Waste for
Disposal.

8.—(1) A licensee under this regulation shall manage and dispose of wastes containing NORM in accordance with Nigeria Radioactive Waste Management Regulations and other applicable requirements of the Ministry of Environment for disposal of such wastes and—

(a) by transfer of the wastes for disposal to a disposal facility licensed by the Authority ; or

(b) in accordance with alternate methods authorized by the Authority upon application or upon the Authority's initiative, and consistent with sub-regulation 5 of these Regulations.

(2) Equipment contaminated with NORM in excess of levels specified in Appendix A, which, is to be disposed of as waste shall be disposed of—

(a) to prevent any reintroduction into commercial or unrestricted use ; and

(b) within disposal areas specifically designed to meet the criteria of sub-regulation (1) of this regulation.

(3) Transfers of waste containing NORM for disposal shall be made only to a person specifically authorized by the Authority to receive such waste.

(4) Records of disposal, including manifests, shall be maintained pursuant to the provisions of these regulations.

(5) Disposal practices and sites shall be subject to institutional control as appropriate and determined by the Authority in accordance with these Regulations.

General
Licence.

9.—(1) Subject to the requirements of this regulation and regulations 5 to 8 of these Regulations a general licence shall be issued upon application to generate, possess, own, use, transfer and dispose of NORM without regard to quantity.

(2) This general licence shall not authorize the manufacturing or distribution of products containing NORM in concentrations greater than those specified in regulation 4 (1) of these Regulations nor the receipt and disposal of wastes from other persons.

(3) Decontamination other than that incidental to routine maintenance by a general licensee of its own equipment or facilities shall be conducted pursuant to a specific licence.

(4) A person subject to the general licence issued by this regulation shall notify the Authority and such notification shall include—

- (a) name and address of the registrant ;
- (b) location and description of the facility or operation ;
- (c) description of the NORM including estimates of the amount and extent of NORM.

10.—(1) The transfer of NORM not exempted from these Regulations from one general licensee to another general licensee shall be authorized by the Authority if—

Transfer of
NORM
contaminated
facilities.

- (a) the equipment and facilities contaminated with NORM are to be used by the recipient for the same purpose ; or
- (b) the transfer of control or ownership of land contaminated with NORM includes an annotation of the deed records to indicate the presence of NORM ; or

(2) The Authority may approve transfers which do not meet the criteria of sub-regulation (1) of this Regulation.

(3) Transfers made under sub-regulation (1) of this regulation do not relieve the general licensee who makes the transfer from the responsibilities of assessing the extent of NORM contamination or material present, evaluating the hazards of the NORM, informing the general licensee receiving the NORM of these assessments and evaluations, and maintaining records required by these Regulations.

(4) A general licensee intending to transfer NORM contaminated facilities for unrestricted use shall document compliance with the requirements of regulation 7 of these Regulations and records of such compliance shall be kept.

(5) The Authority may, by written notice, require any person authorised by a general permit to apply for and obtain a specific licence and the notice shall state the reason or reasons for requiring a specific licence.

11.—(1) Unless otherwise exempted, a specific licence is required to—

Specific
Licences.

(a) manufacture and distribute any material or product containing NORM unless otherwise exempted under the provisions of regulation 4 of these Regulations or licensed under the provisions of the Nigeria Radioactive Waste Management Regulations ;

(b) except as provided in regulation 9(3) of these Regulations, decontaminated equipment or land not otherwise exempted under the provisions of Regulation 4 of these Regulations or facilities contaminated

with NORM in excess of the levels set forth in regulation 7 of these Regulations, as applicable ; and

(c) receive NORM from other persons for disposal.

(2) For the purposes of sub-regulation (1)(b) of this regulation, the term 'decontaminate' includes maintenance which incidentally results in removal of contamination.

Application
for Specific
Licences.

12.—(1) Applications for specific licences shall be made in a manner and on a form prescribed by the Authority.

(2) The Authority may at any time after the submission of the original application and before the expiration of the licence, require further statements in order to enable the Authority determine whether the application should be granted or denied or whether a licence shall be modified or revoked.

(3) An application shall be signed by the applicant or licensee or a person duly authorized to act for and on the licensee's behalf.

(4) An application for a licence may include a request for a license authorizing one or more activities.

(5) An application for a specific licence shall be accompanied by the prescribed fee.

(6) The applicant may incorporate by reference information contained in previous applications, statements, or reports provided to the Authority in the application, provided such references are clear and specific.

(7) Applications and documents submitted to the Authority may be made available for public inspection.

Requirements
for the
Issuance of
Specific
Licences.

13.—(1) A licence application shall be approved if the Authority determines that the—

(a) applicant is qualified by reason of training and experience to use the NORM in question for the purpose requested and in accordance with these Regulations in such a manner as to protect public health, safety and property ;

(b) applicant's proposed equipment, facilities, and procedures are adequate to protect the public health, safety and property ;

(c) issuance of the license will not be inimical to the health and safety of the public ;

(d) applicant satisfied any applicable special requirement in this regulation ;

(e) applicant has met the financial requirements ;

(f) applicant has adequately addressed the following items in the application—

- (i) procedures and equipment for monitoring and protecting workers ;
- (ii) an evaluation of the radiation levels and concentrations of contamination expected during normal operations ;
- (iii) operating and emergency procedures, including procedures for waste reduction and quality assurance of items released for unrestricted use ; and
- (iv) a method for managing the radioactive material removed from contaminated equipment and facilities.

(2) An application for a specific licence to decontaminate equipment, land, or facilities contaminated with NORM in excess of the levels set forth in regulations 4(1) and 7(b) or Appendix A of these Regulations, as applicable, and the disposal of the resulting waste will be approved if the—

(a) applicant satisfies the general requirements specified in sub-regulation (1) of this regulations ; and

(b) applicant has adequately addressed the following items in the application—

- (i) procedures and equipment for monitoring and protection of workers ;
- (ii) an evaluation of the radiation levels and concentrations of contamination expected during normal operations ;
- (iii) operating and emergency procedures, including procedures for waste reduction and quality assurance of items released for unrestricted use ; and
- (iv) the method of disposing the NORM removed from contaminated equipment, facilities or land.

(3) An application for a specific license to manufacture or initially transfer products or materials containing TENORM to persons exempted from these regulations pursuant to regulation 4(1) of these Regulations shall be approved if the—

(a) applicant satisfies the general requirements specified in sub-regulation (1) (a) of this regulation ;

(b) NORM is not contained in any food, beverage, cosmetic, drug, or other commodity designed for ingestion or inhalation by, or application to, a human being ; and

(c) applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling or marking, and conditions of handling, storage, use, and disposal of the NORM material or product to demonstrate that the material or product will meet the safety criteria set forth in regulation 14 of these Regulations and the information shall include—

(i) a description of the material or product and its intended use or uses ;

(ii) the type, quantity, and concentration of NORM in each material or product ;

(iii) the chemical and physical form of the NORM in the material or product, and changes in chemical and physical form that may occur during the useful life of the material or product ;

(iv) an analysis of the solubility in water and body fluids of the NORM in the material or product ;

(v) the details of manufacture and design of the material or product relating to containment and shielding of the NORM and other safety features under normal and severe conditions of handling, storage, use, reuse, and disposal of the material or product ;

(vi) the degree of access of human beings to the material or product during normal handling, use, and disposal ;

(vii) the total quantity of NORM expected to be distributed annually in the material or product ;

(viii) the expected useful life of the material or product ;

(ix) the proposed method of labeling or marking each unit of the material or product with identification of the manufacturer or initial transferor of the product and the radionuclides and quantity of NORM in the material or product ;

(x) the procedures for prototype testing of the material or product to demonstrate the effectiveness of the containment, shielding, and other safety features under both normal and severe conditions of handling, storage, use, reuse, and disposal ;

(xi) the results of the prototype testing of the material or product, including any change in the form of the NORM contained in it, the extent to which the NORM may be released to the environment, any change in radiation levels, and any other changes in safety features ;

(xii) the estimated external radiation doses and dose commitments relevant to the safety criteria in Regulation 14 of these Regulations and the basis for such estimates ;

(xiii) a determination that the probabilities with respect to doses referred to in regulation 14 of these Regulations meet the safety criteria ;

(xiv) the quality control procedures to be followed in the production of production lots of the material or product, and the quality control standards the material or product will be required to meet ; and

(xv) any additional information, including experimental studies and tests, required by the Authority to facilitate a determination of the radiation safety of the material or product.

(4) An application for a specific license to dispose of NORM received from others will be approved if—

(a) the applicant demonstrates that operation of the facility will comply with the standards of regulations 5 and 8 of these Regulations ; and

(b) the applicant demonstrates that adequate institutional controls have been implemented.

(5) Notwithstanding the provisions of regulation 14(b) of these Regulations, the Authority may deny an application for a specific licence if the end uses of the product are frivolous or cannot be reasonably foreseen.

14. An applicant for a license under regulation 13 of these Regulations shall demonstrate that the product is designed in such a way that, when manufactured—

Safety
Criteria for
Products.

(a) the use and disposal of a single exempt item and the handling and storage of the quantities of exempt items likely to accumulate in one location during—

(i) marketing,

(ii) distribution,

(iii) installation, and

(iv) servicing of the product,

is unlikely that the external radiation dose in any one year or the dose commitment resulting from the intake of radioactive material in any one year by individuals who are most exposed to radiation or radioactive materials from the product will exceed the doses in Column I of the Table in Appendix B of these Regulations ;

(b) in use and disposal of a single exempt item and in handling and storage of the quantities of exempt items likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, the probability is low that the containment, shielding, or other safety features

of the product would fail under such circumstances that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column II of the Table in Appendix B of these Regulations ;

(c) the probability is negligible that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column III of the Table in the Appendix B of these Regulations ; and

(d) it is unlikely that there will be a significant reduction in the effectiveness of the containment, shielding, or other safety features of the product from wear and abuse likely to occur in normal handling and use of the product during its useful life.

Issuance of
Specific
Licences.

15.—(1) Where an application meets the requirements of regulation 13 of these Regulations, the Authority will issue a specific licence authorising the proposed activity in such form and containing such conditions and limitations as it deems appropriate or necessary.

(2) The Authority may incorporate in a licence at the time of issuance or thereafter by amendment, such additional requirements and conditions with respect to the licensee's receipt, possession, use, and transfer of NORM subject to these Regulations as it deems appropriate or necessary in order to—

(a) protect public health and safety or property ;

(b) provide for such inspections of activities under the licence as may be appropriate, require report of the inspections and keep the record of same ; and

(c) prevent loss or theft of NORM subject to these Regulations.

Conditions
for issuance
of Licences
under
regulation
13.

16. (A) General Terms and Conditions :

(1) Each licence issued pursuant to these Regulations shall be subject to all the provisions of other Rules, Regulations and Orders of the Authority.

(2) Any licence issued under these Regulations and any right to possess or to utilize NORM granted by any licence issued pursuant to this regulation shall not be transferred, assigned, or disposed of in any manner either voluntarily or involuntarily, directly or indirectly, through transfer of control of any licence to any person unless the Authority shall, after securing full information, finds that the transfer is in accordance with the provisions of this regulations, and shall give its consent in writing.

(3) A person licensed by the Authority pursuant to these Regulations shall confine the use and possession of the NORM licenced to the locations and purposes authorised in the license.

(4) A person licensed by the Authority pursuant to these Regulations is subject to the general licence provisions in regulations 6, 7 and 8 of these Regulations.

(B) Quality Control, Labeling, and Reports of Transfer :

An applicant under regulation 13(3) of these regulations shall—

(a) carry out adequate control procedures in the manufacture of the product to ensure that each production lot meets the quality control standards approved by the Authority ;

(b) label or mark each unit so that the manufacturer, processor, producer, or initial transferer of the material or product and the NORM in the product can be identified ; and

(c) maintain records of any person to whom NORM is transferred for use under regulation 4(2) of these Regulations stating—

(i) the kinds, quantities, and uses of NORM transferred,

(ii) an annual summary ;

(iii) the total quantity of each radionuclide transferred under the specific licence which shall be provided to the Authority,

and the report shall cover the year ending December 31, and shall be filed within 90 days thereafter and if no transfers of NORM have been made pursuant to regulation 13(3) of these Regulations during the reporting period, the report shall so indicate.

17.—(1) Except as provided in sub-regulation (6) of this regulation and regulation 18(b) of these Regulations, a specific licence shall expire at the end of the specified day in the month and year stated therein.

Expiration
and
Termination
of Licences.

(2) Each licensee shall notify the Authority in writing and request termination of the licence when the licensee decides to terminate all activities involving NORM authorized under the licence.

(3) The notification and request for termination of the licence must include the reports and information specified in sub-regulation (5) of this regulation.

(4) Not less than 30 days before the expiration date specified in a specific licence, the licensee shall either—

(a) submit an application for licence renewal under regulation 18 of these Regulations ; or

(b) notify the Authority in writing, under sub-regulation (2) of this regulation, if the licensee decides to discontinue all activities involving NORM.

(5) Where a licensee does not submit an application for licence renewal under regulation 18 of these Regulations, the licensee shall on or before the expiration date specified in the licence—

- (a) terminate use of NORM ;
- (b) remove NORM contamination consistent with the requirements of regulation 7 of these Regulations ;
- (c) properly dispose of NORM ; and
- (d) submit a report of disposal of NORM and radiation surveys to confirm the absence of NORM or to establish the levels of residual NORM contamination and the licensee shall, as appropriate—
 - (i) report levels of radiation in units of microsieverts per hour of beta radiation at one centimeter and gamma radiation at one meter from surfaces,
 - (ii) report levels of radioactivity in units of Becquerels per 100 square centimeters on removable and fixed surfaces, Becquerel per milliliter in water, and Becquerels per gram in contaminated solids such as soils or concrete ; and
 - (iii) specify the instruments used and certify that each instrument is properly calibrated and tested.

(6) If no radioactivity attributable to activities conducted under the license is detected, the licensee shall submit a certification that no detectable NORM contamination was found.

(7) If the Authority determines that this certification and the information submitted under sub-regulation (5) of this regulation is adequate and surveys confirm the findings, the Authority will notify the licensee in writing that the license is terminated.

(8) If levels of residual NORM are not in conformance with criteria established in regulation 7 of these Regulations, the licence continues in effect beyond the expiration date, if necessary, with respect to possession of residual NORM until the Authority notifies the licensee in writing that the licence is terminated and during this time, the licensee is subject to the provisions of sub-regulation (7) of this regulation.

(9) Subject to the provisions sub-regulation (5)(d) of this regulation, the licensee shall submit a plan, if appropriate, for decontaminating the location(s) and disposing of the residual NORM.

(10) A licensee who possesses residual NORM under sub-regulation (7) of this regulation, following the expiration date specified in the licence, shall—

(a) be limited to actions involving NORM related to preparing the locations for release for unrestricted use ; and

(b) continue to control entry to restricted areas until the locations are suitable for release for unrestricted use and the Authority notifies the licensee in writing that the license is terminated.

18.—(1) Applications for renewal of specific licenses shall be filed in accordance with regulation 12 of these Regulations.

Renewal of
Licenses.

(2) Where a licensee, not less than 30 days prior to expiration of an existing license, has filed an application in proper form for renewal or for a new licence authorising the same activities, such existing licence shall not expire until final action by the Authority.

19. Applications for amendment of a license shall be filed in accordance with regulation 21 of these Regulations and shall specify the respects in which the licensee desires the licence to be amended and the grounds for such amendment.

Amendment
of Licenses
at Request
of Licensee.

20. In considering an application by a licensee to renew or amend the license, the Authority will apply the criteria set forth in regulation 13 of these Regulations.

Authority
action on
applications
to renew and
amend.

21.—(1) The terms and conditions of all licence shall be subject to amendment, revision, or modification or the licence may be suspended or revoked by reason of amendments to these Regulations or by reason of Rules, Regulations or Orders issued by the Authority.

Modification
and
Revocation
of Licence

(2) A licence may be revoked, suspended, or modified in whole or in part for—

(a) any material false statement in the application ;

(b) any statement of fact required under provisions of these regulations ;

(c) conditions revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Authority to refuse to grant a licence on an original application ; and

(d) violation of, or failure to observe any of the terms and conditions of the regulations, or of the license, or of any rule, regulation, or order of the Authority.

(3) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, the Authority shall not modify, suspend or revoke a license prior to the institution of proceedings unless facts or

conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

Offences
and
penalties.

22.—(1) A person who contravenes any of the provisions of these Regulations has committed an offence and shall be liable to the penalties as established in the enforcement policy issued by the Authority.

(2) The Authority shall impose penalties such as suspension or revocation of authorization, imposing administrative fine or closure of facility or any combination of these.

(3) A holder of authorization under these Regulations who commits an offence is liable and upon conviction shall pay a fine of not more than ₦1,000,000 for an individual and not more than ₦10,000,000 for a corporate body or imprisonment for a minimum term of not less than two years or both.

(4) Any person or organization may appeal to the Board of the Authority against any decision made by the Authority pursuant to these Regulations.

Citation.

23. These Regulations may be cited as the Nigeria Naturally Occurring Radioactive Materials (NORM) Regulations 2008.

APPENDIX A

ACCEPTABLE SURFACE CONTAMINATION¹ LEVELS
FOR TENORM

	<i>Average</i> ^{2,3,6}	<i>Maximum</i> ^{2,4,6}	<i>Removable</i> ^{2,3,5,6}
Alpha	80 Bq/100 cm ²	250 Bq /100 cm ²	16 Bq /100 cm ²
Beta gamma	80 Bq/100 cm ²	250 Bq /100 cm ²	16 Bq /100 cm ²

1. Where surface contamination by both alpha and beta-gamma emitting nuclides exists, the the more restrictive limit applies.

2. As used in this table, Becquerel (Bq) means the rate of emission by radioactive material as determined by correcting the counts per second observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

3. Measurements of average contamination level should not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each object.

4. The maximum contamination level applies to an area of not more than 100 cm².

5. The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

6. The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 2 uGy/hr at 1 cm and 10 uGy/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

APPENDIX B

TABLE OF ORGAN DOSES

<i>Part of Body</i>	<i>Column I Dose</i>	<i>Column II Dose</i>	<i>Column III Dose</i>
Whole body; head and trunk; active blood-forming organs; gonads; or lens of eye.	0.05 mSv	5 mSv	150 mSv
Hands and forearms; feet and ankles; localized areas of skin averaged over areas no larger than 1 square centimeter.	0.75 mSv	75 mSv	1000 mSv
Other organs.	0.15mSv	15 mSv	500 mSv

*Dose limit is the dose above background from the product.

MADE at Abuja this 11th day of November, 2008.

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

