AEC RADIATION SAFETY GUIDE
SAFE USE OF INDUSTRIAL RADIOGRAPHY DEVICES (X-RAY AND GAMMA)

AEC-RSG 2.2, 2015
FOREWORD

The Atomic energy Council (AEC) was created by the Atomic Energy Act No. 24 of 2008 with a mandate to regulate the peaceful applications of ionising radiation; to provide for the protection and safety of individuals, society and the environment from the dangers resulting from ionising radiation; to provide for the production and use of radiation sources and the management of radioactive waste; to provide for compliance with international safety requirements for the use of ionising radiation, radiation protection and security of radioactive sources; and for other related matters.

This guide was prepared to assist the Registrant/Licensee to follow systematic procedures which will facilitate an effective implementation of the provisions of the Atomic Energy Regulations, 2012.

This guide was prepared by the Atomic Energy Council with the assistance of the International Atomic Energy Agency.
PREFACE

In the frame work of the IAEA-Country Project “Strengthening the National Regulatory Infrastructure and developing a National Nuclear Security System to Control radiation Sources and Occupational Exposure”, some of the essential elements were developing of regulatory capability for licensing and inspection, enforcement and occupational radiation protection, medical exposure control and public exposure control. The need to prepare supporting documents such as codes of practice, standards, guides and relevant documents was recognized.

This guide was prepared basing on the following hierarchy:

- Legislation-The Atomic Energy Act No. 24 of 2008 that established the Atomic Energy Council and its powers and functions
- Regulations- The Atomic Energy Regulations, 2012 which were made for the better carrying into effect of the provisions of the Act
- Radiation Safety guides which provide guidance for regulators, registrants, licensees and stakeholders for complying with the regulations as required by s.74 of the Act.

The recommendations in this guide are intended only for all persons/organisations involved in the use/handling of radiation sources. They include the regulatory staff, employers, licensees, registrants, management bodies and their advisers, Radiation Safety Committees, Radiation Safety Officers and Radiation Protection Officers.

Approved by

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Under section 74 of the Atomic Energy Act No. 24 of 2008, Atomic Energy Council (AEC) is authorised to issue general instructions, known as Radiation Safety Guides, concerning the use and practices involving ionising radiation.

The Atomic Energy Act stipulates that the authorised person for a radiation practice is responsible for the safety of the operations. The authorised person is obliged to ensure that the level of safety specified in Radiation Safety Guides is attained and maintained.
DEFINITIONS

“Approved” means approved by the AEC.

“Authorisation” means licence granted in writing by the AEC to a licensee who has submitted an application to carry out a practice.

“Authorised person” means a person issued an authorisation under section 37 of the Atomic Energy Act No. 24 of 2008.

“Control panel” means an operating and control device of an X-ray device, containing controllers for current and voltage, a timer, radiation signal lights and the main switch with its key.

“Defence in Depth” means the application of more than a single protective measure for a given safety or security objective such that the objective is achieved even if one of the protective measures fails.

“Dose” means a measure of the radiation received or absorbed by a target.

“Dose rate” means dose received or absorbed by a target per unit time.

“Emergency plan” means a set of procedures to be implemented in the event of a radiation accident.

“Environment” means the physical factors of the surroundings of human beings, animals and plants including land, water, atmosphere and their interactions.

“Exposure” means being subjected to ionising radiation.

“Gamma radiography device” means a device containing a radioactive source. It consists of source container, source assembly, guide tube, exposure head, diaphragm, winding gear, winding cable, winding cable sheath and associated connectors and couplings

“Industrial radiographer” means a person approved and registered by the AEC, who performs radiography, assists in radiography or acts as a lead industrial radiographer for open area industrial radiography.

“Lead industrial radiographer” means an approved industrial radiographer in charge of safety and operations in open area radiography.

“Leakage radiation” means the portion of radiation that penetrates the protective housing of an X-ray tube unit or the exposure container wall of a gamma radiography device.

“Monitoring” means the measurement of a dose or contamination for purposes related to the assessment or control of exposure to radiation or radioactive substances, and the interpretation of the results.
“Panoramic X-ray device” means an X-ray device with a radiation window of 360º.

“Practice” means any human activity that adds or may add to the exposure of personnel or the members of public.

“Radiation” means ionising radiation.

“Radiation Safety Officer” means a person appointed and approved under section 36 of the Atomic Energy Act No. 24 of 2008.

“Radiation worker” means any person, whether full time, part time or temporarily employed, who can be exposed to annual dose in excess of 1 mSv, and has recognised rights and duties in relation to occupational radiation protection.

“Radioactive material” means any matter or substance containing one or more radionuclides, the activity or concentration of which is sufficiently intense to entail a significant risk of disability or disease to any body or organ in exposure, whether external or internal, and whether continuous or total.

“Radioactive source” means radioactive material that is permanently sealed in a capsule or closely bonded in a solid form.

“Sealed source” means a source consisting of radioactive material firmly incorporated in a solid of effectively inactive materials, or sealed in an inactive container of a strength sufficient to prevent, under normal conditions of use, any dispersion of radioactive material and any possibility of contamination.

“Security” means measures to prevent unauthorised access or damage to, and loss, theft or unauthorised transfer of radioactive materials;

“Source” means anything that may cause radiation exposure, such as by emitting ionising radiation or releasing radioactive substances or materials;

“Team” means personnel tasked to undertake open area industrial radiography, a team consists of a lead industrial radiographer in charge of operations and a trainee radiographer or an assistant.

“X-ray crawler” means an X-ray tube unit mounted on a mobile platform equipped with wheels and a power unit. The device is used for pipeline radiography; it is guided to the appropriate spot from outside of the pipeline using a radiation source or some other tracking mechanism.

“X-ray radiography device” means a device generating ionising radiation through electrical means. It consists of X-ray tube, lead cap, diaphragm, high voltage generator, control panel, and cables.
1.0 INTRODUCTION

This radiation safety guide presents the radiation safety requirements for industrial radiography practices (both x-ray and gamma radiography). The radiation safety guides shall also apply to scanning and imaging practices, where they are undertaken in conditions and with devices similar to those in industrial radiography. Such practices include, for example, scanning of objects using pulsed X-ray devices and particle accelerators.

Industrial radiography is usually undertaken in field conditions or in premises of an industrial plant where other workers are present. Industrial radiographers, trainee radiographers and assistants must be classified as radiation workers, therefore their radiation exposures must be monitored and the work areas must be classified. Other workers will not need to be classified as radiation workers, nor will any monitoring of radiation exposure be required, provided that the practice is conducted in accordance with the requirements of this guide.
2.0 ADMINISTRATIVE REQUIREMENTS

a) Anyone planning to start industrial radiography operation must notify AEC for pre approval of the practice.
b) An application for license to possess and use industrial radiography devices shall be submitted to AEC by the authorized person. A separate application must be submitted for all new device(s).
c) An application for renewal of license has to be submitted no later than three months prior to the expiry date.
d) All changes to the practice carried out under the license must be submitted in an application to the AEC.
e) The applicant shall nominate a Radiation Safety Officer (RSO) for approval by the AEC. Should the approved RSO be changed at any stage, an application to nominate a new RSO must be submitted to the AEC in writing.
f) The applicant shall nominate all industrial radiographer(s) for approval and registration by the AEC as authorised industrial radiographers and radiation worker(s).
g) The applicant shall send a list of all radiation workers to AEC for registration prior to work commencing. Changes in the list of radiation workers must be notified to the AEC.
h) The authorized person, herein referred to as licensee, shall provide an inventory of radiation sources to the AEC at periodic intervals indicated on the license.
i) In case of incidents and accidents in industrial radiography, the licensee shall notify AEC without undue delay.

Atomic Energy Act No. 24 of 2008, sections 34, 35, 50, 51 and 55(c,d).
AER, 2012, sections 9,15, 34 and 65.
3.0 EXPOSURE MONITORING

a) Radiation workers (i.e. radiographers, trainee radiographers and assistants) must be issued with appropriate personal dosimeters (e.g. TLD, the dosimeters), must be worn by radiation workers to whom it is assigned (e.g. attached to their clothing) during the course of their work. Reported doses must be retained and recorded by the licensee, and such records shall be kept for at least 30 years after the end of the employment of the radiation worker.

b) Licensee must have an appropriate radiation meter to monitor radiation exposure, define and continually assess controlled and supervised areas. If a licensee has more than one radiography team or unit each of them must have their own radiation meter.

c) Industrial radiographers performing radiography must be issued with a personal alarming dosimeter (pocket dosimeter) giving a clear audible response at dose rates demarcating the controlled area (in excess of 50μSv/h). The personal alarming dosimeter should work at high dose rates without saturation.

d) Radiation meters and audible-alarm dosimeters must be checked for correct response to radiation at periods not exceeding 12 months. Records of all checks must be kept.

e) Radiation monitors must be calibrated at an approved facility in accordance with the manufacturer’s recommendation and in consultation with AEC.

AER, 2012, Sections 33, 34, 35, 37, 39, 40 and 43.
4.0 TRAINING REQUIREMENTS FOR INDUSTRIAL RADIOGRAPHER, TRAINEE RADIOGRAPHER AND ASSISTANT

a) The licensee must ensure that all industrial radiographers are approved by the AEC, and that trainee radiographers and assistants performing tasks associated with industrial radiography are trained and familiar with the correct operating and safety procedures.

b) All radiation workers must be given training at least once a year in radiation safety aspects relating to their work.

Where an industrial radiographer has not participated in a radiographic operation for more than 3 months, or has not used a particular type of radiographic apparatus for the above period, the RSO must observe that individual’s performance the next time they participate in radiographic operations.

c) The licensee shall keep records of all training provided. These records must include but not limited to; details of the performance of radiographers, content and date of periodic training, awarded certificates.

AER, 2012, sections 29,30 and,35(g).
5.0 OPERATING PROCEDURES

5.1 General Requirements

a) Industrial radiographers, trainee radiographers and assistants shall have access to the operator’s manuals and local rules including emergency plans drawn up by the licensee. The forementioned documents must be made available to all radiation workers even when performing their tasks outside their regular places of work.

b) Industrial radiography may only be performed by:
   i) a qualified industrial radiographer approved by the AEC; or
   ii) a trainee radiographer under the direct supervision of an approved industrial radiographer who assumes full responsibility for the actions of the trainee radiographer.

c) Radiography devices, accessories and auxiliary equipment (i.e. radiation monitors, alarming dosimeters, etc) must be checked by the radiographer before and after use, and the condition of such equipment noted in a logbook. If any equipment is not in a proper working condition, radiography must NOT be carried out and the component or item replaced or repaired before use.

Atomic Energy Act No. 24 of 2008, sections 60 and 61.
AER, 2012, section 38.

5.2 Radiography in Open Areas

a) Industrial radiography in open areas must be performed by a team consisting of an industrial radiographer who leads the team and a trainee radiographer or an assistant.

b) The team must have the necessary equipment (e.g. barrier rope, mechanical supports, etc) for demarcating supervised and controlled areas as well as radiation warning signs, and in the case of night-work, warning lights.

c) Appropriate diaphragms must be used for collimation of the field size of the
primary beam to the minimum practicable size necessary for the performance of the work. Where it is not possible to use a diaphragm, appropriate shielding material should be used in the direction of the primary beam.

d) Barriers must be erected at a distance calculated prior to commencing the exposure, so as to ensure that the dose rate does not exceed 10µSv/h.

e) Boundaries of adjacent sites on which industrial radiography is done should not overlap. If overlap is unavoidable, close liaison shall be maintained between lead industrial radiographers responsible for the overlapping sites to avoid accidental exposure.

f) Before commencing the exposure the team must ensure that no people are within the demarcated area.

AER, 2012, sections 37, 41 and 63.

5.2.1 Additional requirements for open area x-ray radiography

a) When the X-ray machine is left unattended the lead industrial radiographer must render the X-ray device inoperable by locking the control panel and removing the key.

b) When not in use, X-ray radiography devices must be stored safely and securely.

AER, 2012, section 63.

5.2.2 Additional requirements for open area gamma radiography

a) After rewinding the radioactive source to a secured “beam off” position and before rolling up the guide tube, the lead industrial radiographer must use a radiation meter to monitor the entire circumference of the source container, as well as the length of the guide tube. This is to ensure that the radioactive source has indeed returned to a secured “beam off” position before locking the source container and returning it to the storage facility or to the transport vehicle.

b) Radiography apparatus containing radioactive sources must not be left unattended to unless secured in an approved storage facility.

AER, 2012, sections 35 and 63.

5.3 Radiography in Enclosed Exposure Facilities

a) Before commencing the exposure, the industrial radiographer must ensure that there is nobody inside the exposure facility.

b) The exposure must be terminated according to the correct termination
procedures. Use of safety devices such as interlocks for exposure termination is not permitted.

c) Before entering the enclosed exposure facility after an exposure, the operator must ensure that the exposure has been terminated. With gamma radiography devices the check must be done with a radiation meter.

d) When the facility is not in use the door(s) should be locked. The X-ray radiography device must be rendered inoperable by locking the control panel and removing the key and for gamma radiography devices the winding gear should be deactivated (e.g. by locking or removing the handle).

e) The industrial radiographer must ensure compliance with the maximum rating (e.g. maximum voltage and current and/or activity of used radionuclides) and limitations on the primary beam directions established for the installation. If these conditions can not be met, the installation is no longer considered to be an enclosed installation, and the work must be carried out in accordance with the requirements for open areas.

Atomic Energy Act No. 24 of 2008, section 56(2)

AER, 2012, sections 37 and 62(2).
6.0
DEVICE AND FACILITY SPECIFICATIONS

6.1. X-ray radiography device specifications

a) The X-ray radiography device shall conform to ISO 3999.

b) An X-ray tube must be enclosed in a tube housing in such a way that the dose equivalent rate from leakage radiation measured at a distance of 1 metre from the focus does not exceed the following values for the given applied voltages and the corresponding maximum tube currents:

- Up to 150 kV: 1000 µSv/h
- Above 150 up to 200 kV: 2500 µSv/h
- Above 200 kV: 5000 µSv/h

c) All X-ray radiography devices should have appropriate filtration of the primary beam.

d) The X-ray radiography device must have a lead cap for covering the radiation window during testing and warm up.

e) The lead cap must be easy to mount correctly and it must attenuate the primary beam so that the leakage radiation limits are not exceeded. For panoramic X-ray equipment the lead cap (belt) must be mechanically strong.

f) The X-ray radiography device must have diaphragms giving different field sizes of the primary beam and they must be easy to mount correctly. Panoramic X-ray equipment must have diaphragms enabling directional beam exposure. This is not required for x-ray crawlers. X-ray radiography device must be equipped with a control cable between the X-ray tube and the control panel. The length of this cable must be at least 20 m for X-ray radiography devices with X-ray tube voltage exceeding 200 kV, and 10 m for X-ray tube voltages of 200 kV and lower.

g) The control panel must be provided with a key activated control. Without this key the control panel must not be operable. Removal of the key after exposure should
not result in any damage to the equipment e.g. overheating.

h) Proper operation of the unit via the control panel must be the only way of controlling exposures. Accidental grounding of an electrical conductor must not result in generation of X-rays.

i) Two independent means which indicate when X-rays are being generated must be provided on the control panel. One of these indicators must be a red lamp of reliable design.

j) The control panel must be provided with door switch connectors for use on enclosed installations. This system must be designed in such a way that the opening of a door will interrupt X-ray generation and that the X-ray generation may only be resumed from the control panel after all doors have been closed again.

k) The control panel must be provided with a connection for an external warning lamp.

l) The X-ray tube head must be distinctly marked with the following information:
   - Location of focal point
   - Primary beam angle and
   - For panoramic units the cylindrical window must be marked with a colour distinctly different from that of the rest of the housing

m) Periodic testing of the X-ray radiography device should be done in accordance to manufacturer specification, but never exceeding 24 months. All components of the device which do not meet the requirements specified by the manufacturer must be replaced, or repaired and retested.

n) The licensee must keep record of all testing and keep the documentary evidence of all testing for the duration of use of the device. Such documents must be available for inspection purposes.

o) A radiation warning sign and an advisory note stating that the device must be only operated by approved industrial radiographer, shall be placed on the control panel.

p) The operator’s manual for the use of x-ray installations shall be written in English and shall only deal with the specific device.

AER, 2012, sections 21(8), 32 and 64.
6.2 Gamma radiography device specifications

a) The Source container must in general, comply with the requirements of the International Standards ISO 3999, as well as the IAEA requirements for a type B (U) transport container.

b) The source container must be capable of being locked in the “beam off” position.

c) When the source assembly is in the “beam off” position, the dose rate must not exceed the following limits;
   - 2 mSv/h at any point on the surface of the container
   - At any point 1 m from the surface of the container
     - Portable containers: 20 µSv/h
     - Mobile containers: 50 µSv/h
     - Fixed containers: 100 µSv/h

Portable containers are those which weigh less than 50kg, mobile containers are those which are not portable, but which can be easily moved by suitable means and fixed containers are those with mobility restricted to the confines of a particular working area.

d) There must be a provision to prevent the unauthorised operation of the device when the operator is not in immediate attendance, for example, a removable winding gear handle.

e) Gamma radiography devices must be provided with a visual indicator to show whether the source assembly is in the secured “beam off” position. Such an indicator may, however, at no time be used in place of prescribed monitoring procedures.

f) During storage or transport, apparatus for gamma radiography must be fitted, at each end, with suitable protective caps or plugs to protect the source assembly from water, sand or other foreign matter.

 g) The winding cables used for gamma radiography must be at least 8 meters long, and the guide tube, as short as practicable. In open areas, when the activities of the radioactive sources exceed 1100GBq (30Ci) of Iridium or 300GBq (8 Ci) of Cobalt are used, the winding cable must be at least 15 m long.

h) The sealed source itself must comply with ISO 2919, as well as the “special form”
requirements laid down by the IAEA. The activity of the source must be as low as practicable.

i) Source assemblies should be replaced at the same time the sealed source is replaced.

j) The source assembly should be automatically secured in the “beam off” position when it is cranked back into the fully retracted position within the source container. This securing system must only be released by means of a deliberate action on the device.

k) The dimensions of the winding cable, winding cable sheath, guide tube, and associated connectors and couplings must be within the tolerances specified by the manufacturer of the device.

l) An exposure head designed to prevent the source assembly from passing out of the end of the guide tube must be attached to the outermost end of the guide tube during radiographic operations. Diaphragms of different sizes must be available to collimate the primary beam.

m) Only lubricants specified by the manufacturer of the source container should be used on gamma radiography devices and associated accessories. (Usually graphite powder is recommended. Oils must not be used).

n) The source container must have a metallic label bearing the radiation warning sign, the maximum rating of the container, radionuclide, activity, the date when this activity was determined, source serial number, the device manufacturer and model. The labels must be durable and legible.

o) A radiation warning sign and an advisory note stating that the device must be only operated by approved industrial radiographer, shall be placed on the winding gear.

p) Periodic testing on the gamma radiography device in accordance with guidance given in Appendix A. All components of the device which do not meet the requirements specified by the manufacturer must be replaced, or repaired and retested.

q) The licensee must keep record of all testing and keep the documentary evidence of all testing done in accordance to Appendix A for the duration of the use of the device. Such documents must be available for inspection purposes.

r) Electrically activated gamma radiography devices must be designed so that system failure automatically causes the device to return the radioactive source to the secure “beam off” position. In addition, such devices must be provided with a manual means of returning the radioactive source to the secure “beam off” position.

s) The operator’s manual for the use of gamma radiography devices shall be written in English and shall only deal with the specific device.

AER, 2012, sections 21, 64, 92 and 101.
6.3 Enclosed exposure facility specifications

Any facility that does not comply with the following requirements is considered to be an open area (for example an exposure within walls, maze and portable equipment).

a) An enclosed exposure facility may not be located in domestic premises.
b) The facility must be clearly marked with radiation warning signs. The warning sign should also contain contact details of the designated person in control of the facility.
c) The control panel or winding gear shall be placed outside the enclosure.
d) The enclosed exposure facility must have a red warning light to indicate that an exposure is underway. Preferably the warning light should be connected to a control panel of the x-ray radiography device or in the case of a gamma radiography device to a radiation meter inside the enclosure.
e) Electrically activated devices must have an interlock system which interrupts the exposure if one of the entrance doors is opened. Resumption of exposure must be possible only after manual restart at the control panel after the door has been closed.
f) Enclosures which have more than one door, the doors that are not controlled by the operator must be lockable from the inside, and the door under his control, lockable from the outside. If the facility has only one door it must be lockable from the outside.
g) All doors of the enclosed exposure facility must be easy to open from the inside to allow a person accidentally left in the room to exit.
h) Enclosed installations must have a notice stating the maximum rating of the device (e.g. maximum voltage and current and/or activity of used radionuclides) and limitations on the primary beam directions established for the facility.
i) The radiation dose rate at walls of the enclosed exposure facility should preferably not exceed 10 µSv/h and must not exceed this value at a distance of 1 m from the walls of the facility at the maximum rating.

AER, 2012, sections 37 and 63.
7.0
TRANSPORT

Radioactive sources used for industrial radiography must be transported in accordance with the requirements of the current edition of “Regulations for the safe Transport of Radioactive Materials” published by the IAEA, as well as relevant sections of the AER and guidance from the AEC.


8.0
STORAGE OF DEVICES CONTAINING SEALED SOURCES USED IN RADIOGRAPHY

a) Any devices containing sealed sources used in radiography which are not required for immediate use or which have been removed from service for any reason should be placed in storage. A store for devices containing sealed sources should, where possible, be reserved for that purpose only so that personnel are not needlessly exposed to ionising radiation.

b) The radioactive source store should be constructed according to the provisions of the atomic energy regulations and the following additional requirements:

   i. The materials used in the construction of the store should be strong and durable.

   ii. The store should be secure, lockable and under the control of designated person.

   iii. For categories 1 and 2 sealed sources, the principle of defence-in-depth should be applied. The additional security measures should include measures such as but not limited to; electronic remote surveillance, twenty four hour guard, interlocks.

   iv. Dose rates outside the store must not exceed 10 µSv/h.

   v. The store should be located so that the annual exposure in any occupied area is as low as reasonably achievable and well under the annual dose of 1mSv.

   vi. The store should not be located close to or be used to house explosives, combustible or corrosive materials.

   vii. The store should have a radiation warning sign. The radiation warning sign should include the text ‘RADIOACTIVE MATERIAL’. The warning sign should also contain contact details of the designated person in control of the store or the RSO.

   viii. All devices containing sealed sources being brought into the store should have the shutter controls locked in the ‘beam off’ position. This should be checked by monitoring with a dose rate meter.
ix. No devices containing sealed sources should be stored in any domestic premise.

x. An inventory of stored sources and store plan should be maintained and kept in the store.

c) Temporary storage facilities in the field must comply with storage requirements b.ii, b.iv, b.v, b.vi, b.vii and b.ix. Category 1 and 2 sources should not be stored in temporary storage unless 24 hour guards are present.

AER, 2012, section 63.
9.0 DISPOSAL OF DEVICES CONTAINING SEALED SOURCES USED IN INDUSTRIAL RADIOGRAPHY

a) During purchase of the devices containing sealed sources used in industrial radiography, the licensee shall enter into an agreement with the supplier or the manufacturer that the radioactive sources shall be taken back to the supplier or the manufacturer when no longer needed.

b) The licensee shall not dispose off a sealed source, or device containing a sealed source, without the authorisation from AEC. “Dispose” herein includes selling, lending, donating, exchanging, as well as returning of the device to the supplier.

c) An application to dispose devices containing sealed sources used in industrial radiography must be submitted to the AEC. Where no clear disposal route exists the operator has a responsibility to store the sealed source until a disposal route has been established and approved by the AEC.

Atomic Energy Act No. 24 of 2008, section 55 (a,b).
AER, 2012, sections 16, 64-1(f), 66(2), 83 and Schedule 1 form 7.

9.1 Notifying AEC

a) AEC must be notified without delay and not later than 24 hours of:
   i. Any incident involving the use of radiation that is substantially detrimental to safety at the place where the radiation is used or in its environment.
   ii. The disappearance, theft or other loss of a radiation source such that it ceases to be in the possession of the licensee.
   iii. Any other incident essential to the safety of industrial radiographers, other workers or the environment.
b) AEC must be notified immediately of any accident endangering life of the industrial radiographers, assistants, other workers or result in the contamination of the environment. Examples of such accidents include, but are not limited to, radioactive source stuck in a guide tube, loss of gamma radiography device, loss structural integrity of the gamma radiography device and loss of containment for the radioactive source.

c) The first notification of an incident and accident (normally by telephone) must state the following details:
   
   i. the responsible person (licensee) and the RSO.
   
   ii. the name and contact details of the person reporting the incident or accident.
   
   iii. the time and place of the incident or accident.
   
   iv. a description of the incident or accident.
   
   v. details of any persons involved and their possible radiation exposure and the immediate measures taken.

   d) In addition to the above details, a written report must also be submitted to AEC within 15 days from the date of occurrence of the incident or accident. The report should give an account of the causes and consequences of the incident or accident (particularly of possible radiation exposure or contamination) and of the measures taken to prevent future corresponding incidents or accidents.

AER, 2012, sections 67,68, 69 and 70.
10.0
EMERGENCY PROCEDURES

a) Licensee must identify in advance the possible incidents and accidents associated with industrial radiography. Examples of possible incidents and accidents associated with industrial radiography include, but are not limited to, radioactive source stuck in a guide tube, loss of radiography device, over exposure of industrial radiographers and exposure of other workers.

b) The licensee must plan and implement operations in a manner that minimises the likelihood of incidents and accidents. Steps must nevertheless be taken to prepare for possible incidents and accidents by such means as issuing emergency plans for all incidents and accidents.

c) These emergency plans should include:
   i. Persons to implement the emergency plan.
   ii. Equipment and its availability to implement the emergency plan.
   iii. Persons and organisations to be notified at various stages of implementation.
   iv. Procedures to bring the situation back to normal.

d) Training should be provided to all relevant personnel and the emergency plan should be practiced through emergency exercises and drills.

e) The emergency plan should be periodically reviewed and updated.

AER, 2012, sections 67,68, 69 and 70.
APPENDIX A

Gamma radiography device testing
Gamma radiography devices shall be tested and serviced at least once a year. During the testing, it shall be ensured that the device conforms to manufacturer specifications. Testing shall be carried out as specified below.

Winding cable sheath
It shall be checked that:
- the winding cable sheath is not worn out or damaged, it has no fractures, and it has not become brittle
- the fixing joint is not damaged and it operates faultlessly
- the inside of the winding cable sheath is clean and undamaged.

Winding cable and fixing joint
It shall be checked that:
- the entire winding cable is not corroded and no strands are damaged (damage often occurs near the fixing joint of the source assembly)
- the winding cable should be well lubricated
- the winding cable is not bent (the cable must be replaced if it cannot be straightened without tools)
- the fixing joint between the winding cable and the source assembly is not worn or damaged; the tensile strength of the joint must be tested by subjecting it to a force of 400 N.

Winding gear
The winding gear must be opened to check for worn parts that may endanger the faultless operation of the gamma radiography device.

Source container
The source container shall be inspected at least once a year and always when the radiation source is replaced. The source container can be inspected either loaded or empty. Locking devices and radiation shields must not be dismantled for the sake of carrying out an inspection. The inspection shall ensure that:
- the structural integrity of the shielding has not degraded (e.g. cracks) by using a radiation meter to monitor the surface of the source container
- the source container has been marked properly; the plate indicating the radionuclide shall be in its place only when the container is loaded
- the container shows no visible signs of damage that can affect its shielding properties, and the radioactive source has not caused any wear to the internal
parts of the container

- all the fastenings of source container are tight and in good condition
- the connections to the winding sheath are clean and undamaged
- the source container and locking mechanism function faultlessly and show no visible signs of damage
- the markings indicating radioactive source in secure “beam off” position can be seen clearly.

**Wipe test**

Wipe tests should be done by a competent person under the supervision of the RSO. Refer to AEC RSG 2.1 Appendix A for additional information.
REFERENCES

14. Proposed code of practice for the industrial use of ionizing radiation, Part II: Radiation from listed electronic products, Document for committee draft stage SABS.
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