

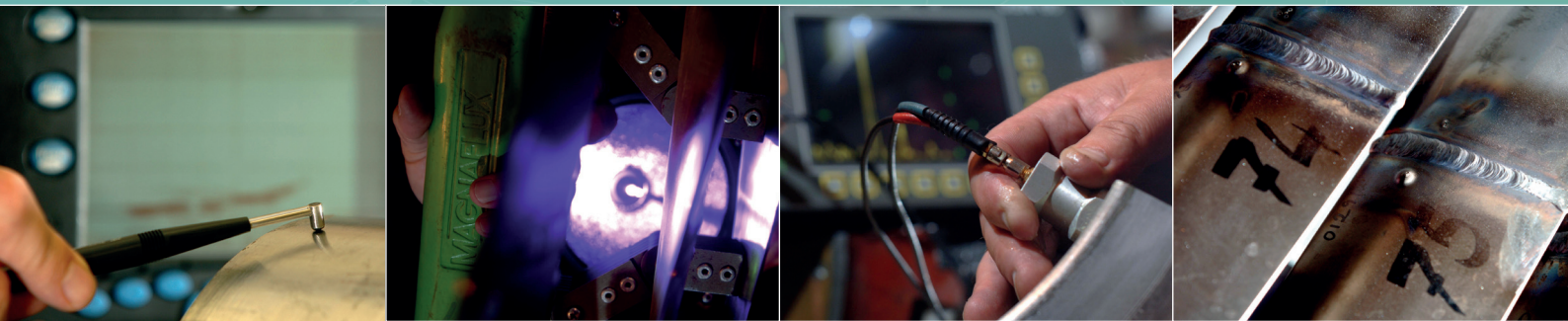
PCN24/RAD/SAFE

PCN certification of personnel for Basic Radiation Safety (BRS) and Advanced Radiation Safety (ARS)

Issue 1 • September 2026



A division of



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The British Institute of Non-Destructive Testing is an accredited Certification Body offering personnel and quality management systems assessment and certification against criteria set out in international and European standards through the PCN Certification Scheme.

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1. Scope

- 1.1 This document explains the process for examining personnel and issuing PCN certification for Basic Radiation Safety (BRS) and, where required, Advanced Radiation Safety (ARS). ARS certification may support employer consideration when appointing Radiation Protection Supervisors (RPSs). These requirements supplement PCN24/GEN, General requirements for qualification and PCN certification of NDT personnel, and any applicable PCN24 supporting documents.
- 1.2 This document sets out the PCN training and experience requirements that candidates must meet before taking PCN radiation safety certification examinations.
- 1.3 This document identifies the key radiation safety knowledge that candidates need for the work they may carry out in roles appointed by their employer.
- 1.4 Candidates seeking PCN Industrial Radiography certification are exempt from further radiation safety examinations if they already hold valid PCN BRS certification and/or ARS certification where required for RPS-related roles.

2. Introduction

The PCN Scheme recognises two levels of competence for radiation safety:

2.1 Basic Radiation Safety certification

The award of PCN BRS certification confirms that the individual has received appropriate training in the hazards associated with ionising radiation. It also demonstrates that they understand the precautions required when working with ionising radiation and the protection measures that must be applied. The knowledge and principles covered by BRS certification are equally applicable to both site operations and permanent facilities. This includes the application of the as low as reasonably practicable (ALARP) principle, as well as the actions and controls required in the event of a radiation incident. These arrangements shall be in addition to any local rules, procedures and site-specific requirements. In this regard, the employer and certificate holder shall pay particular attention to Regulation 15 of the UK Ionising Radiations Regulations 2017 (IRR17), which states:

2.1.1 IRR17 – Regulation 15: information, instruction and training

1. Every employer must ensure that:

- (a) those of its employees who are engaged in work with ionising radiation are given appropriate training in the field of radiation protection and receive such information and instruction as is suitable and sufficient for them to know:
 - i. the risks to health created by exposure to ionising radiation as a result of their work.
 - ii. the general and specific radiation protection procedures and precautions which should be taken in connection with the work with ionising radiation to which they may be assigned.
 - iii. the importance of complying with the medical, technical and administrative requirements of the Regulations and that
- (b) adequate information is given to other persons who are directly concerned with the work with ionising radiation carried out by the employer to ensure their health and safety so far as is reasonably practicable.

(Extracts taken from the IRR17 Approved Code of Practice).

2.2 Advanced Radiation Safety certification

PCN ARS is an optional, advanced level of radiation safety certification. Employers may consider ARS certification when assessing the suitability of an individual for appointment as an RPS.

Successful completion of the PCN ARS examination confirms that the certificate holder has demonstrated knowledge and understanding of radiation protection principles and the regulatory requirements relevant to the role of an RPS.

ARS certification may assist an employer when considering the appointment of an ARS certificate holder to the role of RPS in accordance with Regulation 18 of the IRR17 Approved Code of Practice.

It must be clearly understood, however, that the formal appointment of an individual as an RPS remains the responsibility of the employer.

When appointing an ARS certificate holder to the role of RPS, the employer must ensure that the individual is provided with:

- suitable authority to discharge their duties effectively;
- adequate time and resources to fulfil the responsibilities of the role;
- appropriate knowledge of the applicable local rules, working environment and operational context;
- knowledge of relevant emergency procedures; and
- the authority and competence necessary to supervise all radiation protection aspects of the work being undertaken.

Limitations of BRS and ARS certification

BRS and ARS certification confirms that the certificate holder has successfully passed the relevant PCN radiation safety examination and has demonstrated knowledge at the level applicable to the certification awarded.

However, it must be clearly understood that the issue of BRS or ARS certification by PCN does not, in itself, authorise the certificate holder to undertake industrial radiography, supervise radiographic activities or carry out radiation safety duties.

Responsibility for authorising an individual to undertake radiation safety work, or for formally appointing an ARS certificate holder to the role of RPS, remains with the employer. The employer must ensure that any such appointment or authorisation is supported by the individual's competence, experience, knowledge of the work environment and understanding of the applicable local rules and procedures.

- 2.3 Where there is any doubt regarding the suitability, competence or appointment of an individual to undertake radiation safety duties or to act as an RPS, the employer should seek advice from a suitably qualified Radiation Protection Adviser (RPA). A candidate for PCN ARS certification will have received training relevant to the RPS role. They will also have been assessed on their knowledge and understanding of how to assess dose, carry out hazard assessments, apply contingency plans and emergency procedures, arrange dosimeters and maintain dose records. **In part, Regulation 18 confirms that:**

1. *for the purposes of enabling work with ionising radiation to be carried on in accordance with the requirements of the regulations, every employer engaged in work with ionising radiation must, in respect of any controlled area or, where appropriate, having regard to the nature of the work carried out there, any supervised area, make and set down in writing such local rules as are appropriate to the radiation risk and the nature of the operations undertaken in that area.*
2. *local rules must identify the main working instructions intended to restrict any exposure in that controlled or supervised area.*

2.3.1 Suitability for appointment as an RPS

An employee who is appointed as an RPS should:

- (a) *know and understand the requirements of the regulations and local rules relevant to the work with ionising radiation;*
- (b) *command sufficient authority from the people doing the work to allow them to supervise the radiation protection aspects of that work;*
- (c) *understand the necessary precautions to be taken and the extent to which they will restrict exposures;*
- (d) *be given sufficient time and resources to carry out their functions; and*
- (e) *know what to do in an emergency.*

- 2.3.2 *They should receive appropriate training under Regulation 15 to carry out the task adequately. The training will need to reflect the complexity of the work being done. This should include periodic refresher training to maintain competency levels and if changes are made to local rules.*

In general, an RPS will be an employee of the employer carrying out the work with ionising radiation. They will usually be in line management positions, closely involved with the work being done, to allow them to exercise sufficient supervisory authority. Additionally, the role may be carried out by a radiation protection unit established within the employer's business or by a Radiation Protection Adviser (RPA).

Appointment of the RPS (by the employer): *an RPS should be clear about the role they are expected to fulfil. This should be confirmed in writing so there is no confusion about the work expected of them. Employers may wish to display the name of the relevant RPS on notice boards at fixed locations where the work is carried out.*

Consultation with the RPA: *employers should consider the need for advice from the RPA about the suitability of RPS appointments.*

(Extracts above taken from the IRR17 Approved Code of Practice).

3. Eligibility for PCN radiation safety certification

All candidates must successfully complete the required PCN-approved training course for BRS or ARS certification and must have the industrial experience specified below:

- 3.1 BRS certification: candidates must complete a PCN-approved theoretical training course at a BINDT Approved Training Organisation (ATO). The course shall include a minimum of 16 hours of formal training covering the relevant parts of the syllabus contained within PCN24/RAD/SAFE Annex A.

Note: For BRS certification, there is no mandated experience requirement as this is an entry-level certification often required prior to obtaining experience in radiographic testing.

3.2 Advanced Radiation Safety certification for employer consideration when appointing Radiation Protection Supervisors

- 3.2.1 Complete a PCN-approved theoretical training course at a BINDT ATO, covering the relevant parts of the syllabus in PCN24/RAD/SAFE, Annex A. The minimum course duration is 40 hours for candidates who do not already hold BRS certification or 24 hours for candidates who have previously attained BRS certification.
- 3.2.2 Provide verifiable evidence of a minimum of nine months' relevant industrial experience involving work with ionising radiation. This experience does not need to have been gained after obtaining BRS certification but must be relevant to the scope of ARS certification and satisfactory to BINDT. Where experience is gained following a successful ARS examination, the candidate must complete and submit PCN24/PSL57C to PCN.
- 3.3 **NOTE:** As per the requirements of IRR17, the responsibility for the appointment of a suitable person for the role of Radiation Protection Supervisor rests with the employer, whose attention is drawn to Regulation 18 of the Approved Code of Practice.

4. Assessment of candidates

- 4.1 Industrial radiography is carried out in many different working environments. For this reason, the assessment does not separate the requirements for site radiographers from those for operators working only in an exposure bay with mechanical or electronic safety controls. BRS and ARS assessments therefore cover radiation safety competence for laboratory, site and workshop conditions.

4.2 Basic Radiation Safety examination

- 4.2.1 Applications for BRS certification examinations must be submitted directly to a PCN Authorised Qualifying Body (AQB) using the current PCN24 examination application form, PCN24/PSL57A.

4.2.2 BRS written examination format for X-ray or X- and gamma ray

- The written examination consists of 30 multiple-choice theory questions set at BRS knowledge level. Each question has four possible answers. One answer is correct; the other answers are wrong or incomplete.
- Two minutes are allowed for each question.
- The total examination time is 60 minutes.
- The pass mark is 70%.

4.3 Advanced Radiation Safety examination

- 4.3.1 Applications for ARS certification examinations must be submitted directly to a PCN AQB using the current PCN24 examination application form, PCN24/PSL57A.

4.3.2 ARS written examination format for X-ray or X- and gamma ray

- The written examination consists of 30 multiple-choice theory questions set at ARS knowledge level. Each question has four possible answers. One answer is correct; the other answers are wrong or incomplete.
- Three minutes are allowed for each question.
- The total examination time is 90 minutes.
- The pass mark is 70%.

5. Certification available

- 5.1 Basic Radiation Safety certification is available for:
- X-ray only.
 - Both X-ray and gamma ray.
- 5.2 Advanced Radiation Safety certification is available to support employer consideration when appointing Radiation Protection Supervisors covering:
- X-ray only.
 - Both X-ray and gamma ray.
- 5.3 **NOTE:** *In accordance with PCN24/GEN, PCN industrial radiography certification may become invalid, be suspended or be withdrawn if the certificate holder has not passed a PCN radiation safety examination within the previous five years.*

6. Procedure for recertification

- 6.1 PCN BRS or ARS certification cannot be recertified without completing a further full assessment examination.
- 6.2 Personnel whose PCN BRS or ARS certification expires at the end of the maximum five-year validity period must complete the initial examination process again. This consists of:

6.3 Basic Radiation Safety

- 6.4 A written theory examination that meets the requirements in clause 4.2.

6.5 Advanced Radiation Safety

- 6.6 A written theory examination that meets the requirements in clause 4.3. If radiation safety regulations or legislation have changed since the expiring PCN certificate was issued, candidates are advised to complete relevant refresher training at an ATO before taking the recertification examination at an AQB. The refresher training must cover the new or revised requirements.

7. Complaints and appeals

- 7.1 **Complaints:** a party that believes it has reasonable grounds to question the competence of a PCN-certificated individual may request withdrawal or cancellation of certification. The request must be made in writing and include all relevant facts. If BINDT considers that an adequate case has been presented, the circumstances will be investigated.
- 7.1.1 Details of the complaint or appeal must first be submitted in writing using PCN24/CP21.
www.bindt.org/admin/downloads/PCN24-CP21-INT.pdf
- 7.1.2 Each complaint or appeal will be acknowledged, investigated and resolved. Verbal complaints or appeals will not be accepted.
- 7.1.3 If the BINDT Certification Management Committee (CMC) or a committee acting on its behalf accepts that the complaint is justified, certification may be withdrawn for a period set by the investigating committee. To regain certification after that period, the candidate must pass a further initial PCN examination.
- 7.2 **Appeals:** a candidate or certificate holder may appeal against certificate cancellation or against a decision not to certify or recertify. Appeals must be made in writing to the PCN Scheme Manager and must follow the guidance in PCN24/CP21.
- 7.3 The CMC may delegate complaints and appeals to a properly constituted subcommittee.

8. Reference literature

References cited in the text are essential reading. References listed below, but not cited in the syllabus, are recommended reading.

8.1 Essential reading

- 8.1.1 The Ionising Radiations Regulations, 2017. Statutory Instrument No 1075:
www.legislation.gov.uk/ukxi/2017/1075/contents/made
- 8.1.2 Working with Ionising Radiation. Ionising Radiations Regulations 2017. Approved Code of Practice and guidance:
www.hse.gov.uk/pubns/books/l121.htm
- 8.1.3 HSE information sheet – Industrial radiography – Managing radiation risks. Ionising Radiation Protection:
www.hse.gov.uk/pubns/irp1.pdf
- 8.1.4 Managing Industrial Site Radiography Work:
www.l2businessconsulting.com/wp-content/uploads/2017/06/SRP-Guidance-on-Managing-Industrial-Site-Radiography.pdf
- 8.1.5 The Control of Lead at Work Regulations 2002:
www.hse.gov.uk/pubns/books/l132.htm

8.2 Recommended reading

- 8.2.1 Relevant British, European or international standards.
- 8.2.2 Ionising Radiation: Protecting Workers and Others – HSE guidance
Information on the reporting of incidents involving ionising radiation, including incidents reportable under the Ionising Radiations Regulations (IRR17) and the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), is available from the HSE:
www.hse.gov.uk/radiation/ionising/protection.htm
- 8.2.3 Public Health England website:
www.gov.uk/government/organisations/public-health-england

ANNEX A – EXAMINATION SYLLABUS FOR THE CERTIFICATION OF PERSONNEL IN RADIATION SAFETY AND PROTECTION

Specific requirements for the certification of personnel for Basic Radiation Safety (BRS) and, where required, Advanced Radiation Safety (ARS) certification for consideration by the employer when appointing persons as Radiation Protection Supervisors (RPSs).

1 – INTRODUCTION

Unless stated otherwise, all examinations are closed book. The general syllabus is the same for both certification levels but ARS requires greater depth of knowledge and a higher level of difficulty than BRS.

Candidates taking the BRS examination should have general knowledge of the listed syllabus subjects and awareness of the referenced documents.

Candidates taking the ARS examination are expected to have detailed knowledge of all syllabus subjects and the documents listed.

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2 – BASIC RADIATION SAFETY CERTIFICATION

- 2.1 Candidates must attend a structured classroom training course at a BINDT Approved Training Organisation (ATO). By the end of the course, candidates should be able to:
- 2.2 Understand the basic concepts of ionising radiation.
- 2.3 Recognise and use common radiation protection terminology.
- 2.4 Be familiar with the main requirements of:
 - 2.4.1 The Ionising Radiations Regulations 2017: www.legislation.gov.uk/uksi/2017/1075/contents/made
 - 2.4.2 Working with ionising radiation. Ionising Radiations Regulations 2017. Approved Code of Practice and guidance: www.hse.gov.uk/pubns/books/l121.htm
 - 2.4.3 Associated guidance/approved training notes.
- 2.5 Understand the potential health hazards associated with ionising radiation.
- 2.6 Understand and apply practical radiation protection principles to minimise exposure to ionising radiation.
- 2.7 Understand good working practices for keeping radiation doses as low as reasonably practicable (ALARP) during site and compound radiography.
- 2.8 Calculate source intensity and dose rates and understand and apply the inverse square law.
- 2.9 Know the appropriate actions to take in emergency situations.

NOTE: The minimum training time for covering the Basic Radiation Safety syllabus is 16 hours. Additional time may be needed for practical exercises, group work and demonstrations. The approved training hours stated in this document are mandatory minimum requirements and must not be reduced. An Approved Training Organisation may provide additional training time where it considers this necessary to ensure candidates are adequately prepared for the certification examination and the Basic Radiation Safety role and responsibilities.

3 – ADVANCED RADIATION SAFETY CERTIFICATION – FOR EMPLOYER CONSIDERATION WHEN APPOINTING RADIATION PROTECTION SUPERVISORS

- 3.1 Advanced Radiation Safety certification is intended for personnel who may be considered by their employer for appointment as Radiation Protection Supervisors for site and/or compound radiography at the employer's facilities or at customer facilities. Advanced Radiation Safety certification may support the employer's consideration of suitability, but it does not determine suitability on its own and does not appoint the holder as a Radiation Protection Supervisor. The regulations require the Radiation Protection Supervisor to know and understand the current IRR requirements and the local rules that apply to the work they supervise. They must also understand the precautions needed for the work and how those precautions restrict exposure. By the end of the course, candidates should, in addition to the Basic Radiation Safety requirements, be able to:
- 3.2 Have a detailed understanding of the basic concepts of ionising radiation.
- 3.3 Understand radiation protection terminology in detail.
- 3.4 Have a detailed understanding of the main requirements of:
- 3.4.1 Radioactive substances legislation, as applicable by jurisdiction: Environmental Permitting Regulations 2016 for England and Wales; Environmental Authorisations (Scotland) Regulations 2018 for Scotland; and the Radioactive Substances Act 1993, where applicable, including Northern Ireland. Candidates should understand that these environmental regulatory requirements are separate from, and additional to, duties under IRR17.
- 3.4.2 The Ionising Radiations Regulations 2017: www.legislation.gov.uk/uksi/2017/1075/contents/made
- 3.4.3 The Approved Code of Practice: www.hse.gov.uk/pubns/books/l121.htm
- 3.4.4 Associated guidance/approved training notes.
- 3.4.5 Transport of radioactive material under the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, including the requirements for classification, packaging, labelling, documentation, training, security and emergency arrangements.
- 3.5 Thoroughly understand the potential health hazards associated with ionising radiation.
- 3.6 Thoroughly understand practical protection principles used to minimise exposure to ionising radiation.
- 3.7 Understand good working practices for keeping radiation doses ALARP during site and compound radiography.
- 3.8 Fully understand the role and duties of the RPS and the records that must be maintained.
- 3.9 Calculate source intensity and dose rates and complete inverse square law and shielding calculations needed to keep radiation doses ALARP.
- 3.10 Understand emergency arrangements in detail and be able to take control using agreed and authorised procedures.

NOTE: The minimum training time for covering the ARS syllabus is 40 hours. Where candidates have previously passed PCN BRS, the 16 hours from the original BRS course can be deducted from this minimum.

- ARS direct: 40 hours minimum.
- ARS holding or having previously held PCN BRS: 24 hours minimum.

Additional time may also be required for practical exercises, group work and demonstrations.

The approved training hours stated in this document are mandatory minimum requirements and must not be reduced. An Approved Training Organisation may provide additional training time where it considers this necessary to ensure candidates are adequately prepared for the certification examination and the ARS role and responsibilities.

4 – SYLLABUS CONTENT FOR BRS- AND ARS-LEVEL CERTIFICATION

Examination syllabus for the certification of personnel in Basic Radiation Safety and Advanced Radiation Safety

Unit	Unit contents
1	Basic concepts of matter, energy and radiation
1.1	Elements
1.2	Atoms
1.3	Subatomic particles
1.4	Atomic number
1.5	Mass number
1.6	Isotopes
1.7	Molecules
1.8	Radionuclides (radioisotopes)
1.9	Half life
1.10	Naturally occurring radionuclides
1.11	Artificial radionuclides
1.12	Decay
1.13	Corpuscular (particulate) radiation: alpha radiation/beta radiation/neutron radiation
1.14	Electromagnetic radiation
1.15	Properties of X- and gamma rays
1.16	Ionisation: Compton scatter/photoelectric effect/Rayleigh scatter/pair production
2	Equipment used for industrial radiography
2.1	Gamma sources: sealed sources/exposure containers/projection containers/markings of exposure containers/identification of the sealed source in the exposure container/source exchangers/small-controlled-area radiography (SCAR)/testing of isotope containers and sealed sources/collimators
2.2	X-ray sources: generation of X-rays/the X-ray equipment control panel/timer/milliamp (mA) control/kilovoltage (kV) control
2.3	Other types of X-ray equipment: pipeline crawler equipment/high-energy units/electrostatic generators/electron linear accelerators/the betatron
3	Quantities and units
3.1	Activity/exposure/absorbed dose/equivalent dose/effective dose/dose rate
4	Interaction of radiation with the human body
4.1	Exposure: exposure pathways/external and internal exposure/effects of exposure to ionising radiation/somatic effects
4.2	Deterministic effects (also known as 'early effects'): blood-forming system/skin/gastrointestinal (GI) tract/eyes/probable effect of an acute radiation dose on the whole body
4.3	Stochastic effects (also known as 'probabilistic effects'): genetic effects
5	Dose limitation, measurement and recording
5.1	ALARP/IRR17 dose limits per calendar year/additional dose limits for female employees/action levels
5.2	Radiation measurement and monitoring: ionisation chambers/Geiger-Müller tubes/direct reading/indirect reading/testing of radiation monitors
5.3	Making measurements
5.4	Frequency of monitoring: regulatory requirements/radiography in an enclosure/site radiography/source stores/other monitoring
5.5	Personal dosimetry: introduction/classification/dose assessment/duties of the ADS/duties of the employer/health surveillance
5.6	Types of dosimeter: film badges/thermoluminescent dosimeters (TLDs)/personal alarm monitors or personal electronic dosimeters (PEDs)/care of passive dosimeters/lost dosimeters/exposed or defective dosimeters
5.7	Dose investigations: unusual exposure ALARP investigation/over-exposure investigation

6	Legal requirements
6.1	Overview: radioactive substances legislation by jurisdiction: Environmental Permitting Regulations 2016 for England and Wales/Environmental Authorisations (Scotland) Regulations 2018 for Scotland/Radioactive Substances Act 1993, where applicable, including Northern Ireland/Registration, permitting, authorisation, source security, accountancy and radioactive waste controls/relationship with IRR17 duties
6.2	Ionising Radiations Regulations 2017: Approved Code of Practice (ACOP)/guidance notes
6.3	Transport legislation: Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, as applicable to the transport of radioactive material
6.4	Requirements of the Ionising Radiations Regulations 2017: ● Authorisation: Regulations 5, 6 and 7 ● Radiation risk assessment: Regulation 8 ● Designation of areas: Regulation 17 – Controlled area/X-ray in an enclosure/site radiography/supervised area ● Classification: Regulation 21 – Classified persons ● Appointment of Radiation Protection Supervisors: Regulation 18 – RPS qualifications/duties of the RPS ● Appointment of Radiation Protection Adviser: Regulation 14 ● Local rules: Regulation 18 ● Information, instruction and training: Regulation 15 – Radiation employees/other persons ● Administrative requirements: source accountancy/leak testing
7	Principles and practices of radiation protection
7.1	Introduction Output: gamma sources/X-ray sets Time Distance Shielding: transmission factor/reduction factor/collimation
7.2	Practical methods of radiation protection Radiography in an enclosure or compound: exclusion of persons/X-radiography/high-energy systems/gamma radiography/warning signals/powered wind-out systems/alarms Testing of safety systems: routine checks/thorough examination Site radiography: exclusion of persons/warning signals and notices/typical set-up for site radiography using a gamma source/'worst-case' boundary distances/working within a controlled area once established
7.3	Source storage for gamma radiography
8	Emergency procedures
8.1	Introduction
8.2	Typical scenarios: gamma radiography/X-radiography
8.3	Contingency plans (Regulation 13) Gamma radiography: source failing to return to container/lost or stolen source/fire or mechanical damage to a source container/failure of safety systems leading to suspected overexposure Contingency plans (Regulation 13) X-radiography: failure of X-ray set to terminate an exposure automatically/fire or mechanical damage to X-ray set Contingency plans (Regulation 13) Rehearsal of contingency plans: gamma radiography incidents
9	Transport of radioactive sources
9.1	Introduction Regulations and compliance/training Summary of requirements and procedures: Risk assessment/local rules/dosimetry/sources and containers/routine conditions of transport/foreseeable incidents/security

ANNEX B – EXAMPLE EXAMINATION QUESTIONS FOR THE CERTIFICATION OF PERSONNEL IN RADIATION SAFETY AND PROTECTION

Specimen examination questions for the certification of personnel in Basic Radiation Safety (BRS) and Advanced Radiation Safety (ARS).

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1 – GENERAL INFORMATION

- 1.1 Source activities or dose rates to be used within the example questions are given in dual units on the paper, for example:
 - 740 GBq ⁶⁰Co (20 Ci ⁶⁰Co)
 - 185 GBq ¹⁹²Ir (5 Ci ¹⁹²Ir).
- 1.2 In order to offer a variety of example questions, various sources and shielding materials will be referenced with the relevant half- or tenth-value thickness, for example:
 - Concrete
 - Steel
 - Lead.

2 – BASIC RADIATION SAFETY EXAMINATION AND EXAMPLE QUESTIONS

The candidate will be required to achieve a pass mark of 70% in an examination comprising 30 multiple-choice questions, including at least one question involving a calculation.

A period of 60 minutes is allowed for the BRS examination; two minutes per question.

The following example questions are indicative of the type and complexity of question that the candidate may be expected to answer in a PCN BRS examination.

1. Atoms of a single element which have different numbers of neutrons in the nucleus are:
 - (a) radioactive
 - (b) unstable
 - (c) isotopes
 - (d) beta emitters.
2. The radiation intensity at 1 m from a source is 10 µSv/h. The distance required to reduce this to 2.5 µSv/h is:
 - (a) 2 m
 - (b) 5 m
 - (c) 10 m
 - (d) 20 m.
3. The thickness of a specified material necessary to reduce the exposure rate to 25% of the initial value is the:
 - (a) two-half value thicknesses
 - (b) one-tenth value layer
 - (c) attenuation coefficient
 - (d) inverse square law factor.

4. Classified persons are those persons/workers who are likely to receive an effective dose rate greater than:
- (a) 150 mSv/year for the skin
 - (b) an equivalent dose greater than 15 mSv/year for the lens of the eye
 - (c) an effective dose greater than 6 mSv/year
 - (d) all answers are correct.

3 – ADVANCED RADIATION SAFETY EXAMINATION AND EXAMPLE QUESTIONS

Candidates will be required to achieve a pass mark of 70% in an examination comprising 30 multiple-choice questions.

The examination will include calculations.

The examination will also include multiple-choice questions, which will require the candidate to select the correct answers provided to them from within paragraphs of narrative text. This will require in-depth knowledge and a greater understanding of the subject matter/sequence of succession events and of calculations in order for the candidate to select the correct answer.

The following example questions are indicative of the type and complexity of question that the candidate may be expected to answer in a PCN ARS examination.

1. Every employer shall designate as a controlled area any area under their control that has been identified as an area in which:
 - (a) special procedures have to be adopted to restrict significant exposure
 - (b) any person working in the area is likely to receive an effective dose greater than 6 mSv per year
 - (c) any person working in the area is likely to receive an equivalent dose greater than three tenths of any relevant dose limit
 - (d) both (a) and (c).
2. The quality factor of different forms of ionising radiation is a measure of their relative:
 - (a) wavelength
 - (b) biological effect
 - (c) electrical charge
 - (d) penetrating ability.
3. Every employer shall ensure that an investigation is carried out when the effective dose of ionising radiation received by any of their employees for the first time in any calendar year exceeds:
 - (a) 1 mSv/year
 - (b) 2 mSv/year
 - (c) an effective dose greater than 6 mSv/year
 - (d) 10 mSv/year.
4. You are required to carry out on-site radiography from the centre of a 20 m-long × 4 m-diameter 45 mm WT steel pipe using a panoramic technique with an iridium 192 isotope of 700 GBq (19 Ci). Calculate the distance from the pipe you need to set barriers for a maximum dose rate of 7.5 µSv/h (source output = 130 µSv/h/GBq).
5. From a provided scenario, select the correct requirements applicable to the local rules, detailing how they should be controlled.
6. From a provided scenario, select the correct procedures to be followed when an employee of a company reports that they have reasonable cause to believe that they have received excessive exposure to radiation.
7. A 370 GBq (10 Ci) iridium source is being used on a panoramic shot inside an open-ended pipe. The pipe wall thickness is 39 mm and the pipe outside diameter is 2 m. If the barrier is 25 m away from the source at the open end of the pipe, where should the barrier be positioned to achieve a maximum dose rate at the barrier of 7.5 µSv/h?
 - (a) 80 m
 - (b) 55 m
 - (c) 8.0 m
 - (d) 3.28 m.

4 – DATA TO BE USED IN EXAMPLE CALCULATIONS

Half-value thicknesses		Dose rates at 1 m		
Steel (iridium)	13 mm	Iridium	μSv/hr/GBq	130
Steel (cobalt)	20 mm	Iridium	rem/hr/Ci	0.48
Steel (250 kV X-rays)	12 mm	Cobalt	μSv/hr/GBq	357
Steel (200 kV X-rays)	6 mm	Cobalt	rem/hr/Ci	1.32
Lead (cobalt)	11 mm	Ytterbium	μSv/hr/GBq	33.8
Lead (iridium)	5.5 mm	Ytterbium	rem/hr/Ci	0.125
Concrete (iridium)	43 mm	Thulium	μSv/hr/GBq	0.676
Concrete (cobalt)	63 mm	Thulium	rem/hr/Ci	0.0025
Lead (selenium)	1.5 mm	Selenium	μSv/hr/GBq	55

9. Change control record

PCN24/RAD/SAFE – Document issue and review status		
Document issue for review	Changes/amendments	Current document status
Issue 1	Document reviewed and updated to the PCN24 Scheme format.	September 2026.

