SOP RSC 6.2 Radiation Safety with Neutron Gauges

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Written by:	Radiation Safety Committee
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BACKGROUND

Neutron gauges (soil moisture/density measuring equipment) are used for field research, scientific research and teaching purposes. These portable devices have radioactive sources. Their portability means that they are more readily lost or stolen and therefore the Commonwealth of Australia has special acts and guidelines to control these devices. To ensure that the various Acts are abided by, a Code of Practice has been developed by ARPANSA - Code of Practice RPS5 (Code of Practice and Safety Guide for Portable Density/Moisture Gauges Containing Radioactive Sources (2004)) and compliance with this code is a condition of the University Radiation Management Licence.

NOTE: Due to the nature of the legislation, researchers wishing to purchase or acquire such a device should plan for a six-month lag period between submission of the proposal to being able to purchase and use the equipment.

RESPONSIBILITIES

The University/Radiation Management Licence Holder

The University via the Radiation Management Licence (RML) holder alone is responsible for the purchase, acquisition, possession storage and disposal of radiation apparatus (neutron gauges) and for ensuring that relevant records are maintained.

The University via the Radiation Management Licence Holder will be responsible for ensuring that:

(a) the purchase, storage, repair, maintenance, disposal or sale of radiation apparatus comply with the Protection from Harmful Radiation Regulation 2025.

(b) copies of all maintenance and inspection reports undertaken on radiation apparatus, together with a copy of the registration certificate are kept with the apparatus and copies are sent to the Radiation Safety Committee (RSC) / Work Health and Safety (WHS) Unit.

(c) annual and random inspections in regard to the management of this apparatus are conducted by the RSC Unit.

NOTE: The records may be in hardcopy or electronic form.

NOTE: The records must be kept for at least 5 years and made available on request to an authorised officer of the EPA. They can only be disposed of after permission is granted from the State Director General.

The Radiation Management Licence Holder and the Principal Investigator

Both the RML Holder responsible for the equipment and principal investigators using the equipment must ensure compliance with the following procedures relating to the purchase or acquisition, storage, repair, maintenance, disposal or sale of radiation apparatus. In terms of purchase or acquisition please refer to RMP Booklet 4. Normally, the processes would occur jointly between these parties.

The Radiation Management Licence holder has the recommendation to notify the appropriate fire authority and police of the storage locations of each portable density/moisture gauge under their

control if and when required by the authority. This may be required for storage at permanent locations and is of particular importance when the gauge or gauges are stored at semi-permanent locations (as may be the case in field studies). The RML holder is required to organise the safety training of personnel, by an accredited trainer, on the use of the gauge, and should be done at the initial induction of these personnel. Refresher training should be undertaken at no more than 5-year intervals however, training may need to be more frequent where there have been changes to legislation or other safety requirements that are relevant to those personnel.

NOTE: NSW legislation requires that users are licensed and are suitably trained by an EPA approved trainer, or that students are exempted and under appropriate supervision during use of the gauge.

Every use of or project using ionizing radiation by a student, or staff member, of the University at any site, or the use by other persons at a University premise, requires prior project approval of the RSC. The persons involved must hold either an appropriate licence or an exemption.

The ARPANSA document suggests that the review period is annual.

No testing is allowed unless all relevant authorisations (licences, permission from the landowner to access land for testing, etc.) are to be obtained in writing before the testing is to be conducted.

All users of soil density and moisture gauges shall:

(a) hold a current radiation user's licence issued by the EPA (NSW), or hold a written exemption issued by an appropriately licensed person;

(b) acquaint themselves with and obey all notices and all instructions issued to them for the safe use of these devices;

(c) must only use the device in accordance with RSC approved project details;

(d) wear an appropriate personal monitoring device at all times when these instruments are in use;

(e) not interfere with, remove, alter, damage or render ineffective any soil density and moisture gauge or radiation protective equipment provided;

(f) comply with any method or working procedure adopted to reduce radiation exposure;

(g) immediately report to the Principal Investigator and the WHS unit any difficulties with working procedures or defects in equipment which may have caused or are likely to cause a radiation hazard; and

(h) complete moisture gauge usage log records whenever the gauges are used, and store these log records together in a folder (close to the stored gauges) so that they are available for future radiation audits.

(i) The user or principal investigator must maintain records of calibration and maintenance with these being kept near the gauge;

(j) Before using the gauge, the user must confirm that calibration and maintenance are current.

GUIDELINES FOR THE SAFE USE OF SOIL MOISTURE GAUGES

Only the Radiation Management Licence Holder (or their delegate) can purchase and possess such sealed source items. Therefore, the requirement is that all ownership and use of such items is approved through the set University procedures. An important part of these procedures is having a path of disposal organised before the purchase of these items.

SOP RSC 6.2 Radiation Safety with Neutron Gauges

The following Standard Operating Procedures (SOPs) are in addition to any other requirements that are already listed in this Radiation Management Plan.

The following is based on the relevant sections of Safety Guide: Portable Density/Moisture Gauges Containing Radioactive Sources, Radiation Protection Series No. 5 (May 2004).

Every use of or project using ionizing radiation by a student, or staff member, of the University at any site, or the use by other persons at a University premise, requires prior project approval of the RSC. The persons involved must hold either an appropriate licence or an exemption. The ARPANSA document suggests that the review period is annual.

These SOPs are based on the following from the Code of Practice.

Working Rules based on ARPANSA RPS 5

(a) All operators/users of the gauge are to be registered with the WHS Unit and are to be personally monitored with a Neutron Type Thermoluminescent Dosimeter (TLD) and possibly a standard Personal Monitoring Device (PMD) dosimeter as issued by the University's dosimetry service provider (both these dosimeters are to be a regulatory authority approved service):

(i) The TLD is to be worn at the belt level.

(ii) The control monitor is not to be kept near the gauge at any time.

(b) The expected radiation levels around each portable density/moisture gauge are to be such that the dose received by the operator is kept at less than 60% of the annual dose limit, and the dose rate one metre from the gauge should be no greater than the following:

(i) When the source(s) is/are in the shielded position, the radiation levels must not result in an ambient dose equivalent rate or directional dose equivalent rate, as appropriate, exceeding:

- 250 µSv/hr at any point 0.05m from the gauge surface; and
- 10 µSv/hr at any point 1m from the gauge surface.

(c) Using the instruction manual (or the supplier/manufacturer's recommendations), safe methods for the use of the gauge are to be employed at all times. No more than 3 people are to be involved in the direct use of the gauge at any time, all other persons are to be at least 3 metres from the instrument;

(d) From (b) above the method(s) for conducting the survey, any other safety tests are to be documented.

(e) When not in use the gauge is to be housed in an RSC approved secure and shielded storage facility with the appropriate warning signs (see Appendix 17.1), this storage facility is to have a dose rate of less than 5 µSv/hr at the surface of the facility.

(f) All operators/users of the gauge are to be personally monitored with a Neutron Type TLD and possibly a standard TLD:

(i) The TLD is to be worn at the belt level.

(ii) the control monitor is not to be kept near the gauge at any time.

(g) When soil testing is being conducted, the general public and those not directly operating the unit are to be kept a minimum of 3 metres from the site, the use of appropriate signs such as the example in Annex A is to be displayed at the four compass points of the testing site. An individual from the testing team is to be appointed as the site supervisor, so as to maintain safe distance, the appropriate use of signs and equipment as well as all safety records.

(h) Emergency Procedures approved by the WHS Unit and an emergency kit are to be kept near (but not with) the gauge at all times. The emergency kit consists of:

(i) portable neutron and radiation monitor/instrument,

(ii) cones/poles and tape to demark the crisis area,

(iii) communication device (mobile phone, radio, etc.), and

(iv) appropriate tools and utensils to deal with most envisaged situations.

(i) All relevant authorisations (licences, permission to access land for testing, etc.) are to be obtained in writing before the testing is to be conducted.

(j) During transport (see part 3.6 below), and when in the field but not being used, the gauge is to be transported in its packaging as far from the driver and passengers as possible (preferably in the boot of the vehicle). The unit is to be secured within the vehicle to prevent theft and loss, and the source(s) kept locked in the shielded position when the unit is not in use. The unit is not to be left unsecured or uncontrolled at any time.

(k) The integrity of the gauge is to be maintained by regular servicing by an authorised service agent/company. This will also include calibration of the source on an annual or bi-annual time frame. Records of all services and calibrations are to be maintained.

(l) The emergency contacts are:

(i)	Campus Security (all campuses)	Ph: 1800 931 633
(ii)	CSU Radiation Safety Committee	Ph: 02 6338 4504
(iii)	The NSW EPA Radiation Control Branch	Ph: 131 555

(m) The documentation to be maintained is as follows:

(i) Storage Logbook, that is a record of the time the gauge is in the storage facility;

(ii) User/Use Logbook, that is a record of all use or display of the unit, when, where and by whom;

(iii) Service, Repair and Calibration Logbook, and

(iv) Instrument Accident/Incident Records.

Emergency Procedures

Written emergency procedures are to be developed and kept with the gauge at all times. Users of the gauge are to be familiar with the emergency procedures. The manufacturer's instructions should always be the first source of information for the development of these procedures.

Responsibilities of the Licensee or Senior Researcher

The RML holder has the recommendation to notify the appropriate fire authority and police of the storage locations of each portable density/moisture gauge under their control. This may be required for storage at permanent locations and is of particular importance when the gauge or gauges are stored at semi-permanent locations (as may be the case in field studies). The RML holder is required to organise the safety training of personnel, by an accredited trainer, on the use of the gauge, and should be done at the initial induction of these personnel. Refresher training should be undertaken at no more than 5-year intervals however, training may need to be more frequent where there have been changes to legislation or other safety requirements that are relevant to those personnel.

NSW legislation requires that users are licensed and are suitably trained by an EPA approved trainer, or that students are exempted and under appropriate supervision during use of the gauge.

One of the licensee's responsibilities is to ensure the integrity of the sealed source, and a trained, experienced service technician should be employed for this purpose.

Service technicians involved with repair of portable density/soil moisture gauges might also need to be equipped with a suitable contamination monitor, particularly if they are performing wipe tests (Note: wipe tests are not recommended by the industry or the EPA). Contamination monitors should also be considered where there is a possibility that a source capsule can become ruptured.

User Responsibilities – CSU Requirements

All users of soil density and moisture gauges shall:

(a) have an RSC approval number for the project use of this equipment;

(b) hold a current radiation user's licence issued by the EPA (NSW), or hold a written exemption issued by an appropriately licensed person;

(c) acquaint themselves with and obey all notices and all instructions issued to them for the safe use of these devices;

(d) refrain from careless or reckless practice or action likely to result in a radiation hazard to themselves or others;

(e) wear an appropriate personal monitoring device at all times when these instruments are in use;

(f) not interfere with, remove, alter, damage or render ineffective any soil density and moisture gauge or radiation protective equipment provided;

(g) comply with any method or working procedure adopted to reduce radiation exposure;

(h) immediately report to the owner any difficulties with working procedures or defects in equipment which may have caused or are likely to cause a radiation hazard; and

(i) complete moisture gauge usage log records whenever the gauges are used, and store these log records together in a folder (close to the stored gauges) so that they are available for future radiation audits.

Storage of Gauges

When in storage, the gauge should be locked in its transport case.

As far as practicable and taking into account the As Low As Reasonably Achievable (ALARA) principle, portable density/soil moisture gauges should not be stored near regularly occupied or frequented areas. The dose rate at the surface of the storage facility is to be less than 5 µSv/hr if only occupationally exposed persons have access, or less than 0.5µSv/hr if accessible by the general public. Furthermore, portable density/soil moisture gauges should not be stored in the same storage area as dangerous goods of the following Dangerous Goods Classes:

1	Explosives
2.1	Flammable gas
3	Flammable liquid
4.1	Flammable solid
4.2	Spontaneously combustible
4.3	Dangerous when wet
5.1	Oxidising agent
5.2	Organic peroxide
8	Corrosive

As radioactive materials are to be stored (in general) in a storage facility solely dedicated to radioactive storage, and designed for such storage, consideration needs to be given to ARPANSA and relevant Australian Standards documents, as well as legislative requirements (that is registration).

Also, portable density/soil moisture gauges should not be stored with undeveloped X-ray or photographic film or foodstuffs.

The name and contact details of the CSU Work Health and Safety and RSC, or other relevant person, should be placed on the store in a conspicuous location.

Transport of Gauges

(a) While in a vehicle, the case must not be visible to a passer-by.

(b) The container cannot be transported in the passenger compartment.

(c) When transported on roads, the gauge shall be locked in its original carry case/transport container.

(d) The container shall be locked.

(e) The container shall be fixed in location within the vehicle with the shutter mechanism facing away from the vehicle occupants or facing downwards.

(f) The unit must be secured in such a fashion that theft is very difficult and loss from the vehicle during transport is not possible.

Gauges will not be transported with incompatible classes of dangerous goods unless written approval has been obtained from WHS.

The gauge cannot be transported across State borders without prior written approval from the RSC and the relevant regulatory authorities.

DOCUMENTATION

Storage Logbook, that is a record of the time the gauge is in the storage facility.

User/Use Logbook, that is a record of all use or display of the unit, when, where and by whom.

Service, Repair and Calibration Logbook.

Instrument Accident/Incident Records.

AUDIT

Every 2 years

REFERENCES

ARPANSA. Code of Practice & Safety Guide: Portable Density/Moisture Gauges Containing Radioactive Sources (2004) Radiation Protection Series Publication No. 5.

REVISION & APPROVAL HISTORY

Date	Revision No.	Author and Approval
Dec 2014	Version 1	William Bartolo, Bartolo Safety Management Service
May 2016	Version 2	William Bartolo, Bartolo Safety Management Service
Dec 2016	Version 3	Radiation Safety Committee, Charles Sturt University
Jan 2017	Version 4	William Bartolo, Bartolo Safety Management Service and Radiation Safety Committee, Charles Sturt University
Nov 2022	Version 5	Radiation Safety Committee, Charles Sturt University
Oct 2025	Version 6	Dr Ketema Zeleke; Radiation Safety Committee, Charles Sturt University

APPENDIX 17.1

Radiation Warning Signs and Labels

Radiation warning signs and labels must conform to AS 1319 - 1994 Safety signs for the occupational environment, and AS 2342 - 1992 Development, testing and implementation of information and safety symbols and symbolic signs. Examples of suitable warning signs and labels are given below.

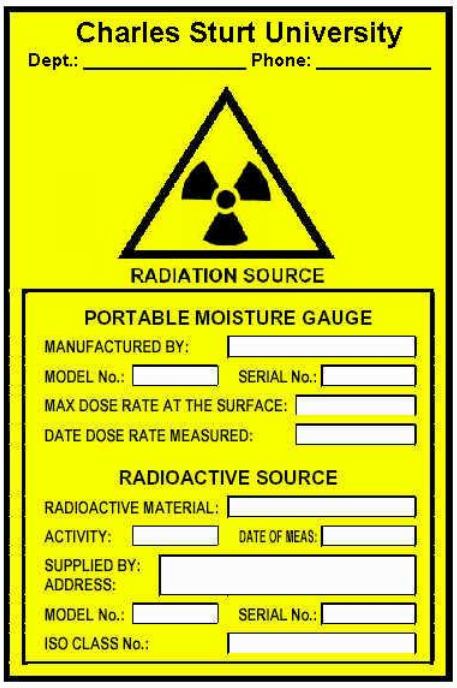
Colours for radiation warning signs and labels

Background: yellow

Marking and trefoil: black

EXAMPLE OF A SUITABLE WARNING SIGN FOR POSTING IN THE AREA ADJACENT TO PORTABLE DENSITY/SOIL MOISTURE GAUGE WHEN IN USE (55 x 22cm min size)

EXAMPLE OF A SUITABLE WARNING LABEL FOR ATTACHMENT TO A PORTABLE DENSITY/SOIL MOISTURE GAUGE CONTAINING A RADIOACTIVE SOURCE



The information included on this label should reflect the gauge's use (e.g. Density only, moisture only (version depicted above) or combination) and its total radioactive contents (e.g. caesium only, 241Am/Be only or both).

(NOTE: the lower part of this label may be unpainted metal with black lettering).

EXAMPLE OF A SUITABLE WARNING LABEL FOR DISPLAY ON A RADIATION STORE