

RADIATION SAFETY MANUAL

REVISION 1

FEBRUARY 2021

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1 ACRONYMS & INDUSTRY TERMS

|  |  |
| --- | --- |
| **2IC** | 2nd in Charge |
| **ARPANSA** | Australian Radiation Protection and Nuclear Safety Agency |
| **CMT** | Construction Materials Testing |
| **Departure** | To leave intended course or method sufficiently enough to constitute significant change. |
| **Deviation** | To vary or alter the intended or common course or method |
| **EPA** | Environmental Protection Agency |
| **FAD** | Field Application Document |
| **HR** | Human Resources |
| **HSE** | Health, Safety and Environment |
| **IEC** | International Electrotechnical Commission |
| **ISO** | International Organisation for Standardisation |
| **PGLS** | Pilbara Geotechnical & Laboratory Services |
| **LQM** | Laboratory Quality Manual |
| **MD** | Managing Director for PGLS |
| **NAR** | NATA Accreditation Requirements |
| **NATA** | National Association of Testing Authorities |
| **NDG** | Nuclear Density Gauge |
| **OHS** | Occupational Health and Safety |
| **OM** | Operations Manager |
| **PM** | Project Manager |
| **PRR** | Preliminary Result Register |
| **QA** | Quality Assurance |
| **QC** | Quality Control |
| **QMR** | Quality Management Representative. |
| **QMS** | Quality Management System |
| **QPS** | Quality Policy Statement |
| **RSM** | Radiation Safety Manual |
| **RSO** | Radiation Safety Officer |
| **RTO** | Registered Training Organisation |
| **Technician** | A person employed by a CMT service provider such as PGLS |
| **Test** | Any procedure or method that is used to determine qualitative or quantitative results |

2 INTRODUCTION

**2.1 Purpose**

Nuclear Moisture / Density Gauges contain radioactive sources for the determination of the wet density and the moisture content of soils, concrete and asphalts. Though the activity of the sources is sufficiently low to present a negligible and acceptable risk to the operators, the gauges are classified as potentially hazardous and may only be used, repaired or adjusted by trained and authorised persons. Under no circumstances should untrained or unauthorised persons attempt to use, repair or adjust Nuclear moisture / density gauges.

This Radiation Safety Manual (RSM) contains the working practices, procedures, safety and operational requirements as set out by the Radiation Safety Act and by Pilbara Geotechnical & Laboratory Services (PGLS).

The Radiation Safety Act 1975 - 1999 requires that a radiation safety and protection plan be developed. This plan has been formulated for the purpose of ensuring that all sealed source apparatus used for geotechnical measurements are conducted in compliance with the Radiation Safety Act 1975 - 1999 and the Radiation Safety Regulation 1983.

This plan applies to the portable density and moisture gauges detailed in the maser inventory. This inventory will be updated when the gauges are acquired, sold or relocated.

Compliance with this radiation safety and protection plan should help ensure that the radiation doses to users and other persons involved in the practice are below the prescribed limits and are as low as reasonably achievable. It will lSO help ensure that the number of people exposed to radiation and the likelihood of unexpected exposure to radiation are minimised.

This plan outlines the obligations of the possession licensee and persons who carry out a radiation practice with the possession licensee's equipment.

**2.2 Who Must Read This Document**

All persons who use the gauges described in the master Inventory must be familiar with this plan. All radiation practices involving the use of the gauges must be conducted in accordance with this plan.

**2.3 Reference Documents**

In addition to the radiation safety and protection plan, the following documents must be complied with:

• Radiation Safety Act 1975 - 1999 and Radiation Safety Regulation 1983

• RPS No. 2 ARPANSA Code of Practice for the Safe Transport of Radioactive Material (2008)

• RPS No. 5 ARPANSA Code of Practice and Safety Guide for Portable Density/Moisture Gauges Containing Radioactive Sources (2004)

• RHS No. 11 ARPANSA Code of practice for the safe use of soil density and moisture gauges containing radioactive sources (1984)

• RHS No. 24 ARPANSA Code of practice for the design and safe operation of non-medical irradiation facilities (1988)

• Radiation safety standard NM011:1999 Standard for sealed radioactive substances incorporated in sealed source apparatus used to carry out moisture/density measurements

• Radiation safety standard PR002:1999 Standard for premises at which radioactive substances are stored

3 REGISTERED DETAILS

**3.1 Base Laboratories**

Geotechnical Laboratory Services WA t/as Pilbara Geotechnical & Laboratory Services (PGLS) laboratories are located at:

Lot 10 Camp Road

Paraburdoo, WA 6754

Telephone: 0477 300 100

**3.2 Radiation Safety Officer**

Steven John Hoffman

15 Yookson Road

Picton, WA 6229

Telephone: 0477 300 100

4 RESPONSIBILITIES

**4.1 Pilbara Geotechnical & Laboratory Services (PGLS)**

Under the provisions of the Radiation Safety Act 1975 - 1999 and the Radiation Safety (General) Regulations 1983, PGLS is registered as the lessee of the premises where the Gauges are stored or operated.

**4.2 Radiation Safety Officer**

The Radiation Safety Officer under the provisions of the Radiation Safety (General) Regulations 1983 is responsible for matters relating to radiological safety, training of operators, transportation, calibrations, operational checks and maintenance and repairs of Nuclear Density Gauge. The RSO may delegate the following responsibilities to suitably qualified and trained technicians.

The RSO is responsible for:

• The security of the Nuclear Density Gauges;

• Distribution and collection of personnel radiation monitoring TLD badges;

• Monitoring radiation levels of the Nuclear Density Gauges;

• Handling and operation of the Nuclear Density Gauges in accordance with relevant safety procedures i.e., Radiation Safety Manual;

• Operation and calibration of the Nuclear Density Gauges in accordance with the appropriate test methods;

• Conducting of Wipe Tests;

• General maintenance and repairs of the Nuclear Density Gauges; and

• Recording of all pertinent data in the NDG files / log books for each Nuclear Density Gauge.

5 HAZARD ASSESSMENT

The density/moisture gauges covered by this plan incorporate radioactive substances which are used for geotechnical measurements. The principle of operation depends on the detection of a beam of radiation transmitted through, or backscattered from, the material. These gauges are capable of in-situ measurements of the density and/or moisture of soils, sands, asphalts and other materials or in backscatter mode, the thickness of asphalt.

The radioactive substances incorporated in the gauges are generally of a level of activity that would, if not adequately shielded or handled properly, result in a significant health hazard. Unauthorised persons should not remove, or in any way interfere with, the radioactive substances or carry out any maintenance, adjustment or modifications to gauges, other than the cleaning of the shutter as recommended by the manufacturer. The most common cause of loss of shielding integrity is due to a vehicular accident at a construction site.

Radiation doses to persons involved in the practice, other employees and members of the public, depend mainly on the type of radioactive substances being used, the extent of compliance with work practices, and the extent of compliance of the gauges and the premises with relevant radiation safety standards made under the Radiation Safely Act 1975 - 1999.

The Radiation Safely Regulation 1983 prescribes an annual radiation dose limit of 20mSv for persons involved in carrying out a radiation practice, and an annual radiation dose limit of 1mSv for all other persons. Also, if a female employee who is involved in the radiation practice becomes pregnant; her radiation dose limit is reduced to 1mSv per annum for the term of the pregnancy. Pregnant staff should avoid work which may result in high radiation doses.

In WA, the personal radiation monitoring results of persons using gauges for geo-technical measurements indicate that radiation doses at or near 1mSv per year are normally received from this radiation practice. By comparison, the annual average natural background radiation dose to a person is 2mSv per year. However, a significant radiation dose can be received as a result of poor work practices or if the gauges do not comply with the relevant standards.

6 RESPONSIBILITIES OF POSSESSION LICENSEE

The person or corporation (possession licensee) shown in the Radiation Safety License and Registration Certificate holds a licence to possess the density/moisture gauges. The Radiation Safety License and Registration Certificate will be updated if the name or contact details of the possession licensee changes.

The possession licensee obtained this licence after demonstrating to the Chief Executive, WA Health that all the radiation safety criteria set by the Radiation Safety Act 1975 - 1999 have been satisfied.

Nevertheless, there are on-going obligations borne by the possession licensee. The possession licensee must take reasonable steps to ensure any person's health and safety is not adversely affected by exposure to radiation because of the way a person carries out the practice.

To do this, the possession licensee must:

• ensure that the radiation doses arising from the radiation practice are kept below the limits specified in the Radiation Safety Regulation 1983 and as low as reasonably achievable;

• hold a licence, issued under the Radiation Safely Act 1975 - 1999, with an authority to possess sealed radioactive substances incorporated in density/moisture gauges for geo-technical measurements;

• ensure that all users of density and moisture gauges hold licences, issued under the Radiation Safely Act 1975 - 1999, allowing them to use such equipment for geo-technical measurements;

• ensure compliance with any conditions imposed on the possession licensee by the Chief Executive, WA Health and with those stated in the Radiation Safely Act 1975 - 1999 and the Radiation Safely Regulation 1983,

• ensure that the version of the radiation safety and protection plan being used has been approved by the Chief Executive, WA Health;

• appoint a radiation safety officer certified under the Radiation Safety Act 1975 - 1999;

• ensure that the radiation safety officer is carrying out his/her functions properly so that the possession licensee can be adequately appraised of the radiation safety status of the practice at all times;

• ensure that adequate resources are provided to implement this radiation safety and protection plan (e.g. provision of appropriate training, radiation monitoring equipment, records);

• ensure that the records, specified in this radiation safety and protection plan, are kept;

• ensure that the density and moisture gauges continue to comply with radiation safety standard NM011 :1999 Standard for sealed radioactive substances incorporated in sealed source apparatus used to carry out moisture/density measurements, and obtain certificates of compliance from an appropriately accredited person, before initial use and every three years thereafter;

• ensure that the premises where the density and moisture gauges are stored continue to comply with radiation safety standard PR002: 1999 Standard for premises at which radioactive substances are stored, and obtain certificates of compliance from an appropriately accredited person, before initial use and every five years thereafter;

• ensure that, if there is any proposed change which may affect radiation doses, (e.g. an increase in the number of density and moisture gauges or change of the use of adjacent areas, an appropriately accredited person performs an assessment of the premises for compliance with radiation safety standard PR002: 1999 Standard for premises at which radioactive substances are stored, before the changes are effected;

• provide appropriate personal monitoring devices to persons as required by this radiation safety and protection plan, and ensure that:

i. personal monitoring devices are handled properly

ii. monitored persons are advised of their personal monitoring assessment results

iii. copies of the personal monitoring assessment results are submitted to the Chief Executive, WA Health;

• ensure that the approval of the Chief Executive, WA Health is obtained before acquiring gauges;

• ensure that the approval of the Chief Executive, WA Health is obtained before relocating gauges to a place outside WA;

• ensure that the transport of radioactive substances is conducted in accordance with the ARPANSA Code of practice for the safe transport of radioactive material (2008) (Transport Code), as amended from time to time;

• immediately notify the Chief Executive, WA Health after an incident, either orally or in writing, after an incident. If the notice is given orally, written confirmation must be provided within seven (7) days; and

• notify the local fire authority of the radioactive materials store.

7 DUTIES OF RADIATION SAFETY OFFICER

**7.1 Functions**

The radiation safety officer advises the possession licensee, employees and agents on radiation safety matters associated with the practice. The name and contact details of the radiation safety officer are detailed in the Radiation Safety License and Registration Certificate. The Radiation Safety License and Registration Certificate will be updated if the name or contact details of the radiation safety officer change.

**7.2 On an On-going Basis**

On an on-going basis, the radiation safety officer must:

• ensure that the density and moisture gauges continue to comply with radiation safety standard NM011: 1999 Standard for sealed radioactive substances incorporated in sealed source apparatus used to carry out moisture/density measurements, and obtain certificates of compliance from an appropriately accredited person, before initial use and every three years thereafter;

• ensure that the premises where the density and moisture gauges are stored continue to comply with radiation safety standard PR002:1999 Standard for premises at which radioactive substances are stored, and obtain certificates of compliance from an appropriately accredited person, before initial use and every five years thereafter;

• provide, or arrange for the provision of training about radiation hazards and safe working practices (see section 7 of this plan);

• examine the personal radiation monitoring results to ensure that radiation doses that a person could receive are within the limits prescribed by the Radiation Safety Regulation 1983, and are as low as reasonably achievable;

• ensure that personal monitoring records are updated and; if a user declares her pregnancy, ensure that, during her pregnancy, her radiation dose is kept as low as reasonably achievable and below the radiation dose limits prescribed by the Radiation Safety Regulation 1983 i.e. pro rata 1mSv per annum. Such a user must not be engaged in procedures which may result in a high radiation dose.

**7.3 Annually**

At the commencement of the practice and once every year thereafter, the radiation safety officer must check, and record, that:

• all users and staff have read, understood, and are complying with this radiation safety and protection plan;

• the details of the gauges are accurately stated in this radiation safety and protection plan;

• the person in possession of the gauges is appropriately licensed under the Radiation Safety Act 1975 - 1999,

• the users of the gauges are appropriately licensed under the Radiation Safety Act 1975 - 1999,

• all maintenance and safety checks are being conducted and recorded and any relevant problems have been appropriately rectified;

• compliance certificates for the gauges and radioactive materials stores have been obtained within the necessary time frames; and

• the calibration of the radiation monitoring device has been checked and is within calibration, i.e. ±25% (This is done by checking the calibration check report submitted by the service provider) (see section 12).

**7.4 Reporting to the Possession Licensee**

The radiation safety officer must report the following to the possession licensee:

• any radiation incidents immediately;

• any contravention of this radiation safety and protection plan and relevant radiation safety standard;

• any action that needs to be taken to achieve compliance with this radiation safety and protection plan and/or relevant radiation safety standard;

• the effectiveness and extent of compliance with this radiation safety and protection plan on an annual basis; and

• recommendations about changes to the plan to ensure its continued effectiveness by reviewing this radiation safety and protection plan on an annual basis.

8 RESPONSIBILITIES OF USERS

All users of density and moisture gauges are responsible for ensuring that any radiation doses received by persons as a result of carrying out the practice are below the radiation dose limits prescribed in the Radiation Safety Regulation 1983 and are as low as reasonably achievable.

Users must take reasonable steps to ensure that a person's health and safety are not adversely affected by exposure to radiation because of the way the user carries out the practice.

Users must:

• hold a licence, issued under the Radiation Safety Act 1975 - 1999, with an authority to use sealed radioactive substances incorporated in density / moisture gauges for geo-technical measurements;

• comply with the conditions of the licence imposed by the Chief Executive, WA Health and with those stated in the Radiation Safety Act 1975 - 1999 and the Radiation Safety Regulation 1983;

• ensure that they are authorised by the possession licensee to use and transport the density and moisture gauges;

• comply with this radiation safety and protection plan;

• undertake and satisfactorily complete the training specified in this radiation safety and protection plan;

• wear a personal monitoring device and, if provided, use personal protective equipment and safety devices as required by this radiation safety and protection plan;

• report any contravention of this radiation safety and protection plan to the possession licensee;

• report to the possession licensee any difficulties with working procedures or defects in the gauges that come to their notice;

• report any incident which may adversely affect the health or safety of any person, including gauge malfunction, to the possession licensee;

• in the event of an incident involving a gauge, cordon off area, restrict access and contact the radiation safety officer;

• record the movement of the gauges in and out of the radioactive materials store in the log book provided by the possession licensee; and

• ensure that no repair or routine maintenance is conducted on the gauges unless the radiation safety officer considers it safe.

9 ACCESS CONTROL

Only persons permitted by the possession licensee may use the gauges.

The names of the persons permitted to use the gauges are listed in the NDG License Holder Register. The NDG License Holder Register will be updated from time to time to reflect the current arrangements.

10 TRAINING

The radiation safety officer must provide, or arrange for the provision of, appropriate training to users and other persons on radiation safety matters.

The radiation safety training program must include at least the following:

• a description of the radiation hazards in the practice

• how to avoid the hazards

• minimising radiation dose (e.g. minimum exposure time and maximum distance)

• details of the radiation safety and protection plan

• remedial procedures

All staff involved in using the gauges for moisture/density measurements must be trained in correct techniques initially and their skills reviewed every year thereafter.

Training for all staff;

• initial half hour familiarisation in basic radiation safety issues and practices

• re-familiarisation every year

Training for users:

• specific instructions on how to use, and the features of, the gauges

• in-house examination to determine competency

• re-familiarisation every year

• in-house examination to be repeated every 2 years

• radiation safety discussion once or twice a year

11 SAFE WORK PRACTICES

The three simple rules to minimise personal radiation doses are;

**Time**: optimise number of exposures and the exposure time   
**Distance**: keep as far away as practicable from the gauges during an exposure   
**Shielding**: return the source rod to the safe position when the gauge is not in use

To ensure radiation doses to all persons are minimised, the following practices must be followed.

**11.1 General**

• All persons involved with using the possession licensee's density/moisture gauges must comply with this radiation safety and protection plan.

• Density and moisture gauges are only to be used by an appropriately licensed person who is permitted to use the gauges by the possession licensee.

• A gauge may only be used if it is in compliance with radiation safety standard NMO 11: 1999 Standard for sealed radioactive substances incorporated in sealed source apparatus used to carry out moisture/density measurements.

• Gauges may only be stored at premises that are in compliance with radiation safety standard PR002: 1999 Standard for premises at which radioactive substances are stored.

• All maintenance work on the gauges, that is not intended by the manufacturer to be undertaken by the user, is to be conducted by a person qualified to perform such work.

**11.2 Use of Gauge**

When using a density/moisture gauge, the user must:

• ensure that he/she is authorised by the possession licensee to do so.

• ensure that all persons not required to assist with the measurements are excluded from the vicinity of the gauges (i.e. to a distance of 3 metres), prior to moving the Nuclear Density Gauge probe from its shielded housing;

• ensure that appropriate stands (or witches hats) with radiation warning notices are placed in the vicinity of the gauge when used at a construction site;

• only move the Nuclear Density Gauge source rod from the shielded housing to make a measurement;

• only move the Nuclear Density Gauge source rod from its housing immediately prior to making a measurement, then immediately return the probe to its shielded position on the completion of the measurement;

• at the completion of measurements, lock the source rod in the shielded position and place the gauge in its transport container. Before closing the lid check by inspection that the shutter has closed;

• Clean the shutter at least once per month, consistent with the conditions it is being used m;

• never waste time while conducting measurements;

• never stay close to the gauge except when necessary to conduct measurements;

• never conduct measurements unless those workers directly involved with using the gauges are correctly wearing appropriate personal monitoring devices;

• never place the gauge where it may be damaged by vehicles or machinery; and

• never leave the gauge unattended unless it is securely stored in a vehicle or another safe place and appropriately placarded.

**11.3 Transport**

• The packaging and transport of radioactive substances are to be in compliance with the ARPANSA Code of practice for the safe transport of radioactive material (20081) (Transport Code), as amended from time to time.

• Except in emergency situations, the gauge must only be transported in its transport case with the source rod locked in the shielded position.

• The gauge must not be transported in the passenger compartment of the vehicle and should be placed at the maximum distance from the driver's position to reduce exposure to the driver. The gauge must also be adequately chained, strapped or otherwise held in this location to prevent movement in an accident.

• Transport signs in compliance with the Transport Code are to be affixed to both sides and the rear of the vehicle.

• Only persons authorised by the possession licensee are to transport gauges.

• Radioactive substances may only be transported by:

i. persons who are licensed under the Radiation Safety Act 1975 - 1999 to use a density/moisture gauge for geo-technical measurements; or

ii. a person who is licensed under the Radiation Safety Act 1975 - 1999 to transport radioactive substances.

iii. If a density/moisture gauge is to be consigned for transport, a shipper's declaration for the transport of radioactive substances must be correctly completed.

**11.4 Storage**

• When not in use, gauges are to be stored in the radioactive materials store which has been certified as meeting radiation safety standard PR002: 1999 Standard for premises at which radioactive substances are stored.

• The company's radioactive materials store which has been certified as meeting the relevant radiation safety standard is located at Lot 10 Camp Road Paraburdoo WA 6754

• The gauges are not to be stored with X-ray or photographic film, explosives or combustible / corrosive chemicals.

• Only the possession licensee, the user licensee and the radiation safety officer are responsible for the keys to the store.

• The gauges placed in the store must be stored with the source assembly fully retracted and locked in the shielded position. If the gauge cannot be stored in this manner, the placement of such gauges into the store must be closely supervised by the radiation safety officer. A radiation monitoring device must be used to ensure that the radiation beam is properly attenuated.

• The gauge must be stored in its transport case, except when it is necessary to re-charge the battery.

• The movement of the gauges in and out of the radioactive materials store is to be recorded on a log book provided by the possession licensee.

• A temporary field store, approved by the radiation safety officer, will be available to store the gauges on field sites. The radiation levels are to be checked to ensure that dose limits are not exceeded.

**11.5 Source Leakage Tests**

• Source leakage tests are to be conducted under the direction of the radiation safety officer.

• Leakage tests are to be undertaken in accordance with Annex A.3 of IS09978 Radiation protection -Sealed radioactive sources - Leakage lest methods.

• Radioactive substances are to be leak tested at least once every five years, or more often as tile manufacturer recommends.

• Source leakage testing is to be undertaken as a precautionary measure prior to service maintenance (particularly for source changes or shutter maintenance).

• Source leakage tests are to be conducted when maintenance is performed on the gauge and after every incident.

• If the leakage test fails, the radioactive substance is to be stored in the radioactive material store, and the possession licensee notified.

• Source leakage tests are to be conducted every six months after a sealed radioactive substance reaches the end of its recommended working life, as set by the manufacturer.

12 PERSONAL RADIATION MONITORING

**12.1 Personal Monitoring Devices**

Persons who use the density/moisture gauges are to be provided with personal monitoring devices which are capable of measuring both gamma and neutron radiation. The following personal monitoring program must be followed:

• users of the gauges are required to wear an appropriate personal monitoring device, at chest or waist height, whenever they use the gauges;

• personal monitoring devices are to be obtained from, and assessed by Global Medical Solutions, or other suitable organisations who have a personal radiation monitoring service that uses reference sources directly traceable to the Australian National Standards as required by the National Measurement Act 1960;

• the personal monitoring device wearing period is 3 months;

• personal monitoring devices must not tampered with or misused;

• at the end of each working day the devices must be stored away from the radiation sources;

**Note:** *A common cause of unusually high readings is for the user to place the dose gauge in the transport case at the end of a day's work.*

• personal monitoring devices are not to be worn if the monitored person is undergoing a radiographic examination as a patient;

• the control device must be stored away from radiation sources and is located in the Radiation Safety Officer's office at Lot 10 Camp Road Paraburdoo WA 6754

• as soon as practicable after the assessment of the personal monitoring devices, the possession licensee must:

i. arrange for a copy of the results to be sent to the Chief Executive of WA Health (refer to contact details in Radiation safety License And Registration Certificate), and;

ii. advise the monitored persons of their radiation assessment results

The control device is the dose gauge used to detect background radiation and any radiation received during mailing. This dose gauge must be stored away from sources of radiation and extremes in environment at all times.

• the radiation safety officer is to monitor the updated personal monitoring record, provided by the monitoring service provider, for each monitored person, and is to file the records in a manner which will enable easy retrieval when required;

• the personal monitoring records are to be kept for the duration of the wearer's working life and for not less than 30 years after the last exposure assessment, and at least until the person has reached the age of 75 years; and

• the personal monitoring records are to be checked by the radiation safety officer to ensure the radiation doses are below the prescribed limits in the Radiation Safety Regulation 1983 and are as low as reasonably achievable. If any unusual doses are received, the work practices of the wearer are to be investigated and, if necessary, remedial action taken.

**12.2 Personal Alarm Monitoring Devices**

Personal alarm dose gauges are not required to be worn for this practice.

13 SAFETY DEVICES AND PERSONAL PROTECTIVE EQUIPMENT

**13.1 Safety Devices**

No specific devices are provided.

**13.2 Personal Protective Equipment**

No specific personal protective equipment is provided.

14 RADIATION MONITORING DEVICES

A radiation monitoring device (or radiation survey gauge) having the following characteristics is provided by the licensee:

• has a dose range of at least between 10µSv/h and 1000µSv/h, or equivalent for the radiations emitted from the radioactive substances;

• has appropriate energy response;

• has a measurement uncertainty not greater than ± 25%; and

• continues to indicate, either visibly or audibly, when radiation levels exceed the maximum readings in their measurement range.

The radiation survey gauge is stored in the Radiation Safety Officer's office.

Radiation survey gauges must not be tampered with or misused.

Prior to use, the radiation survey gauge will be subjected to a battery test and a test to ensure that it responds to radiation, by measuring the dose rate emitted on the top surface of a Nuclear Density Gauge.

***Note:*** *The moisture/density gauge emits both neutron and gamma radiation. As the survey gauge provided only detects the gamma radiation, there is a need to be aware that the radiation levels detected do not provide an indication of the total amount of radiation being emitted.*

15 REPAIRS AND MAINTENANCE

The following sections detail the requirements for repair and maintenance of the gauges. Records of all maintenance procedures are to be kept in the equipment log book provided by the possession licensee.

**15.1 Non-routine Maintenance**

All maintenance and repair work not intended by the manufacturer to be undertaken by the user is to be conducted by a person qualified to perform such work. Typically, the person will hold a licence to use radioactive substances in gauges during maintenance, repair or commissioning. The licence of the person engaged to perform this work is to be sighted by the radiation safety officer prior to the commencement of work.

Modifications to the gauge will not be made without the prior approval of the Chief Executive, WA Health. The gauge will not be used until it has been certified by an accredited person as complying with radiation safety standard NM011:1999 Standard for sealed radioactive substances incorporated in sealed source apparatus used to carry out moisture/density measurements.

**15.2 Routine Maintenance**

The Nuclear Density Gauge shutter block assembly and the source rod shall be cleaned once per month. Records of this maintenance activity shall be recorded in the equipment file for each Nuclear Density Gauge.

Only persons who hold a licence to use radioactive substances shall perform this maintenance activity.

**15.3 Radiation Monitoring Device**

A calibration check of the radiation survey gauge will be performed once every twelve months and following suspected damage or repair. The survey gauge is to be calibrated if the calibration check yields erroneous results.

This check will be performed by the Radiological Council of Western Australia, who have a calibration service that uses reference sources directly traceable to the Australian National Standards, as required by the National Measurement Act 1960.

16 SAFETY CHECKS

The following safety checks will be performed by the person(s) mentioned in the NDG License Holder Register. The NDG License Holder Register will be updated from time to time to reflect the current arrangement.

Records of all safety checks are to be kept in the equipment logbook provided by the possession licensee. Any action taken as a result of the inspection must also be recorded.

**16.1 Three Monthly Checks**

The following checks are to be conducted every three months:

• Radiation warning signs, as required in radiation safety standard NM011:1999 Standard for sealed radioactive substances incorporated in sealed source apparatus used to carry out moisture/density measurements, are displayed on each gauge, and are in a dean, intact and legible state.

• An area warning sign for the radioactive substances store, as required in radiation safety standard PR002: 1999 Standard for premises at which radioactive substances are stored, is available and is in good condition.

• Warning signs which are displayed when the gauges are in use at construction sites are available and are in good condition.

• The condition of the gauges by checking:

i. radiation dose rates around the gauges. Monitoring is to be undertaken at designated points as shown on the designated equipment check form.

ii. for any damage or wear (a worn or jammed soil density shutter can cause high dose rate levels even in the Off position);

iii. that the gauge performs satisfactorily when used in accordance with manufacturer's instructions;

iv. that all labels are intact and legible; and

v. to ensure that the shutter or source control mechanism, where fitted, operates correctly and is free of dirt or other clogging agents, and is not worn.

The soil moisture/density gauge emits both neutron and gamma radiation. As the survey gauge provided only detects the gamma radiation, there is a need to be aware that the radiation levels detected may not provide an indication of the total amount of radiation being emitted.

• An on-site operational check of the radiation survey gauge. This check shall be achieved by measuring the dose at a marked point on the surface of a Nuclear Density Gauge. This condition check shall also include a battery check.

• Radiation monitoring is to be performed around the radioactive materials store. Monitoring is to be undertaken at designated points as shown in the Radiation Monitoring procedure.

**16.2 Six Monthly Checks**

• If any radioactive substances have passed the end of their recommended working life, as set by the manufacturer, a source leakage test is to be conducted every six months.

**16.3 Five Yearly Checks**

• Radioactive substances are to be leak tested every five years, in accordance with Annex AJ of IS09978 Radiation protection - Sealed radioactive sources - Leakage test methods, to confirm that they are not leaking. The WA Radiation Monitoring Service shall be used to measure the wipe tests and to provide a report on the leak test result for each Nuclear Density Gauge so tested.

17 RECORDS

The following records are to be maintained by the possession licensee. These are held in the Radiation Safety Officer's office.

• Possession licence issued under the Radiation Safety Act 1975 - 1999.

• The radiation safety and protection plan approved by the Chief Executive, WA Health.

• Approvals to acquire radioactive substances.

• Reports by the radiation safety officer.

• Personal monitoring records. (min 30 years)

• Equipment maintenance log book.

• Results of all safety checks performed.

• Inventory and location of the gauges.

• Assessment reports of the gauges and premises.

• Calibration check certificate of the radiation survey gauges.

• Movement log book of the gauges, in and out of the radioactive materials store. (The log book is displayed on the entrance gate to the Radioactive Materials Store).

• Incident reports.

18 ACQUISITION, SUPPLY AND RELOCATION OF GAUGES

This section outlines the legislative requirements associated with the acquisition, supply and relocation of a gauge incorporating radioactive substances. The Radiation Safety License And Registration Certificate provides the contact details for Radiation Health and the Chief Executive, WA Health.

**18.1 Acquisition**

An approval of the Chief Executive, WA Health must be sought and obtained prior to acquiring the gauge. Application forms are available from Radiation Health.

**18.2 Supply**

If the gauge is to be sold to another person in WA, the possession licensee must ensure that the proposed new owner has an approval to acquire the gauge.

**18.3 Relocation**

An approval of the Chief Executive of WA Health is to be sought and obtained prior to the relocation of the gauge to a place outside WA. Application forms are available from Radiation Health. The Chief Executive must be notified within seven (7) days after the device has been relocated.

**Note:** *Approval to relocate is not required if the possession licensee is remaining in possession of the radioactive substance, ego if the gauge is being sent to an interstate service company for maintenance etc]*

19 REMEDIATION PROCEDURES

A radiation incident is an incident adversely affecting, or likely to adversely affect, the health or safety of any person because of the emission of radiation, for example, if a radioactive substance is lost or stolen or when unintended exposures may occur or have occurred. The following emergency procedures are to be implemented in the event of an incident involving a gauge containing radioactive substances.

• Immediately take action to protect human life, to limit injury and to provide first aid, if necessary.

• Allay panic.

• Cordon off area and prevent unauthorised and unnecessary access to the secured area.

• Contact the radiation safety officer who is named on the Radiation Safety Licence And Registration Certificate

• Do not attempt to move or interfere with the gauge unless directed by the radiation safety officer.

• Remain at an appropriate distance from the gauge (consistent with maintaining site access control, 6m minimum).

• The radiation safety officer is to conduct a radiation survey around the gauge and compare the results with previously monitored results.

If the radiation measurements are not significantly different and the radioactive substance is in the shielded position, the gauge is to be returned to the radioactive materials store.

If the measurements differ significantly from the established values, or the radioactive substance cannot be returned to the shielded position, the radiation safety officer should determine the course of action to be taken to render the situation safe (e.g. placing additional shielding over the gauge). Pending advice from the radiation safety officer, access control must be maintained.

• The radiation safety officer is to notify the possession licensee and the Chief Executive, WA Health of the incident as soon as possible.

• The gauge involved in an incident is not to be used again until the radiation safety officer confirms the safety of the gauge by obtaining a certificate of compliance for the gauge from an appropriately accredited person.

• The possession licensee and the Chief Executive, WA Health are to be immediately advised if a radioactive substance is unaccounted for.

**19.1 Incident Notification**

A written incident report is to be produced by the radiation safety officer and submitted through the possession licensee to the Chief Executive, WA Health at the address shown in the Radiation Safety License and Registration Certificate within seven (7) days of the occurrence of an incident. This report is to include: incident description (including details of the source and its location); estimates of radiation exposure to individuals (if applicable); action taken; and proposals to prevent a recurrence.

*(Such reports are important to identify, for example, if there is a recurring problem with a particular gauge model)*

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20 RADIATION SAFETY

**20.1 General**

The Nuclear Density Gauge contains radioactive materials and careful handling is essential. Only trained and licensed personnel shall use the gauge.

The intensity of radiation at any point is inversely proportional to the square of the distance, therefore, distance offers the most economical and convenient protection from radiation.

The distances specified in Clause 2.7 provide adequate protection; however, the principle of using greater distances whenever is a good one.

**20.2 Responsibilities**

In cases where the PGLS Radiation Safety Officer is not available, the responsibilities listed hereunder become that of the Assistant Radiation Safety Officer.

The R.S.O. shall be responsible for:

• The overall security of the instruments whilst not under the direct control of field technicians

**20.3 Safety and Work Procedures**

• Monitoring of radiation levels radiation levels by radiation detection gauges whilst not under the direct control of field technicians

• Training of personnel

• Distribution and collection of TLD badges

• Performing of wipe tests as required

• Forwarding data to the Radiation Health Branch as required

• Compliance with the rules, regulation and specified conditions laid down in the relevant Australian Standards and by NATA

• Ensure all NDG operators' licences (WA) are current.

• Observing all things relevant to the requirements of the "Radiation Act 1975".

• Delegation of duties as appropriate.

The Operator of the Gauge on site is responsible for:

• Security of the instrument on site

• Observation of safe work procedures

• Placing Warning Keeping

• Keeping spectators clear

• Recording of standard counts, radiation levels and other pertinent data in field file for the instrument

The person operating the instrument shall have a current license with the Health Department of WA to use the Portable Radiation Devices.

Each gauge has a Master file kept at our base lab and a Field file that travels with the gauge, copies of all calibrations, operational checks and any other information relative to a gauge is to be kept in the field file.

21 MONITORING RADIATION

**21.1 Calibration and Operational Checks**

Calibration and Operational Checks

Nuclear Density Gauges shall be checked within the guidelines of WA 2040.2 and AS1289.5.8.1 which outline the calibration and operational checks of portable Nuclear Density Gauges.

**21.2 Monitoring Devices**

A radiation monitoring device will be made available with each gauge, or group of gauges, and shall be kept in office at all times.

**21.3 Radiation Readings**

Radiation readings are to be taken on the surface of the instrument and at distances of 0.5m and 1.0m from the instrument along the orthogonal the axis through the instrument:

• at intervals not exceeding one month

• when any noticeable deviations from the standard count are observed

• immediately after the instrument has received a severe knock or bump

• immediately after any damage to the instrument

The radiation readings shall be recorded on QMS Admin Form and any significant change in the radiation level shall be investigated and reported to the Radiation Safety Officer.

A visual inspection of the gauge shall be carried out for damage or wear, correct operation of sliding shield and source rod retraction assembly and that all warning labels are intact. Any faults should be reported to the Radiation Safety Officer in writing.

**21.4 Wipe Tests**

Routine tests on Gauges are to be carried out at intervals of twelve months. The Radiation Safety Officer will request the test as required. Additional tests may be requested to check the integrity of the source containment.

The following wipe test procedure is to be employed for Gauges with the gamma source fixed to the lower end of a moveable source rod and with the neutron source affixed to the base of the instrument:

• Prepare the equipment for the test The equipment required: mirror, filter paper of approximately 100mm diagauge, tongs of a length at least 150mm, methylated spirit, small unused plastic bag to hold the filter paper after the test, adhesive label for recording information to be attached to the bag.

• The wipe test of the neutron source housing is carried out at first. If access to the housing is from the outside of the base of the Gauge, it should be laid on its side in front of the mirror so that the reflection of its base can be observed by the operator positioned close to the handle. If access to the housing is from the inside of the base the Gauge should be in an upright position and the module(s) and the warning label, Plate 5, removed to access to the of the housing of the neutron emitter. The filter paper then should be moistened with methylated spirit held by the tongs, wiped several times along and across the of the cavity cover. The filter paper then should be placed in the plastic bag if applicable, the label reattached to its original location.

• For the wipe test of the gamma source both types of Gauges, with the components replaced if necessary, are laid on their side in front of the mirror so that the operator positioned close to the handle can observe the reflection of the base. The handle is then depressed to locate the source in the 50mm direct transmission position. After removing the filter paper from the plastic bag with the tongs, the exposed part of the source rod is thoroughly wiped with the paper. The filter paper must be held by the tongs during this operation. The handle is then returned to the storage position, the Gauge replaced on its base and the filter paper placed in the plastic bag.

• The wiping of each housing shall be completed within 15 seconds. During the test no person, other than the operator, shall be within a radius of 10 gauges of the Gauge.

• The make and serial number of the Gauge, the date of the test and the name of the person conducting the test shall be recorded on the label which is attached to the sealed plastic bag, this is sent to the Radiation Safety Officer who will then forward a batch lot to the Radiation Health Branch for processing. The results will be sent out for filing in the field file.

**21.5 Personal Radiation Monitoring**

Radiation monitoring badges record the radiation levels to which the wearer has been exposed.

Radiation monitoring badges will be issued by the Radiation Safety Officer to all operators of Nuclear Density Gauges. Badges shall be worn by all personnel associated in any way with the use, transport or handling of a Nuclear instrument.

At 12-week intervals the Radiation Safety Officer will issue replacement insert and a request for the return of the previous issue, the radiation monitoring inserts are reusable and heavy penalties are charged for their non-return.

All radiation monitoring wearers are responsible for their issued badge and its return when requested.

Badges should be returned immediately if exposure to high levels of radiation is suspected or if it is suspected that the badge is faulty. In the case of high radiation levels, the operator should not work with the gauge until the has evaluated and appropriate advice received from the Radiation Safety Officer.

**21.6 Storage**

When not in use the gamma source shall be in the shielded position and the handle of the gauge shall be secured by a padlock.

With the exception of short-term storage, the Gauge should be in an upright position with the base on, or just above, a dense material of a thickness of at least 100mm. Examples of suitable materials are the reference block, concrete, soil, and hardwood. Gauges must not be placed on benches or on similar raised structures.

All relevant information shall be entered into the Source Register whenever the Gauge is placed into or removed from the store.

22 RADIATION SAFETY

**22.1 Personnel Monitoring - TLD Badges**

The TLD (thermoluminescence dose gauge) badges provide a record of the exposure of the operator to radiation emitted by a Nuclear Density Gauge. TLD badges are issued by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and shall be worn by all personnel operating Nuclear Density Gauges and by other persons attached to the laboratory who during that work may be exposed to radiation emitted by the gauge. Each badge is identifiable by its serial number and name of the person to whom it was issued and may only be worn by that person.

TLD badges are issued with one Control Badge which is to be stored in the base laboratory office away from any radiation source. The control badge shall be stored away from the NDG storage area in an envelope labelled TLD Badges. This box should be placed in a desk drawer or similar, away from radiation sources.

For work in annex / mobile laboratories, operators must wear the TLD badges at all times during working hours and store TLD badges away from the annex laboratory after working hours. This is due to the relative close proximity to the NDG storage area in temporary laboratories.

All TLD badges will be exchanged with new badges at eight-week intervals as prescribed by ARPANSA. TLD badges shall not be worn outside working hours.

TLD badges must not be exposed to high temperatures or left exposed to strong natural or artificial light sources. In particular, they should not be left on the dashboard of a vehicle parked in the sun. TLD badges must also be protected from moisture, fuels and oils.

The operator should ensure that the TLD badge holder is securely fixed to his / her clothing. The attachment of the TLD badge holder should be checked regularly. If a TLD badge and holder is lost, every effort must be made to recover it. If it cannot be found, ARPANSA should be notified so that a replacement can be issued as soon as possible.

A TLD badge should be returned immediately if there is reason to believe that it is faulty or if it is suspected that the person to whom it was issued received a dose in excess of 1000 µSV while wearing the TLD badge. If an operator has received a dose in excess of 1000 µSV, the operator shall not be permitted to work with Nuclear Density Gauges until advised by the Radiation Safety Officer.

The TLD badge must not be worn while the person to whom it was issued is exposed to medical or dental x-rays, or to ionising radiation from any other source such as exposure to radiation materials in industrial operations or medical treatments. In the assessment of the TLD badge, allowance is made for the effect of background radiation by using the control badge as a standard.

23 NUCLEAR DENSITY GAUGE MONITORING

**23.1 Radiation Survey Gauge**

A radiation survey gauge is held at the base laboratory, or any other location where Nuclear Density Gauges are stored, such as at annex / mobile laboratories.

The following requirements must be observed:

• The radiation survey gauge must be kept at the location where the Nuclear Density Gauge is stored unless required in the field for measurements of radiation levels.

• The radiation survey gauge may only be transported in the box or carry case provided for this purpose.

• Malfunctioning of a radiation survey gauge must be attended to at the earliest opportunity by the Radiation Safety Officer. The radiation survey gauge must be repaired or replaced as soon as possible. The rectification of a fault by changing the calibration of a radiation survey gauge must not be attempted.

• Radiation survey gauges must be returned for calibration at intervals not exceeding twelve months. Calibrations are to be conducted by a WA Radiological Council approved calibration provider.

**23.2 Measurement of Radiation Levels in Proximity to Nuclear Density Gauges**

Readings of radiation levels are to be taken at the sides and at the upper surface of the gauge and at a perpendicular distance of 0.5m and 1.0m from these surfaces. During the measurements, the line on the radiation survey gauge must match the lines on the Nuclear Density Gauge to ensure correct alignment and both instruments must be located on a dense level surface.

Readings of radiation levels are to be taken:

**• At intervals not exceeding one month.**

**• Immediately after the Nuclear Density Gauge has received a severe impact.**

**• Immediately after any damage to the Nuclear Density Gauge.**

**• Immediately after a significantly different or unusual standard count value is noted.**

All readings are to be recorded in the log book of the Gauge. Significant changes are to be confirmed by duplicate measurements and then are to be reported to the Radiation Safety Officer. As a guide, the following deviations from the usual values measured in accordance with the specified procedure and by the same model of radiation survey gauge may be considered significant when:

**• At a distance of 0.0m readings greater than 30% of usual values**

**• At a distance of 0.5m readings greater than 50% of usual values**

**• At a distance of 1.0m readings greater than 150% of usual values**

**23.3 Wipe Tests**

Routine wipe tests on Nuclear Density Gauges are to be carried out at intervals of twelve months. The Radiation Safety Officer will conduct the tests. If the Nuclear Density Gauge has received a severe impact or it is suspected that damage to the gauge has been sustained, additional wipe tests may be conducted to check the integrity of the source containment. The following wipe test procedure is to be employed:

Equipment required to conduct a wipe test:

• Disposable gloves;

• Sealable plastic bags;

• Permanent marker;

• Pen;

• Filter paper approximately no more than 100mm diameter;

• Tongs/Tweezers;

• Methylated spirits;

• Small unused plastic bag to hold the filter paper after the test; and

• Adhesive label to record the information to be attached the bag if the bag has no provision.

The wipe test of the neutron surface housing is carried out first. Access to the housing is from the inside of the base. The Nuclear Density Gauge should be in an upright position. Carefully unfasten and remove the LCD display keypad to gain access to the inside of the base. Moisten the filter paper with methylated spirits. Using and gloved hands, wipe several times along and across the edges of the neutron source cover. The filter paper is then placed into the plastic bag. Immediately re-assemble the Nuclear Density Gauge.

For the wipe test of the gamma source, the Nuclear Density Gauge is laid on its side in front of a mirror so that the reflection of the base can be observed by the protected operator positioned close to the handle of the gauge. The handle is then depressed to locate the source in the 50mm direct transmission mode. Brush the exposed source rod to remove any dirt. Using the tongs, remove the filter paper used for the neutron wipe test from the plastic bag and thoroughly wipe the exposed source rod. Place the filter paper back into the plastic bag and seal. Retract the source rod back to the safe shielded mode and place the gauge back to the upright position.

The wiping of each housing shall be completed within 15 seconds so as to minimise excessive exposure to the operator. During the test, no person other than the operator shall be in a radius of ten metres of the Nuclear Density Gauge.

The adhesive label, if required, is attached to the sealed plastic bag containing the filter paper. The make and the serial number of the Nuclear Density Gauge, the date of the test and the name of the person conducting the test shall be recorded on the label.

24 TRANSPORT OF NUCLEAR DENSITY GAUGES

**24.1 General Requirements**

Nuclear Density Gauges shall be transported in accordance with the requirements of the Code of Practice for the Safe Transport of Radioactive Substances (1990) under the Environmental Protection (Nuclear Codes) act 1978.

Prior to the transport of Nuclear Density Gauges the following shall be complied with:

• The appropriate warning labels and placard are attached to the handle and to the shell of the Nuclear Density Gauge (Appendix 1 – Figure 1).

• The handle of the Nuclear Density Gauge is in the shielded position and is secured by a padlock.

• The Nuclear Density Gauge is in its transportation case which is secured by a padlock.

• Category II warning labels with the relevant information are attached to the four sides and the top of the transportation case (Appendix 1 – Figure 2).

• Complete the shippers/consignors Transport of Dangerous Goods declaration form and place a copy into a clear plastic sleeve and attach with tape to the top of the transportation case (Appendix 1 – Figure 5).

• Details of the transport of the Nuclear Density Gauge are entered in the movements register for that gauge, from the store from which the gauge was removed.

25 TRANSPORT OF THE NUCLEAR DENSITY GAUGE IN A VEHICLE

As per the guidelines set out in the Radiation Safety (General) Regulations 1983, Nuclear Density Gauges shall only be transported in vans or utilities which have been fitted with a sturdy weather proof case which is secured within a steel cage. The case containing the Nuclear Density Gauge must be fitted with operating locking devices. Nuclear Density Gauges may be transported in vehicles other than that stated above (such as in the boot compartment of a sedan type vehicle) only in an emergency and only at the discretion of the Radiation Safety Officer. In these instances, the Nuclear Density Gauge must be secured in the gauges original manufacturers transportation case showing type two radioactive substances labels and is padlocked. A Nuclear Density Gauge shall not be transported in the passenger compartment of a vehicle.

The distance of the Nuclear Density Gauge from the driver and passenger of the vehicle should be the maximum possible, but not less than 1.2m.

The vehicle transporting the Nuclear Density Gauge must attach magnetic yellow radiation signs (minimum 150mm) (Appendix 1 – Figure 3) to each side and to the rear of the vehicle. Every reasonable effort must be made to recover lost signs. The replacement of lost or illegible signs should be requested at the earliest possible convenience.

Transport of the Nuclear Density Gauge outside daylight hours should be avoided. Fuel, with the exception of that required for the transporting vehicle, explosive, combustible or corrosive materials must not be carried in the vehicle. It should be noted that undeveloped x-ray or photographic film may be affected by radiation emitted by Nuclear Density Gauges.

26 STORAGE OF NUCLEAR DENSITY GAUGES

**26.1 Storage at the Base Laboratory**

When not in use, the gauge/s are held in the NDG storage room and which shall remain locked at all times, with NDG store keys held in the office. The Nuclear Density Gauges should be stored in an upright position and placed on its nylon reference block, with the gamma source in the shielded position and the handle of the gauge secured by a locking device. Nuclear Density Gauges must never be stored on bench tops or other similar raised structures. All relevant information shall be entered into the NDG Movements Register whenever a Nuclear Density Gauge is removed from or placed back into the NDG store.

27 STORAGE AT ANNEX/MOBILE LABORATORIES

When operating from an annex/mobile laboratory, there are two things to consider when storing Nuclear Density Gauges. They are:

• Security of the Nuclear Density Gauges; and

• Protection of personnel from radiation.

During working hours, the Nuclear Density Gauge is stored in the locked transportation box mounted on the rear of the testing vehicle. Magnetic radiation signs must be placed on the back and sides of the vehicle. The vehicle and Nuclear Density Gauge shall be secure so as to prevent theft and is the sole responsibility of the Radiation Safety Officer or his appointed representative.

After working hours, the Nuclear Density Gauge shall be stored in the manufacturer’s plastic transportation case, which is to be padlocked and stored within the locked annex/mobile laboratory. A sign displaying "Store for Radioactive Substances" must be attached to the door of the laboratory.

28 NUCLEAR DENSITY GAUGE OPERATION

**28.1 Operation in the Field**

Operators working with the Nuclear Density Gauge in the field shall ensure that the gauge is not endangered by vehicles or construction equipment. To achieve this, the following requirements shall be adhered to:

• The vehicle used for transporting the Nuclear Density Gauge must be equipped with an amber flashing light.

• The vehicle must be parked in the general proximity of the Nuclear Density Gauge when the gauge is being used. However, when the gauge is being used in front of or behind the vehicle, the separation distance shall be not less than five gauges. The amber flashing light must be operating while the vehicle is in the proximity of the gauge.

• Two free standing radiation signs shall be placed at a distance of five metres and fifteen metres respectively from the Nuclear Density Gauge in the direction from which traffic is expected and one sign shall be placed at a distance of five metres from the other direction. The signs shall be a minimum of 30 x 30 cm and display the radiation symbol with CAUTION above the symbol and RADIATION below the symbol. The lettering and symbol shall be black over bright yellow background.

• Vehicles other than those used for transportation of a Nuclear Density Gauge shall not be parked closer than fifteen metres from the Nuclear Density Gauge.

• The Nuclear Density Gauge shall remain in full view of the operator at all times.

The operators shall keep a distance of at least two metres from the Nuclear Density Gauge except when:

• Transporting of the gauge;

• Carrying the gauge;

• Carrying out monitoring of the gauge; and

• Carrying out test method procedures.

Operators must be wearing their TLD badges while using the Nuclear Density Gauge. All persons not wearing a TLD badge shall keep a distance of at least five metres from the Nuclear Density Gauge except when required to assist in the case of an emergency.

29 OPERATION IN THE LABORATORY

An area within the laboratory of at least 5 x 5 metres is to be designated as the NDG operation/calibration area. Operators shall only use the Nuclear Density Gauges within this designated area and shall place two free standing radiation signs not less than five metres from the gauge when used in this area. Operators shall wear their TLD badges at all times when working in the laboratory, even when they are not using or working in close proximity to the Nuclear Density Gauges.

30 NDG CALIBRATION and MAINTENANCE

**30.1 Calibrations**

The Radiation Safety Officer shall ensure that all Nuclear Density Gauges have current full calibrations and ensure that periodical laboratory calibration checks are conducted at the required intervals and recorded in the NDG file for each gauge.

The following calibration checks and minimum intervals shall be adhered to:

|  |  |
| --- | --- |
| **Stability and Drift** | Monthly |
| **Radiation Levels Monitoring** | Monthly |
| **Consistency Checks using Standard Granite block** | Initial and Monthly thereafter |
| **Datum Density Value (DDV)\*** | Monthly\* |
| **Full Calibration (conducted externally)** | 24 Months |

\* DDV’s are to be established for each gauge on the standard granite block immediately following the full NDG calibration as conducted externally (such as by Main Roads WA), or when a Nuclear Density Gauge is placed at an annex/mobile laboratory where DDV's will need to be re-established for that laboratory/location.

31 NUCLEAR DENSITY GAUGE MAINTENANCE

Maintenance of the Nuclear Density Gauges is conducted as required so as to ensure proper functioning of gauges at all times. All operators using the gauges are responsible for general maintenance of the gauges. The Radiation Safety Officer shall ensure that all operators are sufficiently trained to carry out general maintenance.

General maintenance of the Nuclear Density Gauges includes:

• Cavity cleaning and application of dry lubricant to probe and sliding block;

• Application of grease to bearing assembly surrounding the probe;

• Charging the gauge as required; and

• Replacement of battery packs.

Detailed information on how to carry out the above maintenance and checks can be found in the Nuclear Density Gauges operations manual as supplied by the manufacturer.

Under no circumstances shall any significant repairs be carried out on the Nuclear Density Gauges. If such repairs are necessary, an approved repairer shall be instructed to carry out this work.

NOTE: All Nuclear Density Gauges shall be adequately cleaned and maintained and fully charged as per the instruction above, prior to being sent for calibration.

32 ACCIDENTS

In the case of accidents involving a Nuclear Density Gauge, the following procedures shall be followed:

• As soon as possible following an accident, the radiation levels shall be checked with a radiation survey gauge.

The operator shall record the location of the measurements relative to the Nuclear Density Gauge and all information considered to be relevant.

• If the Nuclear Density Gauge appears to be undamaged and the radiation levels are normal, the gauge shall be returned to its storage location. At the storage location the manufacturer’s check procedures shall be carried out as soon as possible. If the results of checks are within specified limits and the standard counts are normal, the Nuclear Density Gauge may return to operational use.

• If the radiation levels at the sides and at the upper surfaces of the Nuclear Density Gauge exceed the normal levels by more than 50% and/or the Nuclear Density Gauge is damaged or is suspected of being damaged, the gauge shall be placed in a strong plastic bag. While doing this the operator shall wear plastic gloves. The plastic gloves then shall be placed in the plastic bag which shall be tied. The Nuclear Density Gauge shall then be returned to its storage location and secured.

• Radiation Safety Services and/or the Department of Radiation Health should be notified.

• If, due to an accident, a Nuclear Density Gauge is under a vehicle or construction equipment, the vehicle or equipment may only be moved if by this action further damage will not be caused to the Nuclear Density Gauge. If there is any doubt that this can safely be done, the vehicle or construction equipment must be raised to permit the removal of the gauge. All care must be taken to minimise exposure to radiation of personnel involved in this operation. Radiation levels in the proximity of the gauge must be measured and recorded.

• If the Nuclear Density Gauge has been broken in two or more pieces, all of these shall be placed into a strong plastic bag. The operator shall wear plastic gloves at all times when handling the gauge. The source rod shall only be carried by its handle or the end nearest the handle. All other pieces shall be placed into the bag using a long-handled shovel. The gloves shall then be placed into the plastic bag which shall be tied and carefully moved, preferably with the bucket of a front-end loader or similar to a close but isolated location. The site of the accident shall be checked visually and by radiation survey gauge to ensure both radiation sources have been removed. The area around the Nuclear Density Gauge shall be roped off at a radius of approximately ten metres. A responsible person shall remain in attendance outside this area to prevent people from entering the restricted zone. The Radiation Safety Officer shall notify the Radiation Safety Service and/or the Department of Radiation Health for further instructions.

• If a damaged Nuclear Density Gauge creates an obstruction on a road or area open to the public, it should be moved to a close but isolated location using the bucket of a front-end loader or similar. If this equipment is not available, it may be moved with a long-handled shovel or any other means that will not further damage the gauge and ensure maximum possible distance to the operator. The site of the accident shall be checked visually and by a radiation survey gauge to ensure that both radiation sources have been removed. Further action should then be carried out as detailed in the previous paragraph.

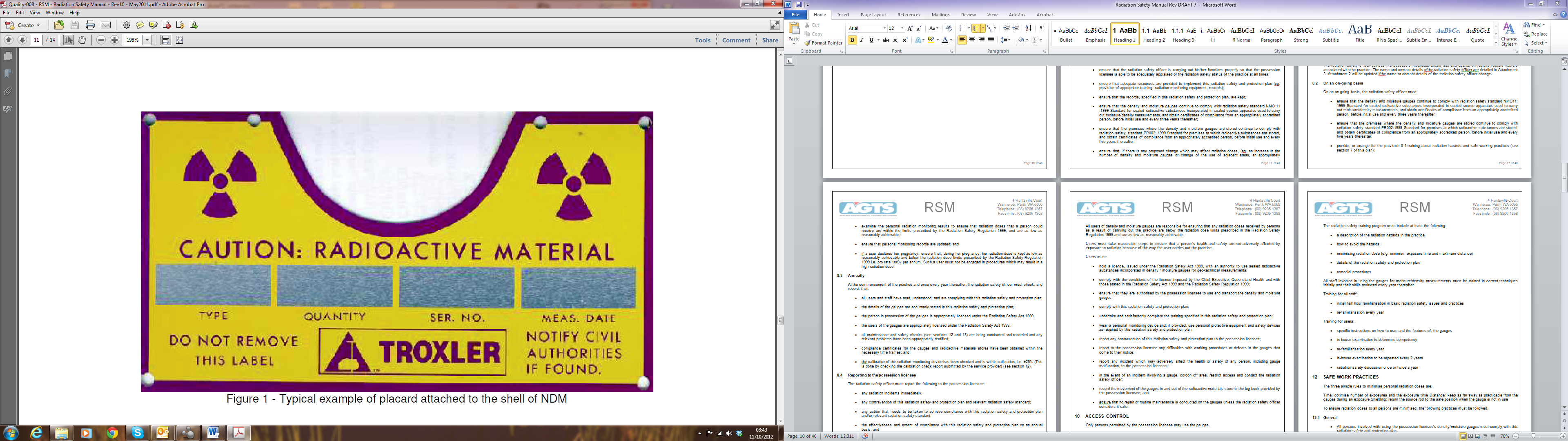
33 LOSS OR THEFT

If the Nuclear Density Gauge is lost or has been stolen, the Department of Radiation Health and the Police shall be notified immediately.

The Radiation Safety Officer shall be notified and an incident report completed as soon as practicable after notifying the relevant authorities.

34 APPENDIX 1 SIGNAGE FOR HANDLING AND TRANSPORT

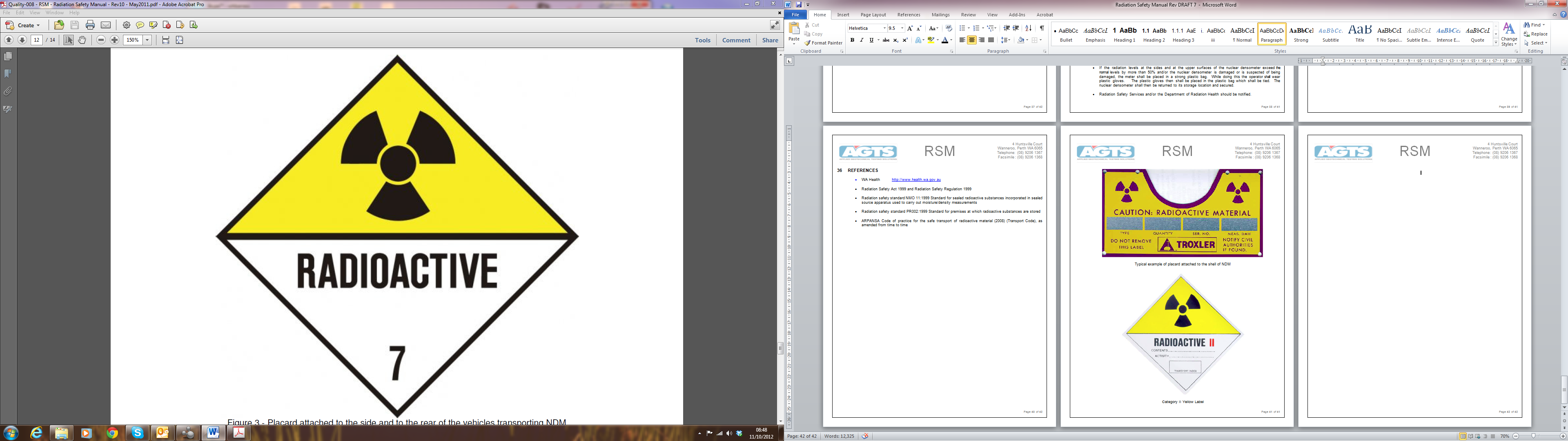
**Figure 1 - Typical example of placard attached to the shell of NDG**



**Figure 2 - Category II Yellow Label**



**Figure 3 - Placard attached to the side and to the rear of the vehicles transporting NDG**



**Figure 4 - Radiation Warning Sign**



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