Radiation Protection Authority

Zambia

SAFETY GUIDE

RPA SG 5

Industrial Radiography

2015

NOTICE OF APPROVAL

The Radiation Protection Authority Board (RPAB), has on the (day/month/2015), approved the safety guide on Industrial Radiography. This guide is approved for the purposes of providing practical guidance with respect to the Ionising Radiation Protection Act, No. 16 of 2005.

Dr. Esther Munalula Nkandu	Mr. Boster Dearson Siwila
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CHAIRPERSON	EXECUTIVE DIRECTOR
Radiation Protection Authority Board	Radiation Protection Authority

FOREWORD

Over the last 50 years, the use of Ionising Radiation in Zambia has significantly increased. Institutions using Ionising Radiation include those in Health, Manufacturing, Mining, Agriculture, Research and Training sectors.

The liberation of the economy and subsequent privatization of the mines has led to massive investment in the manufacturing, mining, agriculture and processing industries in Zambia. This has resulted in the utilizing of modern and highly mechanized equipment like pressure vessels, pressurized piping, and high-capacity storage tanks in order to increase production. In order to inspect these equipment without disturbing production, industrial radiography, a non- destructive technique, using ionizing radiation is applied to view the integrity of these equipment. Other applications of industrial radiography in Zambia are; airport security screening of both hand and hold luggage, nonintrusive cargo scanning like the one at Chirundu border, testing and grading of welds.

In 2005, the Zambian Government enacted the Ionising Radiation Protection Act to provide for the protection of the public, workers and the environment from the harmful effects arising from the use of devices or materials that produce ionising radiation. The Ionising Radiation Protection Act allowed for the establishment of the Radiation Protection Authority to spearhead the implementation of provisions of the Act. To fully implement the Act the Zambian Government has priotised strengthening national regulatory capacity. Strengthening national regulatory capacity includes among other equally important elements, the development and implementation of Safety Guides for Practices using ionizing radiation.

This Safety Guide is intended for use by those involved in all aspects of industrial Radiography it summarizes good and current state of the art practices in industrial radiography and provides technical advise on radiation protection and safety. It contains information for Regulatory Authorities, operating organizations, workers, equipment manufacturers and client organizations, with the intention of explaining their responsibilities and means to enhance radiation protection and safety in industrial radiography.

It is my sincere hope that this guide will be a good basis for attaining sustainable radiation protection of the public, workers and the environment and compliance by Licensees with the provisions of the Law.

Hon Dr. Joseph Kasonde, MP

MINISTER OF HEALTH

LIST OF ACRONYMS

RPAB Radiation Protection Authority Board

RPA Radiation Protection Authority

IAEA International Atomic Energy Agency

RS Radiation Safety

RPMP Radiation Protection Management Plan

RPO Radiation Protection Officer

ALARA As Low As Reasonably Achievable

GPS Global Position Satellite

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1.0 INTRODUCTION

1.1 General

Worldwide the majority of industrial radiography is performed with either x-ray generators or gamma emitting sealed sources. Industrial radiography performed with neutron radiation generated either from radioactive sources or neutron generators is relatively rare hence; the technical requirements for this aspect of radiography are not specifically addressed in this guide. Therefore, this guide focuses on x-ray generators and gamma emitting sources. However, the general principles described in this guide, such as provision of adequate shielding and administrative procedures, shall still apply to neutron radiography situations.

This guide specifies the minimum requirements for the radiation protection and safety for industrial radiography. This includes industrial radiography performed inside shielded facilities that have engineering controls (fixed facilities) and outside shielded facilities using mobile sources (site radiography).

1.1.1 This guide covers:

1.1.1.1 the monitoring of individuals and workplace;

1.1.1.2 requirements for the;

A. security of sources,

B. radiography equipment,

C. shielded enclosures,

D. Procedures for site radiography,

1.1.1.3 transport of radioactive sources; and

1.1.1.4 procedures for emergency preparedness plan and response.

1.2 Objective

The objective of this safety guide is to provide specific guidance to ensure proper and consistent application of basic safety requirements of the Ionising Radiation Protection Act, No. 16 of 2005 on the use of radioactive sources in industrial radiography in Zambia. In addition to this Guide, the provisions of the other national and international safety standards will apply.

2.0 PRINCIPAL REQUIREMENTS

2.1 Radiation protection requirements

2.1.1 The principal radiation protection requirements related to justification of the practice, dose limitation and optimization of protection, and dose constraints, as specified in the Ionising Radiation Protection General Regulations No. 98 of 2011 shall be applied to industrial radiography practices.

2.1.2 Guidance on the general controls and dose limits as in the Zambian Occupational Exposure Safety Guide and the IAEA safety Guide RS-G 1.1 for occupational exposure shall be applied.

2.2 Management and organizational requirements

2.2.1 General

2.2.1.1 Licensees shall:

A. provide the human and material resources necessary to ensure safe working conditions; and

B. ensure that all aspects of radiation protection are covered in a systematic manner. To meet the requirements of this safety guide, licensees shall establish and maintain a Radiation Protection Management Plan (RPMP).

2.2.2 Radiation Protection Management Plan

The general objective for RPMP is to clearly establish the licensee's responsibilities for the radiation protection and safety through the adoption of organizational structures, policies and RPMP procedures. The RPMP shall represent the totality of the actions undertaken to achieve the stated radiation protection and safety objectives of the organisation. In addition, management need to demonstrate on-going commitment to safety.

2.2.2.1 Requirements of the RPMP

Licensees shall ensure that the RPMP includes, as a minimum, the following:

A. a statement from management confirming their commitment to safety and that sufficient resources will be provided to meet the objective;

B. a description of the organizational arrangements with clear allocation of responsibilities and duties relating to radiation protection and safety;

C. the appointment of one or more Radiation Protection Officers (RPO) who are allocated sufficient responsibilities to ensure that radiography is carried out in a safe manner;

D. the Licensee must ensure that appropriate safety measures are in place where site radiography is carried out on premises other than the Licensee's; E. a programme for:

i. carrying out radiation safety assessments; ii. developing, reviewing and updating working procedures; including local rules and emergency procedures; iii. ensuring that radiography equipment are safe and warning systems and signs are maintained; and iv. training and refresher training of operators and managers to ensure that they are aware of the hazards and the safety requirement.

F. The designation of controlled and/or supervised areas;

G. The arrangements; and

i. for monitoring workers and workplace, including a system of reviewing the outcomes, ii. for health surveillance of the radiation workers, as appropriate, iii. for maintaining all appropriate records relating to radiation safety,

H. a record of any critical decisions relating to radiation safety;

Licensees shall ensure that their RPMP is audited internally to ensure compliance with these safety guides.

2.2.3 Safety assessment

2.2.3.1 Licensees shall ensure that a safety assessment is carried out at the following stages:

A. when applying for a new license or for modification to an existing license;

B. at the design stage, prior to the construction of a fixed industrial radiography facility;

C. upon commissioning of the facility and before any routine radiography begins in the facility;

D. when making significant changes to working practices or modifications to permanent radiography enclosures; and

E. 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.

2.2.3.2 The purpose of safety assessment is to identify sources of routine and reasonably foreseeable potential exposures, estimate the probability and magnitude of these doses and to assess the quality and extent of the required protection and safety measures.

2.2.3.3 Licensees shall ensure that the safety assessment is fully documented and is prepared in consultation with the RPO and appropriate qualified experts. The safety assessment shall include, as appropriate, a systematic and critical review of:

A. the nature and magnitude of potential exposures and the likelihood of their occurrences;

B. the limits and technical conditions for operation of radiation sources;

C. the 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 unintended operation of any radiation source and the measures available to prevent, identify and control such occurrences.

2.2.3.4 where the safety assessment indicates a potential risk of a radiation accident, licensees shall take all practical steps to:

A. prevent any such accidents;

B. limit the consequences of such an accident should the accident occur; and

C. provide workers with training in Emergency Preparedness and Response.

2.2.4 Verification of safety

2.2.4.1 Licensees shall carry out regular audits of normal radiography operations to ensure that a satisfactory standard radiation safety is being maintained.

2.2.4.2 The RPO shall participate in these audits, although an element of

independence is also needed. In certain situations the involvement of qualified expert or a Senior Manager within the operating organisation is highly desirable.

2.2.4.3 Licensees shall develop a safety policy that specifies the following:

a) The person responsible for; I. organizing safety audits,

II. carrying out, preparing the audit report and making recommendations, and

III. implementing any corrective actions that are identified during the audit.

b) the normal time interval between audits;

2.2.4.4 The time scale set for implementing corrective action shall ensure that any deficiencies which present a significant radiological hazard are dealt with promptly.

2.2.4.5 It is important that the agreed corrective actions are followed up by management to complete the audit process.

2.2.5 Duties and responsibilities

In order to fulfil their responsibility regarding the establishment and implementation of technical and organizational measures needed to ensure protection and safety, Licensees may appoint persons to carry out actions and tasks related to radiation protection and safety, even though the Licensee

retains responsibility for the actions and tasks. The functions and subsidiary responsibilities of individuals, including those at senior management levels, for radiation protection and safety shall be clearly identified in writing and each individual shall be suitably informed, trained and qualified.

2.2.5.1 The Licensee

The Licensee shall ensure that:

A. practice adheres to the safety guide and the regulations;

B. the responsibilities of the RPO are clearly stated;

C. a qualified RPO is appointed and is: I. supported by senior management;

II. given sufficient authority within the practice;

III. allocated adequate time and resources to carry out their duties;

IV. involved in decision making involving radiation safety issues;

D. only appropriately qualified persons are involved in radiographic operations and the implementation of emergency procedures;

E. there are written administrative procedures for complying with the regulatory or license requirements;

F. conditions and limitations of the licence are understood;

G. radiation protection programme is in place and implemented;

H. proper operation and maintenance of the specific radiography equipment in use;

I. radiation safety assessment is done at appropriate times;

J. Local rules and other operating procedures are established and adhered to; and

K. emergency procedures are followed.

2.2.5.2 The Radiation Protection Officer (RPO)

The principal duties of the Radiation Protection Officer are to ensure that:

A. all radiography work is adequately supervised, and that local rules, procedures, protective measures and safety provisions are adhered to;

B. operational procedures are followed to achieve an" As Low As Reasonably Achievable (ALARA)" exposure state;

C. operational manuals for radiography equipment are available and are understood by the radiographers;

D. safety assessment and emergency plans are in place ;

E. engineering controls and other equipment designed to protect persons against ionizing radiation are functional and well maintained;

F. access to controlled and supervised areas is restricted;

G. individual personnel dosimetry monitoring and dose records are maintained;

H. there is adequate monitoring of workplaces;

I. Investigations are done for any accidents involving radiation sources and notification of senior management and the RPA is done within 24 hours of the accident;

J. protection of any female staff engaged in radiography work who are or may be pregnant is enhanced;

K. inventories of radioactive sources (source records) are maintained;

L. advise is given to management where qualified expert assistance or consultation in terms of radiation protection is required;

2.2.5.3 In the cases where more than one RPO is appointed, the reporting structure and individual duties of each shall be well defined, with one RPO having general oversight of the other(s).

2.2.5.4 The Radiographer

Day to day responsibility for the safe operation of industrial radiography sources rests with the Radiographer. In addition to protecting themselves, Radiographers shall be vigilant to ensure the safety of, other workers and the general public. The Radiographer shall:

A. supervise Assistant Radiographers;

B. only undertake work they are trained and qualified for, and to seek assistance from the RPO if unsure about the safety implications of any work;

C. use the radiographic and ancillary equipment (including safety equipment) and sources only for the purposes for which they are designed;

D. follow the written procedures and local rules provided;

E. wear personal dosimeter(s) at all times when using radiographic equipment;

F. not undertake any radiation work if the equipment is defective or has inadequate maintenance records;

G. promptly report;

I. all equipment defects and malfunction to the RPO, and

II. any real or suspected high radiation exposures to the RPO.

H. respond promptly and correctly in the event of emergencies, according to the documented plans.

2.2.5.5 The Assistant Radiographer

The assistant radiographer shall:

A. only undertake work they are trained and qualified to do;

B. follow the written procedures and local rules provided;

C. wear personal dosimeter(s) at all times when using radiographic equipment;

D. report all equipment defects and malfunction to a qualified radiographer; and

E. inform the qualified radiographer immediately in the event of an emergency;

2.2.5.6 Qualified expert

The qualified expert shall adequately advise the Licensees to ensure that the Licensee complies with the regulatory requirements;

2.2.6 Local rules

2.2.6.1 Licensees shall establish local rules that describe the procedures for ensuring an adequate level of radiation safety for workers and the public.

2.2.6.2 In addition local rules shall specify how industrial radiography will be carried out to ensure compliance with national regulations and license conditions. The local rules shall include:

A. a description of controlled and supervised areas around fixed facilities;

B. designation of controlled and supervised areas during site radiography, including procedures for setting up barriers and erecting warning signs;

C. control of access to designated areas;

D. operating instructions for the radiographic equipment and safety systems;

E. requirements for individual and area monitoring;

F. name and contact of the RPO (s);

G. transport and storage of radioactive sources;

H. arrangements for cooperation with clients and other employees during site radiography; and

I. contingency plans for dealing with unforeseeable emergencies.

2.2.7 Training and education

2.2.7.1 Licensees shall ensure that all persons involved in industrial radiography have basic knowledge about ionising radiation and potential health risks.

2.2.7.2 Women of child bearing age shall be restricted from entering a controlled or supervised area unless appropriate information on the following has been availed to them:

A. the possible risk to the embryo or foetus from exposure to radiation; and

B. the importance of notifying their employer as soon as they are aware of the pregnancy.

2.2.7.3 Licensees shall ensure that radiography is carried out only by qualified radiographers.

2.2.7.4 The Licensee shall prepare and maintain a record of the initial and ongoing training of all personnel involved in industrial radiography. These records shall include the following information:

A. Name of the;

I. person who received the instruction or training, and

II. institution or person who delivered the instruction or training.

B. dates and duration of the instruction or training;

C. a summary or list of the topics covered during the training; and

D. a certified copy of the training certificate obtained;

2.2.7.5 Licensees shall provide details of any in-house training on radiation safety that they provide to individual radiographers, especially if they change employees.

3.0 INDIVIDUAL MONITORING OF WORKERS

Individual monitoring of external radiation exposure is intended to provide information for the optimization of protection, to demonstrate that worker's exposure has not exceeded any dose limit or investigation level, and to verify the adequacy of safe work procedures.

3.1 individual dose assessment and record keeping

3.1.1 Licensees shall:

3.1.1.1 arrange for the assessment of occupational radiation exposure of workers, by individual monitoring where appropriate, and shall ensure that adequate arrangements are made with appropriate personnel dosimetry services with adequate quality assurance programme.

3.1.1.2 ensure that all workers in controlled and supervised areas are provided with appropriate personal dosimeters to assess their occupational radiation exposure.

3.1.1.3 ensure that a copy of dose information is provided to individuals on termination of their employment.

3.1.1.4 develop a procedure to describe the way in which individual dosimeters are administered, and this procedure shall include the following elements:

A. ordering and receiving dosimeters from the dosimetry laboratory;

B. distribution of dosimeters to monitored workers;

C. collection and dispatch of dosimeters to the dosimetry laboratory for evaluation; and

D. review and maintenance of individual dose records.

3.1.2 Use and Management of Personnel dosimeters

Personnel dosimeters shall:

3.1.2.1 only be worn by persons to whom they are assigned;

3.1.2.2 be used to demonstrate compliance with dose limits as specified in the regulations; hence the type of dosimeter shall be approved by RPA;

3.1.2.3 not be stored in or close to radioactive source storage locations, inside radiography enclosures, close to exposure containers, near to radioactive luminous items, or in any other radioactive material with high dose rates;

3.1.2.4 be suitably stored in a manner that will not compromise their integrity or affect the properties of the dosimeter when not in use;

3.1.3 In cases where neutron radiography is undertaken, workers shall be required to wear additional dosimeters such as extremity TLD's during source changes or special dosimeters.

3.1.4 For industrial radiography the wearing period for a dosimeter is one month.

3.1.5 Monitored workers shall take good care of their dosimeters, taking precautions to protect them from loss, theft, tampering or damage and returning the dosimeters promptly at the end of the one month period for evaluation.

3.1.6 Every radiation worker shall inform the RPO without delay if their dosimeter is missing, damaged or has been accidentally exposed to radiation.

3.1.7 If a dosimeter is lost, Licensees shall take all reasonable steps to recover it. If the dosimeter cannot be located, Licensees shall carry out an investigation and prepare a report which includes an estimate of the dose received by the worker for the period under review.

3.2 Investigation of doses

3.2.1 Any person who has or suspects to have been exposed to a high level of radiation shall notify the RPO immediately. If the person was wearing a personal dosimeter it shall immediately be sent to the SSDL for evaluation and this should be treated as an emergency.

3.2.2 Results of personal dosimeters reading shall be reported promptly to the RPO who shall compare them with the dose limits and determine whether individuals

are keeping their doses as low as reasonably practicable, taking into account the amount of work they are undertaking.

3.2.3 The RPA shall set "investigation levels" of dose above which a formal investigation and written report shall be prepared for fixed and non-fixed site radiography respectively.

3.3 Direct Reading Dosimeters

3.3.1 Direct dosimeters shall be used to supplement the TLD or film badge whenever it is important to have an immediate indication of exposure, for example during

nonfixed site radiography in a confined space, or during emergency recovery of a jammed source.

3.3.2 Licensees shall ensure that direct dosimeters and personal alarm monitors are kept in good working condition and are subject to regular operational checks and calibration.

3.4 Personal Alarm Monitors

3.4.1 When working with radiation sources, radiographers shall wear a personal alarm monitor which emits an audible (and sometimes visible) alarm when exposed to dose rates above a pre-set level.

3.4.2 The use of a personnel alarm monitor is not a substitute for using a radiation survey meter or a personal dosimeter but it provides a valuable additional level of protection against radiation in depth during radiography operations.

3.4.3 Personnel alarm monitors shall be checked to ensure that they are working properly prior to use.

4.0 WORK PLACE MONITORING

4.1 The RPA may at any time during operations inspect the facility to ensure compliance with the following requirements;

4.1.1 radiological safety conditions;

4.1.2 radiation exposures in controlled and supervised areas; and

4.1.3 classification of controlled and supervised area.

4.2 Radiation Survey Meters

4.2.1 Licensees shall ensure that a sufficient number of suitable radiation survey meters are available for the Radiographers and RPOs and placed one meter from every source in use. A survey meter shall be used after shielding is put in position.

4.2.2 When radiation generators are used, especially for non-fixed site radiography, survey meters shall be used after every exposure to ensure that the radiation exposure has been correctly terminated.

4.2.3 Licenses shall ensure that radiation survey meters cover the range of 1 μSv/h to about 10 mSv/h scale. They should also have an operating manual and an initial test certificate, and a calibration certificate from the manufacturer or supplier.

4.3 Use of Radiation Survey Meters

4.3.1 The radiation survey meter shall be used to evaluate the radiological conditions in all workplaces, in particular at the following locations:

4.3.1.1 controlled and supervised areas to review classification and assess exposures;

4.3.1.2 transport container when a new gamma source is received;

4.3.1.3 gamma source container when:

A. collecting it from a store;

B. returning it to the store; and

C. loading and unloading it into a vehicle used for transportation.

4.3.1.4 after every exposure of gamma source to confirm that it is fully returned to the shielded position in its exposure container;

4.3.1.5 to check the dose rates at the controlled area barriers during non-fixed site radiography;

4.3.1.6 when transferring gamma sources between containers; and

4.3.1.7 when dealing with emergencies involving gamma sources.

4.3.2 The use of a survey meter after every exposure of a gamma ray source is extremely important. Failure to do so may lead to accidents resulting in severe radiation burns and deaths.

4.3.3 Radiographers shall not only rely on personal alarms but also on other gamma radiation detectors within fixed facilities for this purpose.

4.4 Records of Radiation Surveys

4.4.1 Licensees shall ensure that records of radiation surveys are kept for a period specified in the license condition or regulations.

4.4.2 The results of radiation surveys shall be recorded as appropriate in the following instances:

4.4.2.1 when commissioning a new;

A. fixed radiography equipment or one which has been significantly modified, and

B. radiation source store.

4.4.2.2 when checking for the dose rate around a gamma radiography exposure container prior to transporting it (so that the transport index can be recorded on the consignment guide);

4.4.2.3 routine surveys around fixed radiographic facilities (at least once

every year);

4.4.2.4 during;

A. non-fixed site radiography with mobile sources to confirm that the barrier distances are set correctly, and

B. emergencies and investigations so that dose estimates can be performed.

4.4.3 Records of radiation surveys shall include the following details:

4.4.3.1 location(Global Position Satellite (GPS) if available);

4.4.3.2 date of survey;

4.4.3.3 name of person performing the survey;

4.4.3.4 survey meter type and serial number;

4.4.3.5 radiation source details, e.g. radionuclide, activity, beam direction, X-ray tube settings ;and

4.4.3.6 dose rate.

4.5 Maintenance and Calibration

4.5.1 Radiographers shall check the operation of the survey meter at the start of each working shift. This check shall include:

4.5.1.1 battery condition;

4.5.1.2 background radiation level;

4.5.1.3 sensitivity (response to radiation); and

4.5.1.4 Any other instrument checks.

4.5.2 In addition, every radiation survey meter used during radiography shall be checked regularly (or after repair) by a qualified expert, as follows:

4.5.2.1 normal tests as above;

4.5.2.2 any specific instrument checks specified by the manufacturer;

4.5.2.3 indicated dose rate versus actual rate at one meter range from the source(to establish linearity or calibration function of response); and

4.5.2.4 overload check to confirm that the survey meter indicator remains at maximum under conditions of the very high dose rate.

5.0 GAMMA RADIOGRAPHY SOURCE CONTAINERS

5.1 When carrying out gamma radiography, Licensees shall only use sealed sources that:

5.1.1 are designed, manufactured and tested to ensure they meet the requirements of the appropriate ISO standard or the equivalent National standards;

5.1.2 are certified as meeting the requirements of special form radioactive material as specified in the IAEA transport regulations; and

5.1.3 have been leak tested in accordance with the appropriate ISO standard or the equivalent national standards and have a leak test certificate.

5.2. Requirements for Gamma Sealed Source Containers

5.2.1. The radioactive source is usually contained in a source assembly with a detachable part (often called a pig tail) which is connected to the drive cable source for projection type system.

5.2.2. Sources assemblies shall be:

A. designed, manufactured and tested to ensure they meet the requirements of the appropriate ISO standard or an equivalent

National standard;

B. compatible with the exposure container, ancillary equipment (such as guide tubes) any source changer with which they are use;

C. marked with the radiation trefoil and a legend “RADIOACTIVE”;

D. marked with the manufacturer’s serial number.

5.3. Types of Exposure Containers

5.3.1 Types of exposure containers includes:

5.3.1.1 Category I (Shutter type exposure devices)

5.3.1.2 Category II (“projection containers”)

A. Depleted uranium container

B. Torch containers

5.4 Requirements for Exposure Containers

5.4.1. The Licensee shall only use exposure containers that:

5.4.1.1. meet the appropriate ISO standard requirements; and

5.4.1.2. can withstand the rigors of industrial radiography environment and typical usage.

5.4.2. The Licensees shall ensure that exposure containers are durably and clearly labelled with the following details:

5.4.2.1. the basic ionizing radiation trefoil symbol;

5.4.2.2. a cautionary warning e.g. ‘’DANGER- RADIOACTIVE ‘’;

5.4.2.3. chemical formula and mass number of the radionuclide;

5.4.2.4. model and serial number of the container; and

5.4.2.5. Licensees name and address.

5.4.3. Licensees shall ensure that they:

5.3.3.1 have an operational and maintenance manual for each exposure container. The manual shall be in English.

5.3.3.2 projection type of exposure containers should meet the following minimum requirements:

A. the coupling between the source assembly (the detectable element which is stored inside the exposure container when not in use) and the control (or “wind-out) cable shall be designed in such a manner that the source assembly cannot become disconnected if cranked outside of the guide tube;

B. the container shall automatically secure the source in the shielded position;

C. all connecting fittings shall have protective covers or safety plugs installed during storage and transport;

D. guide tubes shall be used at all times when cranking the source out of a projection type container;

E. a Guide tube shall have source stop on them (i.e. a closed end) and drive (wind-out) cable shall be of sufficient length

to allow the source to be projected all the way to the end of a guide tube;

F. when the source is in a shielded position, dose rates on the outside of an exposure container shall not exceed 0.1mSv/h at one meter from the surface and 2 mSv/h at the surface.

G. all ancillary equipment shall have its compatibility tested with the exposure of the container prior to use.

H. where the container contains depleted uranium the container should be treated as a radioactive source even when empty.

5.5. Collimators and Additional Shielding

5.5.1 The use of collimators will reduce radiation levels around the source during exposures.

5.5.2 Additional shielding, such as lead sheet, shall be used when practicable and compatible with the radiography technique.

5.6. Requirements for Ancillary Equipment and Source Changers

5.6.1 Licensees shall:

5.6.1.1 use only ancillary equipment that complies with the appropriate ISO standard. In addition, the equipment shall be checked by the Licensee to confirm that it is suitable for the intended purpose prior to first use; and

5.6.1.2 carry out pre use test on any equipment not covered under a recognized standard.

5.7. Leak Testing of Sealed Sources

5.7.1 Licensees shall ensure that every new gamma radiography source is supplied with a leak test certificate.

5.7.2 To ensure the integrity of the source capsule, subsequent leak tests shall be carried out at intervals not exceeding one year.

5.8. Requirements for Radiation Generators

Any radiation generation equipment, including X-ray tubes, linear accelerators (LINACs) or betatrons shall meet the following minimum requirements:

5.8.1 Cable Length -Where radiography cannot be carried out in a shielded enclosure, cable lengths typically should not be less than 20m for X-ray generators up to 300 kV and other equipment with higher tube potentials.

5.8.2 Electrical Safety - Electrical safety contributes indirectly to radiation safety, since electrical faults in x-ray equipment have resulted in serious accidents with radiological consequences, x-ray equipment therefore needs to conform to national and international standards.

All metallic items including casings, interconnecting cables, power supply unit (transformer/generator), x-ray control equipment, tube assembly, warning signals, other safety devices and the irradiated object should be bonded and earthed.

5.8.3 Equipment safety features- The equipment should have the following safety features:

5.8.3.1 A radiation symbol (trefoil), mechanism to prevent unauthorized

operation;

5.8.3.2 A warning light when equipment is in operation, and an emergency shutdown mechanism. In addition, the equipment shall have;

5.8.3.3 Exposure duration control; and

5.8.3.4 Exposure factors (kilovolts (kV) and the current in mille amperes (mA)).

5.8.4 X-Ray Tube-Head - The x-ray tube head should, wherever practicable, besupported in a suitable stand or clamped into position, to prevent inadvertent movement. It should not leak radiation when not in use.

5.9 Requirements for Underwater Radiography Equipment

5.9.1 Equipment used for underwater radiography shall comply with the standards specified for conventional radiography equipment.

5.9.2 Licensees shall ensure that labels on the equipment clearly indicate maximum depth rating at which it can be safely used, and any additional restrictions shall be described in an operations and maintenance manual.

5.9.3 Licensees shall ensure that radiographers are aware of all such restrictions and that these are clearly stated in the local rules.

5.10. Requirements for Pipeline Leak Testing Equipment

Pipeline leak test equipment used for radiography shall meet the applicable minimum standards for gamma sources or x-ray tubes as specified in this guide.

5.11 Maintenance of Source Exposure Containers

5.11.1 The routine daily pre operational safety checks of Source Exposure

Containers shall include:

5.11.1.1. Verification that :

A. the source locking mechanism functions properly;

B. accessible screws and nuts are tight and many threads are not damaged; and

C. the source assembly connection to the driver cable is secure;

5.11.1.2. checks;

A. that show that the radiation levels are normal; and

B. to ensure that labels are legible and fastened securely to the device.

5.11.2 The periodic inspections and servicing of exposure containers should include the following;

5.11.2.1. security of source assembly connections;

5.11.2.2. ability of the source to move freely within the shielded container;

5.11.2.3 lock mechanisms should not be worn out, damaged or out of specification;

5.11.2.4 lubrication as described by the manufacturer;

5.11.2.5 operational check after re assembly;

5.11.2.6 measurements of the exposure levels on the outside of the exposure container;

5.11.2.7 structural integrity of the device, e.g. no cracks in welds, other obvious damage, or missing parts;

5.11.2.8 fasteners are in good condition and are secured to the proper

torque; and

5.11.2.9 Condition and legibility for the identification and radiation labelling on the exposure device.

5.12. Maintenance of Ancillary Equipment

5.12.1 The routine daily pre operational safety checks for ancillary equipment (to be done by radiographers or RPO) shall include:

5.12.1.1. drive cable checked for freedom of movement;

5.12.1.2. absence of excessive kinks or damage to guide tubes; and

5.12.1.3. presence of Collimators.

5.12.2 The periodic inspections and servicing of ancillary equipment should include the following:

5.12.1.2. removal and cleaning of the drive cable , inspection for corrosion, fraying and bends or kinks;

5.12.1.3. application of proper lubrication to the drive cable as described by the manufacturer;

5.12.1.4. all source stops and fittings are securely fastened with no visible damage, cracking , or excessive wear; and

5.12.1.5. all threaded fittings are not damaged (and are replaced as necessary).

5.13 Maintenance of X-Ray Equipment and Other Radiation Generators

5.13.1 Licensees shall ensure that the following daily pre-operational safety checks are carried out Periodic inspections and servicing shall include the items listed below:

5.13.1.1. there is no visible damage to the equipment;

5.13.1.2 cables have no cuts, breaks, kinks or broken fittings;

5.13.1.3 any liquid cooling systems are not leaking;

5.13.1.4 all interlocks are operational;

5.13.1.5 all warning indicators and lights are functioning properly; and

5.13.1.6. fasteners are tight, and threaded connections are secure.

5.13.2 Additional tasks that can be carried out by the operating organization should include:

5.13.2.1 Checks for :

A. electrical safety, including earth grounding and tests of electrical insulation of cables;

B. X ray leakage from the tube;

C. to ensure that all cables are in good condition, with no fraying or bare wires;

5.13.2.2 cleaning or replacement of any filters in cooling systems that may not be properly functioning;

5.13.2.3 tests on all interlocks and emergency cut-out switches;

5.13.2.4 tests on all permanently installed radiation detectors inside shielded enclosures

5.13.2.5 other routine checks and maintenance as recommended by the manufacturer;

5.14 Security of radiation sources

5.14.1 Licensees shall:

5.14.1.1 establish physical controls and administrative procedures to ensure that radiation sources remain secure at all times;

5.14.1.2 ensure that controls and procedures are used to prevent entry by unauthorized persons into radiation source stores, fixed radiography facilities and controlled areas during fixed site radiography procedures;

5.14.1.3 Control of a source is not relinquished without prior notification to the Radiation Protection Authority:

A. a source is not transferred unless the receiver possesses a valid licence from RPA;

B. all workers are informed of the need and importance of radiation source security; and

C. suitable permanent and purpose designed radiation source storage is available.

5.14.1.4 suitable temporary stores are established, where necessary, at non fixed sites where radiography with mobile sources is undertaken;

5.14.1.5 the potential ways in which sources can be lost or stolen be identified and closely monitored, in particular the risks of theft during temporary storage and transport; and

5.14.1.6 an effective system for accounting for radiation sources is implemented and is fully complied with by all workers.

5.15 Storage of industrial radiography sources

5.15.1 Licensees shall ensure that radioactive sources used for industrial radiography are stored in locked exposure containers or source changers, which in turn are kept in a suitable store that meets the following minimum requirements:

5.15.1.1 be designated as a controlled area;

5.15.1.2 be lockable to prevent removal or tampering with the radioactive sources;

5.15.1.3 protect the equipment from mechanical damage and harsh environmental conditions;

5.15.1.4 provide protection against fire;

5.15.1.5 shall not be contained or be located in proximity to flammable, corrosive or oxidising materials, or explosives;

5.15.1.6 provide shielding against gamma radiation;

5.15.1.7 be clearly labelled at the entrance with a radiation trefoil symbol, the words “danger radioactive material”

5.15.1.8 if the store is located at a place not on licensees premises, a label giving the name, address and telephone number of the Licensee shall be displayed.

5.16 Accounting for Radiation Sources

5.16.1 The accounting procedures shall be guided and consist of a number of elements which together provide adequate security to ensure the records are complete and accurate.

5.16.2 The location of sources shall be verified on a regular basis and the loss of any radioactive source shall be immediately reported to the Radiation Protection Authority.

5.16.3 Licensees shall ensure that the location of their radiation sources is known at all times. A formal accounting system shall be established for the following radioactive sources:

5.16.3.1 sealed sources used in gamma radiography;

5.16.3.2 pipeline crawler sources;

5.16.3.3 calibration sources such as those used to test radiation survey instruments;

5.16.3.4 exposure containers incorporating depleted uranium shielding, even when these containers do not contain a gamma radiography source.

5.17 Record of Radiation Sources

Licensees shall maintain a master record of all radiation sources as soon as they are received. The records shall contain the following information:

5.17.1 Sealed Source;

5.17.1.1 details of the source supplier;

5.17.1.2 date of receipt by the operating organisation;

5.17.1.3 manufacturers serial number;

5.17.1.4 radionuclide and activity on a stated date;

5.17.1.5 normal storage condition;

5.17.1.6 type and serial number of the exposure container in which source is located;

5.17.1.7 source identification number;

5.17.1.8 original manufacturer leak test certificate;

5.17.1.9 copy of any subsequent leak test certificate;

5.17.1.10 original supplier certificate if one is issued and any updated certificates; and

5.17.1.11 date, method, and destination for final disposal or transfer to another party as authorized by RPA.

5.17.2 Sealed Source Container

5.17.2.1 Details of container supplier;

5.17.2.2 Date of receipt into the operating organisation;

5.17.2.3 Manufacturers serial number;

5.17.2.4 Container type or model number (or descriptor);

5.17.2.5 Transport package type (e.g. Type A, type B etc);

5.17.2.6 Maximum activity of the source allowed to be used in the container;

5.17.2.7 The quantity of any depleted uranium shielding (in Kg);

5.17.2.8 Date, method, and destination for final disposal or transfer to another party as authorized by Radiation Protection Authority.

5.17.2.9 Where appropriate, copies of all of these records shall accompany each mobile source so that they can be readily inspected by the Radiation Protection Authority or internal auditors.

5.17.2.10 When sources or exposure containers are finally disposed of, the central records for each source or container shall be kept and stored in a secure place for such a period as may be specified by the Radiation Protection Authority.

5.18 Source Movement Records

5.18.1 The Licensee shall ensure that source movement records are completed every time a source is taken from the store and returned.

5.18.2 Licensees should know exactly where their sources are at all times during source movement.

5.18.3 The source movement records shall be retained by the Licensee for periods specified by the RPA.

5.18.4 Licensees shall maintain source movement records for every mobile radioactive source; and for every exposure container and source changer that incorporates depleted uranium shielding. Details shall be recorded as follows:

5.18.4.1 Source identification number which is sufficient to allow the exposure container to be related to the master records;

5.18.4.2 The radionuclide present;

5.18.4.3 The date and the time that an exposure container is removed from the store;

5.18.4.4 The name and the signature of the radiographer removing the source;

5.18.4.5 The location to where it is taken;

5.18.4.6 The date and time it is returned to the source store; and

5.18.4.7 The name and the signature of the radiographer returning the source.

5.19 Radiation Source Audits

5.19.1 Licensees shall ensure that monthly audits of the source accounts and movement records are carried out. The physical location of each source

(and any exposure containers incorporating depleted uranium) shall be verified. The audit shall include the following:

5.19.1.1 identification from the central record of which sources are currently held by the licensee;

5.19.1.2 preparation of a checklist for these sources;

5.19.1.3 confirmation by visual inspection that every source and depleted uranium source container is physically counted

5.19.1.4 confirmation that the source movement records are being correctly completed with no discrepancies;

5.19.1.5 a written record of the audit shall be endorsed by the auditor and the responsible person.

5.20 Maintenance Programme

5.20.1 The Licensee shall ensure that exposure devices, radiation generators, ancillary equipment, and safety systems are regularly inspected and maintained in good working order. A formal programme of inspection and maintenance shall therefore be prepared and implemented by the licensee and this programme shall take into account the recommendations of the equipment manufacturer and supplier. This programme shall incorporate the following:

5.20.1.1 routine checks to be carried out at the beginning of each radiography session and which all radiographers are trained to perform;

5.20.1.2 planned periodic inspection and servicing of equipment that shall only be done by a qualified expert or the equipment manufacturer or appointed agent.

5.20.2 The Licensee is responsible for ensuring that the maintenance programme is implemented. Any maintenance arrangement made between the licensee and a

service organization shall be specified in writing. A written guide detailing the maintenance works carried out shall be made available to the licensee after each servicing operation.

5.20.3 Any equipment found to be defective shall immediately be taken out of service, labelled as defective and not used until repaired. The RPO shall be promptly notified of such defects.

6.0 REQUIREMENTS FOR SHIELDED RADIOGRAPHY ENCLOSURES

A shielded radiography enclosure is an enclosed space engineered to provide protection in depth, against both accidental and routine radiation exposure during radiography procedures.

6.1 Establishment of a shielded radiography enclosure

6.1.1 The design of a shielded enclosure shall be based on protection in depth as in section 6.4 in this safety guide.

6.1.2 The design shall be submitted by the Licensee to the RPA for authorization.

6.1.3 Construction of the enclosures shall not commence until a licence is granted.

6.1.4 Modifications that may affect the safety of an enclosure shall not be made unless authorised by the RPA.

6.2 Commissioning of Shielded Enclosure Facilities

Prior to the industrial radiography facility being brought into routine operation, the Licensee shall ensure detailed commissioning safety assessment and radiation survey are carried out for the purpose of establishing that the:

6.2.1 facility has been constructed in accordance with the approved design specifications;

6.2.2 construction is such that radiation outside the facility does not exceed permissible dose limits, under the most critical conditions of the operation;

6.2.3 safety and warning systems have been properly installed and confirmed to be in accordance with the design specification; and

6.2.4 administrative systems, local rules and operating procedures are in place.

6.3 Classification of Operational Areas in the shielded enclosure

The Licensee shall designate any area as:

6.3.1 Controlled Area; and

6.3.2 Supervised Area.

6.4 Protection in Depth of operational areas within the shielded enclosure

6.4.1 Protection in depth is the provision of independent and engineered control systems that afford near-absolute safety. Licensees shall ensure that protection in depth is achieved. Such safety features shall operate in such a manner that the failure of one does not result in the failure of other safety measures/features. The safety features shall be commensurate with the probability and magnitude of potential radiation exposures.

6.4.2 Only after engineering controls have been applied, shall consideration be given to the use of administrative controls.

6.4.3 The following are the minimum requirements for in depth protection:

6.4.3.1 adequate shielding for all persons in the vicinity;

6.4.3.2 systems safety (interlocks, etc.) that are fail-safe;

6.4.3.3 radiation warning systems, that are fail safe where practicable;

6.4.3.4 appropriate Administrative safety procedures;

6.4.3.5 clear and enforced operating procedures.

6.5 Shielding of the enclosures

6.5.1 Licensees shall ensure that the:

6.5.1.1 enclosures used for fixed radiography are adequately shielded;and

6.5.1.2 following factors are taken into consideration:

A. the type of radiation ;

B. direction of the main radiation beam;

C. sticking of primary and secondary barriers, and the calculation of adequate barrier thickness, including walls, doors, roofs and floors as applicable;

D. personnel access to areas in the vicinity of the shielded enclosure, including areas above and below the enclosure, if applicable;

E. access into the enclosure for personnel; and

F. design of cable penetrations and door seals to prevent leakages paths for scattering or direct beam radiation.

6.6 Safety and Warning Systems

The Licensee shall ensure that appropriate safety and warning systems are in place.

5.17.3 6.6.1 Safety Systems

In shielded enclosures where radiation generators or high output gamma sources (>10 mSv/min) are used, the Licensee shall ensure that the following safety systems are installed and are maintained:

6.6.1.1 effective device interlocks that:

A. prevent operation of the device when the door is open;

B. automatically terminate operation of the device if the door opens; and

C. prevent initiation of operation of the device upon closing of the door.

6.6.1.2 emergency stop switches or other means of terminating the exposure.

6.6.1.3 access control.

5.17.4 Warning Systems

6.6.2.1 Licensees shall ensure that the following warning systems are installed and maintained:

A. A warning that goes off immediately prior to a radiation exposure commencing (normally an audible signal, such as a siren to warn people inside and outside the enclosure);

B. warning lights (rotating/flashing beacons both inside and outside the enclosure);

C. warning symbols;

D. visible notices, and

E. notices inside the enclosure that clearly state any working restrictions that must be observed;

6.6.2.2 In the case of radiation generators, warning signals described above shall operate automatically.

6.6.2.3 In the case of radioactive sources, it is preferable that the warning signals operate automatically (e.g. actuated by a signal from a radiation monitor or, possibly, a switch which detects the initial movement of the source as it leaves the exposure container).

6.6.2.4 In shielded enclosures where radiation sources of very high output are used, consideration shall be given to installing fixed radiation monitor(s) inside the enclosure to provide one or both of the following features:

A. a visible indication of radiation levels, and

B. a trigger to a door actuator that prevents the door being opened unless the dose rate is below a predetermined level.

6.7 Decommissioning of a Facility

The Licensee shall follow the decommissioning guidelines prescribed by the RPA.

7.0 REQUIREMENTS FOR ON-SITE RADIOGRAPHY

7.1 On-site Radiography

7.1.1 On-site radiography, where practicable, shall be carried out inside shielded facilities. The safety requirements for an on-site shielded facility are the same as those stipulated for mobile medical exposure.

7.1.2 Where this is not practicable, such as radiography of a truck or shipping container, the activity shall be undertaken under "non-fixed site radiography" conditions. The non-fixed site radiography shall be confined to a controlled area where specific protective measures and safety provision are strictly enforced.

7.1.3 Non-fixed site radiography presents a range of very different problems depending on the site circumstances, but will involve consideration of the following:

7.1.3.1 the location, particularly how easily non radiographic personnel can be effectively excluded from the vicinity of the work;

7.1.3.2 availability of a suitable area or compartment within the location for the radiographers protection while conducting non-fixed on-site radiography;

7.1.3.3 whether the protection of the public needs to be considered when establishing protection measures;

7.1.3.4 environmental conditions;

7.1.3.5 other activities, such as the need to work outside of normal working hours to avoid disruption of other work in the vicinity;

7.1.3.6 ease of access, such as when working at elevated heights, in

confined spaces or under difficult circumstances; and

7.1.3.7 production requirements that may create unreasonable pressure for the rapid completion of the radiography.

7.2 Preparation for Non Fixed site Radiography

Prior to commencing work under non-fixed site radiography conditions, the licensee shall:

7.2.1 carry out non fixed site specific safety assessment;

7.2.2 establish a secure store that provides an adequate level of safety and security if radiation sources are to be left on site; and

7.2.3 an appropriate source is used, such that its output is not significantly greater than required to produce the required radiograph.

7.3 Designation of non-fixed site controlled Areas

7.3.1 A controlled area shall be designated, without exception, during non-fixed site radiography. The main function of the boundary is to prevent access of nonradiographic personnel to the controlled area and it shall, therefore, include the complete periphery of the controlled area including, where necessary, access from areas above and below the working level.

7.3.2 In order to determine the extent of the controlled area, Licensees shall take into account the nature and frequency of non-fixed site radiography at the specific site as well as the occupancy of the vicinity of the designated controlled area.

7.3.3 The boundary of the controlled area shall be physically secured at the positions where access is possible

7.3.4 The boundary of the controlled area shall be delineated. The boundaries of controlled areas may include the use of existing structures such as walls, using temporary barriers or cordoning the area with tape/rope.

7.4 Protection in Depth for Non-fixed Site Radiography

During non-fixed site radiography, Licensees shall ensure that protection in depth is achieved by providing multiple layers of safety that include:

7.4.1 restriction of access to the controlled area;

7.4.2 patrolling the controlled area;

7.4.3 use of warning signals

7.4.4 having clear and well implemented operating procedures;

7.4.5 use of survey meters before and after every exposure; and

7.4.6 use of personal alarm dosimeters.

7.5 Shielding during non-fixed site radiography

Licensees shall ensure that, where practicable, shielding is used during non-fixed site radiography. This should include use of:

7.5.1 natural boundaries around the work place where this is possible; and

7.5.2 localised shielding such as collimators, beam stops and flexible lead sheet.

7.6 Safety and Warning Systems

7.6.1 The use of safety and warning systems has prevented many accidents. The lack of such systems or the fact that people have ignored them has resulted in serious health consequences to the radiation exposed persons.

7.6.2 Warning notices and warning signals shall be clearly visible at the boundary of the controlled area;

7.6.2.1 Warning Notices

A. warning Notices shall be displayed at the controlled area boundary at suitable positions.

B. the notices shall bear the international radiation trefoil symbol,

C. warnings and appropriate instructions shall be in the English language

D. the meaning of the warning signals shall be clearly stated. The notice shall include a phone number for use in case of emergencies.

7.6.2.2 Warning signals

An adequate warning shall be given immediately prior to and during every radiation exposure. In the case of radiation generators, these shall operate automatically and be designed “fail-safe”. Similarly, in the case of sealed sources, it is preferable that the warnings be arranged to operate automatically (e.g. actuated by a signal from a radiation monitor).

The following are preferable:

A. an audible pre-warning (such as a siren) that an exposure is about to take place, and

B. visual warning throughout the duration of the radiation exposure, preferably in the form of a rotating, flashing beacon.

7.7 Monitoring the Boundary

7.7.1 Before the start of radiographic work, the area is to be cleared of all people except for authorised personnel.

7.7.2 The boundary should be clearly visible and continuously monitored to ensure that unauthorised people do not enter the controlled area.

7.7.3 The radiation levels at the boundary are to be checked during radiography particularly when the position of the radiation device within the area or the direction of the radiation beam is changed.

7.8 Non Fixed site Radiography

Licensees shall ensure that the following are included in the local rules:

7.8.1 Non fixed site radiography shall not be undertaken unless at least two trained radiography staff are in attendance for each radiation source in use;

7.8.2 Radiographic techniques shall be chosen with a view of minimizing doses received by radiography staff and other persons;

7.8.3 Physical control shall be exercised over the radiation beam in as far as this will assist in restricting the size of the controlled area;

7.8.4 Only the RPO, radiographers and trained radiography assistants shall be permitted inside the controlled area;

7.8.5 Radiation levels at the boundary of the controlled area shall be checked during the first exposure and re-checked whenever exposure conditions are altered and the results shall be recorded;

7.8.6 The boundary of the controlled area shall be kept under continual surveillance throughout all radiation exposures. This may require additional personnel if the area is large and/or complex;

7.8.7 A survey meter shall be used at every radiation exposure to confirm that the radiation exposure has ceased and , in case of the use of a sealed source, that the source is fully shielded;

7.8.8 Any person who enters the controlled area shall wear a personal dosimeter and a functioning personal alarm monitor;

7.8.9 The wind-out crank or radiation generator control panel shall normally be outside the controlled area. Where this is not possible it shall be positioned such that the authorized radiographer who enters a controlled area shall not be exposed to dose rate in excess of 2 mSv/h;

7.8.10 On completion of the radiation exposure using a sealed source in the container, the container should be securely closed;

7.8.11 whenever entering the controlled area on completion of an exposure using a radiation generator, the operator shall ensure that the key is removed from the console;

7.9 De-designating a Controlled area

On completion of non-fixed site radiography work, the controlled area shall be dedesignated following the steps outlined below:

7.9.1 all radioactive sources are fully shielded and in their exposure containers;

7.9.2 containers have been removed ;

7.9.3 a final radiation survey of the site is done; and

7.9.4 all warning notices have been removed.

7.10 Accident Report

7.10.1 A comprehensive accident report is necessary.

7.10.2 A report of any accident shall be prepared by the RPO in consultation with a qualified expert.

7.10.3 The report shall be submitted to the senior management and to the RPA as specified in the license terms and conditions.

7.11 Content of Accident Report

7.11.1 In the event of an accident a report containing an accident and a dosimetry component shall be prepared.

7.11.2 The accident component shall include the following:

7.11.2.1 a description of the accident, giving as much detail as possible concerning the specific equipment involved, including model numbers and serial numbers wherever possible;

7.11.2.2 environmental conditions at the time of the accident e.g, wind speed and direction, temperature, humidity ;

7.11.2.3 number of persons present at the accident scene.

7.11.2.4 the specific or suspected cause of the accident, if it is established;

7.11.2.5 details of the actions taken to stabilize the accident situation and restore conditions to normal;

7.11.2.6 exposure time; and

7.11.2.7 precautions taken with the aim of preventing a similar accident

occurring in future.

7.11.3 The dosimetry component of the report shall include the following;

7.11.3.1 Exposure time;

7.11.3.2 Time and date of the accident;

7.11.3.3 The normal background reading;

7.11.3.4 The type of dosimeter used;

7.11.3.5 The last date of calibration;

7.11.3.6 The person who did the calibration

7.11.3.7 Summary of the doses received by all persons who were present at the accident scene.

7.11.3.8 Site location (GPS),

The entire report (containing both the accident and dosimetry sections) shall be sent to the RPA as specified in the licence terms and conditions.

DEFINITIONS

Authorization

The granting by a *regulatory body* or other governmental body of written permission for a person or organization to conduct specified *activities*.

Clearance level

A value established by a *regulatory body* and expressed in terms of *activity concentration*, at or below which *regulatory control* may be removed from a *source* of *radiation* within a notified or authorized practice.

Dose

- A measure of the energy deposited by *radiation* in a target.
- *Absorbed dose*, *committed equivalent dose*, *committed effective dose*, *effective dose*, *equivalent dose* or *organ dose*, as indicated by the context.

Dose constraint

A prospective and *source* related value of individual dose (*dose constraint*) or risk (*risk constraint*) that is used in planned exposure situations as a parameter for the optimization of protection and safety for the source, and that serves as a boundary in defining the range of options in optimization.

- For occupational exposure, a constraint on individual dose to workers established and used by registrants and licensees to set the range of options in optimizing protection and safety for the source.
- For public exposure, the dose constraint is a source related value established or approved by the government or the regulatory body, with account taken of the doses from planned operations of all sources under control. The dose constraint for each

particular source is intended, among other things, to ensure that the sum of doses from planned operations for all sources under control remains within the dose limit.

Effective dose

The quantity *E*, defined as a summation of all 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:

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

Where w_R is the *radiation weighting factor* for *radiation* R and $D_{T,R}$ is the average *absorbed dose* in the tissue or organ T.

Emergency plan

A description of the objectives, policy and concept of *operations* for the response to an *emergency* and of the *structure*, authorities and responsibilities for a systematic, coordinated and effective response. The *emergency plan* serves as the basis for the development of other plans, *procedures* and checklists.

Employer

A person or organization with recognized responsibilities, commitments and duties towards a *worker* in the employment of the person or organization by virtue of a mutually agreed relationship. (A self-employed person is regarded as being both an *employer* and a *worker*.)

Exemption

The determination by a *regulatory body* that a *source* or *practice* need not be subject to some or all aspects of *regulatory control* on the basis that the *exposure* and the *potential exposure* due to

the *source* or *practice* are too small to warrant the application of those aspects or that this is the optimum option for *protection* irrespective of the actual level of the *doses* or *risks*.

Health Professional

An individual who has been formally recognized through appropriate national *procedures* to practise a profession related to health (e.g. medicine, dentistry, chiropractic, podiatry, nursing, medical physics, medical radiation technology, radiopharmacy, occupational health).

Inspection imaging device

An imaging device designed specifically for imaging persons or cargo conveyances for the purpose of detecting concealed objects on or within the human body or within cargo or a vehicle.

Licence

A legal guide issued by the *regulatory body* granting *authorization* to perform specified *activities* relating to a *facility or activity*.

Licensee

The holder of a current *licence*.

Medical exposure

Exposure incurred by patients for the purposes of medical or dental diagnosis or treatment; by *carers and comforters*; and by volunteers subject to *exposure* as part of a programme of biomedical research.

Member of the Public

For *protection and safety* purposes, in a general sense, any individual in the population except when subject to *occupational exposure* or *medical exposure*. For the purpose of verifying compliance with the *annual dose limit* for *public exposure*, this is the *representative person*.

Natural source

A naturally occurring *source* of *radiation*, such as the sun and stars (*sources* of cosmic

radiation) and rocks and soil (terrestrial *sources* of *radiation*), or any other material whose *radioactivity* is for all intents and purposes due only to radionuclides of natural origin, such as products or residues from the processing of minerals; but excluding radioactive material for use in a nuclear installation and radioactive waste generated in such an installation.

Notification

A guide submitted to the *RPA* by a person or organization to notify an intention to carry out a *practice* or other use of a *source*.

Occupational exposure

Exposure of *workers* incurred in the course of their work.

Potential exposure

Prospective *exposure* that is not expected to be delivered with certainty but that may result from an *anticipated operational occurrence*, *accident* at a *source* or owing to an *event* or sequence of *events* of a probabilistic nature, including equipment *failures* and operating errors.

Practice

Any human activity that introduces additional *sources* of *exposure* or additional *exposure pathways*, or modifies the network of *exposure pathways* from existing *sources*, so as to increase the *exposure* or the likelihood of *exposure* of people or the number of people exposed.

Protection and Safety

The *protection* of people against *exposure* to *ionizing radiation* or due to *radioactive material* and the *safety* of *sources*, including the means for achieving this, and the means for preventing *accidents* and for mitigating the consequences of *accidents* if they do occur.

Protective action

An action for the purposes of avoiding or reducing *doses* that might otherwise be received in an *emergency exposure situation* or an *existing exposure situation*.

Longer term protective action

A *protective action* that is not an *urgent protective action*.

- Such protective actions are likely to be prolonged over weeks, months or years.
- These include measures such as relocation, agricultural countermeasures and remedial actions.

Mitigatory action

Immediate action by the *operator* or other party:

- To reduce the potential for conditions to develop that would result in *exposure* or a release of *radioactive material* requiring *emergency actions* on or off the site; or
- To mitigate *source* conditions that may result in *exposure* or a release of *radioactive material* requiring *emergency actions* on or off the site.

Precautionary urgent protective action

A protective action in the event of a *nuclear or radiation emergency* which must be taken before or shortly after a release of *radioactive material*, or before an *exposure*, on the basis of the prevailing conditions to prevent or to reduce the *risk* of *severe deterministic effects.*

Urgent protective action

A *protective action* in the event of an *emergency* which must be taken promptly (usually within hours) in order to be effective, a nd the effectiveness of which will be markedly reduced if it is delayed.

Public exposure

Exposure incurred by *members of the public* due to *sources* in *planned exposure situations*, *emergency exposure situations* and *existing exposure situations*, excluding any *occupational exposure* or *medical exposure*.

Registration

A form of *authorization* for *practices* of low or moderate *risks* whereby the person or organization responsible for the *practice* has, as appropriate, prepared and submitted a *safety assessment* of the *facilities* and equipment to the *regulatory body*. The *practice* or use is authorized with conditions or limitations as appropriate.

Registrant

The holder of a current *registration*

Regulatory body

An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory *process*, including issuing *authorizations*, and thereby regulating *nuclear*, *radiation*, *radioactive waste* and *transport safety*.

Risk

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

Safety assessment

Assessment of all aspects of a *practice* that are relevant to *protection and safety*; for an *authorized facility*, this includes *siting*, *design* and *operation* of the *facility*.

Safety culture

The assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, *protection and safety* issues receive the attention warranted by their significance.

Source

1. Anything that may cause *radiation exposure* — such as by emitting *ionizing radiation* or by releasing *radioactive material* — and can be treated as a single entity for *protection and safety* purposes.

- For example, materials emitting *radon* are *sources* in the environment; a sterilization gamma irradiation unit is a *source* for the *practice* of *radiation* preservation of food and sterilization of other products; an X ray unit may be a *source* for the *practice* of radiodiagnosis; a nuclear power plant is part of the *practice* of generating electricity by nuclear fission, and may be regarded as a *source* (e.g. with respect to *discharges* to the environment) or as a collection of *sources* (e.g. for occupational *radiation protection* purposes). A complex or multiple installation situated at one location or site may, as appropriate, be considered a single *source* for the purposes of application of international *safety standards*.

Natural source

A naturally occurring *source* of *radiation*, such as the sun and stars (*sources* of cosmic *radiation*) and rocks and soil (terrestrial *sources* of *radiation*), or any other material whose *radioactivity* is for all intents and purposes due only to radionuclides of natural origin, such as products or residues from the processing of minerals; but excluding radioactive material for use in a nuclear installation and radioactive waste generated in such an installation.

Radiation generator

A device capable of generating *ionizing radiation*, such as X rays, neutrons, electrons or other charged particles, that may be used for scientific, industrial or medical purposes.

2. *Radioactive material* used as a *source* of *radiation*.

- Such as those sources used for medical applications or in industrial instruments. These are, of course, *sources* as defined in (1), but this usage is less general.

Dangerous source

A *source* that could, if not under *control*, give rise to *exposure* sufficient to cause *severe deterministic effects*. This categorization is used for determining the need for *emergency*

response arrangements and is not to be confused with categorizations of *sources* for other purposes.

Radioactive source

A *source* containing *radioactive material* that is used as a source of radiation.

Sealed source

A *radioactive source* in which the *radioactive material* is (a) permanently sealed in a capsule or (b) closely bonded and in a solid form.

Unsealed source

A *radioactive source* in which the *radioactive material* is neither (a) permanently sealed in a capsule nor (b) closely bonded and in a solid form.

Standards dosimetry laboratory

A laboratory, designated by the relevant national authority that possesses certification or accreditation necessary for the purpose of developing, maintaining or improving primary or secondary standards for radiation dosimetry.

Supplier (of a source)

Any person or organization to whom a registrant or licensee delegates duties, totally or partially, in relation to the design, manufacture, production or construction of a source.

Worker

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 selfemployed person is regarded as having the duties of both an *employer* and a *worker*)

Workers' health surveillance

Medical supervision intended to ensure the initial and continuing fitness of *workers* for their intended tasks.

ANNEX: CHECKLIST

RPA SG 5

CHECKLIST FOR SAFETY GUIDE 5

INDUSTRIAL RADIOGRAPHY

INSPECTION FORMS FOR RADIATION SOURCES IN INDUSTRIAL RADIOGRAPHY

FORM SG 2D-IR-1

THE RADIATION PROTECTION AUTHORITY

INSPECTION PROCEDURES AND RECORDS OF RADIATION SOURCES IN INDUSTRIAL RADIOGRAPHY

INSPECTION RECORD SUMMARY

INDUSTRIAL RADIOGRAPHY

Inspection number	

Authorization number	

Name of the authorized legal person	
Address of Legal Person's principal premises:	
Address (location of the site inspected if other than principal premises)	
Telephone Number	
Name of Radiation Protection Officer	
Name of legal person's representative for the inspection	
Date of LAST Inspection	_____/_____/_____
Date of THIS Inspection	_____/_____/_____
Starting time:	**Exit time:**

Type of Inspection Pre-authorization Routine Investigational Termination	☐ ☐ ☐ ☐
Recommended Date of NEXT Inspection	_____/_____/_____
Summary of Findings and Actions	
NO items of non-compliance found Items of non-compliance found Follow-up on previous non-compliance	☐ ☐ ☐

RPA Inspector name & signature Date	
Licensee's name & signature Date	

FORM SG 2D-IR-2

INSPECTION RECORD

INDUSTRIAL RADIOGRAPHY

This inspection record/checklist is to be used by the inspector to assist with the performance of the inspection. Note that all areas will not necessarily be applicable to each licensed facility. In addition, with supervisory approval, the inspector may choose not to review a particular program area during each inspection. However, for those areas ***not examined*** *or* ***not relevant*** *during the inspection a notation such as "Not Reviewed" or "Not Applicable" should be made in the relevant section and a brief explanation as to why the area was not reviewed should be provided, where applicable.*

All areas investigated during the inspection should be documented in sufficient detail to describe the activities and procedures observed and/or demonstrated. In addition, the types of records that were reviewed and the time periods covered by those records should be noted. If the operator demonstrates any work practices at the inspector's request, describe those demonstrations. The observations and demonstrations described in this report, along with measurements and the records reviewed, should substantiate your inspection findings. Attach copies of all relevant documents and records required to support item(s) of non-compliance.

1. AMENDMENTS AND PROGRAM CHANGES *Prior to the inspection, list for review any licence amendments submitted by the operator and approved by the RPA since the last inspection*

2. INSPECTION AND ENFORCEMENT HISTORY

Prior to the inspection, list for review any items of non-compliance identified during previous 2-3 inspections

DATE	INSPECTOR	VIOLATIONS

3. INCIDENT / EVENT HISTORY

Prior to the inspection, list for review any incidents or events reported to the RPA since the last inspection

4. ORGANIZATION AND SCOPE OF THE PROGRAM

Briefly describe the present scope of activities, including types and quantities of use involving licensed sources, frequency of use, staff size, etc. (Note deviations from the authorization certificate)

5. TRAINING AND INSTRUCTION OF WORKERS

Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities, and emergency response

	Yes	No
Do all Industrial Radiographers have a suitable level of training?		
Do all industrial radiography assistants have a suitable level of training?		
Refresher radiation safety training is provided periodically?		
Are radiography assistants directly supervised by a competent person at all times?		

Are training records maintained for each worker?		
Do interviews with Industrial Radiographers and assistants demonstrate an appropriate level of understanding of safe working rules and emergency procedures (e.g. source recovery?)		
Discussion with the RPO demonstrates an appropriate knowledge of the RPA, the authorization certificate, the legislation, conditions, safe working procedures, etc.?		
Does the RPO have appropriate resources (time, personnel) and authority (to take independent action to remedy urgent safety issues) to properly perform the role?		
Comments:		

6. INTERNAL AUDITS AND REVIEWS		
	Yes	No
Operator reviews the radiation protection program at appropriate intervals?		
Audits of the facilities, source inventory, working rules and emergency procedures performed at appropriate intervals?		
Frequency		

Operator conducts regular audits of employees working at field sites?		
Audits conducted by		
Records of program reviews and audits maintained?		
Comments		

7. FACILITIES AND EQUIPMENT

Facilities as described; uses; control of access; engineering controls; calibration facilities; shielding [BSS Section 2.34]

	Yes	**No**
At the principal authorized premises		
- are the facilities as described in the application for authorization?		
- is access to radiation sources restricted to authorized persons only?		
- are radiation sources properly secured to prevent unauthorized removal?		
- is a source (x and γ) movement register maintained and up to date?		
- is the store for radiation sources (all types) secure?		
- does the store for radioactive sources bear appropriate warning signs (in the local language)?		
- are fire protection measures adequate?		

- are adequate methods used to prevent unauthorized individuals from the enclosures for radiography?		
- appropriate emergency equipment is available in order to properly deal with the retrieval of jammed sources, etc.?		
At the inspected field site		
- are adequate methods used to prevent unauthorized individuals from entering irradiation zones?		
- is access to irradiation zone restricted to authorized persons only?		
- are radiation sources properly secured to prevent unauthorized removal?		
- is the transitory store for radiation sources secure?		
- does the store for radioactive sources bear appropriate warning signs (in the local language)?		
- are fire protection measures adequate?		
- appropriate emergency equipment is available in order to properly deal with the retrieval of jammed sources, etc.?		

8. RADIATION SOURCES	Yes	No
Radiation sources and uses are as authorized?		
Leakage tests are periodically performed on sealed sources (other than those subject to frequent replacement such as ^{192}Ir)? e.g. ^{137}Cs crawler control sources, ^{60}Co, etc.?		
Inventory of sealed sources maintained? (inspector to confirm)		
Decayed radiation sources (e.g. ^{192} Ir) disposed of where?		
Records of leakage tests and inventory maintained?		
Are the source containers, X ray equipment and crawler control sources subject to periodic testing to ensure the design and operating characteristics comply with the IEC/ISO or other requirements of the RPA?		
Collimating devices are provided with every radiation source (x and γ) and used whenever practicable?		
If so, at what frequency; by whom; date of the last test?		
Radioactive source containers		
- are properly labelled (as radioactive, details of the contained source, contacts)?		
- have key locks and, if not in immediate use, are locked?		
- meet the minimum length requirement for wind-out and delivery cables?		
- are subject to wear testing, source disconnect checks and maintenance procedures in compliance with the manufacturer's requirements?		
X ray equipment		
- is key operated?		
- meets the minimum length requirements for connecting cables?		

- is fitted with filtration appropriate to the task?		
- for crawler equipment, is fitted with appropriate exposure warning device (e.g. klaxon)?		
- for crawler equipment, is fitted with a safety shut-off switch to be activated prior to removal of the equipment from the pipe?		
RPO keeps records of testing, compliance and maintenance?		
Comments:		

9. RECEIPT AND TRANSFER OF RADIATION SOURCES		
	Yes	**No**
Radioactive package opening procedures established and followed?		
Incoming radioactive packages surveyed for damage, dose rates and potential radioactive contamination before opening?		
Satisfactory procedures are in place for the disposal of radiation sources that are no longer required. e.g. disposal only to authorized persons;		
notification to the RPA, etc.?		
Records of packaging surveys, source receipt and transfer maintained?		

Comments

10. AREA RADIATION SURVEYS *Radiological surveys; leak tests; inventories; handling of radioactive materials; records; [BSS – Section I.38]*		
	Yes	**No**
Operator possesses appropriate, functioning radiation survey instrument(s) suitable for the detection and measurement of x and/or γ radiation as appropriate?		
Operator performs proper function checks on instruments prior to use?		
Survey meter calibrations are current?		
Survey meter calibration is performed by an approved facility?		
Name of facility		
Sufficient functional survey meters are available for each radiography operation? (i.e. for each Industrial Radiographer and assistant team)		
Direct reading pocket dosimeters performance checked at appropriate intervals?		
Sufficient functional direct reading pocket dosimeters are available for each radiography worker?		
Area exposure rate surveys are performed at appropriate intervals?		

Is it evident that workers always use a survey meter at the conclusion of every exposure to confirm that the radioactive source has been returned to its container?		
Surveys for removable contamination conducted as required?		
Records of calibrations, contamination surveys, etc. maintained?		
Comments:		

11. PERSONNEL RADIATION MONITORING

Radiation protection program with ALARA provisions; dosimetry; exposure evaluations; dose and survey records and reports; notifications to workers] [BSS –

Schedule II]

	Yes	**No**
Operator provides personal dosimeters to all radiation workers?		
Dosimetry supplier is an authorized provider?		
Name of provider		
Dosimeters provided are appropriate for the radiation type and energy?		
Dosimeters are exchanged at the prescribed period?		

Dosimetry reports are promptly reviewed by the RPO?		
Is it evident that personal dosimeters are being worn by workers?		
Individual workers are informed of their monitoring results when each monitoring report is received (regardless of the dose measured)?		
Does the operator apply the optimization principle (ALARA) to occupational exposure?		

12. TRANSPORT OF RADIOACTIVE SOURCES

IAEA Regulations for the Safe Transport of Radioactive Material-Safety Standard Series No. TS-R-1]

	Yes	**No**
Does transport of radioactive material (from supplier, by operator) comply with IAEA transport regulations?		
Approved packages used?		
Packages properly labelled and marked?		
Operator's vehicles, if used for transport, comply with regulations?		
Shipper's declaration papers have correct details and used when shipping sources?		
Comments		

Personnel monitoring (reading pocket dosimeters and personal dosimeters) records are maintained?		
Dosimetric results of both systems are in acceptable agreement?		
Inspector reviewed both personnel monitoring records for the period from/to		
Comments *(include the maximum doses to workers during this review period*)		

13. NOTIFICATIONS AND REPORTS *Reporting and follow-up of theft; loss; incidents; overexposures; safety-related equipment failures; change in RPO, and radiation dose reports to workers [BSS - Section 3.12]*	**Yes**	**No**

Have any program changes been implemented that required (but have not received) approval by the RPA?		
Have any notifiable incidents or accidents occurred since the last inspection?		
If yes, have they been reported to the RPA? (*If no, list the incidents or accidents in Comments)*		
Have any significant structural or other safety related changes been made to the principal facilities or to radiation devices without approval of the RPA?		
If yes, was a safety assessment performed by a Qualified Expert?		
Comments		

14. WARNING SIGNS AND LABELLING

Proper warning signs in use areas and labelling of containers with radioactive material [BSS - Section I.23]

	Yes	**No**
Controlled areas, including field sites (if relevant for this inspection), have appropriate barriers and warning signs (in the local language)?		
Devices containing radiation sources are properly labelled?		
Notices to workers (in the local language) are displayed as required?		
Comments		

15. INDEPENDENT AND CONFIRMATORY MEASUREMENTS		
	Yes	**No**
Inspector made area and other measurements for comparison to operators		
Comments: *Describe the types and results of measurements taken. Identify the instruments used by the inspector (make, model, last calibration).*		

16. ITEMS OF NON-COMPLIANCE AND OTHER SAFETY ISSUES
List any breaches noted during the inspection (what, when, where and who).

17. PERSONNEL CONTACTED
Identify the personnel contacted during the inspection

INSPECTION FORMS FOR RADIATION SOURCES IN RESEARCH AND INDUSTRIAL IRRADIATORS

FORM SG 2E-RIR-1

THE RADIATION PROTECTION AUTHORITY

INSPECTION PROCEDURES AND RECORDS OF RADIATION SOURCES IN RESEARCH AND INDUSTRIAL IRRADIATORS

INSPECTION RECORD SUMMARY

IRRADIATOR

Inspection number	
Authorization number	

Name of the Facility	
Address (location of the facility)	
Telephone Number	
Name of Radiation Protection Officer	
Legal person's representative for the inspection	

Date of LAST Inspection	_____/_____/_____
Date of THIS Inspection	_____/_____/_____
Starting time:	**Exit**

Type of Inspection Pre-authorization Routine Investigational Termination	**time :**
Recommended Date of NEXT Inspection	_____/_____/_____
Summary of Findings and Actions NO items of non-compliance found Items of non-compliance found Follow-up on previous non-compliance	
RPA Inspector name & signature Date	
Licensee Name's & signature Date	

FORM SG 2E-RIR-2

INSPECTION RECORD

IRRADIATOR

This inspection record/checklist is to be used by the inspector to assist with the performance of the inspection. Note that all areas will not necessarily be applicable to each authorized facility. In addition, with supervisory approval, the inspector may choose not to review a particular program area during each inspection. However, for those areas ***not examined*** *or* ***not relevant*** *during the inspection (the form may be adapted to irradiators using either* ***radioactive substances*** *or* ***electrically generated radiation****) a notation such as "Not Reviewed" or "Not Applicable" should be made in the relevant section and a brief explanation as to why the area was not reviewed should be provided, where applicable*

All areas covered during the inspection should be documented in sufficient detail to describe what activities and procedures were observed and/or demonstrated. In addition, the types of records that were reviewed and the time periods covered by those records should be noted. If the operator demonstrated any practices at your request, describe those demonstrations. The observations and demonstrations you describe in this report, along with measurements and some records review, should substantiate your inspection findings. Attach copies of all operator's documents and records needed to support items of non-compliance.

1. AMENDMENTS AND PROGRAM CHANGES *Prior to the inspection, list for review any licence amendments submitted by the operator and approved by the RPA since the last inspection*

2. INSPECTION AND ENFORCEMENT HISTORY *Prior to the inspection, list for review any items of non-compliance identified during previous 2-3 inspections*		
DATE	**INSPECTOR**	**VIOLATIONS**

3. INCIDENT / EVENT HISTORY *Prior to the inspection, list for review any incidents or events reported to the RPA since the last inspection*

4. ORGANIZATION AND SCOPE OF THE PROGRAM *Briefly describe the present scope of activities, including types and quantities of use involving authorized sources, frequency of use, staff size, etc. (Note deviations from the authorization certificate)*

5. TRAINING AND INSTRUCTION OF WORKERS

Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities, and emergency response

	Yes	**No**
All occupationally exposed personnel are provided with initial safety training?		
Refresher radiation safety training is provided periodically?		
Proper supervision of workers by appropriately trained persons?		
Are training records maintained for each worker?		
Do interviews with workers demonstrate an adequate level of understanding of safe working rules and emergency procedures?		
Discussion with the RPO demonstrates an appropriate knowledge of the RPA), the authorization certificate, the legislation, conditions, safe working procedures, etc?		

Does the RPO have appropriate resources (time, personnel) and authority (to take independent action to remedy urgent safety issues) to properly perform the role?		
Comments:		

6. INTERNAL AUDITS AND REVIEWS		
	Yes	No
Operator reviews the radiation protection programme at appropriate intervals?		
Audits of the facilities, source inventory, working rules and emergency procedures performed at appropriate intervals?		
Audits conducted by		
Frequency		
Records of program reviews and audits maintained?		
Comments		

7. FACILITIES AND EQUIPMENT *Facilities as described; uses; control of access; engineering controls; calibration facilities; shielding [BSS Section 2.34]*		
	Yes	**No**
Are the facilities as described in the authorization application?		
Is the irradiator subject to periodic testing to ensure the design and operating characteristics comply with the IEC/ISO or other requirements of the RPA?		
If yes, by whom, date of last test?		
Do those checks include		
- each aspect of the system controlling access to and emergency exit (e.g. safe life system) from the irradiation room?		
- source position (or beam ON) indication?		
- emergency source return (or beam OFF) control?		
- heat/smoke detectors, fire extinguisher system?		
- assessment of potential radiation damage to electrical wiring?		
- ozone concentration measurement, if needed?		
For radioactive sources		
- confirmation that water circulation system is leak tight?		
- pool water replacement system high and low water indicators?		
- assessment of water volumes added to the pool to determine if there is		
pool leakage?		
- water conductivity and analysis?		

Is repair and maintenance of the irradiator performed periodically by the manufacturer or other persons specifically authorized by the RPA?		
If yes, name of organization, date of last maintenance		
Are malfunctions and defects found during inspection and maintenance checks repaired without delay?		
Is access to the radiation source(s) adequately controlled?		
Are radioactive sources secured to prevent unauthorized removal?		
Are adequate procedures in place to prevent unauthorized individuals from entering controlled areas?		
Is the store for radioactive sources secure?		
Does the store bear appropriate warning signs (in the local language)?		
Is the level of fire protection in the store satisfactory?		
RPO keeps records of checks, maintenance and follow up actions?		
Comments		

8. RADIATION SOURCES	Yes	No
Radioactive sources (radionuclides, activities and uses) at the facility are as authorized?		
Other irradiators (e.g. linear accelerators, etc) at the facility are as authorized?		
Are sealed radioactive sources leak tested at prescribed intervals?		
Are leak tests performed in accordance with approved procedures?		
Have any sealed radioactive sources been found to be leaking?		
If yes, were appropriate actions taken and the RPA notified?		
Records of leakage tests and inventory maintained?		
Comments:		

9. RECEIPT AND TRANSFER OF RADIATION SOURCES	Yes	No
Radioactive package opening procedures established and followed?		
Incoming radioactive packages surveyed for damage, dose rates and potential radioactive contamination before opening?		
Satisfactory procedures are in place, if relevant, for the disposal of radiation sources that are no longer required. (e.g. disposal only to authorized persons; notification to the RPA, etc.)?		
Records of packaging surveys, source receipt and transfer are maintained?		
Comments		

10. AREA RADIATION SURVEYS AND CONTAMINATION CONTROL *Radiological surveys; leak tests; inventories; handling of radioactive materials; records; contamination control [BSS – Section I.38]*	**Yes**	**No**
Operator possesses appropriate functioning survey meters?		
Suitable function checks are performed on survey meters prior to use?		
Survey meter calibrations are current?		
Survey meter calibration is performed by an approved facility?		
Name of facility		
Date of last calibration		
Area exposure rate surveys are performed at appropriate intervals?		
Are appropriate and functioning conductivity meters possessed and used?		
Are conductivity meters calibrated at appropriate intervals?		
Is the location, sensitivity and function of fixed radiation monitor to detect sources that may be carried by the product conveyor system satisfactory?		
Is the location, sensitivity and function of fixed monitor(s) used to detect the presence of high radiation levels in the irradiation room satisfactory?		

Is the function and sensitivity of monitor(s) used to detect contamination of the pool water due to a leaking source satisfactory?		
Is the function of all monitors routinely tested at prescribed intervals?		
Records of calibrations, surveys, tests, conductivity measurements etc. maintained?		
Comments		

11. PERSONNEL RADIATION MONITORING

Radiation protection program with ALARA provisions; dosimetry; exposure evaluations; dose and survey records and reports; notifications to workers] [BSS –

Schedule II]

	Yes	**No**
Operator provides personal dosimeters to all radiation workers?		
Dosimetry supplier is an authorized provider?		
Name of provider		
Dosimeters provided are appropriate for the radiation type and energy?		
Dosimeters are exchanged at the prescribed period?		

Dosimetry reports are promptly reviewed by the RPO?		
Is it evident that personal dosimeters are being worn by workers?		
Individual workers are informed of their monitoring results when each monitoring report is received (regardless of the dose measured)?		
Does the operator apply the optimization principle (ALARA) to occupational exposure?		
Personnel monitoring records are maintained?		
Inspector reviewed personnel monitoring records for the period from/ to		
Comments *(include the maximum doses to workers during this review period*)		

12. TRANSPORT OF RADIOACTIVE SOURCES

IAEA Regulations for the Safe Transport of Radioactive Material-Safety Standard Series No. TS-R-1

	Yes	**No**
Does transport of radioactive material (from supplier, by operator) comply with IAEA transport regulations?		
Approved packages used?		
Packages properly labelled and marked?		
Operator's vehicles, if used for any transport, comply with regulations?		
Shipper's declaration papers have correct details and used when shipping sources?		
Comments		

13. NOTIFICATIONS AND REPORTS

Reporting and follow-up of theft; loss; incidents; overexposures; safety-related equipment failures; change in RPO, and radiation dose reports to workers. [BSS -

Section 3.12]

	Yes	No
Have any program changes been implemented that required (but have not received) approval by the RPA?		
Have any notifiable incidents or accidents occurred since the last inspection?		
If yes, have they been reported to the RPA? (*If no, list the incidents or accidents in Comments)*		
Have any significant structural or other safety related changes been made to the facilities or irradiator without approval of the RPA?		
If yes, was a safety assessment performed by a Qualified Expert?		
Comments		

14. WARNING SIGNS AND LABELLING

Proper warning signs in use areas and labelling of containers with radioactive material [BSS-Section I.23]

	Yes	No
Controlled areas have appropriate warning signs (in the local language)?		
Containers of radioactive material are properly labelled (with hazard warnings in the local language)?		
Notices to workers are displayed as required?		
High radiation areas properly identified?		

Comments

15. INDEPENDENT AND CONFIRMATORY MEASUREMENTS

	Yes	No
Inspector made area and other measurements for comparison to operators		

Comments: *Describe the types and results of measurements taken. Identify the instruments used by the inspector (make, model, last calibration).*

16. ITEMS OF NON-COMPLIANCE AND OTHER SAFETY ISSUES *List any breaches noted during the inspection (what, when, where and who).*

17. PERSONNEL CONTACTED *Identify the personnel contacted during the inspection*

INSPECTION FORM FOR RADIATION SOURCES IN GAUGES

FORM SG 2F-G-1

THE RADIATION PROTECTION AUTHORITY

INSPECTION PROCEDURES AND RECORDS OF RADIATION SOURCES IN GAUGES

INSPECTION RECORD SUMMARY

GAUGES (PART 1)

Inspection number	
Authorization number	

Name of the facility	
Address (location of the site inspected)	

Telephone Number	
Name of Radiation Protection Officer	
Licensee's representative for the inspection	
Date of LAST Inspection	_____/_____/_____
Date of THIS Inspection	_____/_____/_____
Starting time:	**Exit time :**

Type of Inspection Pre-authorization Routine Investigational Termination	
Recommended Date of NEXT Inspection	_____/_____/_____
Summary of Findings and Actions NO items of non-compliance found Items of non-compliance found Follow-up on previous non-compliance	

RPA Inspector name & signature Date	
Licensee's name & signature Date	

FORM SG 2F-G-2

INSPECTION RECORD

GAUGES (PART I)

The inspection record/checklist is to be used by the inspector to assist with the performance of the inspection. Note that all areas will not necessarily be applicable to each authorized facility. In addition, with supervisory approval, the inspector may choose not to review a particular program area during each inspection. However, for those areas ***not examined*** *or* ***not relevant*** *during the inspection a notation such as "Not Reviewed" or "Not Applicable" should be made in the relevant section and a brief explanation as to why the area was not reviewed should be provided, where applicable.*

All areas investigated during the inspection should be documented in sufficient detail to describe the activities and procedures observed and/or demonstrated. In addition, the types of records that were reviewed and the time periods covered by those records should be noted. If the operator demonstrates any work practices at the inspector's request, describe those demonstrations. The observations and demonstrations described in this report, along with measurements and the records reviewed, should substantiate your inspection findings. Attach copies of all relevant documents and records required to support item(s) of non-compliance.

This inspection record/checklist is divided into THREE parts*. The first deals with matters common to fixed, portable and in-stream radioactive gauges. The second with specific issues for what may be termed "fixed" gauges i.e. those installed on vessels for level*

detection, on pipelines and conveyor belts for density and/or weight measurement. That part includes in-stream analysis gauges where the radiation source is immersed in a slurry. The third part deals with portable gauges i.e. neutron moisture/density gauges such as those used in road construction and related activities.

*The officer should use the **common** first part plus either the **second or third** part as applicable to the authorized use. **For fixed or portable X ray gauges** (electrically generated X rays), complete the sections and items that are relevant.*

1. AMENDMENTS AND PROGRAM CHANGES *Prior to the inspection, list for review any authorization amendments submitted by the operator and approved by the RPA since the last inspection*

2. INSPECTION AND ENFORCEMENT HISTORY *Prior to the inspection, list for review any items of non-compliance identified during previous 2-3 inspections*		
DATE	**INSPECTOR**	**VIOLATIONS**

3. INCIDENT / EVENT HISTORY *Prior to the inspection, list for review any incidents or events reported to the RPA since the last inspection*

4. ORGANIZATION AND SCOPE OF THE PROGRAM *Briefly describe the present scope of activities, including types and quantities of use involving authorized sources, frequency of use, staff size, etc. (Note deviations from the authorization certificate)*

5. INTERNAL AUDITS AND REVIEWS		
	Yes	No
Operator reviews the radiation protection program at appropriate intervals?		
Audits of the facilities, source inventory, working rules and emergency procedures performed at appropriate intervals?		
Operator conducts regular audits of employees working at field sites?		
Audits conducted by		
Frequency		
Records of program reviews and audits maintained?		
Comments		

6. RECEIPT AND TRANSFER OF RADIATION SOURCES		
	Yes	**No**

Radioactive package opening procedures established and followed?		
Incoming radioactive packages surveyed for damage, dose rates and potential radioactive contamination before opening?		
Satisfactory procedures are in place for the disposal of radiation sources that are no longer required. e.g. disposal only to authorized persons; notification to the RPA, etc.?		
Records of packaging surveys, source receipt and transfer maintained?		
Comments		

7. TRANSPORT OF RADIOACTIVE SOURCES

IAEA Regulations for the Safe Transport of Radioactive Material-Safety Standard Series No.

TS-R-1

	Yes	**No**
Does transport of radioactive sources (from supplier, by operator) comply with IAEA transport regulations?		
Approved packages used?		
Packages properly labeled and marked?		
Operator’s vehicles, if used for transport, comply with regulations?		

Shipper’s declaration papers have correct details and used when shipping sources?		
Comments		

8. WARNING SIGNS AND LABELLING *Proper warning signs in use areas and labeling of containers with radioactive material [BSS-Section I.23]*		
	Yes	**No**
Controlled areas have appropriate warning signs (in the local language)?		
Gauges housings are properly labeled (hazard warning in the local language)?		
Notices to workers are displayed in the local language?		
Comments		

9. NOTIFICATIONS AND REPORTS *Reporting and follow-up of theft; loss; incidents; overexposures; safety-related equipment failures; change in RPO, and radiation dose reports to workers. [BSS -*

Section 3.12]		
	Yes	**No**
Have any program changes been implemented that required (but have not received) approval by the RPA?		
Have any notifiable incidents or accidents occurred since the last inspection?		
If yes, have they been reported to the RPA? (*If no, list the incidents or*		
accidents in Comments)		
Have any significant structural or other safety related changes been made to the facilities or radiation sources without approval of the RPA?		
If yes, was a safety assessment performed by a Qualified Expert?		
Comments		

10. ITEMS OF NON-COMPLIANCE AND OTHER SAFETY ISSUES
List any breaches noted during the inspection (what, when, where and who).

11. PERSONNEL CONTACTED *Identify the personnel contacted during the inspection*

FORM SG 2F-G-3

INSPECTION RECORD

GAUGES – FIXED (PART 2)

This inspection record/checklist *deals with matters pertaining to "fixed" gauges i.e. those installed on vessels for level detection, on pipelines and conveyor belts for density and/or weight measurement. It includes in-stream analysis gauges where the radiation source is immersed in a slurry.*

X ray Gauges *- Complete relevant items for gauges that use electrically generated X rays*

1. TRAINING AND INSTRUCTION OF WORKERS

Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities, and emergency response

	Yes	No
Is basic radiation safety training provided to all persons who may be required to work in the vicinity of a gauge?		
Is more advanced training given to personnel whose tasks require them to install or work in close proximity to a gauge or where there is the potential for exposure to the useful radiation beam (e.g. during maintenance inside bins or hoppers fitted with level gauges)?		
For in-stream analysis gauges, are workers responsible for replacing protective source windows provided with special training?		
Refresher radiation safety training is provided periodically?		
Are training records maintained for each worker?		
Do interviews with workers demonstrate an adequate level of understanding regarding safety and emergency procedures?		

Discussion with the RPO demonstrates an appropriate knowledge of the RPA, the authorization certificate, the legislation, conditions, safe working procedures, etc?		
Does the RPO have appropriate resources (time, personnel) and authority (to take independent action to remedy urgent safety issues) to properly perform the role?		
Comments:		

2. FACILITIES AND EQUIPMENT *Facilities as described; uses; control of access; engineering controls; calibration facilities; shielding [BSS Section 2.34]*		
	Yes	**No**
Are the facilities as described in the authorization application?		
Is access to gauges in use adequately controlled by		
- appropriate area warning signs (in the local language)?		
- physical barriers, where appropriate?		
Except for in-stream analysis gauges, is access to the useful radiation beam prevented by physical barriers?		
Are adequate controls in place to prevent unauthorized persons from entering controlled areas and from accessing the useful radiation beam?		
Do the design and performance characteristics of the gauges comply with relevant IEC/ISO standards or other requirements of the RPA?		

Are gauges subject to regular testing to ensure continued compliance?		
If so, at what frequency; by whom; date of last test?		
Are gauges subject to routine maintenance by authorized service agents?		
If so, at what frequency, by whom; date last maintenance?		
Are adequate controls in place to ensure that all gauges are secured from unauthorized removal? e.g. through training of personnel and by ensuring that the RPO is given prior notification of any work requiring a gauge to be removed from its usual site, or of planned work in a bin or hopper to which gauges are fitted?		
Is the store for radioactive gauges currently not in use		
- Properly identified and sign posted (in the local language)?		
- Unlikely to be affected by the storage of other potentially hazardous substances?		
Records of compliance tests, maintenance, inspection and service maintained?		
Comments:		

3. RADIATION SOURCES	**Yes**	**No**

Radionuclides, chemical form, activities and uses as authorized in the authorization certificate, i.e. inventory confirmed? (Also confirm inventory for X ray gauges)		
Leakage tests performed on sealed sources (other than in-stream analysis gauges)?		
For in-stream analysis gauges, is the source protective window routinely checked for contamination by an approved method when replaced?		
Records of leakage tests and inventory maintained?		
Comments:		

4. PERSONNEL RADIATION MONITORING *Radiation protection programme with ALARA provisions; dosimetry; exposure evaluations; dose and survey records and reports; notifications to workers] [BSS –* *Schedule II]*		
	Yes	**No**
Operator provides personal dosimeters to all radiation workers?		
Dosimetry supplier is an authorized provider?		

Name of provider		
Dosimeters provided are appropriate for the radiation type and energy?		
Dosimeters are exchanged at the prescribed period?		
Dosimetry reports are promptly reviewed by the RPO?		
Is it evident that personal dosimeters are being worn by workers?		
Individual workers are informed of their monitoring results when each monitoring report is received (regardless of the dose measured)?		
Does the operator apply the optimization principle (ALARA) to occupational exposure?		
Personnel monitoring records are maintained?		
Inspector reviewed personnel monitoring records for the period from/ to		
Comments *(include the maximum doses to workers during this review period*)		

5. TRANSPORT OF RADIOACTIVE SOURCES

IAEA Regulations for the Safe Transport of Radioactive Material-Safety Standard Series No.

TS-R-1

	Yes	**No**

Does transport of radioactive material (from supplier, by operator) comply with IAEA transport regulations?		
Approved packages used?		
Packages properly labeled and marked?		
Operator's vehicles, if used for transport, comply with regulations?		
Shipper's declaration papers have correct details and used when shipping sources?		
Comments		

6. INDEPENDENT AND CONFIRMATORY MEASUREMENTS	**Yes**	**No**
Inspector made area and other measurements for comparison to operators		
Comments: *Describe the types and results of measurements taken. Identify the instruments used by the inspector (make, model, last calibration).*		

FORM SG 2F-G-4

INSPECTION RECORD

GAUGES – PORTABLE (PART 3)

This inspection record/checklist deals with portable gauges i.e. neutron moisture/density gauges such as those used in road construction and related activities.

1. TRAINING AND INSTRUCTION OF WORKERS

Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities, and emergency response

	Yes	No
All occupationally exposed personnel are provided with initial safety training?		
Refresher radiation safety training is provided periodically?		
Are training records maintained for each worker?		
Do interviews with workers demonstrate an adequate level of understanding regarding safety and emergency procedures?		

Discussion with the RPO demonstrates an appropriate knowledge of the RPA), the authorization certificate, the legislation, conditions, safe working procedures, etc?		
Does the RPO have appropriate resources (time, personnel) and authority (to take independent action to remedy urgent safety issues) to properly perform the role?		
Is staffing appropriate for the radiation workers to discharge assigned duties safely?		
Comments:		

2. FACILITIES AND EQUIPMENT

Facilities as described; uses; control of access; engineering controls; calibration facilities; shielding [BSS Section 2.34]

	Yes	**No**
Are the ad-hoc controlled areas and devices as described in the authorization application?		
Are adequate controls in place to prevent unauthorized persons from entering those controlled areas?		
Are adequate controls in place to ensure that all gauges are secured from unauthorized removal from either the operator's premises or from a field site or other temporary transport or storage location?		
The design and performance characteristics of the gauges comply with relevant IEC/ISO standards or other requirements of the RPA?		
Gauges are subject to regular testing to ensure continued compliance?		

If so, at what frequency; by whom; date of last test?		
Gauges are subject to routine maintenance by authorized service agents?		
If so, at what frequency, by whom; date last maintenance		
Records of compliance tests, maintenance, inspection and service maintained?		
Comments:		

3. RADIATION SOURCES

	Yes	**No**
Radionuclides, chemical form, activities and uses as authorized in the authorization, i.e. inventory confirmed?		
Leakage tests periodically performed on sealed sources by an approved method?		
Records of leakage tests and inventory maintained?		
Comments:		

4. AREA RADIATION SURVEYS AND CONTAMINATION CONTROL *Radiological surveys; leak tests; inventories; handling of radioactive materials; records; contamination control [BSS - Section I.38]*		
	Yes	**No**
Operator possesses appropriate (particularly in case of neutron detection), functioning survey instrument(s)?		
Suitable function checks are performed on instruments prior to use?		
Survey meter calibrations are current?		
Survey meter calibration is performed by an approved facility?		
Name of facility		
Sufficient functional survey meters are available for each field operation?		
Area exposure rate surveys are performed at appropriate intervals?		
Surveys for removable contamination conducted as required?		
Is it evident that workers always use a survey meter at the conclusion of every exposure to confirm that the radioactive source has returned to its container?		
Records of calibrations, contamination surveys, etc. maintained?		
Comments:		

5. PERSONNEL RADIATION MONITORING *Radiation protection programme with ALARA provisions; dosimetry; exposure evaluations; dose and survey records and reports; notifications to workers]. [BSS –*

Schedule II]		
	Yes	**No**
Operator provides personal dosimeters to all radiation workers?		
Dosimetry supplier is an authorized provider?		
Name of provider		
Dosimeters provided are appropriate for the radiation type and energy?		
Dosimeters are exchanged at the prescribed period?		
Dosimetry reports are promptly reviewed by the RPO?		
Is it evident that personal dosimeters are being worn by workers?		
Individual workers are informed of their monitoring results when each monitoring report is received (regardless of the dose measured)?		
Does the operator apply the optimization principle (ALARA) to occupational exposure?		
Personnel monitoring records are maintained?		
Inspector reviewed personnel monitoring records for the period from/to		
Comments *(include the maximum doses to workers during this review period*)		

6. TRANSPORT OF RADIOACTIVE SOURCES *IAEA Regulations for the Safe Transport of Radioactive Materials Safety Standard Series No. TS-R-1]*		
	Yes	**No**
Does transport of radioactive material (from supplier, by operator) comply with IAEA transport regulations?		
Approved packages used?		
Packages properly labeled and marked?		
Operator's vehicles, if used for transport, comply with regulations?		
Shipper's declaration papers have correct details and used when shipping sources?		
For gauges transported by the operator's workers e.g. during field operations		
- are vehicles properly labeled?		
- are gauges properly secured for transport?		
- if also used for storage, are the vehicles and gauges secure from theft?		
Comments		

7. INDEPENDENT AND CONFIRMATORY MEASUREMENTS	

	Yes	No
Inspector made area and other measurements for comparison to operators		
Comments: *Describe the types and results of measurements taken. Identify the instruments used by the inspector (make, model, last calibration).*		

INSPECTION FORM FOR WELL LOGGING

FORM SG 2G-WL-1

THE RADIATION PROTECTION AUTHORITY

INSPECTION PROCEDURES AND RECORDS OF RADIATION SOURCES IN WELL LOGGING

INSPECTION RECORD SUMMARY

WELL (BOREHOLE) LOGGING

Inspection number	
Authorization number	

Name of the Operator	
Address of Operator's Main Office	
Address (location of the site inspected)	
Telephone Number	
Name of Radiation Protection Officer	
Licensee's representative for the inspection	

Date of LAST Inspection	_____/_____/_____
Date of THIS Inspection	_____/_____/_____
Starting time:	**Exit time:**
Type of Inspection Pre-authorization Routine Investigational Termination	☐ ☐ ☐ ☐
Recommended Date of NEXT Inspection	_____/_____/_____

Summary of Findings and Actions NO items of non-compliance found Items of non-compliance found Follow-up on previous non-compliance	
RPA Inspector name & signature Date	
Supervisor's signature	

FORM SG 2G-WL-2

INSPECTION RECORD

WELL (BOREHOLE) LOGGING

*This inspection record/checklist is to be used by the inspector to assist with the performance of the inspection. Note that all areas will not necessarily be applicable to each authorized facility. In addition, with supervisory approval, the inspector may choose not to review a particular program area during each inspection. However, for those areas **not examined** or **not relevant** during the inspection a notation such as "Not Reviewed" or "Not Applicable" should be made in the relevant section*

and a brief explanation as to why the area was not reviewed should be provided, where applicable.

All areas investigated during the inspection should be documented in sufficient detail to describe the activities and procedures observed and/or demonstrated. In addition, the types of records that were reviewed and the time periods covered by those records should be noted. If the operator demonstrates any work practices at the inspector's request, describe those demonstrations. The observations and demonstrations described in this report, along with measurements and the records reviewed, should substantiate your inspection findings. Attach copies of all relevant documents and records required to support item(s) of noncompliance.

1. AMENDMENTS AND PROGRAM CHANGES

Prior to the inspection, list for review any authorization certificate amendments submitted by the operator and approved by the RPA since the last inspection

2. INSPECTION AND ENFORCEMENT HISTORY

Prior to the inspection, list for review any items of non-compliance identified during previous 2-3 inspections

DATE	INSPECTOR	VIOLATIONS

3. INCIDENT/EVENT HISTORY *Prior to the inspection, list for review any incidents or events reported to the RPA since the last inspection*

4. ORGANIZATION AND SCOPE OF THE PROGRAM *Briefly describe the present scope of activities, including types and quantities of use involving authorized sources, frequency of use, staff size, etc. (Note deviations from the authorization certificate)*

5. TRAINING AND INSTRUCTION OF WORKERS

Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities, and emergency response

	Yes	No
Occupationally exposed personnel are provided with initial safety training in the hazards associated with both sealed and unsealed radiation sources?		
Refresher radiation safety training is provided periodically?		
Supervision of logging assistants satisfactory?		
Are training records maintained for each worker?		
Do interviews with workers demonstrate an adequate level of understanding regarding safety and emergency procedures?		
Discussion with the RPO demonstrates an appropriate knowledge of the RPA, the authorization certificate, the legislation, conditions, safe working procedures, etc?		
Does the RPO have appropriate resources (time, personnel) and authority (to take independent action to remedy urgent safety issues) to properly perform the role?		

Comments:

6. INTERNAL AUDITS AND REVIEWS		
	Yes	**No**
Operator reviews the radiation protection programme at appropriate intervals?		
Audits of the facilities, source inventory, working rules and emergency procedures performed at appropriate intervals?		
Operator conducts regular audits of employees working at field sites?		
Audits conducted by		
Frequency		
Records of program reviews and audits maintained?		
Comments		

7. FACILITIES AND EQUIPMENT *Facilities as described; uses; control of access; engineering controls; calibration facilities; shielding [BSS Section 2.34]*		
	Yes	**No**
Are field site facilities as described in the authorization application?		
Is access to radioactive material adequately controlled?		

Are radiation sources secured to prevent unauthorized removal?		
Are adequate methods used to prevent unauthorized individuals from entering controlled areas?		
Is there adequate fire protection?		
RPO reviews results of quality control checks and maintains records of checks?		
Comments:		

8. RADIATION SOURCES		
	Yes	**No**
Radionuclides, chemical form, activities and uses as authorized in the authorization certificate, i.e. inventory confirmed?		
Leakage tests performed on sealed sources?		
Inventory of sealed sources conducted?		
Records of leakage tests and inventory maintained?		
Comments:		

9. RECEIPT AND TRANSFER OF RADIATION SOURCES		
	Yes	**No**
Radioactive package opening procedures established and followed?		
Incoming radioactive packages surveyed for damage, dose rates and potential radioactive contamination before opening?		
Satisfactory procedures are in place for the disposal of radiation sources that are no longer required. e.g. disposal only to authorized persons; notification to the RPA, etc.?		
Records of packaging surveys, source receipt and transfer maintained?		
Comments		

10. AREA RADIATION SURVEYS AND CONTAMINATION CONTROL *Radiological surveys; leak tests; inventories; handling of radioactive materials; records; contamination control [BSS - Section I.38]*		
	Yes	**No**
Operator possesses appropriate, functioning survey instrument(s)?		
Suitable function checks are performed on instruments prior to use?		

Survey meter calibrations are current?		
Survey meter calibration is performed by an approved facility?		
Name of facility		
Sufficient functional survey meters are available for each field site operation?		
Area exposure rate surveys are performed at appropriate intervals?		
Surveys for removable contamination conducted as required?		
Is it evident that workers always use a survey meter at the conclusion of every exposure to confirm that the radioactive source has been returned to its container or, for unsealed sources that contamination is within prescribed limits?		
Records of calibrations, contamination surveys, etc. maintained?		
Comments:		

11. PERSONNEL RADIATION MONITORING

Radiation protection programme with ALARA provisions; dosimetry; exposure evaluations; dose and survey records and reports; notifications to workers] [BSS –

Schedule II]

	Yes	**No**
Operator provides personal dosimeters to all radiation workers?		

Dosimetry supplier is an authorized provider?		
Name of provider		
Dosimeters provided are appropriate for the radiation type and energy?		
Dosimeters are exchanged at the prescribed period?		
Dosimetry reports are promptly reviewed by the Radiation Protection Officer?		
Is it evident that personal dosimeters are being worn by workers?		
Individual workers are informed of their monitoring results when each monitoring report is received (regardless of the dose measured)?		
Does the operator apply the optimization principle (ALARA) to occupational exposure?		
Potential for exposure of workers to airborne radioactive substances exists?		
Monitoring for airborne radioactivity conducted?		
Bioassay program has been established and is implemented as appropriate?		
Personnel monitoring records (including bioassay results) are maintained?		
Inspector reviewed personnel monitoring records for the period from/to		
Comments *(include the maximum doses to workers during this review period*)		

12. RADIOACTIVE WASTE MANAGEMENT

Disposal or transfer of sources; packaging, control, and tracking procedures; records [BSS

-

Section III.8]

	Yes	**No**
Decay-in-storage method used?		
Sealed source disposal in accordance with regulatory requirements?		
Unsealed radiation sources disposed of in accordance with regulatory requirements?		
Records maintained?		
Comments:		

13. TRANSPORT OF RADIOACTIVE SOURCES

IAEA Regulations for the Safe Transport of Radioactive Material-Safety Standard Series No.

TS-R-1

	Yes	**No**

Does transport of radioactive material (from supplier, by operator) comply with IAEA transport regulations?		
Approved packages used?		
Packages properly labelled and marked?		
Operator's vehicles, if used for transport, comply with regulations?		
Shipper's declaration papers have correct details and used when shipping sources?		
Comments		

14. NOTIFICATIONS AND REPORTS

Reporting and follow-up of theft; loss; incidents; overexposures; safety-related equipment failures; change in RPO, and radiation dose reports to workers [BSS -

Section 3.12]

	Yes	**No**
Have any program changes been implemented that required (but have not received) approval by the RPA?		
Have any notifiable incidents or accidents occurred since the last inspection?		
If yes, have they been reported to the RPA? (*If no, list the incidents or*		

accidents in Comments)		
Have any significant safety related changes been made to the facilities or radiation devices without approval of the RPA?		
If yes, was a safety assessment performed by a Qualified Expert?		
Comments		

15. WARNING SIGNS AND LABELLING

Proper warning signs in use areas and labelling of containers with radioactive material [BSS-Section I.23]

	Yes	**No**
Controlled areas at field sites have appropriate barriers and warning signs (in the local language)?		
Containers of radioactive material are properly labelled?		
Notices to workers are displayed as required (in the local language)?		
Comments		

INDEPENDENT AND CONFIRMATORY MEASUREMENTS **16.**		
	Yes	**No**
Inspector made area and other measurements for comparison to operators		
Comments: *Describe the types and results of measurements taken. Identify the instruments used by the inspector (make, model, last calibration).*		

17. ITEMS OF NON-COMPLIANCE AND OTHER SAFETY ISSUES *List any breaches noted during the inspection (what, when, where and who).*

18. PERSONNEL CONTACTED *Identify the personnel contacted during the inspection*